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Ergonomics and Mining: Charting a Path to a Safer Workplace

Department of Health and Human Services
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By Janet Torma-Krajewski, Lisa Steiner, Pauline Lewis, Paul Gust, and Kean Johnson

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
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ERGONOMICS AND MINING: CHARTING A PATH TO A SAFER WORKPLACE

By Janet Torma-Krajewski,[1] Lisa Steiner,[2] Pauline Lewis,[3]
Paul Gust,[4] and Kean Johnson[5]

ABSTRACT

Ergonomics processes described in the literature have been associated mostly with manufacturing, financial, electronics, and office settings where working conditions tend to be rather constant and repetitive. The information presented in this document demonstrates, however, that an ergonomics process can also be implemented in a setting such as mining where working conditions frequently change and workers are periodically exposed to extreme weather conditions. This document describes how Bridger Coal Company implemented an ergonomics process at its Jim Bridger Mine from 2001 through 2004. The process developed by the Ergonomics Committee, the promotion of the process to management and employees, and the impacts of the process on working conditions at the mine are reviewed. Barriers overcome and lessons learned are also described. Quotes from Bridger Coal Company employees are included in the document to add a personal perspective. Other industries with working conditions similar to mining, such as construction and agriculture, may find this information useful.

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INTRODUCTION

Ergonomics has played an important role in helping Bridger Coal reach our goal of providing the safest and healthiest working environment possible for our employees. Our management and hourly employees alike understand the value of what has been developed. In the beginning, when the idea of establishing such a program surfaced, we were all skeptical of just how things would work. However, thanks to the combined efforts of NIOSH, PacifiCorp, and the employees at Bridger Coal Company involved in the creation process, we found that an ergonomics program could not only be efficiently developed, but that it could be highly effective as well. The Ergonomics Program is currently an integral part of our company and we are confident that it will continue to improve and enhance the safe working experience at our mine.

Kean Johnson
Ergonomics Coordinator
Bridger Coal Company

Mining is one of the most physically demanding occupations. As a result, musculoskeletal disorders (MSDs) have long been identified as a significant and costly problem for the mining industry. To address this problem, the National Institute for Occupational Safety and Health (NIOSH)[1] supports the application of ergonomics to make working conditions safer and healthier for employees.

Numerous reports demonstrating the effectiveness of ergonomics processes in industrial settings have been published during the past 10 years; however, no examples of ergonomics processes in mining have been reported. The purposes of this Information Circular are, first, to provide specific information that should be considered when implementing an ergonomics process and, second, to describe in detail how one mining company integrated an ergonomics process with existing programs to improve working conditions for its employees.

MUSCULOSKELETAL DISORDERS AND MINING

During the past 20 years, numerous analyses have shown that miners experience a high rate of musculoskeletal disorders (MSDs). These disorders affect one or more parts of the soft tissues (such as muscles, tendons, ligaments, and cartilage) and bones of the body [NIOSH 1997]. The nerves and blood vessels servicing the musculoskeletal system can also be affected. During the development of an MSD, a worker may experience a variety of signs and/or symptoms. Signs are objective findings that include decreased range of motion, decreased grip strength, and swelling or change in skin color when exposed to cold or vibration. Symptoms are more subjective in nature and include pain, fatigue, numbness, or tingling sensations. Failure to seek early treatment can result in chronic pain or permanent disability.

[1]The National Institute for Occupational Safety and Health (NIOSH) is a federal agency responsible for conducting research and making recommendations for the prevention of work-related injury and illness. NIOSH was established as a nonregulatory agency within the Centers for Disease Control and Prevention to help assure safe and healthful working conditions by providing research, information, education, and training in the field of occupational safety and health.

The U.S. Department of Labor [1991] reported that mining is among the most hazardous occupations in terms of exposures to MSD risk factors. In 1986, Stobbe et al. reported that strain and sprain injuries in 1983 and 1984 accounted for 24.0% and 25.2%, respectively, of all reported injuries in underground coal mining, and 19.4% and 20.4%, respectively, of all injuries in underground metal/nonmetal mining. A review of lost-time injuries from 1998 through 2002 [NIOSH 2005a] indicated that 33% (underground) and 36% (surface) resulted from handling materials, and 16% (underground) and 27% (surface) resulted from slips and falls. In addition, from 1988 through 1997, sprains to the back accounted for the highest number of lost work days [NIOSH 2002]. In 2003, the back continued to be the most frequently reported body part injured, accounting for 22.6% of all days lost (105,510). Forty-four percent of all illnesses were related to joint, tendon, or muscle inflammation [NIOSH 2005b,c].

In the late 1980's, NIOSH conducted the National Occupational Health Survey of Mining (NOHSM) to characterize health-related agents found in U.S. mines [NIOSH 1996]. An important aspect of this survey was to identify potential exposures to musculoskeletal overload conditions. A total of 491 mines was surveyed—60 coal mines and 431 metal/nonmetal mines. The percentage of coal and metal/nonmetal miners potentially exposed to each of 12 musculo-skeletal overload conditions defined in NOHSM was then calculated [Zhuang and Groce 1995]. Averaging the potential for exposure to all 12 conditions yielded figures of 26.2% and 17.2% among coal and metal/nonmetal workers, respectively. The three most common musculoskeletal overload conditions were (1) bending forward, bending to the side, hyper-extending, or twisting the neck or back; (2) unsupported abducted elbows, forearms resting on sharp edges, tossing motions at extreme ranges of motion, or working with hands above shoulders; and (3) lifting more than 50 pounds unaided. At least 35% of all mine workers were exposed to each of these three conditions at some time.

