BULLETIN

HOLMES SAFETY ASSOCIATION

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SAFETY EFFICIENCY

MINERAL INDUSTRIES

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Please note: The views and conclusions expressed in HSA Bulletin articles are those of the authors and should not be interpreted as representing official policy of the Mine Safety and Health Administration.

KEEP US IN CIRCULATION

The Holmes Safety Association Bulletin contains safety articles on a variety of subjects: fatal accident abstracts, studies, posters, and other health and safety-related topics. This information is provided free of charge and is designed to assist in presentations to groups of mine and plant workers during on-the-job safety meetings.

Welcome new members

NAME	CHAPTER NO.	LOCATION
William Penn	10879	Shenandoah, PA
Conrad Sand & Gravel, Inc.	10880	Conrad, MT
General Chemical Partners	10881	Green River, WY
William Mueller & Sons	10882	Hamburg, MN
Henderson Specialists, Inc.	10883	Russellville, AR
Lea County	10884	Hobbs, NM
Corona Aggregate, Inc.	10885	Corona, CA
Country Club Aggregates, Inc.	10886	Clifton Park, NY
Tripoli Sand & Gravel	10887	Hudson Falls, NY
Lafarge Corporation—Alpena Plant	10888	Alpena, MI
Paul Moore Sand And Gravel	10889	Pahrump, NV
Alloy Prep. Plant #1	10890	Boomen, WV
Lapis Plant #10	10891	Marina, CA
FMC Wyoming Corporation	10892	Green River, WY
May Go Trucking	10893	Gauley Bridge, WV
Calmat Saticoy Plant	10894	Oxnard, CA
S.P. Milling, Co.	10895	Oxnard, CA
Pacific Lightweight Products	10896	Frazier Park, CA
P.W. Gillibrand Co.	10897	Simi Valley, CA
Bulk Materials Coal Hauling	10899	Forest Hill, WV
Farmers Supply And Explosives	10900	Beckley, WV
Falls Creek #2	10901	Gauley Bridge, WV
Pike Floyd	10902	Prestonburg, KY
Leonard Winner & Sons Trucking	10903	Frostburg, MD
Hadeka Slate Flooring, Inc.	10904	Poultney, VT
S & W Industries, Inc.	10905	Masontown, WV
Winol Preparation Plant	10906	Ovapa, WV

Twelve die in mine inundation on October 19, 1911

In October 1911, the New Langdon shaft was being sunk and had reached a depth of 1,500 feet on the variable dip of the ore. At the same time a drift, several levels above the shaft bottom, was being driven to tap some old workings supposed to be about 250 feet from the shaft. These workings had been abandoned and filled with water, so that their exact extent could not be determined. On October 19, the drift was thought to be over 100 feet from the old workings, but blasting of a round in the face broke through, allowing water to enter and flood the drift and the shaft below its level. Miners working in the drift and adjacent levels escaped, but 12 men in and near the bottom of the shaft were drowned.

No accurate maps of the area were available, and estimates of the distances involved underground were obtained by measurements between surface openings. No test holes were drilled ahead of the drift face, and men were allowed to remain on the lower levels while the drift round was blasted, because it was estimated that the drift still had more than 100 feet to go to the water-filled workings. After the mine was unwatered, a drift was safely driven on a lower level to tap the flooded workings. Test holes were kept ahead, and the unwatering was done through boreholes. HSA

Reprinted from the Department of Interior's Bureau of Mines ***Information Circular 7493*** *dated April 1949.*

Holmes Safety Association monthly safety topic

Fatal powered haulage accident

GENERAL INFORMATION: A 23-year old quarryman, with 5 years of mining experience, was fatally injured when the front-end loader he was operating rolled over an embankment and crushed him.

The quarry was a surface granite operation. The mine employed 6 persons working one 8-hour shift a day, 5 days a week.

Granite was mined in large blocks about 6 feet by 6 feet by 8 feet, weighing from 20 to 25 tons each. The blocks were removed by line drilling, blasting, and, where necessary, channel burning.

DESCRIPTION OF ACCIDENT: After attending to personal business, the victim reported to work at about 10:00 a.m. When the victim arrived, the foreman assigned him to operate the front-end loader. The brakes did not hold properly, and about two cups of fluid were added to the system. Reportedly, the victim then tested the brakes and said they were working well. After moving a compressor with the loader, the victim began to dig and fill areas of the quarry roadway. The foreman came by and saw that digging in that area was difficult and he showed the victim the loose material piles at the quarry.

Around 12:00 noon, the victim told the foreman that this was his last day of work. He was to attend an over-the-road truck driving school the following week.

After lunch the victim continued hauling dirt and smoothing the roadway. At about 3:30 p.m., three quarrymen who had completed their shift and were leaving the mine, passed where the victim was working. They observed him picking up a bucket load of material at the piles.

At about 4:20 p.m., the foreman and two quarrymen quit work for the day and passed by the area where the victim was last seen working. As they came near, they saw the overturned loader. They ran to the victim and checked for signs of life. They then drove about seven-tenths of a mile to the nearest phone and called for emergency assistance.

The Sheriff arrived at 5:09 p.m. The victim was pronounced dead at the scene by the county coroner.

In the area of the accident the granite was overlaid with unconsolidated (gravel like) material about 6.5 feet deep. One area of the gravel had been stripped, leaving an embankment of unconsolidated material about 13 feet east of the quarry wall.

There were imprints in the soft surface of the sloped strip that matched the loader's tires. This track showed that the loader had backed up the slope, heading southerly, dropping the left rear wheel over the embankment.

CONCLUSIONS: The accident occurred when the victim failed to control the loader as he backed it up a slope, allowing the left wheels to slide off the vertical embankment, overturning the loader.

Contributing to the severity of the injuries was the fact that the loader was not equipped with ROPS and seatbelts. Loaders which are not equipped with ROPS and seatbelts should not be used in any area where rollover hazards exist.

Subsequent investigation revealed the presence of a bag of marijuana in the victim's pocket. This was described as enough material to make two joints (cigarettes). Urinalysis showed a presence of the drug leading to the possibility that narcotics may also have contributed to the accident. HSA

Assessment of accident risk during haulage truck and power shovel maintenance and recommendations for improved safety

By Thomas J. Albin, U.S. Bureau of Mines

Introduction

Accidents associated with equipment maintenance account for a substantial portion of all U.S. surface mining accidents. Maintenance and repair operations in U.S. surface mines, during the 1978-84 period, accounted for 34.1 percent of all lost-time accidents and 16.5 percent of all fatalities.[1] This report is based on Mine Safety and Health Administration (MSHA) records of maintenance accidents that occurred in the surface mining industry from 1978 through 1984, which identify 18,331 accidents as maintenance related.[2] Of these accidents, 5,776 (31.5 percent) occurred during the maintenance of mobile mining equipment.

Accidents linked to maintenance work on large haulage trucks (50-st capacity or larger) constituted 21.2 percent of all accidents associated with maintenance of surface mining mobile equipment in the period 1978-84. During the same period, accidents occurring during the maintenance of power shovels and draglines accounted

for 34.5 percent. Thus, research addressing maintenance safety for these two classes of equipment can potentially have an impact on 55.7 percent of the total number of maintenance accidents involving mobile mining equipment.

As part of its mission to increase the safety of mining operations, the U.S. Bureau of Mines (BOM) examined 1978-84 MSHA maintenance accident records, including 1,225 accidents associated with off-road haulage trucks of 50-st or larger capacity and a sample of 100 accidents from about 2,000 associated with power shovels. This report identifies highly hazardous areas of haulage truck and power shovel maintenance and suggests modifications to machines or procedures that would improve maintenance safety.

Methods

In order to evaluate the relative hazard of working on the various systems that comprise surface mining machines, the Bureau collected maintenance and repair work-time records from three surface iron mines. These work-time data were then classified by the system worked on. Accidents that occurred during maintenance and repair activity were then assigned to the same set of systems.

A statistical analysis was used to evaluate the contribution of each truck or shovel system to the total accident frequency and injury severity, relative to the portion of the total maintenance time spent maintaining or repairing that system. That is, systems with a high percentage of total accident frequency and a low percentage of work time are highly hazardous, and systems with a low percentage of total accidents and a high percentage of work time are less hazardous. These relative values were expressed as ratios.

The first ratio calculated was the percentage of total accident frequency (total number of accidents) divided by the percentage of total maintenance time spent maintaining or repairing the particular system. The second ratio calculated was the percentage of total injury severity divided by the percentage of total maintenance time spent maintaining or repairing the particular system. Injury severity is defined as the sum of lost workdays and statutory days charged, plus one-half of the restricted workdays.

Statistical confidence intervals were established for these ratios. Confidence intervals specify a range of values around an overall mean, in this case, the overall mean of a group of ratios. The more distant the severity or frequency ratio of a particular system from the average of all systems, the more or less hazardous the system is, depending on whether the ratio is more or less than the average. Those ratios that are more distant, in the sense of being farther than a statistically specified distance from the average of all ratios, indicate systems that are more hazardous to work on than the average system. The statistical technique allows a statement of confidence that the systems are correctly identified as hazardous. In this report, that confidence level is 95 percent.

Table 1.—Accident and injury ratios for truck systems.

System	Ratio, actual-expected accident frequency	Ratio, actual-expected injury severity	Pct. total accidents
Air	0.7698	0.2805	1.0
Blower	1.1400	0.0702	0.5
Box	0.4438	0.6267	7.3
Brakes	1.5663	1.6888	6.1
Cab	1.0265	0.7478	2.3
Cooling	*4.8380	*4.8102	10.5
Electric brake	0.2292	0.0069	0.3
Electric	1.0074	0.9448	5.5
Engine	1.3115	1.7010	22.1
Exhaust	1.0813	0.3415	1.3
Frame	0.8763	0.7268	6.8
Fuel	2.3140	1.4535	2.0
Hydraulic	1.1350	0.5714	5.8
Radio	0.4857	†	0.2
Steering	1.4872	2.4402	3.5
Suspension	*8.4386	*10.4737	4.8
Tires	*8.2092	*6.7449	16.1
Wheel motors	0.2228	0.0184	1.3
Overall average	**2.034**	**1.98**	**NA**

NA=Not available * Excessively high accident frequency or injury severity.
† Undefined
Source: Based on MSHA accident records, 1978-84, and worktime records from 3 mines.

