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NSC-234

Volume 7

# 1973

National Safety Congress Transactions

# Coal Mining

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## Coal Mining Sessions

# SAFETY TRAINING AT CONSOL

By GEORGE H. PUDLO
Manager, Employee Development,
Consolidation Coal Co., Pittsburgh, Pa.

The effective safety program has three main components: (1) training; (2) standards; (3) enforcement of standards or follow-up. Sincerity in all three components is a must. Recent research into the causes of mine accidents indicates that one of the most significant things is lack of task experience, which indicates an untrained miner has more accidents. Consol's own studies show that approximately 85 percent of accidents are man related as opposed to job related. Further studies have also shown that only a small percentage of the accidents in Consol's mines are caused by any of the factors covered by the various mining laws and regulations.

About two years ago, our director of safety, chief insepctor, and I started discussing how we could train all the new miners we were hiring, as well as the inexperienced machine operators. The problem was to train the new roof bolter or shuttle car operator in the correct method of performing his job at the time of changing jobs. This means the safest, most productive way of performing that job. Although we did not do any scientific sampling, it became evident that most miners were learning their job to a large extent on their own with minimal instruction from their foreman. Thus, the problem is compounded in that we also have a lot of un-learning to do in order to correct poor work habits where the employee was not taught to correctly perform his job in the first place. There was also evidence that our first line supervisors did not feel as much responsibility to train their people as we had previously thought, that somehow the employee would pick it up on his own or that the employee just ought to be trained without much involvement on the part of the foreman.

In Consol this year we will hire 2,000 to 2,500 new miners—most of them inexperienced—just to replace turnover. This means that most of these new employees have never been underground. In addition, for each turnover we have about three miners changing jobs due to the job bidding procedure. So, in addition to the new miners to train, we have an additional 4,000 to 6,000 miners to train in new jobs each year just due to changing jobs. Therefore, if we consider the new miners and the miners changing jobs each year, we have to train about 50 percent of our hourly workforce each year. This is a tremendous undertaking, and to a large extent I think we are spinning our wheels, since even with the best of training programs we will not have well-trained employees if we cannot keep a man in a job long enough to benefit from the training. If we consider the U.S.B.M. studies that in effect say a man is most likely to get hurt in his job the first year and to a lesser extent the second year and third year, and that substitute operators have a many times greater chance of getting hurt than a regular operator, then we have to conclude that the best training system will not be the total answer until the problems of turnover, absenteeism, and job bidding are corrected. Therefore, turnover was also a factor which we felt we could attack by training. Absenteeism and job bidding are not training problems, although they cause training programs to be less effective.

The above analysis of the training problem in Consol led to the conclusion that:

1. We had to have a company-wide orientation program for new hires in Consol.

2. We had to establish a training program for miners changing jobs which, to be effective, had to make the section foreman responsible for the actual training of the miner. The foreman not only has the most contact with the miner, but also has to be responsible for

the follow-up, which is just as important as the initial training. The foreman has to be the key man in the effective training of miners.

Since we have had orientation programs in several of our divisions for a number of years, we had our experience to guide us. We had found that in addition to introducing a new employee to Consol, giving him some initial safety training and, in effect, getting him started off on the right foot, we also were able to significantly cut turnover of miners with less than one year's experience. In one mine, we were able to reduce turnover by 100 percent. This is not too surprising, in that if you show an interest in the new employee and help him understand how Consol operates, he is more likely to stay and be a more safety-conscious employee.

In September 1972 we implemented a three-day orientation program for all new hires, both experienced and inexperienced. We have had many comments from both our new hires and our operating management on the benefits of the orientation program. Last week, a superintendent from one of our operations in Ohio told me he had just hired a section foreman from the outside, and that the section foreman objected to going through the program with the new hires since he had been a section foreman for a number of years. He attended the program after the superintendent re-explained the facts of life. On his own initiative, upon completing the orientation program, he came back and enthusiastically endorsed the program, being surprised that he learned some new things, particularly about how Consol operates.

