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Cement, Quarry & Mineral Aggregates Sessions

STOP ENDLOADER ACCIDENTS BEFORE THEY HAPPEN

By DAVID C. MEYERS
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The guy who operates your endloader is the most important link in the elimination of endloader accidents. I classify this individual as "Mister Amazing." If you have exercised the proper procedures in hiring, trained him properly, and supplied him with well maintained equipment, then and only then are you on the right track in stopping loader accidents.

Of course you and I both know that to achieve a zero accident experience rate is a very remote possibility. A man can be injured in various ways while operating equipment. At this point our Mister Amazing is no longer of value and you have to scurry around to put someone in his place.

There are various ways that man can be injured which I'm going to show you in the following series of slides. I hope as you view these slides they will give insight on what can be done to eliminate similar occurrences in your operations. (Following is a summary of the author's commentary which accompanied the showing of slides. —Ed.)

A large stone fell off a quarry face and struck the raised bucket of an endloader. The force was such that the operator was jammed against the roof of the cab, causing compression fractures of the 3rd, 4th, and 5th vertebras. The man was totally disabled. If proper care had been exercised by the supervisor in making sure the quarry face was scaled of loose material or the operator instructed on not working under such over hangs, this accident may not have happened.

A mechanical failure and unsafe condition (no berm) caused an incident and nearly the operator's life. The engine on a loader died while in the process of clean up on a ramp. The loader started to roll back toward the edge. The operator panicked and made an attempt to jump clear. On going out the door his bib-overalls caught on the door handle, and before he could clear himself it was too late so he fell back into the seat and held on. As luck would have it, the loader never turned over while going down a 40 degree incline sideways. The results were: no injury to the operator, although he died a thousand deaths in this short trip; no damage to the loader, but the main conveyor from the primary to the secondary was knocked four feet off center. In this case, a proper height berm would have eliminated this loader accident.

To prove my point, shortly after this loader accident, prestressed beams were inserted along this ramp and saved the day for an outside trucker who lost power on the ramp and brakes as well.

To further make my point on the importance of berms, a drill operator had finished drilling 6½" holes and then drove the drill unit back to the shop for lunch. The powder man was due in after lunch to start loading the holes, so the drill operator felt no urge to barricade the area, which used to be a regular haul road. Little did he know what a catastrophe he was about to create.

The general superintendent on this particular day was out showing the

purchasing director some very recent expenditures and sure enough, it happened. Suddenly the station wagon was air borne and turned a half revolution in the air before landing on its top. Close call? You'd better believe it! All because of inadequate berming or barricading.

There is more to be said about berming to eliminate not only loader accidents but other vehicle accidents as well. Picture yourself traveling at a reasonable speed on a haul road. You're new to the quarry, and as you go by a drill rig on your right the operator waves frantically, and you wonder what his problem is. Oh, but you're about to find out. The car suddenly becomes airborne, and it doesn't take long to realize that you're headed for the quarry floor 147 feet below. No way are you going to live to tell the tale of this accident, and you now become another vital statistic.

At a sand and gravel operation nearly an identical situation exists. Overburden had been removed and digging continued below so that the regular roadway on the right had disappeared. Another road was opened up to the left. No berm was placed to keep out intruders, which invited expensive litigation from outsiders as well as W/C claims from employees if they ran over the edge 40 feet below.

A car was being driven daily into the plant by an employee and parked next to his work area. At the end of the shift he backed his car up to pull onto the haul road and thought he could beat a large loader stockpiling from the end of a conveyor. The car stalled at the most inopportune time and the only thing that saved the car driver was the pin in the draw bar of the loader caught just above the door. The car was pushed back 65 feet with the driver completely frozen in his seat with fear.

In another case, a plant employee went into the pit to deliver a message to a loader operator. They conversed for about 15 minutes, the car driver climbed down, and the endloader operator reversed his machine, forgetting the car was behind, and backed right up on the car.

In a ready mix concrete plant the EPA had just required a bag collection system be installed. When a truck pulls underneath, the flaps fold down around the hopper and contain the dust. On this particular day, the yard end loader was cleaning up under the plant and the operator was watching the ground area rather then the overhead. The air had leaked off the ram holding up the rear flap and it had dropped down at chest level to the man in the loader. Before he could stop the loader in time, the flap pinned him against the seat. Here a mechanical failure plus not getting the big picture nearly caused this operator his life.

Another operator not paying attention to the job at hand hit his head (hard hat being worn) on the overhead during a clean up operation. The impact was such that it caused compression fractures of the 5th and 6th lumbar section.

An endloader was involved in a turn over because the operator was having problems with his girl friend. The night before she had informed him that she was in a family way, which caused him to lose the remaining night's rest. Due to the lack of sleep and searching for a solution to his problem, the operator backed away from the hopper to the left over the embankment, instead of to the right as he had done for the past several months. The loader turned over a complete revolution and the only thing that saved the operator was the soft sand. An adequate berm would have allowed for this man's mistake; a day off to cope with his problem would have been even better.

A foreman thought he had the operator's attention and stopped his truck to relay a message. About that time, the loader operator reversed motion on the articulating loader and the right front tire of the loader ran right over the front end of the pickup. The loader operator never even realized the accident happened, and of course the truck driver lost about ten years of his life in those brief seconds. My advice to those of you who drive around heavy equipment is that a wide berth be given. Also, wave at the operator when in close proximity. If he waves back you'll know you have his attention and he is aware of your presence.

An unguarded A-frame to a conveyor system is a constant target where loaders are on the move. A large concrete block protects one side but not the other, and contact by a loader nearly put one plant out of commission.