Haulage truck maintenance accidents

Accidents involving haulage trucks have been analyzed to determine the truck system being worked on at the time of the accidents. This information, listed in table 1, was obtained from MSHA accident narratives. Using maintenance and repair work-time histories obtained from surface iron operations, the percentage total of all work-time spent in maintaining each truck system was also estimated. The percentage total of all accidents in the sample involving each system was then compared with the percentage of work-time devoted to each system to identify the systems that were most hazardous. Accident frequency and injury severity were both considered.

The overall injury severity ratio for trucks was 1.96 days, and the overall accident frequency ratio for trucks was 2.034 days. Three truck systems were identified as having higher than average accident frequency and injury severity ratio: the cooling, suspension, and tire systems.

Cooling system

Accidents involving the cooling system were broken down into two subgroups, one group of 27 that occurred in the field and another group of 40 that occurred in the shops.

Field accidents were predominantly (70 percent) the results of opening hot cooling systems, which caused scalding by the hot coolant. Another 25 percent of these accidents were slip-and-fall-type accidents. All of the falls occurred because of footing problems; that is, they resulted from insufficient traction on the surface on which the individual was standing, including deck surfaces, ladders, and tires.

Shop accidents were more diverse. A major, identifiable class of accidents is falls, which accounted for 57 percent of all shop accidents. The falls occurring in the shop also resulted, primarily, from footing problems. Slipping handtools and overexertion of the worker accounted for about 13 percent each of the accidents.

Suspension system

Of a total of 35 accidents associated with the suspension system, 35 percent involved the fall of large, unsecured parts on workers. In another 30 percent, workers overexerted themselves, primarily while pushing or pulling on wrenches. An additional 10 percent was workers falling while working on the suspension system.

Tires

A total of 63 accidents involving tire work were examined. Of these, 19 percent resulted from explosions of the tire. About 25 percent of the explosions occurred while the tire was on the truck. Some of the explosions involved the mate of the tire that was actually being worked on. In most of these accidents, the injured individual was struck by projectiles, either parts of the tire or rim, or dust and dirt kicked up by the explosion.

Eighteen percent of the tire accidents involved the fall of unsecured tires on individuals while the tires were being moved. In another 2 percent of the cases, the chain or cable used to secure the tire was inadequate and failed under load. Thus, one of five tire accidents resulted from moving inadequately secured tires.

Fourteen percent of the tire accidents involved overexertion of the worker. The overexertion injuries resulted from both lifting and push-pull actions.

Inadequate eye protection accounted for about 10 percent of all tire injuries, as did slipping handtools and "caught in" injuries. "Caught in" injuries typically involved catching a hand or fingers between a tire and the rim, or between a retaining ring and the seating groove.

Falls accounted for 6 percent of the tire accidents.

Recommended actions for truck systems

Cooling system

Cooling system accidents that occurred in the field are predominantly the result of opening hot, pressurized cooling systems. Often this appears to be the result of the operator's, or less frequently the mechanic's, impatience in waiting for the system to cool sufficiently before opening the system for inspection or servicing.

A general approach to safety engineering is to first formulate a solution to the problem. A simple solution would be to develop a "sight glass" appropriate to field conditions that could be added to the cooling systems. This would indicate coolant levels while the system is closed. A similar approach would be to add a transparent overflow reservoir, similar to those found in automobiles, which indicates fluid levels while the cooling system is closed.

If impatient operators and mechanics are going to open hot cooling systems, a straight forward solution to this problem would be the development of a method for the remote release of pressure in the cooling system. Using such a device, the operator or mechanic could vent a hot cooling system from a safe distance, thus avoiding scaldings. If coolant loss is

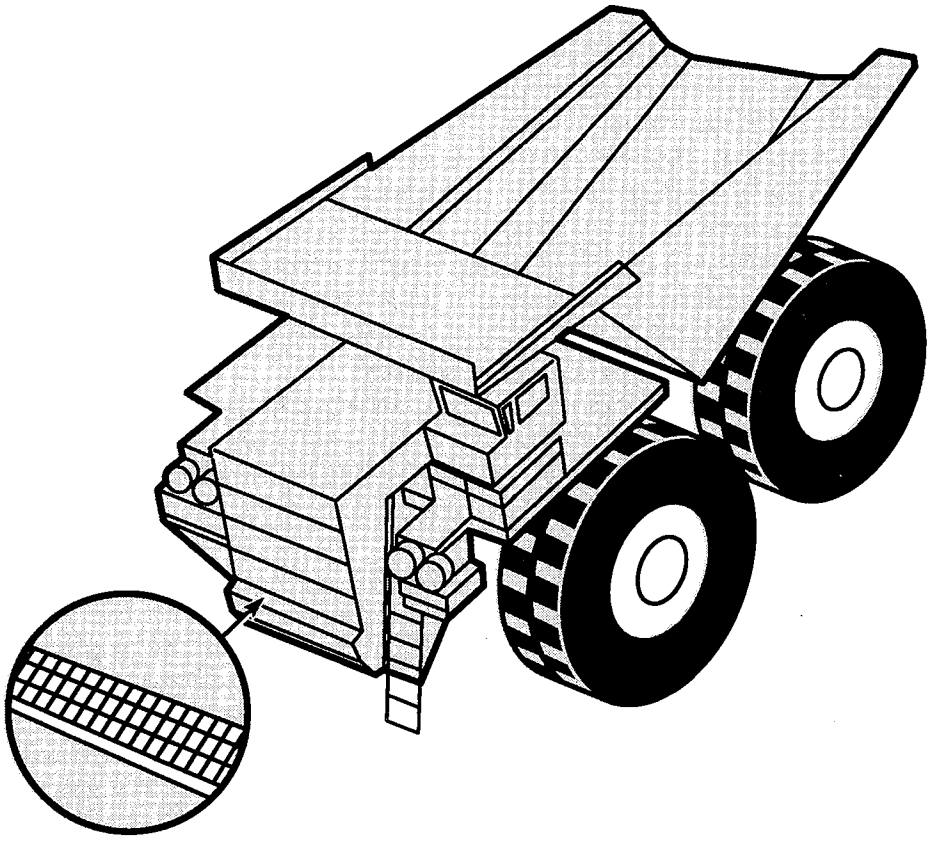


Figure 1.—Hypothetical step point on truck bumper improved with grating material. Detailed section (circled) shows grating.

unacceptable, the system could be modified so that it would vent into a reservoir from which the coolant could be recovered.

Another approach would be to install locking caps and limit the distribution of keys. Kits to add locks to radiator caps are available from some Original Equipment Manufacturers (OEM). These are sometimes sold as antivandalism kits. This would limit the number of individuals who could open radiators to those who presumably know the risks involved. It would also build in some delay time, possibly allowing the system to cool down.

A secondary approach to safety engineering is to train the individuals involved to recognize hazards. Information regarding the danger entailed in opening a hot cooling system should be included in operator training. Finally, warning signs or tags should be prominently displayed in the vicinity of the cooling system.

The second most common source of accidents involving field maintenance or repair of the cooling system is slips and falls. The cause of these accidents can be directly attributed to the condition of the surface on which the individual was standing. In some cases, these surfaces were inappropriate, such as tires. In other cases, they were more reasonable, e.g., decks and bumpers. In all cases, they involved insufficient frictional forces, primarily because of lowered coefficients of friction. Frequently, this decrease in friction was due to lubricants, such as fluids or granular material (sand, dirt, fine ore spillage, etc.).

An engineering solution would be to identify all positions where a worker might stand within a reasonable reach envelope of major cooling system components. These standing points could then be improved by attaching grating material. This material has the advantage of allowing small granular material and fluid to drain through and has an intrinsically high coefficient of friction due to its rough surface. A schematic of such an installation is presented in figure 1.

The majority of shop accidents (57 percent) involving the cooling system are falls. About two-thirds of these accidents also resulted from slips while standing on truck surfaces as described above, and these surfaces would benefit from improved traction. About one-third of these injuries in the shop resulted from the absence of railings on the workstand the individual was using. Although space limitations may not be as great a problem while individuals work on the cooling system, this problem often prevents the use of either workstands or guardrails, or both, during maintenance. The development of guiderails for purchase or construction of an adjustable-height workstand with guardrails that could be used within confined spaces could improve maintenance safety. As a starting point, such a workstand could be similar to the "bucket" of a cherry picker, essentially a cylinder enclosing the worker.

A second approach would be to use safety lines. Attachment points for these lines could be affixed to the machine.

Overexertion of the worker and slipping handtools accounted for approximately 26 percent of shop accidents. Because posture is often involved in such injuries, the location of improved surfaces for standing so that major components

are within standard reach envelopes could help to reduce overexertion injuries. Training to avoid high risk postures would also be beneficial.

In summary, cooling system injury accidents could be reduced through:
1. Development of a durable sight glass or transparent overflow reservoir to indicate coolant levels;
2. Development of a remotely activated pressure release for haul truck radiators;
3. Purchase and installation of locking radiator caps;
4. Inclusion of warnings in the operator's and mechanic's training as to the hazards of opening hot cooling systems;
5. Location and improvement of the footing at positions on the truck such as bumpers, decks, etc., where a mechanic or operator might stand to work on or service the cooling system, whether in the shop or in the field;
6. Development of a workstand with adequate railings and toeboards that could be used within the confined spaces of an off-road haulage truck;
7. Use of safety belts and safety lines;
8. Training for maintenance personnel in avoiding high risk postures, including lifting and push-pull exertions, while exerting force.

Suspension system

Ninety-five percent of all maintenance accidents involving the suspension system occurred in a shop, as opposed to a field location. Thirty-five percent of accidents that occurred during maintenance of the suspension system resulted from unsecured parts, which fell and struck workers. An additional 30 percent were overexertion injuries, and 10 percent were falls.

Characterization of work practices at mines with good truck maintenance safety records emphasizes that the suspension system components are always secured against movement. One mine's procedure involves clamping the suspension system component to a forklift. This gives the ability to move the component as well as to secure it. This mine uses a shop-fabricated bracket to clamp the system component to the forklift. Development of specifications and drawings for a similar fixture for dissemination to mines would assist in accident prevention. Similarly, plans for alternative shop-fabricated systems of securing and moving suspension system components could be developed.

Falls and some overexertion injuries are related to workstand characteristics. As previously mentioned, the absence of railings may increase the severity of an injury, and the frictional properties of the surface may increase the probability of an accident. Workers exerting force while assuming an awkward posture because of the height of the workstand are at increased risk of an overexertion injury. Workers attempting to exert the required forces may slip because the workstand surface is inadequate and may fall because of absent railings or toeboards.

Overexertion injuries resulting from lifting or attempting to lift system components could be reduced by ensuring the availability and use of lifting devices such as light cranes or forklifts or other fixtures as described above. Training in safe lifting techniques should also be provided.

