Proceedings

TWENTY-FOURTH ANNUAL INSTITUTE ON MINING HEALTH, SAFETY AND RESEARCH

Edited by
GLENN TINNEY ALEX BACHO
MICHAEL KARMIS

PROCEEDINGS
OF THE
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Michael Karmis
Conference Co-Chairman
Blacksburg, Virginia
September 1993

INTRODUCTION

This *Proceedings* contains the presentations made during the program of the Twenty-Fourth Annual Institute on Mining Health, Safety and Research held at Virginia Polytechnic Institute and State University, Blacksburg, Virginia, on August 31 and September 1, 1993.

The Twenty-Fourth Annual Institute on Mining Health, Safety and Research was the latest in a series of conferences held at Virginia Polytechnic Institute and State University, cosponsored by the Mine Safety and Health Administration, United States Department of Labor, and the Bureau of Mines, United States Department of the Interior.

The Institute provides an information forum for mine operators, managers, superintendents, safety directors, engineers, inspectors, researchers, teachers, state agency officials, and others with a responsible interest in the important field of mining health, safety and research.

In particular, the Institute is designed to help mine operating personnel gain a broader knowledge and understanding of the various aspects of mining health and safety, and to present them with methods of control and solutions developed through research.

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KEYNOTE SESSION

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Mine Health and Safety:
The Importance and the Contributions of Research

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Focus 2000

ED HUGLER
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Keynote Address

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The Human Element in Achieving a Total Safety Culture

MINE HEALTH AND SAFETY: THE IMPORTANCE AND THE CONTRIBUTIONS OF RESEARCH

David R. Forshey

Assistant Director for Research
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INTRODUCTION

It's a pleasure to be with you and to share in the opening session for the 24th Annual Institute on Mining Health, Safety, and Research. If I may reflect for just a moment on the past Institutes, much of the progress in Mine Health and Safety has been advanced by the previous Institutes in terms of either identifying issues, critiquing the means to overcome problems, or presenting new findings to address important issues for the mining industry. My congratulations to VPI and to the organizers of past Institutes for their important contributions to our mutual goals of improving Mine Health and Safety.

Looking forward, the Clinton Administration has reaffirmed the Government's commitment to the health and safety of the American miner. The Department of the Interior and the Department of Labor are committed to worker health and safety. We must also be concerned about the health and safety of the public and the maintenance of a quality environment. The U.S. Minerals Industry needs to be competitive, but also needs to meet the obligations of worker and public protection. The Assistant Secretary of Water and Science - Department of the Interior is concerned about the vitality and the criticality of the American Mining Industry. The continued movement of minerals production offshore affects the jobs available in this country, as well as the economic security of the country. The vitality of the industry can only be sustained by new and improved technologies.

It is also very clear to me that the Assistant Secretary of Labor for MSHA continues to be proactive in addressing the health and safety problems of the mining industry. For example, I would like to share with you the priority items that MSHA has communicated to the U.S. Bureau of Mines: these include:

Continuous Dust Monitoring Technology,

Handheld monitor for Dust Measurement, and

Dust Control Technology for High Production Longwalls.

By working together, the Government and all components of the industry can work to effectively address the critical problems facing us.

BUREAU OF MINES STRUCTURE

The Bureau of Mines recognizes that a quality organization must ensure that it is responsive to its customer needs and stands the scrutiny of peer review. We have historically worked closely with MSHA relative to MSHA needs, and are currently working with MSHA to strengthen these ties. Towards this end, the Bureau is negotiating with the National Research Council - National Academy of Sciences to provide Visiting Committees which will visit Bureau facilities to help ensure that the Bureau's programs are at the state-of-the-art in the various program areas, as well as being responsive to customer needs. The National Research Council will invite specialists from all aspects of this industry to participate in the Visiting Committees.

Other customer input includes identification of needs from the United Mine Workers of America. Specific priority items from the UMWA include addressing increased roof fall incidents associated with extended cut mining. Analysis of current statistics suggests that there is a disproportionate increase in roof falls with extended cut mining. Bureau research is addressing means to reduce or eliminate such roof falls, as well as exploring novel means to provide protection of workers when using extended cut mining.

The UMWA has also expressed interest in issues relating to ventilation in mine roadways, and in particular fire safety issues as a function of the ventilation conditions. Full-scale research is under way at the Bureau's Lake Lynn Laboratory addressing these issues. Additional experiments will be conducted and an assessment will be made of the criticality of ventilation velocity as a function of different fire conditions.

The Bureau is pleased to have an opportunity to participate in the Reinvention Laboratory Program under the guidance of Vice President Gore. Reinvention Labs are experimental rearrangements of the manner in which Federal organizations respond to customer needs, and they provide the opportunity to remove administrative and organizational impediments. Such changes should substantially expedite the response to customers. The Pittsburgh Research Center of the Bureau has been chosen to participate in the Reinvention Lab Program. Currently analysis is under way to identify opportunities for change, and we have included in the team conducting this analysis a representative from MSHA, one of the Bureau's major customers. I will keep you posted on the progress of this Reinvention Lab; I expect that in the next 3 to 4 months, we will be able to begin to see firsthand the potential impact of the changes being made through this process.

COOPERATIVE RESEARCH

The Bureau has always considerated cooperative research endeavors as a critical component of our overall program. Currently we have 260 Memorandums of Agreement with different organizations within the minerals industry. Without the support and cooperation of the industry, the progress that has been made in much of Bureau research would not have been possible. Only through the cooperation of operators, manufacturers, MSHA, and labor, as well as state regulatory organizations, has it been possible to identify mining problems, develop hypothetical solutions, and then evaluate these proposed solutions under real world conditions. We estimate that in the past 10 years the contribution in cash and in kind from cooperators to the Bureau's research efforts is almost 110 million dollars!

As we look forward to additional innovations and new opportunities for improvement in the industry, it is clear to me that the extent and degree of cooperation must grow. Incremental changes have had a positive cumulative effect on Mine Health and Safety issues. While incremental changes in the future will continue to be important, I believe that reaching the goals that we mutually share, in terms of significant reductions in Health and Safety indices, will require us to make major changes to the way in which we are addressing these problems. As an example, in past years significant improvements were realized in reducing respirable dust exposure by using "dust avoidance techniques." One such example is the Shearer Clearer, where the relatively simple addition of strategically placed and oriented water sprays moved the location of dust clouds and reduced shearer operator exposure by as much as 50 percent. While the Shearer Clearer or similar concepts are still used significantly within the industry, I anticipate that more extensive modification to face machinery will be necessary to realize the next gains in dust reductions that are of a similar magnitude. For example, we are currently evaluating the use of an exhaust duct along the armored face conveyor. In its preliminary design, the duct has remotely actuated suction points that are controlled by the position of the shearer and remotely actuated for the extraction of dust laden air in the immediate vicinity of the shearing operations. Full-scale laboratory results suggest dust reduction on the order of 80 percent. However, to successfully implement such a concept, we need the full participation and cooperation of equipment manufacturers, as well as longwall mining organizations. While I am excited about the opportunities presented by this auxiliary ventilation system, it would be premature for me to say that this approach merits full-scale application within the industry. Hopefully, in the near future through the successful completion of laboratory trials, followed by in-mine evaluation, this will be another tool available to minimize dust exposure problems in the industry.

While addressing dust-related issues, there are two other Bureau research findings, both of which are capital intensive, but which offer promise for significant reduction in the amount of respirable dust generated. Specifically, these are the linear cutter and slower rotation cutting drums. In the case of the linear cutter, laboratory studies have shown that dust reductions on the order of 65 percent could be realized by the utilization of a linear cutter head. While this is the good news, this concept does require substantial modification of the mining machine to accommodate the linear cutting system. The Bureau has explored cost-sharing ventures with equipment manufactures and rebuild shops to implement this technology in the field. To date, there has been insufficient interest to finalize an agreement, but we remain hopeful and prepared to participate in a technology transfer venture related to this technology.

I also mentioned that significant dust reductions can be realized by reducing the rotational speed of the cutting heads. As an example, for a longwall shearer traditional rotation is 60 rpm; however, laboratory studies suggest that if the drum rotation was reduced to 30 rpm there would be a 50 percent reduction in respirable dust. While reduced drum rotation speeds do require some noticeable machine modifications, they are substantially less involved than the modifications for the linear cutter. This Bureau research confirms earlier findings abroad on the merits of slow speed cutting.

THE FUTURE

It is clear that early involvement by potential customers in research programs expedites the internalization of the new technology at the customer's location and reduces the time and cost of product engineering by the private sector. We continue to aggressively seek input and participation in our research programs. I encourage equipment manufacturers and the operating industry to consider cost-sharing ventures by which we can expedite the development and application of technology to meet specific customer needs. The U.S. Bureau of Mines has many unique laboratories and world-renowned technical specialists. The best partnerships that I can imagine will involve technical and financial sharing of projects, both from a developmental perspective and through the implementation of the research and the successful evaluation of these emerging technologies under actual mining conditions. I encourage you to continue to provide input into our program formulation; I also encourage you to be more proactive in the financial participation in our programmatic efforts. Where applicable, the industry needs to consider utilizing the Bureau's facilities and staff as necessary on a cost reimbursable basis to address site-specific or manufacture- specific needs and interests.

Only by our working together can we continue to make the type of progress realized in recent years. I welcome the opportunity to be with you for this Institute. Best wishes for a successful meeting, and thank you for the opportunity to share these thoughts with you today.

FOCUS 2000

W. Hoyl Gill

President, American Limestone Co. and
Past Chairman, National Stone Association

It is a real pleasure to join you today, to provide you with a general overview of the aggregates industry and to share with you some of the ways in which the National Stone Association is preparing to meet the challenges and opportunities of the upcoming millennium.

The aggregates industry constitutes an integral segment of the nation's economy. It is a $9 billion industry which--in turn--supplies construction materials for the transportation industry, which represents 18 percent of the U. S. gross national product. Within the aggregates industry, crushed stone is the largest element, having last year produced 1.16 billion tons, with a value of more than $5.6 billion.

Illinois led the nation in crushed stone production last year with 72.7 million tons, followed closely by Pennsylvania and Texas. Virginia, ranked ninth in crushed stone produced with 47.5 million tons, with my home state, Tennessee, rounding out the top 10 with 46.7 million tons. Therefore, Virginia Tech is strategically located in the heart of the nation's most abundant sources of our product. American Limestone is proud to have operations in both Virginia and Tennessee.

In 1992, the crushed stone industry experienced slightly more than a four percent growth as we started to rebound from the 1991 recessionary economy. This year we expect to do even better with just over five percent growth over 1992, due mainly to federal highway financing from the Intermodal Surface Transportation Efficiency Act (ISTEA), accelerated public works financing and other infrastructure projects, and significant increasesin the number of single family home starts.

Looking at the decade of the 1990's as a whole, the National Stone Association foresees a total growth of 35 percent in the decade, with the 1.16 billion tons of production for 1992 moving to approximately 1.40 billion in 1995, and 1.65 billion by the turn of the Century.

EDUCATION IS A KEY TO OUR FUTURE

NSA firmly believes that education is a key element in the growth and development of our industry, consequently it is an important part of our Association's game plan for meeting our goals. We must have a workforce that is capable of employing state-of-the-art production techniques, based on application of the best available technology.

Our Association's new Aggregate Handbook has been a factor instrumental in building credibility for the aggregates industry, in general, and for NSA, in particular. The 16-chapter, 800-page volume was developed to provide information to those who use, produce, specify and regulate the products of the aggregates industry. It is especially targeted toward professional engineers, aggregate producers, contractors and builders, government agencies at all levels --federal, state and local--as well as educators and engineering students.

We've already sold the 10,000 Handbooks from the first printing and are busy distributing the 5,000 books in the second printing. An excellent indication of the Handbook's credibility is the fact that it already is in use as a course reference at 21 colleges and universities--including Virginia Tech. To stimulate the Handbook's use in academia, NSA offers it to any fulltime college student at the special price of $10.

NSA joined with our colleagues at the National Aggregate Association in the development for the Center for Aggregate Research--another program dedicated to both research and education. It took several years of preparation to build an appropriate foundation for the Research Center. With that behind us in early 1992, we made establishing the Center as a credible operational entity our goal for the 1992-93 academic year.

The Research Center brings together some of the world's top engineers and scientists, state-of-the-art research laboratories and two of the highest ranked engineering universities in the nation--the University of Texas at Austin and Texas A&M. Its prime purpose is to identify the most efficient uses of resources for the $9 billion industry, to which I refered earlier.

Besides the four research projects initiated this year--Design and Evaluation of Large Stone Mixtures; Evaluation of Stabilized Bases, Subbases and Subgrades; Solidification/Stabilization of Hazardous Blast Sand; and Evaluation of the Performance of Texas Pavements made with Different Coarse Aggregates--the Research Center initiated an annual Research Symposium. More than 150 participants attended the Center's initial Seminar, held March 11-13, at the Balcones Research Center, in Austin. The industry is proud of the Center for Aggregate Research. We believe that the Center can be one of our most helpful resources in gaining more control over the destiny of our industry--especially in determining how our products are utilized.

Still another tangible way in which NSA demonstrates its commitment to education is through the Association's Quarry Engineering Scholarship Program. Now in its third year, it provides the industry with a means for competing for the "brightest and best" of the mining and civil engineering students throughout the nation. Each year the program makes available five scholarships to students planning to pursue a career in the crushed stone industry.

We are very pleased that Virginia Tech students have been prominently in the forefront of scholarship winners in NSA's program. In the 1992-93 academic year, Virginia Tech was the only institution of higher learning in the nation to have two Quarry Engineering Scholarship winners--Peter Dunn from your mining engineering program, and Chris Woofter from civil engineering. And, in the 1993-94 academic year Tim Smith from civil engineering is one of our scholarship winners.

In order to foster closer ties between scholarship winners and the aggregates industry, we make a concerted effort to assist them in finding summer jobs in the crushed stone industry. Peter Dunn was a summer intern for Luck Stone Corporation and Chris Woofter has been employed at both Vulcan Materials Company's Mideast Division headquarters, in Winston-Salem, North

Carolina, as well as at Vulcan's Manassas Quarry, in suburban Washington, D. C. Tim Smith, meanwhile, who will be working toward a Masters Degree here at Tech in the fall, is working this summer at Genstar Stone Products Company's Medford Quarry, near Baltimore. If you know of students interested in learning more about the aggregates industry, please urge them to consider applying for next year's Quarry Engineering Scholarships. I know that Mike Karmis is well versed on NSA's Scholarship Program and maintains a strong liaison with those on the Association's professional staff who administer the program.

Rapid advances in technology demand that our industry make continuing education an prominent part of our program. As a result, NSA offers a full complement of educational, training and professional development activities. In the areas of sales and marketing of our products, we offer very popular Basic and Advanced Sales Courses and a Seminar of Sales Management, as well as specialized seminar on SO2 Capture, to offer sorbent options and considerations, and an Aglime Seminar to address limestone marketing opportunities in agricultural applications.

For operating personnel, we offer both a Supervisory and Advanced Supervisory Training Program and professional development technical meetings on such topics as automation, environment/safety and health, marketing, and public relations. We also have an annual Mid-Year Meeting which traditionally has included the Operations and Environment/Safety and Health Divisions, but which in 1993 also encompassed activities of NSA's Marketing Division. There were more than 400 participants for the Mid-Year Meeting, held last month in Kansas City. Most of these sessions have included students and professors as guests of NSA.

The National Stone Association also features extensive activities in government affairs, environmental programs, and public affairs/image outreach programs aimed at developing a good working relationship with our quarry neighbors by creating a better understanding of the unique needs of our industry. I will not go into detail on these programs, because they all are addressed in a short video which I will be showing at the conclusion of my remarks.

I would like to specially cite two NSA programs in which technical preparation and perseverance by the Association quite literally paved the way for notable industry victories. Last year, we won a hard-earned, six-year victory over OSHA, costing NSA $600,000, when the federal agency was compelled to rescind its 1986 regulation that would have treated nonasbestiform actinolite, tremolite and anthophylite (AT&A) commonly found in aggregates as asbestos.

As a result of this victory--which by OSHA's own estimates will save aggregate producers between $38 and $46 million annually--the American Society of Association Executives presented NSA the ASAE's highest award for Excellence in Government Relations.

Earlier this year, stone producers throughout the nation began to realize a significant payback, as a result of participating in AP-42 Emission Testing for granite quarries, jointly financed by NSA and EPA. Using our new AP-42 emission factors, an Oklahoma producer had his annual operating permit fee reduced by 75 percent, saving the company $27,000; and a Wisconsin producer had his fees reduced 60 percent, thereby saving $18,000. Our Association is cautiously optimistic that similar results will come from counterpart AP-42 Emission Testing that currently is being done in my state. And, savings promise to be even greater next year when states are expected to raise their operating fees to the full amount permitted by law.

I believe that the common thread interwoven into the outcomes of these two programs is the ability to harness technology in our responses to government programs. This is precisely why we feel that research and education are such critical commodities in the future of our Association.

One of the major accomplishments of my tenure as NSA Chairman was completion of a strategic plan entitled "Focus 2000." The purpose of this exercise was to determine the appropriate mix of programs and services that will be required to meet our industry's strategies, goals, and objectives for the coming millennium and beyond. Pure and simple, our purpose was to look down the road and visualize what will be needed to meet demands on our industry. And, with this date in hand, develop a plan--or roadmap, if you will--to get NSA to where it needs to be by the year 2000!

The Focus 2000 Report yielded six conclusions, none of which was too surprising to us. They included:

1) Adequate levels of Highway Funding at federal, state, and local levels of government. (Intuitively obvious, since 40 to 45 percent of all crushed stone mined in America has historically been used for highway and bridge construction.)

2) Increased federal Governmental Affairs activities and programs. (A natural extension of number one.)

3) Expanded Marketing capabilities and Association support of promotional effort. (Vital to reaching our production goals for 2000 and beyond!)

4) Assurance that Environmental Standards are based on sound science and that the industry practices are respected by the communities which NSA members serve. (The type of activity that led to the AT&A victory over OSHA which I cited and the basis for our industry's prevailing position in current activity, such as the crystalline silica issue.)

5) Increased support for closely-held Family Owned Businesses to meet the ever increasing complexities of business and succession planning. (An important program for preventing the extinction of the small business orientation that historically has characterized our industry.)

6) Work more closely with the State Aggregate Associations--NSA's 34 state level partners--to serve the members of our respective Associations and to provide technical support in a more cooperative and coordinated manner. (This alliance has always been informal and NSA foresees it remaining informal. But such a relationship can be very productive if developed in a spirit of cooperation.)

I have attempted to provide you a brief overview of what the National Stone Association is all about. In addition, I hope that you have ascertained the important role which we feel that Virginia Tech and other university-level schools of mining and civil engineering have in the future of the aggregates industry. To amplify some of the detail on NSA programs and services, I would now like to share with you a video that we developed for our 75th Anniversary, which we observed at our 1993 Annual Convention, in Orlando, Florida.

In closing, I would like to extend my appreciation--and the appreciation of our Association--for the opportunity to participate in this fine program. We look forward to extending our cordial working relationship throughout the '90's and far into the 21st Century!

KEYNOTE ADDRESS

Ed Hugler

Acting Assistant Secretary of Labor for Mine Safety and Health
Mine Safety and Health Administration

Good morning. It's a pleasure to join you today at this important conference.

This annual event, which began in 1970, has become something of a mining community tradition; one we in MSHA are especially pleased to be co-sponsors of, along with Virginia Tech and the Bureau of Mines.

In the past, I have been among the chairmen who assisted in the preparations for prior conferences. So it is a personal pleasure as well to address you in this kick-off portion of your agenda.

What I'd like to do this morning is sketch out what I've seen the last several years, and offer you my frank opinions about where the mining community--management and labor, as well as manufacturers, trade associations, and MSHA--need to direct their attention.

So that the issues I raise are set in the right context, let's start with a conclusion that just about everybody can agree on. That is that the mining industry, labor, and government--working together--have done a remarkable job of making the workplace safer over the years. Injury rates over the long-term have declined, and, last year, the entire mining industry recorded an all-time low in on-the-job deaths.

I doubt there are many, if any, American industries that can point to such a strong record of safety progress. Contributing to the improving national record, of course, were many individual safety and health success stories.

Some mining operations have gone on to win Sentinels of Safety trophies in a competition sponsored by MSHA and the American Mining Congress for being the safest operations in the country during the previous year. These mines worked for hundreds of thousands of hours without a lost-time accident during 1992. Many other operations also had long periods of safe operation.

In general then, while the mining industry still has a long way to go to reach zero fatalities, there is much that's positive in the national safety and health picture.

* * *

You could say the water glass is half full--to use the old analogy about the different ways that people perceive the world. However, it is the nature of our job at MSHA that we must focus the greater part of our efforts on the half of the glass that is empty--the fatalities, injuries, and health problems that still persist.

By directing MSHA to cite all violations we find, investigate all fatalities, track accidents, and so on, Congress made it quite clear that our agency is intended to serve as a beacon to the industry, directing attention to those safety and health areas, large and small, that need to be improved.

What then is the current state of affairs?

- On the general topic of enforcement, it is my experience that a minority of mining officials and miners, not the great majority of safety-conscious people, are responsible for many of the accidental deaths and serious injuries that occur each year.

- With that in mind, flagrant violators, especially repeated offenders and those whose neglect of their responsibilities leads to a fatality, are subject to **heavy civil fines** and, in many cases, **criminal prosecution**. It's our clear policy to **use the full range of our enforcement powers to reduce accidents**, and we haven't hesitated to do so.

- We also have been directing special attention to several areas that account for **disproportionately high numbers of fatal and disabling accidents**.

- One area of urgency is the increasing number of **accidents involving employees of independent contractors** working on coal and metal and nonmetal mine sites. In the past five years, the workforces of coal mine operators have declined significantly, while the number of contract workers they hired more than doubled. During this same time, contractors' fatality rates were more than twice as high as those for mine operators' workers. Last year, 20 percent of all coal mine deaths involved contractors (11 contractors out of 54 coal deaths). So far this year, that rate has nearly doubled (10 contractors out of 26 coal deaths). Contractor deaths also have grown in the metal and nonmetal industry in recent years. Fortunately, to date this year, the rate of contractor fatalities has sharply improved over last year's total.

- Another area clearly demanding attention is the special risks of working at small mines, specifically, those with fewer than 50 employees.

- Other areas with disproportionately high numbers of fatalities are **haulage accidents**, particularly in metal and nonmetal mining.

- **And health issues--across the board--also demand more attention,** as they do in other areas of our national life. Control of respirable coal dust and silica dust continue to be two areas of concern. Pending mine air quality, diesel, noise, and other regulations reflect additional areas of risk needing attention.

* * *

The special hazards involving small mines, independent contractors, haulage operations, and health risks have been among the most persistent problems confronting industry, MSHA, and state safety agencies. In fact, they have been prominent topics in recent years at many conferences, including this one.

The persistence of such high-risk situations raises some big questions. Why haven't we--meaning the mining community at large--been able to find the key to stopping the deadly toll at our smallest mining operations? Why have the risks to independent contract workers skyrocketed in the past half a dozen years, and what has been done to stop it?

Also, why has not more been done to advance the methods and technology for controlling respirable dust, particularly in longwall mining?

I don't have definitive answers to these questions. But I know we can't stop asking them, and talking frankly about the answers. Forums such as this conference are one such opportunity. Many of the issues I've touched on are on the agenda. And to the credit of each of you in attendance, you're interested in finding out what works and what doesn't and how to apply new insights to health or accident prevention situations back at your operations.

* * *

As a very different form of communication, and one I know is not always appreciated, we at MSHA have made it a practice to talk frankly about those who blatantly ignore safety and health. We've done so by widely publicizing **criminal investigations and prosecutions** of persons and companies whose actions recklessly threatened miners' safety or health or led to their deaths. We've also publicized **major civil fines** in mine safety and health cases. We do this because it is good public policy.

In today's global, free-market, democratic society, the public, the political leadership, and the responsible members of the business and corporate community demand to know the facts. The public wants good government. The political leadership wants to know how to help make it happen. And the business and corporate community do not want competitors gaining an unfair, illegal advantage by violating the law.

During the past two years, **more than 140 mining companies, mine officials, and or individuals have been convicted on or pled guilty to criminal charges** involving safety or health violations. Mainly these have been cases of altering respirable coal dust samples. Other cases involved penalties for safety and health violations, some totaling **hundreds of thousands, and even millions of dollars.**

And still, miners and supervisors continue to die and suffer crippling injuries every year in senseless and **preventable** accidents, and face **avoidable** health risks as well. We should all ask: How can that be?

Part of the answer to that question might have a lot to do with the next question, which is: "What kind of a **company culture** do you work and make decisions in?" To put it another way, is it the kind of environment that causes supervisors and employees to work and make decisions with a high regard for safety--or just the opposite?

That's a pretty fancy phrase--"company culture." But whatever we call the bundle of company traditions, attitudes, managerial systems, policy, beliefs, from the boardroom to the work area, I think it's an aspect of our working lives worth focusing on.

The odds are that most of you work in healthy company cultures. But, such environments vary widely from company to company. The best company cultures feature top management with the character, and leadership ability, to clearly show its unswerving devotion to **strong** safety and health policies and practices. In these companies, every employee knows without asking, and carries out, the rules set by the company.

The underlying principle, of course, is real, long-term **commitment** to improving safety and health conditions on an ongoing basis. And recognizing that accidents can still happen, even at the best of operations. But the best operations learn from those experiences, and move ahead.

Many companies fit this description. One that I was recently impressed with is a Kaolin operation in Georgia, which I visited earlier this summer.

This company focuses on good work practices, equipment maintenance, and mandatory use of personal protective equipment. It has had low accident rates over the years, and top management of the company keeps a close eye on its employees safety and health.

Characteristic of this approach, but not common in my experience, is **the unusually strong stand management takes also on contract workers' safety**. I don't recall when I've seen a safety policy for **contractors** stated in the clear, no-nonsense way it appears in the company's half-inch-thick Manual for Contractors.

Among other things, the policy states that:

> **If there is not a safe way of doing a job, it will remain undone until a safe way is found**

and

> **There are no jobs in this operation so critical that we will risk hurting our people.**

The message goes on to note that all employees must identify hazardous areas or tasks, implement interim controls, make sure they are maintained, and recommend solutions.

Company safety officials routinely meet in advance with the contractor's supervisors to make sure they know the exact safety rules that apply to that job--for example, the requirement to use safety belts and lines on any job where there's a risk of falling. And, when the contract job is under way, a company engineer continually monitors contractor supervision of the job.

In addition, all operator and contract employees are required to immediately stop and correct hazards due to either the operator's or the contractor's actions, and to take follow up measures. A contract firm that fails to correct unsafe practices or conditions is subject to replacement.

At one point, the statement says, **"We cannot, and will not, compromise on safety."** You can't be more plain-spoken than that.

Interestingly, this principal of commitment to safety and integrating it with the long-term identity of the operation was expressly endorsed by a 1981 National Academy of Sciences study on making underground coal mining safer.

In reality, of course, there is a range of company cultures. There is the kind of company culture in which management has put written policies and rules in place, but doesn't enforce them. The company may mean well, but can't seem to follow through and see that supervisors and miners receive consistent marching orders.

Sometimes, there's an isolated incident of safety and health rulebreaking. That mine's injury rate may hover between average and mediocre. They might not have a fatal accident, but the work environment is ripe for trouble.

More troubling, and what we've found much too often, is a management practice that tacitly acknowledges violating the law at the front-line supervisor level to keep production moving. At the higher management levels, in some operations, we find a practice of not knowing--and **not wanting to know** about safety and health conditions in the mine.

The result is that management, knowingly or not, encourages risk-taking at the mine site. At such a mine, supervisors are indifferent to their own safety or to the well being of fellow employees. They apparently cannot see that cutting corners on safety costs a company much more than using safe, productive methods.

These are harsh words. But these things happen, all too often. I think you're all familiar with the types of failings that have contributed to highly publicized mine explosions and other types of accidents in which there were multiple deaths in the past few years.

Findings of our accident investigators routinely identify clear-cut violations of the most basic safety rules and practices:

For years we have issued fatal accident reports which find that miners travelled beyond roof supports....Time and time again, we find mine officials were fully aware of certain violations....More recently we found that a fatal explosion occurred when methane was ignited by a cigarette lighter, and that the company's procedures for preventing smoking, monitoring methane, controlling ventilation and other requirements were poor at best....Another recent explosion was caused when ventilation had been short-circuited because of illegal changes.

You and I both understand the simple fact that an underground coal mine explosion will not occur unless one or more federal regulations for preventing explosions are violated.

Whether an investigator's findings refer to willful acts of noncompliance or to a serious safety lapse, the reader can't help thinking that, **"This should have been prevented."**

We should also ask: Is it possible that the individual employees in many of these examples would have routinely chosen to take unsafe actions, **unless** they had reason to believe that this was how the company expected them, or at least allowed them, to do their jobs? I think not. And I would ask each of you to take this issue with you and talk about it. If we continue to ignore it, future successes in the safety and health performance of the mining industry will be hard to come by.

* * *

Now, changing gears somewhat, I'd like to offer another theory. The theory is that **the mining industry has more influence over the stance that MSHA takes toward mine operators than you might think it does.** Said another way: any operator who ignores or bends safety or health rules, or otherwise endangers workers, will feel the effects of everything in our enforcement arsenal that it takes to bring about the needed changes.

On the other hand, mine operators who embrace their safety and healthy responsibilities, and affirmatively manage those responsibilities, will be recognized for their good faith efforts. In short, my point is that MSHA's behavior can't help but be a reflection of industry's actions or inactions.

So, what does this common-sense notion suggest? I think it strongly suggests that those in the industry who have not already done so should adopt a **"self-help"** philosophy. By **"self help,"** I mean getting control over accidents, injuries, and health hazards at your own operations.

Companies that have tried to do this have learned that it requires patient leadership, not only at the top, but also at the middle. And perhaps most important of all, among the miners.

The experience of a Pennsylvania coal mining company is instructive. In 1990 and 1991, with falling production and rising injuries, it was a mine in serious trouble.

Brought closer by adversity, company management and United Mine Workers local members agreed to form a partnership they called Relationship by Objectives, or RBO, to revive the operation. A safety official said later that labor and management "just felt it was time to get together and pull on the same rope."

Under the RBO approach, all safety and health activities are conducted by joint management-union teams, and union safety committee members, and others, often contributed their own time to the effort. The teams made safety contacts daily on all three shifts, and expanded investigations and analysis of accidents. Rank and file workers were given safety instructors' training, something previously given only to company supervisors.

Production, safety, and employee morale improved dramatically.
In 1992, the mine, with several hundred employees, had a total of 38 lost-time accidents, slightly more than half of the 70 lost-time accidents experienced in 1991.

Between 1991 and 1992, MSHA citations dropped by one third.
During the same period, the company turned a 10 million dollar **loss** into a seven million dollar profit--a gain of 17 million dollars.

This year, production has been adversely affected by difficult ground conditions, and injuries have risen from 1992 levels. But the new "self help" system is still in place, and both workers and managers are staying the course. I feel certain they will enjoy future success. They are also a model the mining industry should look at seriously.

My boss, Secretary of Labor Robert Reich, recently talked about what he calls a "high performance workplace" in which workers are more fully involved in the creative and decision making processes. When workers talk about their company, they say "we," indicating unity, rather than "they," meaning a more arms-length relationship. The company makes a profit and customers get what they want. The company I've just been describing seems to be working hard at becoming such a workplace.

* * *

No part of the mining community, of course, can achieve further safety and health gains alone. We in MSHA know that we need to keep improving the way we do things. **And I've just talked about the need and potential for mine operators and miners to provide leadership toward better working conditions.**

Mining industry trade and professional associations also have a role and responsibility in miner's safety and health. Historically, these organizations have, in some cases, shown leadership in facilitating the advancement of improved working conditions. The MSHA and American Mining Congress sponsorship of Sentinels of Safety comes to mind. However more leadership, which focuses on industry-wide improvement, is needed to deal with some of today's toughest problems, such as the escalating injuries and deaths involving contractors. To give credit where it is due, I know some of the coal associations are looking at this issue now.

Mine equipment manufacturers, in my view, also share responsibility for the safety and health of the nation's miners. Here, again, the "self help" concept is for everybody.

I recognize that there are marketing and cost considerations that could, arguably, inhibit the development of innovative products that are safer and more protective of workers' health. That may well be why manufacturers have not put enough effort into resolving coal dust exposure problems, for example. Today, we have highly sophisticated longwall mining machines which produce vast amounts of coal. They also generate increased amounts of respirable coal dust, a well-known health hazard. It seems quite clear that safeguards for the control of dust have **not** been an equal part of the effort to increase the productive capacity of this mining equipment.

In this and other areas of worker well-being--noise and ergonomics to name just two--manufacturers can and should show more leadership. This is an issue whose resolution is long past due.

No doubt, this could be done in a number of different ways. One I would suggest is to thoroughly assess the safety and health record associated with the type of equipment being developed. Also forecast the need for further innovation that enhances the safety features and health protection of the equipment. And then do this on an ongoing basis. Don't wait for the government to create a market by issuing a regulation, or for your competitor to go first. Lead the way with technological solutions to safety and health problems.

To sum up, leadership, self help, and unflagging commitment on all levels of the corporate chain are the keys.

If all of us in the mining community remain open to the possibilities of growth and change, we can expect to see the industry's past progress accelerate in years to come.

Thank you.

THE HUMAN ELEMENT IN ACHIEVING A TOTAL SAFETY CULTURE

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THE COMPLEXITY OF THE HUMAN ELEMENT

Achieving a total safety culture is a continuous fight with human nature, because (a) unsafe behaviors (the cause of most occupational injuries) are usually more comfortable, convenient, and time efficient than safe behaviors, (b) unsafe behaviors rarely receive the sort of consequences (e.g., an injury) sufficient to discourage their occurrence, and (c) initial safety awareness and carefulness (as when learning to drive an automobile or operate industrial machinery) is usually transient because of a natural ongoing learning process. In other words, we learn that safe, precautionary behaviors are not followed by pleasant or supportive consequences, and alternative unsafe behaviors receive desirable consequences of comfort, convenience, and sometimes even peer approval. In addition, we usually get away with continuing the more convenient and efficient unsafe work practices. When work injuries do occur, they usually occur to the "other guy." Thus, it's human nature to believe "it's not going to happen to me."

Understanding human nature can lead to an understanding of why certain safety programs work and why others don't work, and can enable the development of more successful strategies for managing safety. In other words, an understanding of human nature provides insight for recognizing the need to include certain process variables into an occupational safety and health system. It also fosters the realization that safety and health promotion is the most difficult ongoing challenge facing all industrial personnel at the work site, and leads to the conclusion that all work injuries are not preventable (given available knowledge and resources, and the complexity of the human element).

Dimensions of the Human Element

The complexity of human nature can be appreciated by considering the acronym BASIC ID - each letter representing one of seven aspects of the human element in occupational health and safety: B = Behavior, A = Attitude, S = Sensation, I = Imagery, C = Cognition, I = Interpersonal, and D = Drugs. The relevance of these human factors in understanding human nature on the job are demonstrated in the following simple scenario of a "near miss."

Frank, an experienced and skilled craftsman, worked rapidly to make an equipment adjustment, while the machinery continued to operate. As he worked, the production line employees watched and waited to resume their work. Frank realized all too well that the sooner he completed his task, the sooner would his co-workers resume quality production. Therefore, he had not shut-down and locked-out the equipment power. After all, he had adjusted this equipment numerous times before without locking out the power and never experienced an injury. A morning argument with his teenage daughter pervaded Frank's thoughts as he worked, and suddenly he experienced a "near miss" (actually a near hit). His late timing nearly resulted in his hand being crushed in a "pinch point." After removing his hand just in time, Frank felt weak in his knees and began to perspire. This stress reaction was accompanied by a vivid image of a crushed right hand. After gathering his composure, Frank walked to the switch panel, shut-down and locked-out the power; and then lit up a cigarette. He thought about this scary event for the rest of the day, and during his breaks, he related his "near miss" experience to fellow workers.

This brief episode illustrated each of the psychological dimensions represented by BASIC ID, and demonstrates the complexity of human activity. (a) Behavior is illustrated by such overt and observable actions as adjusting machinery, pulling a hand away from the moving machinery, lighting up a cigarette, and talking to co-workers. (b) Frank's attitude about work was fairly neutral at the start of the day, but immediately following his "near miss" he felt a rush of emotion or affect. His attitude toward "energy control and power lock out" changed dramatically, and his commitment to locking out power when necessary increased after relating his "near miss" to his friends. (c) Sensation was evidenced by Frank's dependence on visual acuity, hand-eye coordination, and a keen sense of timing when adjusting the machinery. His ability to react quickly to the dangerous situation prevented severe pain and potential loss of valuable touch sensation. (d) Imagery occurred after the "near miss" when Frank visualized a crushed hand in his "mind's eye," and this contributed to the significance and stress of the incident. Frank will probably experience this mental image periodically in the future, and this will likely enhance his motivation to perform appropriate lock-out procedures, at least for the immediate future. (e) Cognition or "mental speech" about the morning argument with his daughter may have contributed to the timing error that resulted in the "near miss." Frank will probably remind himself of this episode in the future, and these cognitions may help to motivate lock-out behavior. (f) Interpersonal refers to the other people in Frank's life space that contributed to his "near miss," and will be influential in determining whether Frank will initiate and maintain appropriate power lock-out practices. For example, it was the interpersonal discussion with his daughter that occupied his thoughts or cognitions before the "near miss"; and the presence of production-line workers influenced Frank (e.g., through subtle peer pressure) to attempt a quick adjustment of equipment without lock-out practices. These on-lookers may have distracted Frank from the task, or could have motivated him to show-off his efficient adjustment skills. After Frank's "near miss," his interpersonal discussions were "therapeutic," helping him relieve his stress and increase his personal commitment to occupational safety. (g) Drugs in the form of caffeine (from morning coffee) may have contributed to Frank's timing error. The extra cigarettes Frank smoked as a "natural" reaction to stress also had physiological consequences, which could have been reflected in Frank's subsequent behavior, attitude, sensation, or cognitions.

A Simple Conclusion with Complex Ramifications

The lesson in this brief scenario and interpretation is that people are complex, and this complexity (of human nature) interacts with environmental factors to cause unsafe work practices, "near misses," and sometimes personal injuries. It is relatively easy to control the environmental factors contributing to work injuries, and it is feasible to measure and control the behavioral factors contributing to work injuries. However, the complex human factors, implied by the BASIC ID acronym, are quite illusive, being difficult to define and measure objectively and to manage efficiently. This leads to the occurrence of some work injuries that could not have been prevented. However, the field of psychology provides important knowledge pertinent to understanding the individual worker and transferring such understanding to facilitate the achievement of a total safety culture. This paper reviews principles of psychology relevant to understanding the human aspects of achieving a total safety culture. The principles and concepts were derived from theory and research in the behavioristic and humanistic disciplines of psychology.

SAFETY AS A VALUE

Perhaps the most common safety slogan displayed in industrial sites and verbalized by safety personnel relates directly to making safety a priority. I've seen signs, pens, buttons, hats, T-shirts, and notepads with the message, "SAFETY IS A PRIORITY." And, when I ask participants at safety and health workshops if safety should be a priority, almost every hand is raised high to affirm a "yes" consensus. Most are quite surprised when I assert my belief that safety should not be considered a priority. To justify my minority opinion, I offer the following explanation.

When we awake on the morning of a workday, we follow a prioritized agenda (often a standard routine) before traveling to work. The routine varies widely from individual to individual, as well as the time allocated to complete the get-ready-for-work routine. Some will allow enough time to prepare and eat a hearty breakfast, read the morning newspaper, make their bed, take a shower, and even wash dishes. Some will wake up early enough to go for a morning jog before leaving for work. Others will grab a roll and a cup of coffee, and leave their home in disarray until returning in the evening. Although morning priorities differ across individuals, depending partially on the amount of time allocated to the task, every schedule of morning behaviors have one activity in common. This activity is not a priority but a value. Indeed, this activity is so basic that workshop participants often omit it when describing their morning routine. Do you know what it is?

To make my case, consider for the moment that you wake up much later than usual (perhaps because your alarm-clock fails), and as a result, you have only 15 minutes to prepare for safe travel to work. Your morning routine will no doubt change dramatically. Your priorities will be rearranged. The few remaining activities in the short-cut list of priorities might differ remarkably across persons. Some might skip breakfast altogether in order to have enough time for a brief shower, whereas others might skip a shower in order to have a necessary cup of coffee. Some men wouldn't consider missing a shave, but others (e.g., those with lighter beards) might skip their usual shave in order to fit in another "essential" morning task. Yet every schedule of morning activities will again have one item in common. This activity is not a priority, capable of being "adjusted" out of a routine as a result of time constraints or a new priority list. Rather this particular morning activity represents a value which we've been taught as infants, and is never compromised. Have you guessed this activity by now? Yes, the activity in everyone's morning routine, regardless of time constraints, is "get dressed."