We should give near-accidents as much consideration as the real thing. A lot of operators feel because there is no damage involved, why say anything? Operating people are strange that way.

In one incident there was no damage involved, but had it not been for the mud in the ditch could have easily been a turnover with extenuating circumstances. This operator was having marital difficulties at home, unknown to management people, and was not paying too close attention to unbermed right of way. The time of placing this piece of equipment back on the roadway must be taken into consideration. Operator error and unsafe condition made for a costly situation.

A very near accident happened when an overhang of frozen material came down after being undermined and struck a dump truck backed up too close to the pile. In another incident another frozen piece came down and bounced a loader around pretty well after striking the bucket. The operator had a severe headache for several days.

Accidents interrupt work in more ways than one. In one case concrete blocks made from leftover concrete were being loaded onto a flat bed truck. The driver was directing the operator in the placement of the blocks and in the process had his left hand on the edge of the block while unhooking with the right hand. On backing away the operator dropped the bucket at the same time. Yes, you guessed it. The driver's left hand was crushed between block and bucket. This hand injury cost the company $30,000 and the man lost six months from work.

Again, let me re-emphasize that accidents interrupt work beyond all stretches of the imagination. An operator was charging a recrush hopper, and just before starting up the ramp the operator would raise the bucket. On this occasion the operator saw a small two-axle dump truck move in front of the bucket and assumed it had gone on through. The next thing the operator knew, the arm of the loader was on the truck cab and the truck came into view under the bucket. The truck driver had stopped to level his load, unknowingly in the loader's line of travel. Everything came to a stop at this operation while the driver was pried out of the cab and taken to the hospital.

There are signs at all the entrances to a quarry operation indicating that all heavy equipment has the right of way, but how do you impress this upon the one-shot customers who come in a couple times a year?

Then we have the accident that happened out in the middle of nowhere with no one around but one loader and one haul truck. The truck had just finished dumping and the loader operator, pre-occupied with his thoughts, backed into the overhang of the dump box, putting the loader completely out of business.

In any accident or near accident a thorough investigation should be made with a determination of whether the situation was preventable or non-preventable. The necessary disciplinary measures should be taken to show that you mean business and that you will not tolerate similar circumstances in the future. This is another good way to stop endloader accidents.

Stopping endloader accidents before they happen is a big task, but I think if everybody puts their minds to it, loss of lives, injuries, and property damages can be kept at a bare minimum.

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TOP MANAGEMENT'S INVOLVEMENT IN SAFETY

By BROOKS R. EDWARDS
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As I sit in church on Sunday morning, I thank God and pray for another safe and accident-free week for everyone in our region at Alpha. I would like to think that prayer and prayer alone could accomplish the task. However, I have been around long enough to realize that God will do His—but expects me and my staff to cooperate and get the job done! It takes personal involvement and active participation, not only in designing a pre-planned safety procedure, but continuous input from the supervisory staff and, more important, the men themselves!

That's where we begin. We study what can be done and what we are actually doing in Frederick, Maryland, in an effort to accomplish safe and accident-free days—weeks—months—and even years!

It has to begin right at the top! As a representative of corporate management, it is my job to be dedicated to the principle of safety and to let my philosophies be known by my own activities and interest. Employees are not at all impressed by "lip service," and this is one of the first things a manager must learn. Your employees can spot a phony a mile away, and the manager who adopts an attitude of "Do as I say and not as I do!" will get the exact reaction he is asking for! Nothing!

As the late, famous President Harry S. Truman said, "The buck stops here!" And every manager has this brought home to him very quickly if he personally doesn't practice what he preaches! This philosophy must be developed by the chief executive and—the more difficult task—disseminated to all management and hourly employees.

It isn't enough to say we want our region to be a safe and accident free place for all employees to work. Knowing this to be a fact, we have developed an attitude of caring for our fellow employees in our region. We call it the "we" attitude.

This is an easier problem to handle than you might think! Example to others is a vital part of creating the "we" attitude. There is seldom a week that passes that I do not make a personal plant inspection. I am not talking about a motor tour around the area and taking the "windshield inspection" approach. I am talking about "walking tours," including the obvious wearing of the hard hat, safety shoes, and goggles, as well as other personal protection equipment already required for the area in which the inspection is made! Incidently, I have learned the hard way that employees do not like to wear hard hats and other equipment provided by the company for their personal protection. Working in hot, cold, dusty, or hazardous areas can often make this personal protective equipment inconvenient even though the employees know—many of them from personal experience—the value of the equipment furnished them in preventing serious injury. But the first time a member of top management ignores the safety regulations and walks around the plant without them he has made himself a target for criticism and has created an even more difficult job for his supervisors to enforce the company safety rules! That is the first thing not to do!

In making walking tours, eventually take in every department, let it be known by your own actions that you are not just curious but actually making a personal inspection. As you are looking around the area, stop and talk with the workers. You can start off by talking about yesterday's ball game or any subject, even hunting and fishing (if you really know your employees preferences)—it helps to create a personal relationship and a tremendous amount of respect and appreciation. I always make it a point to inquire about the worker's family, their health, about their hobbies, and even home problems. When a personal relationship has been established, ask them about their job, about how the company can make their job more safe, what hazards they find that haven't been corrected, and their suggestions on how these hazards can be corrected. A man who is on the same job day after day knows a lot more about the job than even his supervisor. He is glad to share his thoughts with you, especially when he knows you are really interested and not just "trying to pump him!"

