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SAFETY CULTURE ASSESSMENT IN UNDERGROUND COAL MINING

Contract No. 254-2006-M-17202
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Safety Culture Assessment in Underground Coal Mining

Conducted by
Human Performance Analysis, Corp.

For the
**National Institute of Occupational Safety and Health
Pittsburgh Research Laboratory**

Contract No. 254-2006-M-17202

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EXECUTIVE SUMMARY

The Sago Mine Disaster, on January 2, 2006, placed renewed focus on several different aspects of safety in the underground coal mining industry. One area which received increased attention since Sago and other underground coal mining events is the concept of Safety Culture.

This report describes the results of a pilot Safety Culture Assessment implemented at a small Appalachian underground coal mine, hereafter referred to as the Mine. The purposes of this pilot assessment were to (a) evaluate the feasibility and usefulness of a methodology for assessing safety culture that had previously been developed for use within other industries, (b) to initiate an investigation into the understanding and defining of the existing safety culture of the underground coal mining industry, and (c) provide meaningful and useful recommendations for the participating mine for their consideration in their ongoing quest to enhance their existing safety culture. This pilot assessment was conducted in July 2007. The report provides information regarding the presence or absence of safety culture characteristics within the Mine. Observations regarding the characteristics of the Mine's safety culture that should be sustained are presented. Areas in need of attention and management focus to improve the Mine's safety culture are presented as well as recommendations for moving forward.

Safety culture characteristics that are important for the existence of a positive safety culture have been identified to include:

- **Safety is a clearly recognized value in the organization.**
- **Accountability for safety in the organization is clear.**
- **Safety is integrated into all activities in the organization.**
- **A safety leadership process exists in the organization.**
- **Safety culture is learning driven in the organization.**
- **A process for establishing a strong and effective Safety Conscious Work Environment (SCWE) is in place.**

Performance objectives are associated with each of the safety culture characteristics and particular behaviors and attitudes have been identified that can be measured to evaluate these objectives.

Using a methodology originally developed with the support of the U.S. Nuclear Regulatory Commission, an assessment of selected organizational behaviors and attitudes was conducted to evaluate the Mine in terms of these safety culture characteristics and their associated performance objectives. The methodology involves obtaining a variety of quantitative and qualitative information, using multiple data-gathering methods. The information collected is largely based upon the perceptions of the individuals in the organization. The evaluation is a 'point in time' snapshot of the Mine, but cultural beliefs and assumptions do not change quickly.

The feasibility and usefulness of the methodology was successfully demonstrated during this pilot assessment. All aspects of the methodology including functional analysis, structured interviews with accompanying behavioral scales, work observations, and the paper and pencil

survey administration were implemented without any difficulties. Mine participants were able to provide all information necessary for the successful implementation of the methodology without any problems. Lessons learned from this implementation for future use of the methodology are discussed.

The existing safety culture at the Mine was assessed against the characteristics identified to be important for the promotion of a positive safety culture. Initiatives and behaviors that are designed to facilitate and promote a positive safety culture and safety conscious work environment at the Mine were identified in the course of the assessment. These include:

- Documentation that describes the importance and role of safety in the operation of the Mine exists and there are multiple mechanisms available to communicate the value of safety to all employees;
- Individuals are held accountable for safety by the Company through various programs including, random drug testing, progressive discipline, and a corporate reward for safety incentive program;
- Safety standards and norms exist for several different aspects of mine operations including maintenance and operation of equipment as well as the conduct of personnel;
- Most individuals identified being satisfied with communication and believe that they are well informed about what is going on around the site; and
- The majority of employees believe that they are responsible for identifying problems.

The results of the assessment however also indicated that several of the behaviors associated with the safety culture characteristics need more management attention. These include:

- While there are multiple mechanisms to communicate the value of safety to all employees, the lack of clear and consistent expectations and standards is evident in the variability of behavior with respect to safety.
- Individuals at some levels in the organization are reluctant to accept personal responsibility and ownership for safety issues that they perceive to be someone else's job.
- There is a need for more strategic thinking about the integration of safety into all activities and processes and how behaviors important to safety can enhance the quality of all work to be done.
- The multiple differences in attitudes and perceptions between the various crews and groups indicate that a safety leadership process is not internalized in the organization.
- Efforts to learn from past performance have been addressed for some major industry events, but the process of learning from all aspects of day to day performance is not consistently or systematically conducted in the organization.
- The behaviors important to creating an environment where concerns can be raised without fear of reprisal are not perceived to be present by a large percentage of the organization. In fact, the organization may have created an environment where things are not reported.

Based on the conclusions of the Assessment Team with regard to the existing safety culture at the Mine, recommendations are presented for consideration for the continued enhancement of safety performance.

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# 1	INTRODUCTION

The Sago Mine Disaster, on January 2, 2006, placed renewed focus on several different aspects of safety in the underground coal mining industry. One area which received increased attention since Sago and other underground coal mining events is the concept of Safety Culture. Safety Culture has been identified as a contributing cause in many of the catastrophic events that have occurred across many industries in the recent past including Challenger, Chernobyl, Bhopal, the BP Texas Refinery Fire. Safety culture is defined as the characteristics of the work environment, such as the norms, rules, and common understandings that influence facility personnel's perceptions of the importance that the organization places on safety. The National Institute of Occupational Safety and Health's (NIOSH) Program for Mining Safety and Health Research has an interest in understanding and defining the existing culture of the underground coal mining industry. By so doing, the characteristics of the culture can be evaluated to determine which can be sustained and which need enhancement to effect long-term improvements in the industry's safety performance.

