Analysis of surface powered haulage accidents

January 1990 to July 1996

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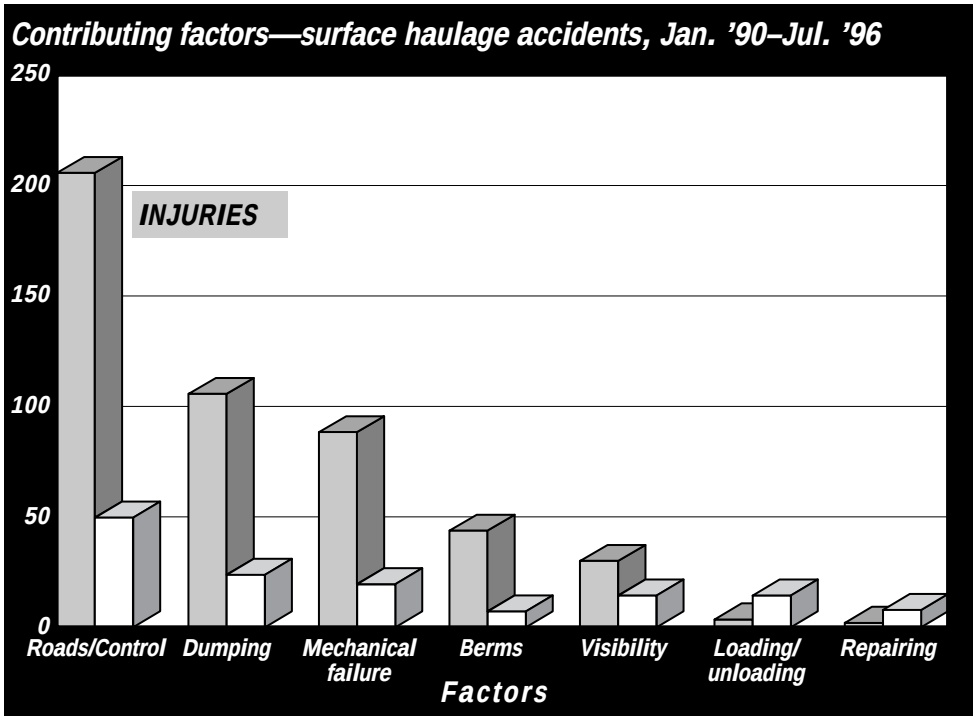
This report addresses surface haulage accidents that occurred between January 1990 and July 1996 involving haulage trucks (including over-the-road trucks), front-end-loaders, scrapers, utility trucks, water trucks, and other mobile haulage equipment. The study includes quarries, open pits and surface coal mines utilizing self-propelled mobile equipment to transport personnel, supplies, rock, overburden material, ore, mine waste, or coal for processing. A total of 4,397 accidents were considered. This report summarizes the major factors that led to the accidents and recommends accident prevention methods to reduce the frequency of these accidents.

Information for this report was gathered from Mine Safety and Health Administration (MSHA) Accident Investigation Reports, accident and injury data submitted by mine operators on MSHA Form 7000-1, and other studies conducted by MSHA and the U.S. Bureau of Mines. All powered haulage accidents involving self-propelled mobile equipment used in surface mining activities were initially considered. This report, however, is limited to surface haulage lost time accidents associated with water trucks, front-end-loaders, tractor/scrapers, ore carrier/large trucks, ore haulage trucks, or other utility trucks. A detailed study of 1,300 truck haulage accidents is the primary focus of this report. Of the 1,300 truck accidents reviewed, 640 resulted in traumatic occupational injuries such as severe cuts, broken limbs, internal injuries, or burns. During the six and one-half year period, 139 fatal accidents occurred involving surface mobile equipment. Seventy-two of these involved trucks hauling ore, coal, or waste rock. Another 24 involved utility trucks, such as maintenance vehicles and water trucks. This paper highlights some of the critical factors that contributed to the occurrence of these surface haulage accidents and the severity of the injuries suffered.

