M/NM Accident Analysis and Problem Identification Course

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METAL/NONMETAL ACCIDENT ANALYSIS AND PROBLEM IDENTIFICATION COURSE

Outline and Table of Contents

INTRODUCTION

This accident prevention technique asks each of us to draw on insights about mines and mine accidents derived from years of experience as miners, supervisors, and safety personnel.

The technique suggests utilizing those insights with a practical-based approach for the analysis of a mine's accidents to determine what options are available to prevent injuries.

A different perspective is called for at the outset. Gone is the "brush fire" mentality which assumes that each accident is unique and exists in a vacuum. Gone is the thinking which separates accidents into neat classification, e.g., electrical, roof fall, haulage, etc. These traditional methods are replaced by a perspective which calls for "a way of thinking" generated by the awareness that accidents are not "the problem" but instead are the symptoms of a mine's problems.

The approach to prevent accidents discussed in this manual is based on the following premises.

1. Mine operations personnel are in control of the day-to-day activities associated with mining.

2. Mine operations personnel are practical, rational and experienced mining people who want to run a safe, productive mine.

3. Mine operations personnel whose mines are experiencing accidents will take additional measures to prevent accidents when those measures seem practical, economical, and effective.

The technique proposes the application of the years of field experience we have to the examination of a specific set of variables common to all accidents. Within this analysis lie the questions and ultimately the answers to the greater questions, "What options are available to prevent injuries?"

Purpose and Goals

The purpose of this course is to provide you with a method which can help you pinpoint the causes of accidents and develop solutions tailored to a particular mine. Our goal is to be able to produce sound recommendations which are supported by and logically derived from information on the mine. We will proceed through this course, step by step, to show you how to make a strong case which consists of being able to tell an operator --

What is causing problems at the mine?
What are the problems?
What kinds of accidents are resulting from those problems?
What actions can be taken to eliminate or alleviate those causes and, therefore, reduce the problems and accidents?

REVIEW OF COURSE CONTENT

1. We will first give you a conceptual overview. We believe it's important that you have an understanding of why we put the parts of the course together like we did. If you have a conceptual understanding of the technique we're offering, the tools which we will show you how to use and the results from their use should be more meaningful.

   We will also discuss the "customizing" approach to addressing accident prevention and reduction.

   The technique we will present can best be described as occurring in three stages: Events which occur before going to the mine site, events at the mine site, and events that are carried out when mine site activities are completed.

2. There are three activities performed before going to the mine site. The preliminary data analysis covers some methods for rapidly screening accident data. We will use two tools, Physical Barrier Analysis and Human Barrier Analysis, to screen the data. Since these tools are the foundation of the technique, we will spend quite a bit of time discussing and using these tools..

   We will then interpret the results of the Physical and Human Barrier Analyses to come up with the potential cause of the accident patterns we have discovered. The potential causes lead us to develop a planned inquiry -- questions to ask, areas to observe -- in order to carry out a more systematic investigation at the mine. The planned inquiry helps us to narrow our investigations to specific aspects of the total mining operation rather than having to look at the entire operation.

   The final activity in this stage is a discussion of the factors necessary to ensure the cooperation of MSHA, mine management, and labor in carrying out the on-site activities. A well planned and executed initial notification and meeting can provide a positive foundation on which all subsequent on-site activities can be built.

3. In the next stage we cover what we want to do at the mine. This is a data gathering step. Activities at the mine concern problem identification through interview and observation. The purpose is to point out that the interviews and observations must be flexible rather than rigid; that it is necessary to go where the data leads rather than following a predetermined set of observations and asking a static set of question.

4. The third stage, which covers activities required after returning from the mine, is entirely organizational. The purpose is to demonstrate how to put all the data together to form a logical sequence which supports our recommendations. We have gathered a lot of information and we need to be able to interpret it and put it together so we can answer:

   What is causing problems at the mine?
   What are the problems?
   What kinds of accidents are resulting from those problems?
   What action can be taken to eliminate or alleviate those causes and, therefore, reduce the problems and accidents?

Those answers are our bottom line!

Logic of the Technique

As we have indicated before, we think it's a good idea if you have some understanding of the logic behind the technique we are discussing. We think it will give you a better understanding of how everything fits together and how the tools you will be given can help you answer these four important questions:

> What is causing problems at the mine?
> What are the problems?
> What kinds of accidents are resulting from those problems?
> What action can be taken to eliminate or alleviate those causes and, therefore, reduce the problems and accidents?

If I'm feeling ill, I may decide that, rather than take matters into my own hands, I'll go see a doctor. This is especially true if I treated myself and got no results. What do I expect from the doctor? While I might be interested in finding out what's wrong with me, I want to know what I have to do to get rid of what I have. Furthermore, I expect that the recommendation the doctor makes will produce results.

Final Product -- "Recommendations that can lead to results"

When I go to the doctor, I'm asked what's wrong. Of course if I knew, I wouldn't be there. What I am able to describe are my symptoms.

1. Symptoms - runny nose, headache, watering eyes and fever.

With this limited information and maybe a few more questions, the doctor will come up with some potential causes. What the doctor has done here is a very important step. From the symptoms, the list of potential causes has been narrowed. The doctor knows that to get the results wanted, the correct cause must be found and treated. The doctor certainly cannot treat all the potential causes, since each must be treated differently and to treat all would be a waste of resources and could be counterproductive.

2. Potential causes - bacterial or viral infection or allergic reaction.

Now that the doctor has an idea of the potential causes, a search for problems that will lead to the real cause can begin. More data will be gathered, but because the doctor has some idea of the potential cause a more focused and systematic search will be carried out. The doctor will give me a blood test, but not a chest x-ray; a test for allergy, but not a CAT scan.

3. Discovery of the problems which identify the cause.

Once the cause is determined the doctor can then make recommendations, which, if I follow them should cure or alleviate many problems and symptoms. We have completed the cycle.

4. Recommendations which can lead to results.

The technique we will present considers accident prevention and reduction as requiring the same sort of analysis as the one described in our oversimplified medical example.

Rather than having symptoms, we have accidents which have occurred or, if really lucky, data on near misses. These accidents result from some underlying causes not readily apparent without more in-depth investigation. Just as the doctor started with the symptoms to help reduce the causes, we use accidents as our starting point. Our analysis of the accidents will lead us into potential causes.

Once we have reduced our causes, we can more systematically search for problems resulting from the causes. This discovery of the problem takes place at the mine. But rather than look at everything we could possibly look at, we can now focus our search at the mine. Just like the doctor - we are gathering more specific information.

Having discovered the problems that exist, we cannot define the cause. Just like the doctor, at this point we can recommend action directed at eliminating or alleviating the cause(s). And, just like the doctor, we want to be sure that our recommendations, if implemented, can lead to results. Because we are dealing with the behavior of humans, and our data is often softer than that in our medical analogy, we want our recommendations rigorously supported by the data and a logical outgrowth of our analysis.

The doctor can say, "You have an allergy that has caused an increased level of histamine which has resulted in a headache, runny nose, etc. Now take this drug if you want relief." Similarly, our analysis can produce a product which says, "Here is what is causing problems at your mine. These are the problems and these are the accidents that are resulting from these problems. If you take this action, you can impact those causes and improve safety in your operation." How to accomplish this is what the course is about.

Customizing Solutions

When spring comes and we have to take care of our lawns again, most of us will notice all kinds of new green plants (weeds) in the yard. These plants are definitely not in the grass family and are not actually plants we desire to have in our yards. If the problem is not too severe, we may ignore it. However, if we ignore the problem, we begin to notice more and more of the green plants and less and less grass. We are finally forced to act when, four days after mowing, the weeds are 7" high and the grass only 3" high.

There are two basic approaches to getting rid of the weeds:

1. We can dig out the weeds, one at a time, or

2. We can attack them all at once with a general approach such as an herbicide.

Anyone who tries the first approach knows what happens. Because we never get all the roots, the weeds grow back.

That leaves us with the second approach. We have two options:

1. We can purchase herbicides, try them, and if they kill the weeds, fine. If they don't, we try different herbicides until we find one that attacks the types of weeds we have or we give up, surrender.

2. We can identify the particular plants that are the problem, select the herbicides developed for that plant, and apply it as directed.

Anyone who has tried the blind purchase of herbicide also knows what happens. Not only do weeds go, but so do other desirable plants, like the flowers. We also find ourselves spending more money than we want to for the weed killers, and our storage areas become more pressed for space.

Mine accidents have some fundamental similarities to the weeds in our yards.

1. There are many different types of accidents.

2. While they may not be too frequent or severe, if we ignore them, things usually get worse.

3. All the accidents can't be prevented by the same methods.

The quickest and least expensive way to eliminate the weeds is to first identify them, and then select the appropriate action to eliminate them, and finally implement the action as directed.

What would be the quickest and least expensive way to eliminate accidents? If we generalize from our weed example, we would:

- identify groups of accidents which lend themselves to the same preventive measures,
- determine **causes** for lack of those measures,
- select appropriate methods to **eliminate** those causes, and finally
- implement those methods.

Does training prevent accidents? Of course!

Does engineering prevent accidents? You bet!

Does inspection prevent accidents? Sure!

Does any one of the three methods eliminate the causes of all accidents? Of course not. Each method reduces only the accident which is caused by a lack of it.

Many times an accident prevention program is implemented that does a good job of reducing a certain type of accident. Just like an herbicide doesn't kill all weeds, no one accident prevention technique can prevent or reduce all accidents.

We want an accident prevention program that is customized to attack the accidents at a particular mine. If we want to be effective and efficient, we must apply remedies which will eliminate the specific causes of accidents. To do this we must first identify and understand as much as we can about the causes of accidents. Once we do this we can customize solutions which will put us into a proactive rather than a reactive mode of accident prevention.

ACTIVITIES BEFORE GOING TO THE MINE

Preliminary Data Analysis

The first step in most traditional accident prevention programs has been to look at information to determine where the mine appears to be having problems. Collecting and analyzing data as a first step in finding out what's going on makes such good sense that we also begin at this point. Because this activity prepares us for the main course of business, we call this procedure a Preliminary Data Analysis (PDA). We will introduce two highly structured techniques for performing this analysis: The Physical Barrier Analysis (PBA) and the Human Barrier Analysis (HBA).