This report describes the results of a pilot Safety Culture Assessment implemented at a small Appalachian underground coal mine, hereafter referred to as the Mine. The purposes of this pilot assessment were to (a) evaluate the feasibility and usefulness of a methodology for assessing safety culture that had previously been developed for use within other industries, (b) to initiate an investigation into the understanding and defining of the existing safety culture of the underground coal mining industry, and (c) provide meaningful and useful recommendations for the participating mine for their consideration in their ongoing quest to enhance their existing safety culture. This pilot assessment was conducted in July 2007. The report provides information regarding the presence or absence of safety culture characteristics within the Mine. Observations regarding the characteristics of the Mine's safety culture that should be sustained are presented. Areas in need of attention and management focus to improve the Mine's safety culture are also presented.

# 2	BACKGROUND

Since its inception, the concept of safety culture has been a key topic in discussions of safety across many industries. There is "a general recognition that while the importance of engineered safeguards and formal management systems to control risks is essential, it is equally important to win the commitment of the workforce to treat safety as a priority through a genuine corporate commitment to achieve high levels of safety" (INSAG-15, 2002).

Evaluating the safety culture of a particular organization poses some challenges. Cultural assumptions, which influence behavior and, therefore, safety performance, are not always clearly observable. Schein (1992) presents a model of culture that helps in understanding how the concept can be assessed. In Schein's model, culture is assumed to be a pattern of shared basic assumptions, which are invented, discovered or developed by an organization as it learns to cope with problems of survival and cohesiveness.

According to Schein's three-level model, an organization's safety culture can be assessed by evaluating the organization's artifacts, claimed values, and basic assumptions. On the first level

of the model are the organization's artifacts. Artifacts are the visible signs and behaviors of the organization, such as its written mission, vision, and policy statements. The second level consists of the organization's claimed or espoused values. Examples of claimed values might include mottos such as, "safety first" or "maintaining a blame-free work environment." The third level is comprised of the basic assumptions of the individuals within the organization. Basic assumptions are the beliefs and attitudes that individuals bring into the organization or that are developed as a result of experience within the organization. Examples of basic assumptions may include, "safety can always be improved" or "everyone can contribute to safety." The organization's basic assumptions regarding safety culture are less tangible than the artifacts and claimed values. They are often taken for granted within the organization that shares the culture.

Artifacts, claimed values, and basic assumptions are evaluated to identify the presence or absence of the characteristics that have been found to be important for the existence of a positive safety culture (IAEA Safety Guide No. GS-G-3.1, 2006).
These characteristics include:

- **Safety is a clearly recognized value in the organization.**
- **Accountability for safety in the organization is clear.**
- **Safety is integrated into all activities in the organization.**
- **A safety leadership process exists in the organization.**
- **Safety culture is learning driven in the organization.**

Performance objectives are associated with each of the safety culture characteristics. Particular behaviors and attitudes have been identified to evaluate the extent to which the organization has attained these objectives. The relationship between the five characteristics identified as important for promoting a positive safety culture, the performance objectives associated with each characteristic, and the organizational behaviors that can be measured to assess the safety culture characteristics is depicted in Figure 1. This framework provides the basis for the evaluation of safety culture that was conducted.

A sixth characteristic was added to the framework to specifically evaluate the absence or presence of a Safety Conscious Work Environment (SCWE). A Safety Conscious Work Environment is one in which individuals feel free to raise concerns of any type without the fear of reprisal. Therefore the framework also looks at whether:

- **A process for establishing a strong and effective SCWE is in place.**

The methodology described in this report was originally developed with the support of the U.S. Nuclear Regulatory Commission (1991) to assess the influence of organization and management on safety performance within the nuclear power industry. The Canadian Nuclear Safety Commission used a modification of the methodology in the assessment of its licensees (Haber and Barriere, 1998) which included uranium mining facilities. The methodology has also been implemented at nuclear power plants in Spain in collaboration with the Spanish Research Center for Energy, Environment and Technology (CIEMAT). Recent implementations of the methodology have included assessments at facilities that have had significant events with the objective of trying to understand the elements of the safety culture that need enhancement.