The report discusses each factor, with recommended actions for a cooperative safety program involving inspectors, miners, mine operators, maintenance personnel, equipment manufacturers, and mine engineers. The combined resources of MSHA and the mining industry can develop



Coal stripping operation in Kemmerer, Wyo.

a comprehensive safety program to reduce the number and severity of powered haulage accidents at surface mines.

A total of 640 accidents involving surface truck haulage equipment resulted in traumatic injuries or fatalities. Of these accidents, 117 occurred on road gradients exceeding 7%. A total of 36 fatalities occurred where haulroad gradients ranged between 8% and 23%. Although road gradients were not the specific cause of these accidents, the severity of accidents caused by broken drive shafts, failed brakes, or overloaded trucks was increased when the vehicles operated on steep grades. Broken drive shafts or failed service brakes almost always caused a serious accident. Trucks with loads exceeding recommended capacities severely compromised the safe operation of these vehicles. Generally, metal and nonmetal mining operations use off-road haulage trucks, which travel empty into mine pits and quarries, and are loaded when climbing out of the pits. They do, however, use some of this same equipment to haul water and other material down into mine pits. Coal mining operations frequently use over-the-road trucks, which are designed for highway travel, to haul coal down steep mountain roads.

Inadequate haulage road design and construction has resulted in situations where equipment operators, truck drivers, and other workers were operating on gradients much steeper than recommended by the haulage equipment manufacturer. Some manufacturers failed to provide guidance on recommended load limits for mountainous grades since they design their equipment for over-the-road travel, which is regulated by the U.S. Department of Transportation. Imprudent engineering, maintenance, and equipment operating practices place equipment operators and the surrounding workforce at serious and unnecessary risk. Additionally, equipment operators who fail to follow appropriate traffic rules, do not perform pre-operational checks, disregard safe driving habits, or are inattentive to their surroundings also place co-workers at great risk. As grades increase, payloads and/or operating speeds must decrease in order to operate within the designed operating limits of properly maintained equipment. Equipment which is not properly maintained, however, is not safe to operate on any grade.

In 1995, an 18-year-old miner with 3-weeks experience was fatally injured when he lost control of a water truck (converted from a drill truck) he was driving. The truck had a full 3,560 gallon tank and was traveling down a haul road with an average grade of 8.43 %. In this situation, inadequate truck brakes and a faulty transmission, combined with a steep road gradient and the driver's inadequate training and experience, resulted in a tragedy.

Only six states currently have regulations limiting the steepness of haulroad gradients at surface mines. There is no consensus among them

A Cat TS 475-41 working for R.E. Hazard in San Diego, Calif.

as to maximum grade relative to overall distance of roadways. Nor are there general guidelines for correlating equipment size or type with the loads that may be safely transported over a particular grade. This problem needs to be studied thoroughly so that construction guidelines can be developed that are applicable to the surface mining operations of today. For such a study to be ultimately beneficial and useable by the mining community, it must involve input from mine operators, equipment operators, and equipment manufacturers, along with their commitment to abide by the findings.

Some of the most frequent accidents recorded during the six and one-half year period under study were related to mechanical failures of brakes, steering, or drive systems. These problems were sometimes aggravated by overloading trucks and operating trucks on steep road gradients. Unfortunately, some accident investigation reports do not contain sufficient information concerning truck weight capacity to determine the relationship between load capacities and accident causes.

Mine operators, contractors, and equipment operators should recognize the hazards inherent in overloading haulage equipment, particularly on steep road gradients. Brake, steering, and drive-train effectiveness are reduced dramatically when the manufacturers' recommended loading limits are exceeded. Between January 1990 and July 1996, 112 of the 640 traumatic injury accidents were caused by failure of the brake, steering, or drive-train systems. Twenty fatalities on surface haulage equipment were directly attributed to the failure of the vehicles' braking systems. This was generally directly related to poor equipment inspection and maintenance practices.