In summary, suspension system injuries could be reduced by:
1. Development of a fixture or fixtures to be mounted on a forklift for the purpose of securing and moving suspension system components;
2. Development of a similar fixture capable of supporting and moving system components without the use of a forklift;
3. Development of an adjustable-height workstand that can be used within the confined spaces of a haulage truck as previously discussed;
4. Training for workers in safe lifting and push-pull procedures, including recommended postures and load limits.

Tires

Nineteen percent of all tire accidents resulted from the explosion of the tire. Eighty-three percent of the explosions could have been prevented if the tire and its mate were both deflated before any work was done on them, including removal from the vehicle. The recommended action is to emphasize this in the training of individuals who work on or may be expected to work on tires.

Eighteen percent of all tire accidents resulted from the fall of tires and/or rims on workers while the tires were being transported, installed, or removed from the vehicle.

Another 2 percent of all tire accidents resulted from failure of the chain or cable to support the tire during movement or transportation. These accidents could be prevented by emphasizing the importance of supporting the tires while they are being moved. Tire workers should be made aware of the required chain or cable strength necessary to support tires. Equipment capable of moving and supporting tires should also be available for the worker's use.

Overexertion injuries accounted for 14 percent of all tire injuries. Training in proper lifting tech-

niques, especially when to lift and when to use a mechanical assist, should be provided periodically.

Inadequate eye protection, slipping handtools, and catching hands between tires and rims accounted for 30 percent of all tire accidents. These accidents are best addressed by changing worker behavior, which could be done through training and behavioral management of safe working practices.

A final 6 percent of tire accidents were falls that resulted from poorly constructed workstands. The need for well-designed workstands with adequate toe and guardrails has already been discussed.

In summary, recommended actions for improving tire safety are:

1. Deflating the tires, including both tires of dual mounts, prior to any work on tires;
2. Providing adequate supports for tires while they are being removed, transported, or installed on trucks, and developing guidelines for adequate support of cables or chains;
3. Providing all tire workers appropriate training in proper lifting and exerting push-pull force;
4. Ensuring that personal protective equipment, such as eye protection, is used;
5. Utilizing adequate workstands, including toeboard and guardrails.

Power shovel system accident analysis

An analysis similar to that performed on trucks was conducted for accidents that occurred while working on power shovels. That is, the frequency and injury severity of accidents while working on various power shovel systems were compared with the time spent maintaining and repairing those systems. The results are presented in Table 2.

Table 2.—Accident and injury ratios for power shovel systems.

System	Ratio, actual-expected accident frequency	Ratio, actual-expected injury severity	Pct. total accidents
Air	0.94	0.17	3.3
Boom	0.65	0.23	7.8
Bucket	0.96	0.61	28.1
Cab	0.40	0.13	0.6
Car body	0.69	1.40	5.0
Electrical	1.10	2.76	6.9
Hoist	*12.37	3.55	11.5
Hoist cable	*13.65	*8.94	11.6
Lubrication	1.22	1.51	4.5
Propel	0.25	0.10	7.8
Superstructure	2.73	4.47	4.1
Swing	*6.62	*19.98	8.6

* Excessively high accident frequency or injury severity.
Source: Based on MSHA accident records, 1978-84, and worktime records from 3 mines.

Three power shovel systems were identified as highly hazardous in terms of the frequency of accidents relative to the time spent working on the systems. These systems are the hoist, hoist cable, and swing system. Two systems were identified as highly hazardous in terms of the severity of their associated injuries; they are the hoist cable and the swing systems.

Because of the larger sample of power shovel accidents, it was decided to use a random sample of power shovel accident narratives, rather than examine all narratives, as was done with trucks. A random sample of 100 power shovel accidents was selected from all MSHA power shovel accident records for the period 1978-84. The following sections are based on this sample.

Hoist and hoist cable systems

Although the hoist and hoist cable systems combined account for only 1.75 percent of power shovel maintenance and repair work time, 20 percent of all power shovel maintenance accidents occurred while working on these two systems.

The predominant types of accidents while working on the hoist and hoist cable systems are being hit by the cable or flying chips (40 percent), slips and falls (30 percent), and being caught in the cable (25 percent). In 6 percent of the "hit by" accidents, the worker was struck by a whipping cable end. In the remainder of the "hit by" accidents, chips flew off of pins, etc., which were being driven with hammers. Fifty percent of the slips and falls occurred when a worker was standing on a cable drum while it was turning. The remainder were due to decreased surface friction. The "caught in" injuries typically involved hands or fingers caught between the cable and some other object, such as the drum.

The most readily addressable of these accidents appear to be falls and being hit by chips. Falls have been discussed in detail under truck system accidents. A worker's being struck by a chip while driving a pin, etc., is a very common type of power shovel accident. A potential method for reducing the number of such accidents is to use a soft metal hammer. A soft metal hammer would reduce the number of chips and may actually be more efficient than a steel hammer in converting swing energy in actual work.

A second method of driving or removing pins would be to utilize a hydraulic jack. In some instances, this may require the development of jigs or fixtures to hold the hydraulic tool in position.

Swing system

Seven percent of all accidents in the sample involved the swing system. All of these accidents occurred when an object, such as a tool, fell and struck a worker below. In a situation where work will be carried on at different levels, any protection, such as a portable canopy, for the lower-level worker would be appropriate.

Recommendations for improved safety while maintaining power shovels are:

1. Improved access, including better means of access and better housekeeping of walking surfaces;
2. Utilization of soft metal hammers or hydraulic tools for driving or removing pins;
3. Protection from falling hand tools and from small parts for workers at lower levels.

Summary

Three haulage truck systems were identified as most hazardous to work on in terms of both accident frequency and injury severity. These systems are the cooling, the suspension, and tires. Three power shovel systems were identified as most hazardous in terms of accident frequency. These systems were the hoist, hoist cable, and the swing. Two power shovel systems, the hoist cable and the swing, were identified as most hazardous in terms of injury severity. Some of these accidents are amenable to engineering intervention. Others may be more readily addressed through behavioral intervention.

Falls are a serious type of maintenance accident, as has been seen in the analysis of these highly hazardous systems. Falls accounted for approximately 25 percent of all surface mine haulage truck maintenance accidents. In the sample of 100 power shovel accidents, 44 percent of all accidents involved falls, mostly from ladders. An underlying theme of these falling accidents is the apparent inadequacy of current workstands or other means of access to the machines. Some of the design shortfalls include the lack of toeboards and guardrails coupled with low-friction work surfaces. Another serious problem is the space constraint imposed by working within the haulage trucks and power shovels. Many workstands cannot be used in confined spaces.

Many falls result from inadequate footing on the surfaces on which mechanics stand while performing maintenance tasks. The location of such standpoints and improvement of these surfaces with nonslip surfaces, such as grating, would decrease the number of falling accidents, as would the use of safety belts and lines. Currently, many standpoints are structural elements of the machine and are surfaces on which workers stand. Spilled liquids and particulate matter, which are allowed to accumulate, are examples of poor housekeeping, which increases the risk of a falling accident.

A second general problem is parts that are not secured. The development of new workstands with toeboards capable of being used within confined spaces, or the utilization of existing systems with toeboards, would decrease the number of accidents where system components may fall on individuals.

Finally, a large portion of all maintenance accidents may be best addressed by behavioral intervention. This type of behavioral intervention would consist of initial training in workplace hazards and safe working methods, followed by behavioral management strategies for maintaining safe work practices.

Injuries while working on haulage trucks and power shovels account for a significant portion (55.7 percent) of mobile surface mining equipment maintenance accidents. The systems identified within this report are the most hazardous systems to maintain and repair on these machines, in terms of both accident frequency and injury severity. The suggested solutions to these problems are primarily (1) gaining access to work areas on the machines, (2) protecting the employee in the work area, and (3) training the worker in safe work practices, such as safe lifting techniques. HSA

[1] *Long, D.A., An Analysis of Off-Highway Haulage Truck Maintenance and Repair Accidents, 1975-84. BuMines IC 9139, 1987, 15 pp.*
[2] *Ibid.*

Do night shifts encounter more perils because safety works only nine-to-five?

Multiple shift operations should keep everyone as informed and prepared as the day shift

By Don Penkala

On the graveyard shift, resources were often scarce. An employee experiencing recurring problems with a bucket conveying system found out that the two mechanics that were assigned to the "11-7" shift were too busy with other priority jobs. So he decided to troubleshoot the problem himself. He opened the safety cage covering the bucket assembly, disabled the automatic shut-off and began cycling the machine, testing it to determine the source of the problem.

At 2:10 a.m., the moving conveyor caught his right hand, completely severing his right middle finger.

Subsequent mistakes by the night shift's supervisors delayed obtaining proper medical attention and ultimately resulted in the permanent loss of the finger. The total costs of the injury to the company, including lost productivity, were over $100,000. The ultimate cost to the individual was even greater.

A full investigation of the incident was conducted during the following day shift. As is typical with injuries on the off-shifts, there were numerous factors. The causes of this incident were cited as:

- Risk-taking and poor safety awareness.
- Violation of a safety rule prohibiting the disabling of safety switches.
- Poor supervisory follow-up with employee when the mechanical problem was reported.
- Poorly understood procedures for handling emergencies on the off-shifts.
- Inadequate employee training.
- Inadequate maintenance resources on the off-shifts.
- Failure to solve a recurring mechanical problem (first reported several shifts earlier).

On the surface, the employee's supervisor appeared to be at fault—poor maintenance follow-up, poor employee supervision, ineffective employee training, poor safety awareness, poor loss-control follow-up. However, much of the blame was placed on management.

The supervisor, for example, had complained about being understaffed for months, but former employees were never replaced. He *had followed up* with the maintenance department several times regarding the mechanical problem, but the bucket conveying system was but one of a long list of items scheduled for repair.

In addition, the supervisor hosted regular safety meetings with employees. However, the off-shift crews were often left out of plant-wide safety awareness programs. Clearly, the supervisor was at fault for not understanding the procedure for handling emergencies on the off-shift and for inadequate follow-up of the machine problem.

SAFETY AFTER FIVE. Managing safety in a three-shift operation is literally a never-ending job. However, addressing the issues unique to the "off" shifts is vital to improving overall safety and plant performance.

No doubt, there was plenty of blame to be distributed in the case above. The real issue was, "What can be done to prevent recurrence?"

In most three-shift operations, employees assigned to the day shift typically have the highest seniority and are, therefore, the most experienced. In addition, management is visible, communication and employee involvement are facilitated, and resources are, generally speaking, available.