Winn et al. [1996] also analyzed NOHSM ergonomic hazard data for 24 commodities associated with the metal/nonmetal mining industry. They determined that potential exposures to MSD risk factors were most likely for the following body parts: neck and/or back; forearms, arms, and shoulders; and fingers and hands. Overall, they stated that the potential exposure to MSD risk factors for metal/nonmetal miners was high compared to nonmining occupations.

Comprehensive mine worker injury and illness data are compiled by the Mine Safety and Health Administration (MSHA); however, MSHA does not have an MSD classification in its database. As part of a NIOSH-funded research project, Battelle Centers for Public Health Research and Evaluation Laboratory [1999] developed selection criteria to identify MSD incidents based on a study of stratified samples of 1997 and 1998 MSHA incident data. Using these criteria, almost one-third of all incidents from 1996 to 2000 could be classified as MSDs, and of these, handling materials and slips and falls accounted for almost 70%.

Mining workplaces are by nature in a constant state of change and as such can be classified as very dynamic work environments [Steiner et al. 1999; Scharf et al. 2001]. This dynamic nature demands that workers be able to adapt to changes in their work environments. Examples of physical demands and environmental stressors are restricted spaces; hot and/or cold environments with muddy, wet, or icy floor and ground conditions; exposures to high levels of whole-body and segmental vibration; and significant amounts of repetitive and manual work.

In evaluating the need for ergonomics processes, one cannot ignore the unique and sometimes severe environmental conditions under which miners are required to work. It can be argued that these environmental conditions, especially the restricted vertical workspaces in many underground coal mines, makes mining one of the most difficult environments in which to effect

ergonomic change. For example, space restrictions limit opportunities to ease worker's postural demands. In fact, restricted spaces in many underground mines practically compel workers to adopt awkward postures that ergonomists strive to avoid. Thus, traditional techniques for reducing musculoskeletal disorder risk may not be feasible. Restricted space also greatly limits the number and type of mechanical devices (cranes, hoists, or forklifts) that can be used to reduce physical workload. Environmental conditions, compounded by the use of very large equipment and new, perhaps unfamiliar, technology, result in dynamic work environments riddled with specialized ergonomic challenges.

APPROACHES TO ERGONOMICS PROCESSES

No regulations define the specific requirements of an ergonomics process. Instead, guidelines describe basic elements that should be part of every ergonomics process. An example of a guideline is the NIOSH document, *Elements of Ergonomics Programs: A Primer Based on Workplace Evaluations of Musculoskeletal Disorders* [Cohen et al. 1997]. Because this and other guidelines are general in nature and are designed to be applicable in many different industries, they may not address specific needs of the mining industry on how to actually implement a program.

A review of existing processes conducted by the authors found that, in a variety of industries, no single "right" way exists for implementing an ergonomics process. Each company needs to determine the most effective way to integrate the process successfully by considering its organizational and cultural characteristics. Nonetheless, although companies with current ergonomics processes are very different in many aspects, five basic implementation approaches have been used [Cohen et al. 1997; Hägg 2003]. These approaches are categorized by the driving force spearheading the implementation as management/employee, consultant/expert, management, corporate, or employee.

The most popular of the approaches to implementing an ergonomics process is the management/employee approach, that is, both management and employees actively participate in the process [Ridyard and Hathaway 2000; Zalk 2001; Hägg 2003]. A committee or team of 6 to 15 people is designated specifically to address ergonomic issues retroactively and sometimes even proactively [Cohen et al. 1997; Alexander and Orr 1999]. In the majority of the case studies where a management/employee work group approach was used, the team received training to build teamwork skills and learn more about ergonomics so they could identify and solve problems more effectively [Cohen et al. 1997; Alexander and Orr 1999; Robinson 2002; Smyth 2003; Butler 2003]. These teamwork skills included how to communicate properly in a team environment, brainstorm, and build confidence within the team. The means used to identify, evaluate, and control exposures to risk factors associated with MSDs differ from industry to industry and even within a single facility, depending on resources and the nature of the tasks being performed.

The consultant/expert implementation approach is a variation of the management/employee approach. With this method, an ergonomics consultant or expert identifies the risk factor exposures within the facility. Once the exposures are identified by the expert, an internal ergonomics team develops solutions [Cohen et al. 1997].

Both management and corporate approaches are closely related in that employees are not actively involved in the ergonomics process until solutions are implemented. On the other hand, these two approaches have a major distinction. With the management approach, management at the site or business unit spearheads the ergonomics process within the organization, whereas in the corporate approach, the ergonomics process begins at the corporate level and ergonomics concerns are brought to the attention of corporate ergonomics staff by management at specific locations. In addition to investigating concerns from the site locations or business units, these corporate groups or individuals also organize training sessions and develop ergonomics-related communication materials. The corporate approach is more of a general program, sharing information with employees about overall good work practices applicable to all workers [GAO 1997; Moore and Garg 1998; Hignett 2001; Joseph 2003].

An employee method is one in which employees are the ergonomics advocates in the facility. The employees who make up an ergonomics group are usually selected because of their expressed interest in ergonomics and their willingness to dedicate time and effort to the process. This approach can be effective if the involved employees have the appropriate training to identify and control MSD risk factors properly and are provided the required resources to implement solutions [GAO 1997; Moore and Garg 1998; Hignett 2001; Joseph 2003; Moreau 2003; Hägg 2003].

The approach selected for implementing an ergonomics process will depend on the organizational climate within the company. While one approach may be effective at one company, it may be ineffective at another. For example, approaches involving a committee may work best in organizations that have union representation and a history of using committees to implement processes, and where employees are routinely encouraged to participate on committees. In contrast, organizations that view committees as bothersome and time consuming may not want to follow an approach that relies on the formation of a committee. Instead, this type of organization may want to consider a management or corporate approach. Table 1 outlines the advantages and disadvantages of each approach and may help in making a decision on how to implement an ergonomics process.