The presentation of these techniques results in two distinct considerations:

1. The thought process or "way of thinking" about the data to get usable information from it.

2. The mechanics of documenting the results of that thinking in the form of organizers, tally sheets, etc.

The first concern, thinking about accidents, is a critical step in the analysis of accidents at any mine, be it large or small, with many or few accidents.

The second concern, staying organized while working with large amounts of data, results in the use of several recording aids to keep track of the products of various phases of the analysis. At a mine with large numbers of accidents these tools, forms, and aids are a necessary part of the analysis process. At a mine with few accidents where the amount of data to be analyzed is not so overwhelming, these organizing aids are probably not necessary.

You can use the PBA and HBA tools as appropriate, but the use of Physical and Human Barriers conceptually will provide you with a different perspective on accident causes and their solution.

The PDA, using this different perspective, helps us to:

1. Identify the types of accidents as a function of how they can be prevented.

2. Begin to understand what may be causing absence of or deficiencies in these preventive measures.

From this perspective we can say that mine accidents fall into one of two types:

1. Accidents which could have been prevented by some type of physical barriers.

2. Accidents which could have been prevented by the individuals involved.

Mines differ with respect to numbers of accidents, specific contributors to accidents and the relative magnitude of the HUMAN vs. the PHYSICAL condition problem. Each of the accidents at any given mine is a manifestation of either the presence of a human barrier or the absence of a physical barrier.

Any accident which can be prevented will be prevented by one or a combination of the following nine actions.

Introduce a physical barrier:

1. On the energy source
2. Between the energy source and the person
3. On the person
4. That separates energy from people (time/space)

Remove a Human Barrier which causes a lack of or deficiency in a person:

1. Information
2. Tools/Equipment
3. Knowledge
4. Capacity
5. Incentive

The preliminary data analysis allows us to determine which barriers may be provided, modified, or removed to prevent accidents.

A clearer picture of the distinct difference between physical vs. human preventive measures is provided by the Swimming Pool Analogy.

Swimming Pool Analogy

I have a two-year-old child. My neighbor owns a swimming pool.

1. Is this a recipe for an accident?
2. How can my neighbor and I prevent it?

Most likely our list will include some of the following:

1. Teach the child to swim.
2. Put a fence around the pool.
3. Put a leash on the child.
4. Punish the child for going near the pool.
5. Supervise the child closely.
6. Move.
7. Fill in the pool.
8. Cover the pool.
9. Drain the pool.
10. Make the salt concentration of the water so high the child would float.
11. Put a life preserver on the child.

As we can see from the list, our solutions fall into two general types. Either a physical change has been suggested (2, 3, 5, 6, 7, 8, 9, 10, 11) or we have suggested making a change in the child (1, 4). Accidents at the mine can be prevented in the same two general ways - **change the physical environment** or **change the person.**

Physical environments can be changed by bolting, cutting, welding, etc.

People can be changed by altering factors which shape their behavior, knowledge, skill, understanding, etc.

Physical Barrier Analysis (PBA)

Most safety professionals concur that a well-engineered mine is the foundation for a safe mine. To us this means that the appropriate physical barriers are in place and functional. The PBA takes a quick look at the potential for improved engineering at a mine.

It is reasonable to assume that some mines make better use of barriers to prevent accidents than others. Our primary interest is to determine the extent to which a particular mine is using these preventive measures and how much of their accident problem can be attributed to the lack of their use.

Barriers prevent the release of unwanted energy, reduce its forcefulness, or prevent the energy from contacting the individual. If the barrier is adequate, the individual should not be injured and thus no accident will occur. There are four classes of barriers which can be used singly or in combination, to prevent miners from becoming injured by unwanted energy. Unwanted energy is whatever figuratively or literally draws blood.

Generally, barriers in category I provide more positive protection than those in II, II more than III, etc.

I. Barriers on the energy source:
The primary purpose is to prevent the release of unwanted energy.

Example: A roof may be bolted or supported; a vehicle can have brakes or speed control.

II. Barriers between the person and the energy source:
The primary purpose is to prevent unwanted energy from contacting the person.

Example: Guards on moving parts of equipment; a shield between a welder and other workers.

III. Barriers on the person:
The primary purpose is to reduce the forcefulness of the unwanted energy.

Example: Goggles; hard-toed shoes; self-contained breathing apparatus.

IV. Barriers that separate the person from the unwanted energy by time or space:
The primary purpose is to prevent the unwanted energy from contacting the person.

Example: Removing all persons from blasting areas (space barrier). Re-entry to blasting area when concentrations of smoke, dust, or fumes have been reduced to safe limits (time barrier).

We can see that some of the barriers are not clear-cut. Barriers on the person could very easily prevent the unwanted energy from contacting the person. Thus, goggles will keep objects out of a person's eyes. But if the object has any force behind it, it could break the goggles. However, the amount of damage to the eye should be less as a result of the amount of impact the goggles have absorbed.

Barriers on the person can also be distinguished from barriers between the person and the energy source, if we consider the former as being extensions of the person. Gloves are extensions of the hands and skin, goggles are extensions of the eyes. This is in contrast to a guard or fence that is not an extension of the person, and protects more parts of the body. Any personal protective equipment is a barrier on the person.

A more difficult discrimination exists between barriers between the person and the energy source and barriers that separate the person from the energy by time or space. The latter is in fact a special case of the former. When we think of barriers between the person and energy source, we are thinking of barriers that are constructed of some substance; they are engineered for the purpose of separating the person and the energy source.

Time and distance are always present and become used as a barrier, often based on someone's judgment. Since time and space are always present, it is easy to make them into barriers. In order to clarify what we mean by a time or space barrier, we have imposed an additional criterion. A time or space barrier must be based on a written policy or must signal that the time or space barrier is in effect. This criterion limits the person's judgment. The signal or policy tells the person what the appropriate response should be. For example:

> I see some people breaking rocks with a hammer. If I need to get by the group, I can wait until they stop hammering, take a route that will put me out of range of any flying rock, or take my chances and walk right by hoping no rock will be flying. Whatever my choice, I have made it based on my <u>judgment</u>. While a time or space barrier is appropriate, it was not defined by signal or policy.

Contrast that example with the following excerpts from 30 CFR:

56.9305 Truck spotters

(a) If truck spotters are used, they shall be in the clear while trucks are backing into dumping position or dumping.

(b) Spotters shall use signal lights to direct trucks where visibility is limited.

(c) When a truck operator cannot clearly recognize the spotter's signals, the truck shall be stopped.

57.6310 Misfire waiting periods

When a misfire is suspected, persons shall not enter the blast area –

(a) For 30 minutes if safety fuse and blasting caps are used; or

(b) For 15 minutes if any other type detonators are used

These are examples of space and time barriers established by regulation. No room is left for individual judgment concerning either time or space.

When using the Physical Barrier Analysis, the latter examples describe the time or space barrier. Both time and space barriers are independently determined so that no judgment, of what the proper time or space should be, is left up to the person making the response.

Doing a Physical Barrier Analysis

Our Physical Barrier Analysis (PBA) is based on four assumptions:

1. There are four types of physical barriers. When a physical intervention can prevent an accident, that intervention will always be one or a combination of the four types of physical barriers.

2. Accidents which were not caused by the lack of a physical barrier cannot be prevented by introducing one.

3. Identifying accidents which a physical barrier could have prevented and accident which a physical barrier could not have prevented allows us to fit remedies to the causes of accidents more accurately.

4. Accidents which can be prevented by physical barriers are almost always the easiest type to prevent.

These four assumptions place physical barriers in a proper perspective. While stressing their importance, their limitations are also defined.

In order to do a Physical Barrier Analysis, we need:

1. accident information;

2. groups of physical barrier analysis statements (pp. 13-14);

3. a physical barrier analysis matrix (p. 15);

4. instructions (p. 17); and

5. familiarity with the practices, procedures, methods and strategies of the mine you are analyzing.

Accident Information

Although any accident report can be used, the accidents we will analyze are the ones from the Office of Injury and Employment Information (OIEI). Since this information comes from Form 7000-1, that document could also be used.

From the form, we will primarily use the narrative description of the accident. The narrative is on the right side of the printout. The only purpose for using the information on the left side is to help us understand the narrative.

The first thing we will do in analyzing the accident is to read the narrative and visualize what happened. Often the report is sketchy but most of the time we will be able to draw on our experience to read between the lines and get the picture.

Example 1: In the 2 south one left section a timberman, while setting a post, struck a wedge with an ax. The wedge splintered and cut the timberman's right eyeball.

Once we have visualized the situation and what occurred, we then ask, "What could have prevented this accident?" To help us determine the appropriate preventive measures, we have provided a list of Physical Barrier Analysis Statements. (See next page)

The statements refer to each of the four types of physical barriers. For each type there are four possibilities. Going back to our example of the wedge and using our PBA statements we want to find the one statement, for each type of physical barrier, which best fits our opinion.

Physical Barrier Analysis Statements

For <u>each</u> of the four types of barriers described below select the statement which best represents your opinion of the accident:

1. A physical barrier on the energy source was:
   (Prevent Release)

   (a) not possible and practical
   (b) practical and possible, but not provided
   (c) provided, but not used
   (d) used, but failed

2. A physical barrier between the energy source and the person was:
   (Prevent Contact)

   (a) not possible and practical
   (b) practical and possible, but not provided
   (c) provided, but not used
   (d) used, but failed

3. A physical barrier on the person was:
   (Prevent Forcefulness)

   (a) not possible and practical
   (b) practical and possible, but not provided
   (c) provided, but not used
   (d) used, but failed

4. A barrier of time or space between the energy source and the person was:
   (Prevent Contact)

   (a) not possible and practical
   (b) practical and possible, but not provided
   (c) provided, but not used
   (d) used, but failed

If, in Statement 1, we think that a physical barrier on the energy source was not possible and practical, we would select (a). Once (a) has been selected it is not necessary to check (b), (c), and (d). We would simply go to Statement 2.

If, in looking at Statement 2, we decide a physical barrier between the energy source and the person was not possible and practical, we again choose (a) and proceed to Statement 3.