The second problem of training new operators due to turnover, job bidding, and expanding new operations required a different approach. We did not have much experience in formal training systems of this nature. Although we had tried a number of approaches, they did not appear adequate to effectively train the numbers of miners that we needed to train. We examined the safety training programs of other coal companies. A few coal companies had been conducting such training programs for a number of years, notably the steel company operations. After examining these, we decided to try a system to some extent patterned after the U. S. Steel system, who's training systems we felt had a proven track record of being able to reduce accidents. So, in the spring of 1972 we hired an outside safety consultant, a retired U.S. Steel safety man, to help us introduce the training system into Consol.

After trying the program on a pilot basis and tailoring it specifically to Consol's needs, we introduced the program on a company-wide basis, calling it the Consol Safety Action Program.

To introduce the safety action program, we are conducting a series of four-day programs for all supervisors from the section foreman to the superintendent. The purpose of these classes is to teach the supervisors the safety action program and how it will work when it is implemented at their particular location.

This is a never-ending training system. As accident statistics indicate that a particular job is having accidents in a particular step of that job, that particular step is again analyzed and then added to the previously developed safe work instructions. This is a rifle approach to preventing such an accident from occurring again, as opposed to a shotgun approach.

One other aspect of this program is important. It takes time to introduce and implement the program in all locations and, as a system, will require constant follow-up to insure that it will work as designed. It has been our experience that it takes a year from the time the initial classes are conducted to the time the foremen are actually using safe work instructions to train miners. This is for a division with 1,500 to 2,000 employees.

To date, two of our divisions have implemented the program, two are developing safe work instructions, two are conducting introductory classes, and four are to begin introductory classes this year.

We are enthusiastic that Consol's safety action program will be effective in reducing the number of accidents. We have also conducted a large number of other safety training classes this year.

While recognizing that training is only one component of an effective safety program, our frequency has dropped from 23.46 in 1972 to 12.32 through September 1973—or the frequency has almost been cut in half. The severity has dropped from 6,200 in 1972 to 3,920 through September 1973. We feel we are making progress.

# TRAINING PROGRAMS FOR MONTEREY COAL COMPANY

By T. T. STEELE,
Training Coordinator, Monterey Coal Co.,
Carlinville, Ill.

During the planning stage of the Monterey No. 1 Mine, it became evident that staffing an underground mine capable of producing three million tons of coal per year would be a major undertaking.

A survey of the area indicated that coal mining had been a major industry in Macoupin County and the surrounding area in the past; however, there had been little coal mining activity for approximately 15 years. The major market for coal from this region had been railroad fuel, and with the dieselization of the railroads the coal mining in this area suffered a severe decline. It was apparent that a vigorous recruiting program would be necessary to attract a sufficient number of employees with appropriate certification in order to comply with the Illinois Coal Mining Act and the Federal Coal Mine Health and Safety Act of 1969. With full production of three million tons per year scheduled by 1973 and a limited number of experienced miners and supervisors available, a comprehensive training program that would include safety and orientation of all new wage earner employees, supervisory training for foremen, assistance for certification qualification, maintenance, equipment operation, mine rescue, first-aid, and accident prevention would have to be effected. Top management recognized that training was the responsibility of management and, therefore, as a matter of company policy the trainees would be paid at their regular rate while they were enrolled in the company-sponsored training programs.

It was the recognition of the need to train our employees that prompted management to create the position of training coordinator, who would have the responsibility for developing courses, obtaining instruction and study material, assisting instructors, and the overall coordination of the program. The training coordinator reports directly to the employee relations manager. It is significant to note that this was one of the first supervisory positions filled at Monterey Coal Company.

Prior to the production of coal, the training coordinator visited equipment manufacturers' facilities, vocational schools, and several mining companies to gather background material to develop the overall program. The U. S. Bureau of Mines Training Division was particularly helpful and provided much valuable assistance in developing the program.