This simple scenario illustrates that certain circumstances (e.g., time requirements) can force us to alter our priorities. In fact, situational demands periodically influence a rearrangement of behaviors so that some priorities can be dropped. Actually, labeling a behavior as a "priority" implies that its order in a hierarchy of daily activities can be altered. Does a reordering of behavioral priorities occur intermittently at work? Does "safety" sometimes take a "back seat" when the emphasis is placed on other "priorities" such as production "quantity" or "quality"?

Priorities Change More Than Values

It is human nature to adjust priorities (or behavioral hierarchies) according to situational demands or contingencies. This is shown by the example of getting ready to leave one's home in the morning under a different time constraint. The behavior of "getting dressed" represents a value, however, and never gets dropped from a morning routine. Shouldn't "working safely" hold the same status as "getting dressed"? That is, regardless of the work priorities or company demands on a particular day, "safe work practices" should occur. In other words, safety should not be considered a "priority" among other priorities that get shifted as a function of situational demands. Rather, safety should be considered a "value"--associated with every one of the activities (or priorities) in a work routine. Hence, regardless of whether the current focus is on "quantity," "quality," or "cost-effectiveness" as the "number one priority," safe work practices should be the norm, just as sure as you put on clothes before leaving the house for work or anywhere else.

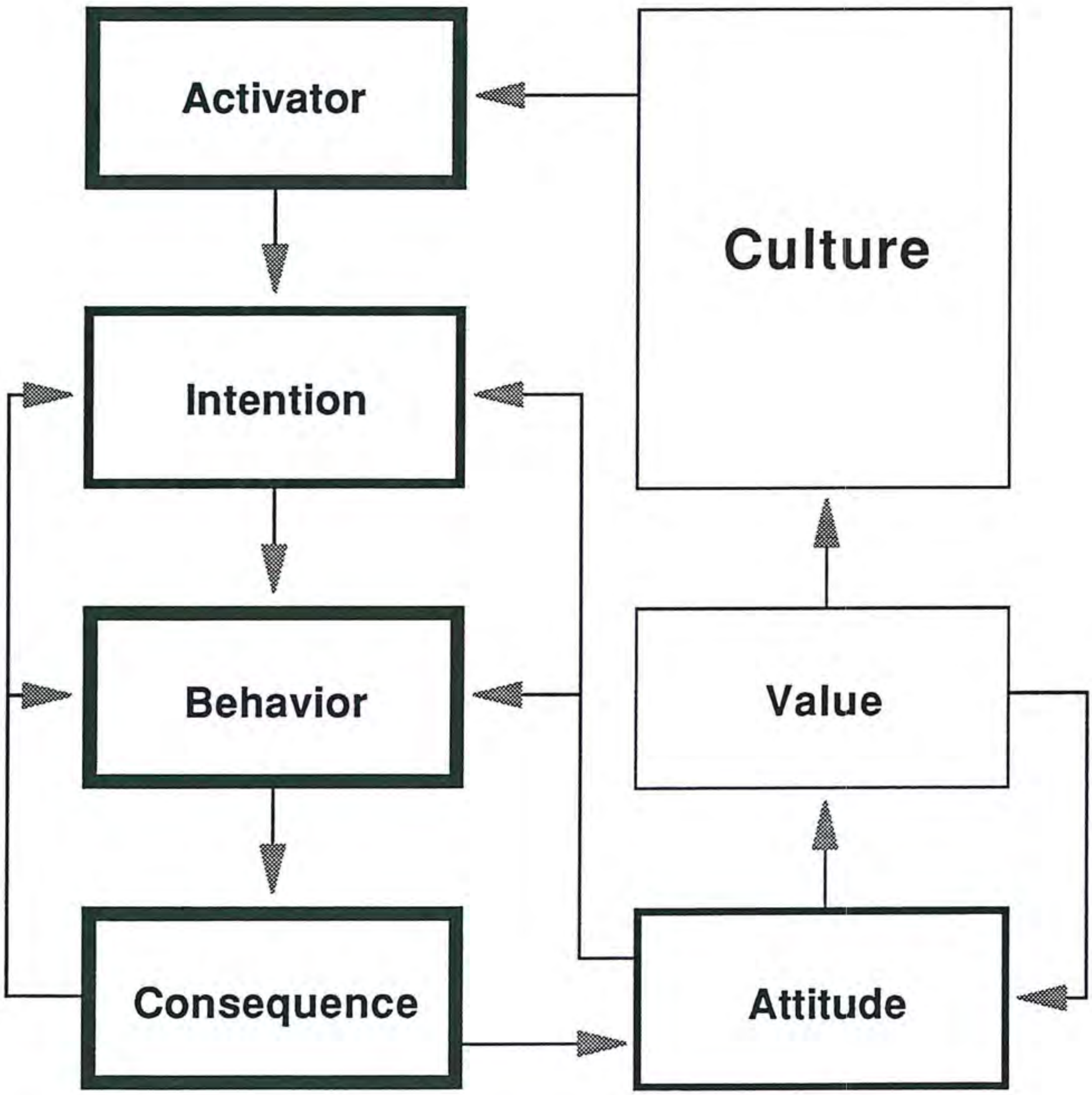
Thus, the ultimate goal of a total safety culture is to make "safe" an aspect of all performance, regardless of the task. Safe should be more than the behaviors of "using personal protective equipment," more than "locking out power" and "checking equipment for potential hazards," and more than "practicing good housekeeping." Safe should be an "attitude" or "value" an employee brings to every job, regardless of priorities or task requirements. Safe should be an unwritten rule (or social norm) that workers follow regardless of the situation. Safe should become an aspect of each routine that is never questioned--never compromised.

Acting Into Safe Thinking

Obviously, the safety "should's" stated above are much easier said than done. How does one begin to work for such lofty goals? The diagram on the next page summarizes the relationship between intentions, behaviors, attitudes, and values and implies a starting point and general process for developing safety as a value in the corporate culture. A key point is that "attitudes" and "values" follow from behavior, and thus appropriate behavior management techniques can be used to "act a person into safe thinking ." Briefly, when a worker practices safe work procedures consistently during every job routine and attributes such behavior to a voluntary decision, then it is likely the worker will begin thinking "safe," and "working safely" will eventually become a part of that worker's value system.

Figure 1 on the following page illustrates that "attitudes" and "values" influence "intentions" and "behaviors" directly, but it is not cost effective to manage "attitudes" and "values" directly and attempt to "think workers into safe acting." One reason for this is illustrated in the diagram by the differential thickness of rectangles enclosing the terms. The thicker the boarder, the more measurable, manageable, and accountable the concept. Thus, "activators" (conditions established to motivate behavior change), "behaviors," and "consequences" (events following behaviors and determining their future occurrences and accompanying attitudes) are easiest to define, measure, and manage; whereas "values" and "culture" are the most difficult to measure

Figure 1. Behaviors, Intentions, Attitudes, Values, and Culture. The thicker the boarders, the greater the degree of measurement objectivity (from Geller, 1990).



reliably and influence directly (Geller, Lehman, & Kalsher, 1989).

FROM SAFETY AS PRIORITY TO SAFETY AS VALUE

Occupational safety is often a confrontation between a rule enforcer and a rule breaker. In other words, safety is viewed by many as compliance with certain safety policies and mandates; and therefore the primary responsibility of safety personnel is to check for worker compliance with safety procedures and to correct (or confront) incidences of noncompliance. In this situation, making safety a "priority" means increasing the enforcement of safety policies. The responsibility for this kind of "safety" usually falls squarely on the plant safety engineers, union health and safety representatives, and perhaps a local safety committee. Thus, occupational safety becomes the unenviable responsibility of a select group of individuals; and most often this responsibility translates into "monitoring for compliance with safety rules" and "keeping records of injuries" which presumably occurred because of noncompliance.

The rigorous enforcement of a particular safety policy (e.g., consistent power lock-out, use of certain personal protective equipment) will surely change priorities in favor of "safety." Such a shift in priorities, however, might be quite transitory, and last only as long as the policy is visibly enforced. What can be done to make compliance with corporate safety policy a standard part of the work routine, accepted and monitored by the workers themselves, and not dependent upon enforcement procedures? In other words, how can we facilitate the adoption of a safety policy into an individual's value system of appropriate work performance. Under what conditions will an employee become personally committed to safe job performance all the time? What aspects of a corporate culture will facilitate the transfer of safe performance on the job to safe performance at home? What can be done, for example, to increase the probability that workers will not only wear safety glasses, long-sleeved shirts, and steel-toed shoes on the job, but will also wear this protective clothing while mowing their lawns?

Perceptions of Individual Freedom

Answers to the important questions posed above start with a consideration of another basic principle of human nature. People do not like to feel controlled, especially those people raised in a culture where individual freedom is a societal imperative worth fighting and dying for. Many psychologists and social scientists have written on the topics of "perceived control" and "perceived freedom," and their conclusions support this principle. In order to appreciate this principle of human nature, however, you don't have to read the numerous supportive books and research articles. You need only to reflect upon your own experiences and perceptions. Recall, for example, your teenage years. Teenagers undergo a variety of physical and psychological changes, including the notion of "independence" and "individual freedom." As a result, teenagers often break parental rules they had complied with in the past, just to assert their own freedom. And this rule-breaking behavior is often followed by reinforcing feelings of independence and personal freedom. It feels good to circumvent authority--to beat the system.

When laws mandating vehicle safety belt use were initially passed in certain locations, many people complained loudly, not because they didn't like safety belts, but because they didn't want to be told what to do in the privacy of their own vehicles. In fact, this "individual freedom" principle was used by a radio disc jockey in Massachusetts to rally support for successfully rescinding the belt-use law in that state. Analogously, after the implementation of state belt-use laws or corporate belt-use mandates, several motorists went out of their way to avoid compliance without getting caught. Some beat the system by wearing a T-shirt with a realistic shoulder and lap belt printed on the front; others purchased and used a strap that attached to one's shoulder and waist with Velcro adhesive and gave the impression of shoulder belt use.

Currently, the nationwide belt use rate in the majority of states with belt-use laws range from 50 to 60%, a substantial increase over the pre-law national belt-use rate of 15%. Thus, many motorists have buckled up to comply with belt-use mandates and for many, safety-belt use has become a healthy habit (i.e., "unconscious competence"). At the same time, however, numerous motorists have actively resisted compliance with belt-use laws, and unfortunately these individuals are among the more risky drivers (i.e., "conscious incompetence").

Starting the Transition to Safety Values

The preceding discussion about mandates and perceived freedom leads to another principle of human nature that should be considered when attempting to improve a safety record. Workers' commitment to a safety policy will increase directly with their perceptions that compliance with the policy is voluntary. Hence, a worker's perception of "who's in control" of the safety program determines whether compliance is merely rule-following behavior or an accepted and integral part of the normal routine. If workers perceive that a safety policy or program was "dropped on them" without their input or involvement, they will not sense ownership of the program and their commitment might be minimal. In other words, the transition from safety as compliance to safety as a value cannot be facilitated if safety policy is merely dictated.

The following general guidelines for developing a safe corporate culture are based on the need for employees to do more than comply with safety regulations. They need to accept personal responsibility for their plant's safety record and participate accordingly in ongoing safety achievement processes. Furthermore, they need to perceive that this participation was their own voluntary decision.

- Safety programs should not be "canned" videotapes or training packages from outside consultants or top management unless strategies are incorporated to counteract perceptions of top-down control and facilitate employee ownership of the program.

- A safety committee responsible for designing, implementing, and monitoring ongoing processes to promote and reinforce safe work practices should include majority representation from hourly workers.

- Safety processes should be flexible, allowing for ongoing modification as a result of solicited and unsolicited employee input.

- Safety processes should be dynamic, changing periodically to reflect ongoing changes in worker knowledge, opinions, skills, attitudes, and values regarding occupational health and safety.

- Evaluation procedures should include periodic assessment of workers' perceptions of program ownership and their personal commitment to safety objectives.

- A total safety culture requires continual promotion through local memos, films, and newsletters; and such promotion should illustrate employee commitment, ownership, and empowerment.

ACTIVELY CARING FOR A TOTAL SAFETY CULTURE

If the employees of an industry "actively cared" for the health and safety of their co-workers, record high levels of safe work practices would be reached, as well as record low incidences of work-related injuries. Actively caring is defined as employees demonstrating continually by their actions (or behaviors) that they want optimal safety and health for all personnel in their plant. Of the numerous safety programs I've observed over the past two decades, the "Brothers/Sisters Keeper" process at a DuPont plant I visited in Martinsville, Virginia comes closest to an operational definition of actively caring. After volunteering to become a "Brothers/Sisters Keeper," employees receive behavioral observation and communication training to qualify for a particular actively caring process. More specifically, the plant manager, safety personnel, and many supervisors and hourly workers at this plant recognize that safety requires ongoing monitoring and communicating between co-workers about safe work practices; and to achieve beneficial and continuous involvement for personnel safety, workers need to learn basic skills for observing and recording safe and unsafe work practices, and for communicating constructive feedback following the observations of their peers' safe or unsafe behavior. Indeed, observation and feedback were the intervention procedures responsible for the results of the seminal Hawthorne studies, termed the "Hawthorne Effect." (Parsons, 1974).

Following this observation and communication training, the employees make a public commitment to look out for the safety of themselves and others, and then they begin working to meet the criteria necessary for becoming a certified "Brothers/Sisters Keeper." When meeting these criteria, including 20 safety audits and 40 personal safety contacts with co-workers, employees participate in a formal ceremony and group celebration during which certificates and special "Brothers/Sisters Keeper" pins are distributed, and each employee's name and picture are added to the "Hall of Recognition." Of course, the active caring of these employees does not end with this recognition; the ceremony promotes renewed commitment to actively care for others through behavioral observation and feedback communication. Some of these employees sign up for the "Disciple Program" whereby they become active teachers of new brothers/sisters keepers and work to reach additional criteria of behavioral observation, corrective action, and instruction. Again, ceremonial recognition marks the achievement of Disciple status. Subsequently, they can work toward the special status of "Apostle" in the "Brothers/Sisters Keeper Program."

Cultural Support for Actively Caring

The DuPont "Brothers/Sisters Keeper" process incorporates a sound support system to maintain continual employee involvement, including: (a) top management support and participation, (b) sound leadership from all levels of the organization, (c) supportive communication of all types (from employee newsletters, interdepartmental memos, and bulletin board announcements to one-on-one oral interaction), and (d) motivating recognition processes for the caring activities of both individuals and groups. Recognition processes range from informal rewarding feedback in one-on-one communications to formal ceremonies for acknowledging specific accomplishments.

In some organizational cultures it may be impossible to obtain enough individual and group support for an actively caring community process. For example, I've consulted with several companies that did not experience success with the DuPont STOP Program (an approximation to an actively caring process). Some of these failures may have been due to lack of ownership ("It's a DuPont Program, not ours") or to the failure-based focus of the program (i.e., only unsafe acts or conditions are recognized), but it's also possible that the corporate culture was not "ready" for an actively caring community process. In other words, certain individual and social factors are necessary in a corporate culture for an organization to become an actively caring community.

Readiness to Actively Care

The most recent conceptualization of actively caring (Geller, in press; Geller, Roberts, & Gilmore, 1993) defined three basic types of actively caring, depending upon the target of the intervention--environment, person, or behavior. Thus, when people intervene to reorganize or redistribute resources in an attempt to benefit others (e.g., cleaning another's work area, picking up litter, recycling, conducting an environmental safety audit), they are actively caring (AC) from an environment focus. Actively caring from a person focus is behaving in an attempt to make another person feel better (e.g., intervening in a crisis situation, actively listening in one-on-one communication, verbalizing unconditional positive regard for someone, sending a get-well card). Finally, behavior-focused AC is intervention attempting to influence another individual's behavior in desired directions (e.g., giving rewarding or correcting feedback, demonstrating or teaching desirable behavior, conducting a behavioral safety audit, or using a vehicle turn signal).

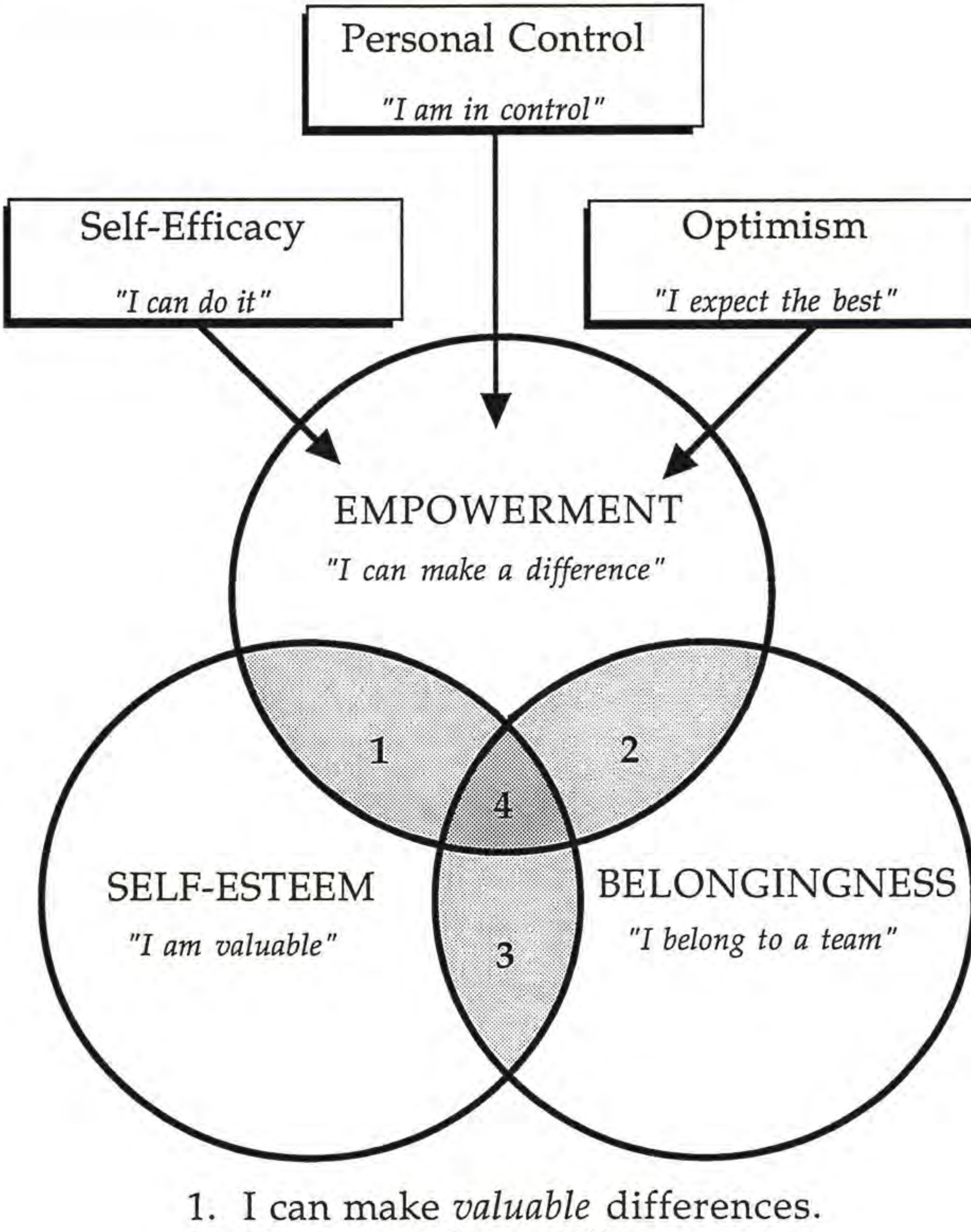
It is noteworthy that these three categories of AC represent the basic dimensions needing attention in a comprehensive occupational safety process (Geller, 1989). That is, occupational safety requires direct manipulation of the environment (e.g., equipment, tools, hazards, engineering) and ongoing work behaviors in ways that lead to increased safety and employee acceptance, commitment and ownership (i.e., personal factors). Although person factors (such as knowledge, intelligence, personality, motives, attitudes) are not objectively measurable nor directly controllable, they certainly influence acceptance of changes and commitment to improve the safety of the environment and ongoing behaviors.

Differential perceptions of ownership, teamwork, commitment, empowerment, and optimism can result from objective manipulations of environments, behaviors, and environment-behavior contingencies. Likewise, although AC intervention might focus on one particular factor (i.e., environment, person, or behavior), the intervention can certainly have indirect impact on other factors. For example, a direct attempt to increase safe behavior with a demonstration or feedback technique can increase perceptions of control and optimism in both the deliverers and recipients of the intervention, and in turn increase their propensity to participate in a subsequent environment-focused or behavior-focused intervention.

Figure 2 on the next page depicts our latest version of an AC model (Geller, in press; Geller, Roberts, & Gilmore, 1993) and represents the foundation of an assessment tool and training program we have implemented at large industrial complexes (i.e., for Exxon Chemical Company, Hoechst Celanese, and Sara Lee Knit Products) to help employees achieve a total safety culture. I teach employees that the individual difference (or person) factors represented in Figure 2 are states or expectancies (not traits) which influence one's propensity to get involved in a safety process to benefit other employees, and these person factors can be directly influenced by environmental and behavioral manipulations. Indeed, a critical group exercise involves the listing of specific situations and incidents in the employees' particular work setting that increase (or facilitate) and decrease (or inhibit) the person characteristics depicted in Figure 2.

Variables consistently listed as determinants of self-esteem include communication strategies, reinforcement and punishment contingencies, and leadership styles, and such discussions lead to a number of suggestions for building self esteem, including: a) soliciting and following up employee suggestions, b) providing opportunities for personal learning and peer monitoring, c) increasing management and peer attention to the occurrence of safe

Figure 2. The Person States Which Influence Propensity to Actively Care. (From Geller, in press).



1. I can make *valuable* differences.
2. We can make a *difference*.
3. I am a *valuable team* member.
4. We can make *valuable differences*.

behaviors as well as unsafe behaviors, and d) increasing recognition of personal competence and accomplishments.

Common suggestions for increasing a sense of belongingness among employees in a corporate culture have included: a) decreasing the frequency of top-down directives and "quick-fix" programs obtained from other facilities, b) and increasing team-building discussions, group goal-setting and feedback, group celebrations for both process and outcome achievements, and the use of self-managed (or self-directed) work teams.

By teaching employees that perceptions of personal control and optimism lead to employee empowerment, we are essentially distinguishing between a management and a psychological perspective of empowerment--one of the most popular constructs in contemporary industry. In the management literature, empowerment refers essentially to the delegation of authority or responsibility, or the sharing of decision making (Conger & Kanungo, 1988). In contrast, the psychological (or person) perspective of empowerment considers the reaction of the employee or work group as a result of a delegation of power or responsibility. This person notion is clearly more subjective than the management view, but does explain variance in employee reactions to a top-management directive that implicates more employee control. In other words, I believe empowerment requires the personal perception that "I can make a difference," and this perception is enhanced by perceptions of personal control (Rotter, 1966), self-efficacy (Bandura, 1977), and optimism (Scheier & Carver, 1985). Such empowerment perceptions are presumed to lead to increased motivation (or effort) to "make a difference" (e.g., to go beyond the call of duty in completing assignments), and there is significant empirical support for this intuitive supposition (Bandura, 1986; Barling & Beattie, 1983; Ozer & Bandura, 1990; Phares, 1976).

Employees in my corporate training groups have listed a number of operations to increase empowerment, including: a) break down overwhelming tasks into discrete smaller ones that are more easily managed (e.g., continuously monitored in terms of behaviors and/or outcomes); b) set short-term goals and track their accomplishment; c) offer frequent rewarding and correcting feedback for process activities (e.g., safe work practices, coaching safe behavior) rather than only for outcomes (e.g., number of injuries or lost work days); d) provide opportunities for employees to set their own goals, teach co-workers, and chart "small wins" (Weick, 1984); e) teach employees how to define, observe, and record desired (e.g., safe) and undesired (e.g., unsafe) environments and behaviors, and give them opportunities (i.e., time and resources) to conduct environmental and behavioral audits; f) teach employees basic behavior change intervention strategies (e.g., response feedback and recognition), and provide them time and resources to implement and evaluate the impact of their interventions; g) teach employees how to graph daily records of baseline, intervention, and follow-up data; and h) post response feedback graphs of group performance (e.g., daily percentages of safe behaviors).

My corporate training for occupational safety and health focuses on the establishment of resources, opportunities, and contingencies to increase the factors presumed to increase AC behavior. I teach employees that certain expectancies or person factors (e.g., as illustrated in Figure 2) influence their work behaviors, including their involvement in safety processes; and that work behaviors including their involvement in safety processes, influence certain person factors (i.e., states or expectancies). However, I emphasize that it is not cost-efficient to intervene directly with person factors in an industrial setting, partly because attitudes are not easy to measure accurately and objectively on a large scale, and because effective person-focused intervention usually requires one-on-one or small group interactions, with assistance from a professional therapist or counselor. On the other hand, scientifically validated behavior-change interventions can be implemented and managed effectively by employees with minimum professional training and a willingness to become an intervention agent (e.g., to actively care for another's safety). In other words, it is much more cost effective to act an employee into safe thinking than it is to think a person into safe acting. Specific strategies for analyzing and managing work practices to improve corporate safety are taught in a three-manual training tool available from the author for $35 (Geller, Lehman, & Kalsher, 1989).

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LUNCHEON SESSION

Robert W. Shanks
President
Arch of Illinois, Inc.
Percy, Illinois

The Changing Course of the United Mine Workers of America - 1920 to 1993

THE CHANGING COURSE OF THE UNITED MINE WORKERS OF AMERICA - 1920 TO 1993

Robert W. Shanks

President
Arch of Illinois
a Division of Apogee Coal Company

Good afternoon, and thank you for your kind introduction.

Certainly, the principal issue before the parties negotiating this year's National Bituminous Coal Wage Agreement (NBCWA) is JOB OPPORTUNITY. This is no secret. The United Mine Workers have made this clear to both the Bituminous Coal Operators' Association (BCOA) and the public. To underscore the importance of this issue, the union has been on strike against various members of the BCOA for more than 130 days since February.

Moreover, it is no secret that the BCOA has offered a job opportunity proposal that represents significant gains for UMWA members, and it is ready and willing to return to the bargaining table to further discuss this and all other issues that must be addressed in this year's negotiations. Specifically, the BCOA will continue to bargain over the issue of job opportunities for persons represented by the UMWA at the operations affiliated with signatory companies but which have never signed a labor agreement with the mine workers. Today, I can offer no prediction of the outcome of this issue in the negotiations. However, as a member of the BCOA negotiating team, I have gained some appreciation of how the union has arrived at its present condition, and why the issue is such a vital one for the UMWA. I would like to share this with you this afternoon.

Following World War I, the coal industry emerged as an elaborate and complex part of our economy. It was extremely diverse. Producers included the nation's major steel companies, railroads and industrial concerns. It was also comprised of hundreds of firms which processed coal and then sold it through extensive distribution networks. This system of producers, processors, transporters and distributors provided the bulk of the fuel used at that time for residential and commercial heating, as well as for electrical generation.

In addition, the industry was geographically extensive. It included most of the major coal producing regions to be found in the United States today. It also included some, such as in California and North Carolina, which no longer produce coal, and others such as Kansas and Iowa which are no longer significant producers.

The history of the UMWA between the wars is nothing short of remarkable. In 1920, it claimed more than 375,000 members. By the end of the decade, following the stock market crash in 1927 and the accompanying decline in industrial activity, it clung to a bare 80,000 card holders. With the inauguration of President Roosevelt in 1933 and the passage of landmark legislation that year and the National Labor Relations Act in 1937, the UMWA once again assumed a paramount presence in the labor movement. During the 1930's, it employed hundreds of organizers in all of the nation's coal producing regions. The ranks of the union swelled. As the U.S. entered the Second World War in 1941, virtually all of the bituminous coal production in the U.S. was represented by the UMWA.

The union, under the leadership of the venerable John L. Lewis, went out on strike against the order of President Roosevelt in 1943. Strikes were authorized again in 1945 and 1946 when the government still technically was in control of bituminous coal mines. In 1950, President Harry S. Truman and UMWA President Lewis concluded an agreement to end a nationwide coal strike. The bargain committed the UMWA to the acceptance of mechanization in coal mines, in exchange for the companies' commitment to certain benefits for UMWA miners, including pensions and health care. At the time of the agreement, more than 90 percent of U.S. coal was produced by UMWA-represented mines, almost all under the National Bituminous Coal Wage Agreement between the union and the newly formed Bituminous Coal Operators' Association.

The arrangement forged by the union and the government paved the way for the application of new coal mining technologies. These higher technologies brought improvements in productivity. Equally important, the new technologies improved the working conditions and the safety and health of miners.[1] Over the 30-year period between 1920 and 1950, one cannot find a better example of a robust union which pursued vigorous organizational and institutional goals than the UMWA.

In retrospect, what is amazing about the 1950's was how quickly the coal industry declined. At the beginning of the decade, more than 516 million tons of bituminous coal were produced by approximately 415,000 coal miners. By 1962, fewer than 403 million tons were mined by slightly more than 150,000 miners. The decade marked the introduction of the modern continuous miner system. Traditional hand methods of production quickly faded into history.

The 1960's saw production gradually increase but not employment levels. Employment continued to decline until it reached fewer than 125,000 in 1969. By the end of 1970, coal production had again risen to above 600 million tons, a figure it had not attained since the mid-1940's.

The decline in mining employment is not surprising in light of the market conditions over those two decades. In 1950, the coal industry had four principal market sectors: electric utilities, metallurgical users, home heating and industrial consumption. The last two markets had substantially disappeared by 1970. Residential home heating over that 20-year period was almost completely replaced by natural gas and electricity. Although substantial industrial markets still remained in 1970, the use of coal in steam locomotives, a significant part of that market in 1950, had been completely eliminated by the use of diesel fuel. Metallurgical usage over that 20-year period was marked by a gradual but persistent decline. Only the domestic utilities moved significantly in the other direction, as their consumption increased to almost 78% of the nation's coal by 1979.

As remarkable as these changes were to coal markets, the union's response over this 20-year period is even more remarkable. Mining employment literally imploded between 1950 and 1960. By the end of that decade, almost 60% of the 415,000 jobs which had existed in 1950 had disappeared. A decade later, in 1969, employment had dropped another 25% to little more than 124,000 miners. These dramatic declines occurred without significant labor disruptions in the coal fields.

Because employment in the mines was declining, the union had little reason to conduct organizing drives. Instead, it shifted its resources and talents to developing contractual and institutional controls over the industry. The 1950's mark the first time that the union secured provisions in its contracts which attempted to control the market through restrictions on production. Thus, the 1958 contract contained a protective wage clause which essentially required the signatories to apply the wage provisions of the agreement to all coal obtained under contracting relationships by the signatory companies. By 1964, the BCOA had agreed that it would voluntarily pay into the multi-employer health and pension funds on all non-union coal procured by signatories to the National Bituminous Coal Wage Agreement.

Likewise, the union was clever in erecting a series of institutional protections in its control of mine labor. It was during the 1950's that the United Mine Workers entered into a number of collusive practices with its BCOA member companies in an effort to control markets and squeeze out non-union production. These practices eventually resulted in the landmark Supreme Court case of UMWA v. Pennington in 1965. In one instance, the union even loaned money out of its trust funds to an individual who acquired stock in a large non-union company sufficient to allow the individual to conduct a takeover and eventually sign a contract with the union.

Beginning in the 1970's, a condition akin to arteriosclerosis began to affect the UMWA. The union was unable to perform activities that only a few years earlier it could have accomplished. Chief among these was organizing.

As ***Figure 1*** shows, the union failed utterly to seize an expansionary market for coal in the 1970's. During that decade, it saw its share of national coal production slip from slightly more than 70% to little more than 40% by 1980. By 1992, its share had eroded still further to roughly 28% of the nation's coal production. I should note that this 28% reflects only the 42,000 miners whose wages and other terms of employment are governed by the National Bituminous Coal Wage Agreement. In addition, there are at least another 75 million tons of production mined by perhaps another 5,000 - 6,000 miners who are members of the UMWA. This coal is mined under either the Western Regional Agreement which the UMWA has signed since the mid 1970's or various nonconforming contracts such as the Island Creek EESP which was negotiated in the late 1980's. Nevertheless, as ***Figure 2*** shows, United Mine Workers now account for less than one-half of the active full-time miners employed in our nation's industry.

The union might argue that these figures are misleading. Much of the production which is shown in ***Figure 3*** reflects Powder River Basin coal mined in Wyoming and Montana. Although it is true that in percentage terms the union's loss of production is less severe when you exclude the largely non-union Powder River Basin production, the figures still are not favorable for the union. Approximately 235 million of the almost one billion tons of coal mined in the United States in 1992 came out of the Powder River Basin regions of Montana and Wyoming. As shown in ***Figure 4***, even excluding this production, almost two tons of bituminous coal and lignite are mined by labor not affiliated with the union for every ton mined by a UMWA member.

The union leadership is clearly concerned about this situation. The active membership in the UMWA has now reached a 90-year low, with all signs pointing to further decline. There are only two methods of reversing this

NBCWA Share of U.S. Coal Production: 1970-1992

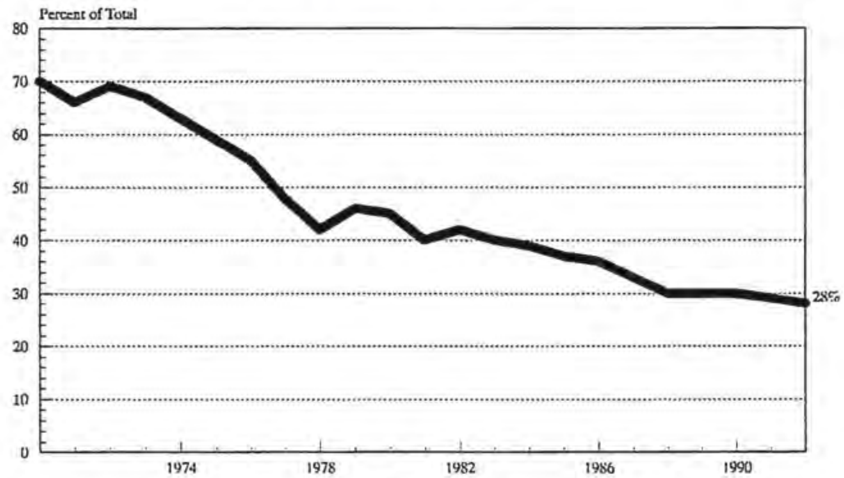


Figure 1

Employment Trends: 1975-1992

(Average Number of Production Workers)

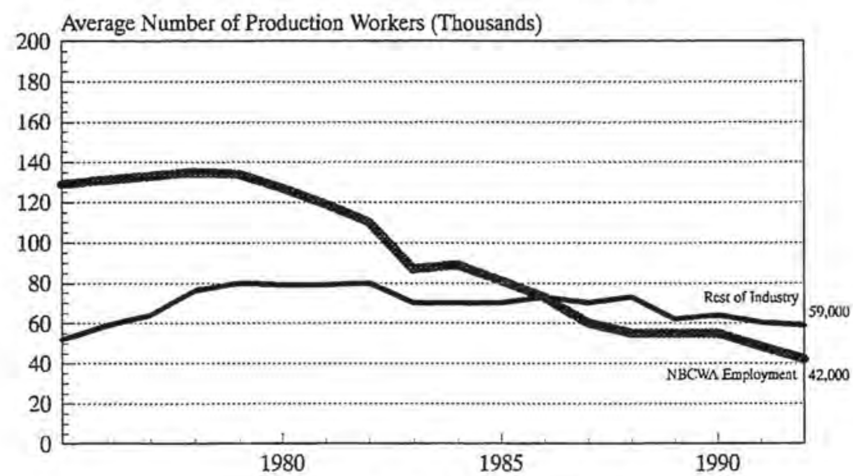


Figure 2

U.S. Coal Production: 1970-1992

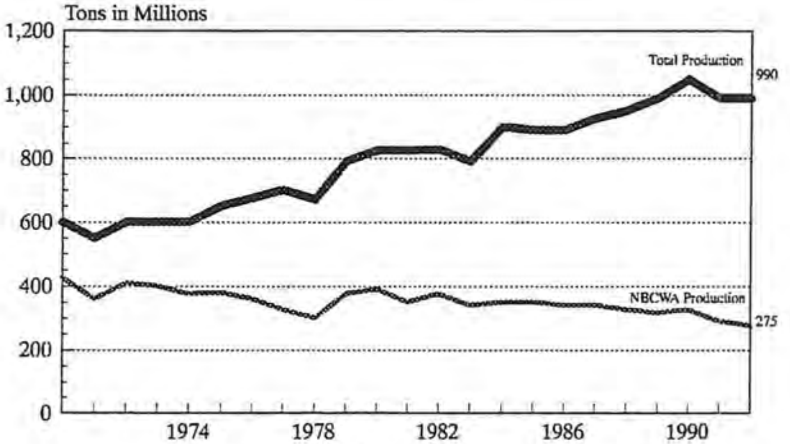


Figure 3

U.S. Coal Production: 1970-1992

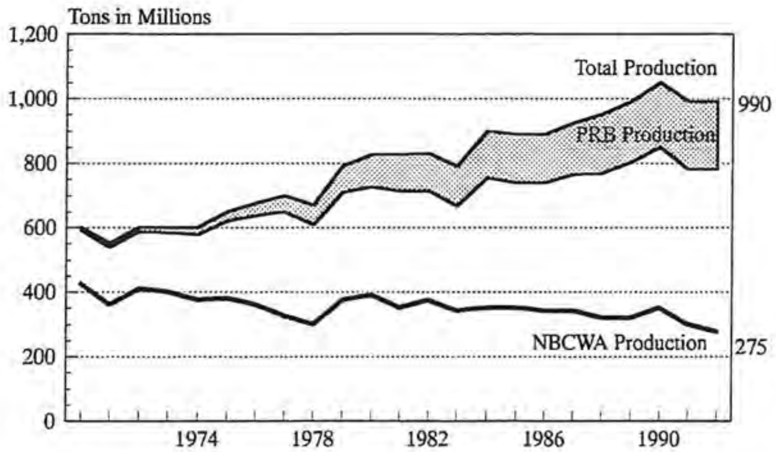


Figure 4

trend available to the union. First, they may organize the unrepresented miner. For the UMWA, this has proven largely unsuccessful in the recent past. Secondly, they can attempt self- perpetuation through agreements with the current signatory employers. The latter, aside from the general legal principles of successorship and alter ego/single employer, require the cooperation of the employer.

Since the late 1970's, this "cooperation" has taken the form of contract language which seeks to predetermine hiring and representation at new operations.

The 1978 NBCWA had the employers agree that the labor contract would cover all coal operations owned or acquired by the employer. Thus, any new mine would be an accretion to the union. The legality of such a clause was put in doubt by the decision of Lone Star Steel Company v. NLRB.

In one sense, the United Mine Workers union has become a victim of its own success. Every significant goal which the union has established for itself over its long history - high wages, health care, pension and government enforced safety regimes - has been achieved. This is a testimony to both the union's persistence and its ingenuity.

If the UMWA has a future, it must redefine its mission in today's domestic coal industry. It will not succeed in attracting new members solely on the basis of reviving hoary stereotypes which long ago lost any resemblance to reality. Neither will the union assure itself of a future by attempting to organize workers outside of miners and the ancillary occupations which support mining. The union must convince people that they are important to the union as more than mere dues payers who support a union bureaucracy in Washington. Only the union can decide what this message should be and how it can be convincingly presented. It is clear, however, that the decline of the UMWA cannot be reversed overnight.

For the union, this begins by accepting the economic realities of coal production in today's economy. It means that the union must understand that the mines represented by the UMWA exist in an extraordinarily competitive environment and that the economics of our industry show no change in this regard. As an example of this, note that total direct employment in the coal industry has declined by 91,000 workers since 1979, although coal production rose 52% during the same period. This trend is likely to continue. Productivity improvements necessitated by competitive pressures will continue to offset future growth in coal industry employment.

During the period 1975-1990, productivity in the coal industry increased from 1.81 tons per man-hour to 3.83 tons per man-hour, an increase of 112%. This is principally because coal companies have made large infusions of capital in new and more productive technologies in an effort to keep pace with competitive pressures. During the same period, average U.S. coal prices declined, in real terms, by 51% .[2]

Since 1981, there have been no significant changes in the basic wages, benefits, mine scheduling and other elements of the NBCWA package that affect productivity and costs, despite the mounting competition and the loss of UMWA jobs.

To respond to the mounting competition and to slow its loss in membership, the UMWA began offering concessionary or "sweetheart" contracts to certain non-BCOA companies during the 1980's. Concessionary labor agreements were signed with a number of producers, including subsidiaries of A.T. Massey Coal Company and the Pittston Coal Group, as well as scores of smaller companies. The concessions were made in many areas. There were changes in hiring practices, improvements in mine scheduling, relaxation of work rules that restrict production, cost-containment measures for health care, and elimination of contributions to certain multi-employer funds used to pay retiree health care benefits.[3]

On the other side of the bargaining table, the BCOA should understand that the acquisition of new job opportunities for existing UMWA-represented employees is a natural expression of self-interest of those people and its collective bargaining representative.