When initiating an ergonomics program, some companies have chosen to integrate the process into established departments [GAO 1997]. Departments frequently selected are industrial engineering, safety, human resources, and medical management. Other companies may choose to implement an ergonomics process by creating a stand-alone group independent of established departments [Joseph 2003]. The ergonomics group may share staff with other relevant departments because of the multidisciplinary nature of ergonomics, but the group does not appear to fall within the responsibility of an existing department. Since a successful ergonomics process demands the involvement of employees and staff from many different departments, the development of an ergonomics group, whether it is a stand-alone group or part of an existing organization, should be created in such a manner that all members believe they have ownership.

Examples of how five companies implemented their ergonomics processes can be found in the report entitled, “Worker Protection: Private Sector Ergonomics Programs Yield Positive Results” [GAO 1997]. One company featured in this report created an independent ergonomics group led by an industrial engineer. Although this group was not part of an existing organization, it received support from the Global Safety Department (corporate-level department) and the site’s environmental safety and health coordinators. Another company also chose to create a new group, but it was deeply rooted in existing departments. The ergonomics

team consisted of an ergonomist (co-leader), United Auto Workers representative (co-leader), worker compensation representative, medical department staff, and in-house engineering staff. This team was rooted in the Safety Department with support from other groups that had a shared interest in the development and implementation of a successful ergonomics process.

The experience of Bridger Coal Company in implementing an ergonomics process is addressed in detail in the following sections of this document. Initially, both management and employees were selected to form an Ergonomics Committee; however, as personnel changed, the committee became an employee-driven group with management serving in advisory and oversight roles. Throughout the implementation process, the Ergonomics Committee had technical support from an outside group of experts. Although the committee is organizationally part of the Safety Department, it is functionally separate from the safety and health program. The story of Bridger Coal Company demonstrates that ergonomics processes can be successfully implemented within the dynamic environments found in the mining industry.

Table 1.—Advantages and disadvantages of five approaches to implementing an ergonomics process.

Approach	Advantages	Disadvantages
Management/ Employee	• Encourages participation by employees • Program implementation incorporates management • Expertise from many organizations and technical areas are included in the decision process	• Committees often require more time to resolve issues than individuals • Too many members on the committee can be a barrier to solving issues • Several different underlying agendas present • Training may be targeted at only a segment of the group
Consultant/ Expert	• Technical expertise is available to the committee • Encourages participation by employees • Introduces a neutral party to the ergonomics process • More accuracy in identifying high-risk jobs	• Hiring outside consultant can add to the cost of the program • Employees may not have the skills to implement recommendations from consultant • Hinders the process continuity for the future and proactive attitudes and behaviors
Management	• Program implementation is supported by management	• Ergonomics programs may lack the support and interest of the workers involved • Problem jobs may be overlooked without the active participation of the employees
Corporate	• Technical expertise is provided to the facilities • Greater resources available for training and interventions	• Corporate staff may not be familiar with ergonomic issues at specific sites • Ergonomics program may not be supported by site management and employees • Ergonomics program may be too general and may not address the real risks
Employee	• Encourages participation by employees	• May be difficult to implement interventions unless resources have been dedicated to the program • High-risk jobs may not be properly identified and/or investigated

THE BRIDGER COAL STORY

Background

In 2000, NIOSH initiated a long-term project at Bridger Coal Company's Jim Bridger Mine to demonstrate the effectiveness of implementing an ergonomics process designed to identify and reduce exposures to the work-related MSD risk factors found in mining. The main benefit of participation in this project for the company was that a strong on-going ergonomics process would be developed that ultimately would improve overall working conditions for employees.

The Jim Bridger Mine is a surface coal mine located 35 miles northeast of Rock Springs, WY, and has one active pit approximately 20 miles long. In 2001, the mine operated with two 12-hour shifts, 7 days a week, and employed a work force of 360 employees: 150 in coal production, 150 in maintenance, and another 60 in administrative and support functions. Nonproduction staff worked either 10-hour shifts, 4 days a week; or 8-hour shifts, 5 days a week. Employees are represented by the Western Energy Workers Union.

For 5 years prior to this project, the average injury incident rate for nonfatal injuries resulting in lost work days at the mine was 1.32 injuries per 100 full-time employees, as compared to the national average of 2.34 per 100 workers for all mines and 1.31 per 100 workers for all Western surface coal mines with more than 100 employees. A detailed review of FY1999 Bridger Coal Company injury data indicated that about 22% of all injuries were sprains or strains. However, only one of the 27 injuries was identified as being caused by overexertion. Although the mine's average incidence rate was well below the national average, and injuries related to MSD risk factors did not appear to be a major issue, the Bridger Coal Company decided to implement an ergonomics process. This action was consistent with mine management's proactive approach to safety and health and its culture of seeking continuous improvement.

By partnering with NIOSH in this ergonomic process, Bridger Coal was provided an opportunity to effectively address health-related issues as a component of its overall health and safety program. The involvement of employee resource teams was critical in the success of this valuable process.

Patrick James
Human Resource Consultant
Power Generation

As a certified mine safety professional, the safety manager was very knowledgeable about the problems associated with cumulative trauma and musculoskeletal disorders and believed that an ergonomics process was an essential element of the overall safety and health program. He supported a process facilitated by employee participation because he believed this type of process would have a better chance of reducing injuries associated with MSDs. The safety manager thought implementing an ergonomics process would lead to overall improvements in the mine's safety culture for both employees and the mine.

Getting Buy-in From Bridger Coal Management

Although the safety manager was very interested in working with NIOSH on this project, he knew that for the process to be successful, it was essential to have the support of Bridger Coal's top management. He saw that the key to successful implementation would be senior management personnel who had a strong understanding of the programmatic concepts and elements. Consequently, the safety manager arranged two meetings to give NIOSH an

opportunity to introduce this project to top management of Bridger Coal and PacifiCorp, and also to officers of the Western Energy Workers Union.