This is not always easy. One primary caution you must keep uppermost in your mind is that a particular worker may be trying to undermine your supervisor's authority over his workers. These situations are easily observed, especially when you make regular inspections and get-acquainted tours. Your best solution is thank him for his remarks and cooperation and then look into it. If he has a good point, let him know it on your next trip around, or even a special visit to talk with him about what you have done and what you have determined. You will learn much and your employee will learn to have respect for you as a sincere and interested manager who respects the opinion of both supervisor and employee. It is one of the quickest ways to overcome pending labor relations problems in your plant.

But, we can't stop here! The personal touch, as valuable as it is to any successful program, is only the beginning.

Like most plants or regions (as they are called in Alpha) we have active safety committees. Our committee meets monthly and is very active. Both salaried and hourly personnel, along with top management, actively participate in and give support to the program. I personally do not attend every meeting, but make it a point to be an observer at over 50 per cent of these sessions. Our other management personnel must attend each meeting.

Our meetings are informative, open for frank discussion, and by no means allowed to turn into union grievance meetings, which is an all too-frequent occurrence at many such meetings elsewhere.

We also hold monthly departmental meetings. At these meetings safety procedures are set up. We firmly believe in setting up a standard safety procedure that would cover any and all possible accidents that were foreseeable or probable. Being human, we may miss something, and we have a procedure for curing that failure. But our prime goal in safety is to be prepared for the worst—know and instruct others what has to be done and in what order. It saves injuries and lives, as I will tell you later. The results of these monthly management meetings are then brought before the general monthly safety meetings where they are reviewed, altered, and adopted as standard operating procedures! Instead of becoming management orders they become a "we" attitude—and the employees know we care about their suggestions and assistance.

Let me share with you a few personal experiences in which our pre-planning saved a life at our Frederick plant in 1976. When you hear this, you can make up your own minds. To us it is personal involvement—caring for our "family" and our determination to keep them safe.

I was spending the pre-Christmas season of 1976 at home on vacation. On the morning of December 22nd, the telephone rang and the plant informed me that we had a serious accident in our quarry. Immediately I headed for the plant. When I arrived, I found that George Woodworth, a driller blaster, was unconscious and in the local hospital. Fast action by his fellow driller resulted in George being removed from his boom, where he had been caught and strangled, and shipped off in an ambulance to the

Case Hist.

local hospital. George's family had been notified and the plant manager and his assistant were at the hospital with George making sure he got the immediate attention he needed.

Had we not preplanned such an incident, George would not be alive today. But because we had developed a plan whereby we had inaugurated a "buddy system" in which no driller was allowed to be out on his job without a buddy and it was being followed (which is important since no plan is any good if it isn't practiced regularly), a life was saved. Thirteen hours after the accident, George had regained consciousness and was removed from the critical list. He was discharged on the morning of December 24th. It was one of the best Christmas gifts I've ever had! A happy ending—and thanks to our pre-planning procedures!

One afternoon during the summer of 1975, I learned of another near tragedy. We had men repairing an overhead crane. Power was restored before the work was completed. Our pre-planning safety procedures had been overlooked. We had to find out why and what we could do to see that it didn't happen again! When lockout procedures are not followed, there can be nothing but trouble—even severe injury and death.

Immediately, we called the plant manager, his assistant, and both mechanical and electrical superintendents into a review meeting. We discussed the incident thoroughly. We wanted to know where our program had failed. The following day all electricians were summoned to review our lock-out procedures and discuss the previous day's incident.

I bring this to your attention—not that we practice safety "after the fact" but again—the personal involvement, caring, and top management's concern for everyone's livelihood.

Safety committee meetings are only part of our program. We meet monthly with all our foremen and weekly with our superintendents. We discuss the many facets of management, but never a meeting goes by that the issue of safety is not discussed. Safety is top priority always. Getting our job of production done is important, but never at the expense of anyone's safety.

We can take all the safety bonuses, hard hats, safety shoes, safety glasses, and best safety program money can buy, but if the supervisors and workers don't practice safety it's all for naught. You must develop and maintain the "we" attitude for each other.

When I go home each day, the most rewarding and comforting part of the day is when I can say "We have had another safe—another accident-free day!"

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THE NATIONAL MINE HEALTH AND SAFETY ACADEMY

By MICHAEL G. ZABETAKIS, Ph.D.
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The Mining Enforcement and Safety Administration (MESA) was established in the Department of the Interior by Secretarial Order No. 2953 on May 7, 1973. Basically, this order separated from the Bureau of Mines the responsibility for administering the Federal Metal and Non-metallic Mine Safety Act (PL 89-577) and, except for certain provisions relating to research, the Federal Coal Mine Health and Safety Act of 1969 (PL 91-173).

Currently, MESA is an organization of about 3,400 employees organized into six activities, each headed by an assistant administrator or, in the case of the National Mine Health and Safety Academy, by a superintendent. These six activities support the concept of accident prevention through *enforcement, engineering,* and *education.* Toward this end, each activity is also involved in the preparation of educational materials for use in the field and at the Academy. MESA is thus heavily committed to the development of a broad range of training aids and materials for use at all levels.

Mission

The Academy has as its primary mission the reduction of accidents and the improvement of health conditions in the nation's mines and the minerals industries through education and training. Each department within the Academy supports this mission. Thus, the Resident Department plans, develops, and presents mine health and safety courses and programs for classroom instruction and training of MESA mine inspectors, other MESA personnel, and persons interested in the reduction of accidents and health hazards in the nation's mineral industry.

The Seminar Department manages timely single-topic training programs designed to meet the educational needs of mine inspectors and other government, industry, labor, and academic personnel.

The Continuing Education Department develops and provides continuing education programs and educational materials for non-resident MESA students in support of the overall objectives of the National Mine Health and Safety Academy. This department also operates a Learning Resource Center for individual resident students and the staff/faculty at the Academy.