Overall the methodology has been implemented in over 40 different organizations, across 5 different countries, representing industries as diverse as nuclear power, fossil energy, research, mining, transportation, health care, and chemical reprocessing.
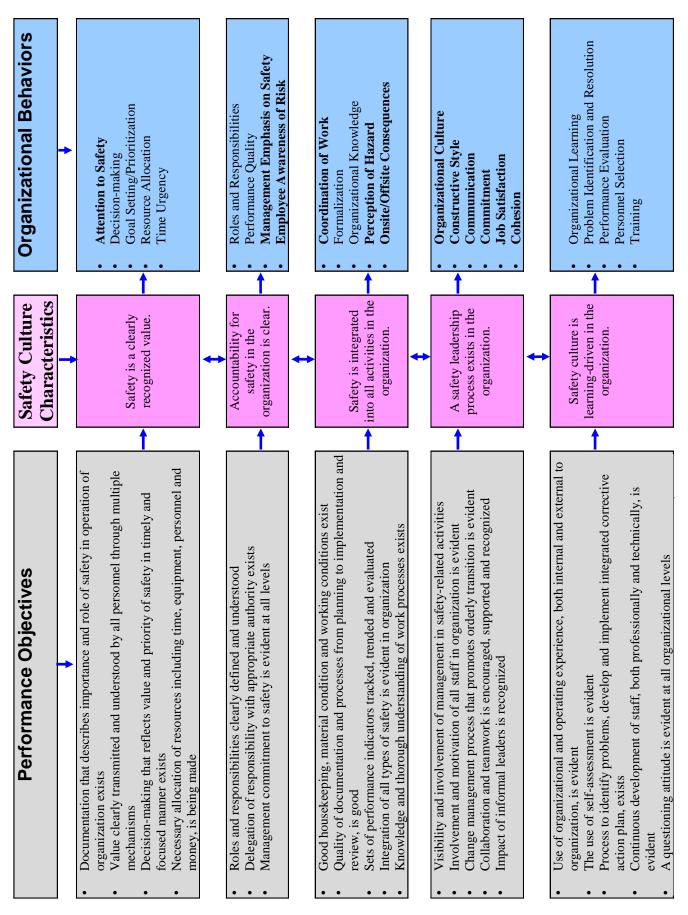
The methodology entails collecting a variety of information that is largely based upon the perceptions of the individuals in an organization, as well as conducting structured observations of individuals performing work activities. Perceptions are often reality when it comes to influencing behavior and understanding basic assumptions. Therefore, the data collected regarding individuals' perceptions are critical to this type of evaluation.

3   SCOPE OF SAFETY CULTURE ASSESSMENT

The scope of this safety culture assessment was defined to include all of the functional areas at the participating Mine as well as a limited inclusion of relevant corporate functions of the parent company. The Assessment Team was on site from July 16 - 20, 2007 to administer an Organizational and Safety Culture Survey and to conduct interviews and observations.

The on-site team was comprised of two consultants from Human Performance Analysis, Corp. (HPA) and two individuals from NIOSH who have extensive experience in underground coal mines.

This Safety Culture Assessment is a 'point in time' snapshot of the participating Mine. Although the team recognizes that organizational and process changes to improve the Mine's safety culture since the point in time at which the assessment was conducted may have occurred, the Team has not evaluated the impact of these actions. Therefore, changes that have occurred subsequent to the time of the assessment are not discussed in this report.

Figure 1. Relationship between safety culture objectives, characteristics and organizational behaviors

Performance Objectives	Safety Culture Characteristics	Organizational Behaviors
• Documentation that describes importance and role of safety in operation of organization exists • Value clearly transmitted and understood by all personnel through multiple mechanisms • Decision-making that reflects value and priority of safety in timely and focused manner exists • Necessary allocation of resources including time, equipment, personnel and money, is being made	Safety is a clearly recognized value.	• **Attention to Safety** • Decision-making • Goal Setting/Prioritization • Resource Allocation • Time Urgency
• Roles and responsibilities clearly defined and understood • Delegation of responsibility with appropriate authority exists • Management commitment to safety is evident at all levels	Accountability for safety in the organization is clear.	• Roles and Responsibilities • Performance Quality • **Management Emphasis on Safety** • **Employee Awareness of Risk**
• Good housekeeping, material condition and working conditions exist • Quality of documentation and processes from planning to implementation and review, is good • Sets of performance indicators tracked, trended and evaluated • Integration of all types of safety is evident in organization • Knowledge and thorough understanding of work processes exists	Safety is integrated into all activities in the organization.	• **Coordination of Work** • Formalization • Organizational Knowledge • **Perception of Hazard** • **Onsite/Offsite Consequences**
• Visibility and involvement of management in safety-related activities • Involvement and motivation of all staff in organization is evident • Change management process that promotes orderly transition is evident • Collaboration and teamwork is encouraged, supported and recognized • Impact of informal leaders is recognized	A safety leadership process exists in the organization.	• **Organizational Culture** • **Constructive Style** • **Communication** • **Commitment** • **Job Satisfaction** • **Cohesion**
• Use of organizational and operating experience, both internal and external to organization, is evident • The use of self-assessment is evident • Process to identify problems, develop and implement integrated corrective action plan, exists • Continuous development of staff, both professionally and technically, is evident • A questioning attitude is evident at all organizational levels	Safety culture is learning-driven in the organization.	• Organizational Learning • Problem Identification and Resolution • Performance Evaluation • Personnel Selection • Training

4   METHODOLOGY

The complete details of the methodology used in this evaluation are presented elsewhere (Haber and Barriere, 1998), but are briefly described in this section. Five methods are used to collect information on the organizational behaviors identified in Figure 1. These methods are:

- Functional Analysis
- Structured Interviews
- Behavioral Anchored Rating Scales (BARS)
- Behavioral Observations
- Organizational and Safety Culture Survey

The use of multiple methods to assess any organizational behavior assures adequate depth and richness in the results obtained. In addition, confirming the results obtained through the use of one method with results obtained through the use of another method provides convergent validity for the results.

A brief description of each method is provided below.

4.1   Functional Analysis

The purposes of the Functional Analysis were to: (1) clearly identify the organizational units of the Mine, (2) gain an understanding of each organizational unit's functions and interfaces, (3) examine the way in which information flows among and within units, and (4) identify the key supervisory and managerial positions of each organizational unit. Information to support this activity was obtained primarily through the review of documentation as well as preliminary discussions with Mine staff.   The organizational behaviors to be evaluated were identified from the information collected during this analysis.