Loss of membership and its lack of success in organizing non-union mines has forced the UMWA to raise the double-breasting issue at the bargaining table.

To make it easier to organize existing non-union mines and to gain automatic recognition as the bargaining agent for future non-union mines, the UMWA has made three demands during the negotiations. If the parent companies of the BCOA members were to accept these demands, the double-breasting issue would evaporate, and the UMWA's membership rolls might be temporarily increased.

Two of the UMWA's three demands are designed to make it easier for the union to organize existing non-union subsidiaries of the parents. The union has demanded that all subsidiaries of the parent pledge neutrality (i.e., silence irrespective of the union's claims) during organizing drives. Because good employee communication is a basic element of good management, neutrality would give the union a major advantage, and it would deprive employees of information. The union also demanded that it be recognized without secret ballot election if 51% of the workers sign a union card. The union's approach would make employees vulnerable to intimidation during organizing campaigns.

The third demand is for the parents to agree that all new mines acquired or developed by the parents' subsidiaries would automatically be UMWA-represented and subject to the NBCWA. This demand places a major restraint on corporate investment. The demand also commits employees of new subsidiaries to union representation without allowing them the freedom of an election.[4]

In conclusion, I do not wish to understate the difficulty in resolving these many issues. It will require, above all else, intellectual honesty on both sides. The union must be able to make distinctions between its institutional interests and those of the individuals who comprise its membership because the two are not necessarily the same. Finally, the BCOA must be prepared to entertain new ideas. Notwithstanding the difficulty in transcending our history, I believe a new contract can be successfully forged in a fashion which secures the economic interests of our industry and our employees.

Thank you very much for the opportunity to speak to you this afternoon.

NOTES

1. *The 1993 Coal Industry Labor Dispute - One Company's Perspective* (Peabody Coal Company, June 11, 1993), p.5.

2. Ibid., p.3.

3. Ibid., p.6.

4. Ibid., p.14.

AWARD

Professional Award for Coal Mining Health, Safety and Research

Professional Award for Coal Mining Health, Safety and Research

John N. Murphy has been Research Director of the U.S. Bureau of Mines' Pittsburgh Research Center since 1978, overseeing research and development pertaining to underground and surface mines, as well as coal or ore beneficiation plants. This includes work in areas related to safety, environmental problems and mine productivity.

Mr. Murphy is a Registered Professional Engineer. He received an undergraduate degree from the University of Pittsburgh in 1961 and a Master's degree from Duquesne University in 1967. He is listed in *American Men and Women of Science* and *Who's Who in Technology Today*. from 1967 to 1978, Mr. Murphy served as Research Supervisor, Industrial Hazards and Communications at the Pittsburgh Mining and Safety Research Center. From 1961 to 1967, he performed various technical and supervisory assignments with the Bureau of Mines in Pittsburgh.

He is the holder of two patents, the author of 80 technical publications, recipient of the Department of the Interior Meritorious Award (1973), Distinguished Service Award (1985), and Meritorious Rank Award (1986).

Mr. Murphy is the U.S. Representative to the International Directors of Security Group, which is comprised of the directors of the major mining research establishments in Germany, France, England, Poland, and the United States. He is also active in numerous professional engineering and mining organizations and has served on many government and industry advisory and review committees.

It is recognition of achievement in coal mining health, safety and research throughout his career that the Twenty-Fourth Annual Institute presents him with this award.

TECHNICAL SESSION I: *CURRENT ISSUES*

Chairman:

Rick Sink
Director of Human Resources
W.W. Boxley Company
Roanoke, Virginia

Training: Answer or Question

Carl R. Metzgar

Manager, Safety and Health
Vulcan Materials Company, Mideast Division

Training and education are not the same thing. A question and an answer are not the same thing. The two word pairs are connected to each other and all four are related. Our coins have high value silver on two sides joined by copper. But copper does something best. The copper is a powerful binding force between the silver slices. The desire for safe productive results is a powerful binding force between the silver slices of training and education.

Teaching and learning begin one to one. Mother and child teaching and learning from each other. The current research keeps showing the learning ability of infants to be greater all the time. One of the great teaching and learning successes is the worldwide success of a literacy program built on "each one teach one." Another success in the East and the West has been the apprenticeship system. Remember all the crafts plus law and medicine were taught one to one.

Each step we take away from teaching and learning one to one leads to a degradation in quality. One to one is the most expensive but it is the most effective way to educate and train an individual.

The great power and the great weakness of one to one teaching is that while a particular skill, task or job is being taught, values are taught and learned at the same time. Isn't it curious that values which are most important can't be taught and learned directly. Ethics, morals and values are learned incidental to learning and practicing some other life activity. If the teacher/master has good values his apprentice will have exposure to good values. If he has bad values, the apprentice could pick up bad values.

Values represent the environment in which training is done. Someone decides what should be taught and learned. That is a value judgement and is a function of education. There are all sorts of circumstances where it is determined to do training.

"More training" is offered as the single most common corrective action on accident investigation reports. If a mining operation has an accident, the corrective action is sure to include training for a worker. This would surely suggest that training is an answer.

But let's look at the nature of questions and answers before we establish certainties about training as either a question or answer.

Part of the fun of Jeopardy, the TV show and the game, is that the usual order of things is reversed. You know the GIMMICK. The answer is given and the contestant has to come up with the right question. This game show has built its appeal and success on the idea that the question is more important than the answer.

The show lasts for half an hour each day not counting reruns. That isn't bad for a truly upsetting idea. TV doesn't usually give time to much that is worthwhile. Think about it. The question is more important than the answer. Now that is a good place to start. It is a good place to start because it is opposite to what we expect.

When things are set up side down the reversed position makes for a new point of view. Looking at things in a new way, generally leads to fresh learning.

In a recent book, a teacher tells a story about a researcher who was trying to find out what one group really thinks about another group. What does production really think about sales and sales about production. What do both of them think about accounting. Groups have different opinions about each other.

In the case in question, the researcher asked a group of people, "What is the greatest fear that a professor is likely to have?" Most people answered that someone will ask a question that he or she can't answer.

The same inquiry to a group of professors got the opposite answer. The professors are most afraid that they won't ask the right questions. They want to ask the right questions of themselves and their students.

That's right! The most highly educated group of people in the United States is not concerned with its own answers. This group of people is afraid it won't ask the right questions. It is questions that lead to progress and improvements. More often than not the progress comes in small units.

How did we get into the fix where most people think that answers are more important than questions?

We are mostly the product of a school system that has trained us to give back information that someone else thinks is important. To get through school, we have to repeat back something that we were told. Our answers had to fit in little boxes. Isn't it just possible that the part of school we didn't like was giving answers when we knew questions were more fun?

Giving back answers does not get us the little bits of improvement that result in increased safer production.

If you don't ask questions your boss and co-workers can't help you. The people working for you are left out as well. The opening of a question is where progress begins. If you ask a question you have started something. If you ask a sincere question you have put the other person on alert. You are saying I want to listen! You have my attention. What you have to say is more important than what I have to say.

Recently a new razor blade has been announced. It is a ceramic of all things. It is 40 times better than today's blades. What is the question? Could the ceramic be used for crusher liners or screens? A 40 times improvement on crusher life would be amazing.

No luck. The ceramic blade is so brittle that the holder has to be specially designed to absorb the shocks of shaving and handling. I never considered shaving as shocking to the razor. It is also expensive. Keep in mind aluminum at one time was so expensive that the top most point of the Washington Monument was a small piece of aluminum. It is now so cheap we make beer cans out of it. But we have to ask the question.

Forty times improvement would have been nice. Not for us. Not yet! There have been metallurgists out there asking questions about alloys for years. Now we know there are ceramic researchers out there that just might give us the chance to be more competitive. Only questions lead to progress.

Where do questions come from?

One man looking backward came up with a rhyme:

> I keep six honest serving men
> (They taught me all I knew):
> Their names are What and Why and
> When and How and Where and Who.
>
> R. Kipling

This man put the rhyme in a story he was writing for children. That's where questions come from. Think back to the last time you wanted to twist off the neck of a little kid that had asked you "why" one more time than you meant to answer.

Kids are full of questions. We manage to knock most of the questions out of them by the time they are about 10. But before they quit asking they certainly learn a lot.

So here comes a writer and he sends a coded message to the kids. Don't pay attention to grown ups, they don't know what they are talking about. This is a secret that has made my life really interesting! I ask questions and you should to. Keep asking. Keep looking.

Keep asking. Keep looking. Not every question leads to an immediate pay off but ask enough and there will be pay dirt.

What, why, when, how, where, and who are beginnings of the questions that get things going.

Is training an answer? Answers more often than not stop thinking rather than encourage thinking. If you are sophisticated enough to agree that accidents have multiple causes then you are ready to agree that preventing a repeat accident requires multiple corrective actions. If training is accepted as a first fix answer it cuts off further questions and training may even be misguided. It takes a lot of questions to find the multiple causes of accidents. Too often the first answer, training, is accepted as the only answer.

In Deming's 14 points, "Institute Training on the Job" is point 6. Point 13 is, "Institute a vigorous program of education and self improvement. Deming and his thinking are fairly popular these days. Note he includes <u>training/skill</u> and <u>education/value</u> in his scheme. The curious thing about Deming's 14 points is that there is no direct statement about the proportion of things within managements' control compared to the things in control of the worker.

Training and education are mutually supportive but they are not the same thing.

To educate is to develop mentally, morally, or aesthetically especially by instruction.

To train is an order of assurance designed to lead to some result. This is the push/pull at a basic level. If you do A you will get B.

I may be cutting the cheese thinner than two labor lawyers at a negotiation but in education I see development toward a broad goal or value. In training I see a restricted practice toward a narrow task. Use a 12 point socket if you have to deal with both square and hex nuts is a training question.

Training and education are at different levels of abstraction.

Deming includes both training and education in his scheme to improve the operation of a business or institution. Earlier on it was mentioned that training is the most often offered corrective action on accident reports. Since June of 1969, I have never seen "management education and training" offered as a corrective action. Deming might have something to say about that.

The International Loss Control Institute has an audit scheme for evaluating a safety program. In its method as currently published, management training is weighed a bit heavier than employee training. Both are in the top six out of a possible 20 program elements. (See Appendix A)

Management training is #4. Employee training is #6. An organization is started at the top and driven from the middle. This ILCI #4 and #6 looks like Deming's #13 and #6 to me. If you will allow me the opportunity to ADD some of the value judgements that would be included in Deming's #16 to ILCIs number #4, these two systems of thought move much closer together.

There is no doubt that value judgements good, bad, or irrelevant drive organizations. By now, it is obvious that there is a larger question out there than training. Despite the fact that the accident investigation report says train and despite the fact that it is convenient to train when something less convenient might work better, organizations still pick training as the principle solution to accident prevention. We repeatedly see training as the answer. However, we have enough accident reports to show that training might not be the answer.

Who here today is not more than a little bit sensitive about the South Mountain accident. We are all sensitive for different reasons but it kicks and churns at the edge or middle of our thinking about accident prevention, legislation, enforcement, cooperation, and disagreements.

That event had multiple causes. There will have to be multiple responses to prevent both a 1:1 repeat as well as a similar sequence leading to a similar event.

Training certainly will be required. Skills are necessary so that certain functions can be completed. Training will put those skills in place. But the job is not finished. Look at Deming's point 13. One of the multiple contributors to the accident was a lack of response to values that training alone can't put in place.

Recently, I had the occasion to speak with a former Union Safety Committeeman. I was fishing for an attitude toward smoking. He and I have become friends so there was no need for him to impress me and he has been out of his coal situation for nine years.

He said, "I did shake downs so nobody but me knew when. Sometimes I would go down on a man trip and as soon as the crew was off the elevator we stopped and checked everybody and everything. Some people went back to the top and out."

Benjamin Franklin said three people can keep a secret if two of them are dead.

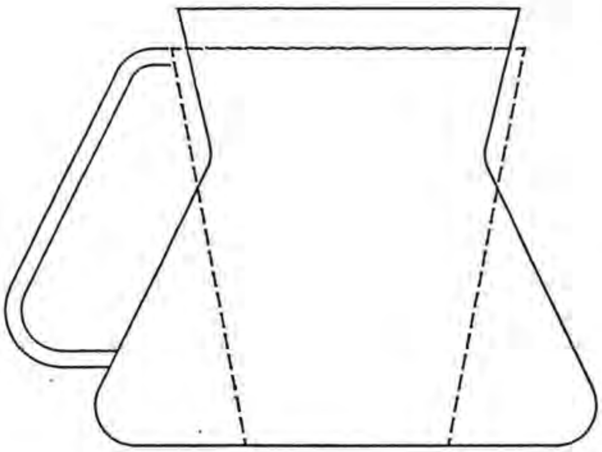
My friend kept his shake down secret and he was effective. He was a safety committeeman for 11 years. I have to believe management and the union had moments when either or both would have wished someone else was in the safety committeeman job. I also have to believe that both were glad he was on the job. He held the job for 11 years; his world had to be satisfied with him more than 51% of the time. To act for 11 years, he had to be reelected.

My point is he was trained to shake down for smoking materials. His value system required that he do the job in an ethical way so that he would be effective.

He was trained and educated. The combination made an effective answer. In his case, training was an answer. However, it was an ethical question that led to the answer.

This was an example that we are all tense about. Let's look at an example we can enjoy.

The drawing represents two drinking cups superimposed on each other.



This small cup was for the children. The large cup for dad.

Now we can train the kids from now until they reach graduation from kindergarten, grade school, jr. high/middle school, high school, college, graduate school and 25 years in the school of hard knocks. The cup inside is a trap. Training will not compensate for its inherent bad design.

All the training and discipline in the world is not going to answer the question of how do we prevent the spill. Use the cup inside on a regular basis and you will have spills!

How do I get this all back together? Stories sometimes are most helpful. I had an 11th grade English teacher. Trust me. He was held in suspicion by everyone in the school system and the community the school served. As happens so often with teachers distrusted by adults he was held in high regard by the students but others always had reasons to want to get rid of him. So far as I could tell his only crime was that he read books and shared ideas.

His greatest gift to me was one gentle line. He said, "you can say anything if you are careful."

It seems to me that we expect things from training that training can't deliver. Training an employee can't make up for the failures in the management systems in organizations. An organization can say its wants more training for its people but that is only a start.

It strikes me as curious that the people calling loudest for the training and the people willing to pay for it can't see the need for their own education to make it effective.

Wit, grace, charm, and tact open the way to discuss bigger questions with the bosses of the company.

The capital or operating budget is as much a way to ask questions as it is to try to predict what will happen. A request for funds is a question and an answer at the same time. Today's question becomes next year's project.

A good question to a listening audience of one or many is likely to get an informed and well-considered answer. The better the question the better the answer.

APPENDIX A

The following program elements are included in the materials in an Accredited Safety Auditor course. The elements are ranked from most important to least important. The rank order is currently under revision by the International Loss Control Institute (ILCI) of Loganville, GA which owns the rating scheme.

INTERNATIONAL SAFETY RATING

ELEMENT	POINTS
1. Leadership and Administration	1170
2. Emergency Preparedness	770
3. Planned Inspections	760
4. Management Training	700
5. Accident/Incident Investigations	680
6. Employee Training	675
7. Health Control	645
8. Organizational Rules	515
9. Engineering Controls	510
10. Task Analysis & Procedures	505
11. Accident/incident Analysis	455
12. Personal Communication	450
13. PPE	450
14. Program Evaluation System	430
15. Purchasing Controls	400
16. Group Meetings	400
17. Task Observation	330
18. General Promotions	355
19. Hiring and Placement	350
20. Off-the-Job	250

Preliminary results in preparation for a rewrite indicate that engineering controls and purchasing controls are likely to get more importance and there will be some reordering in the top one third of the list.

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ENVIRONMENTAL ISSUES AFFECTING THE MINING INDUSTRY

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INTRODUCTION

Concern with environmental issues is a relatively recent occurrence in the history of mankind and parallels the development of industry, the advance of technology and the increase in population density. In the comparatively short span of two decades, the United States Congress has passed comprehensive environmental legislation that carries increased costs for industry and business and includes significant penalties for noncompliance. According to David Lovett, President and CEO of Blue Circle America, Inc. and Chairman of the National Stone Association's Environment, Safety and Health Division, "The environment is one issue our industry can no longer avoid, and one which could eventually make or break our industry depending on how well - or poorly - we manage it" (1).

DEVELOPMENT OF ENVIRONMENTAL REGULATION

The Industrial Revolution began in the middle of the eighteenth century and the newly-developed industrial processes often produced unusable byproducts. With science and laboratory technology in their infancy, little was known of the hazards associated with some of these byproducts. They were treated as any other waste and dumped or stored out in the open.

A key event in the history of the development of environmental law in the United States occurred in the late 1800's when real estate developer William T. Love began work on a canal to divert water from the upper Niagara River to provide water power for industry. Love envisioned a carefully planned industrial city of 200,000 to a million inhabitants built around the canal. Unfortunately, economic hard times in 1910 put an end to the project. In 1920, the partially completed canal began to be used as an industrial dump site, primarily by Hooker Chemical Company. In 1953, Hooker sold the land to the Niagara Falls Board of Education for the token sum of one dollar.

A school and homes were eventually built on the site, with the developers presumably unaware of the chemical wastes buried underground. Residents, however, soon noticed odors and black sludge oozing through the cracks in their basements. On August 2, 1978, following a two-year campaign by the residents' association, the State of New York declared an official emergency and said that the situation at the site represented a "great and imminent peril to the health of the general public." Two hundred and thirty-nine families were evacuated from the area over the next eight months.

Concern over environmental issues had begun to develop in the 1950's and '60s. The Ohio River Sanitary Commission (ORSANCO) was formed to deal with contamination of the Ohio River. Air pollution problems from coal smoke in the industrial cities of the east and midwest were a concern as was smog resulting from heavy automobile traffic in California. However, the widespread publicity surrounding Love Canal made it a marker event in the development of environmental issues in this country and made the consequences of hazardous waste a national concern. Because the problem had begun many years before the danger became visible, and because both the public and Hooker Chemical Company had little knowledge of the type and quantities of substances dumped in the canal, public outcry focused the attention of both laymen and politicians on the potential for similar problems elsewhere in the country. In addition to Love Canal, wide-spread media coverage of other issues, such as dioxin and Times Beach in Missouri, and the contamination of ground water and public water supplies, helped drive the development of environmental legislation in the 1970's and 1980's.

The first major piece of federal legislation dealing with waste was the Solid Waste Disposal Act of 1965. It set forth a philosophy that solid waste management was pretty much a local concern, but recognized the need for federal involvement as a regulator and coordinator. In 1970, this law became the Resource Recovery Act when several amendments were added.

An important event in environmental legislation occurred on January 1, 1970 when then-President Richard Nixon signed the National Environmental Policy Act (NEPA) into law. It said the intention of the federal government was to work in conjunction with state and local authorities as well as with concerned public and private organizations to "...create and maintain conditions under which man and nature can exist in productive harmony...." A newly formed executive branch agency, the Council of Environmental Quality (later the EPA) was given responsibility for coordinating implementation of the NEPA. One of the most important provisions of NEPA is that any project undertaken that may affect the environment, and therefore requires a federal permit for operation, must first supply an environmental impact statement. It must quantify the potential environmental impact as well as any benefits that may be derived from the project, and any alternatives to the proposed action must be discussed.

Between 1970 and 1976, Congress passed legislation dealing with regulation of toxic substances affecting air and water. The Clean Air Act was passed in 1970 and amended in 1977 and again in 1990. The Federal Water Pollution Control Act (Clean Water Act) was passed in 1972 and amended in 1977 and 1981. It is up for re-authorization again this year. FIFRA, the Federal Insecticide, Fungicide and Rodenticide Act was passed in 1972. In 1976, the Resource Conservation and Recovery Act (RCRA) was passed as an amendment to the 1965 Solid Waste Act in order to tie together protection of ground water and surface waters as well as land and air from contamination by surface water. While this law revised solid waste management practices, its most important provisions were in Subtitle C, which forms the framework for a hazardous waste management program. This law provided for identification and listing of hazardous wastes and set forth specifications for facilities that generate, transport, treat store or dispose of hazardous waste. RCRA is also up for re-authorization this year.

RCRA has no provisions for dealing with existing hazardous waste sites that are a threat to the environment and to human health. In the wake of and as a direct result of Love Canal, Congress passed the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) in 1980. This law is commonly known as "Superfund." Perhaps the most important part of this law was the creation of the Superfund. This is a special fund set up through the collection of special taxes for the purpose of having funds available to clean up contaminated sites. This law is administered by EPA, which can only take clean up action at sites on the National Priorities List (NPL). Sites are added to the list based on a risk analysis performed to determine the danger to the environment or to public health. An important part of CERCLA is EPA authority to identify culpable parties. The courts have recognized the concept of joint lability for sites contaminated by several polluters and have placed the financial liability primarily on the generators.

Under CERCLA, EPA may use money from the Hazardous Substances Response Fund to clean up sites where the responsible parties do not respond and then take steps necessary to recover the money spent. CERCLA was amended in 1986 with the Superfund Amendments and Reauthorization Act (SARA). It made remedial standards stricter, empowered the government to "act now, seek payment later" and allocated money to clean up those sites where there are not responsible parties to pay. Title III was added to SARA as "the public's right to know" legislation. For the first time, the public was allowed to learn what substances were contained on a company's property (2).

THE CHALLENGE

Over the past two decades environmental laws and regulations and the costs associated with them have increasingly become a significant factor in business operations. The trend has been for Congress to increase the penalties, fines and enforcement provisions for noncompliance with each re-authorization of an environmental law. An example is the Clean Air Act Amendments of 1990, which increased penalties for clean air violations to $25,000 per day per violation, with *knowing* violations now a felony.

The mining industry in the U.S. today finds itself increasingly challenged and constrained, with the Mining Law of 1892 up for revision, tough environmental laws on the books and environmental activist groups such as the Mineral Policy Center working hard to spotlight problems, perceived or real. The lead story in the June 18, 1993 Wall Street Journal details the current flight of U.S. mining firms to Latin America as a friendlier and more prosperous business environment in which to operate (3).

A RESPONSE

Crushed stone is produced by mining large pieces of rock and reducing it to a desired size - usually less than two inches. It's then used for a wide variety of purposes. Its predominant use is as a construction aggregate in asphaltic and portland cement concrete - pavements, structures and the like. It's also used as agricultural limestone to enhance crop productivity, as ballast for the nation's railroads, as rip rap for erosion control and for a host of other industrial and medicinal purposes. It's a ubiquitous material that's used in paints, toothpastes, plastics and paper making.

In general the crushed stone industry can be considered a local industry in that while the price of the product is a certain dollar amount at the quarry, the cost of transporting that stone to its end use can be as much as the price of the stone at the quarry (4). For this reason, quarries tend to be located close to the markets they serve and thus subject to close public scrutiny for compliance with environmental law and regulations. In his address to this group last year, Charles S. Luck, III, President, Luck Stone Corporation, spoke on the importance to the crushed stone industry of being able to obtain required zoning and permits to open new quarries and expand existing ones, and of the importance of being a good neighbor (5).

Recognizing that the public's perception of the crushed stone industry is critical to its success, NSA established the *About Face Program* in 1973 to provide national recognition to those crushed stone operators who have made constructive and positive efforts to enhance the aesthetic appearance of their operations. The program, which has been extremely successful, is also designed to call attention to these efforts through publicity within the aggregates industry and the local communities.

NSA also has a very successful *Community Relations Program*, begun in 1989, designed to recognize aggregate producers whose community involvement and support activities have contributed to the public's perception of the aggregates industry, in general, and to the public image of the individual producer's quarrying operation, in particular.

These two programs have been extremely successful in elevating the image and improving the public acceptance of the crushed stone industry.

NSA'S ENVIRONMENTAL PROGRAM

The National Stone Association's leadership took steps three years ago to strengthen NSA's ability to provide service to its members on environmental issues affecting the crushed stone industry. A task force headed by Charles Luck, after considerable study, recommended adding an environmental professional to the Association's staff and restructuring the Association to create a new Environment, Safety and Health Division comprised of an Environmental Committee and a Safety and Health Committee. Both recommendations were approved by the Board of Directors and implemented in July of 1990.

NSA today has an active Environmental Committee of about 70 professionals and others drawn from its member companies. The committee is organized into task groups which are formed as needed to deal with current issues of concern to the crushed stone industry. NSA's professional environmental staff person provides assistance to and staff support for the committee, as well as providing technical service on environmental questions to NSA's members.

In addition, the Environmental Committee works closely with NSA's Governmental Affairs Division on legislation of interest to the industry and with NSA's Public Affairs Division to assure that the industry's environmental policies, programs and progress are communicated to the public. The Environmental Committee also works closely with the Operations Division, which represents the operating staff of NSA's member companies.

One of the first items of business under the new organization was to develop a set of Environmental Guiding Principles for the crushed stone industry. Those Guiding Principles were adopted by NSA's Board of Directors in January, 1991 and have provided a focus for NSA environmental activities and programs. In addition, a number of companies have incorporated the concepts into their own corporate environmental policy.

ENVIRONMENTAL ISSUES

There are a whole array of environmental issues affecting the mining and quarrying industries today and NSA's Environmental Committee is addressing them head-on.

One of the first projects undertaken under NSA's new environmental program was a group application for storm water permits for the crushed stone industry. Acting in response to a lawsuit brought by an environmental group in the northwest, EPA promulgated rules to regulate the discharge of storm water from industrial facilities on November 16, 1990. Initially, two options for obtaining storm water discharge permits were offered: either individual permits or development of a group application for different industries. Last fall a general permit also became available.

NSA developed a group application for storm water permits for the aggregates industry. A total of 1142 operations are participating in the group application, making it one of the largest. The group application has afforded a number of benefits to the crushed stone industry: a simplified permit application process; greater input into the details of the permit and the opportunity to negotiate permit terms and conditions; and a significant saving of money from reduced testing and data collection.

NSA developed a storm water sampling video and training manual which was used to train 110 sample collectors at locations across the country in storm water sampling techniques. We estimate that the group application has saved each participating site approximately $10,000 in testing and consultant's fees, for an industry-wide savings of about $10,000,000!

A task group is now developing a guidance and training manual for the crushed stone industry to use in developing storm water pollution prevention plans (SWP3) which must be in place by October 1, 1993.

Clean air issues affect most of us today. Another early project of the Environmental Committee was reviewing and providing industry input to a New Source Performance Standards (NSPS) training manual being written for EPA by a contractor. The quality and accuracy of the manual was significantly improved as a result of NSA's task group input. Further, NSA obtained permission from EPA to reprint the manual as an educational tool for the crushed stone industry and to date we estimate over a thousand copies are being used at quarries and stone operations around the country.

NSA has also held several NSPS training courses to educate the industry in NSPS compliance requirements. NSA also has a task group studying how the NSPS rules need to be changed to eliminate administrative burdens on the industry that don't produce an environmental benefit.

On another clean air issue, an NSA task group has provided input to EPA as it drafted the new model air operating permits which industry will need to obtain in the near future.

Hoyl Gill mentioned a project which has been particularly beneficial and that is the joint venture between EPA and NSA to develop better AP-42 emission factors for aggregate producers. The numbers currently in AP-42 were based on empirical data and information and have proven to be inaccurate. NSA has paid for about half the cost of testing to date and its members have offered their plants as test sites and their professional staff's expertise and assistance for the project which began last year. To date, PM_{10} emissions from tertiary crushers and screens at three granite plants and two limestone plants have measured. The new numbers are being used to calculate the new operating permit fees required under the Clean Air Act Amendment of 1990 and are resulting in significant savings to the industry. Hoyl told you of the significant savings reported by several producers - 75 per cent ($27,000) by an Oklahoma producer and 60 per cent ($18,000) by a Wisconsin producer.

We also have a task group working on using air emissions data collected from a number of quarries in Georgia to develop better mathematical models and tools for the industry to use in predicting air emissions. Our consultant has just completed an evaluation of the data and found it to be of excellent quality. The task group is preparing a request for proposals for further work.

NSA also has task groups actively working on wetlands and endangered species/biodiversity issues. While these are environmental issues, they are also land-use policy issues with significant ramifications for mining and quarrying interests. The Environmental Committee's task groups work with NSA's Governmental Affairs Division to provide technical input to the legislative and lobbying effort. In addition, NSA is a member of the National Wetlands Coalition, the Aggregates Industry Wetlands Coalition and the National Endangered Species Act Reform Coalition.

NSA also has a group working on waste management issues and watching very carefully RCRA re-authorization.

To keep the crushed stone industry informed on environmental issues, NSA publishes environmental updates in its bi-weekly *Digest* and features an environmental column in each issue of the bi-monthly *Stone Review*. NSA develops and holds training courses on environmental issues for the industry as needs develop and is preparing for its second biennial *Environment, Safety and Health Learning Forum* which will be held in Atlanta October 31 - November 2, 1993.

ENVIRONMENTAL RECOGNITION

Finally, following on its success with the *About Face* and *Community Relations* programs, NSA has established an *Environmental Recognition Program* to provide positive role models for companies and individuals to emulate to help encourage and motivate the crushed stone industry to excellence in its environmental affairs. An *Environmental Steward Award* is presented annually to those individuals who have contributed to the industry's progress toward excellence in environmental affairs and the *Environmental Professional of the Year Award* is given to the outstanding environmental professional. The eagle has been selected as the theme for the award program. Recipients of the individual awards are invited to an annual working dinner to discuss ways to strengthen and improve NSA's environmental programs.

In addition, the *Environmental Eagle Award* has been established for individual aggregate operations to recognize those companies and plants which have exceeded technical environmental regulatory requirements. The awards are given for three levels of performance: Honorable Mention, Outstanding Achievement and Excellence.

SUMMARY

Looking ahead to the rest of the decade and on into the next century, we believe that stringent environmental regulatory requirements will continue to be a fact of business life and NSA is working hard to help the crushed stone industry survive and thrive in that environment. As Dave Lovett has noted, the successful firms will be those who operate "Clean, Green and Lean."

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TECHNICAL SESSION II:
HEALTH, SAFETY AND ENVIRONMENTAL INITIATIVES

Chairmen

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The Causes, Behavior and Control of Open Fires in Underground Mines

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INTRODUCTION

Throughout the 19th Century and well into the 20th Century, fires and explosions were the primary cause of loss of life in underground mining and, particularly, in coal mining. Frequent mine disasters caused catastrophic loss of life and provided the background to much of the mining legislation that has been enacted in the United States and other countries.

Advances in the techniques of ventilation technology, coupled with increasing stringency of legislative requirements, have led to significant improvements in the quality of the underground environment in American mines. Nevertheless, the past decade has seen a renewed concern with respect to mine fires and explosions. This is a consequence of two matters: first the growing variety of materials that are imported into modern mine workings, varying from resins and plastics to liquid fuels and hydraulic fluids; a second factor is the continuous increase in the employment of mechanized procedures, many of the machines involving flammable liquids and materials that can produce toxic fumes when over-heated.

In the past 20 years, over 240 reportable fires in coal mines of the United States have been investigated by the Mine Safety and Health Administration. The United States Bureau of Mines has been the primary organization in this country to conduct research into mine fires. Their work has produced beneficial results in:

- the prediction of spontaneous combustion
- the flammability of mine materials
- mine fire awareness
- hazard detection and instrumentation.

Despite such investigations, there has been little progress in the area most vital to the saving of life and property in the event of a mine fire—that of controlling and extinguishing the fire. To quote from the 1990 and 1991 Bureau of Mines Programs of Research:

> *Underground mine extinguishment methods, by direct attack or remotely from the surface, have not changed appreciably in 4 decades, although the average duration of mine fires and the proportion of mines being sealed due to fires has increased steadily.*

The current situation is that unless a fire in a coal mine entry is detected very early and extinguished by prompt local action, then there is a high probability that it will become out of control. This can cause (and has caused) multiple loss of life and result in the mine, or a major part of the mine, having to be sealed. In particular, when the spread of the fire has become limited by the availability of oxygen rather than the availability of fuel (fuel-rich) then there is little hope, with current procedures, that the fire can be extinguished without sealing off.

Fires underground can be classified into two broad groups, *open* and *concealed* fires. Open fires occur in entries, faces and other openings that form part of the active ventilation system of the mine and, hence, affect the quality of the mine airflows quickly and directly. Conversely, concealed fires occur in areas that are difficult or impossible to access such as caved or abandoned zones. This paper is confined to the causes, behavior and control of open fires.

CAUSES OF IGNITIONS

The variety of procedures, processes and materials used in modern mining provides many opportunities for the ignition of flammable materials. However, the most commonly reported causes of fires and explosions in mines are listed in the following subsections.

Mechanized Equipment

Machines intended for use underground should be designed to operate with a high degree of safety in a harsh physical environment, and are subject to legal requirements and conditions in most mining countries. It is no surprise, therefore, that the majority of fires attributable to machines arise out of:

- misuse
- lack of proper maintenance
- removal or bypassing of safety features such as diagnostic devices, environmental monitors or thermal trip switches and
- running unattended for long periods of time.

Exhaust systems on diesel equipment should be fitted with scrubbers that not only reduce airborne pollution but also prevent the emission of incandescent particles. Furthermore, hoses, transmission or brake fluids and a variety of components made from synthetic materials on modern diesels may be capable of producing toxic gases when overheated. All vehicles or other diesel equipment should be fitted with on-board fire extinguishers.

It is particularly important that equipment which contains significant quantities of oil, such as large transformers or air compressors, should be safeguarded by thermal trips, pressure relief valves and other devices necessary for automatic cut-off in the event of any abnormal condition. Such devices should be subjected to routine testing and maintenance. Wherever possible (and as may be required by law) non-mobile equipment should be located within enclosures with fire-resistant roof, floor and walls, and which are ventilated to a return airway. Again, fire extinguishers and, preferably, an automatic fire suppression system should be available within the chamber. In coal mines, the surroundings in adjacent airways should routinely be coated with stonedust.

Electrical Apparatus

In addition to the general comments on mechanized equipment made in the preceding subsection, electrical gear can give rise to incendive hazards from sparking and overheating. Switchgear should be sited such that it is not affected by convergence or falls of roof. This is most liable to occur close to mineral winning areas. Furthermore, start switches should be protected against accidental operation by glancing blows from falling debris or passing traffic. Electrical sub-stations and battery charging chambers should be equipped with non-aqueous fire extinguishers.

Cables in airways should be hung in catenary fashion on cradles suspended from the roof. They should be located such that they will not be pinched by convergence or the yielding of roof supports, nor be impacted by vehicles. The insulation and type of sheathing must be suitable for the electrical load and rigors of the underground environment. All such cables should be inspected routinely for evidence of physical damage.

Electrical failures should result in immediate isolation of the power by means of overload and earth leakage protective devices. In gassy mines, all electrical motors and heavy current devices should be enclosed within flameproof casings so that any ignition of methane is contained within the equipment. Signaling or other light current apparatus should be certified as intrinsically safe, i.e. incapable of producing sparks of sufficient energy to ignite a methane:air mixture.

During non-working shifts, the electrical power supplies to each area of the mine should be isolated at the appropriate highest level control center or substation. Precautions should be taken against power surges caused by lightning strikes on surface power lines, transformers or substations. Similarly, particular care should be taken against electrical leakage in the vicinity of explosives or fuel storage areas.

Conveyors

Conveyor fires have been subjected to particular study because of the rapidity of fire propagation along the early rubber-based types of conveyor belting. Modern conveyor belting for underground use must be subjected to fire propagation tests (e.g. Verakis, 1991). Three types of materials are used for mine conveyor belts, namely, styrene-butadiene rubber (SBR), neoprene (NP) and polyvinyl chloride (PVC). Composites of these materials are also employed. Following ignition of the belt material and removal of the igniting source, the fire should preferably fail to propagate or, if it does, move at a slow rate. However, it should be noted that heated belt material may produce hazardous fumes.

Numerous tests have indicated that fire propagation rates along conveyor belting are influenced by airspeed (e.g. Hwang et al., 1991). At a relative velocity of 1.5 m/s (300ft/min) between the belt surface and the nearby airstream, a phenomenon known as *flash over* attains its maximum effect. This occurs when a flame front from the burning belt reaches forward over an unburned surface with an optimum angle and length such that the radiant effect on that surface reaches a maximum. This can cause flaming of the top layer of belting and a significant increase in flame propagation rate along the surface of the belt. Deeper layers in the weave of the material may or may not be ignited. The effect appears to be most pronounced in SBR belting (Verakis and Dalzell, 1988). Flashover involves a serious hazard as belt surface propagation rates may reach some 10 m/min. The spread of fire along mine conveyors is influenced strongly by the turbulence of the airflow. Hence, laboratory tests of small samples of belting can give misleading results. Large scale gallery tests are more reliable.

Conveyor fires are most likely to be initiated by friction. If the belt becomes staked at any point along its length and the drive rollers continue to turn, then high temperatures will be generated at the drive head. Temperature monitors or belt tension transducers can sense this condition. Such devices should be wired to isolate electrical power from the conveyor drive when an alarm condition is detected. Similarly, a seized idler or return roller can become red-hot from the friction of a belt moving over or around it. Conveyors should be patrolled during operation in order to detect the development of faulty rollers. Worn bearings will often be noisy and may also be detected by the smell of heated surfaces. A further frictional hazard can occur if the conveyor becomes misaligned to the extent that the belt rubs against surrounding surfaces such as the conveyor structure or airway sides.

In all of these cases, a fire may be initiated when lubricants, coal dust or flammable debris reach their ignition points. It follows that dust or spillage should not be allowed to accumulate around and, particularly, underneath conveyors. A clean conveyor road is more likely to be a safe one.

Other Frictional Ignitions

The main cause of methane ignitions on the working faces of coal mines is frictional sparking at the pick points of coal winning machinery. This occurs particularly when the machine cuts through sandstone or pyritic material. Two approaches have been taken to reduce this hazard. One is to ensure that there is sufficient ventilation around the cutting drum to provide rapid dilution of the methane as soon as it is emitted. A number of devices have been employed to enhance air movement across the pick points of shearers and continuous miners (e.g. Browning, 1988). Unfortunately, these may exacerbate the dust problem unless combined with a wet scrubber.

The second approach to the incendive streak of sparks that sometimes trails behind a cutter pick is to quench it with water. This technique combines the suppression of both dust and methane ignitions. It is achieved by pick face flushing and, even more efficiently, by jet assisted cutting.

Rope haulage systems have been the cause of some mine fires. Care should be taken that all pulleys and return wheels are routinely serviced and lubricated. Ropes should not be allowed to rub against solid surfaces such as the roof, sides or floor of airways and, particularly, timber supports. If haulage ropes must pass through holes in stoppings then, again, the ropes should not contact the sides of the orifices. Fluid couplings and enclosed gearings or direct drives are preferred to mechanical clutches, belts or V-drives for the transmissions of mining machinery. However, where the latter are employed then, again, regular inspections and maintenance are required to ensure their continued safe operation. Similarly, mechanical braking systems should be well looked after.

Explosives

The initiation of fires from explosives or igniter cord remains a danger in non-gassy mines. Incandescent particles from blasting operations may contain sufficient heat energy to ignite dry wood or combustible waste material. Igniter cord should never be hung on timber supports. A strict record should be maintained on all explosives and detonating devices at the times of issue and return to the stores. The relevant national or state legislation should be consulted for the conditions under which explosives may be stored or transported underground.

Welding

All welding operations that are permitted underground should be carried out under well-controlled conditions. Where there is any possibility of methane or other flammable gases being present then testing for those gases should be carried out before and, at intervals, during the welding operations. Hot slag and sparks from welding are easily capable of igniting combustible materials such as coal, wood, paper and waste rags. Wherever possible, such materials should be removed from the vicinity of welding operations and the remainder wetted down or coated by stonedust. Molten metal should not be allowed to drop on the floor. Slag pans should be used to capture hot run-off. This is particularly important in coal mines, in shafts and near timber supports. Fire extinguishers must be available at the sites of all welding operations.

Gas containers employed in oxy-acetylene cutting should be stored and used in a secure upright position. Gas bottles must never be stored or used in the vicinity of explosives or concentrations of flammable liquids.

Smoking and Flame Safety Lamps

It is a sad fact that the use of smoking materials has been suspected as the cause of some fires and explosions in mines. In those mines that have been classified as gassy, carrying such materials into the subsurface is illegal. This law should be enforced with the utmost rigor. Furthermore, through well chosen examples during training and refresher classes a workforce will, themselves, ensure compliance with non-smoking regulations.

In mines where smoking is permitted then, again, education, posters and warning signs should be employed as ongoing reminders of the possible disastrous consequences of careless disposal of smoking materials.