In Statement 3, (a) is probably not our opinion since safety glasses possibly would have prevented the accident. Therefore, we must go through the remaining statements (b), (c) and (d) to determine our selection.

Since we believe a physical barrier on the person was possible and practical, we must decide if it was not provided, provided but not used, or used but didn't protect the person. Making that choice depends on our experience and knowledge of the mine.

Therefore, if our knowledge and experience lead us to believe that the mine normally doesn't provide safety glasses, we would select (b) and go to Statement 4.

If we believe the mining operation routinely provides safety glasses, but workers usually don't use them, you would select (c) and proceed to Statement 4.

If we believe that the mine operation is a stickler for safety glasses, then we might suspect glasses were worn, but failed, and we would select (d) and then proceed to Statement 4.

If in looking at Statement 4 we believe that a time or space barrier was not possible or practical, we would again select (a).

We have now made our choices: 1 was (a), 2 was (a), 3 for purpose of the example was (c), and 4 was (a). We now want to record our answers on the PBA matrix.

The PBA matrix is simply our PBA statements in a different format. Normally, we will analyze many accidents. When we do, we number the accidents so we can record our choices for each accident. Each accident has four choices. If our example was accident #1, we would place a 1 in the appropriate cells corresponding to our selections. In example a, 1 would be placed in cells 1A, 2A, 3C, and 4A.

We have now completed the Physical Barrier Analysis of one accident. We have listed the process we normally go through in the PBA instruction (p.17).

PHYSICAL BARRIER ANALYSIS MATRIX

	1	2	3	4
	Barrier on the Energy Source	Barrier Between Energy Source and the Person	Barrier on the Person	Time/Space Barrier Separating the Energy & the Person
A Was Not Possible and Practical	1,	1,		1,
B Was Possible and Practical but Not Provided				
C Was Provided but Not Used			1,	
D Was Provided and Used but Failed				

A representative example showing the physical barrier analysis of 50 accidents

	1	2	3	4
	Barrier on the Energy Source	Barrier Between Energy and the Person	Barrier on the Person	Time/Space Barrier
A Was Not Possible and Practical	1, 2, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 20, 21, 22, 23, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 36, 37, 38, 39, 40, 41, 42, 43, 44, 46, 47, 48, 49, 50	1, 2, 3, 4, 5, 6, 8, 9, 10, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 26, 27, 28, 29, 30, 33, 34, 35, 37, 38, 40, 41, 42, 43, 44, 45, 4, 48, 49	1, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 17, 18, 19, 21, 22, 24, 25, 26, 27, 28, 30, 31, 32, 34, 35, 37, 38, 40, 41, 42, 43, 44, 45, 48, 50	1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50
B Was Possible and Practical but Not Provided	3, 19, 24, 35, 45	13, 31, 50		17
C Was Provided but Not Used		7, 11, 12, 25, 36, 39, 47	2, 11, 16, 20, 23, 29, 33, 36, 39, 46, 47, 49	8, 40
D Was Provided and Used but Failed	5	32		

Physical Barrier Analysis Instructions

1. Gather the accidents you wish to analyze.

2. Number them sequentially.

3. Starting with number 1, read the abstract and visualize the accident.

4. Ask yourself the first group of four questions on the PBA question list. Choose one of the four which best represents your opinion.

5. Ask yourself each of the remaining four groups of questions. Make one selection from each group.

6. Transfer your selections to the PBA matrix.

PHYSICAL BARRIER ANALYSIS MATRIX

	1	2	3	4
	Barrier on the Energy Source	Barrier Between Energy Source and the Person	Barrier on the Person	Time/Space Barrier Separating the Energy & the Person
A Was Not Possible and Practical				
B Was Possible and Practical but Not Provided				
C Was Provided but Not Used				
D Was Provided and Used but Failed				

Now that we have gone through an example, certain questions are in order.

Question - Why go through all four types of Physical Barriers? When I've decided what barrier was missing, I should be able to record in one cell in the matrix.

Answer - Once you begin to use the Physical Barrier Analysis, statements, matrix, and instructions, you should be able to shortcut the process we've described. You'll probably not even have to use the organizers we've presented.

But a word of caution. Once you begin to think in terms of the four types of Physical Barriers and the purpose each serves, you may begin to realize that there are more possible and practical physical barriers than you have considered.

Question - When there is so little data in the narrative, how can I be expected to analyze what happened?

Answer - Our position is that we are aware of your expertise. You know the mines in your area, the environmental conditions and the operating procedures. There is probably not an accident that could occur that you haven't seen before and have a good idea what probably happened.

Question - What if I have a small mine that doesn't have many accidents? Why do I have to go through all this work?

Answer - With few accidents you probably don't. You can analyze those accidents in greater depth. But the PBA is more than just a matrix with numbers on it. It is a way of thinking about accidents; a different perspective.

The bottom line of the physical barrier analysis is that when we've finished analyzing the accidents, we will find clusters of accidents in the matrix. We will no longer look at haulage or fall of ground or electrical accidents. What we will look at, for example, could be "accidents that could have been prevented by a barrier on the energy source."

One of the primary benefits of the PBA is to help us formulate areas of interest or concern for which we will seek additional information when we are at the mine. In this case, that concern might be why those barriers weren't provided. When we find that out, we will know how to prevent accidents in that category.

Example 2: In 2 right off 9 face, an electrician was preparing to splice a shuttle car cable. While cutting insulation, the electrician received burns to both hands and an electrical shock.

Using the PBA instructions and statements, in what cells in the PBA matrix would you place this accident? Remember, you will have a response in each of the columns 1, 2, 3, and 4.

We suspect that a lock and tag were provided but probably weren't used. Lock out and tag would be a barrier on the energy source. There are likely no other barriers possible that would have prevented this accident. We would put this accident in 1C, 2A, 3A, and 4A on the PBA matrix.

Physical barriers are an excellent way to prevent accidents. They remove human judgment from the situation. The regulations that MSHA enforces are primarily mandated physical barriers. The absence of the physical barrier increases the likelihood of an accident. Mines which neglect the use of practical, economical physical barriers are denying themselves the benefits of the most efficient prevention methods known to the industry.

Human Barrier Analysis (HBA)

When we discussed physical barriers, we indicated that the absence of a physical barrier increased the likelihood of accidents. Therefore, if we put the appropriate physical barriers in place, we should reduce or prevent those kinds of accidents.

Human barriers work the opposite. It is the presence of human barriers which increases the likelihood of accidents, and prevents an individual from making the appropriate response.

A. Human barriers increase the likelihood of an individual doing something that shouldn't be done--for example, going under unsupported roof.

B. Human barriers decrease the likelihood of an individual doing something that should be done--for example, locking out and tagging disconnecting devices before working on electrical equipment.

When we use physical barriers, we are changing the physical environment in which the person works. We recall from the swimming pool analogy that we had some solutions that didn't involve changing the physical environment. Those solutions involved doing something to the child (teaching or punishing). When we deal with human barriers, we try to change factors which directly impact the person, or try to change the way the person responds.

In doing the Human Barrier Analysis (HBA) there are three assumptions we make.

I. There are logical, understandable reasons why people perform in ways which lead to an accident.

II. Those reasons usually take the form of barriers which:

a. Cause them to do things they shouldn't

OR

b. Cause them not to do things they should

III. Identifying and eliminating those barriers will increase the likelihood of performance which reduces accidents and reduces the likelihood of performance which causes accidents.

These assumptions are fairly straightforward. There may be some question about the first one. Often we regard the performance of others as illogical, incomprehensible, and sometimes stupid. When we begin to look at their performance from a point of view other than our own and look at it in more depth, we find logical and understandable reasons. The Human Barrier Analysis helps us discover these reasons.

In order to do a human barrier analysis, we need:

1. A completed Physical Barrier Analysis matrix (p.16)
2. Four HBA tally sheets (pp. 31-34)
3. A working knowledge of human barrier definitions (pp. 22-25)
4. Instructions (pp. 27, 35-38)
5. Familiarity with the practices, procedures, methods and strategies of the mine you are analyzing.

There are five major barriers to human performance. Individuals do not perform appropriately because of a deficiency in or lack of:

A. Information
B. Proper tools
C. Knowledge
D. Capacity
E. Incentives

To do a Human Barrier Analysis, we look at accidents which could have been prevented by the individual involved. We wish to know if the presence of one of these barriers caused the accident. As in Physical Barrier Analysis, our experience in mining, our knowledge of the mines in the area, and the operating procedures provide a basis for answering the HBA questions.

A. Information:

When people are not informed of what is expected of them, when they are not told how well they are performing, or when they are not given any guidance or clear direction on how to accomplish a task, an information barrier is present. The lack of consistent, practical operating procedures or the lack of feedback creates situations where people respond based on their own judgments of how things should be done. Often the behavior is incompatible with other aspects of the operation. To determine if there was an information barrier, we ask the question: WAS THE PERSON GIVEN DIRECTION AND GUIDANCE ON HOW TO DO THE JOB? We use direction and guidance as our key words in the question since they cover both expected performance and feedback for performance.

Example of an information barrier:

Employee was welding and cutting zinc and galvanized tubing for the main fan installation. The employee worked two days at this then became sick, dizzy, and sleepy from the fumes.

Guidance and direction can come from a variety of sources. Written plans, policies, and procedures can be direct and guide behavior, as well as verbal direction and guidance from supervisors and co-workers. Whatever the sources, however, direction and guidance that is not clear, consistent, or accurate can be an even greater barrier to human performance than no information at all.

B. Tools or Equipment:

When the appropriate tools or equipment to do a job are not available or are improperly designed, a barrier to human performance is created. Where improper design is the cause for problems, we are generally talking about human factors. Tools are not physical barriers since they generally do not function to protect the person from the energy source. Tools and equipment are extensions of the person which are instrumental in getting the required performance.

To determine if tools and equipment are a barrier, we ask: WERE THE APPROPRIATE TOOLS OR EQUIPMENT AVAILABLE AND WERE THEY PROPERLY DESIGNED FOR THE JOB?

Example of tools as a barrier:

A roof bolt was used to take down loose top because the correct bar was not provided.