In contrast, the afternoon and night shifts are staffed with the least senior, least skilled, least informed, least involved, and least supervised employees.

The off-shifts, of course, have the advantage of less activity and fewer disruptions of normal work flow. This tends to mask the real safety danger. That is why many operations managers find that safety performance *on paper* is not significantly different across shifts. Still, by addressing the unique issues affecting employee safety on the back shifts, there is a

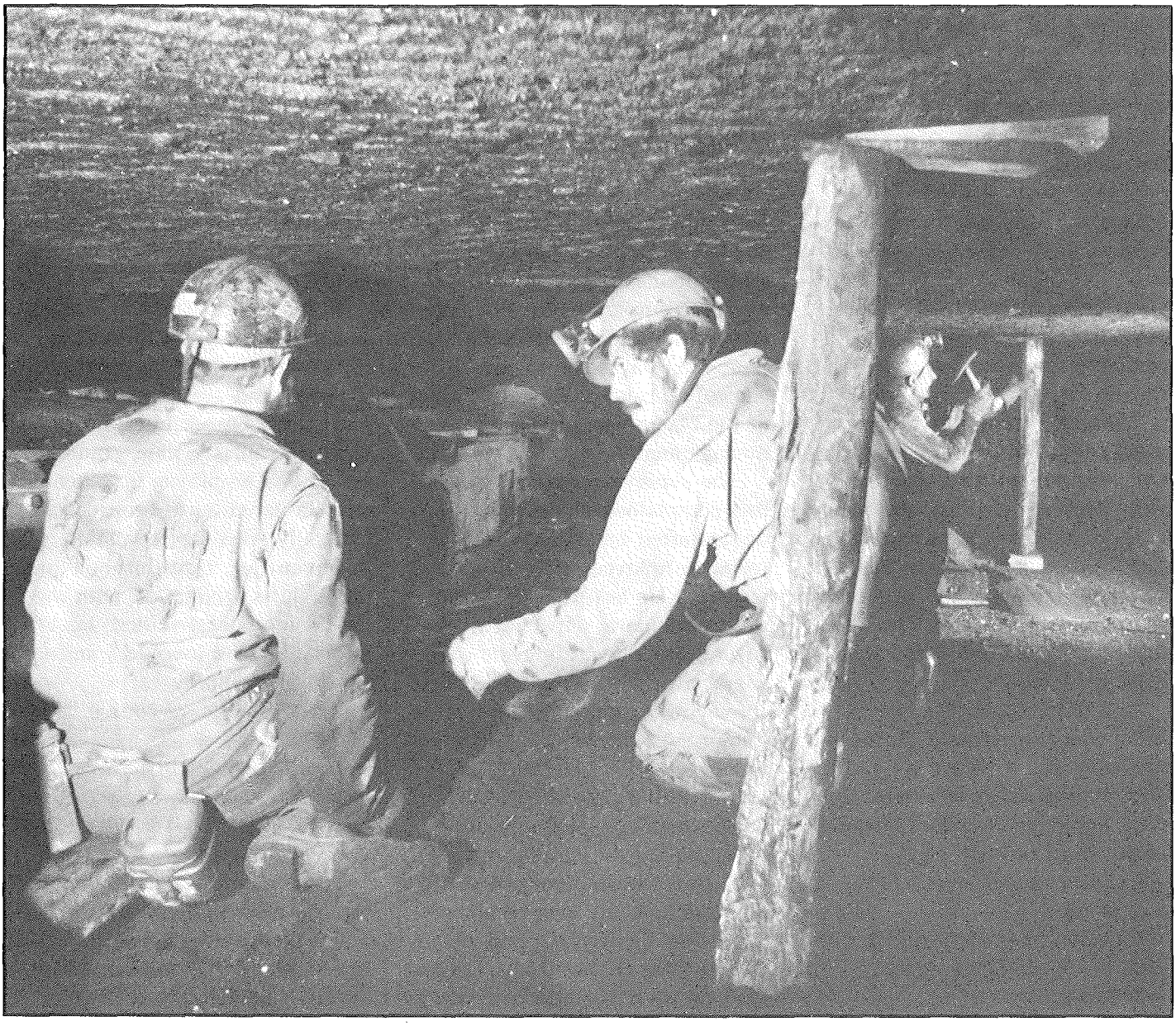
substantial opportunity to improve overall plant safety performance.

While the off-shifts represent a minefield of potential safety problems, eliminating the barriers to improved off-shift safety performance is crucial to improving overall safety and operational performance.

ADEQUATE RESOURCES. In response to cost-cutting objectives, downsizing in U.S. industry remains rampant. While, in theory, a plant or a department may be able to run effectively and efficiently with fewer people, cuts that are not accompanied by sound plans for effective implementation are dangerous.

Frequently, headcount reductions are mandated by operating managers. More commonly, however, reductions in force are gradual and result from restrictions on turnover replacement. In either case, supervisors must learn to absorb the cuts and to work around them. The problem is even more severe on the back shifts which do not have the luxury of drawing from a pool of available resources.

The consequences are predictable. To maintain production on the back shifts, people work faster, take more chances and perform jobs for which they are unqualified or physically unable to do safely alone. In addition, housekeeping deteriorates, creating both employee and, in the case of food and consumer product manufacturing, product safety hazards.



A thorough analysis must be made of the staffing requirements on the back shifts. This includes the impact on productivity, quality and safety which are ultimately inseparable. The practice of "short" staffing, while intended to decrease labor costs, frequently results in *net increases* in overall operating costs because of resulting accidents and work performance errors.

Of course, headcount considerations are only one factor to consider in an off-shift resource analysis. The analysis should ensure availability of proper tools and equipment that are crucial for safe night operations.

ADEQUATE TRAINING. Off-shift personnel are already at a disadvantage because of their inexperience relative to their day-shift counterparts. The problem is exacerbated since, because of insufficient resources, employee training is typically done when mandated or when time permits. On the back shifts, of course, time rarely permits.

Cross-training is usually more common during these hours out of pure necessity. The *effectiveness* and *thoroughness* of the training, however, is typically poor. Off-shift supervisors simply do not have the time to develop, customize and conduct effective employee training. Consequently, training is often not consistent across the three shifts.

In one plant, an employee was considered "fully cross-trained" and competent in every job function. He was viewed this way simply because he had been called upon to work in each of the department positions at one time or another during his employment. This same employee injured another worker in an accident while operating a propane-powered forklift. He was never given adequate training, but he was previously considered qualified for it.

This problem also arises when unqualified employees perform even routine maintenance functions. Since maintenance resources are usually in short supply on the off-shifts, it is not uncommon for an enterprising operator to attempt to troubleshoot a problem solo with little or no mechanical expertise or training.

Off-shift employees will continue to perform numerous job functions out of necessity. The development of a multi-skilled workforce is no longer a luxury that can be accomplished as "time and workload permit." A carefully planned and written cross-training program includes routine maintenance duties that will help to reduce incidents and accidents associated with an off-shift workforce.

Safety training for employees on these shifts should also include specific topics that are covered in depth.

EMPLOYEE PARTICIPATION. If plant-wide employee involvement programs are already in place, the participation rate is probably significantly higher among day-shift employees than among those on the off-shifts .

In many facilities, the off-shifts comprise as much as 60 percent of the total hourly workforce. To improve the effectiveness or the safety effort, managers and supervisors must work hard to ensure the active participation and involvement of all off-shift employees. Communication between shifts and between "day management" and off-shift employees and supervisors is vital to superior safety performance.

In one three-shift operation, communications became so efficient and effective that all employees (including office personnel) knew when an accident had occurred and its cause(s) and discussed what might have been done to prevent it—all within minutes following occurrence. Arriving shifts were briefed before starting work. This helped keep all employees—from the plant manager to the line operator—constantly aware of safety.

MORE DUTIES. Because of the scarcity of management resources on the back shifts, first-line supervision must assume leadership for much more than routine operating decisions. Off-shift supervisors must function more as plant operators and less as foremen. They play a critical role in improving plant safety performance and must be given the resources, training and support needed to do their jobs effectively. They must be able to provide safety leadership on the off-shifts by setting the right examples, knowing and enforcing safety policies and procedures and providing effective follow-up and coaching to their employees. Finally, in plants with superior safety records, the first-line supervisors are accountable for the safety performance of their crews.

Managing safety in a three-shift operation has never been easy. However, the results can be impressive if it can be managed effectively even while management is away. This translates directly into a higher productivity, higher profits and higher morale—truly a 'win-win' opportunity. HSA

Don Penkala is president of D. Penkala & Associates in Foster City, Calif. The company specializes in off-shift operations and safety improvement, and has helped companies in the United States, Australia, and South America improve safety, productivity, and employee morale.

Reprinted from the March 1994 issue of ***Occupational Health & Safety.***

Borehole mining of frozen gold placers tested in Alaska

A new U.S. Bureau of Mines (USBM) placer mining system using multiple boreholes to recover metal values from frozen gold placers offers an alternative for Alaskan miners. Scientists at the USBM Twin Cities (Minn.) Research Center have built and successfully field tested a remote multiple-borehole mining system.

The USBM system features a borehole miner consisting of an assembly of pipes that function as a water-jetting and slurry pumping system. These miners are placed in boreholes 7.6 meters (25 feet) apart.

Mining frozen placer deposits in Alaska has been greatly reduced for economic reasons. Shallower deposits that can be dredged are exhausted. Remaining deposits are under 15 to 60 meters (50 to 200 feet) of overburden. The older dredges cannot effectively operate in deeper deposits, and new replacement dredges are not cost-effective because of the small size of the deposits.

During mining, each of two borehole miners cuts a long, horizontal passage with a cross section of about 930 square centimeters (about 1 square foot) in the direction of the other miner until the two passages meet. The water jet cutter of one miner is operated simultaneously with the slurry pump of the other miner. This cutting jet is directed toward the inlet of the slurry pump; thus the slurry moves toward the inlet with high velocity and turbulence. This keeps the gold in suspension while the slurry is induced to flow into the inlet of the slurry pump and lifted to the surface. The direction of jetting is alternated between the two boreholes until the area is mined out.

Field testing of the two-hole borehole mining concept was done at a mine on Tenderfoot Creek, about 43 kilometers (27 miles) northwest of Delta Junction, Alaska, under a memorandum of agreement with Voytilla Mining Ventures. The multiple borehole mining system tests produced three times as much gold as that produced using single borehole mining.