Damaged flame safety lamps have also been suspected of igniting a methane:air mixture. Where these devices remain in use, they should be treated with care and subjected to inspection after each shift. When a high concentration of methane is detected by a blue flame spiraling rapidly within a flame safety lamp then the lamp should be lowered gently and, if necessary, smothered inside one's clothing. Familiarity with the procedure should be gained through training and will counter the natural reaction of the untrained person to drop the lamp or to throw it away in panic.

BEHAVIOR OF OPEN FIRES

Fires that occur in mine airways usually commence from a single point of ignition. The initial fire is often quite small and, indeed, most fires are extinguished rapidly by prompt local action. Speed is of the essence. An energetic ignition that remains undetected, even for only a few minutes, can develop into a conflagration that becomes difficult or impossible to deal with. Sealing off the district or mine may then become inevitable.

The rate at which an open fire develops depends, initially, upon the heat produced from the igniting source. A fine spray of burning oil from a damaged air compressor can be like a flame thrower and ignite nearby combustibles within seconds. On the other hand, an earth leakage from a faulty cable may cause several hours of smoldering before flames appear. The further propagation of the fire depends upon the availability of fuel and oxygen. A machine fire in an untimbered metal mine airway will remain localized if there is little else to burn in the vicinity. Conversely, an airway that is heavily timbered or with coal surfaces in the roof, floor or sides will provide a ready path for speedy development and propagation of a fire.

When an open fire has developed to the extent of causing a measurable change in the temperature of the airflow then it can affect the magnitudes and distributions of flow within the mine ventilation system. Conversely, the availability of oxygen to the fire site controls the development of the fire. This section discusses the coupled interaction between fire propagation and ventilation.

Oxygen-rich and Fuel-rich Fires

At the start of most open fires in ventilated areas, there is a plentiful supply of oxygen - more than sufficient to maintain combustion of the burning material. Indeed, if the air velocity is too high the fire is "blown out." These are examples of *oxygen-rich* fires. Assuming that the fire continues to proliferate, it will consume increasing amounts of oxygen and, at the same time, produce greater volumes of distilled gases and vapors. The point may be reached when the heat of combustion produces temperatures that are high enough to distill and ignite gases and vapors from the coal, timber or other available fuels but with insufficient oxygen to burn those gases and vapors completely. The fire has then become fuel-rich.The development of an oxygen-rich into a fuel-rich fire is a serious progression and produces a much more dangerous situation for firefighters. When flammable gases at temperatures exceeding their ignition point meet relatively fresh air then they will ignite along the gas:air interfaces. The added turbulence may produce intimate mixing of air and unburned gases resulting in explosions. These phenomena can occur downstream from an open fire if air leaks into the fire path from adjacent airways. Firefighters are then faced with a difficult decision. Leakage of air from adjacent airways must be *into* the fire path in order to prevent spread of the fire into those adjacent airways, yet the admittance of that air may cause explosions and propagation of the fire at a rate much greater than that allowed by burning of the solid material itself.

A similar effect occurs when buoyancy of the hot gases causes roll-back of smoke at roof level against the ventilating current. This can occur over the heads of workers who are fighting the fire from an upstream position. Again, burning of the gases along the air interface can occur, igniting coal or timber in the roof and producing the danger of explosion. Personnel involved in fighting a fuel-rich fire may become aware of pressure pulses or rapid fluctuations in the movement of the air. These are caused by rolling flames and "soft" explosions as gases ignite along gas:air mixing zones. Such pulsations may be a precursor to a larger and more violent explosion.

It follows that every attempt should be made to prevent an oxygen-rich fire from developing into a fuel-rich fire. This underlines the need for early detection and prompt action. An intuitive reaction to a fire may be to restrict the air supply and, hence, reduce the oxygen content of the air. This can be accomplished by building stoppings or erecting brattice cloths upstream from an airway fire. However, consideration of the dangers inherent in fuel-rich fires indicates that restricting the airflow may be inadvisable. Analyses of gases downstream from fires can be interpreted to indicate whether a fire is oxygen-rich or fuel-rich.

Effects of Fires on Ventilation

An open fire causes a sharp increase in the temperature of the air. The resulting expansion of the air produces two distinct effects. First the expansion attempts to take place in *both* directions along the airway. The tendency to expand *against* the prevailing direction produces a reduction in the airflow. This is known as the *choke* or *throttle* effect.

If it assumed that the ventilating energy expended against frictional resistance in a mine entry remains constant, then it can be shown (McPherson, 1993) that the mass flow of the air, M, falls as the air is heated and its density, ρ, is reduced.

$$M \propto \rho^{2/3}$$

where $\propto$ means "proportional to."

This phenomenon produces the choke effect. It should be noted, however, that the *volume* flow, Q, exiting the airway has *increased.* As $M = \rho Q$, the proportionality can be written as

$$Q \propto \frac{1}{\rho^{1/3}}$$

A second effect of the decreased density is that the air becomes more *buoyant,* causing local effects as well as changes in the magnitudes of natural ventilating energy.

The most immediate effect of heat on the ventilating air stream is a very local one. The reduced density causes the mixture of hot air and products of combustion to rise and flow preferentially along the roof of the airway. Smoke and hot gases form a layer along the roof and, in a level or descentional airway, will back up against the direction of airflow.

This phenomenon of roll-back creates considerable difficulties for firefighters upstream from the fire, particularly if the conflagration has become fuel-rich. The roll-back is visually obvious because of the smoke. However, it is likely to contain hidden but high concentrations of carbon monoxide. Furthermore, the temperatures of the roll-back may initiate roof fires of any combustible material above the heads of firefighters. The most critical danger is that tidal flames or a local explosion may occur throughout the roll-back, engulfing firefighters in burning gases.

One method of reducing roll-back is to increase the airflow in the airway. This, however, will increase the rate of propagation of the fire. Another method is to advance with brattice cloths covering the lower 60 to 80 per cent of the airway. The increased air velocity at roof level will help to control the roll-back and allow firefighters to approach closer to the fire. However, this technique may also cause the roll- back gases to mix with the air and produce an explosive mixture on the forward side of the brattice. Furthermore, the added resistance of the brattice might reduce the total airflow to the extent that a fuel-rich situation is promoted. The behavior of open fires is very sensitive to modifications to the airflow. Hence, any such changes should be made *slowly*, in small increments, and the effects observed carefully.

A third method of combating roll-back is to direct mist sprays towards the roof. In addition to wetting roof material, the air induction effects of the sprays will assist in promoting airflow in the correct direction at roof level.

A more widespread effect of reductions in air density is the influence they exert in shafts or inclined airways. The effect is most pronounced when the fire itself is in the shaft or inclined airway, promoting airflow if the ventilation is ascentional and opposing the flow in descentional airways. Indeed, in the latter case, the flow may be reversed and can result in uncontrolled recirculation of toxic atmospheres.

METHODS OF FIGHTING OPEN FIRES

The majority of open fires can be extinguished quickly if prompt action is taken. This underlines the importance of fire detection systems, training, a well-designed firefighting system and the ready availability of fully operational firefighting equipment. Fire extinguishers of an appropriate type should be available on vehicles and on the upstream side of all zones of increased fire hazard. These include storage areas and fixed locations of equipment such as electrical or compressor stations and conveyor drives.

Neither water nor foam should be used where electricity is involved until it is certain that the power has been switched off. Fire extinguishers that employ carbon dioxide or dry powders are suitable for electrical fires or those involving flammable liquids.

Deluge and sprinkler systems can be very effective in areas of fixed equipment, stores and over conveyors. These should be activated by thermal sensors rather than smoke or gas detectors in order to ensure that they are operated only when open combustion occurs in the near vicinity.

Firefighting with Water

Except where electricity or flammable liquids are involved, water is the most common medium of firefighting. When applied to a burning surface, water helps to remove two sides of the fire triangle. The latent heat of the water as it vaporizes and the subsequent thermal capacity of the water vapor assist in removing heat from the burning material. Furthermore, the displacement of air by water vapor and the liquid coating on cooler surfaces help to isolate oxygen from the fire.

Water is normally applied by hoses from a position upstream from the fire. A difficulty is the limited reach of water jets imposed by the height of the airway. This underlines the vital need for water to be available at adequate pressure and quantity in the firefighting range. In order for a water jet to reach some 30m (100ft) in a typical coal mine entry, water pressures should be in the range 800 to 1400 kPa (120 to 200psi) (Mitchell, 1990) and capable of supplying up to five hoses from a manifold connected to a single hydrant. In practice, the range of water jets in mine airways may often be no greater than 10m (30 to 35ft) . The nozzles should preferentially be of the adjustable type to give either a jet or a fog spray.

Hard won lessons indicate the need for careful forethought in designing a mine firefighting water network. The air and the water should flow in the *same* direction so that firefighters do not become dependent on a water supply that passes through the fire before it reaches them. Hydrants should be located at strategic points with respect to areas of increased fire hazard, at intervals along airways and at cross-cuts with access doors. All fittings for hydrants and range components should be standardized throughout any given mine. Hydrant outlets should be protected against damage and corrosion by non-metallic caps. However, these must always be removable by hand and without undue force. Supplies at firefighting stations should be inspected at set intervals to ensure their operational efficiency at all times. Range fittings should include tee-pieces, blank-off caps and manifolds. It is particularly important that hoses be unrolled and examined for deterioration on a planned maintenance schedule and that they be stored according to manufacturers' recommendations.

If access can be gained to an airway that runs parallel to a fire then fog sprays can be directed through doors or holed stoppings into the path of the fire. This can be effective if the sprays are employed at an early stage and immediately downstream from the fire front. However, for a large conflagration or where the fire has become fuel-rich, it is likely to lose its effectiveness.

The locations of pumps and configuration of their power supplies should be considered carefully with respect to the layout of the mine. The pumps and routes of their cables should be chosen such that they are least likely to be disrupted by a fire. Dual power supplies via alternative routes may be considered. Furthermore, power for firefighting pumps should be capable of being maintained when electricity to working sections of the mine has to be isolated. Underground sumps can provide valuable water capacity. However, the firefighting system should also allow water to be supplied in adequate quantities from surface locations.

High Expansion Foam

Large volumes of water-based foam provide a valuable tool for fighting fires in enclosed spaces such as the basements of buildings or in the holds of ships. It has been employed for mine fires since at least 1956 (Eisner). The method is employed on large fires and, although it has had somewhat limited success in extinguishing mine fires, it can play a valuable role in cooling and quenching an area to an extent that allows firefighters with hoses to approach closer to the firefront. Even when sealing an area has become inevitable, valuable time for rescue operations can be bought by employing high expansion foam.

The bubbles are generated by a fan which blows air through a fabric net stretched across a diffuser. The net is sprayed continuously with a mixture of water and foaming agent. Bubbles can be produced at a rate of several cubic metres per second (Strang and MacKenzie-Wood, 1985). Compounds such as ammonium lauryl sulfate may be employed as the foaming agent while the addition of carboxymethylcellulose improves the stability of the bubbles (Grieg et al., 1975).

The objective is to form a plug of high expansion foam which fills the airway and is advanced on to the fire by the ventilating pressure. The ratio of air to water within the foam may be in the range 100:1 to 1000:1. As the foam advances, bubbles break around the perimeter of the airway when they touch a dry surface. However, the liquid that is released wets that surface and allows advancement of the following bubbles. Shrinkage of the foam occurs continuously at the leading edges and accelerates because of radiant effects as it approaches the burning material.

High expansion foam does have some drawbacks. First, it may be quite difficult to generate a foam plug that fills the airway completely. As the plug builds up, the air velocity will increase through the narrowing channel between the plug and the roof, tending to maintain the gap open. Judicious employment of brattice cloths may assist in forming a complete plug of foam. It is important to control the path of the foam and, in multi-entry systems, this can be quite difficult. The natural direction of movement of the foam is dictated by the ventilating pressure. Here again, brattices or stoppings in cross-cuts can assist in controlling the direction of the foam. Major obstructions caused by roof falls are quite liable to occur during a large underground fire. A foam plug may not be able to climb over such obstructions with the ventilating pressure available.

However, the greatest danger of foam plugs is that the reduction in airflow may promote a fuel-rich fire with the attendant danger of explosion. Downstream gases should be monitored for the development of this condition. Both increases and decreases in combustible gases have been reported in differing fires when high expansion foam has been employed. The reduction in airflow will tend to raise the concentration of combustible gases. However, as the heated mixture of air and water vapor progresses downstream, condensation of the water occurs, allowing the air fraction to increase and, hence, modifying the combustible gas concentrations.

After the application of high expansion foam has been initiated, it is important to maintain it in operation during fire fighting as intermittent production of foam can exacerbate the development of an explosive atmosphere. This underlines the need for good training so that operators are familiar with the equipment and procedure. Furthermore, care should be taken that sufficient supplies of foaming agent are available before the operation is started (Timko et al., 1988).

Control by Ventilation

When contemplating changes to airflows and applied pressure differentials during a fire emergency, there are four types of effect that must be considered most carefully.

(a) *The effect on the combustion process*: The importance of avoiding the progression of an oxygen-rich fire into a fuel-rich fire has already been stressed.

(b) *The effect on direction and rate of propagation of the fire*: Every attempt should normally be made to prevent an open fire from spreading into other airways. However, exceptions from this general rule may become necessary to guide products of combustion away from trapped personnel. An example may be the deliberate destruction of a stopping or air crossing to divert or short-circuit a fire path from an intake airway into an adjacent return. Again, any modifications of the airflow passing through the fire zone must seek to achieve a balance between speed of propagation and control of the combustion process.

(c) *Effects on the distributions of products of combustion*: This becomes a critical issue when personnel have become trapped inbye the fire, particularly if their exact whereabouts are unknown. However, any steps that will improve atmospheric conditions in escapeways must be investigated.

(d) *Effects on airflow distributions in other parts of the mine*: While the consequences of ventilation changes in the zone affected by the fire are of immediate concern, the effects of such changes throughout the rest of the mine should not be overlooked, particularly in a gassy mine or when personnel may still be evacuating other areas.

If a computer model of the mine has been maintained up to date then this will prove invaluable in investigating the predicted effects of proposed changes to the ventilation system. With a modern network analysis package, a personal computer or terminal in the emergency control center can produce such predictions within seconds. Nevertheless, the uncertainties inherent in a fire situation demand that actual changes to the airflow system be made incrementally while observing the reactions on distributions and gas concentrations.

Pressure Control

Airways that are parallel and adjacent to the fire path will remain unpolluted provided that they are maintained at a higher atmospheric pressure. These will allow access for escape, the building or strengthening of stoppings in cross-cuts, or to apply water sprays into the fire path. In multi-entry workings, control of such pressure differentials can be achieved by the erection of brattice cloths in the adjacent airway. Even if the pressure differential in the desired direction is not completely achieved, the reduced rate of toxic leakage may allow time for personnel to escape. If necessary, the brattice cloths may be advanced pillar by pillar to remove smoke sequentially from the adjacent airway. Devices such as the "parachute stopping" or "inflatable seal" have been developed to replace brattice cloths in such circumstances. These can be erected quickly and give improved seals around the perimeter of the airway (Kissell and Timko, 1991).

A consequence of this technique is that the airflow over the fire will be increased to an extent that depends upon the configuration and resistances of the local airways. Pressure differentials between airways can also be modified by the use of a temporary fan instead of a restriction in the adjacent airway. In this case, airflow over the fire will be reduced. The location and pressure developed by the fan must be selected with care in order to avoid recirculation of products of combustion. Where pressure differentials are small, even the small pressure developed by a free-standing auxiliary fan can induce the desired effect.

Inert Gases

The injection of inert gases to assist in the control of subsurface fires has been undertaken since at least the 1950s (Herbert, 1988). However, from 1974, significant developments in the deployment of nitrogen took place in Germany. The technique has become commonplace in some overseas coal mining areas where spontaneous combustion occurs frequently (Both, 1981). The overall purpose of injecting an inert gas is to reduce the oxygen content in order to prevent or inhibit combustion.

Three types of gases have been used in the procedure for which the term *inertization* has been coined; carbon dioxide, products of combustion and nitrogen.

<u>Carbon dioxide</u> has a density of 1.52 relative to air. This makes it particularly useful for the

treatment of fires in low-lying areas such as dip workings or inclined drifts (Froger, 1985). However, piping the liquid carbon dioxide can give rise to freezing problems as well as difficulties in handling the pipes. The use of carbon dioxide as an inerting gas has several other disadvantages. It is quite soluble in water and can suffer some loss in wet conditions. More significant perhaps, is the fact that it adsorbs readily on to coal and coked surfaces. When exposed to incandescent carboniferous surfaces it may be reduced to the highly toxic carbon monoxide. Furthermore, it is considerably more expensive than nitrogen.

Combustion gases. Following the sealing of a fire zone, the consumption of oxygen and the gases produced by the combustion processes will produce an extinguishing atmosphere. However, it may be rich in flammable gases and become explosive if air is subsequently re-admitted. The products of *full* combustion, primarily mixtures of carbon dioxide, nitrogen and water vapor, have been employed as an injected inert gas. Where the law allows it underground, or where it can be employed on the surface for an adit mine, the large output of inert exhaust gases makes the use of a jet engine attractive (Strang and MacKenzie-Wood, 1985). However, it nullifies the employment of gas analysis as a means of following the progression of the fire, the capital cost is high and a highly specialized team is required to operate and maintain it.

Nitrogen. Liquid nitrogen is the basis for the majority of inertization schemes now employed for subsurface fires. The liquid gas is supplied in tankers of, typically, 20 t capacity giving about 16500 cubic meters (600,000 cubic feet) of gas. For continuous operation throughout a period of gas injection, the tankers may unload into a bulk storage vessel of up to 40 t capacity and which has been brought to the mine surface. Due to the low boiling temperature of nitrogen, the liquid must be evaporated before piping it into the mine. Typically, two water circuits are employed: a primary circuit using atmospheric heat and secondary heaters powered by electricity or liquid/gas fuels. The maximum gas feed rate into the mine depends upon the duty of the evaporator, but may typically be within the range 1 to 6 m^3/s (2,000 to 13,000 cfm).

Gas inertization also has considerable drawbacks, the most significant of which is the time required to organize and implement injection of the inert gas. This can take many hours or even days, whereas speed is of the very essence if control is to be achieved over a fire in a mine entry. Another difficulty is the effect of injected gases on the atmosphere downstream from the fire. Analyses of the combustion gases are a primary source of information in assessing changes in the type of fire and are invaluable in deciding when it is no longer safe to continue with firefighting efforts. Gas injection may make difficult the interpretation of those gas samples.

The Potential of Water Vapor as an Inerting Gas

The major disadvantage of applying water in the conventional way with hoses is that only the upstream fringes of the fire can be attacked. The primary drawback of current methods of gas inertization is the time taken to obtain and install the equipment. A project now underway at Virginia Polytechnic Institute and State University is seeking to eliminate both of these difficulties.

The idea is to produce a partially inerting atmosphere by means of a dense fog of water particles generated upstream from the fire (water inertization). Droplets of size less than some 50 microns will be similar to those that occur in a natural fog and will tend to remain airborne, even in a low velocity air current. Spinning disk humidifiers of the type used in air conditioning systems in large buildings are capable of producing such a fog without requiring a high pressure water supply.

On reaching the fire, evaporation of the fog particles would accelerate rapidly. The three sides of the "fire triangle" required for combustion, i.e., oxygen, heat and available fuel would all be diminished. A fire tunnel is currently under construction in order to investigate this technique and, in particular, the effect of the fog on products of combustion.

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STATUS OF REGULATIONS AND USE OF DIESELS IN UNDERGROUND COAL MINES

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Mine Safety and Health Administration

ABSTRACT

Diesel-powered equipment's role in underground coal mining is growing to meet the need of changing mining conditions. The trend of increasing productivity in longwall mining is due in part to the expanded use of diesel equipment for longwall support. Diesel equipment's mobility and its ability to provide a high level of power output for extended periods of time fills a niche that electric-powered equipment can not.

Along with the growth in the use of diesel equipment, however, has been a growth in concerns over the safety and health issues associated with its use. Although the high power output of diesel engines can increase productivity, the related fire, explosion, and exhaust emissions hazards of these engines require that greater controls be incorporated into their design.

The control of these hazards has not been addressed by regulations as fast as the growth in the use of diesel equipment. This has resulted in a call for specific regulatory action to help insure the safe and healthful use of diesel-powered equipment.

STATUS OF REGULATIONS

In 1987, the Secretary of Labor, responding to concerns raised over the safety and health effects of diesel-powered equipment, established the Diesel Advisory Committee (DAC). The committee consisted of two representatives of industry, two representatives of labor, and five neutral members with no economic interests in the mining industry. The committee's mission was to advise the Secretary on safety and health standards for diesel-powered equipment in underground coal mines. This effort focused on three areas: approval of diesel equipment, safety of diesel equipment, and the health effect of diesel exhaust.

In 1988, the Diesel Advisory Committee provided the Secretary with its report (1). The DAC recommended that MSHA promulgate regulations for the safe and healthful use of diesel-powered equipment. The committee made specific recommendations covering the approval and use of diesel-powered equipment and the control of diesel exhaust emissions. Although the final recommendation on each specific issue studied by the committee was not agreed to unanimously, the final report was agreed to by all committee members. This was a significant accomplishment considering the different backgrounds of the members.

Proposed Rule and Public Comments

MSHA acted on the committee's recommendations and, in 1989, issued proposed regulations (2) to be included in Code of Federal Regulations, Title 30 (30 CFR) for public comment. These regulations closely followed the committee's recommendations. Formal comments recommending changes to the proposed regulations were subsequently received by MSHA.

Nearly all sections of the rule received some comment, but the three areas which raised the most concern were the ventilation related requirements, the approval requirements, and the maintenance requirements.

Ventilation Requirements (3). Providing adequate ventilation to areas where diesel-powered equipment is used is the principle means for limiting the exposure of miners to harmful gaseous emissions and high levels of diesel exhaust particulate (DEP). The proposed Part 75 regulations use the ventilating air requirement established during MSHA's proposed Part 7 engine approval process to determine the quantity of air needed in each split where diesel-powered equipment is operated. The proposed Part 70 Diesel-Powered Equipment Exposure Monitoring requirements describe the sampling strategy needed to confirm that the quantity of ventilating air is adequate to reduce the level of gaseous emissions for the particular mining operation.

During the proposed Part 7 engine approval process, a diesel particulate index would also be computed. This particulate index would establish the ventilating air quantity required to dilute DEP generated over an MSHA test cycle to an average level of 1 milligram per cubic meter. The diesel particulate index should in no way be confused with a permissible exposure limit (PEL). It is stressed that MSHA has not established a PEL for DEP. MSHA is presently working to determine how to best utilize the particulate index in establishing ventilating air requirements at mines. Further, MSHA is continuing its assessment of both the potential risk associated with diesel particulate exposure and the available technology to control diesel particulate in mines.

In their report, the Diesel Advisory Committee, although acknowledging the scarcity of data, considered that diesel exhaust emissions probably did present a cancer risk to humans.

Since their report was issued, the National Institute for Occupational Safety and Health (NIOSH) has completed an MSHA requested risk assessment of human lung cancer from diesel exhaust particulate. NIOSH estimated a risk of lung cancer of one in one thousand at an exposure of 0.045 milligrams per cubic meter of air using data from animal studies and the Armitage-Doll multistage model.

NIOSH noted that its risk estimate was based on a series of assumptions and it involved a considerable amount of uncertainty. The Armitage-Doll model is a conservative model and only one of several risk assessment models. Other risk assessment models give higher allowable PELs. MSHA, after reviewing the available information for establishment of a PEL, issued an advance notice of proposed rule making (ANPRM) to obtain any additionally available data. In response to the ANPRM, MSHA has received public comments on the development of a DEP PEL.

Separate from examining the need and an appropriate limit for DEP exposure, controlling the DEP released into the mine atmosphere must be accomplished. The most efficient and productive way to reduce exposure to DEP will be effected at the engine. The use of low sulphur diesel fuel (0.05% sulphur) provides an immediate and significant reduction in the production of particulate (4). Other means such as ceramic, wire mesh, or pleated paper filters installed on the exhaust pipe also significantly reduce the liberation of DEP into the atmosphere. For example, three diesel haul trucks and other diesel support equipment used at one mine were found to release 1.91 grams of particulate per minute. The use of pleated paper filters reduced the particulate discharge to 0.10 grams per minute. This can be related to a ventilation rate required to achieve a desired DEP level. It would take 1,500,000 CFM of return air flow to dilute the DEP to a level of 0.045 milligrams per cubic meter in this mine if the mine relied solely on ventilation to reduce the DEP. In comparison, the use of filters would reduce the required air flow to 78,000 CFM.

MSHA recognizes that the establishment of a DEP PEL is meaningless without an accurate and precise instrument to measure the mine diesel particulate level. MSHA, BOM, NIOSH, and the University of Minnesota have all developed sampling devices to measure DEP in mines. These sampling devices are similar; all basically relying on a cyclone and an impactor to remove most of the larger non-diesel aerosol. The impactor produces a final particle cut size of 0.8 micrometers. The particles which make it past the impactor are then collected on a filter element.

MSHA, BOM, and the University of Minnesota use a gravimetric analysis technique to determine the diesel exposure concentration. NIOSH uses a different method to determine the diesel exposure concentration. NIOSH's protocol uses a thermal and chemical process to separate out and quantify the elemental carbon collected on the filter. The quantity of elemental carbon in the sample is then used to calculate the exposure concentration. The elemental carbon is singled out because it can be traced directly to the combustion process of the diesel engine.

In summary, diesel particulate samplers for use in mines have been developed and their use has been evaluated. There are some points to note, however. First, the samplers are not yet commercially available at a reasonable cost. In addition, if the sample is analyzed for elemental carbon, the cost of analysis may be relatively high. Further, the precision of a determination obtained with the current sampling system can limit their applicability. Repeatable results may be difficult to achieve if the DEP concentration is low, particularly if it is below 0.5 milligrams per cubic meter; and, except for the NIOSH protocol, if there is a significant amount of non-diesel aerosol less than 0.8 um present in the environment. Work, however, is continuing on improving the methodology to assess DEP in coal mining.

Approval Requirements. The second area of the proposed diesel regulations which elicited strong comments was the approval related requirements. The Diesel Advisory Committee had recommended that MSHA establish an approval program to address machine features that could best be controlled by the machine manufacturer. These approval requirements would cover inby or permissible equipment and outby equipment with the exception of a new category of "Limited Class" equipment. This last category of equipment, proposed by the Diesel Advisory Committee, would not involve formal MSHA approval.

An ANPRM was issued, concurrent with the proposed rule, requesting public comment on the approach and scope of an approval program. The Limited Class category of equipment, which would not need approval, was defined in the proposed rule and specific requirements for this equipment were presented. MSHA has reviewed the public comments received on the definition of Limited Class equipment and the proposed requirements for this equipment.

Maintenance Requirements. The third area which received many comments was the section of the proposed rule related to maintenance of diesel-powered equipment. Although there was disagreement on some of the specific aspects of the requirements, the majority of commenters supported the rule's emphasis on maintenance.

Engine manufacturers have also moved to improve the maintainability of their engines by adopting ISO 9000 quality control standards. These standards can not only improve the quality and reliability of diesel engines, but also their maintainability. Further, some engine manufacturers are pursuing the use of electronic engine controls, developed for over-the-road vehicles, which may be applicable in underground mining. These controls may reduce the difficulty and frequency of required engine maintenance.

Another advancement in the maintenance of diesel equipment in mines has been the development of a Portable Tailpipe Emissions Measurement Apparatus (5) by Michigan Technological University. Although not yet commercially available, this device has been reported to accurately and precisely detect changes in engine emissions. With this type of device, maintenance personnel can keep engines operating at peak efficiency and within exhaust emissions limits. MSHA is currently reviewing the report.

USE OF DIESELS

When finalized, the proposed regulations will help assure the safe and healthful use of diesel equipment. This assurance should increase the acceptance of diesel equipment underground and promote its greater use. Diesel equipment use has already been promoted by the demands for powerful, highly mobile longwall support equipment.

A significant amount of diesel equipment is currently used in longwall mining. Approximately 44% of the 2227 units of all types of diesel equipment tracked at 156 mines by MSHA's Diesel Inventory is concentrated at 32 longwall mining operations. This breaks down to an average of 31 units at each longwall mine compared to an average of only ten units at each of the other 124 conventional mines. Although the average is 31 machines per longwall mine, the number of machines at these mines ranges from a low of 2 to a high of 117. The three to one ratio in the use of diesel equipment in longwall mining compared to conventional mining reflects its role in the increasing productivity of longwall operations.

Growth in the Use of Diesel Equipment

MSHA field reports indicate that from 1988 through 1992, over 648 units of all types of new diesel equipment have been introduced into underground coal mines. The total number of new units placed in use each year averages 130. The most recent data on their growth rate indicates that the number of diesel units in underground coal mines has grown on average by approximately 9% per year.

Diesel Equipment Types

The six types of machines that account for the majority of equipment reported in use are tractors, locomotives, load-haul dumps (LHDs), utility trucks, haul trucks, and finally, personnel carriers. The cumulative totals of these types of machines over the period of 1988 through 1992, show that of the 648 units, tractors account for 2% of the total; locomotives for 6%; haul trucks for 7%; LHDs for 10%; utility trucks for 24%; and personnel carriers for 42%. All other types of equipment such as air compressors, ambulances, crane trucks, forklifts, generators, graders, longwall component retrievers, lube units, and welders account for the remaining 9%.

As can be seen, the two fastest growing types of equipment have been personnel carriers and utility trucks. An average of 54 personnel carriers and 31 utility trucks have been placed in use per year.

Limited Class Equipment. The new category of Limited Class equipment in the proposed rule covers outby or nonpermissible, light duty equipment. This equipment is generally commercial equipment, designed for use outside of the mining industry. An example would be a common half-ton pickup truck.

Limited class equipment is almost exclusively used as personnel carriers and utility trucks. These vehicles are relatively inexpensive, can be readily adapted to mine use, and have a short life span. The number of machines currently being used which could meet the proposed rule's definition of Limited Class has been growing faster than other categories of equipment. Machines which could be classified as Limited Class equipment have been introduced at an average rate of 49 per year. This accounts for approximately 38% of the total of the 130 new machines introduced each year. In comparison, other, larger outby personnel carriers and utility trucks, designed specifically for mine use, have been introduced at an average rate of only 36 machines (28% of the 130 new machines) per year.

Permissible Equipment. Another major category is the inby or permissible, explosion-proof machines. These machines are approved under Part 36 of 30 CFR. Most of the permissible machines placed in use have been either haul trucks or LHDs. These two types of permissible machines have been introduced at an average annual rate of 22 machines each year. This accounts for approximately 17% of the total of the 130 new machines introduced each year.

The safety features required on permissible machines result in both a high initial cost and a high maintenance cost. They also require additional attention by MSHA enforcement personnel. Although permissible machines constitute only a small percentage of the new machines introduced into mines each year, their additional safety features require mine operators to pay much more attention to these machines than similar nonpermissible machines.

Current Safety and Health Problems

In an attempt to analyze recurring problems with the use of diesel equipment, a sample of MSHA citations issued in MSHA's Coal Mine Safety and Health (CMS&H) District 9 was reviewed. These citations were issued to mines for using diesel equipment not in compliance with existing safety and health requirements. District 9 was chosen because it contains the largest number of diesel-powered equipment of any CMS&H district. A total of 490 citations issued over the period of January 1989 through March 1992 were reviewed.

A breakdown of the citations revealed that the single largest group, approximately 28%, had been issued under Section 75.400 of 30 CFR, Accumulations. This section requires that "...loose coal, and other combustible materials, shall be cleaned up and not be permitted to accumulate in active workings, or on electrical equipment therein." The cleanliness of diesel equipment, in regards to accumulations, particularly fuel spillage is a major, justified concern. Consequently, a considerable portion of the proposed rule deals with fuel handling to prevent spillage.

In addition to addressing the fire hazard presented by accumulations, the proposed rule also addresses heat sources. The emphasis in the proposed regulations on the control of the engine's surface temperature to prevent fires is supported by the fact that almost one third of citations were issued for accumulations of combustible material.

The next largest number of citations were issued under subsections of 75.1722 "Mechanical Guards" and 75.1725 "Machinery and Equipment; operation and maintenance."

Combined, these sections which cover mechanical features of the machines, accounted for approximately 22% of the citations issued. A majority of these citations were concerned with the lack of guards on radiator fans, inadequate or improperly adjusted brakes, and inoperative safety systems on permissible diesel equipment.

The remaining citations were written under Sections of 75.300, 75.1403, 75.500 and 75.1100. Approximately 18% of the citations were written under subsections of 75.300 dealing with ventilation. Most of these citations required correction of inoperative safety systems on permissible equipment and engine emission problems. Approximately 12% of the citations were written under subsections of 75.1403, "Other Safeguards." Most of these citations dealt with chocking of wheels and inoperative electrical systems. Approximately 11% of the citations were issued under subsections of 75.500 "Permissible Electrical Equipment" for defects in the electrical components installed on diesel equipment. And finally, approximately 10% of the citations were written under subsections of 75.1100 "Fire Protection" for inoperative fire extinguishers.

The number of problems found by CMS&H and the various regulations cited, confirms the need for clearer, more specific requirements. The proposed requirements will assist mines in maintaining diesel equipment in proper operation.

Diesel Fire Accidents

The accumulation of combustible material, the inoperative safety systems on permissible equipment, the electrical problems, and the presence of inoperative fire extinguishers accounted for the vast majority of problems cited on diesel machines. All of these conditions directly increase the potential fire and explosion hazard.

MSHA has studied occurrences, over the last eleven years, of fires on diesel-powered equipment used in both surface and underground coal mines. Reportable fires, fires lasting 30 minutes or more, occurring underground on diesel equipment have been too few to provide adequate information to determine their causes. Although the proposed diesel regulations cover only underground diesel mining equipment, fires on surface diesel mining equipment are more numerous and provide a means to understand the potential causes for fires on similar underground equipment.

Reports of 121 fires over the eleven year period covering 1982 through 1992 were reviewed. These 121 fires include the reportable fires and also shorter duration fires, that were voluntarily reported by mine operators. An approximate breakdown of the fires by machine type indicates that 32% of the fires occured on LHDs; 26% occurred on haul trucks; 15% occurred on 'dozers; 7% occurred on scrapers; 5% occurred on utility trucks; and various other equipment accounted for the remaining 15% of the fires.

General information on equipment populations indicate that LHDs account for a disproportionally larger number of the fires. Dozers and scrapers appear to have less than the number of fires that would be expected from their population.

Determining the cause of these fires is difficult since the cause was not determined, or otherwise reported, in 70% of the accidents. However, the source of fuel in approximately 50% of the fires was reported as a leaking hydraulic or fuel line.

It is noted that the ignition of leaking oil or fuel is much more likely on surface than underground equipment because of the higher duty factor, their higher horsepower, and the relatively greater amounts of hydraulic fluid and fuel on surface machines. The higher duty factor and horsepower provide for higher temperatures of the exhaust systems of surface equipment. These temperatures can be well above the auto-ignition temperature of diesel fuel and most hydraulic fluids which may leak onto the exhaust systems. The factors which increase the chance for fires on surface equipment must be prevented from introducing the same hazard on underground equipment.

SUMMARY OF STATUS OF REGULATIONS AND USE OF DIESEL EQUIPMENT

Promulgation of the proposed diesel regulations and the examination of the need and appropriate limit for a DEP PEL is progressing. Public comments must be addressed and the economic impact studies must be completed. MSHA will also renew its effort to determine the approach and scope of a diesel approval program.

Both the current use of diesel equipment and its growth are keyed to its support role in longwall mining. The gains in productivity made in longwall mining are related to the benefits provided by diesel-powered equipment.

The types of equipment required in mines are varied, but the major categores are tractors, locomotives, LHDs, utility trucks, and personnel carriers. Other subdivisions of diesel equipment include Limited Class equipment and Part 36 approved, permissible equipment. Equipment which could meet the proposed Limited Class requirements is the fastest growing category of equipment with Personnel Carriers the fastest growing type.

The vast majority of problems with diesel equipment cited by CMS&H are directly related to the fire and explosion hazards which diesel equipment can pose. An analysis of fires on diesel-powered equipment also supports the need for emphasis in the final regulations on controlling the fire hazard posed by these machines. The proposed regulations will clarify the requirements, making it easier for CMS&H and mine personnel to insure the safe and healthful use of the diesel equipment.

FUTURE OF REGULATIONS AND DIESEL EQUIPMENT

Looking into the future, diesel equipment will likely continue to play a major role in support of longwall mining. The number of diesel machines in use will likely continue growing, in the short term, at about 7% per year. In the long term, diesel equipment's growth will be dependent on general economic conditions and, more importantly, any change in longwall production and the continual need for diesel equipment for longwall support.

Technological advances in engine design and control, emissions control, and new uses for diesel equipment will also influence its role in underground coal mining.

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STATUS REPORT ON THE IMPLEMENTATION OF THE RESPIRABLE DUST TASK GROUP REPORT RECOMMENDATIONS

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INTRODUCTION

Last year at the 23rd Annual Institute on Mining Health, Safety and Research, my colleague, George Niewiadomski, presented a paper which focused on the findings and recommendations listed in MSHA's Coal Mine Respirable Dust Task Group Report and the impact the recommendations would have on the coal industry. As most of you are aware of, this report was the result of a comprehensive, year-long review of MSHA's respirable dust program. The report identified existing problems and potential vulnerabilities in the program and developed recommendations to effectively address these concerns. Today, I want to assure you that the Agency continues to fully endorse these recommendations and has either implemented or is in the process of implementing the programs necessary to accomplish the goals set forth in the recommendations. MSHA believes that the successful implementation of these recommendations will provide a reasonable assurance that all miners will be protected from respirable dust overexposures during their working careers in the coal mining industry.

My presentation today will be divided into three parts. Initially, I want to discuss with you those recommendations that have already been implemented. In no particular order of importance, they are: (1) more frequent one-day sampling and on-site monitoring; (2) the issuance of citations for dust standard violations based on the results of single MSHA sample measurements; and (3) the use of newly designed tamper-resistant cassettes. I will then briefly discuss the status of the rest of the recommendations which focus on monitoring of the work environment, control of worker exposure, education and training, and the role of the miner in the respirable dust program. I will close my presentation with an update on the status of the long-term research recommendations.

ONE-DAY SAMPLING AND ON-SITE MONITORING

Early into their program evaluation, the Task Group recognized the need to modify the existing Agency sampling strategy in order to provide a more accurate picture of the environment miners are exposed to on a daily basis. This new strategy differs significantly from past practices when MSHA conducted sampling on as many as five shifts. The problem with the extended sampling program was that it permitted mine operators the opportunity to change their plan parameters or control their production levels while sampling occurred. As a result, MSHA found that the plan parameters and production levels observed during the initial shift of multiple shift sampling offered the best estimate of the plan parameters and production levels in place during non-sampling periods. Thus part of the rationale for one-day health spot inspections is that it most accurately reflects normal dust exposure levels.

Obviously, the more effective use of inspection resources also influenced our decision to adopt this strategy. One-day spot inspections allow the inspector to more systematically plan inspection activities without having to factor in the possibility of return trips to the mine. But allow me to restate the most important factor. One-day spot inspections provide the best estimate of what operator plan parameters and production levels are during non-sampling periods.

MSHA will also be increasing the number of monitoring inspections conducted during operator bi-monthly sampling periods and abatement sampling. MSHA believes that this increased monitoring of operator sampling procedures will provide a more accurate picture of representative production cycles and that it will encourage compliance with approved dust sampling procedures and dust control plan parameters.

MSHA is currently in the process of rewriting Chapter One of the Health Inspection Procedures Handbook. This rewrite will provide the District Managers with criteria that can be used for targeting mines for increased health spot and monitoring inspections. This new program is partly an expansion of the existing Health Standards Compliance Program. For the most part, the new program will help to identify those operators who are having problems complying with the applicable dust standard, or have been involved in questionable practices and, therefore, need additional MSHA attention.

DUST VIOLATIONS BASED ON A SINGLE SAMPLE

As part of the one-day, respirable dust spot inspection program, the Agency now issues citations for dust standard violations based on the results of single MSHA sample measurements. The option of making a compliance determination based on either a single sample or the combined average of multiple samples has resulted in mine operators taking more immediate corrective action to reduce excessive dust levels. These corrective actions have increased the degree of health protection for the miners.

I know that most of you are aware of the recent decision rendered by an administrative law judge which challenged the legality of this policy. One must put this decision in proper perspective. First, it only prevents the issuance of single sample citations at mines operated by the company that brought the action to the court. Secondly, and more importantly, as the decision did not address the underlying scientific rationale which established the basis for issuing a citation based on a single sample, that rationale has not been invalidated. More specifically, the administrative law judge only questioned the administrative procedures MSHA used to implement the new policy. MSHA is currently appealing this decision before the Mine Safety and Health Review Commission and is also considering taking the necessary procedural steps to place in the Federal Register a notification of the scientific basis which supports the issuance of dust citations based on a single sample measurement. MSHA believes that it will prevail in this matter. Currently, citations are issued based on single sample results by both MSHA's Metal/Nonmetal inspectors and OSHA inspection personnel. NIOSH also accepts the scientific rationale for a single sample protocol.