C. Knowledge:

Sometimes people do unsafe things because they don't know better. When they don't know how to perform safely, we have a barrier (knowledge) to human performance. Knowing how to do things safely is acquired principally through education, training, and experience. Deficient, limited or non-existent education, training, or experience may be our clues that we have a knowledge barrier.

The question we ask to see if there is a knowledge barrier is, "DID THE PERSON KNOW HOW TO DO THE JOB AS IT IS SUPPOSED TO BE DONE?"

Example of a knowledge barrier:

A newly hired, inexperienced miner with very little training is put to work driving a forklift. If the forklift isn't driven properly because the miner doesn't know how, we have a knowledge barrier to human performance.

Knowledge is not the same as information. It implies much more. It implies that the person can use information, and can put education, training, and experience together to appropriately act on information. Knowledge is, therefore, internal to the person, something that the person brings into the work environment. Externals such as information and incentive operate on the person's use of knowledge.

D. Capacity:

- Physical Ability
- Concentration
- Spread too Thin
- Habit Intrusion

Capacity is also internal to the person, and is both mental and physical. When a task exceeds the capacity of the individual performing or when something impairs the person's capacity, a barrier to performance exists. The impairment of capacity can take many forms.

If the job requires an extended high level of concentration, a person with a short attention span will be at a disadvantage. The task exceeds to person's capacity. A job may also become so routine that it is done by habit. This habit may be so strong that changes in the environment, which require a different response, are not recognized. In this case, habit has impaired the mental capacity of the individual to attend to the environment. More obvious examples are the person who is asked to lift more than could possibly be handled and the person who comes to work under the influence of drugs, or alcohol.

These impairments of physical and mental capacities have the potential of turning hazardous situations into disaster for the individual and others. To determine if there is a capacity barrier, we ask, "DID THE TASK EXCEED THE CAPACITY OF THE INDIVIDUAL PERFORMING IT?"

E. Incentive:

One of the most powerful means of strengthening, maintaining, and changing a person's responses is the use of incentives. Our responses result in rewards and punishment which can create barriers to human performance. When unsafe performance has been rewarded or safe performance punished, we can expect inappropriate performance in the future. If cutting corners on safety in order to increase short-term production is rewarded, the frequency of cutting corners is going to increase.

To determine if incentives have created a barrier to human performance we ask "HAS THE PERSON BEEN REWARDED FOR DOING THE JOB INCORRECTLY OR PUNISHED FOR DOING IT CORRECTLY?"

Example of an incentive barrier:

> **A contract miner gets a bonus for the amount of ore mined over quota. The miner knows that if the equipment is operated longer than recommended before it should receive maintenance, more bonus money will be received. The foreman knows what's going on but declines to intervene. The miner is rewarded for unsafe performance resulting in an incentive barrier. The individual is rewarded for unsafe performance resulting in an incentive barrier to proper performance.**

In this example, the miner is reinforced by the bonus money because misuse of equipment allows more production. Note also a second thing. The foreman ignores the unsafe behavior, and therefore, doesn't provide direction and guidance. There are times when there may be a fine line between determining whether the barrier is misuse of incentive or lack of direction or guidance. However, our knowledge of the operation of the mine should help us make that determination.

There is a tendency when discussing incentives in the mining industry, to think in terms of the mine's incentive program. While the incentive program is important, it is a small part of the concept we are presenting. Our major concerns are those little things that occur or fail to occur after the person responds. While the opportunity for bonuses, promotion, jackets and the like are important, events like praise from one's supervisor or coworkers, or a ribbing from one's work crew are powerful determinants of behavior. These events which occur in the normal, everyday interactions at the work site need to be considered if an incentive barrier exists.

Example:

> **An individual wears safety glasses while the rest of the work crew doesn't. The crew may poke fun at the person until he/she stops wearing the glasses. Being a part of a group and getting support from the group are powerful incentives in determining performance.**

When analyzing accidents for human barriers, we need to realize that the five barriers we have discussed often operate together. It is an advantage to present them independently for understanding. However, it is also important to make five judgments as to which barrier may be the primary contributor to an accident. Each type of barrier not only requires a different type of solution, but the implementation costs of the solutions are quite different.

Barriers to Human Performance

INFORMATION (DIRECTION AND GUIDANCE) (See p. 22)

Was the person given direction and guidance in regard to performing the job?

TOOLS AND EQUIPMENT (APPROPRIATE TOOLS OR EQUIPMENT) (See p. 23)

Were the appropriate tools or equipment available and properly designed?

KNOWLEDGE (KNOW-HOW) (See p. 23)

Did the person know how to do the job as it was supposed to be done?

CAPACITY (PHYSICAL CONDITION/IMPAIRMENT) (See p. 24)

Did the task exceed the capacity of the individual performing it?

INCENTIVE (REWARD OR PUNISHMENT) (See pp. 24-25)

Has the person been rewarded for doing the job incorrectly or punished for doing it right?

Doing the Human Barrier Analysis

The Human Barrier Analysis (HBA) proceeds from the data we have on the Physical Barrier Analysis. We will be concerned with the data in the rows:

A. Was not possible and practical

B. Was possible and practical, but not provided

C. Was provided but not used

D. Was provided and used but failed

Transfer accidents from the matrix to the respective HBA tally sheet by doing the following:

Accidents in A – Record any accident number which appears four times in the A category on the tally sheet. (See p. 29)

Accidents in B, C, and D – Record all accidents which appear in these categories on the respective tally sheet. If they appear more than once, record them more than once. (See pp. 29-30)

The matrix categorized the accidents into two groups. In one group (rows B & D), a barrier would have prevented the accident. The second group (rows A & C), human behavior played a significant role.

A & C accidents are generally caused by individuals who did something they shouldn't have or didn't do something they should have. All mines have accidents of this type. The Human Barrier Analysis is our tool for further analysis of the accidents in A & C, where human behavior played a role. The HBA helps us to answer the question, "If a person could have done something to prevent the accident, why didn't he/she?"

Example Showing Transfer of Accidents from Matrix to Tally Sheets

PHYSICAL BARRIER ANALYSIS MATRIX

	1	2	3	4
	Barrier on the Energy Source	Barrier between Energy and the Person	Barrier on the Person	Time/Space Barrier
A Was Not Possible and Practical	(1), 2, (4), (6), 7, 8, (9), (10), 11, 12, 13, (14), 15, 16, 17, (18), 20, (21), (22), 23, 25, (26), (27), (28), 29, (30), 31, 32, 33, (34), 36, (37), (38), 39, 40, (41), (42), (43), (44), 46, 47, (48), 49, 50	1, 2, 3, 4, 5, 6, 8, 9, 10, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 26, 27, 28, 29, 30, 33, 34, 35, 37, 38, 40, 41, 42, 43, 44, 45, 4, 48, 49	1, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 17, 18, 19, 21, 22, 24, 25, 26, 27, 28, 30, 31, 32, 34, 35, 37, 38, 40, 41, 42, 43, 44, 45, 48, 50	1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50
B Was Possible and Practical but Not Provided	3, 19, 24, 35, 45	13, 31, 50		17
C Was Provided but Not Used		7, 11, 12, 25, 36, 39, 47	2, 11, 16, 20, 23, 29, 33, 36, 39, 46, 47, 49	8, 40
D Was Provided and Used but Failed	5	32		

HBA TALLY SHEET

GROUP A

Which human barrier will have to be eliminated or modified to prevent the accident?

Accident Number	Information	Tools and Equipment	Knowledge	Capacity	Incentive
1					
4					
6					
9					
10					
14					
18					
21					
22					
26					
27					
28					
30					
34					
37					
38					
41					
42					
43					
44					
48					
Totals					

TALLY SHEET

GROUP B

Accident Number	Barrier that wasn't provided
3	
13	
17	
19	
24	
31	
35	
45	
50	

Total No. ___________

HBA TALLY SHEET

GROUP C

Accident Number	Physical Barrier not Used	Human barrier that helps explain why it was not used: Information	Tools and Equipment	Knowledge	Capacity	Incentive
2						
7						
8						
11						
11						
12						
16						
20						
23						
25						
29						
33						
36						
36						
39						
39						
40						
46						
47						
47						
49						
Totals						

TALLY SHEET

GROUP D

Accident Number	Barrier that failed
5	
32	

Total No. ____________

HBA TALLY SHEET

GROUP A

Which Human Barrier will have to be eliminated or modified to prevent this accident?

Accident Number	Information	Tools and Equipment	Knowledge	Capacity	Incentive
Totals					

TALLY SHEET

GROUP B

Accident Number	Barrier that wasn't provided

Total No. __________

HBA TALLY SHEET

GROUP C

Human Barrier that helps explain why it was not used

Accident Number	Physical Barrier Not Used	Information	Tools and Equipment	Knowledge	Capacity	Incentive
Totals						

TALLY SHEET

GROUP D

Accident Number	Barrier that failed

Total No. __________

After we have recorded the accidents from rows A and C on the Tally Sheets, we are ready to do an HBA. We now go back to the accident abstract and for each accident we will ask the questions to determine which human barrier was operating. (Questions are shown on page 26.)

When analyzing each accident, we put ourselves in a forced choice situation. We may only select one of the five possible human barriers as the cause of the accident. Using our experience in the mining industry, and our knowledge of the mine operations and procedures, we decide which of the human barriers we think probably led to the performance, and contributed to the accident. Then we place a check mark in the column under the appropriate barrier for that accident. For each accident we have on the Tally Sheet, we have one check mark in one of the five columns. (Examples A and C, pp. 36-37)

After we have recorded the accidents from rows B and D on the Tally Sheets, we complete those forms by filling in the blanks with the barrier that was not provided and the barrier that failed, respectively. (Examples B and D, pp. 36-37)

HBA TALLY SHEET

GROUP A

Which human barrier will have to be eliminated or modified to prevent the accident?