The initial meeting was held in Rock Springs, WY, on January 9, 2001, with Jim Bridger Mine management and the executive board of the union. This meeting was held to discuss the objectives of the project and to define expectations and commitments for both NIOSH and Bridger Coal. Although the process had no set methodology that had to be followed, the process selected by Bridger had to be compatible with project goals and objectives.

During the meeting, information on ergonomics principles, risk factors, and approaches used by other companies in addressing MSD risk factors was presented. The safety manager discussed the benefits of Bridger Coal participating in this project, and a representative from MSHA's Directorate of Technical Support explained that MSHA supported the process and its role would primarily be observational, not regulatory.

NIOSH also explained that Bridger Coal needed to assign a "champion" to the process. This champion would follow the implementation of the process and ensure the process moved forward. The safety manager was named champion for Bridger Coal.

The second meeting, held in Salt Lake City, UT, on March 6, 2001, was attended by over 30 senior safety administrators from many organizations within PacifiCorp's Generation Business Unit around the world. NIOSH again gave a presentation that addressed a range of ergonomics approaches implemented successfully by other companies, methods used to identify risk factors, some results of previous risk factor studies, and the expected benefits for Bridger Coal. Providing information on how ergonomics benefited these other companies was absolutely necessary to get complete buy-in and support from these senior management officials. The result of the meeting was not only corporate awareness of the ergonomics process being implemented at the Jim Bridger Mine, but also the creation of additional champions for ergonomics.

Shortly after this process was initiated at Bridger Coal, the safety manager transferred to a corporate position. Although he continued to be a champion for this process at the corporate level, it was necessary for Bridger Coal to appoint another champion at the local level. The next safety manager for Bridger Coal became the new champion.

Establishing the Ergonomics Committee

Bridger Coal's management decided that the best approach to implementing an ergonomics process would be to establish an Ergonomics Committee separate from the company's existing

A CHAMPION FOR ERGONOMICS

The role of a champion is not only to be a leader for the process, but to promote and serve as an advocate for the process. New processes always have their critics, and the champion has to be prepared to demonstrate the value of the ergonomics process to the organization. Being a champion can involve a great deal of time, particularly at the beginning of the implementation process. The organization must be willing to give the champion and others assigned to this effort sufficient time to ensure a successful implementation. Being a champion should also be included in his or her performance plan or requirements so that the efforts of the champion can be recognized and rewarded.

Safety and Health Committee. This approach would allow Bridger Coal to more easily commit resources specifically to ergonomic interventions. The committee included 11 representatives from labor and management, who were selected by the union and mine management. Specific departments represented were medical, engineering/environmental, safety, human resources, production, and maintenance. The employee's union was also represented on the committee. A member of the Safety Department was assigned as the ergonomics coordinator. This individual took the lead in getting the committee to move forward.

Initially, many committee members felt frustrated at being asked to implement an ergonomics process when they possessed little or no knowledge of ergonomics. This frustration was easily tackled by NIOSH (Figure 1) by providing training on the principles of ergonomics, risk factor identification, job prioritization, developing intervention recommendations, and principles of a cost/benefit analysis. This training eased concerns of some committee members, but the committee was still hesitant about having the responsibility for implementing the process. A brainstorming session was held to address how to develop a plan for implementation. At this meeting, committee members were asked to provide their input on the following four questions:

- What should be done by the committee?
- When should it be done?
- How should it be done?
- Who should do it?

Figure 1.—Instructing members of Ergonomics Committee.

PLANNING AHEAD

When initiating an ergonomics program, it is important to plan the essential components: *who, what, when, where, and how.* According to Chaffin et al. [1999], "as a rough rule of thumb, one hour of planning will save forty hours of unproductive and ineffective work." A clear plan can make the difference between the successful introduction and execution of an ergonomics process and a chaotic, ineffective implementation.

A plan was developed on how the committee would proceed and addressed responsibilities, meeting format, communications, reporting format, and meeting times. The committee also agreed to meet monthly, or more frequently if necessary, during regular working hours. This turned out to be a challenge since the members worked several different shifts. However, communication among the members and the leadership of the ergonomics coordinator kept members who missed meetings informed of committee obligations.

One of the first tasks tackled by the committee was to define a mission statement. The members agreed on the following mission statement and goal:

Mission Statement: Identify, evaluate, and correct working conditions that need ergonomic improvement.

Overall Goal: To improve the fit between the workers and the workplace so that employees have a better quality of life both on and off the job.

During additional meetings with the committee, NIOSH provided instructions on tools that could be used to document interventions and how to conduct a task analysis. Two tools presented to the members were a discomfort survey [Kuorinka et al. 1987] and a general risk factor checklist [Washington State Department of Labor 2001] (Appendix A). In addition to discussing how to use these tools, members were encouraged to evaluate them and recommend modifications to enhance their usefulness. Changes were suggested to improve the section requesting demographic information. Another suggested change was to modify the general risk factor checklist by replacing existing task graphics with ones that depicted tasks more common to mining and more familiar to employees.

The training provided by NIOSH gave the Ergonomics Committee background information necessary to take a proactive approach in establishing a program that would meet the needs of Bridger Coal Company. The training allowed us to fulfill our mission by tracking a concern from when it was received by the Committee to completion of the project, including meetings with employees to insure the solution met their expectations. I gained a great deal of knowledge from my participation on the Ergonomics Committee.

Jesse R. Abney
Electrician/Mechanic
Former Ergonomics Committee Member

Members were also instructed about interviewing techniques, documenting interviews with standardized forms, and videotaping and photographing. Prioritization methods for determining which interventions should be implemented first were also discussed. (See Appendix A for a sample prioritization method presented to the committee.) In this method, incident data, results of discomfort surveys, and information from supervisors and management are scored, and then an overall rank is determined that can be used to establish priorities for implementing interventions. Training was provided as a combination of classroom instruction and field exercises so members could gain experience at conducting task analyses and identifying risk factors.