TAMPER-RESISTANT CASSETTES

As part of an ongoing effort to prevent the willful alteration of respirable dust samples, MSHA encouraged the introduction of a newly designed more tamper-resistant cassette. The new cassette is becoming more widely used by mine operators as inventories of the old cassettes are being depleted. For the most part, the new cassette has proven to be a successful deterrent to some practices of tampering. However, because the new cassette is not tamper-proof, we have identified recent cases where a conscious effort has been made to alter the dust deposition on the filter. Some of you here today may have had the opportunity to observe one or more of these altered cassettes. To date, there have been 29 citations issued for such tampering. All but one involved an independent contractor who provides dust sampling services to operators. We have asked our assessment office to specially assess each individual citation and we plan to aggressively pursue all other civil and criminal sanctions at our disposal. It is unconscionable on the part of anyone to knowingly and willfully attempt to alter the weight of dust cassettes and possibly endanger the health of the coal miner.

The Agency will continue to open and examine every sample for any irregularities such as abnormal deposition, clean filters, and unrealistic weight gain based on production levels. In those instances where irregularities are identified, MSHA will take appropriate enforcement action. To further enhance the security of the sampling process, a tamper-resistant bag has been provided to be used with the new cassette and a warning notice has been placed on the dust data card. The notice alerts the certified person of the criminal consequences of not taking the sample in accordance with the mandatory regulations.

These are the recommendations that have been implemented to date. I would now like to update you on status of the other actions MSHA has under development. They will affect the following areas: monitoring of work environment; control of worker exposure; education and training; and, role of the miner in the respirable dust program.

MONITORING THE WORK ENVIRONMENT

During its deliberations, the Task Group identified four areas where monitoring of the work environment could be improved: 1) minimize the submittal of unrepresentative samples; 2) collection of required number of operator samples; 3) ensure sampling scheme is responsive to samples indicating overexposure; and 4) minimize voiding of representative samples.

To minimize submittal of unrepresentative samples, MSHA is considering developing draft regulatory language to redefine "normal production shift." At the same time, MSHA is also considering language to provide guidelines for calculating exposure time during "non-traditional shifts" and to require the operator to have in place security measures to safeguard the integrity of the entire sampling process.

To ensure that the required number of operator samples are collected, we have instructed our District personnel to evaluate the circumstances each time an operator fails to submit the required number of bi-monthly samples. When warranted, they will request that the violation be specially assessed. The Agency is serious about the responsibility of the operators to sample and protect miners from overexposure. We are also considering regulatory language that will specify that sampling must occur during a bimonthly period if a minimum number of production shifts have been worked.

In the past, MSHA has voided samples based on an operator's request. This may have resulted in some valid samples not being considered in making compliance determinations. To minimize this possibility in the future, the Agency is reviewing all void codes and will eliminate as many codes as possible.

CONTROL OF WORKER EXPOSURE

The Task Group identified three areas where improvements would strengthen the control of worker exposure. They involve the quality of dust control plans, compliance with plans, and primacy of controls.

Regarding plan quality, MSHA is developing draft guidelines for plan parameters to be used on longwall sections. This effort will later be expanded to include all other forms of mining. Also, at the request of MSHA, the Bureau of Mines is developing an "expert system" (a software computer program) to aid an operator in selecting the most effective dust control parameters on longwall mining systems. This system, too, will eventually include all other forms of mining. The longwall version should be available later this year.

MSHA is also developing plan verification guidelines. In the long term, the Agency will consider regulatory language for industry-wide application. However, in the short term, MSHA will apply the guidelines on a selective mine-by-mine basis. The guidelines will define production levels, sampling duration, and plan approval criteria. The Agency is also developing guidelines to help the districts in determining whether or not a plan should be revised based on the results of a single sample measurement. Current policy requires that all plans be reviewed for adequacy whenever a mine operator exceeds the applicable dust standard.

An effective dust control plan in and of itself does not prevent miner overexposure to respirable dust. The plan must be implemented on a continual basis. To ensure that this is accomplished, MSHA is revising its Health Inspection Procedures Handbook to incorporate new guidelines for inspection personnel to follow when monitoring operator dust control procedures during non-sampling periods. The Agency is also drafting regulatory language to require mine operators to make periodic on-shift examinations to verify that the plan parameters are in place and functioning as intended.

The most effective dust control strategy to minimize the potential for miner overexposure to respirable dust is the use of environmental control methods. However, the Task Group concluded, based on its review of selected dust control plans, that there is a growing trend toward the use of administrative controls when additional feasible environmental controls could be implemented. This occurs primarily at mines employing longwall mining systems. Recognizing that the industry could use assistance in selecting and implementing environmental controls that are both feasible and effective, the Agency is developing a handbook that will provide the user with information on what technologies are available and the proper application of each technology.

The Agency is also developing draft guidelines for inspector evaluation of the adequacy of operator respiratory protection programs. However, it should be noted that current regulations still emphasize the primacy of environmental controls. Respirators can not be used as a means to comply with the applicable dust standard.

EDUCATION AND TRAINING

The Task Group recognizes that education and training is an important part of any effective health protection strategy to prevent occupational lung disease. In order to strengthen the current program, the Task Group identified two key areas where significant improvements could be made: the certification process for operator sampling personnel and the training of miners under Part 48 of MSHA's regulations. To accomplish these improvements, MSHA is reviewing the current certification process and will be revising the certification exam. The Agency is also considering the possibility of requiring classroom training as a prerequisite to taking the certification exam. This would require a change in the existing regulations.

Regarding decertification, the Agency has developed a draft regulatory document which will create a formal process for decertifying persons not only in the area of respirable dust but also in other areas such as training, electricity, and noise. MSHA is still considering what would constitute an effective and appropriate recertification process for individuals who have been decertified.

The Agency currently has a Part 48 major rewrite committee working on appropriate training curriculums for independent contractors. This committee will also explore curriculums that would be appropriate for addressing respirable dust hazards. In addition, the committee will be involved with updating existing health training modules.

ROLE OF THE MINER IN THE RESPIRABLE DUST PROGRAM

Without question, the miner plays an important part in achieving improvements in the respirable dust program. Besides the planned revisions for miner training in respirable dust, MSHA is also reviewing what part the miner should play in dust control plan development and the sampling process.

LONG-TERM PROGRAM IMPROVEMENTS

The best solution to protecting miners from overexposure to respirable dust is continuous monitoring of the mine environment. Currently, there are two contractors who are conducting research into continuous monitoring. MEI is developing a novel technology which employs the principle of monitoring a change, or shift, in the frequency of a vibrating body as the mass, or weight, of the body changes. In this case the vibrating body is the filter used to collect the respirable fraction of dust in the environment. The second contractor, R&P, is developing a specially designed filter mounted on an oscillating microbalance. Any change in the mass of the filter causes the frequency of oscillation of the balance to change.

In addition to these two research endeavors, MSHA and the Bureau of Mines are also conducting inhouse work with currently available technologies to assess their feasibility for in-mine use. MSHA is also experimenting with a package of instrumentation to continuously monitor the parameters used to control respirable dust. Some of this continuous monitoring equipment will be available for in-mine testing in the near future.

SUMMARY

I hope that this presentation has provided you with some insight into the direction the Agency has taken and will continue to take to correct the vulnerabilities in the respirable dust program identified by the Task Group. MSHA is confident that a successful implementation of the recommendations therein will significantly improve the overall working environment of the Nation's underground coal mines.

As I have noted in this presentation, a number of the recommendations will require regulatory change. In this effort, we will actively seek and encourage the mining community's full participation in helping us to develop meaningful and effective regulations. We will also look forward to joining with the mining community in the development and application of in-mine continuous monitoring technologies so that an effective and reliable instrumentation package can be utilized in underground coal mines to control miner overexposure to respirable dust.

In closing, we should all be

reminded of our responsibility to make the working environment of the underground coal mine as healthy as possible. This is a shared responsibility between mine operators, mine labor, enforcement agencies, manufacturers, and academicians. We, the mining community, have demonstrated over the years that when we work together to resolve a health or safety problem in the mine, we have been enormously successful. The U.S. coal industry can and should be extremely proud of its health and safety accomplishments during that time period. I feel confident that, working together as a team, we will continue this success story into the coming years.

A REVIEW OF INDEPENDENT CONTRACTOR FATALITY DATA FROM 1983 THROUGH 1990

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ABSTRACT

Fatality data for independent contractors working at coal and metal/nonmetal mines from 1983 through 1990 are reviewed. Fatality data for operators are also presented for comparison.

During these years, there were 132 independent contractor employee fatalities. These accounted for an average of more than 13% of all fatalities in the mining industry. In 1988, independent contractors represented just 9.9% of the mining work force, however, they were responsible for nearly 23% of the mining industry fatalities. Moreover, their fatality incidence rates from 1983 through 1990 were consistently higher than those for operators at all locations of both coal and metal/nonmetal mines.

Some trends observed in looking at a representative sample of the independent contractor fatality data during the eight-year period were: (1) more than half of the workers who were fatally injured had five or fewer years of mining experience; (2) 83% of them had experience of five or fewer years in their particular job classification with the independent contractor employer; (3) 82% of the fatalities occurred at surface locations; (4) two job classifications - truck driver and equipment operator - accounted for 37% of the fatalities; and (5) 71% of the fatalities occurred in just four accident classifications - powered haulage, slips/falls, machinery and electrical.

INTRODUCTION

Components of the mining work force have changed considerably in recent years. The number of independent contractor personnel working in a variety of everyday production and support services has increased and, at the same time, the number of operator personnel has decreased. From 1983 through 1990, independent contractor employees in coal and metal/nonmetal mining, both surface and underground, nearly doubled, but the number of operator employees decreased by approximately nine percent. Table 1 shows how the mining work force changed with respect to industry and location during the eight-year period.

The largest growth of independent contractors from 1983 through 1990 occurred in the metal/nonmetal mining industry. Metal/nonmetal mills (+224%) and surface

Table 1 - Number of independent contractor and operator employees by industry and location from 1983 through 1990

COAL

Year	Operator	Independent Contractor	Operator	Independent Contractor	Operator	Independent Contractor
	Underground		Surface		Prep Plant	
1983	99,015	2,469	58,727	5,648	19,931	3,195
1984	102,703	2,674	61,478	7,195	20,512	3,035
1985	97,488	3,544	57,207	6,445	19,221	2,948
1986	91,052	3,104	54,094	6,509	18,185	2,656
1987	82,829	2,970	51,126	7,329	16,935	2,616
1988	78,797	3,172	48,144	8,191	16,332	2,543
1989	75,922	4,279	45,812	9,325	15,996	3,995
1990	76,777	5,664	45,127	10,441	16,121	4,647

METAL/NONMETAL

Year	Operator	Independent Contractor	Operator	Independent Contractor	Operator	Independent Contractor
	Underground		Surface		Mill	
1983	19,472	2,665	80,190	5,875	72,623	2,813
1984	18,698	1,290	84,076	7,134	75,061	2,931
1985	16,707	1,470	86,352	7,733	71,280	4,807
1986	14,997	1,409	84,441	8,398	67,486	4,692
1987	14,617	1,602	85,742	9,288	68,227	4,958
1988	15,518	2,085	88,031	10,247	71,224	8,881
1989	16,359	3,076	89,108	13,115	73,356	8,685
1990	16,387	2,269	89,900	13,844	72,887	9,120

mines (+136%) showed the greatest increases. Underground coal mining ranked a close third (+129%) on the list during these years. Table 2 shows the percent of change and the relative rankings for each industry/location segment of the mining industry.

In spite of this growth, the percentage of independent contractor employees still remained relatively small as compared with the total number of workers in the mining industry. In 1983, independent contractors represented approximately 6% of the mining work force; in 1990, the number grew to approximately 13% of the work force.

Table 2 - Percent change in the number of independent contractor employees from 1983 through 1990

Rank	Industry/Location	Percent Change
#1	MNM/Mills	+224%
#2	MNM/Surface	+136%
#3	Coal/Underground	+129%
#4	Coal/Surface	+ 85%
#5	Coal/Prep plant	+ 45%
#6	MNM/Underground	- 15%

Note: (+) denotes an increase, (-) denotes a decrease

Who are independent contractors? The Mine Safety and Health Administration (MSHA) defines an independent contractor as "any person, partnership, corporation, subsidiary of a corporation, firm, association or other organization that contracts to perform services or construction at a mine" (*1*).[1] Mine operators employ them to perform a variety of production and support services. Some common independent contractor occupations include: security guards, supervisors, truck drivers, technicians, production workers, chemists, drillers and blasters, construction workers, equipment operators, iron workers, and mechanics.

Other employees, perhaps in the same job classifications above, who work for contract mines and are on the payroll of the parent company that owns or leases the mine are not independent contractors. Contract mines are operated by a contractor company that is hired by the mine owner. The workers, because they are on the parent company payroll, in effect, have permanent jobs with that company, at least for the life of the contract. Injuries to these workers are reported to MSHA by the parent company and are classified as operator injuries. MSHA injury data for employees working at contract mines is incorporated with injury data for operators. Companies that are hired by the contract mine operator to perform specific tasks, however, are classified as independent contractor companies.

Traditionally, both independent contractor and operator injury data are reported in a combined format that represents the general mining work force. The purpose of this paper is to report mining industry fatality data for independent contractors. Some operators' fatality data, however, are also presented so the reader can discern how independent contractors compare with that segment of the industry. Fatality information on certain independent contractor demographic and accident characteristics is reviewed for trends and patterns which the data describes. Information is presented using tables and graphs that depict fatality data over an eight-year period, from 1983 through 1990. Three sources of data were used: (1) the Annual Closeout Editions of MSHA's Mine Injuries and Worktime Quarterly; (2) the MSHA's Safety and Health Technology Center Accident and Injury Data Base; and (3) official MSHA accident investigation reports.

FATALITY DATA FOR INDEPENDENT CONTRACTOR AND OPERATOR EMPLOYEES

Independent contractor employees averaged approximately 8.7% of the mining work force during the years 1983 through 1990 (Table 3). However, their ***all mining*** fatalities averaged a disproportionately higher 13.1% of the industry during this time (Table 4). The term ***all mining*** refers to both coal and metal/nonmetal mining at surface, underground, prep plant, and mill locations.

However, during the last four years, 1987 through 1990, the averages were 10.7% and 16.7%. In one year alone, 1988, 9.9% of the mining work force accounted for nearly 23% of all mining industry fatalities. Overall, independent contractors were responsible for a disproportionate share of mining industry fatalities over the eight-year period.

[1]Italic numbers in parentheses refer to references at the end of this report.

Table 3 - Independent contractor's percent of *all mining* industry work force

Year	*All Mining* Work Force	Independent Contractors	Independent Contractors, % Of Total
1983	372,623	22,665	6.1
1984	386,787	24,259	6.3
1985	375,202	26,947	7.2
1986	357,023	26,768	7.5
1987	348,239	28,763	8.3
1988	353,165	35,119	9.9
1989	359,028	42,475	11.8
1990	363,184	45,985	12.7

Table 4 - ***All mining*** industry fatalities from 1983 through 1990

	Operators	Contractors	Total	Contractors, % of Total
1983	120	12	132	9.1%
1984	188	18	206	8.7%
1985	107	17	124	13.7%
1986	127	9	136	6.6%
1987	113	17	130	13.1%
1988	78	23	101	22.8%
1989	99	17	116	14.7%
1990	103	19	122	15.6%

All mining fatality incidence rates for independent contractor and operator employees are shown in Figure 1. With two exceptions, the relative order of the fatality incidence rates for each industry/segment remained consistent from 1983 through 1990. In other words, the fatality incidence rates of "metal/nonmetal, operator" employees remained lowest for these years; "coal, operator" employees had the next highest rates. These were exceeded, in order, by "coal, independent contractor" and "metal/nonmetal, independent contractor" employees. This last industry/segment group of workers experienced the highest annual ***all mining*** fatality incidence rates in every year except 1988. The two exceptions noted above were (1) in 1986 when "coal, operators" and "metal/nonmetal, operators" reversed their positions and (2) in 1988 when "coal, independent contractors" and "metal/nonmetal, independent contractors" changed their order.

The fatality incidence rates for independent contractor employees were higher than those of operator employees for every year except 1986 where "coal operators" exceeded "coal, independent contractors." In 1990, the rate for independent contractor employees in metal/nonmetal mining was nearly five times higher than for operator employees.

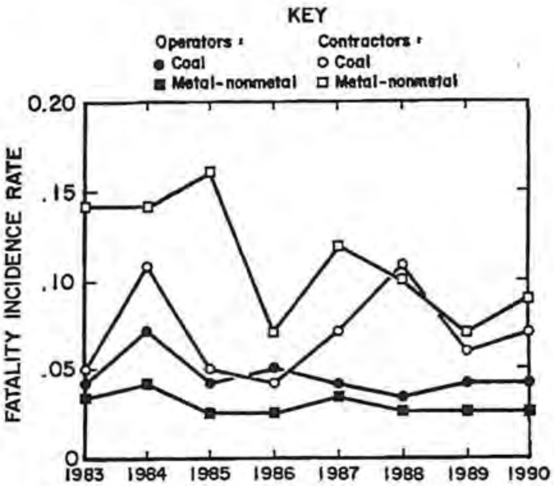

Figure 1.--Fatality incidence rates for independent contractors and operators

FATALITY DATA FOR INDEPENDENT CONTRACTOR EMPLOYEES

Several arbitrarily chosen demographic and accident characteristics of independent contractor fatalities from 1983 through 1990 are reviewed in this section. The objective was to look for trends that characterize this segment of the mining work force. Data was acquired from a sample of 100 (out of 132) MSHA independent contractor fatality investigation reports. Because a form of nonprobability sampling was used to select data, it is difficult to generalize from the results of its analysis (2). The sample results are also not generalized because the number of independent contractor employee exposure hours to specific risks is not available. Despite these limitations, the sample selected for review can be used for observing and reporting trends which developed during the eight-year period.

The ***demographic characteristics*** considered for review include the continuous variables of age, mining experience, job classification with independent contractor employer, and experience in job classification with independent contractor employer. The ***accident characteristics*** include accident location and accident classification.

DEMOGRAPHIC CHARACTERISTICS

Age - The age distribution of the independent contractor employee fatalities in the sample are shown in Figure 2. More than one-half (56.1%) of the fatalities occurred to workers under 35 years of age, and the majority of them were between the ages of 20 and 35. The mean age of the sample is 35.5 years.

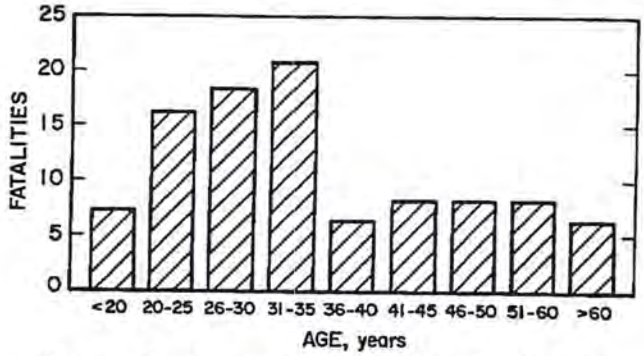

Figure 2.--Ages of independent contractor fatalities, 1983-90

Mining experience - The range of mining experience for independent contractor employees who were fatally injured from 1983 through 1990 was less than one hour to more than 50 years. Figure 3 shows the distribution of mining experience for these employees. More than half (59.7%) of the fatalities in the sample had 5 or fewer years of mining experience. A further breakdown of this "5 or fewer years" subgroup, shown in Figure 4, indicates that over three-fourths (76.1%) of these fatalities had two or fewer years of mining experience. Further, in this "2 or fewer

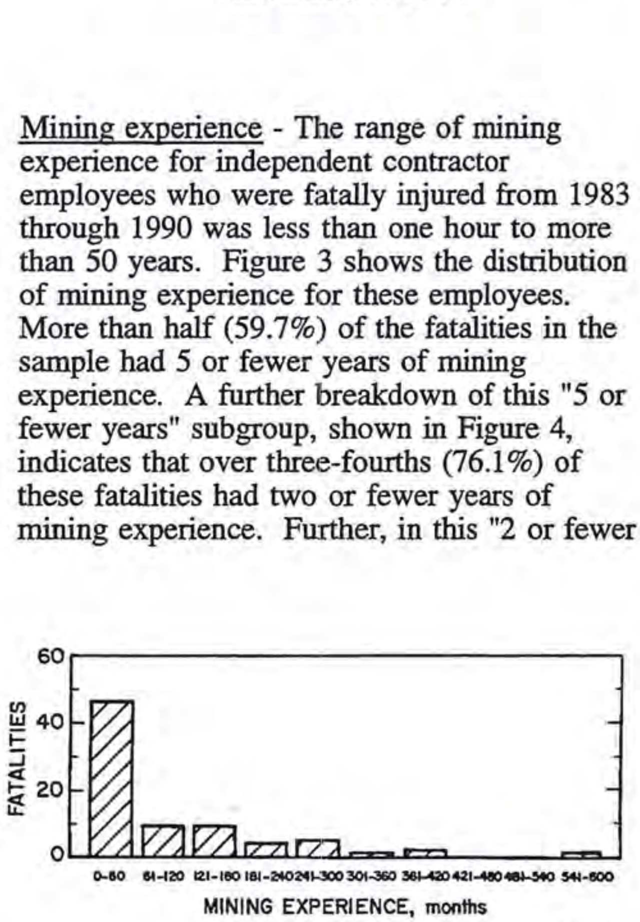

Figure 3.--Total mining experience of independent contractor fatalities, 1983-90

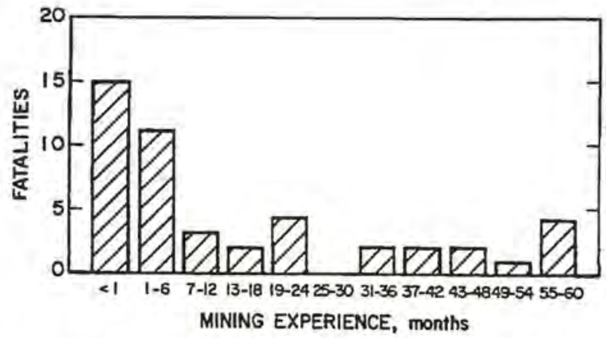

Figure 4.--Independent contractor fatalities with "5 or fewer years" total mining experience, 1983-90

years" mining experience subgroup, 27 of 36 fatalities occurred to independent contractor employees with 6 or fewer months of mining experience.

Job classification with independent contractor employer - Figure 5 shows the specific independent contractor employee job classifications (occupation titles) at the time of the fatality. The job classification in which the largest number of fatalities occurred was truck driver (22). The second highest number of fatalities occurred to equipment operators (15). Equipment operators include: drill operator, bulldozer operator, crane operator, front-end loader operator, hoist operator, power shovel operator and equipment operators not elsewhere classified. Combined, truck drivers and equipment operators accounted for 37% of the independent contractor employee fatalities in

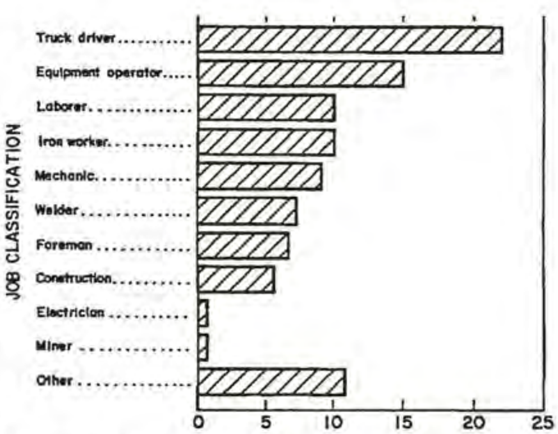

Figure 5.--Job classifications of independent contractor fatalities, 1983-90

the sample during the eight-year period. The "other" job classification category in figure 5 includes such occupations titles as diver, blaster helper, oiler/greaseman, carpenter, superintendent, and owner.

Experience in job classification with independent contractor employer - This demographic characteristic relates to the amount of employment time (experience) the individual had in his/her specific job classification with the independent contractor. Figure 6 shows the distribution of experience in job classification for 1983 through 1990. More than three-fourths (83%) of the fatalities were to persons with experience in their job classifications with that particular employer of 5 or fewer years. A further breakdown of this "5 or fewer years" subgroup, shown in Figure 7, indicates that approximately 85% of these fatalities had experience in their job classification with that independent contractor employer of 2 or fewer years. Further, in this "2 or fewer years" subgroup, 28 of 46 fatalities occurred to independent contractor employees with 6 or fewer months of experience in their job classification with that independent contractor employer.

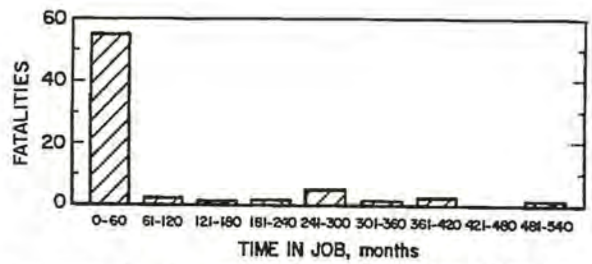

Figure 6.--Experience in job classification with independent contractor prior to fatality 1983-90

ACCIDENT CHARACTERISTICS

Accident Location - In the sample of 100 fatalities, the location in which the largest number of independent contractor fatalities occurred was surface mines, 56%. Preparation plants and mills accounted for another 26% of the fatalities, and 18% of them occurred at underground locations. A total of 82% of these

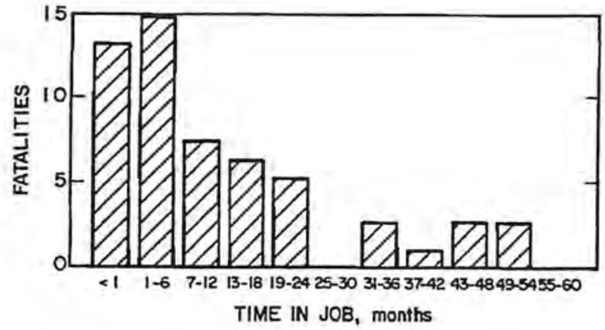

Figure 7.--Fatalities with "5 or fewer years" experience in job classification with independent contractor, 1983-90

fatalities, therefore, occurred at surface operations, that is, at surface mines, prep plants, and mills. [Fatalities at surface areas of underground mines were included in underground data] Figure 8 shows the percentage of independent contractor employee fatalities by location from 1983 through 1990.

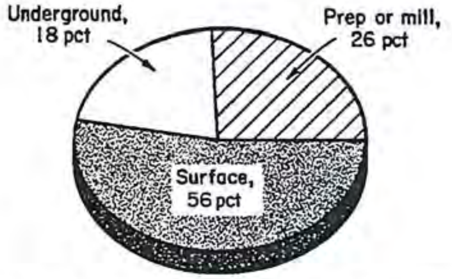

Figure 8.--Locations of independent contractor fatalities, 1983-90

Table 5 lists the independent contractor employee fatalities in the sample of 100 with regard to location and industry. Even though the number of independent contractor employees working at coal and at metal/nonmetal surface mines was nearly the same (determined from Table 2), over half of the surface fatalities, 32 of 56, occurred at metal/nonmetal mines.

Preparation plants and mills, the locations of the second highest number of independent contractor employee fatalities, accounted for 26 fatalities and 20 of these occurred at mills. At underground mines, although there were approximately twice the number of independent contractor employees working in coal than in metal/nonmetal (from Table 2), the number of fatalities was approximately the same for both groups.

Table 5 - Number of independent contractor employee fatalities by location and industry from 1983 through 1990

	Underground	Surface	Prep/Mill
1983			
COAL	3		
M/NM	2	2	3
1984			
COAL	3	4	1
M/NM		5	3
1985			
COAL		4	
M/NM	1	4	2
1986			
COAL		2	1
M/NM			3
1987			
COAL	1	1	
M/NM	2	4	1
1988			
COAL		7	1
M/NM	1	6	2
1989			
COAL		3	2
M/NM	1	5	2
1990			
COAL	3	3	1
M/NM	1	6	4
TOTALS	18	56	26

Accident classification - Four accident classifications (types) accounted for 71% of the independent contractor employee fatalities in the sample. They included (1) powered haulage, (2) slips/falls, (3) machinery and (4) electrical. Figure 9 shows the number of fatalities in each accident classification group.

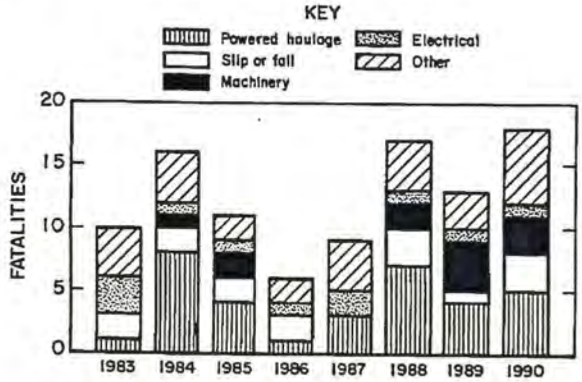

Figure 9.--Accident classifications of independent contractor fatalities, 1983-90

Table 6 lists the *all mining* accident classifications in the sample by location. In addition to the four accident classifications which accounted for the majority of independent contractor fatalities, the fifth most common accident category was "sliding materials".

SUMMARY

For a variety of reasons, independent contractors have become a major component of the mining work force. From 1983 through 1990, the combined number of workers - operators and independent contractors -

Table 6 - Independent contractor employee fatalities by accident type and location for ***all mining*** from 1983 through 1990

	Coal			Metal/Nonmetal		
	Undergrd	**Surface**	**Prep**	**Undergrd**	**Surface**	**Mill**
Power Haulage	2	14	2	1	12	2
Machinery	1	3	1	1	3	3
Slip/Fall	1	2	1	1	2	8
Electrical	3	1		1	4	2
Sliding Material		1	2	1	4	1
Fall of face		2		2	1	
Roof Fall	1					
Hoisting	1			1		
Material Handling		1			1	1
Exploding Vessel					1	
Ignition/Explosion					2	
Hand Tools						1
Other	1				2	2
TOTALS	10	24	6	8	32	20

remained relatively constant, but the number of independent contractor employees more than doubled. Along with this increase in workers came increased fatalities and fatality incidence rates that were much higher for independent contractors than for operators. A total of 132 fatalities occurred to independent contractor employees from 1983 through 1990. During these years, 8.7% of the mining work force were responsible for more than 13% of all mining industry fatalities.

In looking at a representative sample of these fatalities, several important trends were observed. More than half of the workers who were fatally injured had five or fewer years of mining experience, and three-fourths of this subgroup had two or fewer years of mining experience. More than one-third of the fatalities occurred to workers in two job classifications: truck driver and equipment operator. A large majority of the sample, 83%, had experience in their particular job classification with the independent contractor employer of five or fewer years. And, in this subgroup, half of them had such experience of six or fewer months. Most of the fatalities (82%) occurred at surface operations - surface mines, prep plants, and mills. And finally, four types of accidents accounted for 71% of the independent contractor fatalities in the sample: powered haulage, slips/falls, machinery, and electrical.

The safety of independent contractors is a major concern to mine operators and regulatory enforcement personnel throughout the mining industry. The fatality data reported in this paper indicate some of the areas where problems occurred during an eight-year period.

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TRAINING IN MINE EMERGENCY, MINE RESCUE, AND FIREFIGHTING USING THE MINE SIMULATION LABORATORY

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MINE FIRE TRAINING NEEDS AND ACTIVITIES

Mine fires are an increasing hazard for the mining industry. From 1978 to 1987, 280 mine fires occurred, some of which had disastrous consequences. In many cases, resulting losses would have been less severe with better initial response. The ability of management and mining personnel to deal with a mine fire safely and effectively depends on the level of emergency preparation developed and maintained.

After conducting numerous informal evaluations or audits at different mine sites throughout West Virginia (as well as other states), it was concluded that many mining operations are not prepared to handle a fire situation. The results of the audits indicate that while most mines are in compliance with federal and state regulations regarding levels of emergency equipment, water systems and training sessions, these levels - particularly in the area of fire training - are probably not sufficient to enable the mine employees to effectively combat a fire in its early stage.

This paper presents recommendations for designing and maintaining an efficient mine emergency preparedness program. It also offers an overview of some mine fire training activities currently being conducted in conjunction with the Mine Simulation Laboratory at the National Mine Health and Safety Academy.

MINE EMERGENCY PREPAREDNESS PROGRAM

The Mine Emergency Preparedness Program (MEPP) is a management tool developed by the Mining Extension Service at West Virginia University, and is designed to assist company personnel in effectively managing a mine emergency operation. The program goes beyond the traditional and required training of mine rescue teams by offering a complete emergency operations package. Included in the MEPP are suggested approaches for training and organizing all personnel, and ideas for developing plans of action concerning transportation, security and communications. The MEPP program may also be used to assess present readiness levels.

While the MEPP program is designed to address all types of emergency operations, the evaluations and audits showed that emergencies involving mine fires are the ones of greatest concern and so most efforts are concentrated in that direction. Incidents where fires are involved seem to be increasing in frequency and are extremely costly to control if allowed to go beyond the incipient stages. With a proper emergency preparedness program in place and properly trained and equipped fire brigades, we feel that it is possible for mine management to manage a fire situation quickly and effectively. To satisfy the deficiencies identified in the area of fire preparedness, a two-part program has been designed for participating mines that includes both audits and mine fire training.

Fire Safety Audits

In an attempt to make this program as relevant as possible, the field agents at the Mining Extension Service work with the operators in conducting specially-designed mine fire audits. These audits attempt to perform an objective survey of a mine's preparedness level. Designed not only to determine a mine's state of readiness, these audits also are used to identify specific areas of fire vulnerability as well as special needs for personnel training.

Elements included in each different audit vary according to the mine's size, the number of sections, type of mining involved (longwall/conventional, etc.). Generally, typical areas to be investigated include water line locations and pressures; fire hose conditions, sizes, nozzles and storage areas; and the maintenance and locations of other equipment. These inspections differ from compliance inspections by looking at a mine's overall capability to respond to a fire rather than meeting specific requirements. It has been determined that a mine may be in complete regulatory compliance but have a very limited ability to actually fight a fire.

Problems arise from such conditions as the poor positioning of water lines, lack of sufficient water at correct pressure, insufficient quantities of hose, improperly placed and maintained hose line, and ineffective nozzles, among many others. These inefficiencies, though easily resolved, can mean the difference between success and failure of the personnel to control a fire. Adequately trained firefighting personnel is another critical area where many operations are deficient. Following the analysis of the mine audits, the mine's fire brigade is encouraged to enroll in the two-day fire training class conducted at the National Mine Health and Safety Academy by the staff of West Virginia University's Mining Extension Service.

Mine Fire Training Class Curriculum

During the class, the fire brigade members, as well as associated management personnel, participate in an intensive two-day training that includes both classroom review and instruction as well as field exercises. Through the use of lecture and discussions, videotapes and various other instructional tools, the class explores multiple topics including: an in-depth analysis of the fire safety audit conducted at their own mine, basic properties of fire, belt fires and associated problems, personal and respiratory protection, and search and rescue guidelines. The hands-on field exercises are designed to incorporate the classroom material.

Classroom Activities

Physical Properties of Fire. With special emphasis on the situations found in coal mines, the participants learn the elementary conditions under which a fire can exist, as well as basic theories of fire propagation, containment, control, and extinguishment. The students examine the different methods of flame spread and the pyrolysis of solids, liquids, and gases.

Belt Fires. As the numbers of belt-associated fires increase, this section is becoming of greater importance. The class reviews the many toxic by-products which result from belt fires and the harmful effects of these by-products. Special recommendations for personal protection, as well as the proper methods of extinguishment when combatting belt fires, are presented.

Personal and Respiratory Protection Equipment. Class participants are given a complete review of conditions requiring the use of protective breathing apparatus during mine fires and other potentially dangerous situations. The various types of breathing apparatus available to the mining industry are discussed including: pressure demand, which puts out constant pressure, and the demand type, which provides air as needed; supplied air and chemically generated units; and open circuit and closed circuit units. The participants are taught the limitations of each type of device, as well as the limitations imposed by the wearers' own physical characteristics and prior physical conditioning.

The firefighters then are able to appreciate the equipment currently available at their particular operation, and fully understand its advantages and/or limitations. With special emphasis placed on required safety checks and emergency operations, the participants are shown the approved methods of donning and doffing the self-contained breathing apparatus. A brief overview of care and maintenance of this respiratory equipment is included. In classes where participants have supplied their own apparatus, the programs are custom-tailored to address that brand and/or design.

Search and Rescue Procedures. The members of the class discuss and review the basic procedures associated with performing search and rescue attempts. These are: exploration, victim search and removal, as well as rescuer survival techniques that will prepare the students not only for victim rescue but for self-preservation as well.

Field Exercises

To develop their confidence in both the uses of the special firefighting gear and breathing apparatus and working with each other as team members, the students leave the classroom to participate in various field exercises. These practical exercises are held in several different specially-designed smoke chambers using various props.

Smoke Gallery Exercises. The smoke chambers are designed to imitate typical underground mining situations with areas of "bad top" that must be supported; low areas that require the rescuers to crawl through water and mud; dead-end rooms; and other hazards or obstacles in an atmosphere of heavy smoke. These exercises give the students a chance to employ those skills and knowledge accumulated from the previous lectures and discussions.

Fire Pit Exercises. During this section of the program, the fire brigade members are required to extinguish fires involving different fuel types, employing a variety of equipment ranging from hand-held dry chemical extinguishers to fire hoses with water and a foam extinguishant. These live fire exercises are done by individuals as well as by teams.

THE MINE SIMULATION LABORATORY

To help meet the need for improved training such as that described above, the Mine Safety

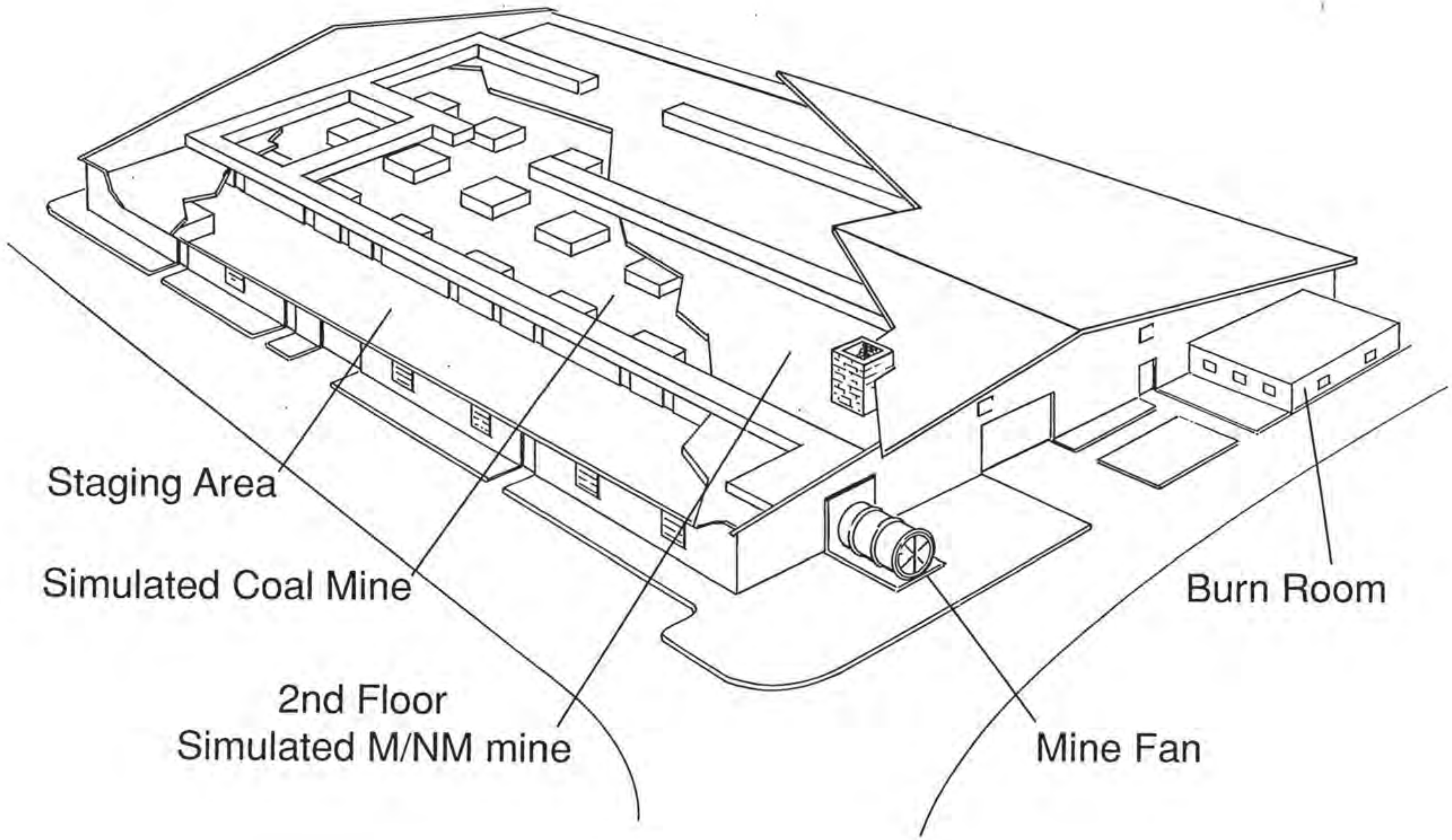

FIGURE 1
MINE SIMULATION LABORATORY
NATIONAL MINE HEALTH AND SAFETY ACADEMY
BECKLEY, WEST VIRGINIA

and Health Administration created a Mine Simulation Laboratory. The laboratory, which was dedicated on September 1, 1992, is a 48,000 square foot building on the grounds of the National Mine Health and Safety Academy at Beckley, West Virginia.