Instruction is carried out by the employee relations group, and other Monterey personnel are used when needed. In addition, manufacturers' representatives are called in to conduct training on their equipment, and both state and federal specialists are being used when their services are of particular value.

Classroom portions of the courses are conducted in a large training room in the Administraiton Building that can seat 50 people. The latest audiovisual equipment is used in training, including a 16mm movie projector, slide projector, overhead projector, tape recorder and player, record player, instrument boards and panel boards from equipment. More than 50 movies on mining and safety are contained in the film library.

Most of the courses are conducted during the 8:00 to 4:00 day shift. Exceptions are the preparation course for state certification test, mine rescue training, welding, and additional first-aid, which are scheduled during periods following the regular shifts.

The orientation and safety training for new employees is believed to be the most comprehensive of any provided by companies in the industry. It runs for 40 hours over a five-day period. All new wage-rate employees, whether experienced miners or not, must take this course. In most cases, they receive this training before they go on the job. In some instances, experienced men may be put to work immediately, but they are taken off the job within a few weeks to receive the training. Safety training required by the U. S. Bureau of Mines is included in the course along with other safety materials, plus information on the company and its policies.

The course is composed of 36 hours in the classroom and four hours for underground demonstration. Since many of the new employees have never been underground, all new employees are taken on a general underground tour the first day, so they will have a better understanding of what will be taught the rest of the week. When they are taken underground, men are shown possible hazards, escapeways, how to test roof, how to cut off power in emergencies, and anything else pertaining to their personal safety. Some topics covered in the classroom are: geology of coal, mine maps, mine ventilation, self rescuer, electricity, permissibility of electrical equipment, gases and gas detectors, use of the anemometer, fires and explosions, principles of mine rescue, mining equipment, lubrication, explosives, first aid, accident prevention, conveyor belts, and respirable dust. The instruction goes into depth on these subjects even though it is recognized that the men will not retain all information presented. This does provide the necessary basic background to be reinforced later as employees take other more detailed courses.

The Introduction to Supervision course is now being conducted at Pere Marquette State Park. Foremen go to the park in groups of ten and stay there in the lodge for five days. Classes consist of a review of original training plus any new developments. Extensive sessions are taught in federal and state mining laws, management principles using I.C.S. materials, labor relations, and other current information on management and mining development. Approximately 75 per cent of staff and management personnel have completed this series of classes All the instructors are staff and management personnel from Monterey.

The initial course on underground maintenance began in 1971 with an enrollment of 14 men. Since that time we have completed four classes. To date 76 men have attended maintenance training classes. Maintenance trainee selection depends on the successful completion of a maintenance knowledge test. All men who make the minimum score on the test are eligible to attend the class. If more men than is needed for a class make over the minimum score, the number of trainees needed for that class will be selected by seniority. The classes will run for 12 weeks. Trainees are divided in two groups. Half the men will be in the classroom, and the other half will be working as repairman helpers. They alternate each week, and in this way all men get some practical experience and learn how to put classroom knowledge to work through hands on experience. When the 12 weeks are completed, they are given the federal electrical exams so they are qualified to do electrical work under the provisions of the Coal Mine Health and Safety Act.

The maintenance training has been highly successful, and the men have a great interest in their training. Often times they will not take a break because they are working on some special problem. They will stay for some time after the class to discuss things of special interest. All men except three who have completed this class are now on our maintenance force and are becoming top-notch repairmen.

Under the federal law, all persons who perform certain electrical work must be retrained each year. To do this, we take two or three men off their regular jobs and put a certified instructor with them for one or two days. This instructor will go over the federal law, schedule 2G, ac and dc current, permissibility, and new equipment. This is accomplished in one of the underground shops. Any time the instructor thinks the trainee needs more instruciton, he can bring him to the training room for that purpose.