Although there are a variety of maintenance guidelines or standards currently in use by the mining industry regarding surface mine haulage vehicles, there are no uniform guidelines specific to the industry that address maintenance and use of off-highway haulage equipment. The Commercial Vehicle Safety Alliance (C.V.S.A.) Uniform North American Out-of-Service Criteria is sometimes used for over-the-road vehicle inspection and maintenance programs at operations that use these type trucks. This criteria is utilized in the 50 United States, Canada and Mexico. At many mine properties, manufacturers maintenance guidelines are appropriately used. MSHA inspection experience, however, has found that a significant number of older haulage units do not have manuals readily available for equipment operators.

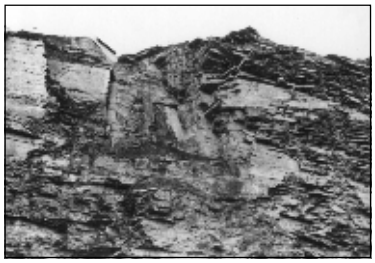
There are many mining operations with well managed maintenance programs for surface powered haulage equipment. Their vehicles are routinely inspected by equipment operators and qualified mechanics trained to maintain haulage equipment used at these mines. They also ensure the equipment is operated within it's design capabilities. Such good practices should be encouraged throughout the mining industry and shared through associations, seminars and training programs for miners, mechanics, mine operators, engineers, and inspectors.

Between January 1990 and July 1996, 136 trucks and other haulage vehicles overturned while dumping material at edges of dump locations. This type of accident occurred more frequently than any other. Twenty-five (25) fatalities were reported while trucks or other haulage equipment, such as front-end-loaders, were backing up or end-dumping at edges of elevated dump locations. Typically these locations were excess mine spoil fills, waste rock dumps, ore stockpiles, processed mine wastes, or valley fills. Most frequently, the haulage vehicle backed onto unstable fill material that gave way, or backed through a perimeter berm, causing the vehicle to topple backward down the slope or onto its side.

◀ ***Dumping overburden***

Some dumping accidents occurred during evening or night shifts. According to the accident reports, the work areas were insufficiently illuminated for the truck drivers to see the edges of the dumps when backing, and the trucks were backed too close to the edges of the slopes. The truck operator's ability to examine the stability of dump edges is also severely impaired when vision is limited at night.

A series of photos detailing a fatality from the fall of a haulage truck over a cliff and the resultant destruction. The progression depicts an approach view from the top; the view from below showing the face of the cliff and the dumping overhang; the view straight down from the lip of the cliff; and two views of the complete damage to the vehicle.



In 1996, the 26-year-old driver of a 190-ton haul truck was fatally injured when he traveled through an inadequate perimeter berm, on a 258-foot high, 73% slope leach dump. The accident occurred in the early morning hours, before daylight, and the dump was provided with a single light plant. The victim was not wearing a seat belt and was thrown through the rear window of his truck after it came to rest 444 feet at the bottom of the dump slope.

Dump locations require continual maintenance to keep the berms maintained and the dump on a slight up slope. The practice of keeping the dump perimeter at a slight upgrade prevents natural water accumulations from absorbing into the dump perimeter which can create an unstable slope edge. Keeping a bulldozer operating during dumping operations to maintain this slight upgrade and adequate dump berms is a prudent method of improving truck driving safety where dumping over the edges is utilized.

The practice of end-dumping over the edges of dump locations should be avoided when possible. Mining operations that dump in this manner should consider alternative methods of disposing of rock or waste material. Some operations in the mining industry dump material short of the edges of dumps and then push the material with bulldozers or other equipment

Improving truck driver control during backing operations by modifying cab locations and design and rear-view mirror design should also be explored. Additionally, truck driver training should include thorough discussion and training in dumping procedures. It appears that many operators need to focus more and better attention on this area.

A number of accidents reviewed in the survey involved the control of traffic through surface mining operations, obstructed visibility, and the maintenance of road surfaces and safety berms.