Layout of the Laboratory

The Mine Simulation Laboratory has three large sections: a staging area, a simulated room-and-pillar coal mine with an attached burn room, and a simulated metal/nonmetal mine. (See Figure 1).

The first section - the staging area - occupies almost one-third of the building and serves as an entry to the simulated mines. The staging area provides an ideal place for mine rescue teams or fire brigade teams to set up for an exercise. Teams can drive their equipment trucks into this area for unloading, if desired. This area typically serves as the fresh air base for smoke exercises. The staging area also provides room for storage, equipment benching, and space for classroom instruction.

The second section of the Mine Simulation Laboratory consists of a four-entry by nine-crosscut room-and-pillar mine. Entry widths are fifteen feet with fifteen foot square pillars. The standard height throughout the room-and-pillar mine is eight feet, but lower areas can be created as needed. Although entry widths and centers are smaller than a typical mine, realistic mining situations can be simulated. The room-and-pillar mine can be used in its entirety, or smaller parts can be bratticed off for different exercises. The four-by-nine configuration can be divided into three-by-four sections so that three mine rescue teams can work simultaneously on the same layout for a mine rescue contest.

A 20-foot by 20-foot fire-proof burn room is attached to two entries of the laboratory building. This room is constructed of fire proof brick and ceiling tile so that fires can be built and used in exercises. Fires can be created by using gas jets located under a grate in the floor of the burn room.

The third large section of the Mine Simulation Laboratory consists of a maze of tunnels or manways that can be used to simulate a metal/nonmetal mine. These tunnels are built as a second story over the room-and-pillar mine, and are connected to the room-and-pillar mine in several different places by stairs, ladders, and drops. The different means of access allow different simulations of mine conditions and confined space situations. The maze of tunnels is six feet high and six feet wide and has a total length of almost 1000 feet.

Simulated Settings

Ventilation measurement and control can be practiced in any number of simulated mine settings with the use of the laboratory's 6-foot, variable pitch, axial fan. This fan, powered by a 125 horsepower motor, can produce up to 100,000 cubic feet per minute of airflow, and can easily ventilate the entire room-and-pillar mine as well as the second level tunnels. In conjunction with the fan, air-flow can be induced into the mine by opening any combination of doors and by using a ventilation shaft - a six-foot by six-foot block shaft that rises above the laboratory building. Airflow can be controlled in the mine with the installation of any typical ventilation control: overcasts, block stoppings, brattice line, etc.

For smoke training for mine rescue teams or fire brigades, the simulated mine can be completely filled with artificial smoke. Teams can gain valuable experience communicating and working in very restricted visibility. The limited visibility provides very different and more realistic training than can be achieved without the smoke. The artificial smoke is a nontoxic smoke such as that produced by special smoke generating machines for movies or theater productions. The smoke can be controlled and varied for different effects.

Actual materials are used in exercises whenever practicable to give teams realistic hands-on training. For example, concrete blocks, crib blocks, timbers, cap wedges, brattice cloth, axes, saws, etc., are available in "supply holes." Mine rescue teams and fire brigade teams can get a real feel for the physical requirements of locating, transporting, and using supplies in a rescue or firefighting situation.

However, due to some limitations, certain equipment and conditions are simulated. The narrow entry and crosscut widths and safety considerations necessitate the simulation of such equipment as a conveyor belt or mobile equipment such as a continuous miner or shuttle cars. Bad roof and sloughing rib conditions are also simulated.

Adjacent to the laboratory building, three concrete pads have been constructed outdoors to give students a variety of fire props with which they can practice firefighting techniques. One large concrete pad has several different propane fire props with which students can get hands-on experience working as a team handling nozzles and hoses. A smaller pad with a cross-pit for diesel fuel fires is especially designed for training in the use of hand-held fire extinguishers. The third concrete pad has a large 20-foot square pan designed for large diesel fuel fires. This large pan is useful for hands-on training with nozzles and hoses, hand-held fire extinguishers, and foam generators.

TRAINING OF FIRE BRIGADE TEAMS AT THE MINE SIMULATION LABORATORY: U.S. STEEL MINING CO.

The U.S. Steel Mining Company (USM) looked long and hard at the fire brigade concept before implementing a system that was in tune with the company's vision.

At USM, the Fire Brigade is not just a team that trains to fight fires, and an Emergency Plan is not just a plan that kicks in after all key players have been notified and have arrived at the mine or plant. The Fire Brigade system at USM is a way of doing business. It's a system that is productive in the company's day-to-day activities, and will be productive should an emergency occur.

Fire Brigade and emergency planning at USM meshes what's needed should an emergency occur with what's needed before the emergency occurs. The Fire Brigade's first response, second response, and third response activities include audits, inspections, education/training, engineering, investigations, and employee involvement. The Fire Brigade involves employees in developing systems, auditing work sites, improving safety, preventing accidents, education and training for emergencies.

An important aspect of Fire Brigade training is to provide skills training to prepare teams to fight actual mine fires. USM's firefighting training is conducted on site, at industrial facilities such as Hoechst Celanese, at state training facilities such as the Alabama State Fire College, and at the National Mine Health and Safety Academy's Mine Simulation Laboratory. This section deals with those training programs developed by USM for use at the mine laboratory.

Several decisions had to be made regarding training at the mine laboratory. They were: How much off-site training will be offered? Who will do the training? What will the training look like?

How Much Off-site Training Will Be Offered?

USM settled on 4 hours of on-site training monthly for each team. This training takes place during the normal work week. For off-site training, USM elected to offer 16 hours per year to each team. This amount has been manageable and fits in with the programs USM has developed for the mine laboratory.

Who Will Do The Training?

This decision was a little harder to make. There are several pros and cons to having in-house instructors versus contractors. Some of the questions USM asked were: What expertise is necessary? Does USM have the expertise or potential expertise needed in-house? Is the expertise available through a contractor? What advantages would USM gain from "in-house" instructors?

USM felt it would be best to develop in-house instructors with the assistance of Donald W. Mitchell, P.E., the well-known mine fire consultant. It was believed that having the in-house instructional expertise would strengthen USM's ability to provide education activities to all employees, strengthen the ability to provide on-site training to Fire Brigade team members, and to better respond in the event of an emergency. The additional training needed for USM instructors would be minimal due to their past experience in firefighting as Mine Rescue team members. These past experiences provided a pool of instructors with strengths in some areas equal to or greater than most contractors available for advanced underground fire-fighting tactics. To ensure USM instructors are qualified, Don Mitchell is used as needed to assist in the development of advanced training courses and advanced instructor training.

What Will The Training Look Like?

Training programs designed for and presented at the Mine Simulation Laboratory and surrounding facilities will be progressive in nature. The programs in place or being developed now are referred to as Fire Fighting I, Fire Fighting II, and Fire Fighting III. Fire Fighting I is a basic training class, while Fire Fighting II and Fire Fighting III are more advanced and challenging to the participants. As each Fire Brigade team moves through the three 16-hour classes, it will receive training in the direct and indirect fire methods that USM will use to control and extinguish a fire.

The Fire Fighting I Class was developed during the Summer of 1992. The majority of USM's Fire Brigade teams had previously attended a Basic Fire Safety class presented by the Mine Academy and West Virginia University Mining Extension Service. Some of the USM teams had also attended a Basic Fire Fighting class at the Alabama State Fire College. Both of these programs were looked at as USM developed its class, with approximately 50 percent of the material pulled from one or both of those programs. The other half of the materials were tailored to meet USM's specific needs.

Fire Fighting I teaches participants the basic fundamentals of team work, the equipment and materials available to them, USM's second response plan, basic firefighting procedures on the surface, and team safety. Day one of the class starts with team safety, the second response plan, and an explanation of USM's involvement in the fire brigade. Instructors then shift to covering the gear and apparatus the team will use. This includes the Drager PA-80 and the Drager BG-174-A. The afternoon is spent using the gear and apparatus in the mine laboratory. The exercises in the laboratory are intended to familiarize the teams with their equipment and with atmospheres having limited or no vision; to test team members' stress tolerance and their physical stamina; and to develop team work.

On day two, instructors cover the chemistry of fires, the use of fire extinguishers, the inspection and maintenance of the extinguishers, nozzles, and handlines as well as tactics for fighting basic surface fires. Again, the afternoon is devoted to hands-on skill practices consisting of a propane fire, a pan fire, and a small pit fire for fire extinguishers. The day is completed with participants cleaning equipment used during the day. Day two allows participants to become familiar with the handlines, nozzles and extinguishers available to them at their work site, to practice basic tactics for approaching fires, and to learn how a fire reacts to extinguishing agents.

The Fire Fighting II Program will be implemented this year, with an instructor training program scheduled for August 25-27, at the mine laboratory. Classes are then scheduled from September through November for the training of Fire Brigade teams.

Fire Fighting II will also be a two-day course with a combination of classroom presentations and hands-on training. Fire Fighting II is devoted to specific skills and methods needed to fight a fire directly in an underground mine. Topics to be covered are emergency structures, communications, assessing the fire area, controlling smoke rollback, monitoring fire gases, and installing firefighting lances. Hands-on training in the laboratory will cover all the above topics in a ventilated section. The simulated fire will be assessed, smoke will be controlled, the second response emergency structure will be in place, communications will take place, and lances will be installed. In reference to the firefighting lances, a stopping with a man door will be erected in the burn room. Teams will be required to enter the burn room through the stopping door and install their lances in the smoke and heat generated in the burn room.

The Fire Fighting III Program will be presented in 1994. It will deal with indirect firefighting methods that will be used at USM. Foam generators will be covered and used to extinguish fires. The training will also cover methods of impounding water, the erection of seals, and the types of seals available.

Instructor guides were developed for each module of these programs. The guides contain details needed by instructors to teach these programs. A binder was given to each participant to maintain the course materials, including safe job procedures, charts, plans, and a text book. The text that USM selected was Don Mitchell's book on mine fires. As team members move through the three firefighting courses, the material in the text book will be covered. At the end of each course, every participant will receive a certificate which is signed by the instructors and by the President of USM.

Instructor courses are to be conducted during late summer of each year. All USM instructors will attend an instructor course which consists of going through the exact course that team members will attend and detailed information for each module presented by experts in that area. These experts include firefighting equipment vendors, USM emergency coordinators, and Don Mitchell.

Team member classes are scheduled from September through November. Each team will attend a class together. This allows the team to do the hands-on training together and build team work. Two teams are scheduled for each class. This keeps the number of participants at 12, and works well in the mine laboratory rotations.

The mine laboratory has been very beneficial to USM in the training of Fire Brigade teams. Having a simulated mine where ventilation can be changed and smoke and heat can be introduced has helped greatly in hands-on training.

CONCLUSION

While mine fires continue to be a threat to the industry, with adequate plans of preparedness including quality personnel training and appropriate equipment, the threat can be lessened significantly. This training and the Mine Simulation Laboratory will help ensure the success of a mine dealing efficiently with a fire situation.

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PANEL DISCUSSION:
HEALTH AND SAFETY ISSUES IN SMALL MINES

Chairmen:

Joseph Turley, III
President
Leckie Smokeless Coal Company
Rupert, West Virginia

Philip L. Longenecker
President
Crystal Resources, Inc.
Marmet, West Virginia

Panelists:

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MEETING THE CHALLENGE OF SERIOUS SAFETY PROBLEMS AT SMALL COAL MINES

Jack Tisdale

Mine Safety and Health Administration

It has long been apparent from accident and injury statistics that small coal mines employing 50 or fewer employees experience a disproportionate number of serious and fatal accidents compared with larger operations. For example, in 1992, small underground coal mines, with fewer than 20 employees, had a fatal incidence rate of about 6 times that of larger mines, and those with more than 20 but fewer than 50 employees had a rate about 4 times that of larger mines.

Clearly, bringing down the toll of miners lost in small mine accidents has been one of the most difficult challenges facing federal and state safety and health regulators and the coal mining industry. A strong, consistent multi-sided approach seems the only avenue to achieving significant safety gains.

In response to the problem, the Mine Safety and Health Administration (MSHA) has developed and is focusing increasingly on procedures for improving safety in the following major areas involving small, underground coal mining:

- Enforcement procedures
- Mine operator assistance
- Financial ties
- State grants
- Collection of fines for violations

ENFORCEMENT PROCEDURES

Following multiple fatality accidents at two small coal mines, internal reviews were conducted by MSHA that identified the need for improvement of enforcement efforts at small mines. In reevaluating its coal mine enforcement strategy, the Agency concluded that it should focus more strongly on basic inspection activities. Accordingly, mandated regular inspections (AAA) along with 103(i) inspections constitute MSHA's core business and have the highest priority. In addition, MSHA recognizes the following categories as priority activities:

- Plan approval activities
- Accident investigations
- Special investigations
- 104(e) pattern of violations
- 103(g) inspections

MSHA recognizes its responsibility to make thorough, complete inspections at all mines, regardless of size. The agency has directed its management to improve enforcement at smaller mines through improved oversight procedures, (PIL I93-V-8, 06/07/93). In addition, MSHA has established procedures for district managers to identify problem mines for increased inspection activity, including the types of inspection activities that should be considered. These procedures allow district managers to determine appropriate inspection activities for problem mines that lead to increased inspector presence, thereby improving the level of compliance at these mines (PIL I93-V-2, 01/11/93).

Management oversight procedures include: supervisors traveling with inspectors; supervisors debriefing inspectors after each inspection; review of citations and orders for appropriateness; rotation of inspector assignments; conduct of compliance follow-up inspections; and enforcement sanctions where operator compliance is deficient.

Increased inspector presence activities include: "impact" inspections at irregular intervals with at least two inspectors; "stretch" inspections in which an inspection is spread over a period of time; additional spot inspections; inspectors traveling in pairs to offset intimidation where it might exist; and group inspections of all or most of a mine in one day.

Information considered when determining whether to apply increased inspection time is: the mine's compliance history; the accident and injury rate along with the number and types of injuries; mine management's safety efforts, such as procedures used in the mine, the quality and type of instructions given the work force, and training provided to the employees; and management's involvement or commitment to the safety and health of the miners.

MINE OPERATOR ASSISTANCE

MSHA's responsibility is to enforce the Mine Act and regulations through fair and impartial inspections. I is understood that mine operators are responsible for their compliance with health and safety regulations and safety records, and should take whatever actions are necessary to make needed adjustments. MSHA expects improvements at mines with poor compliance histories and will assist mine operators where possible. The agency has a number of programs available to assist mine operators in improving compliance. The are:

- Job Safety Analysis program
- Joint Mine Assistance program
- Small mines training initiative
- Technical assistance in mine ventilation, respirable dust, or roof control
- Accident analysis
- Discussions with MSHA mine inspectors, supervisors, and subdistrict and district managers

MSHA has entered into several agreements with four states to provide assistance to mine operators. These agreements are covered by the Joint Mine Assistance program which is a coordinated effort conducted with the state mining authorities of Kentucky, Pennsylvania, West Virginia, and Virginia.

The objectives of this program are to enhance cooperation and improve the coordination of resources between the states and MSHA. It is an effort to provide increased assistance to the mining industry in reducing serious and fatal accidents and improving compliance performance with state and federal mining laws and regulations.

Working together, the mining industry, the states, and MSHA identify mines that need assistance in accident reduction and/or regulatory compliance. Eligibility for inclusion in the JMA program may be based on several factors including: accident history; specific mining problems and/or conditions inherent to the mine; regulatory compliance history; availability and coordination of technical assistance within the mine operator's organization; effectiveness of the operator's mine plans and training plans; and prior efforts of the agencies to provide assistance.

Once a determination has been made to target a mine for the JMA program, MSHA, the state, and mine operations personnel discuss methods to be used to achieve improvement.

Methods for improving a mine's safety performance and accident record may include any/or all of the following: providing technical aid in solving specific mining problems; providing assistance to develop and implement training programs to address specific problems; using MSHA Education and Training staff to carry out the Job Safety Analysis program; provision for joint review, revision, and approval of mine plans; coordination of inspection activities; providing added and/or specialized inspections when necessary; and periodic review to identify additional needs and determine future direction.

FINANCIAL TIES

Business arrangements of small mine operators can be an important factor in the safety and health of mine operations. Small operations may be controlled by higher authority obscured by organizational arrangements, to the extent that the local person in charge lacks authority to make needed decisions to react to safety and health issues.

For example, disapproval of purchases by some distant authority can result in poor maintenance of mining equipment. Safety can be significantly compromised when local management is responsible for safe mining operations but lacks the authority to carry out that responsibility.

A business arrangement of particular concern is that in which a larger company employs a contract mining company to insulate the larger company from

MSHA civil penalty assessments. These smaller operations often refuse to pay civil penalty assessments, then quickly go out of business before the civil penalties are collected, only to be replaced by another small operator. This cycle can be repeated with the larger company subsequently hiring other small contract mine operators to enter the mine site and extract the coal.

Where MSHA finds that the contracting company's control is great enough and available information is such that the contracting company can be classified as a "co-operator" under Section 3(d) of the Act, MSHA will then cite both the contract miner and the contracting entity.

It is important that MSHA continue to explore and uncover business arrangements that adversely affect the safe operation of the mine. Larger contracting entities may exercise control over mining operations that limit local management from exercising full authority over purchasing, planning, or mine operational scheduling without appropriate knowledge or concern for the effect this control has on safety.

STATE GRANTS

In view of the poor safety record of small mines generally, MSHA has determined that applications for grant funding, from states in which coal is mined, must concentrate on accident reduction programs at small coal mines.

Each state applying for federal assistance under the MSHA State Grants program is required to describe in detail how it will address health and safety issues and is encouraged to give a high priority to education and training projects aimed at reducing deaths and serious injuries at smaller operations and in several other high-risk mining areas. Applications will be evaluated to determine how comprehensively each addresses those priority issues and other activities to be performed under the grant. MSHA is interested in grant programs which use innovative training techniques, provide for mine-specific training, and result in improved safety management.

COLLECTION OF PENALTIES

MSHA has taken a number of steps to ensure that civil penalties assessed against mine operators are paid. Each proposed assessment is sent by certified mail, return receipt requested, to mine operators. The operators have 30 days to either pay or initiate a contest of the assessment. Those who fail to do either are sent a payment demand letter. Follow-up activities to collect delinquent civil penalties from nonpayers include **a field collection program.** Under this program civil compliance specialists are stationed in MSHA coal districts having the highest concentration of active mines and delinquent debt, Districts 4, 6, and 7. These specialists meet face-to-face with mine operators or their representatives in Kentucky, West Virginia, and Virginia to collect delinquent penalties. They also provide assistance and advice to operators on how they can reduce the amount of future civil penalties through improved compliance. They do investigations and work directly with the U.S. Attorney in their jurisdiction on those delinquent civil penalties cases referred for enforced collection in U.S. District Court.

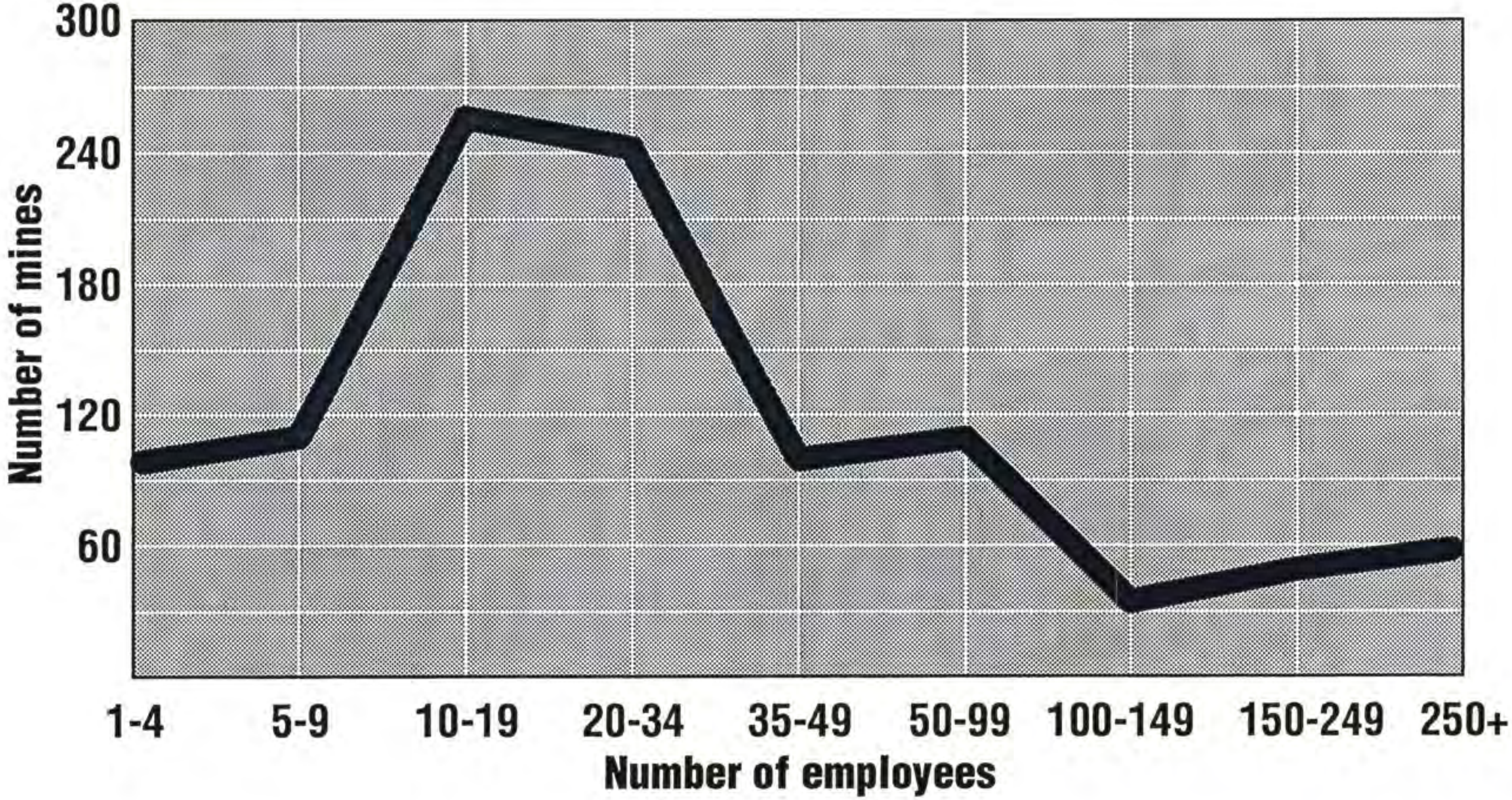
In the remaining districts, a contract debt collection agency is used to attempt collections. This debt collector has 180 days to collect on accounts referred to them. Uncollected accounts are returned to MSHA Civil Penalty Compliance Office (CPCO), and after further research, cases meeting specific criteria are referred to the U.S. Attorney for enforced collection in U.S. District court.

Staff members IN MSHA's CPCO monitor the above activities and pursue contact with debtors one last time before referral to the U.S. Attorney.

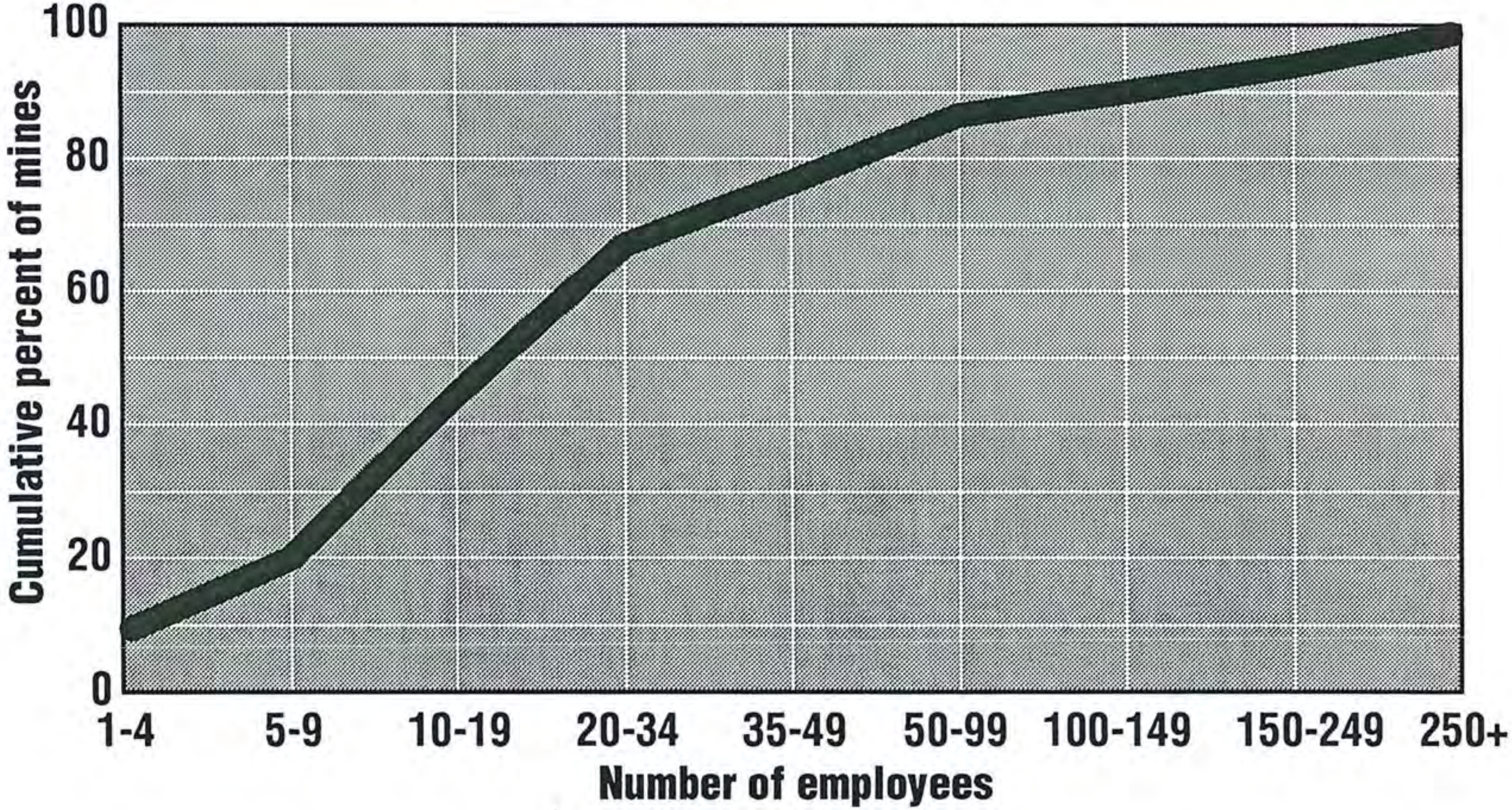
As part of its collection activities, MSHA has established excellent working relations with the U.S. Attorneys nationwide. Because the Department of Justice litigates for all government agencies, enforced collections often times get displaced by other pressing matters before Justice. Therefore, the Special Collections Section of MSHA's CPCO, in cooperation with the MSHA Solicitors office, prepares all legal papers required for collection in U.S. District Court. MSHA also provides resources to serve summonses and other papers related to enforcement collection cases, as well as overseeing those cases where seizure of assets is appropriate.

MSHA maintains an excellent relationship with the Office of Surface Mining personnel and has on-line access to their Applicator Violator System to ascertain ties between companies that may not be readily apparent from MSHA records. This research can lead to co-citing each company for violations and has led to collection of delinquent penalties for "hidden" companies.

Number of underground coal mines by size group, first quarter 1993

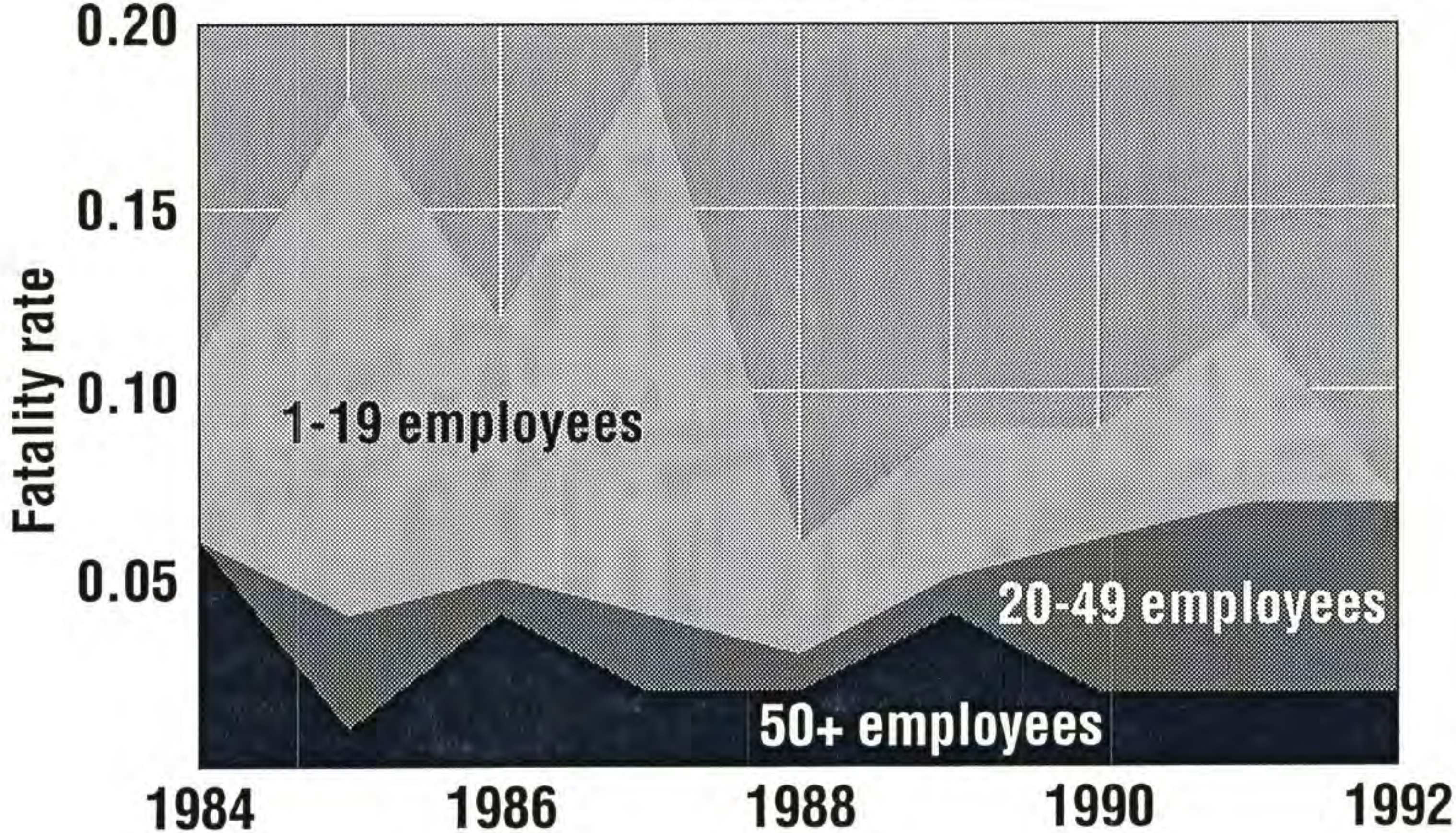


Percent of underground coal mines by size group, first quarter 1993

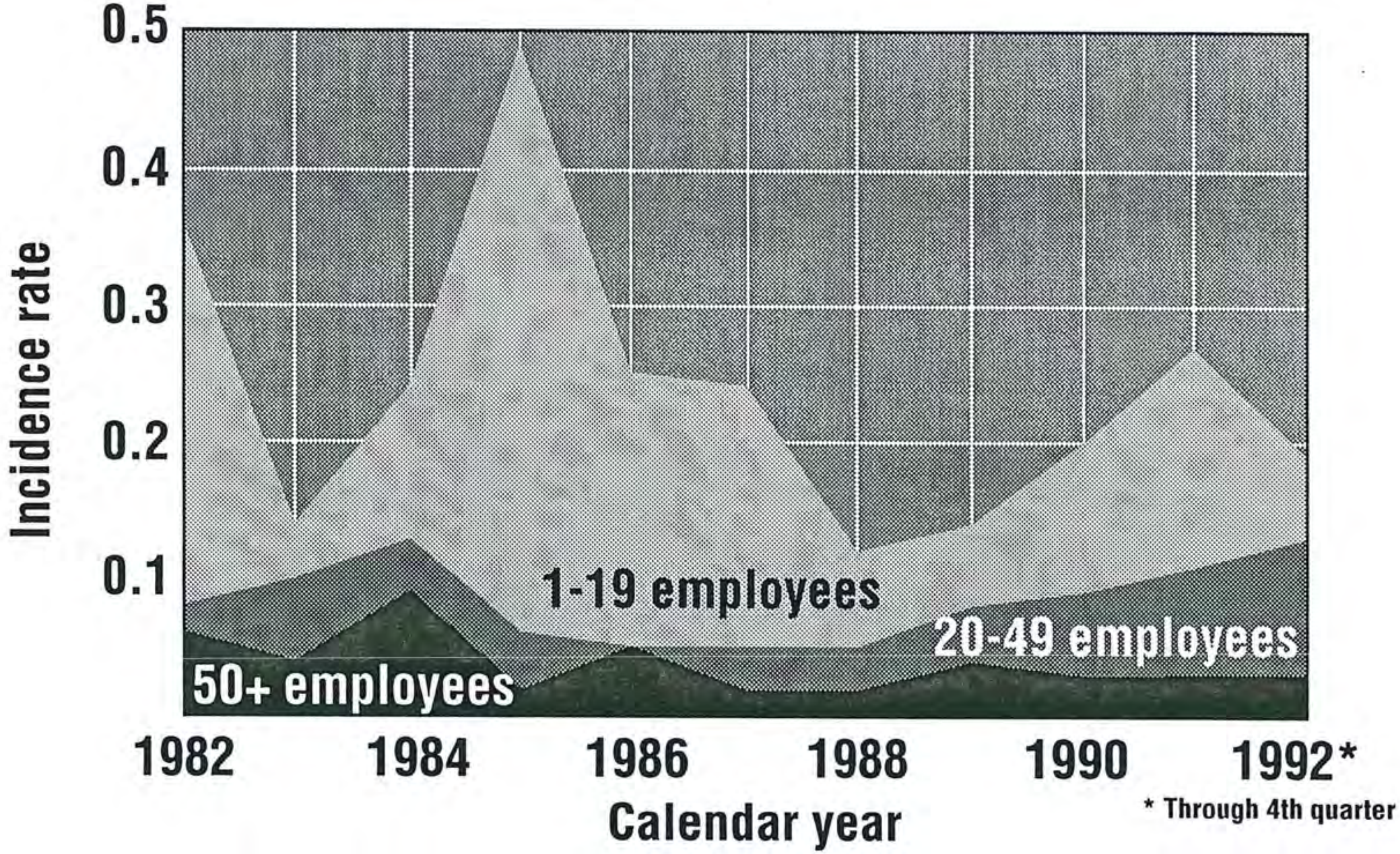


Fatality rates by mine size, 1984-1992

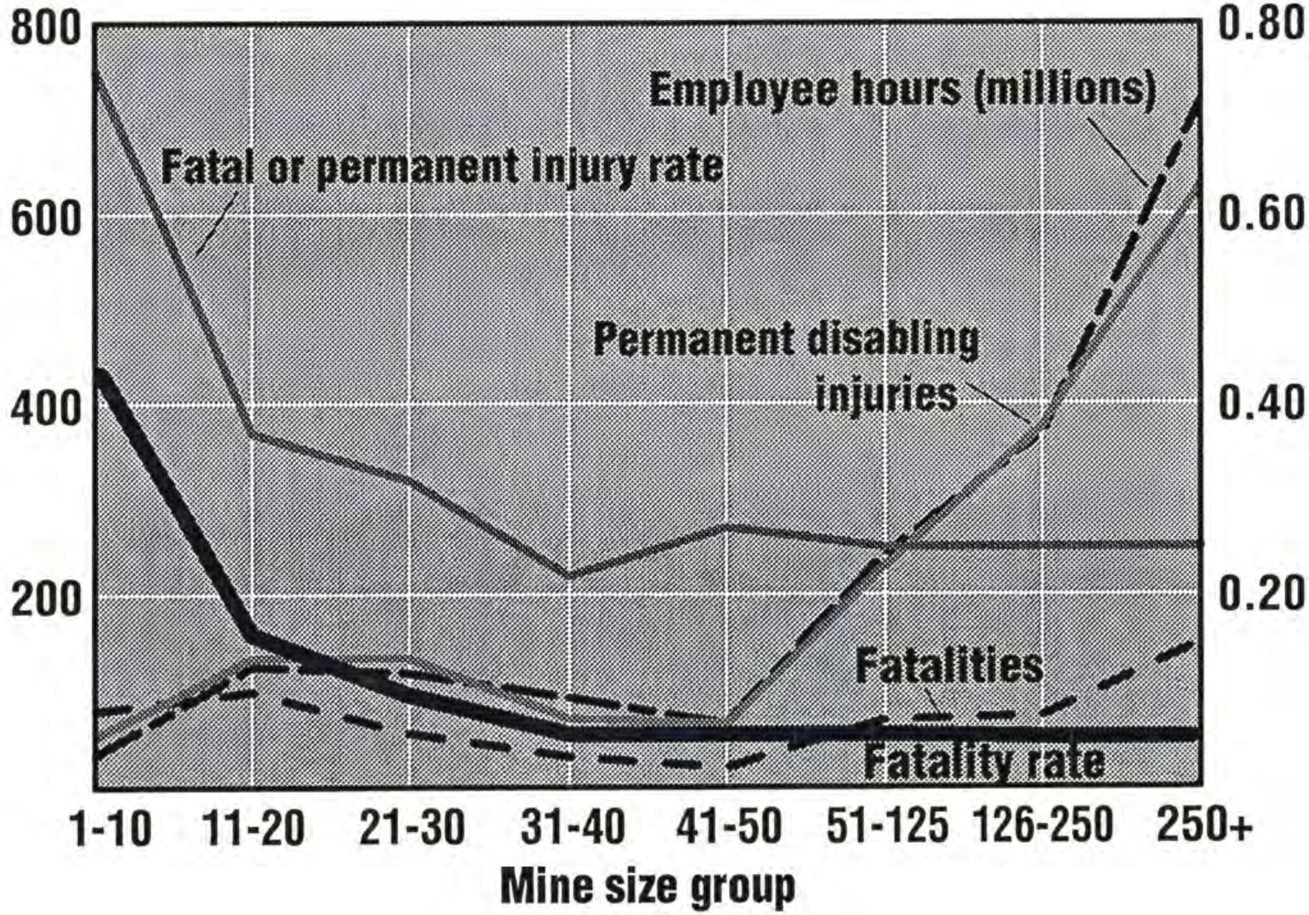
All mines



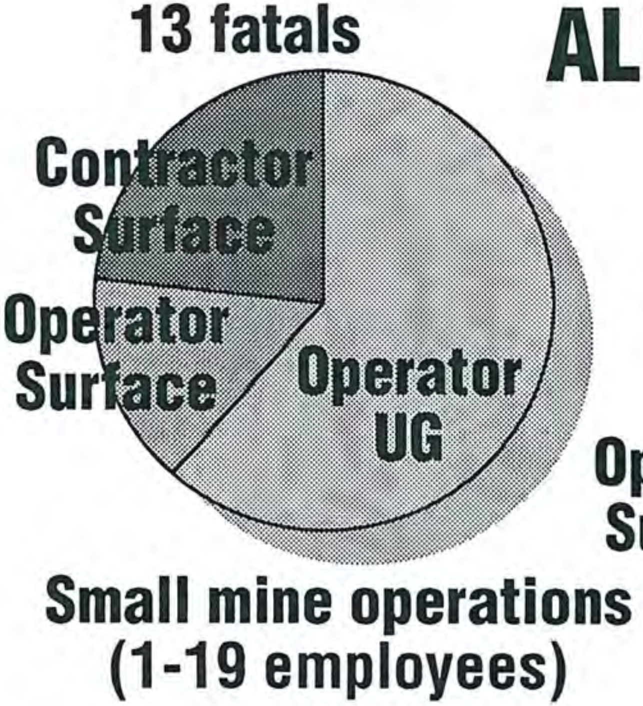
FATALITY RATES
Underground coal mines by mine size, 1982-1992