Other issues raised regarding committee participation were related to the amount of perceived effort and time commitment needed. Many committee members felt frustrated at being asked to implement an ergonomics process in addition to performing their normal duties. That is, many felt they were already committed 100% to their existing task assignments and did not believe they had time to devote to the process. They also were concerned about prioritization of their work tasks, particularly when their performance plans did not include any tasks directly related to ergonomics. Although they wanted to do an effective job with the committee, tasks that supported members' performance plans had first priority.

The above issues had to be addressed by management. In some cases, performance plans were revised to include committee responsibilities and duties. In other cases, issues were not resolved, and members asked to be replaced by employees who had more interest in Ergonomics Committee work. This last action resulted in a significant turnover of membership during the first few months. At first, the turnover was viewed as a setback to establishing the committee, particularly in terms of training. Training took much longer than expected because the initial training had to be repeated as members were replaced. However, in the long run, this turnover probably resulted in committee members who not only had more time for performing committee duties, but also had more interest in building a successful process.

Establishing the Process for Addressing Ergonomics Concerns

Because Bridger Coal decided to implement its ergonomics program separately from its safety and health program, it was necessary for the Ergonomics Committee to define a procedure for processing ergonomic concerns. The existing procedure followed for safety and health concerns involved an informal approach to resolving concerns that could be immediately dealt with, and only those concerns that could not be immediately settled were entered into a formal process. This same operational practice was applied to addressing ergonomic risk factors.

When the committee receives a concern that is easy to correct, we make the change as quickly as possible so employees see results and are more likely to think positive about the process.

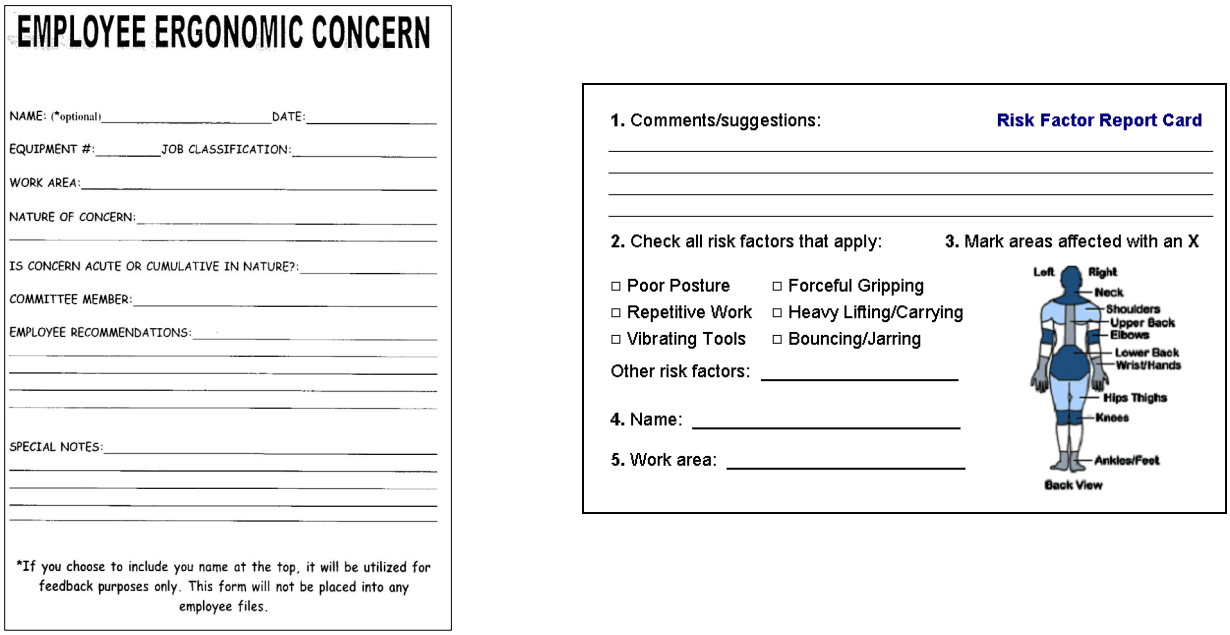
Ruth Bess
Mining Engineer
Ergonomics

Two documents were available to allow employees to present concerns to the committee for followup—an employee ergonomic concern form and a risk factor report card (Figure 2). The employee ergonomic concern form requests specific information about equipment and work area, the nature of the concern, and whether the concern was acute or cumulative in nature. The risk factor report card is a 4- by 6-inch card on which an employee identifies potential risk factors and notes any comments and/or recommendations. Employees can complete either document or both, which is encouraged by the committee.

The steps followed by the Ergonomics Committee for processing an ergonomics concern are shown in Figure 3. First, the concern is screened by the committee chair to determine if the problem involves exposure to cumulative trauma or work-related MSD risk factors or should instead be addressed as a traditional safety and health hazard. For example, high noise levels during air arcing in the maintenance shop were considered a safety and health issue and not an ergonomics concern because it did not involve an MSD risk factor. Therefore the problem was addressed using the process established for safety and health issues and was not forwarded to the Ergonomics Committee.

When addressing risk factors documented by the above process, if the chair believes the problem does involve exposure to MSD risk factors and can be resolved immediately, corrective action is completed. If the problem cannot be resolved immediately, it is assigned to a committee member, who interviews workers and obtains additional data about the problem. The committee member then reports the data to the entire committee, who determines if the concern is a viable one. If the concern is considered not viable, it is tabled for later review. Such problems include those that do not currently have a practical solution, do not involve apparent exposures to risk factors, and/or those that require a solution beyond the scope of the committee.