The Research and Planning Office evaluates the effectiveness of Academy programs, conducts instructional staff development programs, assists in research contract administration, conducts hazards analysis and other analytic studies, and develops long-range plans.

The office of the Business Manager provides the facilities, equipment, and services necessary to support the Academy's mission both internally and externally.

Early Training Programs

A variety of safety training programs has been presented to mine personnel by the Bureau of Mines for a number of years. The first of these, mine rescue, was reportedly presented as early as 1910. Subsequently, other programs were developed for first aid and accident prevention.

In large part, these early programs were presented by interested inspection personnel and others who recognized the need. However, it was not until the

passage of PL 89-577 in 1966 and PL 91-173 in 1969 that a concerted effort was made to develop a comprehensive series of training materials. Each Act specified the development of expanded education and training programs designed to prevent mine "accidents and occupationally-caused diseases in the industry" (PL 91-173).

Additionally, this latter Act specified the development and maintenance of "adequate programs for the training and continuing education of persons, particularly inspectors. . . ." Initial plans were formulated for this purpose in 1970 when funds were requested for, as stated in the committee report, "architectural design of a Mine Safety Institute of provide specialized training for federal mine health and safety personnel and also for health and safety personnel in the industry and in state and local governments."

Interim Programs

During the past six years, a number of programs have been developed to train federal mine inspectors. These have ranged in length from one to 18 months, and approximately 1,500 inspectors have been trained in temporary quarters in Beckley, West Virginia.

Unfortunately, laboratory facilities were limited during this period, so there was little opportunity for hands-on experience. However, this period did offer an excellent opportunity to develop and test a number of educational programs for subsequent use in the new facilities.

Special courses were developed in accident prevention, accident investigation, industrial hygiene, roof control, gas detection, fire protection, ventilation, transportation and haulage, inspection procedures, explosives and blasting, and the mining laws. Criterion-referenced instructional procedures are also being developed for these and other courses to be presented in the new facilities.

Current Developments

Current programs are described in detail in the Academy's general catalog, which is available from the Registrar, National Mine Health and Safety Academy. In brief, these are divided into two broad categories—technical and non-technical. The former are taken by mine inspectors, inspector trainees, scientists, engineers, and education specialists in MESA, other government agencies, the mining industry, and cooperating colleges and universities. Each program is developed by a team of specialists within the Academy with assistance from other segments of MESA, other government agencies, and the private sector as needed.

Non-technical courses (resident and non-resident) are taken by both MESA and non-MESA students interested in a variety of topics, including public administration, supervision, and management. All MESA managers now must take a series of management-oriented courses to better prepare them for their work.

New employees in the enforcement, engineering, or education groups are enrolled in one of six resident programs. These include:

Resident I—a 12-week course of study which provides the academic phase to prepare experienced mining personnel to become mine inspectors after subsequent on-the-job training.

Resident II—a 36-week course of study which provides the academic base that prepares students with little or no direct mining experience to become mine inspectors after subsequent on-the-job training.

Resident III—a 24-week safety management or health management program offered to persons interested in assuming a mine safety or occupational health management role in MESA, other federal or state agencies, or the mining industry. Upon completion of the program, students are prepared to manage special task forces, to investigate accidents and disasters, and to help formulate programs to reduce accident and occupational illness rates.

Resident IV—a six-week program offered to persons from MESA, other federal or state government agencies, or the mining industry. The course is designed for individuals responsible for insuring that a healthy mine working environment is provided.

Upon completion of the course, students will have the necessary skills for the recognition and evaluation of industrial health hazards in mining, and the basic understanding of health-hazard control techniques in mine-work environment.

Resident V—A four to six-week program of study for individuals who are about to conduct health and safety courses for mine personnel. Students from MESA, other federal or state government agencies, or the mining industry completing this program become certified mine health and safety instructors in the field of their choice.

Resident VI—a four to six-week program designed for professional personnel engaged in health and safety work in MESA, other federal and state agencies, or the mining industry. Upon completion of the program, students should have a basic knowledge of accident prevention, federal health and safety laws and standards related to mining, human relations and communications, professional liability, and industrial psychology.

A listing of courses for each program is given in the appendix to this article.

In addition, MESA personnel and others who are interested in mine health and safety will return periodically to the Academy to participate in special short-duration programs sponsored by the Seminar Department. In recent months, short courses and seminars have been presented in more than 20 subject areas including: accident prevention, airborne contaminants, ASSE-T, cardiopulmonary resuscitation, current mining problems, electrical safety, explosives safety, mine communications, mine machinery, mine ventilation, noise measurements, radiation, and roof control.

The Continuing Education Department has developed a series of entry level programmed-instruction courses in a number of areas including: electrical hazards, first aid, mine gases, coal dust control, mine illumination, noise control, roof and rib control, and surface mining.

These and other programmed instruction manuals are available through the Department of Continuing Education.

Physical Facility

The Academy is located on a 40-acre plot adjacent to the Raleigh County Airport donated to the federal government by the Raleigh County Airport Authority. An additional 30 acres is available for the construction of an above-ground simulated mine and other structures as the need arises.

To date, approximately $20,600,000 has been spent for site preparation, construction, equipment, and furnishings. The Academy has about 270,000 square feet of usable floor space in five interconnected buildings and a separate equipment maintenance and storage facility. A four-level residence hall is used to house both students and visiting faculty. As many as 342 students can be housed in this hall in 171 double-occupancy units; small efficiencies are used for the visiting faculty.