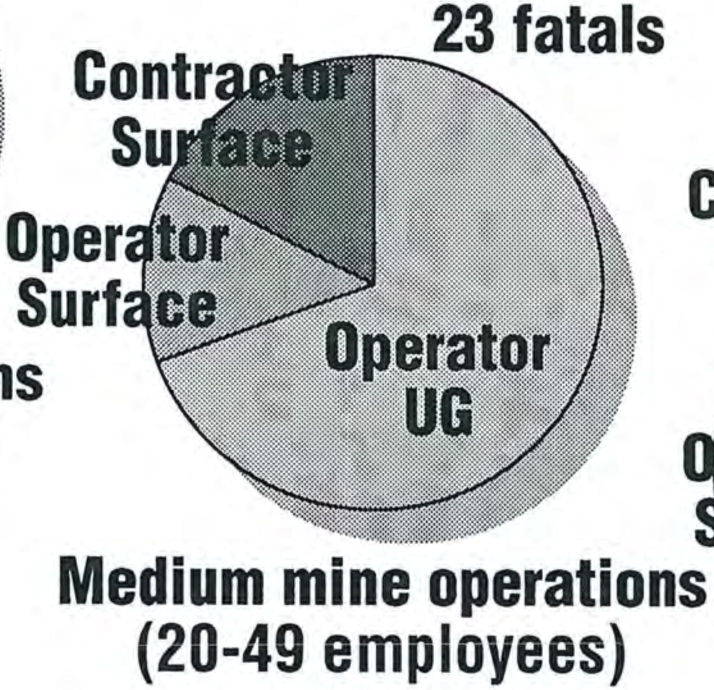


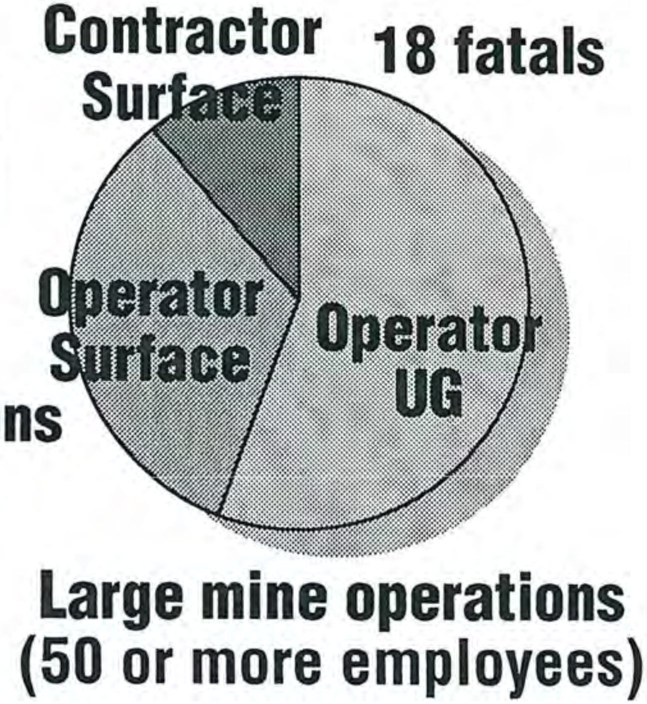
Underground coal mine data, 1982-1992



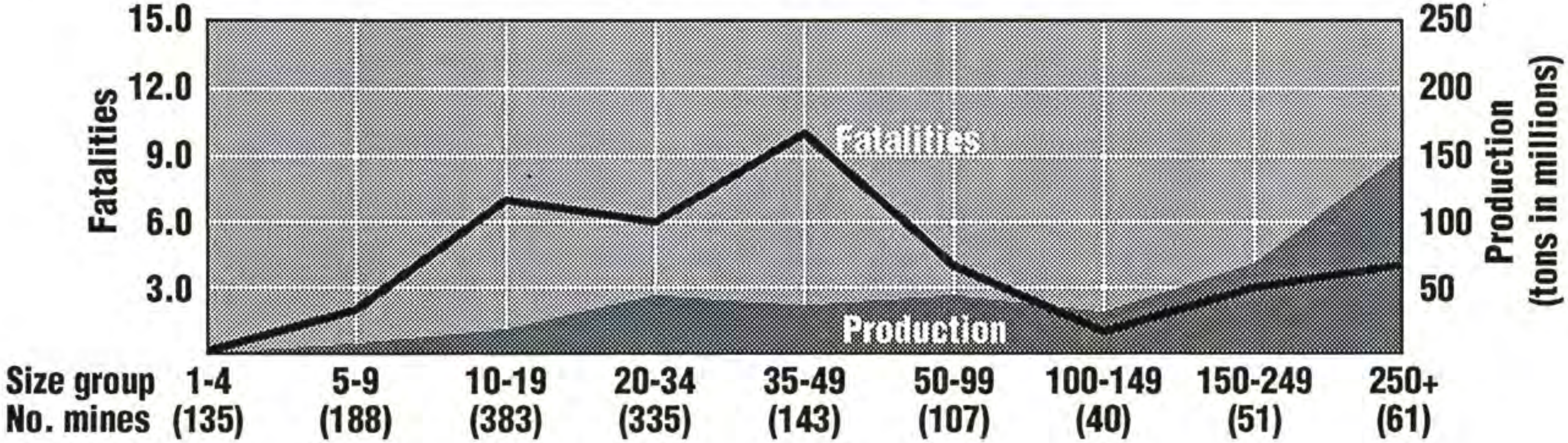
ALL COAL FATALITIES – 1992



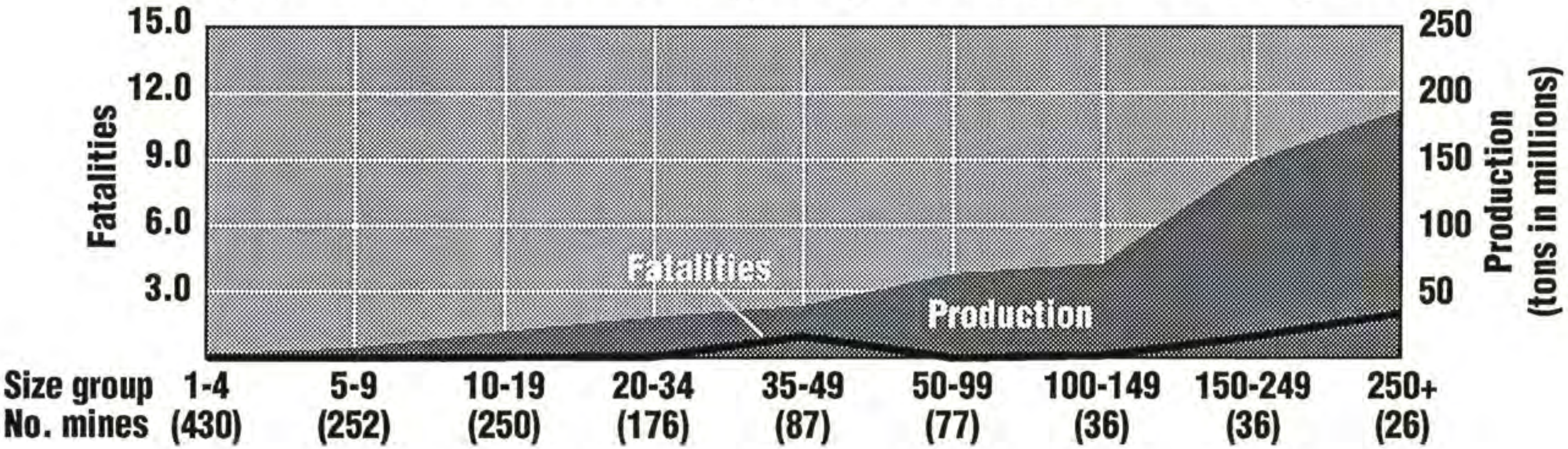




Underground coal 1992 size group national total report



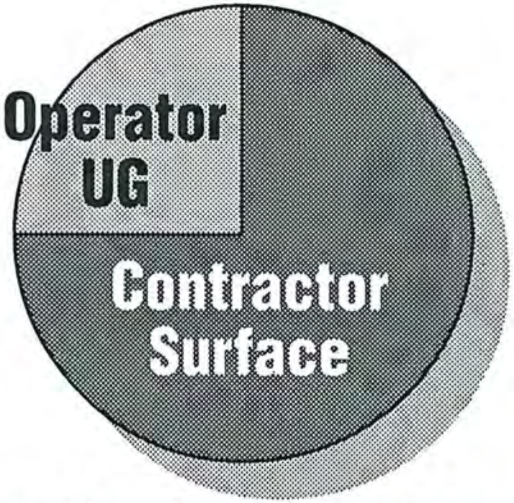
Strip/pit coal 1992 size group national total report



ALL COAL FATALITIES

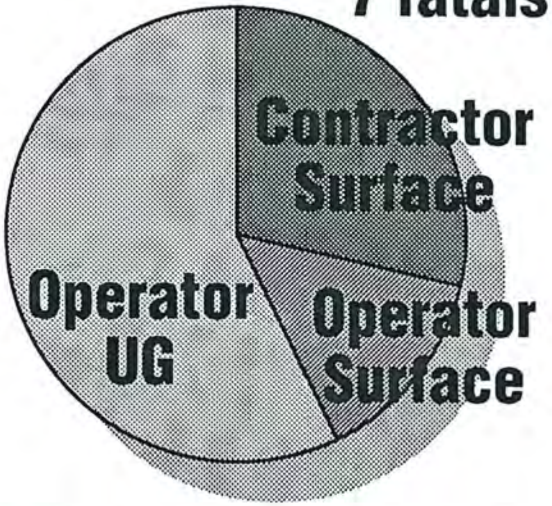
through 19 July 1993

8 fatals



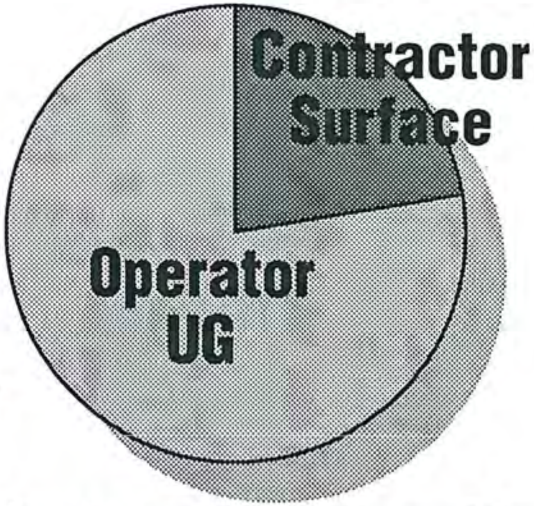
Small mine operations
(1-19 employees)

7 fatals



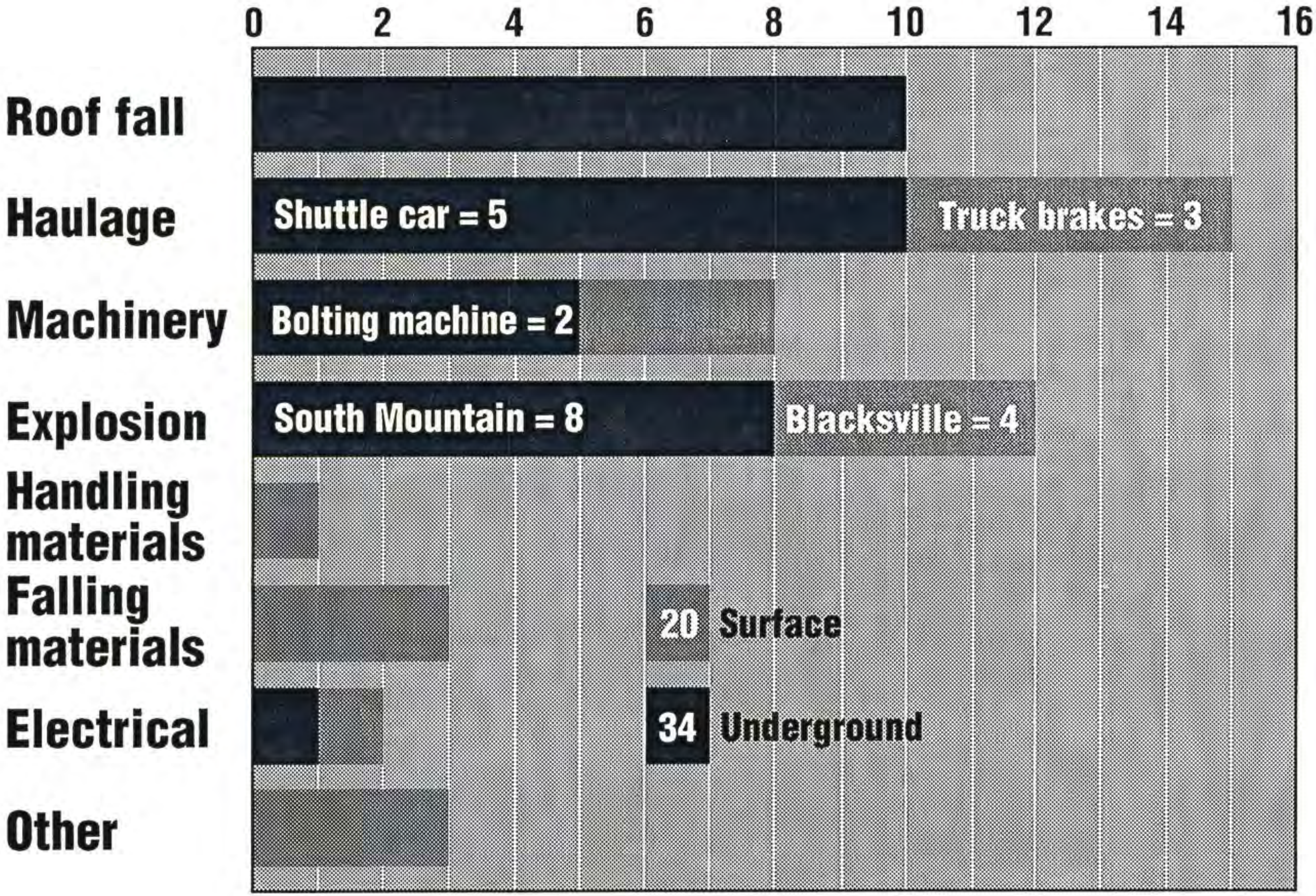
Medium mine operations
(20-49 employees)

9 fatals



Large mine operations
(50 or more employees)

1992 FATAL ACCIDENTS



MINE SAFETY AND HEALTH ADMINISTRATION'S SPECIAL EMPHASIS PROGRAMS FOR SMALL UNDERGROUND COAL MINES

Joseph A. Main, Administrator

Department of Occupational Health and Safety
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Small underground coal mines are, according to statistical data and mine enforcement information, among the most unsafe and unhealthy group of coal mining operations in the United States. Over the past several years, this sector of the mining industry has been recognized for injury and fatality rates that have been higher than the industry average.

There was a downward trend in fatal accidents at these small mining operations in the bituminous industry in the 10 year period following the passage of the 1977 Mine Act that ended in 1988; however, for the 5 year period beginning in 1988, the fatal accident rate at these mines increased every year but one. The rate last year had increased to double that of the 1988 rate. It was also more than 5 times the rate of larger underground mines.

In response to numerous deaths in the small mining industry and to public reaction, the federal Mine Safety and Health Administration (MSHA) instituted various programs. Those included the Joint Small Mines Assistance Program and the Job Safety Analysis Program. Those programs, however, have failed to rein in this problem. The federal agency has recently begun to use the enforcement tools under the mine act to respond. Those tools appear to be the most effective to curtail this coal field crisis that is harming and killing miners, and they are the ones that agency strategy must be built on.

What are small underground mines? What are their fatal rates compared to industry rates? What is their market share of coal? What conditions are miners exposed to? Who operates and controls these mines? What voice do miners have to speak out to protect themselves at these high risk mines? How effective are current agency inspection and enforcement procedures? How are safe mine operators affected by operators that ignore the laws? Are mine operators at small mines investing the capital necessary to provide safe and healthful work places for their employees? What changes are necessary to protect miners at these operations?

These are all questions that beg for answers if this coal field crisis is to be effectively dealt with. As a starter, it must be pointed out that popular federal programs with fancy sounding abbreviated titles are not the real solution to this deadly problem.

For purposes of defining small mines, they are mines that generally employ less than fifty employees. This distinction was made in the National Academy of Sciences' studies on mining accidents in the early 1980s; other distinctions have been made over the years using this same size classification.

THE STATISTICS

Fatal incidence rates at small underground coal mines have been on a steady increase since 1988, leveling off in 1992 at a rate 5 times greater than at larger underground mines. (See table 1.)

While the total underground mining industry's fatal rate was .04 in 1988 and held at .06 from 1989 through 1992, the small mine underground fatal rate rose. In 1988, the small mine fatal rate was .07. In

1989, it rose to 09. In 1990, it increased to .12, and in 1991, it increased to .16. In 1992, it barely dropped to .15.

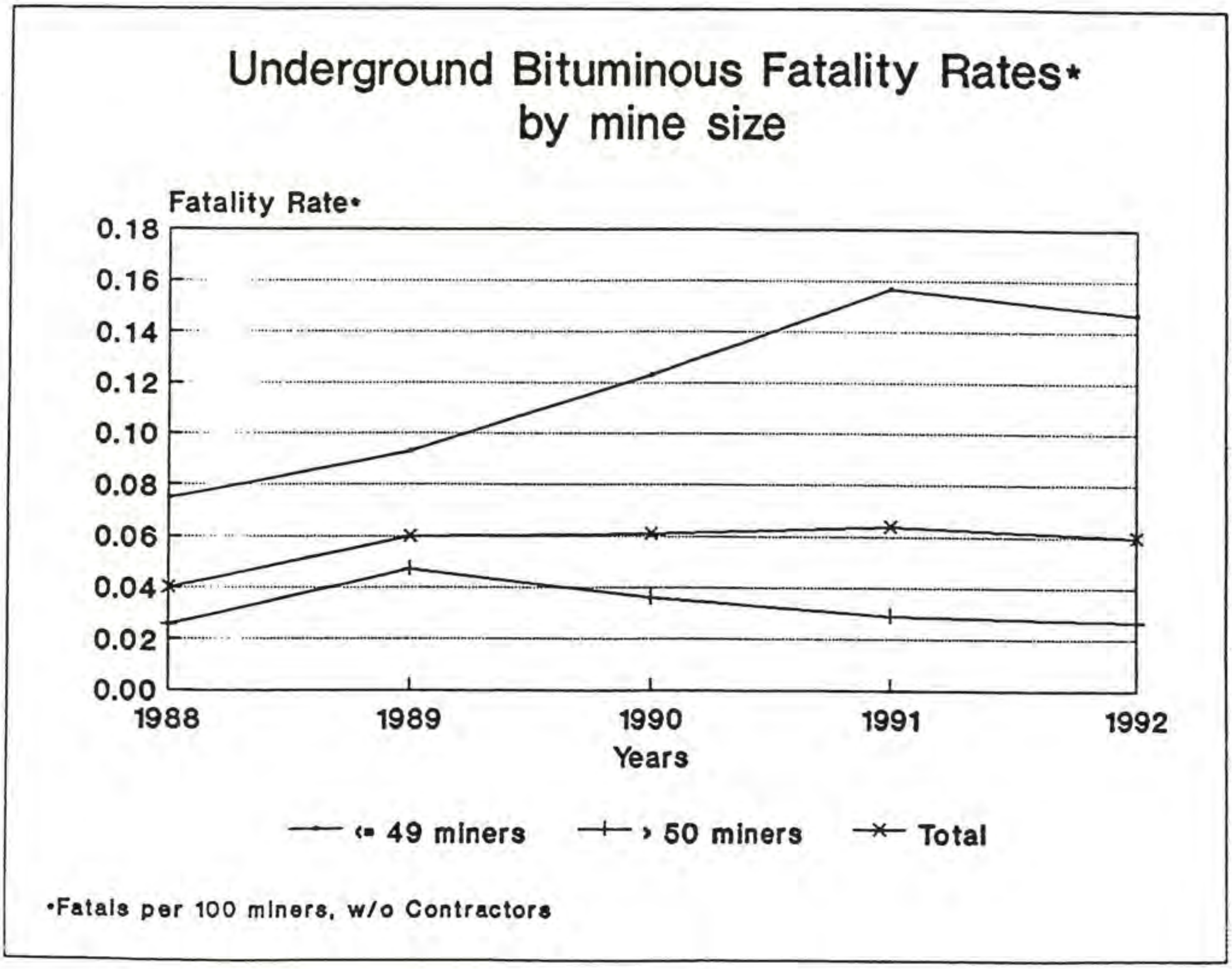
The rates for larger underground coal mines in those same years were .03, .05, .04, .03 and .03. Comparisons in other ways show how far out of balance deaths at small mines are. During the 5 year period of 1988 through 1992, small underground coal mines on the average represented 28% of the total work force and 28% of the total production in the underground coal industry. Yet the percentage of deaths in the small underground sector was much higher. In 1988, small underground coal mines accounted for 52% of the underground mining deaths; in 1989, 44%; in 1990, 58%; in 1991, 67%; and 68% in 1992. (See table 2.)

The conclusion is that when mining deaths at small underground coal mines are compared to fatal rates at larger underground mines and compared to industry production and work force figures, deaths at small mines are far out of proportion. Compared to the coal industry as a whole, the small underground mining industry fatal rate over the past two years was approximately 4 times that of the industry.

CONDITIONS AT SMALL COAL MINES

An examination of the actual conditions described in federal agency mine accident investigation reports discloses that health and safety conditions at small coal mines fail to meet those specified by the mine laws to protect miners. Moreover, as graphically pointed out, these conditions expose miners to death. Report after report describes mine operators who fail to operate safe mines; operators who fail to inspect mines for hazards before and after sending miners into them; and operators who fail to maintain critical aspects of the mine such as roof supports, ventilation systems, respirable and float coal dust, electrical equipment, haulage equipment, and methane detection equipment. They describe operator practices which allow unabated

TABLE 1



hazards to exist They describe mine operators engaging in mining practices that create unsafe conditions.

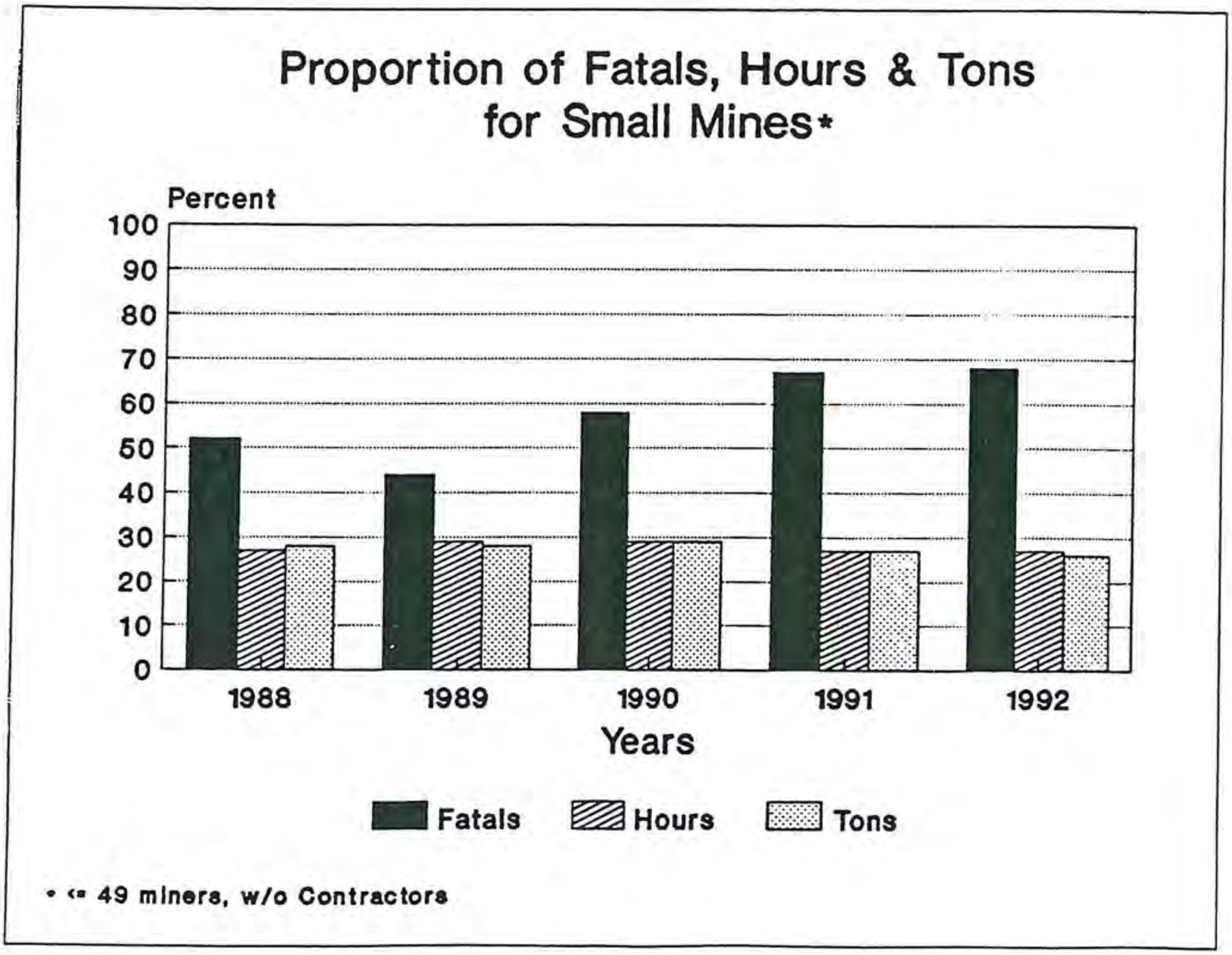
While some stand on the side lines and blame miners for their own deaths, evidence from investigation reports discloses that far too often those that operate and manage the mine and/or exercise control simply do not invest the necessary capital and resources in those mines to protect the workers. The conditions found at these mines demand the simple question, how on earth were these mines allowed to operate? The following outlines some of the conditions from agency accident and inspection reports.

Southmountain No. 3 Mine

On December 7, 1992, a coal mine explosion fueled by methane and coal dust ripped through the Southmountain No. 3 Mine in southwest Virginia. When the smoke cleared, 8 miners at this small underground non-union mine had perished. As investigators began to sift through the rubble of the explosion, evidence of a mine being operated in violation of the Mine Act and an operator attitude of disregard for the safety of the miners began to appear. By the conclusion of the investigation, questions were asked as to how that mine was allowed to operate and why agency enforcement failed to detect and halt the unsafe conditions at the mine.

The investigation disclosed that the mine operator had permitted, and, in cases, caused, by its own actions and inactions, the mine ventilation system and methane bleeder system to deteriorate to the point that dangerous methane gas accumulated to explosive levels. Pillar blocks which were essential to maintain an open bleeder system that would permit traveling the area to inspect it were removed. The mine operator also failed to make legally required examinations of the mine to detect the dangerous conditions that were being created. According to agency tests, the operator did not rock dust the coal mine, as required by law, to

TABLE 2



curtail dangerous coal dust, which explodes if placed in suspension and ignited.

The operator permitted smoking to take place in the mine and failed to put enough air into the mine to control methane, particularly in the area where miners were sent to work. The miners that were killed were sent to their work places by the mine operator without proper examinations to detect hazards.

Although mine record books had been filled out by mine management saying the bleeder system was inspected and was "OK," testimony at the investigation hearings disclosed that the operator was aware of the hazardous roof conditions that blocked examination of the bleeders and no action was taken to correct the conditions. The bleeders were not examined as required by law, as stated in the books.

Ventilation at the work place was not maintained. Maintenance of ventilation controls, to dilute methane and unhealthy coal dust, are required up to the coal face. Investigations discovered that controls were left back as far as 30 feet. Stoppings between intakes and returns were not in place.

The failure of the company to make legally required examinations of the work place to detect all these hazards was not an isolated incident.

Based on the investigation's findings, on-shift examinations and twenty minute gas checks were neglected as well. Machine mounted methane monitors designed to detect methane and de-energize the machine were not maintained. All this occurred despite the fact that mine management was aware that there was methane in the mine. There were numerous other violations found at this mine.

The mine operator's failure to operate a safe mine, examine the mine to detect hazards and prevent miners' entry into that mine cost 8 miners their lives. Many of the operator's practices occurred over a period of time.

Fire Creek No. 1 Mine

On January 16, 1991, a coal mine explosion occurred at the Fire Creek No. 1 Mine in West Virginia. The small union mine employed 10 miners. The mine, like the Southmountain No. 1 Mine, was in retreat mining at the time of the explosion. The explosion occurred when 2 miners were working in the mine while the mine ventilation system had totally failed as a result of management's actions and practices. This mine, like Southmountain No. 3, was one of approximately 6 mines operating under a lease arrangement.

Fire Creek was a carbon copy of the Southmountain explosion in several ways. The bleeder system was not operating as required; the mine was not ventilated to carry away methane gas; and methane tests were not being made before equipment was taken into working places or energized, or at twenty minute intervals. Methane detectors were not being properly tested and examined, and proper pre-shift examinations were not being made.

Mine management made their own rules here as well. If return air course flooded out, they would knock out stoppings and dump the return air in the belt entry. Records indicated that return air courses were often blocked by water, as well as the bleeder entries. The operator would send miners into the mine with the fan off or without the fan operating the required 60 minutes.

The company pre-shift examiner would take the crews in during the examinations, and evidence indicated that the pre-shift examination book would be filled out before the examiner even entered the mine. Smoking was permitted in the mine, which was one of the ignition sources. The methane monitor on the mining machine was inoperative. The mine was not adequately rock dusted to control a dust explosion.

MSHA cited over 100 violations at this small 10 employee mine during the investigation.

Granny Rose No. 3 Mine

On July 31, 1990, an explosive accident occurred at the small non-union Granny Rose No. 3 Mine in Kentucky. The accident occurred when explosives located in the scoop of a battery powered tractor exploded. Three of the 6 miners in the area were killed instantly. As investigators sifted through the aftermath of that explosion, a picture began to emerge that was far different than the pre-accident enforcement record. On its last six visits to the mine, prior to the explosion, MSHA had cited no violations of the mine health and safety laws.

During the investigation, however, agency investigators found disturbing conditions: sight lines were not utilized to maintain projections and entries were mined badly off center. When a coal face was shot, it blew through one of the very narrow blocks created by the bad mining practice and set off the explosives near the victims. The company's mining practice in the area could be compared to the remnants of a remote control miner madly out of control. Entries and crosscuts had been mined every which way.

Agency investigators found that the required mining plans were ignored. The required roof control and ventilation plan was not followed. Ventilation curtains required to control methane and coal dust were not used in any of the entries to ventilate the working faces. That exposed miners to methane, unhealthy float coal dust, and other dangerous gases. The operator failed to control float coal dust through rock dusting and to maintain the electrical equipment. The battery scoop and the electric face drill were not maintained in a permissible condition. The roof bolter had no illumination. Miners were not properly trained. Most of the miners did not have the required new miner training and/or hazard training. Illegal blasting practices were being used; they were blasting far more holes than legally permitted. The operator failed to conduct the required mine examinations and record those in the examination books. Pre-shift and weekly examination books had not been countersigned by the superintendent or assistant for over four months. Roof bolts were not being installed on proper spacings. Instead of 4-foot centers, investigators found roof bolts up to 10 feet apart. A check-in system was not in place for identification of 11 that were underground.

Harlan Kyva No. 3 Mine

Management's failure to conduct their own inspections of mines before miners are sent into dangerous areas and to correct conditions when they find them is a common finding in fatal reports. Take, for example, the March 26, 1993, fatal accident at the Harlan Kyva No. 3 Mine in Harlan County, Kentucky. This small non-union mine employed 21 people on two shifts. The mine had adverse rib conditions in a mining section. The operator had no support procedures to control the conditions. In this particular case, the pre-shift examination recorded one of the conditions; however, it was not corrected and miners were sent into the mine. A miner was fatally crushed. During its investigation, MSHA issued an imminent danger order after finding numerous areas of unstable rib throughout the section and it cited the company for not recording those areas in the pre-shift examination records.

Bullion Hollow No. 1 Mine

At the Bullion Hollow No. 1 Mine in Kentucky, two miners were killed when a roof fall 80 feet in length crushed them on April 23, 1991. This small non-union mine which employs 26 miners on two shifts had adverse roof conditions that were inadequately supported. Inadequately supported visible hillseams and cracks were observed present in the mine roof in the fall area and adjacent crosscuts prior to the accident. The operator was also mining blocks that were taking away support pillar barriers. The roof bolts were also found not to be anchored in the main mine roof.

Miller Branch No. 1 Mine

At another Kentucky coal mine, the Miller Branch Enterprise No. 1 Mine, a fatal roof fall occurred on December 4, 1991. The small non-union mine employed 13 people. A roof fall had occurred at the mine in the belt entry. It was found during a pre-shift examination. In this case, corrective action was taken; however, not in a manner envisioned by the mine act.

The mine foreman, who was also president of the company, had a crew go to the area under his direct supervision to clean up the fall. The president of the company, who was not certified to handle and detonate explosives, brought in and used explosives in a non-permissible manner to blast the fallen rock.

Throughout the day, the crew of miners under the company president's direction and supervision, worked and traveled under the unsupported roof. One miner was killed when the unsupported roof fell on him. Miners were not instructed on the procedures for rehabilitating a fall area. The operator had no plan for those occurrences and supports were not installed to protect miners.

Sure Fire 4-A Mine

At the Sure Fire 4-A Mine in Kentucky, a fatal roof fall occurred on July 30, 1992. This small non-union mine employed 17 people on 2 shifts. As the crew was entering the mine at the beginning of the 6:00 a.m. shift, a roof fall occurred killing one of the miners as they were traveling up the section. MSHA cited the operator for not making an adequate pre-shift inspection in the haulage roadways.

Laurel Coal No. 1 Mine

A fatal roof fall accident occurred at the Laurel Coal Corp. No. 1 Mine on March 8, 1991, in West Virginia. Peabody Coal Company contracted to Laurel Coal Corp. to mine the coal on their property. This mine was union and employed 18 people. The victim was a section foreman. MSHA concluded that the cause of the accident was failure of mine management to adequately support the roof; failure of mine management to follow a method of retreat mining compatible with conditions encountered; and failure of mine management to develop and follow a roof control plan suitable to conditions. All of these factors exposed miners to hazards. The agency report noted that this was the second fatality at this mine using the same pillar recovery method, and two miners had also been trapped under roof falls at this mine in the past.

J&T No. 1 Mine

Four coal miners were killed in a roof fall accident at the J&T Coal Inc. No. 1 Mine in Virginia on February 13, 1991. The mine is non-union and employed 19 people. The accident occurred as a result of mine management (the mine superintendent and section foreman) directing and participating in the shearing of coal ribs which created excessive entry widths from 28 to 35 feet wide for a distance of 115 feet. They were only permitted to mine 22-foot wide entries. Worse yet, no supplemental roof supports were installed in the area of the shearing. Mine management did not conduct adequate pre-shift examinations of the mine and did not restrict access to unsafe areas. MSHA stated that the actions exhibited by Henry Mosley (section foreman) and Gary Williams (mine superintendent) showed **total disregard** for their safety and the safety of the employees they supervised. The investigation disclosed far more problems at the mine. Forty-one citations and orders were issued by MSHA during the post-accident investigations of the mine, which included violations for pre-shift and on-shift examination books not being countersigned and water accumulations blocking passage through return airways. The water was found up to 18" from the roof. Areas of unsupported and inadequately supported roof existed throughout the mine. Accumulation of coal float dust 12" deep was found for a distance of 900 feet in the belt cover entry. Excessive entry widths were found up to 27½ feet wide in other areas of the mine and line curtain was not being installed to course air to the face to control methane and coal dust.

Brent No. 2 Mine

A fatal electrical accident occurred on November 11, 1991, at the Brent Coal Corporation No. 2 Mine in Virginia. The mine is non-union and employed 17 people. MSHA's report of investigation concluded that the fatality occurred while work was being performed on energized conductors. It also stated that a means for locking out the disconnect was not provided. They also found that electrical work was being performed by a non-qualified person; that jumper wires were used to jump out the ground monitor circuit; and grounding resistors were burned open in the power center. The report noted that mine management had been aware for approximately 6 months that the victim was not a qualified electrician and that he had performed electrical work in the past.

Barbara No. 1 Mine

The conditions found at mines following deaths also exist at other mines. As a result of an anonymous phone call, MSHA conducted an inspection at the no-union Hawkview Mining Barbara No. 1 Mine in Pennsylvania on April 16, 1991. The state agency did a follow-up inspection two days later. The following conditions were found and cited as a result of this inspection. Six of 9 working faces were advanced to a point where miners were operating the machine inby permanent roof supports. Canopies were not provided on the machines. Proper on-shift examinations were not conducted. No line curtain was installed in 4 of the 6 working faces that had been mined that day. In the 4 entries, line curtain was behind 63 feet, 39 feet, 30 feet, and 22 feet and a cross-cut was found mined through 36 feet without any roof supports.

Limousine No. 3 Mine

A water inundation occurred at the Limousine Coal Inc. No. 3 Mine in Kentucky on December 14, 1992. The non-union mine employed 42 people., MSHA's investigation into the accident found that this was the third time the mine had been inundated by water and that adequate test holes were not being drilled in areas close to the abandoned mine which contained the bodies of water. During their investigation they found that coal was being mined without any ventilation controls. Air was short circuited 6 crosscuts outby the face. They also found excessive widths were driven in the no. 3 entry where the inundation had occurred.

DUST FRAUD AT SMALL COAL MINES

Miners at small mines have their health placed at risk as well as their safety. Last year the federal government charged more than 500 coal companies with fraudulent dust sampling under the Mine Act. While those cases are being processed through the judicial system evidence of fraudulent sampling is being verified as criminal cases continue to be prosecuted.

An evaluation of the criminal dust fraud cases from MSHA data showed that following the 1991

Peabody Coal Company guilty plea, criminal dust sampling fraud charges were brought involving 64 different coal companies, 81 individuals, and 6 dust sampling contracting services. MSHA was able to provide mine size data on 52 of the companies involved. All but one was a small mine. That data concluded that the most unsafe mines in the country have all the earmarks of being the most unhealthy. The cases involved deliberate acts of distorting dust levels miners were exposed to. Examinations of conditions at small mines following fatal accidents which have had conditions frozen in time, provide a true picture of how the mines are operated. Far too often, face ventilation controls are not present and fraudulent dust samples can hide the coal dust miners are breathing at the face. Other dust data observed for small underground mines has shown suspiciously clean samples called "low weight gain" samples. Some are so clean one wonders what kind of miracle dust controls they have found. The fraudulent dust sampling list is expected to grow.

WHERE ARE MOST OF THESE ACCIDENTS OCCURRING?

Reports on 124 mining deaths that occurred at small underground coal mines in the 5 year period from 1988-1992 showed that Kentucky and West Virginia shared the worst records with 40 deaths each. They were followed by Virginia with 29, Tennessee with 6, Pennsylvania with 3, Colorado and Illinois with 2 each, and Oklahoma and Wyoming with 1. The majority of these deaths are in the Appalachian coal fields. A breakdown of those showed 85% were underground and 15% were at surface areas of underground mines.

THE MINER'S VOICE AT SMALL COAL MINES

Small underground coal mines generally have a shorter life span than larger mines. This means that miners must seek employment more often than miners at the larger, more long-term mines. In examining the agency reports on mine deaths at small underground coal mines during the 5 year period of 1988-1992, it was found that most of the mines were unorganized and, thus, miners had no collective and protective voice to speak with. Of the 124 mining deaths, over three-fourths were not represented by a bona fide labor organization. Many of the mines are located in coal field areas with high unemployment.

Miners in these coal regions worry about things like keeping their jobs, saying or doing something that may result in not getting hired at another mine when theirs works out, or being blacklisted by their own or other mine operators. Given these factors, it's easy to understand the reluctance of the miners to speak out. Miners hear stories about the slow wheels of justice or the lack thereof from state and federal agencies, when mine operators retaliate against those who blow the whistle on unsafe or unhealthy conditions. What's to protect them from the loss of future jobs for speaking out on health and safety conditions, particularly beyond their limited employment at a small mine?