Traffic control rules and safety signs are required at every mine site regardless of size. Traffic control rules, signs and markers that guide vehicles safely through the operation are essential to preventing accidents. Some of these operations have confusing traffic patterns, which change frequently because of mining activities. These changes are not always marked in a manner that mine support personnel understand. Vehicle right-of-ways are normally established at mining operations, however, it is not uncommon for maintenance vehicles to get in the path of loaded haul trucks. Obviously, a more complex mining operation with various mixtures of equipment requires a very careful analysis of traffic patterns, signs and establishment of rules. Dispatchers should be utilized where the complexity of the mining operation warrants.

Fifty-five (55) accidents occurred when trucks over traveled road berms. Eight (8) fatalities occurred under these circumstances. Steep road gradients, berm construction and maintenance, brake failure, and failure to use seat belts were listed as factors in these accident reports. Failure to use seat belts always resulted in more serious injuries and in eight (8) cases fatalities.

Adequate berms or guard railing are required for all elevated roads on mining operations and have proven to be effective means to reduce serious accidents. Road berms are neither designed nor built to stop runaway trucks. They effectively warn haulage

equipment drivers about the close proximity of roadway edges and properly constructed can effectively impede over travel from elevated roadways. There are suitable alternative methods to earthen berms, such as guardrails and Jersey barriers. The most appropriate methods for the anticipated travel on a roadway should be used.

In 1994, a 50-ton haul truck with defective service brakes was traveling down a 17% grade, went through a berm and tumbled 55 feet to the bottom of an embankment. The truck driver was not wearing a seat belt and died as a result of the accident.

The remains of a vehicle that was crushed when it moved into the blind spot of a large haulage truck

Forty-fix (46) accidents occurred when haulage truck driver vision was obstructed due to the configuration or location of the cab. Fifteen (15) of those were fatal accidents in which obstructed visibility from the drivers' cabs was determined to be a significant factor in the cause of the accident. Fifteen (15) of these accidents also involved large capacity haulage vehicles running over smaller vehicles and crushing them. All of these accidents were fatal. Eighty-seven (87) accidents occurred when haulage trucks ran into stationary objects, loading equipment, or another haulage truck. Eight (8) fatalities occurred because of such collisions. Although some of these collisions may have occurred because of driver error, accident investigations indicate that others occurred because there was poor communication between truck drivers or there was obstructed visibility between vehicles. Driver error is used far too often to explain away poor design or work procedures.

Many trucks have zones in which the drivers cannot see the ground, other vehicles, or pedestrians for distances greater than 100 feet from the driver's seat. These "Blind-spot" hazards have caused or contributed to a large number of fatal accidents during the past six and one-half years. Haulage equipment manufacturers, the Society of Automotive Engineers (SAE), and the mining industry should initiate a cooperative effort to improve design of haulage vehicles and warning systems. Innovative cab designs, locations and installation of discriminating warning devices, video cameras, and other state of the art "blind area surveillance systems" would greatly reduce "blind-spot" hazards. Fatalities that occurred where obstructed visibility from the drivers' seats existed may have been avoided with effective discriminating warning devices, cameras, mirrors or improved cab designs.

In 1995, a maintenance supervisor in a pick-up truck, following an off-road haul truck with a disabled radio, was backed over by the haul truck after he stopped on a haulroad in the truck's "blind-spot" area. In this situation individuals were aware of rules and procedures established by the mine operator, however, they were not following them. The haul truck driver had stopped in an active roadway to talk with an oncoming truck driver about his broken radio, rather than returning to the shop or some other safe location as required by company procedure. Also, the maintenance supervisor had stopped within the "blind spot" area of the haul truck, another violation of established rules. Communications was also a factor in this accident since the haulage truck's radio was broken and driver's were improvising.

In 1996, a 46-year-old electrician was fatally injured when a 240-ton haulage truck ran over the utility truck he was driving. The haul truck was parked when the utility truck came along the side of it. As the haul truck driver began pulling forward, he turned to the right and ran over the electrician. The "blind-spot" to the truck driver's side was 73 feet and there was no side discriminating warning alarm on this truck.