Documentation Review

The following types of documents were received and reviewed by members of the team:

- Corporate Safety Policies and Procedures;
- Safety Incentive Program Material;
- Organizational Structure Description;
- Mine Safety and Health Administration (MSHA) on-line database entries related to the Mine.

Organizational Behaviors

Based upon the results obtained from the Functional Analysis, the following organizational behaviors were identified for assessment:

Attention to Safety – Attention to safety refers to the characteristics of the work environment, such as norms, rules, and common understandings that influence personnel's perceptions of the

importance that the organization places on safety. It includes the degree to which a critical, questioning attitude exists that is directed toward organizational improvement.

Communication – Communication refers to the exchange of information, both formally and informally, primarily between different departments or units. It includes both the top-down (management to staff) and bottom-up (staff to management) communication networks.

Formalization - Formalization refers to the extent to which there are well-identified rules, procedures, and/or standardized methods for routine activities as well as unusual occurrences.

Goal Setting/Prioritization – Goal setting/prioritization refers to the extent to which facility personnel understand, accept, and agree with the purpose and relevance of goals.

Organizational Learning – Organizational learning refers to the degree to which individual personnel and the organization, as whole, use knowledge gained from past experiences to improve future performance.

Performance Quality - Performance Quality refers to the degree to which facility personnel take personal responsibility for their actions and the consequences of the actions. It also includes commitment to and pride in the organization.

Problem Identification and Resolution – Problem identification and resolution refers to the extent to which the organization encourages facility personnel to draw upon knowledge, experience, and current information to identify and resolve problems.

Training – Training refers to the degree to which personnel are provided with the knowledge and skills required to perform tasks safely and effectively. It includes personnel's perceptions regarding the general usefulness of the training program.

4.2   Structured Interview Protocol and Behavioral Anchored Rating Scales (BARS)

The Structured Interview Protocol was derived from a database of interview questions. A particular subset of questions can be selected to provide a predefined focus to an interview session. The Assessment Team members selected a set of questions to gather information related to the safety culture characteristics and to assess the organizational behaviors identified from the Functional Analysis.

A total of 20 interviews were requested and 17 were conducted as part of the assessment. Each interview lasted approximately one hour. In addition, some less formal follow-up interviews were conducted to provide further clarification when necessary.

The Behavioral Anchored Rating Scales (BARS) were administered to 15 of the 17 individuals who participated in the structured interviews. Interviewees were administered the BARS belonging to four organizational behaviors. The BARS provided the opportunity to quantitatively summarize qualitative data associated with the interviewee's perceptions of the organization. 60 BARS were collected representing the 8 organizational behaviors.

4.3 Behavioral Observations

The use of behavioral observations provides an unobtrusive assessment of particular organizational behaviors and structures observations of critical processes including things like shift turnovers, training, management and work unit meetings, and responses to planned or unplanned events.

During the course of the evaluation, observations of 5 different work activities were made. The data represent observations of:

- Ongoing work being conducted underground in the Mine
- Initial Employee Training
- Weekly Safety Meeting
- Start of Shift Meeting
- Employee orientation to safety incentive program.

4.4 Organizational and Safety Cultural Assessment

The primary purpose of administering a paper-and-pencil survey is to measure, in a quantitative and objective way, topics related to safety culture, coordination of work, job satisfaction, communications, work group cohesion, organizational commitment, perceived hazardous nature of work, environment, safety and health issues, and safety conscious work environment. By conducting a survey, a broad sample of the individuals in the organization can be obtained and it is possible to gather information from a larger number of personnel than can be reached through the interview process alone.

The total population of 34 employees stationed at the Mine was invited to participate in the survey administration. A total of 32 individuals actually completed the survey, which represents a 94% response rate. This response rate is very acceptable for the purpose of drawing accurate conclusions regarding the perceptions of personnel.

5 RESULTS

The results presented below summarize the insights gained from the Assessment Team's analyses of the structured interviews, BARS, observations, and survey data. The results are presented in terms of the six Safety Culture Characteristics and their associated Performance Objectives from Figure 1. Observations and Areas for Improvement related to each characteristic are presented.

1. Safety is a clearly recognized value in the organization.

<u>Observations</u>

- Documentation that describes the importance and role of safety in the operation of the organization exists, e.g., a comprehensive set of corporate safety guidelines that cover federal and state regulations.
- Memorandum and communications regarding the role of safety in various corporate policies and programs are issued regularly.
- Multiple mechanisms exist to communicate the value of safety throughout the organization. These mechanisms include pre-shift safety talks, weekly safety meetings, postings on various boards around the site, safety handbooks, and company postcard mailings.
- Artifacts related to safety are displayed and distributed throughout the organization, e.g., decals, posters.
- A corporate wide reward for safety incentive program is viewed positively by most individuals.
- Many employees describe a positive increase in the emphasis on safety.
- Some behaviors are occurring which indicate that the value of safety is understood.
  - Increased training related to safety, e.g., Self Contained Self Rescuer (SCSR) smoke training, emergency evacuation plan training.
  - Many individuals indicate that it is not a problem to raise safety concerns.
  - Most interviewees indicated that they were never asked to do anything that was unsafe.
- Examples of conservative decision-making with respect to safety discussed during this assessment included stopping production to insert cable bolts, reducing the distance when starting to cut the cross cuts prior to inserting roof bolts, using pizza pans to provide additional protection for continuous miner operators, and increasing the number of dedicated safety personnel across the company.
- Investment has been made by the company for safety improvements including reflective material, man trip fencing (mesh curtains), and a new man trip.
- Most interviewees describe the availability of budget to operate safely and successfully.
- Results from the survey data indicate that the Production Crews understand the hazardous nature of their work and the need to pay attention to potential danger significantly more so than the Maintenance Crew.
- The overall score for the mine's employee population on the Attention to Safety Scale in the survey indicates that the general employee population at the Mine understands the behaviors important to safety in its work activities. In particular, behaviors identified as "being a reliable team member", "being alert to the potential for serious accidents", "paying attention to potential danger for others, and "learning from mistakes", were perceived to be highly valued.
- Results on the Behavioral Anchored Rating Scales (BARS) for Attention to Safety indicated that most individuals perceived a high degree of attention to safety by the organization.