It's not hard to understand why miners at Granny Rose, J&T, Limousine, Southmountain, or others put up with the conditions they were exposed to. Enforcement personnel inspecting mines, who ignore this realization may well be contributing to the unfair environment these miners are held hostage in. They are very likely the only hope these miners have when they get caught up in an unsafe operator's mine.

CONTROL AND OWNERSHIP OF SMALL UNDERGROUND COAL MINES

Many of those who exercise ownership and control over these small coal mines have been an industry secret when it comes to the health and safety laws. One reason for this is that the agencies charged with health and safety enforcement have not paid necessary attention over the past several years. MSHA has only recently begun to examine this critical aspect. Although federal regulations require mine operators to file reports with MSHA listing those individuals and companies that have financial interest and control in a mine, these standards have not been effectively enforced.

It is a standard practice for those who hold leases on coal reserves to contract out mining to so-called contract operators. Many times, when this occurs, the lessor retains control over the mining operations and the mine. In many cases they make contract arrangements with the contract mining company that allow the lessor to control many aspects of the mining operation. This may include directing what reserves are to be mined, how, and when they will be mined. Some include setting the price to be paid for coal produced and directing the coal to specific markets or customers, including themselves. Some lessors control setting the coal reject rate--meaning they may pay nothing for coal considered reject coal. They also control the contract operator financially by holding loans and leasing or loaning equipment. Most such lease contracts likely contain language that gives the lessor the big gun to put to the contractor's head, allowing the lessor to terminate the contract operator's mining contract with short notice.

Despite these enormous controls and financial interests, lessor operators seem to escape both identification and responsibility under the Mine Act. The contract operator dangling at the end of the lessor's leash has been held as the accountable party. These contract mines are generally small coal mines.

The federal agency has been neglectful in scrutinizing the legal identity documents filed by mine operators. When false reporting has occurred where individuals did not list other connected mines, individuals, and companies, MSHA has failed to take appropriate action for false reporting of information. It is generally believed over the past years that mine operators did not expect scrutiny of the operator legal identity information they filed. Unlike MSHA, its sister agency, the Office of Surface Mining (OSM), is light years ahead in the development of a database to determine ownership and control of coal mines. They keep track of lessors and individuals that operate and control mines. Those systems are utilized to track down those that have control of mines to identify violators of environmental standards, to force them to correct environmental damage and to block individuals from operating mines that left environmental damage in their path. Unlike MSHA, OSM has realized the type of controls lessor operators have over mining operations and they hold them accountable for environmental damage. Unlike MSHA, OSM has and uses tools to prevent violators from further harming that which they have been charged to protect.

Despite what may be a common belief by some--that these small mines are just mom and pop operations struggling to make a living--in many cases this could not be further from the truth. The problem, however, is that much of the information that would disclose who really has financial interest or control over these mines is not in MSHA's information base.

Take, for example, the investigation into the 1992 West Virginia Fire Creek Mine explosion.

The MSHA legal identity report required by mine safety regulations listed the president of Fire Creek Inc. as W. Fred St. John with Ronald Lilly as secretary of the company. It also listed Ronald Lilly as the superintendent of the No. 1 Mine and as the person in charge of health and safety at the mine. It listed Donnie Coleman as the person with overall responsibility for a health and safety program. The legal identity report for that mine said that Fire Creek, Inc. was not a subsidiary and no other individuals or organizations had an interest in Fire Creek Inc. The legal identity report did list one other mine that the Fire Creek Company or its officials had an interest in. This information, however, was far from the truth.

The UMWA's investigation into the ownership and control of the Fire Creek No. 1 Mine disclosed that the mine was not just a small mine with these limited connections. According to entries on the official mine map, the Fire Creek Mine was part of the Pocahontas Land Corporation tract and a company named Southern Minerals, Inc., was listed as the sublessee.

The officers of Southern Minerals, Inc., according to the West Virginia Secretary of State's office, were D.L. "Jack" Bowling, President; W.F. St.John, Vice President; and Brenda Bowling, Secretary Treasurer.

Sorting through an array of paper filed on each mine and piecing the information together, the investigation disclosed that at least six other small mines besides Fire Creek had been set up as separate companies and they had been operating on the Southern Minerals, Inc. lease.

The legal identity reports for each mine were reviewed. That review disclosed that some officials citing interest for one mine were not listed on the other mines' legal ID report. More names started to appear as each form was reviewed with more information failing to match up as reported on other forms. Some of the mine legal ID reports did list, by name, the president of Southern Minerals as having control and interest. Some forms listed the Southern Minerals Company address (but not the company name) as an official address. For the most part, Southern Minerals, Inc., was hidden on the legal identity reports. The mine ID reports claimed they were not a subsidiary of another company, in other words, not a subsidiary of Southern Minerals, Inc. It was interesting that the same individual was filling these reports in different cases. It was obvious that information was withheld from the legal identity forms but the company's sloppy practices left enough of a paper trail to track.

The control and ownership issue became more evident after reviewing events following the accident. According to personnel at the mine following the accident, decisions on rescue, recovery, and rehabilitation actions at the Fire Creek No. 1 Mine would be made by the president of Southern Minerals, Inc. The officials at Fire Creek reportedly contacted him for direction and were in constant communication with him. Officials from others of the six mines showed up at the mine. One of the principal officials listed on two mines under the Southern Minerals lease, not connected with the Fire Creek Mine, was one of the key management people on site at Fire Creek.

Although in the end MSHA used the data collected to tie the group together, they did not take any known action for the false information listed on the legal identity forms. Had the secret worked, Southern Minerals and the individuals that made up the collection of small companies might have walked away from Fire Creek, letting someone else clean up the financial and social mess left behind.

What could easily have happened in many other cases such as this is that mine operators just go out of business and leave the industry or the government to pick up the tab. This hidden information also lowered operator fines. It kept out of sight operator/company size and violation information, which would increase penalty amounts.

Another case involved companies charged with criminal actions of fraudulent dust sampling in the so-called "Triangle Resources cases." After receiving information that the mines charged were connected with larger companies, the UMWA requested that MSHA provide a list of controlling companies who operated the 33 small mine operations charged. Given MSHA's apparent lack of information, the UMWA requested that MSHA contact the Federal Office of Surface Mining to obtain the information. The report on that investigation of ownership showed how much more effective OSM data is. While OSM compiled a list maintained in their data banks, MSHA had personnel in the field go out and, by conversation, piece the information together. In the end, the data provided was enlightening. These small mining operations earlier referred to were actually lease operations and the lessors/permit holders were larger nationally known companies. They included Inspiration Coal, Inc., United Coal Company, the Pittston Company, MAPCO, Rapoca Energy, and Harman Mining. Acknowledgement of mine operator contract mining operations has been hit or miss.

On April 4, 1991, a miner was killed in a roof fall at a small underground mine in McDowell County, West Virginia. The mine operator was listed as Clinch Valley Coal Corporation. Information indicated that the mine was a contract operation for Consolidated Coal Company. That, however, was not included in MSHA's investigation report.

A roof fall accident occurred on March 8, 1991, in Boone County, West Virginia. The operator of the mine was listed as Laurel Coal Corporation. The agency report did state that the mine was contracted by Peabody Coal Company to Laurel Mining. The terms of the contact between Laurel and Peabody, which would disclose the financial interest and control exercised, were not addressed in the agency report.

Control and ownership issues arose at the Southmountain No. 3 Mine. Documents dated December 1991, from the Virginia Department of Mines, Minerals and Energy, Division of Mine Land Reclamation, showed that mining permits for some of the Southmountain operations had been blocked by that state agency. According to the documents, the permit blocking action of the Southmountain mines stemmed from the fact that an individual listed as an operator of some of the mines, Mr. William Ridley Elkins, had unabated environmental violations while operating mines for another company. A hearing action was held over the mine permit block by that division. According to the state document, Mr. Jack Davis, president of Southmountain and Apple Coal Company (the parent company), claimed he had all the control of the Southmountain Company which owned the No. 3 Mine. The report states that Davis indicated that Mr. William R. Elkins was only a consultant, and Elkins' role was described as one not exercising control over the mine operations. According to the Virginia Department of Mines, shortly after Messrs. Davis, Elkins and another Southmountain official convinced the Department of Mines and Land Reclamation that Mr. Elkins was nothing more than a consultant, the permit blocking action was dropped. The mine license was changed, removing Elkins' name and listing Davis as the mine operator of the Southmountain No. 3 Mine. The MSHA required operator legal identity report was changed as well.

Elkins' role at Southmountain gained attention again as the investigation into the Southmountain No. 3 Mine began. According to employees of the Southmountain No. 3 Mine, Elkins exercised extensive control over the No. 3 Mine. Although Mr. Elkins' official title was "consultant," MSHA considered Elkins to be a mine operator with full authority to control all aspects of the No. 3 Mine operation based on information collected during the investigation hearing.

The investigation also disclosed that another company, Virginia Iron and Coke Company, who held the mining lease for the No. 3 Mine, prepared and furnished the mining plans for the Southmountain No. 3 Mine to Southmountain to be followed. They exercised control over the mine and apparently had a financial interest as well. Whether MSHA examined the contractual relationship for compliance with operator legal identity reporting requirements is unknown. The December 8, 1992, Southmountain disaster investigation raised serious unanswered questions as to who had control and interest in the Southmountain No. 3 Mine.

UNSAFE MINE OPERATORS WHO JEOPARDIZE MINERS' LIVES

As pointed out, under the 1977 Surface Mine Reclamation Act, OSM can bar individuals from operating and controlling coal mines to protect the environment. There are no similar tools utilized under the Federal Mine Act where the damage is far more significant--human lives. The recent investigation into the Southmountain No. 3 Mine brought to light the confused priorities between mine safety and environmental laws. MSHA's investigations disclosed that the individual listed as a "consultant" at the Southmountain No. 3 Mine was actually the operator of the mine. The so-called "consultant" was listed that way because he was barred from operating coal mines due to previous environmental violations. The Southmountain Coal Company had their mining permits blocked by the federal Surface Mining Act because the individual was listed as the mine operator. Following the December Southmountain disaster, that individual was cited along with the company for several violations. While he is barred from harming the environment under the Surface Mine Act, he is still free to operate mines under the Mine Act and continue to affect the lives of miners. MSHA stated the violations by Southmountain and Elkins to be cause by a high degree of negligence and a reckless disregard for the mine law.

Equally troubling is another case involving ownership and control of mines. On February 13, 1991, a mine roof caved in at the J&T No. 1 Mine in Virginia, killing four miners. Federal investigators found several serious violations of the mine law. The federal agency fined the company nearly $300,000 in civil fines for the violations.

The U.S. Attorney's Office prosecuted the company. The company was ultimately convicted for six criminal mine safety violations stemming from the four miners' deaths. The company faces additional criminal fines, possibly in the millions of dollars, as a result. According to published reports, the owners filed for bankruptcy and then formed a new coal company called the Red Creek Coal Company.

In other words, mining companies found guilty of egregious health and safety violations at coal mines which lead to coal miners' deaths can, without restraints, start up a new company and go on with business, while the same individuals who operate mines that damage trees or pollute steams or cause other environmental damage, can be blocked from operating coal mines. There is definitely something wrong with the priorities when a minnow in a stream has much more protection from harm than the life of a coal miner. MSHA needs to take a page from the OSM permit blocking book.

MSHA's certification of the management personnel that supervise and examine coal mines for compliance with mine laws is likewise defective. It is in most cases a rubber stamp of state certifications. MSHA has no decertification provisions, so decertification of individuals is left up to the states. When states do act, it is far too often on the heels of major tragedy that gets enormous public attention. In situations like the 1989 Kentucky Pyro disaster, despite massive national attention and boat loads of criminal charges against certified individuals, it just doesn't happen. When action is taken on the state level, it usually is against some low level official. Some states, however, do a better job than others. Another flaw is that many top officials who can dictate the health and safety conditions in mines hold positions exempted from certification requirements altogether. MSHA recently added to that dilemma by eliminating some of the controls which held top level management accountable for correction of unsafe conditions in underground mines through ventilation regulation changes. In its current form, the certification system and management accountability system does not work to hold management officials that make decisions responsible and accountable.

AGENCY INSPECTION OF SMALL MINES

The fatal statistics, investigation findings following mine accidents, inspection reports, conditions unearthed in criminal cases and other information disclose that the current inspection/enforcement approach is not protecting miners from death, injury, or exposure to illness at small mines. Conditions described in accident reports and other investigative findings exhibit the existence of conditions which violate mine health and safety laws at small mines of a most dangerous and unhealthy nature. Those cannot be resolved by throwing some training and cooperative efforts with management at small mines. Although improved training is needed, this will not cure the problem. The sad reality is that some operators lack or just do not invest the capital and resources necessary to operate safe and healthy coal mines. Unsafe mines are at times propped up by ineffective inspections and weak enforcement actions, which result in injuries or deaths. The ones injured or killed are not the ones in control of the purse strings, making the decisions.

Evidence has been mounting which suggests that some small mine operators design compliance around agency inspections. Take the Southmountain disaster, for example. As noted, several violations of the mine law occurred at the mine. MSHA's report suggests that many of those occurred following MSHA's last regular inspection, completed at the end of October. The next regular inspection would occur sometime after the first of the year. The state, likewise, completed its last regular inspection the last part of October, and was on the same inspection cycle.

The mine operator was doing retreat mining and in a short period of time would have completed mining the area where the explosion occurred. It would have been closed off to further inspections through natural caving of the roof. The numerous violations would not have been known, except for the fact that they didn't succeed in their unsafe ventures. By all indications, they were not expecting agency inspections or tough actions for what they were doing. The same scenario can be found at other mines.

There have also been reports that when inspectors show up to inspect a mine, they encounter transportation delays, or they may be met with the offer of a cup of coffee and a discussion with management, or other diversions occur to allow time for cleaning up or hiding violations. Mine operators may just simply shut down the mine.

Inspections can be too predictable and too controlled by the mine operator. The review of enforcement activities following the 1991 J&T accident disclosed that the use of routine inspections provided this predictability for mine operators. Evidence exists that special agency strike force inspections have a different result than a single inspector doing routine inspections.

For instance, following the 1990 Granny Rose accident in Kentucky, MSHA targeted 11 small mines in the general area of the Granny Rose Mine with special inspections using more than one inspector at the mine, with the element of surprise. MSHA issued 11 small mines during those task force inspections.

This compared to only 13 closure orders and 131 citations during the agency's routine regular inspections previously at these same mines.

AGENCY INTERNAL INVESTIGATIONS

MSHA has been criticized for failing to conduct adequate inspections of coal mines and failing to include, as part of accident investigations, possible agency enforcement failures which may have served as contributory factors. At small mines which usually lack a worker representative watch dog, this problem can be most serious.

As a result of long-sanding criticisms from Senate and House congressional committees and the public, the agency, following the 1989 Pyro Mine disaster, implemented a policy to investigate its own actions following accidents.

The policy, unfortunately, applies only when 3 or more miners are killed. As most know, deaths at small mines usually happen one at a time. So this policy, by design, will not apply to the great majority of small mine death investigations. Since the implementation of this policy, MSHA has conducted only three internal investigations following small mine accidents. Those were the Kentucky Granny Rose Mine accident in 1990, the Virginia J&T Mine accident in 1991, and the West Virginia Fire Creek Mine accident in 1991. The results of those three internal investigations, however, raised serious questions.

The three reports disclosed a reckless disregard by mine operators for the mine laws and miners' health and safety. They disclosed a failure of enforcement by MSHA to maintain compliance with the laws to provide any comforting level of protection to the miners.

The agency's internal audit into the explosives accident at the Granny Rose No. 3 Mine in Kentucky produced disturbing findings regarding agency practices. During the agency officials' last six visits to the mine, prior to the accident, no violations were cited. These were generally technical inspections. The last actual agency inspection occurred 111 days prior to the explosion. During MSHA's investigation of the accident they found a mine that gave a new meaning to the phrase unsafe. Sixty-seven violations were cited at this small mine. Fifty-five were so serious they resulted in closure orders. Conditions cited include the following:

- Failure to comply with approved roof control plan;
- Failure to follow the mining plan;
- Failure to comply with approved ventilation plan;
- Improper ventilation of the working place;
- Illegal blasting practices and procedures;
- Failure to control coal dust;
- Failure to apply rock dust;
- Failure to maintain electrical equipment;
- Failure to train miners; and
- Failure of operator to conduct required examinations and record hazardous conditions observed.

Agency enforcement at this mine could be described only in one way--non-existent. The agency's internal investigation report on the Granny Rose accident listed the following conclusions:

> The internal review disclosed several weaknesses in MSHA's enforcement activities at the No. 3 Mine and other similar mines in District 7. These weaknesses are:
>
> 1. District 7 management failed to recognize the need to tailor inspection procedures so that enforcement personnel could effectively evaluate compliance at some small mines. While the inspection procedures may not have allowed District 7 personnel to effectively evaluate compliance at some small mines in the district, the inspection data suggests that enforcement personnel did not strictly enforce the Mine Act and its standards and implementing regulations at the No. 3 Mine and at other similar small mines in District 7.
>
> 2. Inspection data suggests that prior to the accident the level of enforcement at the No. 3 Mine and at other similar small mines was not appropriate for the poor compliance behavior of the operators.
>
> 3. MSHA's civil penalty program was not an effective deterrent to noncompliance at some small mines in District 7.
>
> 4. There have been a disproportionate number of explosives-related fatalities in underground coal mines that blast off the solid when compared to the total number of explosives-related fatalities at all underground coal mines. Approximately 95% of the fatal explosives-related accidents in the last 10 years occurred in mines that blast off the solid. These mines currently account for approximately 18% of the underground mines that use explosives during the coal extraction process.

The internal audit on the Fire Creek Mine explosion discovered disturbing enforcement practices. The conditions found during the explosion investigation which were violations of the mine act were not being cited during routine inspections. The agency post-explosion investigation cited 104 violations at this small mine. Sixty-eight of those resulted in closure orders. The agency's inspections during the last two inspection quarters prior to the explosion, however, cited only fifteen citations and one closure order.

The internal audit disclosed that violations dealing with the mine ventilation system and critical to the safety of miners were ignored, improperly cited and at times condoned.

Coupling the internal report with the UMWA's findings, it was found that citations were issued at the mine on blocked bleeders and return entries as non-serious conditions giving mine operators unreasonably lengthy abatement times. Worse yet, those violations were ignored for months past the abatement period with no action. Although MSHA was aware that one of the mine return aircourses blocked travel due to water accumulations, company examination records indicated that the other main return air course had been obstructed as well. Despite these circumstance, the return air courses were not inspected at all during the agency's quarterly inspection. The day prior to the explosion an inspector found that one of the two mine ventilation fans was inoperative. Based on the company's response that they had a plan to operate without the mine fan, no action was taken. There was no such approved plan.

The quality of inspections underground failed to detect the totally inadequate ventilation system at the mine. The inspections failed to detect the company's failure to conduct adequate pre-shift, on-shift, weekly, electrical, fan, and other required examinations at the mine. The internal report disclosed that inspectors did not arrive at the mine in time to go in with the man trips. Questions remain as to how much time was actually spent underground.

The internal agency report on the February 13, 1991, mine roof fall accident at the J&T Mine in Virginia addressed the findings of agency investigators as compared to routine inspection findings prior to the accident. The agency report stated that while forty-one citations and orders were cited during the accident investigation only 10 were cited during regular inspections in the 4½ month period prior to the accident. As noted previously, the mine had been operated in reckless disregard for the miners' health and safety. The audit noted that various conditions existed at the mine that were not cited during previous agency inspections, and agency inspectors were ignoring more effective enforcement tools designed to achieve compliance when violations were cited. The report noted that when regular inspections began at the mine, inspectors would go to the mine on successive days until the inspection was completed. Regular inspections of the entire mine would not normally occur again until the next quarter. The regular inspections would last only a few days and would not reoccur for months. This type of inspection is far too regular and is easily predictable by mine operators. The J&T internal audit disclosed that the MSHA District ventilation plan review did not disclose several ventilation deficiencies.

The bigger questions left by these internal investigations were, what is going on at the other small coal mines, including those where miners were killed, but where internal audits were not conducted. How bad is the enforcement at other mines?

If agency enforcement flaws exist like those found at Fire Creek, Granny Rose, and J&T, they should be rooted out and cured. When the numerous agency enforcement failures found by MSHA during the Pyro internal investigation are added to the three just addressed, it provides a compelling case for reform of the agency investigation process. Self-serving investigations have been the subject of criticism for years. There is concern where the same branch of the agency investigating accidents is responsible for the enforcement of the law. Other issues have arisen regarding agency investigations, such as allowing mine operators to sit in on hearings at unorganized mines, bearing down on the words of miners, who have no real representation, while they tell what caused an accident. That intimidating setting usually nets poor results. Failure to permit labor representatives' questioning of witnesses during hearings to get at the truth, and failure to examine facts contributing to accidents have also been criticisms. Narrowly focused investigations that fail to get a broad view of both compliance and enforcement allow flaws to continue which will likely surface again.

With most mining deaths occurring at small underground coal mines, and with the outrageous conditions found in this mining sector, the impact of flawed investigations are felt nowhere else more greatly than here. The mine investigation system needs to be overhauled.

EFFECTS OF UNSAFE OPERATORS IN THE COAL MARKET

There are three simple dictates that must be part of any strategy to end the small mine health and safety crisis:

(1) Coal mine operators must comply with the mine health and safety laws, to protect coal miners' health and lives.

(2) Those that enter the market without (or no longer have) the sufficient capital and resources to comply with the mine health and safety laws should be out.

(3) Those who operate unsafe and unhealthy mines and, in particular, those whose negligent actions cause harm to miners should get out and stay out.

After reviewing several mine accidents at small coal mines, it is apparent that these principles are not in place. Unsafe mine operators are in the industry and they have several important effects. Miners are suffering injury, illness, and death. Society is left in many instances to pay for their mistakes through government assistance such as social security or other compensation to injured miners and surviving families. Industry is left with some of the bills when miners contract black lung or environmental damage occurs when under-capitalized mines go under in the wake of tragedies. Safer mines also can be socked with higher compensation rates as a result of injuries and deaths at unsafe mines.

The Federal Office of Surface Mining reportedly pulled the mining permit of a mine operator in Tennessee recently citing, among other things, that the operator did not have the capital necessary to safely implement the mining plan. That is a measure MSHA should employ.

Some that profited from mining by keeping their financial interests hidden behind the scenes have walked away while society and the rest of industry clean up the mistakes. This is unfair to safe and responsible operators and should be unacceptable to the tax paying public. Unsafe mines, in the end, operate at the expense of the public.

Practices are found to exist at many small coal mines that both the mine law and safe operators won't tolerate. They often involve short cuts and cheating in areas that give unsafe operators unfair advantages. For instance, operators that do not halt production as required by law and do not have the common (health and safety) sense to install ventilation curtains; take methane checks; check mining equipment; install roof supports on safe sequences; make proper mining cuts; control float coal dust; and clean up coal spillage can, in a shift's time, outproduce safe operators and sell coal cheaper, so long as they can beat the odds against disaster. Add to that unsafe operators who, to save money, don't control respirable dust by maintaining necessary dust controls; don't employ the personnel necessary to conduct inspections of the mine; don't stop production activities to correct hazards; don't train miners; take more coal out of entries than permitted; don't install roof supports; don't maintain return and bleeder entries; and shut down mine fans to save electrical costs.

Maintaining a coal mine in a safe and healthy condition requires expensive resources with both personnel and capital expenditures. Reports on small accidents reflect that many of these short cuts are being taken and, while disaster is by some miracle avoided, those that play these odds, that recklessly disregard miners' lives, are beating their competitors at the market.

This mining attitude is putting safer mine operators out of business and has created an unfair market disadvantage for the more conscious operator. It would also cause some to think twice about maintaining safe mines while losing coal contracts to competitors. Safer mine operators don't speak out openly about this unfair enforcement/compliance problem. That's unfortunate.

Along those lines, there has been a paring down of safety standards over the past decade. The coal market is so competitive that capital expenditures are being reduced to marginal levels.

Another element is coal buyers. Coal purchasers buy without a conscience. They don't ask questions about health and safety conditions of the mines the coal comes from or the health and safety reputation of the sellers. That is unfortunate. TVA purchased coal, however, may have some obligations along those lines, but at present doesn't appear to exercise them.

CONCLUSION

Death rates at small underground coal mines are significantly higher than those at larger underground mines and the industry as a whole. Conditions found at the small coal mines are threatening miner's lives, health and general safety. Affirmative action is necessary to carry out compliance with the Federal Mine Act to curb deaths, injuries and threats to miners' health and safety.

While increased training and education can be part of that effort, they are not the tools that will be most effective to bring about an ultimate solution.

Evidence shows that some operators do not invest the capital and resources necessary to maintain healthful and safe mines at levels required by the Mine Health and Safety Act. If they cannot, the penalty and enforcement tools of the mine act should be used to prevent them from exposing miners to illness and death. Additionally, new tools should be created such as those used recently by OSM to deal with under-capitalized mining operations.

Evidence shows that some mine operators have exhibited an attitude of reckless disregard toward miners' health, lives, and general safety by the way they design, alter, inspect, and operate their mines. They should not be permitted to operate in that fashion. If their actions have shown a pattern of such attitudes or if their actions have harmed miners, such individuals should be barred from future opportunities of placing miners at risk. Additionally, federal certification and decertification provisions should be developed to address mine site responsibility.

Evidence shows that mine operators are taking maintenance, examination, hazard correction, and other short cuts which allow them to produce more coal at the risk of miners' health and safety. Mine operators that engage in health and safety short cuts which violate the law, place miners at risk, and give them an unfair market advantage over operators that do comply with the mine act, should be dealt with by the fullest measure of the law.

Evidence shows that mine operators have neglected operator examination requirements. Mine operators who fail to conduct their required examinations under the mine act, fail to record the hazards or fail to correct hazards as required by law, should be dealt with by the full measure of the law.

Miners at small mines in many cases lack a protective voice to address the conditions that adversely affect their health and lives. New tools must be created that provide an avenue for them to receive assistance in carrying out the intent of the Mine Act and providing increased health and safety protection. Funding for miner training to educate miners on their rights and representation services should developed. Additionally, a 1-800 telephone number should be conspicuously posted at each mine for miners to report unsafe conditions.

Over the years, individuals and companies that exercise ownership and control and/or have a financial interest in mines have not been properly identified. A comprehensive information system on those that exercise control and hold financial interest in mines needs to be developed by MSHA. Reporting requirements need to be revised to include identification of all those exercising control over the mine and its financial interests. Where contracting out of mining occurs by lessors or sublessors, documents on the contractual arrangements need to be provided to the agency as part of the operator filing requirements.

Where actions by those that have financial interest and control in coal mines adversely affect miner health and safety, they must be held accountable. The current system does not accomplish this.

Agency inspections at small coal mines have been found to be too infrequent and to lack the element of surprise. The inspectors do not move quickly to the work places, and they lack thoroughness. Inspections have been found to occur more during the day shift. Agency inspections of small underground coal mines need to be changed to provide for more frequent inspections, designed with the element of surprise, that get inspectors quickly underground upon arrival. These inspections should be designed to provide the expectation that they may occur at any time, day or night. More than one inspector should be assigned in special task force type inspections. Agency inspections should more effectively target mine operator examination requirements during mine inspections.

Agency investigations of accidents have been the subject of various criticisms. Faulty agency investigations can leave undetected compliance and enforcement problems that can lead to injury, illness, or death of miners. Agency accident investigation procedures need to be changed. A branch separate from the enforcement branch needs to be assigned the tasks of investigating mine accidents. Such investigations need to have a broad focus beyond the accident scene. When a major accident or mine death occurs, all enforcement and compliance actions and conditions should be reviewed through a thorough and complete audit, not just limited to the narrow cause. Investigations of mine accidents should be conducted in a manner that does not permit mine operators to intimidate miners testifying at accident investigation hearings.

These are the types of special emphasis programs for small underground mines that the Federal Mine Safety and Health Administration should implement to address the health and safety crisis in small coal mines.

A COMPARISON OF COAL MINE VIOLATIONS, INJURY AND FATALITY RATES IN VIRGINIA FROM 1988 TO 1992

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Good afternoon. I would like to thank the Executive Committee and the Advisory and Planning Committee for the opportunity to participate in the 24th Annual Institute on Mining Health, Safety and Research. I first would like to provide you with some background information on the Department of Mines, Minerals, and Energy and the Division of Mines.

GENERAL INFORMATION ABOUT DMME

The Department of Mines, Minerals, and Energy was created January 1, 1985, to consolidate the mining, energy, and mineral-related functions of four separate divisions of three separate state agencies into one agency.

This action was partly a result of a blue-ribbon advisory committee on mine safety. The purpose was to consolidate activities that would affect mining and mineral resource activities--to prevent duplication and to increase efficiency in the processes of obtaining permits and addressing public concerns.

We have accomplished these goals, including efforts to streamline the permitting process and to coordinate activities of the multiple divisions.

Soon after the creation of the Department, managerial staff from each of the divisions met to develop a coordinated strategic plan for the whole agency. A variety of changes were initiated, including:

a. institution of procedures to eliminate redundant and overlapping authorities among various programs;

b. sharing of information, particularly permitting data, among divisions; and

c. coordinated issuance of multiple permits for single operations.

The strategic plan was developed around a single unifying mission which is: to enhance the development and conservation of energy and mineral resources in a safe and environmentally sound manner in order to support a more productive economy in Virginia. The strategic plan that grew out of this mission was adopted agency-wide to ensure all divisions worked to achieve mutual goals, and to coordinate a variety of related activities such as coal mining and coalbed methane development.

In 1987, the regulatory divisions were realigned to provide better service to the Department's customers and to strengthen management controls. The Division of Mineral Mining was created from units previously located in two different divisions. This enabled all services to the noncoal mining industry to be provided by one unit, and it gave the coal mining divisions more time to concentrate on coal mining issues. The division of Gas and Oil was established to focus attention on their growing development.

The Department is now organized into an administrative division and six line divisions: Mines, Mined Land Reclamation, Mineral Mining, Mineral Resources, Energy, and Gas and Oil.

GENERAL INFORMATION ABOUT DM

The Division of Mines is responsible for administering and enforcing the Virginia Mine Safety Law of 1966, consisting of Chapters 1 through 14 of Title 45.1 of the *Code of Virginia* as amended.

The primary mission of DM is to protect the lives and health of all people employed at the state's surface and underground coal mining operations, and to ensure that mine operators comply with Virginia coal mine health and safety requirements. The Division conducts regular inspections, investigates accidents and fatalities, conducts training classes, tests and certifies persons to perform certain tasks in coal mines, and provides technical assistance to mine operators.

We recently analyzed data within our computerized Mine Safety System to review the relationship between violations and accidents and fatalities. The following four charts detail our results:

Chart 1 shows the violation rates at mines over the five year period 1988-1992. These rates were normalized by being based on 200,000 production hours. The Department separated mines into quartiles based on their violation rates. The chart indicates the violation rates for all coal mines, the violation rate for mines in the top quartile, and the violation rate for the bottom three quartiles for the 1988-92 period.

CHART 1

COAL MINE VIOLATION RATE

	1988	1989	1990	1991	1992
VIOLATION RATE ALL COAL MINES	50	57	52	54	47
VIOLATION RATE TOP QUARTILE	215	205	211	219	174
VIOLATION RATE BOTTOM 3 QUARTILES	26	37	36	39	33

* PER 200,000 PRODUCTION HOURS

Chart 2 Looks at the top quartile of mines as compared to all mines for the 1988-92 period. It shows the number of mines in the top quartile in the various categories of small surface, large surface, small underground, and large underground, as compared to the total number of mines in each category. Average number of employees in the top quartile mines is compared to the average number of employees in all mines. The percentage of all mines in the top quartile is indicated for each year. Average hours indicates the average number of employee hours (top figures) in the top quartile versus the average number of employees in all mines (bottom figure). The percentage indicates the number of all employee hours in the top quartile mines. The average tons of production in the top quartile mines is indicated for each year by the top figure, while the bottom figure indicates the average tons of production for all mines. The percent indicates the total tons of production in the top quartile.

CHART 2

DEMOGRAPHICS OF COAL MINES IN TOP QUARTILE COMPARED TO ALL COAL MINES

	1988	1989	1990	1991	1992
# MINES IN TOP QUARTILE					
SMALL SURFACE	10/139	7/120	6/92	6/108	5/73
LARGE SURFACE	0/4	0/0	0/2	0/3	0/2
SMALL UNDRGRND	109/303	97/276	83/245	84/221	69/190
LARGE UNDRGRND	0/30	1/24	3/29	1/32	0/29
TOTAL	119/478	105/420	92/368	91/364	74/294
# EMPLOYEES IN TOP QUARTILE MINES					
AVERAGE SIZE	14/23	15/24	17/28	15/27	17/31
% OF TOTAL IN TOP QUARTILE	15%	16%	15%	14%	14%
EMPLOYEE HOURS IN TOP QUARTILE MINES					
AVERAGE HOURS	18,390 41,203	20,554 41,542	17,180 48,442	17,900 46,600	21,001 54,301
% OF TOTAL IN TOP QUARTILE	11%	13%	9%	10%	10%
TONS OF PRODUCTION IN TOP QUARTILE MINES					
AVG PRODUCTION	40,809 97,339	47,513 104,330	46,283 126,253	48,982 116,149	55,461 144,304
% OF TOTAL IN TOP QUARTILE	11%	11%	9%	11%	10%

Chart 3 indicates the percentage of closures, lost time injuries, serious injuries, and fatalities attributed to the mines in the top quartile for the five year period. In each of the categories, the number of closures, lost time injuries, serious injuries and fatalities at the top quartile mines are indicated against the total number of each for all mines.

CHART 3

COAL SAFETY INDICATORS PROPORTION OF INCIDENTS OCCURRING IN MINES WITH HIGHEST VIOLATION RATE

	1988	1989	1990	1991	1992
% CLOSURES IN TOP QUARTILE	51 99/192	45 71/158	42 67/158	68 129/191	41 76/184
% LOST TIME INJURIES IN TOP QUARTILE	16 177/1078	15 159/1096	11 111/1041	14 131/911	12 93/777
% SERIOUS INJURY IN TOP QUARTILE	18 15/84	19 25/130	15 15/99	19 13/70	15 9/62
% FATALITIES IN TOP QUARTILE	0 0/4	14 1/7	20 1/5	67 6/9	0 0/12

Chart 4 shows the relationship of lost time injury rate, serious injury rate and fatality rate to the violation rate for the top quartile, bottom 3 quartiles, and all mines. These rates are based on 200,000 production hours.

CHART 4

COAL SAFETY INDICATORS TOP AND BOTTOM THREE QUARTILES BY VIOLATION RATE

	1988	1989	1990	1991	1992
LOST TIME INJURY RATE					
TOP QUARTILE	16.17	14.73	14.05	16.10	11.97
BOTTOM 3 QUARTILES	10.34	12.26	11.45	10.17	9.49
ALL MINES	11.00	12.6	11.70	10.70	9.70
SERIOUS INJURY RATE					
TOP QUARTILE	1.37	2.32	1.90	1.60	1.16
BOTTOM 3 QUARTILES	0.79	1.37	1.03	0.74	0.73
ALL MINES	0.86	1.49	1.11	0.83	0.78
FATALITY RATE					
TOP QUARTILE	0.00	0.09	0.13	0.74	0.0
BOTTOM 3 QUARTILES	0.05	0.08	0.05	0.04	0.17
ALL MINES	0.04	0.08	0.06	0.11	0.15

PER 200,00 PRODUCTION HOURS

As can be seen from this information, there is a relationship between compliance and accidents although this relationship is not as distinct or pronounced as one might think. There was no relationship between violation rates and fatalities.

The Division of Mines carries out a variety of programs all of which are designed to ensure and promote compliance and safety in Virginia's coal mines. Through regular inspections of coal mines, the Division of Mines ensures that mine operators comply with the state's mine health and safety requirements. DM inspectors conduct one complete inspection of each underground mine at least every ninety days and of each surface mine at least every 180 days, as required by state law. Division inspectors also investigate complaints, serious and fatal accidents, and other unusual events. They issue notices for violations found during their inspections, and recommend ways to correct and prevent unsafe conditions.

Under the supervision of the mine safety manager, the Division's eight (8) technical specialists provide advice and assistance to coal mine operators in roof control, ventilation, and electrical use. Their primary purpose is to help the operators solve problems that could lead to unsafe and unhealthy conditions in their mines. Their duties include review and approval of plans submitted by mine operators for those specialty areas.

The technical specialists may close a mine in case of an imminent danger or an accident, but do not normally conduct enforcement inspections. Specialists conduct on-site mine safety talks, assist in the investigation of complaints and accidents, and conduct seminars on mine health and safety technologies.

The Division of Mines also operates a comprehensive and modern system of record keeping. This computerized system, operated by a well-trained staff, gathers and maintains data on surface and underground mining licenses, permits and plans, serious injuries and fatalities, training and certification, environmental testing, inspections, and enforcement activities.

The Division has hired people with a variety of knowledge and experience in mine health and safety. However, we often turn to people outside the agency, people actually engaged in the business of coal mining, to provide a clearer picture of what is needed to ensure the health and safety of Virginia's miners. The Board of Examiners and the Virginia Mine Safety Board are key examples of this approach. The Mine Safety Board consists of nine members including three representatives each from the coal industry, labor, and the Commonwealth at large. The Board reviews and approves or denies applications for reduced inspections, serves as advisor to DMME on matters relating to the health and safety of persons working in Virginia's coal industry and is designated as the official regulatory work committee on all coal mine health and safety matters not under the jurisdiction of the Board of Examiners. The Board of Examiners consists of seven members, including the Chief of the Division of Mines; a surface coal mine operator; an underground coal mine operator; a mineral mine operator; a non-supervisory underground coal mine employee; a non-supervisory surface coal mine employee; and a non-supervisory mineral mine employee. This board issues certificates of competency to miners involved in certain jobs in underground and surface mining. The Board reviews and approves tests that are administered by the Division to determine whether miners are qualified for certification by the Board.

In a cooperative effort to further improve mine safety in Virginia, DM and MSHA have developed a special initiative focused on small mines. In March 1991, the Division of Mines and MSHA's District 5 signed a memorandum of understanding to implement the Joint Mine Assistance (JMA) Program at selected mines in Virginia. This type of program also has been implemented in West Virginia, Kentucky, and Pennsylvania.

The JMA Program, developed cooperatively with each state, concentrates on underground coal mines with fewer than 50 employees. Such small mines have historically been shown to account for above-average fatality and lost-time injury rates. Mines selected for the JMA Program were evaluated by the Division of Mines (DM) and MSHA based on accident history, compliance records, inspector input and other factors. State and federal mine safety personnel audit injury records, survey training programs, and make "walk and talk" inspections at selected mines to review safe work procedures with the miners.

In the area of certification and training, DM Technical Instructors provide certification classes, gas detection training, electrical retraining, hoisting engineer and automatic elevator training. DM, under the direction of the Board of Examiners, tests and certifies people who perform certain tasks in mines such as First Class Mine Foreman, Electrical Repairman, Surface Foreman, Surface Blaster, Shotfirer, etc.

Through funding from MSHA, this year DM has established an Accident Reduction Program. Five (5) Technical Specialists have developed and implemented a Job Safety Analysis (JSA) Program at targeted mines. Three (3) of the specialists target mines with fewer than 50 employees, while the other two (2) target mines with 50 or more employees. Mine management and the employees are involved in developing the mine-specific program. The DM personnel provide specialized on-site safety talks, accident analysis, observe and evaluate work habits, review and evaluate roof control conditions, and evaluate mine training programs. DM personnel will conduct safety talks on substance abuse and provide a brochure to miners listing telephone numbers for area and regional help centers, statistics, related accidents, reports, etc.

DM incorporates the final reports of serious accidents and fatalities into training and safety talks at the mine site.

DM also develops, publishes, and distributes Safety Alerts based on serious or fatal accidents, accident trends, or other special situations, such as Winter Alert, Vacation Alert, etc.

The State-Designated Mine Rescue Program administered by DM was first made available in 1987 to enable companies with existing mine rescue teams to volunteer services and participate in rescue activities as designated teams. Mines desiring such coverage as a means of complying with federal mine safety regulations may purchase services through the program for a fee.

In 1989, the Department of Mines, Minerals, and Energy and the Mine Safety Board established the Virginia Mine Safety Awards which are presented on an annual basis. The program was developed to provide special recognition to mines which work set time periods with no lost time injuries. Awards are presented in five categories: Large Surface, Small Surface, Large Underground, Small Underground, and a Special Award for individuals, crews, teams, etc. The awards are based on employee hours and no lost-time accidents. Awards will be presented in all five categories in 1993.

To increase community awareness of mine safety issues, we use radio PSA's to contact miners away from the job on such topics as Winter Alert, Vacation Alert, etc.

Mine safety requires a concentrated and comprehensive effort from all involved: operators, workers, and regulatory agencies. DMME is totally committed to mine safety and continues to strive to further improve safe working conditions in Virginia's mines.

Thank you.