Accident Number	Information	Tools and Equipment	Knowledge	Capacity	Incentive
1	√				
4					√
6					√
9					√
10	√				
14					√
18					√
21	√				
22	√				
26				√	
27	√				
28					√
30		√			
34					√
37			√		
38	√				
41	√				
42					√
43					√
44	√				
48				√	
Totals	8	1	1	2	9

TALLY SHEET

GROUP B

Accident Number	Barrier that wasn't provided
3	Trolley Wire Guard
13	Dead Block
17	Sand
19	Derail
24	Switch Signal
31	Safety Latch
35	Padding
45	Clearance
50	Guard
Total No.	9

HBA TALLY SHEET

GROUP C

Human barrier that helps explain why it was not used

Accident Number	Physical Barrier not Used	Information	Tools and Equipment	Knowledge	Capacity	Incentive
2	Safety Glasses					√
7	Guard	√				
8	Slate bar					√
11	Blocks					√
11	Guard					√
12	Switch	√				
16	Seat Belt					√
20	Restraining Device					√
23	Metatarsals	√				
25	Safety Glasses					√
29	Trolley Guard	√				
33	Space between Trips					√
36	Safety Glasses					√
36	ATRS		√			
39	Line Curtain	√				
39	Gloves					√
40	Shield					√
46	Insulators					√
47	Safety Glasses					√
47	Seat Belt	√				
49	Belt Grabbers			√		
Totals		6	1	1	0	13

TALLY SHEET

GROUP D

Accident Number	Barrier that failed
5	GFI
32	Canopy
Total No.	2

Wrap-Up of Preliminary Data Analysis

We have now been through the elements of the Preliminary Data Analysis. By now we should realize that this system is not doing our thinking for us, but instead, provides us with the tools to help us think in a clear, consistent manner. Its design intends to steady our course and at the same time encourages flexibility in pursuing areas of potential use. The supervisory role of organizer and director of the project should also be coming into focus. Consistent, progressive, efficient programs do not run themselves. A tempered rein is normally required to ensure such things.

There are some additional areas that we need to think about which will give us a chance to solidify our roles and responsibilities to make the system work.

Our purpose in the PDA was to familiarize ourselves with the accidents in an effort to establish some broad perspective of what may be causing them. PBA and HBA are only fast screen. As in all fast screening mechanisms, we are willing to trade off a degree of accuracy for expediency. If we are 10% off in our placement of accidents into groups, this is certainly understandable and acceptable considering the lack of information on many of the accidents. Since we look at major groupings or clusters, it really won't make or break us if we miss an accident that probably should have gone in Group A instead of Group C. The result may have made Group A contain 75 accidents instead of 76. So what?

If we are inclined to lean one way or the other, we should give the benefit of the doubt to all groups except Group A. Since Group A will normally be the largest, it's easy to begin to throw everything into Group A without just consideration of the other categories.

We take what's given about the accident, read into it what we need to make sense out of it, trust our instincts and when we're finished our margin of error will be well within the acceptable limits. Mainly we must be consistent. Lack of consistency really shows up when we put Accident #1 in Group A and Accident #73 in Group D when they are identical. Lack of consistency can jeopardize any potential usefulness of the PBA and HBA.

There is no clear-cut number of accidents one should set out to analyze. Generally, 100 accidents is broad enough coverage to exhibit the breakdown of accidents into their representative groups.

If we begin with 10 accidents, for example, it's difficult to get any meaning from the fact that three accidents are in Group 2, two in another, etc. There just isn't enough difference between 3 and 2 to make viable assumptions based on that difference.

If we have a mine with few accidents, say 10 to 20 that we were interested in, we would probably handle the analysis a little differently. Because the number of accidents is small, we can go to the mine, get additional information about each accident, and then factor them into their respective groups as per the PBA and HBA.

But it is important to remember that the HBA and PBA are more than a set of tools. They are a different perspective, a different way of looking at accidents. Even if the mine only had one accident, we would still want to look at it in terms of PBA and HBA, even though we would not go through paperwork of PBA and HBA.

There is no hard and fast rule on how far back to go. Do we look at accidents dating back one year? Two years? Three years? If we were dealing with a large mine which is above the national average, we may not have to go past one or two months to get our 100 accidents.

Has there been a sudden increase in accidents? If so, in order to find out which group accounts for that increase, we will have to analyze accidents before the increase to find out what types were happening before, analyze those that are happening after the increase, and compare the two results to see how they differ.

When we say we can't tell you how many and for what time period to analyze, we are in essence saying that we do as many accidents as resources permit over the time period that we think will yield the most useful insight.

We are putting a puzzle together. Before we can put the pieces together to make something out of them, we must first find them. The PDA yields the first piece. Before any program of this nature is taken to a mine, something or someone must initiate it. We do not have nor do we wish to have any control over what mines need the program. We can, however, discuss some of the ways mines may be selected for the program.

1. MSHA may decide arbitrarily.
2. MSHA may devise mathematical selection process.
3. An operator may request it.
4. The program or parts of it may be used in the course of normal inspection work at all mines.

Regardless of the selection procedure, let's assume that we are assigned a particular mine (target mine) on which to concentrate efforts in reducing accidents. Let's also assume that we want to try this system. Where do we start?

1. Select personnel who will comprise the project team
   A. Two, possibly three team members work best
   B. Personnel who have received training in the system

2. Hold a team meeting outlining the job to be done
   A. Identify mine
   B. Assign duties
   C. Develop schedules

      (1) PDA
      (2) Initial contact
      (3) On site
      (4) Data integration
      (5) Presentation of findings

   D. Select team leader
   E. State facts that are known about the case

3. Clarify to the team what the leader's role will be

4. Clarify what is expected from the team members
   A. Progress checks, etc.
   B. Reports, etc.

We have used the accident narratives as our primary source of data in the PBA and HBA. This doesn't mean that we are limited to using those data in the PDA. We may have other data we think will be useful: Fatal reports, other accident reports, information from inspectors who have inspected the mine, etc. If we think it will be useful, we should use it.

Sometimes people learning the PBA and HBA become overwhelmed at the time it takes to learn the techniques. From that they assume a lot of time and human resources will be required. When someone has learned to use the HBA and PBA and is comfortable with it, it is very easy for one person to analyze 100 accidents in a couple of hours.

Interpretation of PBA – HBA

We wish to use the PBA and HBA data to direct us in carrying out a systematic investigation at the mine site. Since our resources are limited, the fast screen provided by the PBA and HBA will allow us to direct our resources better at the mine. The PBA and HBA will lead us to the things we want to look at and the questions we want to ask when we get to the mine.

In analyzing the PBA and HBA data, we first look for clusters of accidents. Using the following PBA matrix, let's see what we can find.

PHYSICAL BARRIER MATRIX ANALYSIS

	1	2	3	4
	1 - Barrier on the Energy Source	2 – Barrier between Energy and the Person	3 - Barrier on the Person	4 - Time/Space Barrier
A Was Not Possible and Practical	(1), 2, (4), (6), 7, 8, (9), (10), 11, 12, 13, (14), 15, 16, 17, (18), 20, (21), (22), 23, 25, (26), (27), (28), 29, (30), 31, 32, 33, (34), 36, (37), (38), 39, 40, (41), (42), (43), (44), 46, 47, (48), 49, 50	1, 2, 3, 4, 5, 6, 8, 9, 10, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 26, 27, 28, 29, 30, 33, 34, 35, 37, 38, 40, 41, 42, 43, 44, 45, 4, 48, 49	1, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 17, 18, 19, 21, 22, 24, 25, 26, 27, 28, 30, 31, 32, 34, 35, 37, 38, 40, 41, 42, 43, 44, 45, 48, 50	1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50
B Was Possible and Practical but Not Provided	3, 19, 24, 35, 45	13, 31, 50		17
C Was Provided but Not Used		7, 11, 12, 25, 36, 39, 47	2, 11, 16, 20, 23, 29, 33, 36, 39, 46, 47, 49	8, 40
D Was Provided and Used but Failed	5	32		

1. 21 - Barrier not possible or practical
2. 9 - Barrier not provided
3. 18 - Barrier not used
4. 2 - Barrier failed

50

HBA TALLY SHEET

GROUP A

Which human barriers will have to be eliminated or modified to prevent this accident?

Accident Number	Information	Tools and Equipment	Knowledge	Capacity	Incentive
1	√				
4					√
6					√
9					√
10	√				
14					√
18					√
21	√				
22	√				
26				√	
27	√				
28					√
30		√			
34					√
37			√		
38	√				
41	√				
42					√
43					√
44	√				
48				√	
Totals	8	1	1	2	9

HBA TALLY SHEET

GROUP C

Human barrier that helps explain why it was not used

Accident Number	Physical Barrier not Used	Information	Tools and Equipment	Knowledge	Capacity	Incentive
2	Safety Glasses					√
7	Guard	√				
8	Slate bar					√
11	Blocks					√
11	Guard					√
12	Switch	√				
16	Seat Belt					√
20	Restraining Device					√
23	Metatarsals	√				
25	Safety Glasses					√
29	Trolley Guard	√				
33	Space between Trips					√
36	Safety Glasses					√
36	ATRS		√			
39	Line Curtain	√				
39	Gloves					√
40	Shield					√
46	Insulators					√
47	Safety Glasses					√
47	Seat Belt	√				
49	Belt Grabbers			√		
Totals		6	1	1	0	13

FROM THE A AND C TALLY SHEETS

1.	Information	14
2.	Tools/Equipment	2
3.	Knowledge	2
4.	Capacity	2

Using the totals from the Matrix (Page 36, Group B) and A and C Tally Sheets (Pages 36 and 37), we should look into Physical Barriers that are not provided, the presence of information and incentive barriers when we go on site.

1.	Barrier not provided	9
2.	Information Barriers	14
3.	Incentive Barriers	22

Now the question is: From our knowledge of mining and the operation we are reviewing, why wouldn't these barriers be provided, when in fact they are possible and practical? Maybe no one at the operation realized the barriers were possible; maybe the miners kept telling the supervisors that the barriers were missing, but the supervisors didn't do anything about it; maybe no one was aware the barriers were missing; or maybe the maintenance staff was repairing the barriers and didn't provide a replacement. There could be a host of possible causes, only some of which are likely at the operation we are looking at.

From our knowledge, we can make a statement of potential causes.

> "There appears to be a good proportion of accidents that result from physical barriers not being provided. It is very likely at this operation that supervisors are not providing those barriers or taking action to ensure the barriers are provided."

We must remember that the purpose of this statement is guidance in our planning of on-site activities. If we suspect a supervisory problem, we can concentrate on that rather than using our resources elsewhere. We will come back and develop this potential cause later.