Sixty (60) accidents involving trucks sliding on slick road surfaces were reported to MSHA. Five (5) of these accidents resulted in fatalities. Mine operators should curtail or appropriately modify operations during inclement weather when road surfaces become slick because of snow, freezing or wet conditions. All operations should have contingency plans to activate when weather has an adverse effect on continued safe operations.

Mine operators construct mine roads according to geographic location, traffic type, expected weather conditions and frequency of use. Haul roads are not always built with adequate consideration for potential adverse weather. Poor drainage and failure to properly surface the roads often create very slick road conditions during inclement weather conditions. Additionally, mine operators sometimes attempt to maintain daily production goals when conditions have deteriorated, which exposes miners to serious haulage hazards.

Most modern complex surface mining operations have effective communications systems in place to enhance driver safety and the safety of the

A 240-ton capacity haul truck can be loaded in 7 or 8 passes from the 994 loader with its 21-cubic yard bucket.

vendors or contractors entering the mining operations. Such good practices of communication should be freely shared in the mining community and regulatory agencies and the practices should be adopted throughout the industry. Forty six (46) of the obstructed vision accidents reviewed in the six and one-half year period may have been avoided with adequate communication between the drivers of vehicles involved in the accidents and/or a central dispatching operation. Poor communications and obstructed vision were determined to be a primary cause in 15 of the fatal accidents involving collisions.

Sudden movement of vehicles being repaired resulted in eight (8) fatalities. Pressure to get equipment back into service resulted in inadequate safety precautions during some maintenance and ended in tragedy. For instance, unchocked trucks rolled over mechanics working beneath them; several maintenance personnel were run over after pulling their work trucks into blind spot areas of other vehicles; victims fell from elevated access decks and engine compartments with oil spills on them; and maintenance personnel attempted to test equipment they were not qualified to operate. Most of these accidents could have been prevented if the mechanics and maintenance personnel were thoroughly trained in the hazards associated with the sudden or unexpected movement of equipment.

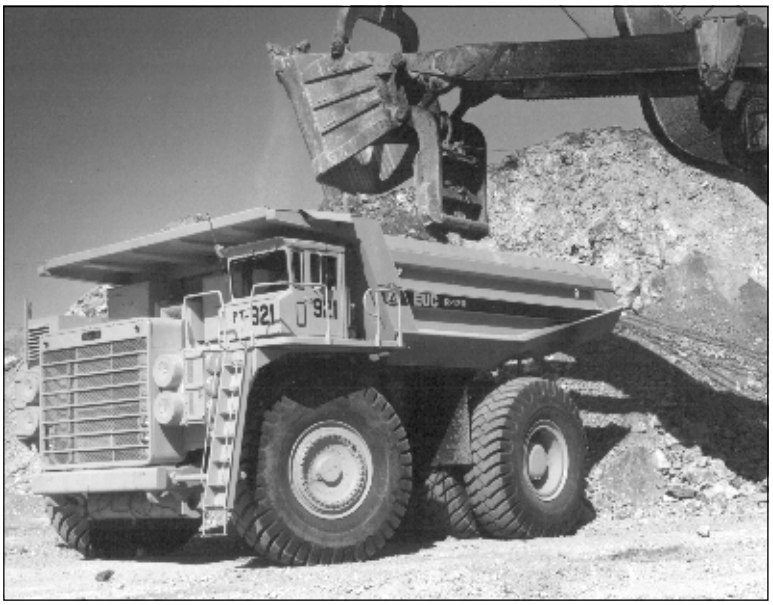
In 1995, a 46-year-old mechanic was fatally injured while working on the exhaust system of a utility truck. He accidentally shorted the truck's starter solenoid and caused the engine to start, running the rear wheels over him. The truck's transmission was in gear, the wheels were not chocked, the battery was not disconnected, and the parking brake was not set. A change in any of these factors would likely have prevented this tragedy.