Qualified foremen are always needed. Most of the men who are employed do not have enough experience to get state certification as an examiner or mine manager. As these men get four years experience, we en-

courage them to attend training at the mine or state training to prepare them to take the state test. All men who attend the classes at the mine will do so when they are not scheduled to work, but they will be paid for their time after they take the state examination. These classes run for four weeks, two days a week, for two hours each day. All men who attend this training are given study materials to study outside of the classroom, because it would be impossible to get all the material covered in 16 hours. In the past, a very high percentage of people who attend this course have taken the examinations and made high scores. After this, they can take jobs as examiners, foremen, hoisting engineers, or mine managers.

It must be recognized that there are inherent hazards associated with the underground mining of coal. In order to be prepared to take immediate action in the event such action becomes necessary, Monterey has four trained rescue teams, one on each shift underground and one outside on straight days. These men are trained to wear self-contained breathing apparatus and auxiliary equipment, fight fires, and do any other emergency work around the mine. The teams meet each month and have a different drill each time. Teams are limited to eight men, and several men are waiting to become members when a vacancy occurs. Interest in this type of training is very high. We have four qualified instructors at the mine.

All people receive first aid training when they begin work, but we offer a 10-hour retraining course each year. This training is scheduled when they are off shift. A first aid course was recently conducted in the Carlinville office for office personnel, and the interest and enthusiasm shown by the office personnel was a pleasant surprise.

Training was recently initiated, directed at improving safety and efficiency of miner operators. Classes were conducted on a Saturday when we could have all the operators and helpers at one time. Instructors from manufacturers and Monterey went into great detail on safety and the operation of the miner. After this class, safety and production improved noticeably. One of the best improvements was in the preparation plant, where reject material was cut considerably. We are now making plans to train operators of all equipment. These plans will include safe operation, maintenance, more efficient operation, and machine functions.

Monterey was recently awarded certificates by MESA for 100 per cent training in 15 different courses. The certificates were numbered 0001 through 0015 and were presented by the deputy administrator of MESA at No. 1 Mine in January 1973.

An effective training program requires a responsible management policy with adequate funding and takes the cooperation of many people. Each member of Monterey's supervisory staff has a never-ending job of training for himself and his men. We are proud of our training accomplishments so far, and results are evident. We have built the capability to offer any mining course needed. Safe, efficient operation of any coal mine is accomplished only when all supervisors recognize their training responsibility and all men know their jobs and will accept responsibility for the safety and efficiency of all.





# DIESELS—MANUFACTURER CONSIDERATIONS

By NORMAN E. HOLBROOK
Vice President, Wagner Mining Equipment, Inc.
Portland, Ore.

This presentation has to do with the considerations faced by a manufacturer of mining equipment in a period of tremendous changes in the thinking regarding health and safety of the miner. I speak only as a representative of one manufacturer and in no way intend to represent the entire equipment manufacturers throughout the world. Wagner Mining Equipment, Inc., is located near the banks of the Columbia River in Portland, Oregon. We are a relatively young company, having been incorporated in 1958. However, we have enjoyed, and I feel honestly earned, the reputation of having been a pioneer in the development and advancement of LHD equipment. To tell the story of our company is also to tell the story of the success of the load haul dump system and the trackless haulage system of underground mining.

Wagner entered into the world of mining in 1958, when we were approached by the Phillips Petroleum Company in Ambrosio Lake, New Mexico, who wanted us to design and manufacture a rubber-tired front end loader to operate in an underground uranium mine. Phillips had recognized, as had so many other mines throughout the world, the limited advantages of slushers, rail mounted equipment, and slow, expensive, high maintenance track laying vehicles and was looking for a fresh new approach to increase production and lower the ever-rising operating costs. Many mines had experienced a limited amount of success in using surface designed rubber-tired equipment. However, since this equipment was not truly designed to withstand the rugged requirements of underground mining, it only succeeded in wetting the appetites of the production mining engineers. This surface equipment was not found unacceptable, but its maintenance costs and long expensive down periods nearly ruled out its use. A question began to develop as to why a manufacturer who was qualified and had successfully designed, built, and supplied heavy equipment to surface operations couldn't design a vehicle to operate under the severe handicaps placed on equipment for underground mining, which would result in lower costs and higher production.