<u>Areas for Improvement</u>

- Performance on behaviors indicative of the value of safety must still be improved and consistently demonstrated and understood by all members of the organization.
    - Basic safety issues that exist with respect to housekeeping and material condition must still be addressed. Observations by the Assessment Team indicated areas in the mine where debris and waste were scattered about.
    - While personal protective equipment is required to be worn by all personnel, the consistent use of this equipment still needs to be enforced.
    - Safety messages, while regularly communicated during weekly safety meetings, may not always be immediately relevant to planned work activities and should be regularly reinforced to ensure importance.
    - Some interviewees describe a lack of attention to detail that needs to be improved, e.g., when ventilation curtains fall, they are not always put back up, corner bolting is not always immediately installed.
    - Attending to detail was one of the lowest ranked items on the Attention to Safety Scale on the survey.
    - Some interviewees indicated that a man trip was not always left at the face of the mine as required.
    - The Assessment Team observed and several interviewees corroborated that at least on the day that the Assessment Team went underground the length of the life line and outby reflectors from the face of the mine had been further ('stretched') than their required distance.
    - Although required to report all minor accidents, most interviewees indicated that they would not report band-aid type incidents.
- Personnel have the perception that management places the value of safety over production, but certain policies and practices do not reinforce the perception and need to be better explained and communicated.
    - Salaried interviewees were not aware if compensation bonuses were tied to safety.
    - Safety has the equivalent percentage of production, cost and environmental compliance factors to the fixed annual bonus.
    - Interviewees could not recall celebrating a success for safety but only for production, e.g., month in which mine made profit.
    - Several interviewees perceive tactics used by management as threatening or intimidating to ensure continuous production, e.g., having corporate managers come to the site.
    - The Safety Department reports directly to the President of the Resource Group rather than to the Vice President of Safety and Training.
    - The company supports a mine rescue team but no one from this particular mine is assigned to it.
    - There is no representative from this mine on the company's safety committee.
- Most interviewees indicated that the number of personnel working at the mine was too few.
    - Many interviewees believed that they were spread too thin and trying to do too many different things on one shift.

- o Interviewees indicated that individuals had left for other companies and that it was difficult to find new employees.
- o Several interviewees indicated that tonnage mined is the benchmark by which the number of employees is determined and the Mine was currently not meeting its production quota for the number of employees it has.
- Results on the Behavioral Anchored Rating Scale (BARS) for Goal Setting and Prioritization indicated that most individuals did not perceive the goals of the organization to be clear. This was more evident for Managers than Non-Managers.

2. Accountability for safety in the organization is clear.

Observations

- Employees are trained that safety is the personal responsibility of everyone.
- Individuals are held accountable for safety through a random drug testing program, a progressive discipline system, and a corporate wide reward for safety incentive program.
- Interviewees indicated most people would admit mistakes, if they realized they made a mistake.
- Foremen hold individuals accountable for safety by talking to them when they observe unsafe behavior, e.g., shuttle car operator going too fast.
- Some interviewees indicated that people would appreciate individuals who admit mistakes caused through their own personal error especially if there are safety implications for others, e.g., shuttle car operators running over power cables or smashing against the rib.
- Almost all interviewees describe the Mine Foreman's commitment to safety as his top priority.
- Interviewees describe seeing the Mine Superintendent underground at various times during the day shift.
- Results on the Behavioral Anchored Rating Scale (BARS) for Performance Quality indicated that overall most individuals took pride and ownership in their performance.

Areas for Improvement

- Standards and expectations regarding taking personal responsibility and accountability for safety still need to be developed and communicated to all employees. Many interviewees indicated that the Mine Foreman and the Safety Department would worry about safety related items, e.g., life line placement, condition of the ribs.
- To date, no formal performance appraisals are conducted for the organization's employees. Thirty, 60, and 90 day evaluations are done for all new hires and the company is beginning to implement annual evaluations for hourly and salaried employees. However, performance is not tied to compensation. The lack of performance evaluation may be contributing to a lack of accountability for undesirable behaviors.
- Safety performance is not currently a consideration in the awarding of contracts.

- Results from the survey indicate that employees' perceptions of how well informed they are of the risks in their work environment is generally lower here than seen in other organizations and also somewhat different between groups within the organization e.g., individuals with a high school education had a significantly more positive perception of how well informed they were about the risks in their work environment compared to those with a degree, individuals with the least amount of mining experience believed that they were well informed of the risks in their work environment compared to individuals with more mining experience.
- Management emphasis on environmental issues was perceived to be low among all survey respondents in this organization and compared to other surveyed organizations.