Surface subsidence and clogging of the borehole miner with cobbles were the main problems encountered during testing. These problems must be overcome before borehole gold mining is used commercially.—*George A. Savanick, (612) 725-4543.* HSA

Reprinted from the U.S. Department of Interior's Bureau of Mines' February 1994 issue of ***Minerals Today****.*

USBM Seeks MSHA approval of mine illumination model

Representatives of the U.S. Bureau of Mines' (USBM) Pittsburgh (Pa.) Research Center and the Mine Safety and Health Administration (MSHA) met last summer to discuss the criteria required for MSHA to approve the USBM's mine illumination computer model for use by MSHA and the mining industry.

The illumination model is a computer software system that allows engineers to analyze quickly alternative lighting designs for underground coal mines by using illumination systems approved by MSHA. The model offers lighting vendors and mining companies greater flexibility in laying out illumination system designs and allows them to address more effectively the problem of glare in underground work areas. The meeting concluded with the decision to develop and implement a formal validation plan for the model which should subsequently lead to MSHA approval. The USBM and MSHA plan to work together toward this goal.—*Richard L. Unger, (412) 892-4372.* HSA

Reprinted from the U.S. Department of Interior's Bureau of Mines' February 1994 issue of ***Minerals Today****.*

HEARING PROBLEM

Once your hearing is damaged—it NEVER recovers

WEAR HEARING PROTECTION!

Valuing, empowering employees vital to quality health and safety management

TQM drives out fear, eliminates barriers and encourages cooperation to achieve mutual goals

By J. Donald Millar, MD, DTPH (Lond.)

Total Quality Management—As a safety and health professional, you have heard these words many times. In recent months, the teachings of [the late] Dr. W. Edwards Deming as variously manifest in "TQM," "CQI," "TQL," "Emancipation Capitalism," and other systems have gained popularity throughout the business community.

The goal of continuous improvement through managing by fact, statistical process control, focusing on customers and empowering workers is the subject of conferences, trade publications and popular magazines. Probably, these concepts have already influenced your board room. Dr. Deming and other management experts say implementation of these concepts is essential to American business' survival.

As an advocate for working Americans' safety and health for the past 12 years as Director of the National Institute for Occupational Safety and Health (NIOSH), I am encouraged by all this attention to "quality." Implementing the philosophy of "quality" requires the practice of "prevention"—the bottom line of occupational safety and health. Thus, the quality movement can be a profoundly significant enabler of workplace safety and health.

The philosophy of TQM and the "gospel of prevention" flow from the same philosophical source. The cornerstone of both doctrines is the fundamental belief in the inestimable value of human beings. TQM sees the worker as "our greatest resource"—which is the best possible rationale for occupational disease and injury prevention.

Do not think, however, that "quality" is either simplistic or easy to implement. On the contrary, based on personal experience leading NIOSH as we embarked upon "quality transformation," I would assert the opposite. It is hard work, requiring complex thought (what Deming terms "profound knowledge") and persistence in the face of resistance to change.

The theory and methods of TQM can be taught and learned. What must come from within is a willingness to change and an innate appreciation for our most valuable resource—the American worker. Without these requisites, TQM and prevention become superficial exercises without lasting effect.

Simplicity is often profound. A modern day author, Robert Fulghum, in "All I Really Need to Know I Learned in Kindergarten," shares his conviction that wisdom is not "at the top of graduate school mountain, but there in the sandpile at Sunday School." What Mr. Fulghum and the rest of us learned in kindergarten could, if practiced, have significant implications in the nation's workplaces.

Imagine a workplace where everyone complied with these guidelines: "Share everything, play fair, don't hit people, put things back where you found them, clean up your own mess, don't take things that aren't yours, say you're sorry when you hurt somebody ...live a balanced life—learn some and think some ... and play and work every day some ... and ... when you go out into the world, watch out for traffic, hold hands, and stick together...."

TQM brings fundamentals of this sort into the boardroom and the rest of an organization. Re-

spect for people, empowering each individual, continuous improvement, the quest for knowledge and balance, and teamwork—all of these principles are essential in the "quality" philosophy. Dr. Deming himself emphasizes the need to "drive out fear," "break down barriers," and "preserve the power of intrinsic motivation, dignity, cooperation, curiosity, joy in learning, that people are born with."

If we, as a nation, can spread the principle of respect for people and their safety and health and assist businesses who want to practice this principle, neither "prevention" nor "quality" can fail. Enlightened management and empowered workers are our best hope for achieving "safe and healthful working conditions" as required in the Occupational Safety and Health Act of 1970.

Research continues to show that focusing on "quality management" brings increased productivity and improved safety and health. One company that changed its management approach during the last decade, Phelps Dodge's Morenci Copper Mine, has tripled its production of copper per employee and has reduced the number of injuries from 14 per million employee hours to two.

Managerial and organizational factors can have a dramatic effect on safety and health. A Miami consulting firm completed a study during the last decade which confirmed this influence. Hank Sarkis, the firm's president, analyzed injury data and corresponding organizational factors and identified the leading organizational factors affecting safety. The most significant variables included the presence or absence of workplace stress, the degree to which the organization hires and promotes people who feel comfortable with their jobs, find their roles clear, are satisfied with the job and would recommend it to others.

And what of the "traditional factors" considered in safety programs? The level of safety training, for example, did not emerge as a key determinant. In fact, it was 37th on the list of variables. The most important factors relate to how companies treat people.

In response to the survey results, one company introduced quality programs to encourage teamwork and communication and gave employees more autonomy in making decisions about their work and safety. As a result, the company experienced a 76 percent reduction in the number of lost-time cases due to injuries and almost a 90 percent reduction in the number of lost work days.

It appears predictable that as "empowerment" spreads, so will progress in prevention. The time has come to humanize the workplace, to build trust, to drive out fear, and to preserve our most valuable resource—workers.

Many years ago, before quality initiatives became fashionable, a former presidential nominee summarized his guiding principles. Adlai Stevenson said, "If I were to attempt to put my political philosophy tonight into a single phrase, it would be this: Trust the people. Trust their good sense, their decency, their fortitude, their faith. Trust them with the facts. Trust them with great decisions. And fix as our guiding star the passions to create a society where people can fulfill their own best selves ..."

Building trust and respect is not easy nor inevitable. As Dr. Deming says, "learning is not compulsory." The simple values on which TQM rests will be difficult to implement for success will depend on a complete transformation of organizational cultures. Yet, if we truly believe in our workers' value, we must instill in this nation the "passion to create a society" which values its people. HSA

Dr. J. Donald Millar, formerly U.S. Assistant Surgeon General and Director of the National Institute for Occupational Safety and Health (NIOSH), retired August 1, 1993, and is now an independent consultant. A physician trained in epidemiology, he began his federal career with the Centers tor Disease Control in 1961. Among his many awards is the Surgeon General's Medallion for exceptional skill and fortitude in the management of program initiatives in the U.S. Public Health Service, 1992, and the 1990-1991 William S. Knudsen Award for outstanding contributions to occupational medicine, the most prestigious award granted by the American College of Occupational and Environmental Medicine.

Reprinted from the September 1993 issue of ***Occupational Health & Safety.***

The newly employed inexperienced miner

Like anyone in unfamiliar surroundings, newly employed inexperienced miners are not likely to fully understand their job duties, and the hazards they will be confronted with. They lack experience and confidence. Most are hesitant to ask for help, and may perform a task not fully understanding the hazards associated with the job.

The solution seems so simple: Give new employees all the safety training required and information they need to perform their jobs safely and effectively. Unfortunately it is not that easy.

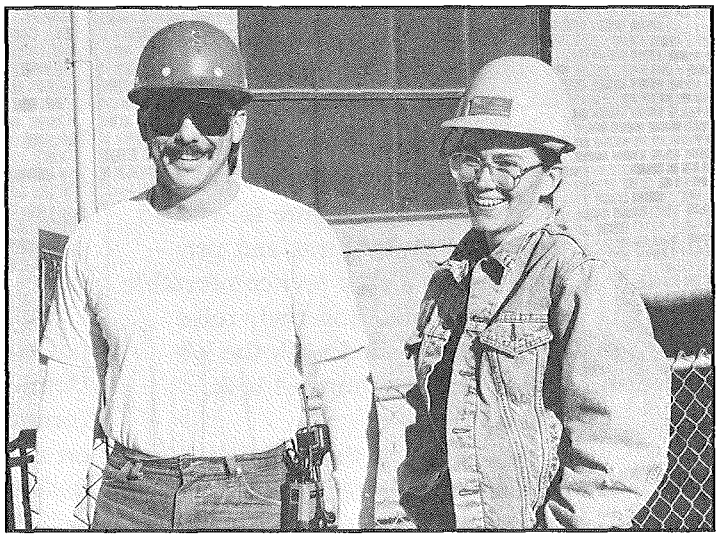
New employees are overwhelmed with rules and regulations, company policies, and mandatory state and federal regulations. They receive a company manual on benefits to read, fill out forms, listen to the company philosophy, and introductions, and haven't even seen the working area or been introduced to their supervisor.

At this point, most new employees are trying hard to remember how to get to the rest room, let alone understanding the basic safety procedures.

When does safety training begin? Obviously, safety concerns should begin, and federal regulations require that before a new employee performs any work related task, the new miner will be introduced to their work environment and the hazards associated with their environment.

Introducing employees to safety procedures on the first day is not only the law, it's just plain good business. Not only is the employee better prepared for their job, but the company has demonstrated its commitment to the new employee's well being.

The employee's perception of the employer concern and commitment to safety is often established during the first few hours of safety training.



A safety training program that covers all the required training and the company's policies cannot be covered completely in one day. The average employee will not remember all the information anyway.

When a company invests a considerable amount of money and time in training, it is only reasonable to expect a return on that investment. Priorities must be established that will ensure that return from safe productive performance.

Immediate, required training covers only the basics. You can't cover every possible situation, unless every employee is introduced to all aspects of safety as they advance from one job description to another.

Supervisors must become involved in the continuous safety effort. New employees must know who they may turn to should they have questions. They must feel comfortable in that they will not be criticized when questions are asked.

For basic safety information, safety department personnel are generally responsible for the new inexperienced miners training. However, the safety department cannot know all the hazards associated with all the jobs involved. For job-specific safety training, supervisors or experienced workers who have performed the job, and have the necessary skill to instruct inexperienced miners make effective teachers.

Refresher or follow-up sessions with new employees are important. Follow-up may be an informal on-the-job observation by the supervisor or a scheduled periodic session by the safety department. Employees should be encouraged to participate. Often new employees who haven't picked up bad habits or fallen into a routine can give a fresh new view to a job.