The PBA clustered accidents in Rows A and C. Thus, we see that we have two large groups of accidents that were the result of "people problems." We now go to our HBA to find out what may be the potential causes (p. 43). We have two clusters of accidents. One is where information (lack of guidance or direction) seems to be the cause. The other cluster is in the incentive category.

Using our experience in mining and our knowledge of the particular mine operation and procedures, we ask, what could be going on? Maybe management's support of safety isn't getting down to the supervisors. Maybe the supervisors know management's safety posture, but are being rewarded for cutting corners to increase production. Could it be that safety procedures simply aren't clear? Or maybe the worker is being reinforced for cutting corners, possibly punished when work is done safely?

Planned Inquiry

We then have two more potential causes to look into.

> It appears that the reward system at this operation is resulting in people being rewarded for cutting corners and behaving unsafely.
>
> It appears that management's concern for safety is not being adequately communicated through the foremen to the workers.

While we don't know exactly why the incentive and communications systems are inadequate, we do suspect they are potential causes for many accidents. Again, this offers guidance in our planning. It is unlikely we would look at miner training if we suspect an inadequate reward system.

We also had a few accidents in the HBA which indicated a knowledge and capacity barrier. We have not used those accidents to determine potential causes, because we want to use our limited resources the best way possible. The HBA indicates we will get the most mileage out of looking at information and incentives.

We cannot better define what we want to look at when we go to the mine. The planned inquiry sheet on the next page will help us organize for on-site activities. The inquiry sheet has been filled in to provide an example of what it may look like when used to plan for on-site activities. The information comes again from our experience and knowledge. The information is abbreviated and directs us only to key areas. Our example has a limited number of questions. In practice we would have several questions for each area we want to look into (next page).

You will notice that in our questions we ask nothing about miner training, but do ask about supervisory training. We ask about some inspection procedures, but no maintenance. The purpose of the PBA and HBA analysis is to narrow those areas at the mine that we want to look at that will lead to the most information at the lowest resource cost. It is important to remember that at this point we don't have answers, only questions!

PLANNED INQUIRY SHEET

Potential Cause	Areas to Look Into	Questions We May Want to Ask
Barriers not being provided by supervisors	• Ordering supplies • Supply budget • Detection plan, coordination between workers, supervisors, and supply • Supervisory knowledge of barriers • Supervisor's authority	• How does the supervisor fit into the identification, requisitioning, procurement chain? • What is the supervisor's knowledge of barriers, their form, and purpose? • Who has responsibility for detecting lack of barriers, and is the responsibility formalized?
Information not being clearly passed from foremen to miners	• Availability of information • Communication chain • Workers' perceptions • Observation of communication process • Clarity of information	• Do the workers think they are getting the straight poop from supervisors? • Is the communication problem widespread or specific to a topic, crew, or management group? • How do employees find out what management expects of them? • What kind of feedback system exists?
The incentive system is rewarding people for unsafe behavior	• Workers' perceptions • Management modeling behavior • Observation of consequences of work procedures • Supervisor's knowledge of the use of incentives • Work group control	• What kinds of incentives are given at the work site? • Are safe behaviors being punished? • Do workers view the incentives as unfair? • Is the lack of incentives widespread, or specific to certain supervisors? • How does management use incentives with supervisors?

PLANNED INQUIRY SHEET

Potential Cause	Areas to Look Into	Questions We May Want to Ask

ON-SITE ACTIVITIES

Regardless of the quality of the product from the Preliminary Data Analysis, the project cannot achieve anything unless we are successful in gaining additional information on-site. On-site data will change probable causes to actual causes. It will change "we think" to "we know"; it can change "I'll be darned if I know what to suggest" to "you may want to consider trying this." In short, any potential this approach has for reducing accidents rests with our ability to obtain information which helps us understand how they can be reduced.

All of the information we collect will not serve in reducing accidents. It's easy to see how a great deal of time and resources could be expended at a mine for the collection of volumes of data only to discover in hindsight that what we've collected doesn't help much in understanding what's going on. Most of the time anything we get can be of some help but truly premium information is that which helps us understand what problems exist, why they exist, and how they are causing accidents.

If we have made the PDA work for us, we have (based on the accidents) an educated guess as to what underlying factors may be the primary difficulty at this mine. If our speculation was correct, the answers to the types of questions we developed on the planned inquiry sheet are, in essence, premium information.

Two traditional approaches to obtaining the kinds of data we need are the interview and direct observation. Both have been practiced for years by MSHA personnel. As applied to this accident prevention system, each approach has two modes between which we may find ourselves alternating as the situation dictates.

These modes - planned and impromptu - are so named because the names describe the modes.

Interviews and Observations

Planned observations and interviews are a direct result of the planned inquiry product. At the mine site we follow up on the notes we have made on the planned inquiry sheet. Now is our chance to ask the questions we jotted down at the office as we said to ourselves, "If I only knew this, I could make some sense out of things." Now is our chance to look at items we listed on the planned inquiry sheet. After analyzing a group of accidents, we said to ourselves, "I'll bet they do that all of the time." Now is our opportunity to get answers to all of the questions which should have been raised as we studied the accidents.

While the planned observations and interviews should yield the greatest amount of premium information, we should be careful not to discount the importance of "playing it by ear." The impromptu mode encourages us to pursue avenues which we hadn't previously considered, or ask questions which our preliminary information didn't bring to mind.

The ability to function in the impromptu mode brings out the dynamic nature of this approach to its fullest. It swings into action when someone tells us something that seems worth pursuing even though we hadn't planned to ask about it; or if it is being practiced in the course of observing a unit in operation, we spot something which, with our recall of the mine's accidents, produces useful information.

Planned work gives the inquiry a sense of direction and focus. Impromptu work allows the flexibility to explore based on immediate need.

They are the tools of the skilled analyst. All of the answers are out there. When the on-site work is completed, the sharp interviewer knows if the right answers have not been obtained, the right questions have not been asked.

In many cases sources of information, in addition to interviews and observations, are useful. Items such as company records, policy memos, plans, programs or any other material which indicates how the operation conducts business may in the end help tie things together.

On-Site: Other Concerns

By its very nature, an Accident Prevention approach such as this operates on an "ask for" basis as opposed to a "demand" basis. The kinds of information we're attempting to acquire will only come our way when a non-adversarial climate is established at the outset and nurtured at each juncture of the project. In view of what, in many cases, are tenuous relationships going in, any precautions we can take against slip-ups which jeopardize our effectiveness are certainly advisable. As we all know, many operations most in need of assistance are the least amenable to such an offering. It is a fact, however, that when a sensible, practical, equitable plan is laid out with no hidden agendas, operations people sometimes listen.

As we meet with operations and labor representatives we should lay all of the cards on the table, so to speak. Discuss with them what is about to take place, how the project is designed to work, what role they will play, and above all, what they can expect to get from it.

Examples of the types of things we may wish to bring up for discussion are:

The objective of the project is to reduce accidents by identifying aspects of the operation which are contributing to them so that they may be modified or eliminated.

Those aspects are systematically identified by collection and analysis of accident data, observation data, and interview data.

Ask that employees be made accessible. The team will conduct interviews with a sample of miners and supervisors. They will basically be asking for opinions as to what problems are causing accidents.

Interviews will be conducted at the employees' work site on a confidential basis with only the person being interviewed and the team present. No information regarding the sources of information will be revealed. Intimidation by supervisors standing near interviews is undesirable.

We are aware of the value of employees' time. If they weren't needed, they wouldn't have been hired.

We will not interview employees who are doing a job that requires constant attention. We will try to disrupt normal operations as little as possible. We will explain to each person interviewed who we are, why we are here, and what we are trying to do. We will consider ourselves guests, and try to schedule activities convenient to the operation. We need the support of both management and labor. Lack of cooperation can produce invalid results.

We are not interested in managing the mine, only holding up a mirror to those who do so that they get a clearer picture of those aspects of the operation which are causing accidents. The result of the project will be suggestions, made in good faith that they represent positive actions that the company and its employees may take to reduce accidents.

The team members, even though they are inspectors, will not be operating in the traditional inspection role. The project differs from a regular inspection as indicated on the next page:

INSPECTION	ACCIDENT PREVENTION
1. Unannounced	1. Mutually convenient times.
2. Observation of conditions to determine compliance with mandatory standards.	2. Collection of accident, observation, and interview data to determine underlying factors which are causing accidents.
3. Miners' representative and/or company representative usually accompany inspector	3. Only need a guide
4. Usually one inspector	4. Usually a team
5. Perceived as: "Hide things because when they are found, it will cost us."	5. Perceived as (hopefully). "Share your opinions and maybe they can help us. After all it doesn't cost anything."

Discussion of these types of items should demonstrate that our plan is well thought out, that we do intend to be considerate of the operator's needs, and above all that we are sincere in our desire to help reduce accidents.

ACTIVITIES AFTER ON-SITE DATA GATHERING

Organization of Information

Introduction

As indicated in the overview, the purpose of this step is to put all the data together to form a logical sequence which will support our recommendations. Our bottom line is to know—

> What is causing problems at the mine?
> What are the problems?
> What accidents resulted from those problems?
> What action can be taken to eliminate or alleviate those causes and, therefore, reduce the problems and accidents?

By the time we get to this step we should have gathered all the data that we need to answer those questions. However, we probably have a lot of data, some specific, some general, and some related to several courses or problems. Some of the data we may want to use as gathered and some we may wish to summarize. Whatever the case may be, we want to present the strongest case possible.

The "MAD" Method

For those unfamiliar with Mad Magazine, every now and then it has a section where readers can create their own stories. The readers are given a story line with parts missing and they choose from columns of words to fill in the missing parts. Example:

When the __(A)__ falls __(B)__ will __(C)__ in the __(D)__.

Fill in the blanks by choosing a word(s) from the appropriate column.

A	B	C	D
Atom bomb	Lassie	Turn green	River
Rain	My boss	Lose his hair	White House
Moon	Crow	Get fat	Management ranks
Stock market	Andy Capp	Go to sleep	Trunk of a VW
Pizza	General Motors	Cut back	Barn

As you can see, what is filled in the blanks can be as logical or illogical as one wishes to make it. The choice of one inappropriate word can turn the otherwise meaningful statement into sheer nonsense.