A two-story central administration building contains the bulk of the administrative and faculty offices. In addition, this building has a 400-seat auditorium, a cafeteria that can handle from 600 to 800 students per hour, a snack bar, and a student store.

A functional classroom building contains 14 classrooms, a mine machinery simulator room, seven laboratories (electricity; ventilation; industrial hygiene; mine emergency procedures; rock mechanics; soil mechanics; computer programming), a learning resource center, and offices.

A large mine machinery laboratory building adjoins the classroom facility. This laboratory is equipped with a full

power panel to permit the operation of actual mining equipment.

Physical fitness has not been neglected. A modern, fully-equipped gymnasium, swimming pool, and playing fields are available for physical education and leisure-time enjoyment.

Status

The National Mine Health and Safety Academy is now fully operational. The faculty and staff of approximately 100 have been involved in the development of operational procedures, text books, laboratory manuals, short courses, and seminars. In addition, classes are underway in each of the areas noted earlier. The present capacity of the facility is about 100,000 student-days/year, which should be attained in 1978.

At the current enrollment rate, Academy utilization should reach 50 per cent capacity (50,000 student-days/year) sometime in 1977.

At present, most of the students are MESA employees. However, students from other government agencies (federal and state) as well as from private industry and labor have been trained at the Academy in recent months. In the near future, cooperative students will be accepted from other institutions of higher learning. Additionally, a number of requests for attendance have been received from foreign nationals that are being considered on a space-available basis.

MESA and other Department of the Interior employees attend the Academy as part of their regular studies. Others are charged a nominal amount to cover out-of-pocket expenses for room and board and instructional materials (approximately $10 per day). To date, most applicants have been accepted—although some have been brought in on a deferred basis when classes have been filled.

Most class sections are limited to 20 participants and seminars are limited only by the size of the auditorium (approximately 400). However, as many as 1,500 people can be handled on special occasions (as for the dedication this past August), using bleachers and temporary seating in the gymnasium.

Summary

In summary, the National Mine Health and Safety Academy is a modern educational facility dedicated to the reduction of accidents and the improvement of health conditions in the nation's mines and the mineral industries through education and training. A variety of educational programs have been developed to create increased health and safety awareness among MESA employees, personnel from other federal and state agencies, university students, members of labor organizations, foreign nationals and others interested in mine health and safety.

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HUMAN FACTORS IN INDUSTRY

By LEONARD RING
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As technology advances it has tended to outstrip our appreciation of human needs in working situations, and lack of such knowledge has led to the design of machinery ill-fitted to human operation. Unsuitable working conditions hamper production and are a cause of dissatisfaction among those who have to work in them.

Poor work conditions in terms of stress and classification lead to costly errors of judgment, which in turn can lead to accidents (or, more correctly, injuries) to themselves or to others, damage to plant, and spoiled material, all of which will affect production. Another direct consequence is absenteeism and increased labor turnover, which are an added unnecessary waste of human resources.

Human factors, or ergonomics, is the study of the relationship between man and his occupation, his equipment, and his environment and applying the knowledge of anatomy-physiology and psychology to the problems that arise from these areas. Its aim is the minimizing of unsafe, unnecessary, and unproductive effort so that a more efficient and worthy use can be made of the human capacities.

Enough historical evidence exists that man's limitations have typically received little attention during the design of equipment for his use. Managers have commonly adapted the man to fit the machine by instructions or training or motivating him to avoid its hazard. What is far more effective is to design the hazard out of the machine in the first place. Numerous studies have shown how minor changes in equipment design produce significant improvements in performance.

Anyone wishing to buy a machine will automatically turn to the engineering sciences for information on function, structure, tolerances, etc., but for the men and women who will work these machines, it is the normal practice to rely on common sense, but human beings have equal limitations and capacities.

There is nothing new about human factors or ergonomics; ever since man began using tools he has attempted to modify his environment to meet his needs—the development of protective clothing arose from man's own functional necessity in the workplace. The design of craftsman's tools like the scythe is another example. However, what is new is the research that has given us definitive data on man's capacities and limitations.

Most of the impetus for ergonomics occurred during the war, when speed and sophistication of equipment reached proportions that severely limited the functional capacity of its operations. For instance, in the early years of the Second World War, more pilots were killed in training than in combat, and in the U.S., while casualty figures in the combat zones ran at 25,000 per month, casualties in the factories rose to 106,000 per month. Thus, it became essential to bring together groups of specialists, those who knew about human capacities and those who knew about machines. Anatomists, physiologists, and psychologists worked together with engineers to make man plus machine an efficient fighting weapon.

The success of this led to its application after the war to industry, but its influence on job satisfaction, accidents, absenteeism, and labor turnover has only recently been appreciated. Its potential for reducing the stress and wasted effort that invariably leads to downgrading incidents and physical injury makes it a very important tool of loss control which

everybody interested in accident prevention should be aware of.

Its elements are:

Anatomy—The relationship of muscles and joints to the task.

Anthropometry—The measurement and proportions of the body applied to the workplace: chairs, workbenches, space, etc.

Physiology—The response of work to body function, space, rest pauses, heart rate, etc.

Psychology—Vigilance, inspection, aging memory, training. Selection.

The visual environment—visual acuity, glare, good lighting, etc.

The thermal environment—optimum comfort temperatures. Measurement of environment. Air temperature. Air movement. Humidity, etc.

The auditory environment—noise and its measurement. The effects of noise and its control. Vibration.

What is attempted in this address is to break away from the simplistic "unsafe acts" or "unsafe conditions" causology of accidents and to show that there is a complex act of inherent, interwoven conditions related not only to a worker's physical or mental make-up but also to the environment in which he works.