Fourteen (14) fatalities occurred while truck drivers and others were attempting to load or unload material such as mine equipment, conveyor systems, and "I" beams. These activities usually involve employees from the mining operation assisting a delivery truck driver. Although the work of loading and unloading can be very hazardous, many operations do not have an effective program for ensuring communications and defining the responsibilities of these persons. Signals to lift, lower, and move forward are not uniformly applied and often result in miscommunication. Additionally, many of the people assigned the tasks of loading and unloading equipment and supplies have not been trained in safe rigging practices or proper communications between equipment operators and ground personnel.

Failure of drivers to use seat belts has caused serious injuries when self-propelled mobile equipment overturned or collided with other vehicles or stationary objects. Accident reports reviewed in this analysis indicate that in more than 200 accidents during the study period, the drivers of this equipment had failed to use seat belts. Most mine operators instruct equipment operators to use seat belts, but many do not have a program which reinforces their use and ensures equipment operators are using them consistently. Also, there is a misconception among equipment operators that it is usually better to jump from an out of control piece of equipment than to ride it out. Fatalities have occurred when equipment operators apparently jumped from the vehicle. In nearly every instance the condition of the equipment operator's compartment indicated the drivers would have been protected if they had worn their seat belts. MSHA has documented testimonials from equipment operators who have survived falling from highwalls, benches and roadways because of their use of seat belts.

The following issues and recommendations are based on the findings of this study. Implementation of these recommendations can help reduce the frequency and severity of powered haulage accidents at surface coal mining and metal and nonmetal mining operations and mineral processing areas.

Issues should be addressed and ultimately resolved utilizing a cooperative effort between equipment



A Euclid 170-ton capacity (R-170) rear dump hauler at work in the Cyprus Copper Mine in Pima, Ariz.

manufacturers, mine operators, miners, mine safety representatives, engineers, State agencies, and MSHA to identify, develop, and implement practical solutions. Some issues require one or more of these participants to effect a solution and the appropriate entity should take the lead on specific recommendations.

Review current material and develop general mining industry guidelines for the design, construction, and maintenance of haulage roads. These guidelines should be followed as near as practicable at metal, nonmetal, and coal surface mining operations. An engineering and design manual for mine haulage road construction and maintenance should be developed.

Develop new training for mine inspectors, miners, mine operators, safety specialists, and engineers regarding haulroad design and maintenance utilizing "best practices" available in the industry.

Mine operators and MSHA should conduct an inventory and technical evaluation of existing haulroads in areas where road gradients may be a factor in haulage safety. Identify unsafe haulroads and haulage practices and take corrective actions. Share good ideas and methods with others in the industry, including various mining associations.

Associations should actively participate in the development of surface haulage guidelines. They can help ensure information is presented in the most efficient manner to the largest groups possible by coordinating training efforts for mines they represent. At the present time, a joint task group involving industry, MSHA, and manufacturers, is developing a comprehensive surface haulage safety program.

Mine operators should plan mine road construction according to geographic location, traffic type, expected weather conditions and frequency of use. Contingency plans should be developed for adverse changes in weather.

MSHA should offer a technical review process for all new haulroad construction that includes review by teams of qualified professionals experienced in haulroad design and construction.

Assemble and consolidate a traffic control manual to assist miners, mine operators, mine engineers, and MSHA inspectors to establish reasonable uniformity in the implementation of traffic control methods.

Continued proper construction and maintenance of road berms is required. Mine operators should ensure that berms are appropriate for the largest equipment which travels the roadway and that they are constructed properly.

Berm maintenance programs which include routine berm inspections and appropriate maintenance should be established at all mining operations.

Develop guidelines for construction of safety berms and road surfaces to foster uniformity in compliance. Stress the importance of adequate berm base width and compaction, in addition to normal height requirements.

Develop general industry guidelines for construction of ore and waste dumps. These guidelines should give examples of factors to consider, such as weather, compaction, loaded equipment weights, slope stability of fills and perimeter berms. This guideline should describe the best methods of maintenance of the dump locations and the dangers associated when undercutting ore or waste stockpiles.

Develop guidelines regarding end-dumping of material at pit or quarry perimeters or at edges of dump locations, fills, and stockpile areas. Consider best safety practices, such as dumping short of the edges and pushing material with bulldozers or other equipment more suitable for working safely at the perimeters. Distribute guidelines with descriptions of the best practices available to miners, the mining industry, and

MSHA mine inspectors.