Since we have such a mass of data from our data collection and analysis, we propose working from the "Mad Method" to put together our findings and recommendations. Instead of filling in the blanks, we will put the information together in "columns" to make our case.

We have five columns:

1	2	3	4	5
Interviews & Observational Data Supporting the Problems	**Problems**	**Accidents Resulting form the Problems**	**Causes**	**Recommendations**
This is the information that was gathered at the mine site. The raw data and/or summaries of the data can be used. This data could be pertinent to one or more of the problems.	The problems result from the interviews and observations done at the mine site. These are statements of a problem which are supported by the data in column 1. The problem is a statement which summarizes data from the field.	The accidents come from the data base used to carry out the PBA and HBA. Now we want to know which of those accidents resulted from the problems identified in column 2.	The basic causes are determined from the problems identified in column 2. Several problems could result from the same cause, or a problem may have one cause.	The recommendations follow from the causes, since it is the cause we are trying to eliminate. Many of your recommendations will come from your experience of what has worked before in other situations. However, there are some basic guidelines for dealing with problems resulting from the presence of human barriers.

Where do we begin? Whoever collected the field data probably has a good idea what the problems are at the mine. Since Column 1 is a detailed account of Column 2, they can be done interchangeably. The goal of the initial step is to create a problem list which is derived from the support by the field data. For example:

Problem	Mine Site Data
Supply procedures appear to be ineffective.	Miners have stated that they have worked with equipment in need of repair because replacement parts were unavailable.
	Maintenance personnel indicated that replacement parts are often not available.
	There were times when the wrong part was provided to repair a piece of equipment.
	Shifters stated that there was no established procedure for ordering supplies.
	Supply personnel said that established procedures were not used. One individual stated: "There is no thinking ahead on what could go wrong. Everyone expects everything now."

For each problem, there will be supporting data. Some problems may have much support, others little support. Note also from our example that some of the data could be used to support another problem. The item - procurement personnel said established procedures were not used - would support a problem concerning information not being made available. For all practical purposes, the problem statement and the supporting data are not separable. The problem statement is a summary or a conclusion of the supporting data.

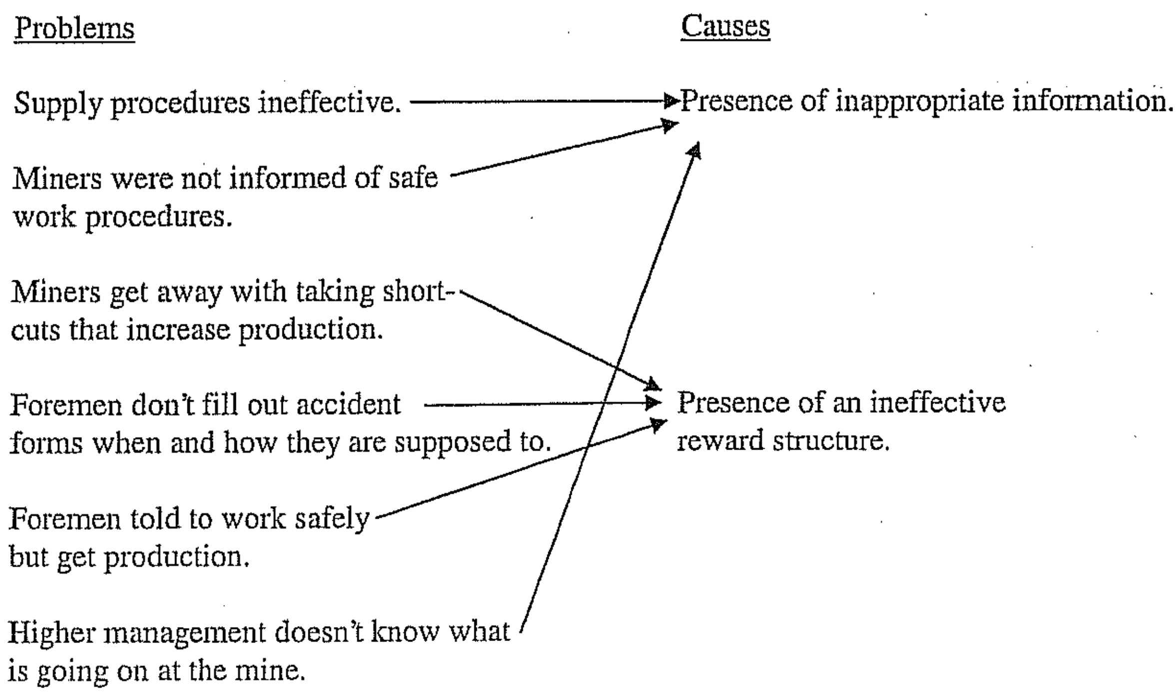
Once the problems are identified and supported by the interview and observation data, our next step is to determine which accidents resulted from the problem. We go back to our original accident data base and match the accidents to the problems. We are asking ourselves what accidents could have resulted from this problem. We are taking the information from Column 3 and adding it to our lists in Columns 1 and 2.

Example Problem	Field Data	Accidents
Supply procedures ineffective.	"Face workers have stated that . . . ↓ Everyone expects everything now."	Jeeps were operated with the first point burned out. Resistor was not available. Operator lost control on rough ground.

At the end of this step we will have supported, with data, the problems we have identified. We should have matched most of our accident data to the problems. What if we have a problem for which we have no accidents? It could be that the problem has no safety implications, that we have misinterpreted our accident data, or have missed gathering some field data. However, we are interested in making a strong case. Even with some loose ends we should still have enough information to make our case.

We are now ready to go to Column 4, Causes. Our problem statements will probably fall into groups which have the same cause. It is also very likely that the potential causes we discovered through the PBA and HBA will have been verified. In that case they are no longer potential.

For example:



Each of the problems listed in our example would have been supported by field and accident data. The problems listed have either of two causes, a faulty reward system or a lack of information.

As you recall, the purpose of the HBA and PBA was to help narrow our investigation at the mine to specific aspects of the mining operation rather than the entire operation. Our organization of information is more than just a mechanical step. It permits us to isolate the causes of problems and accidents so that the operator can better utilize efforts to eliminate causes having the greatest impact.

Having isolated the causes now leads us to Column 5, Recommendations. From our past experience, knowing things that have been done successfully and knowing actions that didn't work, we are in a position to "advise" the operator on what actions may be appropriate. While we cannot tell you what specific actions should be taken because you will be developing customized recommendations, we think the PBA and HBA can offer some guidance.

We have told you that accidents are the result of either the absence of some physical barrier or the presence of some human barrier. Rules of thumb:

1. Where a physical barrier is possible and practical but not provided or a physical barrier has failed, appropriate action <u>must</u> involve some type of engineering solution. That physical barrier must be provided, maintained, or created.

2. Where we have a human barrier present, the type of barrier provides the essential point which any recommended solution <u>must</u> address.

   A. Where lack of guidance and direction is the barrier, methods of getting the correct information to the right people at the right time <u>must</u> be part of the corrective actions.

   B. Where lack of appropriate tools or equipment is the barrier, corrective action <u>must</u> include procedures for determining and providing the appropriate tools and equipment or redesigning the job.

   C. Where the barrier is the lack of the appropriate reward structure or the punishment for appropriate behavior, the solution <u>must</u> involve the manipulation of the reward structure.

   D. Where the barrier is lack of knowledge, the corrective action <u>must</u> involve some sort of effective training.

   E. Where the barrier is a physical condition or impairment which results in the task exceeding the capacity of the individual, the specific physical condition of impairment <u>must</u> be defined and specifically addressed in the recommendation.

Making Recommendations

If these rules of thumb are used, our recommendations will not only be more likely to eliminate the cause of the problems, but applying the correct solutions will be much less costly for the operator.

We have now put all five columns together. We have the problems and the field and accident data which support them. We know the causes of the problems and the requirements of the recommendations. At this point we need to go back to our original "Mad Mode." When we filled in the blanks, we said we could come out with something meaningful or sheer nonsense. At this point we want to do a backward analysis for each of our recommendations.

Starting with one of the causes we have isolated, we go to the problem list. Each problem was supported by field data and accident data. Using only the accident information and our recommendations, we ask --

> If this recommendation had been implemented before these accidents occurred, would the accidents have been prevented or the possibility of their occurrence reduced?

We hope that the answer is yes. We do not want to make a recommendation, though logically sound, that would have no impact on their education or prevention of accidents at that mine. If our answer is no, then we had better make a different recommendation.

If we are satisfied that our recommendations would have prevented or reduced the likelihood of those past accidents, then we can safely assume our recommendations, if implemented, will prevent or reduce the likelihood of those kinds of accidents in the future.

We have previously mentioned that it was not our goal to manage the operation. While we can make recommendations that we are confident in, the operator must do the implementation. That leads us to a final consideration --

Are our recommendations reasonable?

We do not wish to make a recommendation which is so unreasonable that it would be unlikely the operator would ever implement it.

METAL/NONMETAL ACCIDENTS AND INJURIES

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Days away from work as well as days of restricted work	Powered haulage	Labor foreman Bulging foreman			

This man was supervising a crew of men. While splicing a conveyor, the tail pulley counterweight slipped, allowing the belt clamp to pinch the man's leg.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Days away from work only	Powered haulage	Laborer/Mucking machine operator pipe gin operator			

The employee was riding on the front of a tractor. A faulty brake caused the tractor to veer to the right, throwing him to the ground.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Medical treatment only	Machinery	Loading machine operator Joy STJO operator mucking machine			

The man received a foreign body in his left eye while operating a scoop tram. He developed an inflammation of the eye secondary to the injury and was treated.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Medical treatment only	Hand tools (Not electric, air)	Miner NEC			

This man was scaling the back with a scaling bar. He pulled the bar back and struck his right elbow on the rib.