A well structured, positive, functional, safety training program will ensure the transition from the newly employed inexperienced miner to the seasoned worker with a positive attitude and a concern for safety intact. HSA

*Reprinted from the February 1994 issue of Nevada's **Mine Safety Sense**.*

Computerized thermal model developed for power cables

Researchers at the USBM's Pittsburgh Research Center have investigated the thermal characteristics of trailing cables used with coal mining equipment in an effort to reduce fire and explosion hazards. The study was performed in cooperation with the Department of Labor's Mine Safety and Health Administration (MSHA), the American Mining Congress (AMC), and the Insulated Cable Engineers Association.

Mobile mining equipment in underground coal mines is powered by heavy duty trailing cables that act as "extension cords." These portable power cables may lie on the floor behind the continuous mining machines, or they may be wound onto the reels of faster moving equipment.

The flow of electricity through these cables generates heat, so the cables must be sized properly for safety and to prevent fire and explosion hazards. For example, undersized cables tend to overheat, increasing the chance of a fire. Oversized cables, on the other hand, are unwieldy and heavy and may cause strain injuries in mine personnel handling them. Oversized cables also limit the capacity of machines using cable reels.

The laboratory tests, using the relationship between electrical current and temperature rise of cable conductors, served as the basis for subsequent development of computerized thermal models for both drag and reeled cable applications.

Machine designers can apply these interactive computer programs in determining the anticipated cable temperatures given the electrical load requirements of new machines. The use of the cable models ensure that the correct cable size is used on a particular machine. The programs also can be adapted for use in a cable protection system, ensuring that cables do not become the source of fires, burns to personnel, or explosions underground.—*James Cawley, (412) 892-6602.* HSA

Reprinted from the U.S. Department of Interior's Bureau of Mines' February 1994 issue of ***Minerals Today****.*

Tailgate topic—Power tools

We have become so used to using power hand tools, both at work and at home, that many times we overlook potential safety hazards. Power tools make our work easier but anything which runs by electricity can also become dangerous.

MSHA RULE: 56.14116—Hand-Held Power Tools

(a) Power drills, disc sanders, grinders, and circular and chain saws, when used in the hand held mode shall be operated with controls which require constant hand or finger pressure.

(b) Circular saws and chain saws shall not be equipped with devices which lock-on the operating controls.

Inspect powered hand tools before use. Make sure the power cord is in good condition and there is no exposed wiring where it enters the tool case or at the plug. Make sure the tool, such as a surface grinder, has guards that are in place and in good repair. Check to see if there is a lock-on button or switch. If there is a lock-on device, **B.O. the tool.**

Any new or newly rebuilt power tool will have a lock-on device. However, under MSHA law, they are illegal and must be removed or disabled. MSHA believes that a hand tool which can run continuously is a hazard.

A good rule to remember is that any safe tool *can be used unsafely.* HSA

YOU ARE THE DIFFERENCE!

Still time to register TRAM 21—Aug. 15-17

Penn State, West Virginia University, and the University of Kentucky are cosponsoring a three-day mine training conference at the Penn State Scanticon Conference Center Hotel on Penn State's University Park Campus for persons interested in improving skills, management, and mandatory training efforts in their organization. The goal of TRAM (Training Resources Applied to Mining) is expressed in its motto: "promoting professionalism and excellence in mine training."

The fee is $300 payable to PSU. For more information contact Kelly Henry at (814) 865-3437. HSA

Holmes Safety Association monthly safety topic

Fatal electrical accident

GENERAL INFORMATION: A 47-year old shift mine manager, with 25 years of experience, was killed in an electrical accident when he came in contact with energized conductors inside an underground starter box.

The operation is an underground coal mine cutting a slope from the surface to the Illinois No. 6 Seam, which averages about 66 inches in height. The mine has one slope and one dual compartment shaft. The mine produces 7,917 tons of coal daily with three continuous mining machines on three working sections. The mine employs 187 miners on three production shifts per day. Coal is transported from the section loading point to the surface by six 48-inch belt conveyors, including a slope belt. The series of belts are controlled by Pyott-Boone type slippage/sequence control switches.

Electric power for the belt drive motors is supplied by 7200/480volt mine power centers installed at numerous locations in the mine. Each of the three-phase circuits extending from the power centers to the belt drive equipment is of the wye-connected resistance grounded-type. Proper electrical protection for the circuits is provided by circuit breakers located at the power centers and equipped with grounded phase, short circuit, and undervoltage devices. Ground check monitors are installed to monitor continuity of the equipment grounding conductors.

DESCRIPTION OF ACCIDENT: The day shift, under the direction of the victim, entered the mine to start producing coal at its usual starting time of 8:00 a.m. After the start of the shift, the section foreman for Unit No. 5 phoned out to the belt repairman that the (5A) section belt was not running. The victim overheard this conversation and told the belt repairman that he (the victim) would go to the 5A belt drive to check on the problem. The victim then called the maintenance foreman and told him that there was a problem with the belt sequence controls and he needed his help.

When the belt repairman arrived at the 5A belt drive, the victim told him to go to the belt headroller and check the sequence sensor and spill baskets. The belt repairman was also told to go to the out-of-service "D" belt drive, located about two crosscuts away, and return with a spare sequence sensor and spill basket.

The maintenance foreman arrived at the 5A belt starter box shortly after the belt repairman left and met with the victim. The maintenance foreman then proceeded to test the sequence control boxes, which were located about four feet from the belt starter box. He then went to the belt starter box and made additional tests. Since the maintenance foreman was not familiar with this particular starter box and had no schematic, he de-energized the three circuit breakers located in the starter box. These breakers only partly de-energized the circuits inside the box. The maintenance foreman made no attempt at this time to remove incoming line power to the belt starter box. He tested some of the circuits in the starter box with a Square "D" Twiggy (a light indicator voltage tester) at several locations. He determined that the problem must be in the control circuits. After eliminating several components as the source of the problem, the maintenance foreman noticed a bank of small fuses which he thought were part of the control circuit located in the upper left side of the box. However, he could not reach them due to his extra large upper body size and the remote location of the fuses inside the starter box.

The maintenance foreman told the victim that he was going to pull the starter box away from the rib with his battery-powered golf cart so that he could gain access through a rear panel to check the fuses. As he was going to his golf cart, he noticed the victim on his knees looking into the starter box. After he moved his golf cart, he looked again and noticed the victim slumped over with his head and shoulders inside the starter box. He called out to the victim and got no response; however, he thought he heard the victim moan. At this time, he realized that there was something wrong and immediately de-energized the power to the belt

starter box at the belt transformer, which was located four crosscuts away. He called outside for emergency assistance from this location and returned to where the victim was located, removed the victim from the starter box and began CPR. Additional help arrived and CPR continued until the victim was transported to the surface, where an ambulance and EMT's were waiting. At 10:00 a.m., the victim arrived on the surface and was transported to the medical center where he was pronounced dead on arrival.

CONCLUSION: The accident occurred because the victim, who was not qualified to perform electrical work, was working on energized electrical equipment.

The following factors are believed to have contributed to this accident:

1. The 5A belt going to working section No. 5 (super section) had not been in operation for ahout 30 minutes,
2. The communication between the maintenance foreman and the victim was not adequate, and
3. Circuit diagrams for the belt starter box involved in the accident were not available. HSA

CDC: vehicles caused most job deaths

An average of 17 workers a day were killed on the job during the 1980s, according to a study by the Centers for Disease Control and Prevention.

The CDC reports that 63,589 workers died from occupational injuries in just 10 years. The top three causes were motor vehicle accidents (23%), machine-related injuries (14%) and homicide (12%). Falls caused 10% of the deaths, and electrocutions and falling objects caused 7% each. Other causes included air crashes and boating accidents.

Mining was the most dangerous industry, according to the report, with an annual death rate of 31.9 per 100,000 workers. [Italics added by editor for emphasis] Construction was second with 25.6 per 100,000.

The agency has recommended that states examine the industries and occupations at highest risk or with the greatest numbers of on-the-job fatalities to improve prevention efforts. HSA

Reprinted from the May/June issue of ***Industrial Fire Chief.***

Tailgate topic—Housekeeping

Try to imagine that you are a soldier sneaking through an enemy mine field, or that you are walking through a dark room that is full of chairs and toys. Your next step could hurt. It might even be your last.

MSHA RULE 56.20003—Housekeeping

At all mining operations—

(a) work places, passageways, store rooms, and service rooms shall be kept clean and orderly;

(b) the floor of every workplace shall be maintained in a clean and, so far as possible, dry condition. Where wet processes are used, drainage shall be maintained, and false floors, platforms, mats or other dry standing places shall be provided when practical; and

(c) every floor, working place, and passageway shall be kept as free from protruding nails, splinters, holes or loose boards, as practicable.

When we fail to clean up after ourselves, we leave a trap for everyone who must walk or work in that area. That broken part, shovel or hose that is left in the walkway becomes a potential injury for someone, maybe even you.

It is bad enough when someone else leaves a mess in the walkways of our work area, but it becomes worse when we don't clean it up. Just because you didn't leave it there doesn't mean it won't hurt you.

Clean up your work area and expect everyone else to do so also.

Can an object in the walkway be compared to a mine field? Ask the person who fell over the object and broke his or her leg. HSA

"CLEAN UP IS EVERYONE'S RESPONSIBILITY"

Tailgate topic—Drugs and alcohol

In the western movies, the miners are shown as hard-fisted, hard-drinking, mountain-moving men. They leave the saloon just in time to go to work in the mine. My bet is that the old miners didn't like drunk helpers any more than you or I do. Work places are the last place for someone under the influence of a drug or alcohol.

MSHA RULE: 56.20001 Intoxicating Beverages and Narcotics

Intoxicating beverages and narcotics shall not be permitted or used in or around mines. Persons under the influence of alcohol or narcotics shall not be permitted on the job.

We are never helping anyone if we help them to go to work drunk. In fact, we are only helping them to be seriously injured or killed.

There are MSHA rules which people don't agree with, but this is not one of those rules. HSA

ALCOHOL, DRUGS, AND MINING DON'T MIX!

Record attendance at joint mine safety and health conference

This year's South Central Joint Mine Safety and Health Conference, held March 16-17, 1994, in Little Rock, Arkansas, was a great success. There was strong representation from all six states of the South Central District with over 270 participants—the most participants ever at a South Central conference.

Louis Timberlake kicked off the opening session with the motivating and inspiring message that we are all born winners. His entertaining anecdotes and his sense of humor illustrated his point that winners are never surprised when they win and losers are never surprised when they lose. Consider yourself a winner, and you'll experience results, concluded Timberlake.