An example of such a concern involved unlocking the parking brake on a new blade. As designed by the manufacturer, this operation required employees to sometimes use two hands to



EMPLOYEE ERGONOMIC CONCERN

NAME: (*optional)_____DATE:_____

EQUIPMENT #:_____JOB CLASSIFICATION:_____

WORK AREA:_____

NATURE OF CONCERN:_____

IS CONCERN ACUTE OR CUMULATIVE IN NATURE?:_____

COMMITTEE MEMBER:_____

EMPLOYEE RECOMMENDATIONS:_____

SPECIAL NOTES:_____

*If you choose to include you name at the top, it will be utilized for feedback purposes only. This form will not be placed into any employee files.

Risk Factor Report Card

1. Comments/suggestions:

2. Check all risk factors that apply:

□ Poor Posture □ Forceful Gripping
□ Repetitive Work □ Heavy Lifting/Carrying
□ Vibrating Tools □ Bouncing/Jarring

Other risk factors: _____

4. Name: _____

5. Work area: _____

3. Mark areas affected with an X

Figure 2.—Employee ergonomic concern form and risk factor report card.

unlock the brake. The Ergonomics Committee determined that any change to this operation was beyond its scope, but it notified the manufacturer of this concern. As a result of this contact and complaints from other owners of this particular model of blade, the manufacturer redesigned the parking brake. Another example of a nonviable ergonomics concern was the position of the hoist lever in one of the scrapers. The lever had been moved when a new control box was installed, and the operators believed the hoist lever was too low. An evaluation of the controls indicated that the location of the hoist lever was appropriate and that the operators just needed more time to adjust to the change in location. The committee decided to take no immediate action, but instead to revisit the problem in a few months after the operators had time to use the new setup.

If the concern is considered viable, a subcommittee is formed with committee members and employees to investigate further. Information obtained is reported to the full committee, who then decides if there is sufficient information to study possible interventions. If more information is needed, then the subcommittee gathers the requested data and reports back to the full committee. If an intervention is not considered possible, the concern is tabled for later review or while further information is obtained from NIOSH or a consultant. If interventions are considered possible, potential actions are prioritized and the most applicable one is introduced. The intervention is selected on the basis of expected reduction in risk factor exposure and/or injuries, ease of implementation, cost, and potential productivity improvements. Its effectiveness is then monitored by interviewing affected workers. If the intervention is considered effective, the concern is resolved. If other similar situations exist, then the intervention is applied to these situations also. If, on the other hand, the initial intervention is not effective or has created additional problems, the committee restarts the process by again talking to the workers to obtain more data.

The success of a company's ergonomics process is through its employee's efforts and teamwork in defining and solving ergonomic issues.

Valerie Fieseler
Senior HR Administrator
Ergonomics Committee Member

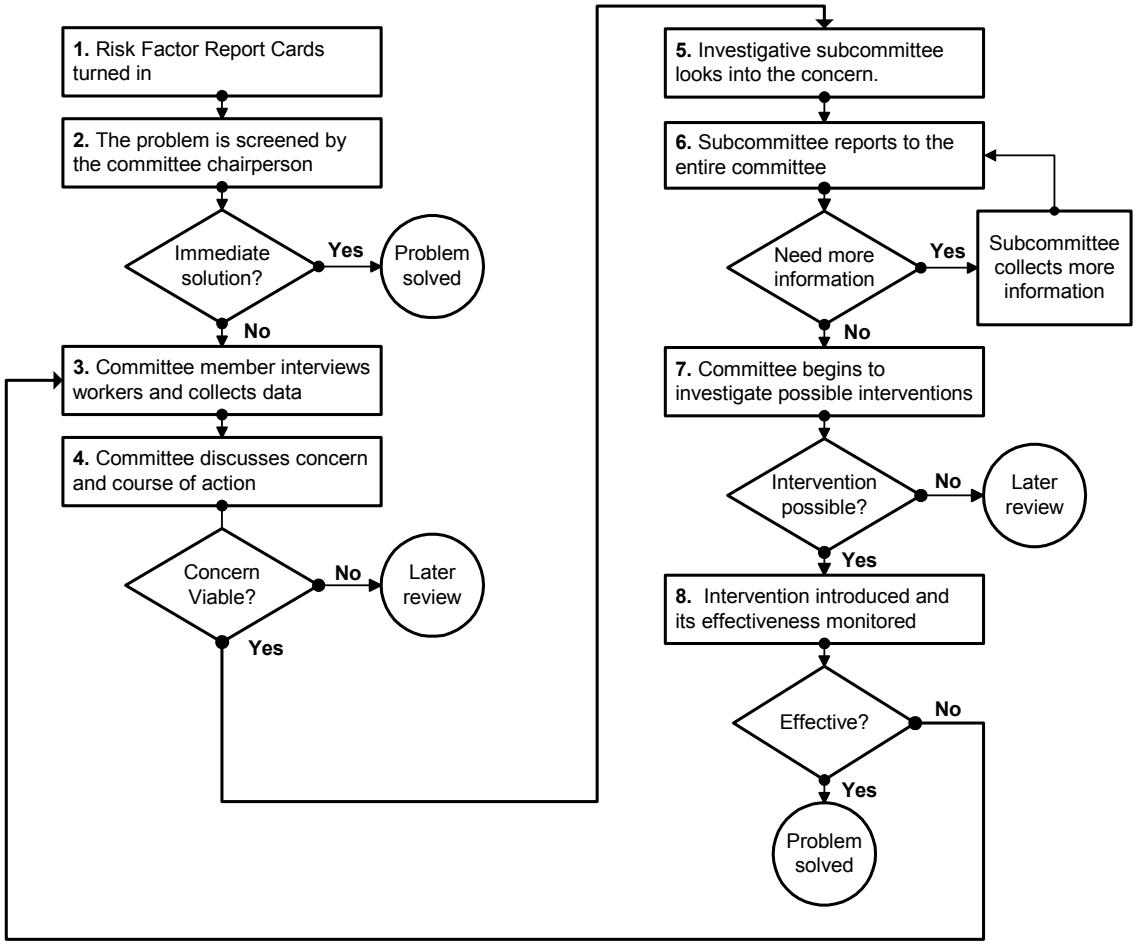


Figure 3.—Ergonomics process flow diagram.