We were asked this question and accepted it as a challenge. We ourselves had spent many years in the surface equipment field designing, building, and supplying front end loaders, four-wheel drive tractors, lift trucks, log handling equipment, etc., and felt that we had been reasonably successful in this field. But if we learned anything, we learned that before you build equipment for any job, you must have a thorough knowledge of the working conditions before putting a pencil to the paper. By the work we did acquainting ourselves with the conditions underground, we were very successful in our first entry into underground mining. This start was followed by a series of successful entries and our company began building to its present day stature. Our present production line covers a range of front end loaders known as scooptrams from the one yard size through 11 cubic yards. Our shuttle trucks range from 10 through 50 tons. These two lines are complemented by personnel vehicles, utility trucks, maintenance vehicles, and a wide variety of special purpose support vehicles.

In the early years of the company's growth, Wagner directed its manufacturing and designing abilities towards the metaliferous mines, due to their ready acceptance of diesel engines underground. As a result, we had little to do with any gassy type mines until about 1966, when one of the coal mines in Australia queried us as to whether we

could build a scooptram of sufficient tonnage, incorporating a flameproof engine that would satisfy the regulations of the Australian Coal Board. Through use of the Hercules engine, which was the only engine approved by the U.S.B.M. under Schedule 31 at that time, we were able to build a 10 yard scooptram that operated very successfully and actually resulted in repeat orders for additional equipment. This initial vehicle proved to be the beginning of our active interest in developing diesel powered equipment for gassy mines throughout the world. It wasn't long before we were manufacturing and selling flameproof diesel equipment to countries such as Australia, South Africa, France, and Canada, as well as the United States. As you well know, there are not very many coal mines in the United States that have used diesel power underground, which is really surprising when you consider that the diesel engine is actually the primary power source for all metaliferous mines, not only in this country, but others as well.

The only regulations currently in print which cover diesel powered equipment operating in gassy mines is Schedule 31. Consequently, at the present time, Schedule 31, along with certain addendums, continues to be our guide to considerations involved in developing this equipment. Reducing Schedule 31 to its basics, we are really talking about:

1. Reducing engine surface temperature to 300°F or below.

2. Incorporating engine intake and exhaust flame arresters.

4. Designing all intake and exhaust lines with joints that will prevent propagation of flame.

5. Producing a vehicle that is able to pass specific tests conducted by U.S.B.M. testing personnel.

It is through the extensive testing done by the U.S.B.M that we are assured that our engine exhaust emissions fall within a range that will not endanger the well being of the miners who operate our vehicles as well as those who work in areas adjacent to the vehicle. This demands that serious consideration be given to the particular engine used and the type of exhaust cleaning system that is incorporated. As far as the engine is concerned, we look at two basic categories, the indirect and direct injection engines.

The direct injection engine has the fuel injected directly into the combustion chamber. The indirect injection engine's fuel is injected into a pre-combustion chamber where the ignition first occurs. Then the rapidly expanding gases in the pre-combustion chamber where the ignition first occurs. Then the rapidly expanding gases in the pre-combustion chamber build up pressure and expel the partially burned fuel mixture through an orfice and into the main chamber at a very high velocity. The combustion of the fuel in the main chamber is controlled by the fuel distribution from the pre-combustion chamber. Direct injection engines are characterized by low thermal load and low fuel consumption. This makes them increasingly popular for surface operations where ventilation is not a requirement.

Direct injection engines provide higher horsepower with less fuel, but unfortunately, require much more ventilating air to operate if used underground. On the other hand, the pre-combustion engines usually have a higher fuel consumption, but their exhaust emissions are much less harmful. A diesel engine throws off unburned nitrogen and combustion matter that is toxic or irritating and must, therefore, be reduced to a tolerable level. Regulations stipulate the the maximum permissible concentration of toxic gases that man can stand without hurting his health during an eight hour period. This emission or pollution level is measured at the point of exposure, normally three feet out and five feet up from the point at which the exhaust enters the atmosphere. Because of the high cost of providing ventilating air underground, we naturally wish to utilize an engine with low emission values.