A somber memorial service for the twelve mine workers who lost their lives in 1993 followed Timberlake's opening. It was a poignant reminder that we must continuously work to prevent such tragic events.

This year's workshops, presented by people who have firsthand knowledge of their subject, were filled to capacity, and in some workshops there was standing room only. The subjects included the following: Bloodborne Pathogen Safety; Developing a Wellness Program; Preparing for a Health and Safety Conference; Electrical Safety; Supervisory Responsibilities; Section 110 of the Mine Act; Back Injury—A National Dilemma; Ergonomics Participatory Training Techniques; Safety in Enclosed Spaces; Physical Effects of Exposure to Hazardous Materials; Confined Space Entry; Heavy Equipment Safety Inspection; Part 48 Training Requirements; Accident Investigation Procedures; and How to Participate in an MSHA Inspection.

Bill Powell, former director of the Industrial Education Department at the University of Texas at Austin, gave the keynote address at Thursday's luncheon. During his speech, Powell credited the decrease in mining fatalities to safety and health conferences which help to inform, train, and educate mine employees, contractors, and other mine related personnel. Powell stressed there is no room for complacency. Instead, we must make it our responsibility to effect change to provide safer work conditions for ourselves and others.

Another highlight of the conference was a visit from the Assistant Secretary of Labor, Davitt McAteer, who also spoke at the luncheon. McAteer reinforced Powell's remarks and said by continuing to train and strengthen training programs, we'll be able to reach our goal of zero fatalities by the year 2000.

Following the conference, the conference committee members determined next year's conference will be in Oklahoma City, Oklahoma. The conference committee wishes to thank everyone who participated in this year's conference and hopes to see everyone in Oklahoma City. Thanks also to Leo Sawyer, his staff, and the people from Little Rock for their hospitality. HSA

Shocking possibility...

[Excerpted from a letter to the editor in the November/December 1993 issue of the International Association of Electrical Inspectors IAEI News.]

I have recently discovered a shocking truth about testing GFCI receptacles in the field. When they are installed on a two-wire or ungrounded circuit, the inspector's body becomes the testing device! Having received three shocks in the past six months, I started to become (even more) paranoid that some of the electricians were trying to get me.

This is the scenario: a residential rewire, an existing two-wire circuit to an attached garage for the outlet and a light. The electrician doesn't want the light to go off if the GFCI trips, so instead of a breaker he installs a receptacle and does not change the wire to a two-wire and a ground. This is permitted by NEC Section 210-7(d).

To save money and comply with Section 210-52, the electrician also installs an outside receptacle fed through the one in the garage. The electrician uses a metal box and cover on the outside outlet.

Everything is done in a neat and workmanlike fashion and complies with the requirements of the National Electrical Code.

The inspector inserts his handy GFCI tester in the outside receptacle. He pushes the button. The tester faults the hot side of the receptacle to the ground. The ground of the device is bonded to the enclosure (Section 250-74). The inspector is standing on the wet earth. He is holding the metal box or cover with one hand. He is now part of a high resistance fault path. He is now certain he has made a serious vocational error!

I'm not certain of my logic since some of the electrons in my brain have stopped talking to each other, but the above situation appears to be consistent with Mr. Ohms' law as enforced by the same power that enforces the law of gravity.

A.H.N.

Dear A.H.N.:

Your letter did not contain a question, but two points may save others the discomfort of the shocking experience you encountered.

First, contrary to your letter, I believe there was a code violation. Here's why.

Section 210-7(d) Exception permits a GFCI receptacle to **replace** an **existing** two-wire receptacle without grounding the GFCI receptacle. Installing a **new extension** of an existing two-wire circuit and not grounding it is not permitted by this exception which covers only replacement of existing receptacles.

Section 210-7(a) requires grounding type receptacles. Section 210-7(b) and (c) require them to be grounded to the equipment grounding conductor of the supply circuit and the FPN refers to Section 25050 concerning extension of existing circuits.

Section 250-50 Exception permits grounding-type receptacles installed on extensions of existing two-wire circuits to be grounded to any accessible point on the grounding electrode system as described in Section 250-81.

Had the installation of the extension been Code compliant you would not have received a shock.

That's the good news. The bad news is that if the outdoor receptacle had been an **existing** two-wire receptacle fed from the GFCI receptacle, Section 210-7(d) Exception would permit it to be replaced with a grounding-type receptacle without grounding it and you still would have received a shock.

Here's why, The internal test circuit of a GFCI receptacle or circuit breaker introduces a differential current within the GFCI of 8mA (at 120V) by closing a circuit from load side hot to line side neutral. The internal test circuit does not involve the equipment grounding conductor. Indeed, it must not because GFCIs must operate with or without the equipment grounding conductor.

Supplemental GFCI testers which plug into receptacles impose the test current between hot and ground. The test current on UL listed testers can range from 6 to 9mA. Nonlisted testers may have considerably higher test currents.

When you pressed the GFCI tester test button you imposed the test current on the ungrounded equipment grounding contacts in the receptacle and, thus, on the receptacle metal mounting yoke and the attached metal weatherproof cover. When you held the cover you presented the only path to ground and, thus, your shocking experience.

An examination of a UL listed GFCI tester reveals the following. It was marked "Read Instructions Before Use." UL 1436, the Standard covering such testers, requires installation instructions to contain a caution that such testers should not be used on two-wire ungrounded circuits. Such a caution is obviously important first to prevent shocks such as the one you experience, but also because the lack of an equip-

ment grounding conductor renders them unable to impose a test current and test the GFCI.

An effective practice on two-wire circuits would be to test the GFCI using the integral test button. Then use a voltage tester to verify which receptacles are being fed from it. You should also use a voltage tester to check the GFCI receptacle contacts. A nightlight will work very well. If the contacts are energized after the GFCI trips, then the line/load connections have been incorrectly reversed and the GFCI receptacle itself is not protected. HSA

Jack Wells
Vice President
Corporate Development
Pass & Seymour/Legrand

Southern Regional Mine Rescue Contest held

The Southern Regional Mine Rescue Association sponsored the Mine Rescue Competition held in New Iberia, Louisiana, May 6 & 7, 1994. Eight teams from Louisiana, New Mexico, and Texas competed. Personnel from the Mine Safety and Health Administration, New Mexico State Mine Inspectors Office, University of Texas at Austin, and Missouri Department of Labor Office officiated the competition. The National Mine Service Company coordinated the Benchperson Competition.

The field problem involved a premature face ignition and accumulation of methane that had to be ventilated to restore power and rescue the victim. To ventilate the explosive range of methane, the teams had to request vent bag, move an auxiliary fan in clear air, and ventilate the face with the trapped miner.

Field competition

1st Place WIPP Blue Team
2nd Place Carey Salt Team
3rd Place Morton Salt Blue Team
4th Place Morton Grand Saline Team
5th Place AKZO Salt Salty Cajun Team

Drager Bench competition

1st Place Morton Grand Saline Walt Bryant, Jr.
2nd Place AKZO Salt Harold LaBlanc
3rd Place WIPP Blue Joe Baca
HSA

Southwestern Regional Mine Rescue Contest held

The Southwestern Regional Mine Rescue Association sponsored the Mine Rescue Competition held at Carlsbad, New Mexico, on April 14-15, 1994. Eight teams from New Mexico and Arizona competed. Personnel from the Mine Safety and Health Administration, New Mexico State Mine Inspectors Office, University of Texas at Austin, and Arizona State Mine Inspectors Office officiated the competition. The National Mine Service Company and Biomarine Company coordinated the Benchperson Competition.

The field problem involved a shaft contractor who was attempting to seal the shafts of an abandoned mine. The contractor was lowering a 30 feet beam down a shaft when it came loose, fell down the shaft, and caused a power cable fire in the utility compartment of the shaft. Teams that did not travel the shaft slowly and cautiously inspect the shaft, would travel past the fire which was signified by an official turning over a placard and raising it above his head very quickly. The teams were also required to remove their apparatuses and crawl through a 24" to 30" high by 16' long low back area.

Field Competition

1st place Mississippi Potash Team
2nd place WIPP Blue Team
3rd place WIPP Silver Team
4th place Eddy Potash Rangers

Drager Bench Competition

1st place WIPP Silver Team Fred Miller
2nd place WIPP Blue Team Joe Baca
3rd place Mississippi Potash Team Tim Briones

Biomarine Bench Competition

1st place New Mexico Potash—Terry White
2nd place Oricle Ridge—Ron Sammeth

First Aid Competition

1st place Western Ag. Minerals First Aid Team of Chris Onsurez & Kathy Littleton
HSA

Skin cancer and sun smarts

How many people develop skin cancer annually? For years, doctors and public health officials have struggled to calculate that figure, but were hampered by the fact that the vast majority of skin cancers—perhaps as many as 97 percent—go unreported.

Now, as millions of Americans are preparing for the summer months and their greatest sun exposure, scientists believe they have a better handle on the statistics. A study released last week by Boston University researchers estimated that 1 million Americans will be diagnosed with skin cancer this year.

The researchers estimated that as many as one in three Caucasian Americans will develop basal cell skin cancer (the kind that afflicted former President Reagan) if they live to be 75 years old. They also found that one in 11 will develop squamous cell skin cancer at some point in their lives. The study, which was co-authored by Martin A. Weinstock, director of Brown University's Dermatoepidemiology Unit and chief of dermatology at the Providence Veterans Affairs Medical Center in Rhode Island, and Dena Miller, appears in this month's Journal of the American Academy of Dermatology.

Skin cancer is the general term used to describe an array of skin malignancies. Basal and squamous cell skin cancers account for nearly all cases of skin cancer. Neither type grows very fast or spreads rapidly. Both are easily detected and treated. Very rarely is either type life-threatening. Another kind of skin cancer is malignant melanoma, the least common and potentially most dangerous of all skin cancer.

Because at least 90 percent of skin cancer is closely linked to sun exposure, dermatologists and public health officials said the new findings underscore the importance of being sun-smart. Most important is to limit exposure from 10 a.m. to 3 p.m., when rays are strongest.

"We're not saying be a vampire and only come out at night," said New York University dermatologist Darrell Rigel. "If you work outdoors, wear a hat with a wide brim, wear long-sleeved shirts and pants, if you can. Use a sunscreen with an SPF [sun-protection factor] of 15 or higher and put it on at least 15 minutes before going into the sun."

The specialists stressed that preventive measures for children, particularly Caucasian youngsters, are important to stop the increase in the disease. While African Americans and other people with darker complexions have more natural protection against skin cancer, anyone can develop the disease.