Accident Date	Degree of Injury	Classification	Occupation Activity	Total Exp	Mine Exp	Job Exp
	Days away from work only	Other	Miner NEC			

This employee was stepping up onto a utility truck when his knee gave out on him.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Medical treatment only	Machinery	Laborer Mucking Machine Operator			

While retightening the air hose coupling to an impact wrench, the man's foot inadvertently engaged the start mechanism causing the wrench to spin upward.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Days away from work only	Slip/Fall of person	Shotfirer/shooter Blaster			

This employee was moving tools off of one underground truck onto another when he slipped and fell off the truck.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Medical treatment only	Other	Skip tender			

Man was running from shaft collar to change housing with his cap lamp hung around his neck. The lamp slid down and struck by his knee which propelled the lamp up, striking him in the mouth.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Medical treatment only	Powered haulage	Yard engineer operator Fireman			

This man was sitting on the edge of a pickup truck bed riding toward the change house. The driver made a sudden stop throwing the rider forward. He cut the fingers on his left hand.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Days away from work as well as days of restricted work activity	Handling materials	Miner NEC			

Employee was pushing a 2-ton rocker dump car. There was spilled muck on the tracks causing resistance. The employee strained his lower back pushing the car against the spilled muck.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Medical treatment only	Handling materials	Mechanic/repairman			

Employee was cutting a metal tube. He picked up a piece of the 2-inch tube and cut the fingers of his left hand on the inner edge of the metal tube.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Days away from work only	Inundation	Drill Helper			

This employee and a contract test driller began working in a drift where the ventilation had been blasted down at the end of the previous shift. He was overcome by blasting smoke and gases.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Days away from work only	Powered Haulage	Loading machine operator Joy STJO Operator Front			

An operator was back dragging a heading after mucking it out with an ST 8 while back dragging. The dump cylinder stabilizer linkage slipped allowing the front end of the loader to drop.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Days away from work only	Powered haulage	Scoop car operator Unitrac operator			

A man developed a lower back strain while operating a mucking machine. He stated that he received numerous jolts due to road conditions as he trammed muck from the face.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Days away from work as well as days of restricted work	Machinery	Drill Operator			

A drill operator was drilling out a raised round with a stopper, when he was struck in the right eye by a small rock. He developed eye irritation and was treated the next day.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Medical treatment only	Hand tools	Miner NEC			

An employee was cutting a plastic hose which he was repairing with a pocket knife. The knife slipped cutting his left index finger.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Days away from work as well as days of restricted work	Handling materials	Mechanic Repairman			

An employee and a coworker were installing a receiver tank on a get man service truck. While the injured man was connecting hoses underneath the truck, his partner dropped receiver tank. While attempting to position the tank on the service vehicle, the tank fell approximately 2 feet striking the man on the instep of his left foot.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Days away from work only	Other	Mechanic Repairman			

While in process of repairing car dump tripper on a bottom dump rail car, employee squatted down to pick up a piece of the tripper mechanisms and his right knee, which had previously been injured in a football game, locked in a bent position.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Medical treatment only	Handling materials	Mechanic Repairman			

This man and a coworker were attempting to lower a frame used to lift heavy equipment in the underground shop. They had lifted the upper section on its side in order to remove the holding pin. Once the pin was removed, the men were unable to hold the sliding section up and it fell pinching the inner-space of the right hand.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Days away from work only	Powered Haulage	Mine foreman Mine manager/owner			

The mine foreman was run over by rear wheel of a John Deere Model JD301A Tractor. He was attempting to restart the tractor while standing beside it on the ground.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Medical attention only	Hand tools(not elec, air)	Mine NEC			

Employee using 18-inch pipe wrench to loosen 41 feet of string of jack. Long hole steel jaws on wrench were worn and slipped causing wrench to strike employee on forehead.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Days away from work only	Stepping/ kneeling on object	Laborer/foreman Bulging foreman			

Employee was stepping around a tram motor. He stepped on a board with a protruding nail.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Days away from work as well as days of restricted work activity	Machinery	Trainee			

Employee was the signal man to the slusher operator. He was standing downhill from the bucket when a rock rolled out of the bucket. He jumped to the side and twisted his ankle on other rocks in muck pile.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Days away from work as well as days of restricted work activity	Powered haulage	Miner NEC			

Employee and others had set a 12" diameter 350 pound air cylinder on an LHD bucket. The cylinder was not secured and the loader operator raised the bucket causing the cylinder to drop on employee's foot.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Restricted work activity only	Handling materials	Miner NEC			

Employee strained his back while installing mats and rockbolts. According to the doctor, he had a chronic back problem.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Days away from work only	Slip/fall of person	Trainee			

Nippers had washed down collar of shaft at or near shift change, causing slick conditions at the time of heavy foot traffic. Employee slipped carrying core, fell with full weight on knee, losing time for knee injury several days later.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Days away from work only	Handling materials	Drill Operator			

Employee was getting ready to watch welder. A welding lens was setting on the equipment being welded. Welder jerked the welding stinger and hit the lens causing it to shatter. A piece of flying glass hit employee in the throat cutting him.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Days away from work only	Machinery	Mechanical/repairman			

Employee was going to work on a slusher dipper. Another employee started the slusher without notification, causing the slusher cable to tighten, striking the employee.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Medical treatment only	Hand tools (not elec, air)	Miner NEC			

Employee was sizing rock with a sledge hammer on a grizzly when a piece of flyrock hit his middle finger causing a laceration which required 3 stitches. The employee was not wearing gloves at the time.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Days away from work only	Handling Materials	Timber man Ropeman/jacksetter			

A timberman was taking some measurements on open air door without blocking door. Door slammed shut on his arm, causing large bruise.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Medical treatment only	Hand tools (not elec. Air)	Electrician			

Employee was stripping insulation from an electrical wire when the knife slipped, causing the employee to cut his leg.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	All other cases submitted to MSHA	Powered haulage	Miner NEC/quarry worker			

Employee was driving down mine road after working graveyard shift and had head-on collision with car driving toward the mine.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Days away from work only	Handling materials	Drill Operator			

An employee lifted a core barrel so the core would slide out of the end. The salesman, thinking he needed help for some reason grabbed the other end of the barrel. Employee was not prepared for the lift and the movement of the weight strained his back.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Days away from work as well as days of restrictive work activity	Hand tools (Not elec, air)	Miner NEC			

Employee was using a double-jack breaking rocks on the grizzly and strained his back. The double-jack being used had a short handle. The employee used the short handled jack because he said he could not find a longer handled double-jack.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Days away from work only	Powered haulage	Laborer/utility man Pumper			

Employee was traveling from the ore sorter building to the fines bin hauling clean-up muck. The loader traveled over a 9 foot elevated concrete wall and fell upside down in the bin. The investigation indicated excessive speed. Traveling with the loaded bucket elevated or misjudging the distance to the elevated concrete portion of the bin may have contributed to the accident.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Days away from work only	Handling Materials	Trainee			

Employee attempted to open air door between 2 and 3 shaft when the handle came off the door, causing employee to fall. The counterweight normally on the door had been removed and lag bolts holding handle were not sufficient for the amount of pressure needed to open it.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Days away from work only	Hand tools (not elec, air)	Trainee			

As employee was breaking rocks on the 500 level grizzly using sledge hammer, a piece of flying rock struck employee's safety glasses, breaking the left lens. The employee received a bruise to his left cheek and corneal abrasion.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Days away from work as well as days of restricted work activity	Exploding vessels	Trainee			

Employee was attempting to repair leak in 4-inch air line when the air line blew apart. He was thrown from the top of LHD that he was working from into drainage ditch. He thought he had bled the excess air from the line using a bull hose that was attached, but had closed the valves causing air to be trapped in 110 PSI Line.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Restricted Activity only	Hand tools (not elec, air)	Miner NEC			

Employee was attempting to break loose a hang-up on a grizzly using a pick. Rock rolled from pile and struck the employee on top of his foot. The employee did not use boards provided to improve his footing and therefore could not move away from the rock quickly enough.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Medical treatment only	Handling materials	Mechanic Repairman			

Employee was moving a metal ladder. As he laid it down, he cut his finger on a sharp piece of metal on the ladder from a weld. The employee was not wearing gloves at the time.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Medical treatment only	Hand tools (Not elec, air)	Miner NEC			

While attempting to dislodge a hang-up in the #2 shaft ore chute, employee was struck in the jaw by the bar he was using. The bar had bends in it and when a rock struck it, it caused the bar to turn and strike the employee. The resulting cut on the jaw required sutures.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Restricted activity only	Machinery	Drill operator			

Employee was breaking core at 16D core drill station. Chips of rock flew up and into his left eye and were imbedded there.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Medical treatment only	Striking/ Bumping	Mechanic Repairman			

Employee was walking in the shower area and stubbed his toe on the foot disinfectant sprayer located on a corner of an outside wall. This resulted in a fracture of his small toe.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Restricted work activity only	Hand tools (not elec, air)	Miner NEC			

Employee was attempting to pry a rock loose that was wedged between the 1100 level grizzly straps when he felt a pain in his right groin area. Employee indicated that he was too far from the rock and that he twisted his body wrong.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Days away from work only	Machinery	Mechanic Repairman			

Employee was brushing a #4 hydraulic hose on a 10-inch wire wheel in a bench grinder at the 100 stop. The fitting caught on the wire wheel and pulled his hand into the wire brush. The employee was not holding the small hose with pliers and was not wearing gloves.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Days away from work only	Machinery	Miner NEC			

Employee was drilling a scram round and water and mud splashed in his eye about mid-shift. He reported to the doctor the next day, complaining of eye irritation. He was released for regular duty but visited doctor again. As a result of that visit, he began missing time.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Days away from work only	Machinery	Timber man Propman/jacksetter			

Employee was installing a 4-inch header on an air line. He had his ladder propped up at a right angle against the ladder of a coworker. When the line was pressurized, the header came off because it was not properly clamped in place. This caused the employee to fall from the ladder resulting in him striking his head or getting struck by the header. He also injured his hip in falling.

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Restricted work activity only	Machinery	Thermn/propmn/jckstr			
Cutting piece of plywood using electric saw and foreign material got in eye.						

Accident Date	Degree of Injury	Classification	Occupation/Activity	Total Exp	Mine Exp	Job Exp
	Days away from work only	Stepping/ kneeling on object	Labor foreman Bulging foreman			
Employee was in scrap yard and stepped on piece of wood with nail in it.						