3.   Safety is integrated into all activities in the organization.

Observations

- Safety standards and norms exist for several different aspects of mine operations, including,
  - Personal protection equipment
  - Meters and tracers for detection of electrical currents
  - Proper methods to replace circuit breakers
  - Use of checklist for bolt machine prior to start up
  - Availability of man trip at face while someone is working
  - Reporting of all injuries including minor ones
  - The Mine Map is available on the section being worked
  - Emergency Medical Technician is required on each crew
- Many individuals identified that the Corporate Safety Guidelines are a good tool and that they provide everything necessary to work safely.
- Interviewees identified that corner bolting is not required in the roof control plan but is being implemented in this mine as an industry best practice.
- Data obtained on the Behavioral Anchored Rating Scale for Formalization indicated that personnel overall have a favorable perception of the company's documentation and standardization process.
- Responses on the Coordination of Work Survey Scale indicated that individuals who worked in the mining industry the longest had the most positive perception of the way that work was coordinated in this organization
- Survey responses indicate that the Production Crews perceive the consequences of poor performance on the job significantly more than the Maintenance Crew does. New employees tended to have a lower perception of the consequences of poor performance than employees that have been working for at least 5 years.

Areas for Improvement

- Housekeeping and material condition in the mine needs some attention, e.g., rubbish on mine floor, untidy conditions around supply cabinet.

- Interviewees indicated that they normally worked 15 – 20 hours of overtime each week. While they describe the overtime as voluntary, individuals are expected to work the time most of which is usually worked on Saturdays.
- Some individuals indicated that the new regulatory requirements were overwhelming and that it seemed as if they were always doing some type of training. The reasons and expectations for this additional training need to be better communicated and understood by all personnel.
- The expectations for standardizing common processes and procedures across different mines within the same company still needs to be formally established and communicated to mine personnel by company management. Individuals identified differences in the life lines used, e.g., hanging directional cones versus securely mounted cones, in the decisions regarding the choice and type of the new underground shelters, and in the purchasing procedures used by the different Resource Groups. This has raised some issues for those working across the different locations.
- There is a need for more strategic and big picture thinking and understanding of integrating safety into all activities, e.g., lack of pedestrian crosswalks on the site property.

4.   A safety leadership process exists in the organization.

Observations

- Interviewees describe seeing Mine Management underground primarily during the day shift.
- Most individuals feel that they are well informed about what is going on around the site.
- Several mechanisms are used to convey information including interaction with the Section Foreman, the Mine Foreman, and the Mine Superintendent, white boards in the bath house, underground, and at the gate and the Company sending a newsletter to employees' homes.
- The survey results from this assessment indicate that respondents are generally satisfied with communication with Salaried Employees slightly more satisfied than Hourly Employees.
- Perceptions regarding organizational commitment and job satisfaction were also generally higher within the Salaried Workers Group.
- Survey scores on the Work Group Cohesiveness Scale were higher among Hourly Employees than Salaried Employees.
- Perceptions of organizational commitment, work group cohesiveness and job satisfaction were consistently higher for the Maintenance Crew than the Production Crews.
- Scores on the Behavioral Anchored Rating Scale for Communication were consistent with the survey results indicating an overall satisfaction with communication across all respondents.
- The very high response rate (94%) for completing the survey during this assessment is a positive indication of leadership's commitment and interest towards safety for the organization.

- The effectiveness of management involvement in all safety-related activities depends on communications. While there appears to be some satisfaction with communication, results from this assessment indicate that differences do exist between groups on several aspects of communication. These differences occurred primarily in the areas of accuracy and trust in communication. The Maintenance Crew and Hourly Employees had the higher scores on perceived accuracy of communication, while the Salaried Employees had the higher scores on perceived trust in communication.
- Overall, survey respondents indicated that their desire for interaction and communication across the organization is low and the lowest among other surveyed organizations.
- Several interviewees indicated that a good communication system is still of concern to them.
- Differences between Salaried and Hourly personnel were largely in the direction that might be expected, with Salaried Employees typically having higher scores on the more positive types of behaviors than Hourly Employees.
- Some individuals expressed concerns about not being too strict with enforcing some requirements because it is currently a miners' job market and individuals could decide to leave and find employment relatively easily elsewhere.
- The current process being used by Mine Management to effect behavioral change is an informal one.
    - Some of the differences observed between the groups in the Mine in this assessment may reflect an inconsistency of implementation of expectations and standards due to the absence of a more formal approach.
    - Effectiveness of changing behavior can only be accomplished if Corporate and Mine Management recognizes, understands, communicates, and takes ownership of the need for change. While the need for changing some behavior is acknowledged along with the difficulty in doing so, there is a lack of organizational infrastructure to support such change, e.g., performance management.

5. Safety Culture is learning driven in the organization.

Observations

- Information, both internal and external to the Mine, is collected and distributed by various mechanisms, e.g., internet, e-mails, reports, meetings, and training.
- Events at other mine locations within the Company have changed policies for all the locations, e.g., installation of fire valves and hose locations.
- The Safety Department is the primary point of contact for receipt and dissemination of all relevant operational experience information.
- During this assessment the effective integration of operational experience information into training was observed.
- Ratings on the Organizational Learning Behavioral Anchored Rating Scale indicated that individuals from the Hourly Employees Group tended to perceive the organizational

learning process in place at the Mine in a more favorable manner than the Salaried Employees Group did.