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SAFE OPERATION OF OVERHEAD CRANES

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The National Safety Council tells us that 25 per cent of all disabling injuries are caused by materials handling. Electrical overhead traveling cranes are the giants of industry, and if an accident occurs it can have serious consequences.

Handling material by crane is a vital part of the production process and a review of the crane program can pay handsome dividends.

A crane review program should encompass crane inspection, maintenance, crane safety rules, qualification and training of crane operators, schools for craneman learners, schools for chainmen and hook-up men, annual safety meetings for cranemen, chainmen, and supervisors, record keeping, and an overall crane program evaluation.

Let us consider some elements of the program:

Crane Inspection

In evaluating a crane program, some of the items to look for when making a preliminary crane inspection are:

1. Crane hoisting mechanisms to have a safety factor of five.
2. Crane capacity signs on both sides of the crane and visible from the floor.
3. All gearing enclosed.
4. No overhanding gears or pinions that may work loose.
5. Adequate stops on bridge and trolley with energy absorbing bumpers to reduce shock and impact and secured to prevent fall.
6. Rail Sweeps. Bridge trucks shall be equipped with rail sweeps which extend below the top of the rail and project in front of the truck wheels; trolley trucks should be equipped with similar sweeps.
7. Guards over cross shaft couplings.
8. Stairways, ladders, walkways, hand railings, and toeboards in accordance with U.S.A. Standard Safety Codes.
9. Two brakes on hoist—one, a control braking means either mechanical or elec-brake.
10. A hoist limit switch of the automatic reset type to prevent overtravel of the hoist block.
11. Enclosed and guarded hoist blocks to prevent cables from unraveling from sheave wheels if block is set on floor.
12. All wiring properly insulated and run in conduits or ducts.
13. All electrical equipment suitably guarded for protection against accidental contact.
14. Main line switch enclosed in steel cabinet, interlocked so that main switch is "out" before cabinet can be opened.
15. Circuits, cabinets, and controls labeled for identification.
16. Lubrication points should be accessible without the necessity of removing guards or other parts.
17. Cab arranged to give operator full vision of load hook in all positions.
18. Hook and block painted for high visibility.
19. Fire extinguishers and warning devices in working order.
20. A permanently fastened tool box shall be provided for storage of oil cans, tools and other necessary articles.

Qualification and Training of Crane Operators

Cranes operated from a cab should have licensing and training requirements for operators. A candidate for crane operator should pass a physical examination administered by the medical department and complete 72 hours of operator

training. The craneman should be given a test based upon his proficiency in operating the crane and his knowledge of the safety rules. The test should be given by a qualified crane examiner, and if the candidate passes he should be given a license. He should thereafter be given a physical examination by the medical department at least once a year.

Periodical and Interval Crane Inspection

Cranes are graded into six classifications. The highest classification is the crane in constant heavy duty service. This is also the classification for cranes used in handling molten metal. A definite schedule should be made up for inspecting each crane depending upon its classification. Records should be kept of the periodic inspections with progress reports on correction items. In addition, interval crane inspections should be specified.

Crane Safety Codes

Each plant should have a complete list of crane safety rules. It is not unusual for a large plant in a heavy industry to have a safety code containing over a hundred rules on crane operation, crane repair, and chainman regulations.

School for Craneman Learners

I have conducted two-day schools for craneman learners utilizing indoctrination, crane movies, crane inspection, hands-on crane operation, floor model demonstrators for trolley, controls, and lubrication, classroom review, safety, crane code, rules, tests and quizzes.

Here is an outline of a two-day crane school. Sessions were no more than 50 minutes in length, followed by a rest or coffee break.

1. Introduction—movie, "The Craneman"; orientation.
2. Operate Shop Crane—familiarization; inspection; test limit switch; "hands-on" operation.
3. Floor Model Demonstration—trolley; manual controllers; master controllers; lubrication panel.
4. Classroom—overhead projector; Slides: "Operating Tips," "Condition Reports," "Safety Rules."
5. Hands-on operation of yard crane—depth perception exercise; control swing in load.
6. Operate Sandhouse Bucket Crane.
7. Test and Quiz—crane nomenclature; terminology.
8. Chaining and Hookup.
9. Co-ordination and Cooperation.
10. Safety.
11. Nomenclature—Test #2; Terminology—Test #2.
12. Summary and Critique.

After attending the school, the student returns to his department and practices on his shop crane under the guidance of an experienced craneman. When the student demonstrates reasonable proficiency in operating the crane and a knowledge of the crane rules, his foreman should indicate in writing that the student is ready to take his crane test from a qualified examiner. After successfully passing his crane test, it generally takes a new craneman about one month of crane operation before he gains the confidence that he can operate the crane efficiently, just as if the crane were an extension of his own body.

Annual Meetings for Cranemen, Chainmen and Supervisors

1. *Cranemen.* If a department has kept records of crane incidents and crane-related injuries there will be enough material at the end of one year to present an interesting and dramatic yearly safety review. The meeting should cover the crane operator's duties and responsibilities. Review how the crane operator is to inspect his crane at the start of his shift and how to fill out the daily crane inspection report, how he is required to test the hoist limit switch at the start of the shift, how he is responsible for keeping his crane clean—no flammables, no loose material on the crane—and how to report any defects or unsafe conditions. Review the past year's accident experience and, if there have been no injuries in that department, review accidents that have happened in other plants within that industry. Review some of the more important safety rules. Discuss crane lubrication and maintenance. Allow for group discussion, comments, and evaluation before closing the meeting.

Before holding a craneman safety meeting, the instructor should inspect each crane so that he will be able to understand the items that may come up during the group discussion.