"Unfortunately, although trends may change, we see no evidence that the skin cancer epidemic has

Melanoma

The most serious skin cancer is malignant melanoma. While relatively rare, melanoma's incidence "is rising faster than any other cancer," said Howard K. Koh, director of cancer prevention and control at Boston University Medical Center.

The rate of new cases increased 321 percent between 1950 and 1989. Malignant melanoma arises from melanocytes, cells in the lowest layer of the epidermis, the top layer of the skin. They release the protein melanin, which gives skin its color and protects against sunlight, giving skin its tan.

For reasons not yet understood, malignant melanoma spreads rapidly to nearby lymph nodes, where it gains ready access to the entire body through the lymph system.

Detected at less than 1/16 of an inch thick and less than a dime in diameter, melanoma can be cured in 92 percent of cases, specialists said. But with delayed diagnosis, five-year survival rates drop dramatically. Only about 14 percent of those whose cancer has spread live five years after diagnosis.

"The bottom line is that the death rate from melanoma is rising despite everything that we are doing," said Darrell Rigel, assistant professor of dermatology at New York University.

Among the people who have the greatest risk of melanoma include those who have a family member diagnosed with the disease, according to the Skin Cancer Foundation. Also at increased risk are people who experienced painful or blistering sunburns as children or teenagers; those who have unusual moles on their skin or moles that change often, and people with fair skin, light hair, and eye color who sunburn easily or tan with difficulty.

Among the signs of melanoma are moles or spots on the skin that have asymmetrical borders, uneven colors, and large diameters.

peaked," Weinstock said.

The findings are based on data collected at eight National Cancer Institute survey locations in the United States. Also included in the calculations are data from the Kaiser-Permanente Health Maintenance Organization of Portland, Oregon, where a skin cancer registry began in 1960, and from British Columbia, which has recorded all skin cancer data from its population since 1971.

"But the good news is that with education, early detection, and prevention, we should in theory be able to eliminate a lot of this, if not all of it," said Howard K. Koh, director of cancer prevention and control at Boston University Medical Center and chairman of the skin cancer screening task force for the American Academy of Dermatology.

A 1994 national survey conducted for the academy found that 59 percent of Americans consider a tan a sign of health and think it generally enhances appearances. Yet a golden glow from the sun is really a sign of skin damage that can never be repaired. Sunburns produce even more damage as they

Skin cancer at a glance

Experts stress that skin cancer is one of the most preventable of all cancers. They recommend the use of sunscreens, protective clothing and hats and urge people to limit exposure when the sun's rays are strongest—between 10 a.m. and 3 p.m. One million new cases are expected in 1994. Most cases occur among light-skinned individuals, particularly those of Northern European heritage, although no racial or ethnic group is immune from developing skin cancer.

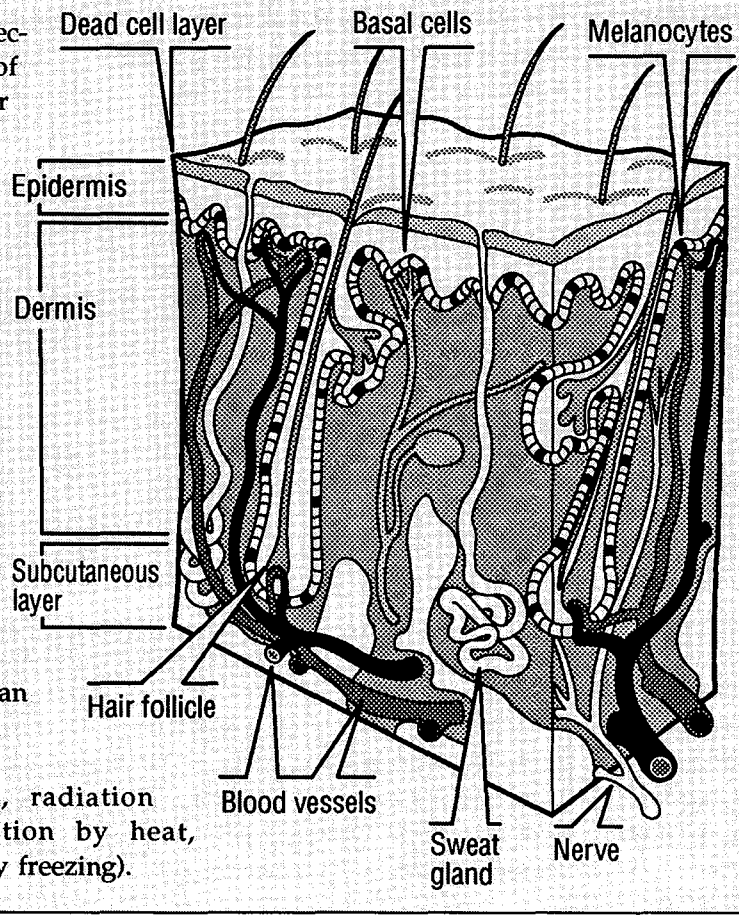
Common forms

■ **BASAL CELL CANCER:** Most common form of skin cancer in the United States. Roughly 800,000 new cases will be diagnosed this year alone.

■ **SQUAMOUS CELL CANCER:** Second most common type of skin cancer, accounting for 168,000 cases diagnosed annually. This is often preceded by a pre-cancerous condition called actinic keratosis. These pink or reddish, gritty and scaly spots usually occur on the face and tops of hands.

■ **SYMPTOMS:** Basal and squamous cell skin cancers often appear as pale, waxlike, pearly nodules or scaly red sharply outlined patches. Sudden progressive changes in moles or skin lesions that don't heal can also signal cancer.

■ **TREATMENT:** Surgery, radiation therapy, tissue destruction by heat, cryosurgery (destruction by freezing).



Malignant melanoma

■ **INCIDENCE:** 32,000 cases projected this year in the United States. Melanoma accounts for 75 percent of all deaths from skin cancer.

■ **SYMPTOMS:** Sudden progressive changes in moles, skin lesions that don't heal. Other signs include an irregular mole or a mole larger than 6 millimeters (about a quarter of an inch) that increases in size, changes color, becomes ulcerated or bleeds easily.

■ **TREATMENT:** Surgery, radiation therapy. Nearby lymph nodes are often removed in advanced cases to detect any spread of this aggressive skin tumor.

SOURCES: American Academy of Dermatology, Skin Cancer Foundation, National Cancer Institute

sear the top skin layers.

The vast majority of lifetime sun exposure occurs before age 18, which is why both the Academy of Dermatology and the Skin Cancer Foundation urge parents to protect their children from infancy (sunscreens are not recommended, however, for babies less than 6 months of age because of possible skin irritation). Instilling safe sun habits early—especially regular use of sunscreen, seeking shade during peak hours and wearing protective clothing—often establishes safe habits for a lifetime.

"Anybody can get skin cancer," said Koh, who has been applying sunscreen religiously to his three children since they were young. As Asian Americans, Koh said, his family's risk of skin cancer is less. Yet "everybody should have some level of sun awareness."

While sun-induced skin damage can't be reversed, it may be possible to slow the progress of changes that results in skin cancer. A study of 76 non-melanoma skin cancer patients published [May 2nd], in the New England Journal of Medicine, found that those who adhered to a low-fat diet after diagnosis significantly reduced the risk of developing new actinic keratosis—pre-cancerous skin lesions.

The results suggest, said the study's lead author Homer S. Black, that people who are at risk for skin cancer "could expect to have some benefits from modifying their diet." HSA

Reprinted from the Volume 13, Number 1 issue of the Arkansas Department of Labor's ***Safety News.***

Four more reasons to quit

Interesting facts for smokers and for those who live with them:

1) A study of 5,000 workers at Boeing Corporation found that smokers were 40% more likely to injure their backs. Scientists say that at least one of the reasons for this is because nicotine reduces blood flow to the nerves and bones of the spine, depriving them of oxygen and increasing the likelihood of disc degeneration. Reduced blood flow also increases the time required for back injuries to heal.

2) The University of California has provided the first laboratory evidence that exposure to second-hand smoke increases the risk of heart disease. Rabbits exposed to tobacco smoke nearly doubled the amount of fat deposited in their arteries during the ten week experiment. The U.S. Environmental Protection Agency (EPA) estimates that of the more than 50,000 Americans who die each year due to passive smoking, 37,000 die from heart disease, compared to 3,000 from lung cancer and 12,000 from other cancers. Passive smoking is the third leading preventable cause of death, after smoking and alcohol abuse.

3) The EPA also estimates that second-hand tobacco smoke is responsible for 300,000 serious respiratory diseases among children and infants (such as pneumonia and bronchitis), and an additional 26,000 cases of asthma. And a study of six- to nine-year-olds by Ottawa's Carleton University found that children whose mothers were exposed to second-hand smoke during pregnancy scored lower in tests of speech and language development, intelligence, motor skills, visual/spatial abilities, academic achievement and behavior problems. Children of mothers who themselves smoked during pregnancy scored lower still.

4) A study of South African gold miners who had been exposed to silica dust has shown that smoking may have a synergistic effect with workplace air contaminants, i.e., increasing the incidence and/or severity of lung disease. Of the workers studied who died of chronic obstructive lung disease (COLD), scientists calculate that 5% of the deaths were due solely to the dust, 34% were from smoking, and 59% were from the combined effects of the dust and smoking. HSA

Reprinted from the May/June 1994 issue of the Ontario [Canada] Natural Resources Safety Association's ***Health & Safety Resource.***

Let's all work safe out there!

THE LAST WORD...

"Advice after injury is like medicine after death."

"It may be that those who do most, dream most."

"Work done with little effort is likely to yield little result."

"You miss 100 percent of the shots you never take."

"Experience is not what happens to a man. It is what a man does with what happens to him."

"To see ourselves as others see us is a most salutary gift. Hardly less important is the capacity to see others as they see themselves."

"We may be willing to tell a story twice, never to hear it more than once."

"A good storyteller is a person who has a good memory and hopes other people haven't."

"A conference is a gathering of important people who singly can do nothing, but together can decide that nothing can be done."

"We make a living by what we get; we make a life by what we give."

"When someone says, 'It's not the money but the principle of the thing,' you can be darned sure that it's the money."

"Running amok doesn't necessarily qualify as exercise."

NOTICE: We welcome any materials that you submit to the Holmes Safety Association Bulletin. We cannot guarantee that they will be published, but if they are, we will list the contributor(s). Please let us know what you would like to see more of, or less of, in the Bulletin.

REMINDER: The District Council Safety Competition for 1994 is underway—please remember that if you are participating this year, you need to mail your quarterly report to:

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