- The Company has restarted the use of audit teams across locations and the Safety Directors are put on the teams. In house audits are also conducted.
- A monthly meeting is conducted to go over accident reports, Lost Time Accidents, reportable events and minor accidents.
- Immediate accident investigation reports help with tracking and trending of incidents. A yearly review broken down by category, trended by job position and location is conducted by the Safety Department.
- The decision to conduct this independent Safety Culture Assessment indicates the Company's desire to learn more about its' behavior and will provide Mine Management with a tool to enhance future safety performance.
- Most individuals express the belief that anybody throughout the organization can identify problems.
- Individuals are encouraged to report problems through their line management and most indicated they would do so.
- The use of 'buddy checks' is perceived as a positive way for individuals to learn from one another.
- Most interviewees indicated that serious safety concerns get addressed quickly and that Mine Management is supportive when it is necessary to pull back and even out of the mine.
- Ratings on the Behavioral Anchored Rating Scale for Problem Identification and Resolution indicated that all respondents perceive those processes favorably.
- Training activities are generally perceived to be effective and plentiful by most individuals. Examples include:
    o Annual 8 hour retraining
    o Mentor program
    o Emergency evacuation training including use of SCSRs and primary escape way walk outs
    o Additional 8 hours of electrician training
    o Monthly supervisor training for regulatory updates
    o Use of every opportunity to provide training, e.g., if power goes out at mine
- Several interviewees indicated that the Company would pay for individuals to receive Emergency Medical Technician Training and Certification.
- Data obtained on the Behavioral Anchored Rating Scale for Training indicated that Hourly Employees had a more positive perception of training than all employees overall.

Areas for Improvement

- The effectiveness and role of operational experience information as part of a learning process at the Mine is not internalized based on the results obtained during this assessment.
    o While Mine Safety and Health Administration violations are posted in the Mine Office, several interviewees could not identify what they were and admit to not keeping up with them.

- o Communication and integration of operational experience information is not consistently conducted across the organization, e.g. daily meetings, pre-shift reviews. Many individuals had not heard from Mine Management about a significant event that had occurred a few days before.
  - o Individuals indicated that there are no formal debriefs after the emergency evacuation and fire drills.
  - o The communications specialist does not participate in the emergency drills.
- Some individuals interviewed do not perceive that the organization learns from its mistakes. Examples of repetitive problems include:
  - o Not installing corner bolts
  - o Making cross cuts too wide
  - o Not keeping water boxes filled and filters changed on roof bolting machines to prevent dust blowing out the back.
  - o Not wearing all the appropriate personal protection equipment.
- Problems with obtaining regulatory upgrades from vendors impede the rapid implementation of the upgraded safety features identified from previous mine events, e.g., SCSRs training units.
- Many interviewees could not identify any celebrations for success in safety but only for production, e.g., when the mine posted a profit.
- Although most interviewees expressed the belief that individuals were not afraid to raise problems, several organizational inhibitors to reporting mistakes are perceived to exist. The absence of this type of reporting does not facilitate the opportunities for the organization to learn from its mistakes.
  - o While no disciplinary action is taken for filing an accident report, the structure of the corporate incentive for safety program may be deterring individuals from reporting. The program is reactive and only reduces incentives for behavior that is detrimental to production, e.g., extended absences, loss time accidents, rather than also rewarding for behavior that is proactive and positive for safety, e.g., wearing personal protection equipment, identifying mistakes and hazardous conditions.
  - o Individuals are identified by name on the Lost Time Accident Board which is posted at the entry to the site. The name is not removed until the next Lost Time Accident occurs regardless of whether the first individual has returned to work. Almost all interviewees disagreed with this policy and identified the practice as intimidating. Examples were related of individuals that were injured but either did not report it or ensured that they could go back to work because they did not want their name on the board, e.g., burns, broken bones.
  - o The 'at risk worker' program assigns points based upon the medical treatment that a worker requires. After an accumulation of a certain number of points the individual is assigned to training with Mine Management.
- Results from the survey indicated the lowest ranked item with regard to helping perform a job safely was reporting mistakes.
- While interviewees indicated that training is a high priority, some training issues are in need of attention.
  - o During SCSR training for some individuals simulated smoke was not available during their training session.

- o Many individuals described never having inserted the SCSR mouthpiece during training.
- o Most interviewees indicated that there is no additional training after they receive their qualifications, e.g., black hat.
- o Many individuals expressed concerns that there has not been any communications training since the Sago Mine disaster over one and a half years ago.
- o Training is not typically based upon a systematic analysis of needs and therefore is not sensitive to the variability in knowledge, competency and skills of the population.
- o No formal management or supervisory soft skills training is conducted for mine personnel.
- o No formal process for assessing training effectiveness is consistently used across the organization.

6. A process for establishing a strong and effective Safety Conscious Work Environment (SCWE) is in place.

Observations

- A hotline for raising safety concerns is available to all employees through the Mine Safety and Health Administration. Individuals are encouraged to first report concerns through their line management, then through the Safety Department, and finally through the hotline if they do not believe that their concerns are being addressed.
- Most individuals (84%) expressed the belief that they are responsible for identifying problems.
- The majority of personnel (78%) indicated that they believed they could approach management with concerns.
- 69% of survey respondents indicated that they believe that management wants concerns identified.