Training Employees

Targeting Risk Factors

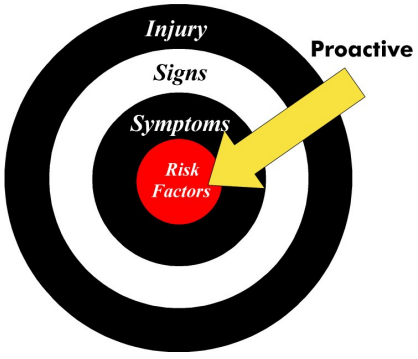


Figure 4.—Targeting risk factors for a proactive approach.

Once the Ergonomics Committee was trained and became comfortable with its role in implementing the process, it was time to train all Bridger Coal employees. NIOSH developed a 1-hour awareness training program that focused on recognizing MSD risk factors and taking action by reporting risk factors to the Ergonomics Committee. Employees were told to be proactive and to target risk factors before an injury occurred (Figure 4). They were given information on how an MSD may develop and how it is better to take action by eliminating risk factors. Employees were taught how to report a concern using the risk factor report card. The primary training module was geared to employees in production and maintenance and

included interactive exercises that gave participants practice with identifying risk factors and root causes and suggesting improvements. A second version of the training that focused on office ergonomics was developed and given to administrative support employees.

This training was presented by NIOSH personnel and members of the Ergonomics Committee (Figure 5). Employees were encouraged to be involved in the process. Approximately 280 employees were trained during 21 sessions. Because of the different shifts worked by employees, the sessions were held over a 7-day period and were generally scheduled either at the end or beginning of a shift. NIOSH designed a sticker, shown in Figure 6, to give to workers attending the training. Because the miners then placed the stickers on their hard hats and lunch containers, the stickers also provided a continuing reminder to employees about the importance of ergonomics.

During the employee training, the committee wanted to assure employees that any concerns reported would not be placed in employee files and would not be reported to MSHA. In addition, the committee wanted employees to understand that it could not address all concerns immediately and concerns would be prioritized and addressed accordingly. In each case, however, the committee responded to each concern submitted.

Figure 5.—Training employees during one of 21 awareness training sessions.

For the most part, the training was well received by employees. Employees participated in the interactive exercises and seemed quite knowledgeable regarding identification of risk factors at the conclusion. In fact, 27 employees submitted report cards to the Ergonomics Committee immediately following the training.

The training made employees more aware of problems and how ergonomics applied to their job.

Mike Audevart
Welder

A few criticisms expressed during the training involved opinions that management would be reluctant to spend funds on improvements and that employees submitting report cards would be considered "complainers." The committee members present at these sessions were able to address both of these issues satisfactorily.

Refresher Training

Two years after employees first received awareness training, Bridger Coal provided a short refresher briefing as part of its quarterly safety meeting. The briefing again focused on identifying risk factors and encouraged employees to report them to the Ergonomics Committee. Since the number of new concerns reported to the committee had declined during 2003, the refresher training was an important reminder to employees to continue to be proactive and report risk factors.

Communications

The Ergonomics Committee established a bulletin board in the ready room, an area that all employees pass through when reporting to work. The bulletin board includes information about the committee, how to report a concern, and a status report of interventions completed by the committee. NIOSH periodically provided posters to display on this bulletin board and at other meeting areas at the mine. The posters focused on introducing the ergonomics committee to the employees, identifying and reporting risk factors, ergonomic interventions completed by the committee, and risk profiles for specific tasks. The first poster (Figure 7) set the stage for implementing the ergonomics process at the Jim Bridger Mine. The other posters are shown in Appendix C.

PacifiCorp's quarterly safety newsletter, *Safety Times*, twice featured the success of Bridger Coal's ergonomics process. This newsletter is distributed to all employees of PacifiCorp, including Bridger Coal employees. These articles have served as recognition not only to committee members, but also to those employees submitting concerns for actively participating in the process.

Like every successful program, it takes a lot of communication so employees feel they are part of the process.

Ruth Bess
Mining Engineer
Ergonomics Committee
Member

Recordkeeping

Figure 6.—Sticker designed to promote ergonomics process at Jim Bridger Mine.

A simple recordkeeping system has been used for the ergonomics process. A listing of concerns is maintained as a Microsoft Excel spreadsheet that includes all the information provided on the risk factor report card. In addition, each concern is color-coded to document the status of the concern. Concerns are labeled as either "completed projects," "projects in progress," "items referred elsewhere or dismissed," or "items on hold." The committee also maintains a status/update document posted on the ergonomics bulletin board that provides a short description of the concern and the current status. This document allows employees to monitor the status of their concerns. If a concern is referred elsewhere or dismissed, the basis for this decision is provided.

Bridger Coal Ergonomics Committee

Team Members

Jesse Abney, Dan Allen, Ruth Bess, Val Fieseler, Paul Gust, Mike Hesse, Jerry Lamberth, Kerry McKenzie, Ricky Olson, Carl Persinger

Ergonomics Coordinator: Kean Johnson

Our mission is to identify, evaluate, and correct working conditions which need ergonomic improvement.

Our goal is to create a healthier workplace through employee involvement.