2. *Chainmen, Hook-up Men and Crane Directors.* The chainman annual meetings should follow the craneman's meetings and use the same general format. The use of slides, movies, flip charts, illustrations, demonstrations, and other visual aids can make for a highly interesting and provocative session. Many valuable suggestions have come forth from the group discussions.

3. *Supervisors.* Each year the supervisors should attend a craneman-chainman review. A list of craneman and chainman malpractices can be made up and a discussion held on how supervision can reduce the abuses.

Summary

Cranes are such a vital part of the production process that it pays to have a periodic review, evaluation, and update of the entire crane program.

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A NATIONAL SAFETY PROGRAM EVALUATION SYSTEM TURNS COMPENSATION TRENDS DOWNWARD

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My objective today is to share with you some of our experiences in South Africa covering the way in which we tackle accident prevention, which in turn has assisted in bringing about dramatic reductions in workmen's compensation insurance rates.

The South African Workmen's Compensation Act is based on the Canadian act. All employers, by law, must make provision for the workmen in case of injury at work. Some 80 per cent of all employers pay their insurance premiums into the State Injury Fund, which is run on a non-profit basis. Employers cannot opt out.

The employers are grouped into 112 different classes according to the various types of industry. For instance, Cement and Lime Works, Quarry of Stone, Stone Crushing, Salt Pans. Each class must be self financing. If the claims are greater than income, then the insurance rate is increased to recoup the losses, and vice versa.

Despite increased benefits—increased medical and hospitalization costs—an analysis of the rates over the last six years show 92 classes reduced, 15 classes remained constant, and five classes increased (Dry Cleaners and Undertakers).

How have management achieved this? By meeting specific objectives set them in the field of accident prevention on a national scale. NOSA—The National Occupational Safety Association—sets the objectives. Before getting down to the nuts and bolts it would be well to explain how NOSA works and how we are financed.

NOSA is a non-profit company formed by the various employer organizations with the sole objective of assisting in the prevention of occupational accidents. The finances come from the State Injury Fund, where some two per cent is set aside and paid to NOSA. NOSA is a non-governmental body. It has no authority. It gives through its servants a service to industry; on the whole, gratis. Some of you may recognize the system, as it is based on the IAPA of Ontario, Canada; we used their blueprint.

YCSSSSOYT—this may be a little difficult to pronounce. It means "You cannot sell safety successfully sitting on your tail." This is where our company differs greatly from most other national safety organizations except IAPA of Canada. We go out and sell safety on the shop floor. We believe that this is the only way in which one can do it successfully. We knock on doors and influence management to introduce safety programs.

NOSA makes contact with the firm. This is done on request from the firms or by our contact with the firm. We call the firms where we have to make contact, the "market firms," as we wish to cover some 70 per cent of all the employees in South Africa. Invariably this is a firm employing more than 50 workers. We have found that of the 30,000 factories and mines, 11 per cent employed over 70 per cent of work force. Our objective is to motivate management, to educate them, evaluate the present situation, and develop a safety program for them.

For many years we at NOSA have been carrying out safety inspections of the various plants under our jurisdiction. We

had pointed out hazards, but quite frankly our progress was not really spectacular at all. Around about the 1960's we thought that we should think up something new. We realized that man, by nature, is competitive. He likes a challenge. So, if we could develop something that could meet this need, then possibly the industrialist would rise to the occasion.

Just at that time two people were receiving quite a lot of publicity in South Africa concerning the management techniques which they were teaching. These two people were Louis A. Allen and John Humble, who were doing work in the field of management by objectives. Allen makes the point that effective management is always management by objectives. We felt that we should also get on the band wagon. Because objectives must be established, if logical action is expected to be taken we should set objectives in the field of accident prevention as well.

We then thought that if we break up a safety program into certain objectives—certain key areas such as housekeeping, guarding, fire protection and prevention, record keeping, and safety organization—we could then urge management to attain these objectives. We went further. We prepared actual checklists of the various items, for instance, housekeeping, buildings, and floors in a good and clean state of repair. Lighting good, ventilation good.

But having a checklist is still not the ideal situation. We should quantify the items on the list. We should allocate points to the various items, depending on how we see the items as being important for the safety program.

A perfect program for each specific plant is worth 2,000 points. The total points. Good lighting is 20 points and 2,000, but we break this down further and see that buildings and floors have 40 points. Good lightins is 20 points and ventilation, 30 points. Electrical, mechanical, and personal safeguarding have a total of 650 points. Machine guarding was considered to be more important than any of the others and 150 points was allocated to this item. The lockout system has 40 points and labelling, 30 points.

You may ask, why go to all this trouble to actually allocate points to the items? Why put a figure to the various aspects of a safety program? Why do we worry to quantify? I think Peter Drucker, one of the best known management consultants in the English-speaking world, weighs the situation up very well when he says: "The measurement used determines what one pays attention to. It makes things visible and tangible. Things included in the measurement become relevant; things omitted are out of sight and out of mind."

How is the evaluation done? The firm starts with a clean sheet. It starts with a full 2,000 points, as if it had a perfect program. With guidance from the NOSA staff, optimum requirements for each plant can be determined, using the criterion: How much more could management be expected to do within the specific plant?

Let us take dust, for example. What standards of dust are not acceptable? If we compare a mineral water factory, I am sure you will agree that there should be no dust in the plant where the bottling is taking place, but in a foundry, which is by nature a slightly dusty process, one can expect the standard to be different than that of the mineral water factory. It is fully realized that this becomes a little subjective, but because there are numerous small items making up the whole, anyone who is biased in one specific direction, for instance in first aid boxes, cannot influence the overall evaluation to any great extent.