Areas for Improvement

- Only 53% of survey respondents indicated that they believed their concerns were addressed constructively. The Salaried Employees believed this to a greater extent than the Hourly Employees did.
- In response to the question 'I can openly challenge decisions made by management' only 56% of survey respondents indicated that they believed they could. In particular, Salaried Employees believed this to a significantly stronger degree than Hourly Employees did. The Maintenance Crew also believed this to be true slightly more than the Production Crews.
- Concerns about retaliation being tolerated exist among members of the organization. More than half of the survey respondents (59%) indicated that they either believed or were uncertain that retaliation did or could occur.

- Similarly, only 42% of the survey respondents indicated that they believed that helpful criticism was encouraged in the organization. The Maintenance Crew believed this to a greater degree than the Production Crews.

6   CONCLUSIONS

There were several purposes for conducting this pilot assessment. The conclusions around each of those purposes are discussed in this section.

6a.   Evaluate the feasibility and usefulness of the methodology for assessing safety culture in the underground coal mining industry.

The safety culture of a Central Appalachian small underground coal mine was assessed against the characteristics identified to be important for the promotion of a positive safety culture using a systematic methodology that had been originally developed for use in other industries. All aspects of the methodology including functional analysis, structured interviews with accompanying behavioral scales, work observations, and the paper and pencil survey administration were implemented without any difficulties. Mine participants were able to provide all information necessary for the successful implementation of the methodology without any problems.

Lessons learned from this pilot implementation of the methodology for future safety culture assessments in the underground coal mining industry include the importance of having team members with underground mining experience, the ability to observe underground mining activities, and having the cooperation and support of the corporate organization. These were all things that were available during this pilot assessment and contributed significantly to its successful implementation.

6b.   Initiate an investigation into the understanding and defining of the existing safety culture of the underground coal mining industry.

The existing safety culture at this underground coal mine was assessed against the characteristics identified to be important for the promotion of a positive safety culture. Initiatives and behaviors that are designed to facilitate and promote a positive safety culture and safety conscious work environment at the Mine were identified in the course of the assessment. These include:

- Documentation that describes the importance and role of safety in the operation of the Mine exists and there are multiple mechanisms available to communicate the value of safety to all employees;
- Individuals are held accountable for safety by the Company through various programs including, random drug testing, progressive discipline, and a corporate reward for safety incentive program;
- Safety standards and norms exist for several different aspects of mine operations including maintenance and operation of equipment as well as the conduct of personnel;

- Most individuals identified being satisfied with communication and believe that they are well informed about what is going on around the site; and
- The majority of employees believe that they are responsible for identifying problems.

The results of the assessment however also indicated that several of the behaviors associated with the safety culture characteristics need more management attention. These include:

- While there are multiple mechanisms to communicate the value of safety to all employees, the lack of clear and consistent expectations and standards is evident in the variability of behavior with respect to safety.
- Individuals at some levels in the organization are reluctant to accept personal responsibility and ownership for safety issues that they perceive to be someone else's job.
- There is a need for more strategic thinking about the integration of safety into all activities and processes and how behaviors important to safety can enhance the quality of all work to be done.
- The multiple differences in attitudes and perceptions between the various crews and groups indicate that a safety leadership process is not internalized in the organization.
- Efforts to learn from past performance have been addressed for some major industry events, but the process of learning from all aspects of day to day performance is not consistently or systematically conducted in the organization.
- The behaviors important to creating an environment where concerns can be raised without fear of reprisal are not perceived to be present by a large percentage of the organization. In fact, the organization may have created an environment where things are not reported.

6c.   Provide meaningful and useful recommendations for the Mine for their consideration in continuing to enhance safety performance.

Based on the conclusions of the Assessment Team with regard to the existing safety culture at the Mine, the following recommendations are presented for consideration.

- While there are multiple mechanisms for communication in the organization, the message that safety is a clearly recognized value must be more effectively transmitted and understood. Corporate and Mine Management need to reinforce the verbal communication of the message through appropriate modeling behavior using the standards and norms that are expected of all employees.
- Employees must be held accountable to the expectations and standards. A rewards and sanction system that recognizes not only the immediate and short term consequences of behavior, but also the long-term consequences of actions needs to be implemented. Opportunities to recognize small wins and accomplishments along the path of improvement for safety performance so that desired outcomes, results, and behaviors can be rewarded need to be provided.
- A working environment where employees are not concerned about negative repercussions for reporting mistakes, accidents, or events is the foundation for a learning environment. An organization must be aggressively seeking to know what it does not know so that it can be proactive about safety for future performance. Such an environment is created

through employee involvement and ownership, trust and accuracy in communication, and a leadership team that will promote and facilitate those behaviors.

7 REFERENCES

Haber, S.B. and Barriere, M.T. (1998). "Development of a regulatory organizational and management review method." Research Report RSP-0060, Canadian Nuclear Safety Commission, Research Report, Ottawa, Canada.

Haber, S.B., O'Brien, J.N., Metlay, D.S., and Crouch, D.A. (1991). "Influences of Organizational Factors on Performance Reliability," NUREG/CR-5538, U.S. Nuclear Regulatory Commission, Washington, D.C.

International Nuclear Safety Advisory Group, INSAG-15 (2002). "Key Practical Issues in Strengthening Safety Culture", International Atomic Energy Agency, Vienna, Austria.

International Atomic Energy Agency – Application of the Management System for Facilities and Activities, Safety Guide No. GS-G-3.1 (July 2006)

Schein, E.H. (1992). "Organizational Culture and Leadership", Jossey-Bass, San Francisco, CA.