Enhance awareness within the industry of the hazards associated with dumping material at the edges of dump locations, fills, stockpiles and highwalls and develop an industry-wide analysis of "best practices" to prevent these kinds of accidents from recurring. Gather data regarding the safest methods for construction, and make the information available to the mining industry, miners, and MSHA mine inspectors.

Distribute training materials to equipment operators regarding risks when backing trucks and end-dumping material near unstable dump locations, fills, stockpiles, and highwalls. Truck driver training should include thorough discussion and training in dumping procedures. Have mine inspectors present training materials at mine sites and trade association meetings.

Good maintenance practices should be encouraged throughout the mining industry and shared through associations, seminars and training programs for miners, mechanics, mine operators, engineers, and inspectors. The C.V.S.A. Uniform North American Out-of-Service Criteria or other appropriate methods for removing unsafe haulage equipment from service should be well understood and used by truck drivers, mechanics, equipment operators and inspectors.

Information on pre-operational inspections, inspection checklists, equipment operational manuals and common traffic rules should be distributed widely. This information should identify the difference in defects which need immediate attention and those which can be scheduled for repair when convenient. Defects which create an imminent danger should be clearly defined, such as the loss of service brakes.

Manufacturers should review operating manuals and ensure they are complete and that hazardous operations and proper maintenance practices are covered. Equipment should have safety features which would prevent inadvertent starting of the equipment when it is in gear, including features to allow a mechanic to safely jump a solenoid for maintenance purposes. Manufacturers should also provide information regarding safe load limits for all equipment. This should include relevant data regarding gradient ranges for safe operation.

A cooperative effort should be initiated to develop guidelines regarding field testing of braking systems on the wide variety of self-propelled mobile equipment. This information should be shared with other manufacturers, associations, mining industry personnel, and MSHA to achieve as much consistency as possible.

Equipment manufacturers should ensure original equipment manufacturer (OEM) parts are available for all equipment. If parts are no longer available, they should notify industry associations and MSHA. Information should be shared with the mining industry when black-market parts are found to have been manufactured and sold.

Improve truck driver control of backing operations by modifying cab location and design as well as rear view mirror locations should also be explored.

Establish guidelines for determining truck and other haulage equipment operating load carrying capability. Develop procedures to be undertaken by mine operators and MSHA mine inspectors for determining load amounts, such as weight factors for type material being hauled, water amounts being hauled and develop lists describing equipment capacities. Load carrying capability guidelines must take into account haulroad designs and gradients, along with intended operating speeds. MSHA inspectors should have this information readily available to share with mine operators during inspection activity.

Manufacturers should provide information to clients relative to proper equipment usage and assist in training and developing mine equipment operator training programs.

Encourage equipment operator seat belt use by having MSHA mine inspectors emphasize the advantages of seat belt use during regular inspections and "walk and talk" training sessions. Develop handout material which describes the use and advantages of wearing seat belts. Testimonials from equipment operators who have had accidents and survived would be of interest to those who use the equipment. Mine operators, miners representatives, equipment manufacturers, and trade associations should stress the importance of seat belt use at every opportunity.

Clarify the methods to be used for testing brakes and other safety features on haulage equipment. Develop field methods for the equipment operator and mechanic.

All operations should have contingency plans to implement when weather has an adverse effect on continued safe operations.

Prepare guidelines regarding the establishment of communications systems at surface mine operations. Radios, signal systems and other forms of communications for equipment operators should be made available for older equipment that is still in use. This equipment should be standard on any new equipment.

Haulage equipment manufacturers, the Society of Automotive Engineers (SAE), and the mining industry should initiate a cooperative effort to improve the design of haulage

vehicles and warning devices. Innovative cab designs, and the installation of discriminating warning devices, which include front/side/rear video cameras, and the installation of other state of the art "blind area surveillance systems" would greatly reduce "blind-spot" hazards.