We are now ready to carry out our evaluation. The action plan is now ready.

The NOSA man visits the factory with a special note book so designed that he has the checklist headings already prepared for him. He then merely makes a note in his note book of the hazards or deviations from the standard which he expects for the plant. The NOSA man's

objective is the guidance, education, and training of the various echelons of management in the techniques of accident prevention and, as we progress, loss control management. Because accident prevention is basically a management technique, the NOSA technical man is required to assist management in introducing management control methods.

Let us use Louis Allen's terminology, paraphrased by Frank Bird, for the control activity. This is an actual case study in applying the control technique.

1. Identify those key items which have a bearing on the Loss Control Program. For example, it is felt that portable electrical equipment should be checked and controlled.

2. Set standards of performance, valid understandable yardsticks and accountability. For example, all portable electrical drills and extension leads will be checked at monthly intervals for grounding, broken cables, polarity, and switches. The foreman electrician will be held responsible for the task and the findings will be recorded in a suitable register.

3. Measure the activity or work in progress against the set standards. For example, on the first Friday of each month the foreman lays before his supervisor the Portable Equipment Register reflecting the checks made and findings recorded. As a further check the supervisor asks for extension lead No. 7 to be checked in his presence. The polarity is incorrect; a deviation from the standard set has taken place.

4. Evaluation of deviation must be made to determine the final step. On investigation it is found that an apprentice had connected up the wiring and had not been taught the new color coding.

5. Corrective action: Have foreman teach all persons under his control the new color coding for electrical wiring. Improve standard by spelling out this requirement using Point of Problem poster.

It is therefore, only natural for management to show a resistance and be suspicious of anyone wishing to change his methods of conducting his business. To break down this resistance to change and to get the intangible concept sold, one has to follow a specific modus operandi. Intangible sales are possibly the most difficult sales to clinch, especially as, in the case of NOSA's services, they are gratis.

We try to change the abstract thinking to something concrete by taking the manager virtually by the hand and showing him where his problem areas lie. Showing him the advantages of grounding his tools and introducing a control into the system.

The NOSA man, having gone through the factory and made his notes using our criteria how much more, etc., then quantifies his observation in terms of the various objectives. Take fire prevention and protection, for instance. The point allocated for the correct fire extinguishers is 40. The firm has, say, soda-acid fire extinguishers in the electrically hazardous area, which would be incorrect and so full points could not be allocated. It may be found that half of the extinguishers are incorrect and so only 20 points are allocated to this item instead of 40.

Let's take the last item on the list, maintenance of the equipment. Possibly the fire extinguishers are not maintained at all. They have merely been put into position and left in that position. In this case, the firm would have no marks allocated to this item at all.

As far as electrical equipment is concerned, the portable electrical equipment may be found to have the groundwire broken or extension leads with the line and neutral wires swapped. Again, the NOSA technical man will quantify the hazard and instead of, say, 40 points, this firm would only be half way up the ladder, earning 20 points for the item.

The NOSA man must now report back to senior management verbally on that very day, if possible. He reports back on his findings as tactfully as he can and so encourages the management to introduce a program. Although the NOSA man is not a law enforcement officer, he draws attention to the Factories Act, because virtually every item listed is covered by an aspect of the Factories Act—our OSHA. He follows this up with a written report and a checklist which draws management's attention to certain weaknesses. These weaknesses are marked with an X next to each item and a detailed report is an explanation of each item.

To back up the whole action plan kit, the manager also receives a booklet, "Management by Objectives in the Field of Accident Prevention." If management wants to go further, they can, from the booklet, order further pamphlets and detailed information explaining the various aspects of the program.

The real motivator, however, is giving recognition to management for their effort in the form of the star grading system. This is a system similar to the hotel grading system where the best hotel is graded a five-star and the weakest a one-star. This has really caught the imagination of management, and many of the firms have prepared special notice boards which state that this establishment has been graded a three-, four-, or five-star by NOSA. The rating values are: five-star, which is excellent, 91 to 100 percent. Ratings go down to one star, which is fair, 40-50 per cent of the objectives. This rating must correlate with drop in IFR—we want to see results, therefore we added the further criterion of IFR. Five-star, IFR five or less; four-star, IFR 10 or less; three-star, IFR 15 or less; etc.

The next step in the hierarchy of recognition is our national competitions. The best five-star firms in each of the 11 regions go forward in 11 categories to the national competitions. Panels of judges evaluate the various competitors to arrive at the best in each class in the country. The Factory and Mines inspectorate are invited to judge, together with a NOSA man and a specialist.

The final degree of recognition is our very own Oscar—only we call it a NOSCAR—National Occupational Safety Accredited Award. The winners of the two major competitions are skimmed off and they compete against themselves—they must achieve 95 per cent of the objectives and have an IFR of less than five.

Let's look at some of the success stories. We use the measurement of injury frequency rate as set out in the American Standards Association under Z16. In other words, a disabling injury is one which results in a man not able to return to his normal duties the following day. Expressed as a million manhour exposure.

You will recall that we said NOSA makes contact with the firms and establishes a safety program. We now close the loop and have a feedback from the firm in the form of statistics. These statistics are the number of disabling injuries which the firm experiences together with the number of manhours worked. From this we can calculate the lost-time injury frequency rate or disabling injury frequency rate.

We believe that this documentation and the supply of registers and logbooks to meet the requirements of the various acts has gone far in systemizing the programs. This has enabled the industrialist to establish programs of very high caliber. These programs form the basis of loss control management which is progressing very well.

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