There are several advantages for the indirect injection type engine for underground mining versus the direct injection engine, but the prime factor is that the indirect injection engine has, in effect, an internal pressurized after burner, thus giving off less toxic gases and making it much more acceptable for underground use, because the ventilation requirement for the engine is greatly reduced over that which is required for a direct injection engine. Since high speed and the necessary horsepower are not of prime concern to most underground mines, a mine can operate anywhere from two to four more vehicles at a given heading with an indirect injection engine than they can with a direct injection engine. A pre-combustion type engine produces less oxides of nitrogen per horsepower than do other designs. The choice between direct or indirect engines leaves little for consideration; therefore, we have elected to go with the indirect engine.

The next thing to consider, in order to make the engine more compatible with its environment, is proper calibration of the fuel injection pump. We know that the carbon monoxide can be controlled by limiting the amount of fuel injected during each power stroke; consequently, proper calibration of the fuel injection pump becomes a prime consideration. The proper settings of these fuel pumps are determined by the engine manufacturer and confirmed through tests at Bruceton. The injection pumps are set and sealed by qualified people. Now we have done just about as much as we possibly can to the engine in order to control its emissions. In other words, we have chosen the engine that will provide us with the most complete burning of the fuel, as well as assuring that no more than adequate fuel is supplied to the engine.

We next turn to the exhaust gases to consider what can be done in this area to further reduce emissions. We at Wagner have chosen a water spray—water bath combination water scrubber that not only injects a spray into the exhaust system in order to cool the exhaust, but also forces the exhaust gases to percolate through a water level, assuring further cooling as well as doubling as a flame-trap. This type of scrubber, in all fairness, has little or no effect on carbon monoxide or nitrogen oxides, but it does effectively assist in reducing particulates. As a manufacturer, once the exhaust gases leave the scrubber and enter the mine atmosphere, there is little else we can do and the responsibility from here on depends on the mine operator, who must provide the proper ventilation to insure that the exhaust gases are reduced to specified limits. The amount of air required in cubic feet per minute is determined by tests conducted by the Bureau of Mines in their laboratories and forwarded to us as an enclosure within our overall approval. We comply with their request and post this information in the operator's area for all to see.

In addition to control of emissions, there are other areas that we are equally concerned about. One is the possibility of propagating a fire that may lead to explosion. This possibility is controlled by proper selection of components and design of shutdown controls that sense any area that could contribute to producing a flame or an explosion. As I said earlier, the engines are, by Bureau of Mines regulations, limited to a maximum of 300°F surface temperature. This is controlled through the use of sensing devices which will automatically shut off the air and fuel to the engine, resulting in complete and immediate engine shutdown.

As exhaust temperatures are limited to 185°F, we achieve this by injecting a spray of water directly into the exhaust system near the outlet of the exhaust manifold. This cooling effect is monitored through use of temperature probes located at the point where the spray contacts the exhaust and also as it enters the atmosphere. If heat in excess of permissible levels is detected, instant engine shutdown will occur.

The water level in the scrubber is also monitored through a level sensing device. If the water falls below a prescribed level, again engine shutdown will occur. Our main concern in the area of controls is that they be reliable and compatible to the environment in which they must work.

The U.S.B.M. is presently finalizing new regulations that will govern the next generation of diesel equipment. In order to develop this next generation of equipment, it is going to require not only the manufacturers but the cooperation of the coal operators, the union, and the U.S.B.M. We have worked very closely with the Bureau and have participated extensively in the development of the present draft of the new coal mining regulations. In discussions with the U.S.B.M. I am told that there is a tremendous lack of response from everyone when these drafts of

regulations are sent out for review by manufacturers, coal operators, etc. The number who responded is something like three per cent. It is a shame that a subject with such magnitude can only encourage a three per cent response. I want to echo the pleas of the U.S.B.M. in requesting your participation in responding to the regulations by offering your constructive criticism.



# COAL MINING SECTION

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