Review Bureau of Mines and industry publications regarding novel cab design concepts and use them in the design of new haulage vehicles.

Miners' representatives, safety committee members, and persons representing the mine operator in safety matters should take an active part in promoting miner awareness of surface haulage accidents. Serious accidents noted in this study might have been avoided if equipment operators had been made aware of the important role they play in equipment maintenance, safe operations, insight to potential problems, training and their right to have safe equipment to operate and safe roads to travel. Additionally, they should actively take part in making customer and delivery drivers aware of potential hazards in areas where they interact with them. They can significantly help in communicating the responsibilities they have for each other when unloading materials.

Form a joint industry/miner training committee to develop and conduct a haulage safety training program in conjunction with MSHA. Utilize mine sites with varied haulage equipment in conjunction with MSHA safety training programs for mine operators, truck drivers, safety engineers, technicians, equipment operators, and others associated with surface mine haulage.

Use experienced truck drivers and maintenance personnel to conduct training. Use a mentoring type program, where a work group can choose from their peers the driver they would most like teaching their son, daughter or close friend to operate equipment. Seek active participation from equipment operators in sharing their expertise with others.

Continue to train MSHA mine inspectors, mine employees and supervisors in the identification of unsafe dumping procedures and load out practices and remedial actions to take when necessary.

Develop public awareness programs in selected regions where there are high concentrations of surface mining operations. Provide industry personnel, miners, and the public, including families of miners, with descriptions of hazards associated with surface mine haulage and methods to avoid dangerous conditions. Motivate those at risk to become involved in the solutions for improving their workplace safety.

Encourage the mining industry to use preventative safety maintenance programs.

The primary tools to make an effective change in the numbers of surface powered haulage accidents are available through some MSHA and industry training programs and regulatory efforts. Policy clarification, sound engineering, development of guidelines where necessary, and the assimilation current information, can achieve further reductions in the number of fatalities and traumatic injuries.

This paper attempts to define the hazards associated with mobile powered haulage equipment at surface mines and specifically, truck haulage. The mining industry, manufacturers, miners, and MSHA recognize the serious risks to mine personnel created by steep haulroad gradients, mechanical failure of safety features on haulage equipment, dumping at edges of fill and dump locations, "blind-spots," slick road surfaces, and uncontrolled traffic through mine operations.

There is a substantial need for the mining industry, manufacturers, miners, and MSHA to work together to develop uniform methods for the construction of haul roads and equipment. Additionally, the development of haulage equipment safety maintenance programs, traffic control programs, and engineering programs that eliminate "blind-spot" hazards are essential for improving consistency within the industry. There is also a need to evaluate the hazards to those who do not regularly operate mobile equipment. Several victims in this study were maintenance employees who did not operate equipment on a daily basis. Additionally, the causes and influences of the hazardous conditions or work practices of miners need to be further explored if we are to identify trends that all in the mining industry should address.

Communications, seat belt use, and the exercise of safe work practices while repairing or unloading vehicles are also areas of concern that must be addressed by the mining industry, manufacturers, miners, and MSHA on a day-to-day basis. Contractors, customers, delivery truck drivers, and other mine visitors must receive adequate training, instruction, and, where appropriate, some guidance to help educate them about potential hazards associated with mine environments.

Training programs and vigilance by mine workers, supervisors, mine operators and mine inspectors will ultimately result in safer work places.

In June of this year, a Surface

◀ Over 40% of people killed in heavy equipment-related fatalities were not the operators of the equipment

Haulage Task Group was formed that includes persons from MSHA, the Department of Energy's Safety and Health Research Center (formerly the Bureau of Mines), surface coal and metal/nonmetal mining industries, and equipment manufacturers. The Task Group is exploring what can collectively be done to confront the increasing number of surface haulage lost-time accidents and fatalities occurring at both coal and metal/nonmetal mines. The proceedings from the Task Group will be in the form of "Best Practices" and will be published for use by the mining industry. These resource materials will be shared with operators through MSHA's cooperative efforts.

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