Find out more at your July Safety Meeting

PEOPLE ENVIRONMENT MACHINES ENVIRONMENT METHODS ENVIRONMENT
ENHANCING SAFETY THROUGH ERGONOMICS

Figure 7.—One of five posters created by NIOSH to promote ergonomics process at Jim Bridger Mine.

Process Effectiveness

Three years into the process, the Ergonomics Committee received a total of 55 concerns and successfully completed improvements for 22 concerns. A few examples of the modifications are shown in Appendix B. Some of the modifications were completed by equipment maintenance staff and did not result in significant expenditures of funds. Other modifications involved purchasing new equipment, such as lighter-weight welding helmets and floor mats. The easiest type of concerns addressed by the committee involved rearranging equipment or work areas. At the current time, another five concerns are in the process of being evaluated for potential interventions. Nineteen concerns submitted to the committee, however, were not considered viable concerns and were either forwarded to a more appropriate committee or were dismissed.

Before the change to the water pump switch, my arm would get tired from reaching for the switch and then rotating my arm to turn on the switch. Now, the switch is easier to operate. It is a 100% improvement. The Ergonomics Committee was very responsive in correcting this problem.

Keith Coble
Water Truck Driver

In March 2004, several members of the Ergonomics Committee were interviewed by NIOSH as to whether they thought the ergonomics process was effective. Overall, the members strongly believed the process was effective and did not believe any changes were needed. When problems with resolving concerns were encountered, the problems were generally related to external factors not associated with the process. For example, employees sometimes failed to follow up with the committee member evaluating the concern, equipment manufacturers could not develop a retrofit, or the suggested modifications voided the equipment warranty. Another issue the committee encountered was that interventions were not necessarily accepted by all employees affected by the intervention. For example, after changing an operator seat with an improved model, one employee continued to prefer the old seat. The committee had to accept that not all of the employees will be satisfied with the interventions even though the interventions lead to improvements. Because of individual differences, particularly with seating issues, this situation will likely occur again as interventions are implemented. As one measure of effectiveness, the physician assistant and manager of the on-site health clinic stated that since the ergonomics process was implemented, he has seen fewer employees reporting to the medical clinic with health complaints possibly related to MSDs.

On several occasions, NIOSH has encouraged the committee to expand its documentation efforts and collect additional information that could be used to garner additional management support. However, the committee has been reluctant to commit to further documentation and has taken the position that such additional documentation is not necessary for a successful process. Even though the Ergonomics Committee has not needed additional documentation to date to implement its interventions, such documentation may be needed as the process grows and more costly interventions are considered. Demonstrating quality cost-benefit data for initial interventions may help sell implementation of future, more costly interventions.

DEMONSTRATING EFFECTIVENESS FOR ERGONOMICS PROCESSES

Quantifying the effectiveness of ergonomics processes depends strongly on the organization and the original goal of the ergonomics process. It is common to see benefits measured in the number of work days lost, number of injuries/illnesses, number of near misses, or changes in workers compensation costs. But for some organizations, particularly small companies with limited injuries and illnesses, these measures may not be suitable. In these cases, use of survey tools, such as the Nordic Discomfort Survey, may be more useful. Another constructive approach may be to quantify exposure levels to risk factors before and after the implementation of an intervention. For example, for a lifting task the amount of weight lifted during a work shift may be measured before and then again after an intervention has been applied. Other examples include posture improvements, reducing the distance objects are carried, and reducing the number of repetitions performed. Some tools that may be used to show reduced exposures include Rapid Upper Limb Assessment or RULA [McAtamney and Corlett 1993], Rapid Entire Body Assessment or REBA [Hignett and McAtamney 2000], NIOSH Lifting Equation [Waters et al. 1994], Hand Activity Level or HAL [ACGIH 2005] and the Strain Index [Moore and Garg 1995]. Additional tools can be found at: http://www.hsc.usf.edu/~tbernard.

Lessons Learned

When implementing new processes, there are always lessons to be learned. At the Jim Bridger Mine, such lessons included—

- ***Committee Participants:*** Early on in the implementation phase, a number of leadership and committee members were replaced. The designated champion moved to a corporate position, and a new champion had to be selected, and some committee members chosen to represent their departments either did not have the time or were not interested in being on the committee. Although some changes in membership are inevitable, it is important to select participants who want to be a part of the process and to allocate sufficient time for participants to perform their work duties as well as committee responsibilities. This latter item was addressed by Bridger Coal Company by including Ergonomics Committee participation in the performance plans for salaried personnel and by altering employee schedules to permit sufficient time for committee activities. In addition, committee members supported each other by helping with tasks when other members did not have time to complete their assignments. While other companies have assigned a full-time coordinator to implement an ergonomics process, this was not considered necessary at the Jim Bridger Mine. Management at the mine was willing to put ergonomics ahead of other required duties.

- ***Process Development:*** There is no single "right" method that will work for all companies when developing a process. Although the Ergonomics Committee was given a lot of information and a number of ideas on how to proceed, it was necessary for committee members to determine what would work best to meet their needs. Because the committee

had the responsibility for selecting the path it would take in implementing the process and ensuring its success, it was critical to have the right people on the committee.

- ***Process Implementation:*** Although employees received training after the Ergonomics Committee developed a procedure for submitting concerns, sufficient time was not allowed for the committee to become thoroughly familiar with the procedure. Then, because employee training resulted in the submission of numerous employee concerns, the committee was initially overwhelmed at the same time it was learning the procedure to address these concerns. Committee members were apprehensive about the amount of time needed to address all the concerns and how the delay in responding would affect support for the process. Sufficient time should be given for a committee to become thoroughly familiar with its procedures prior to giving employee training and requesting that employees submit concerns.

- ***Employee Training:*** When developing the employee training, several video clips were selected to demonstrate examples of risk factors; approximately half of these video clips were of Bridger Coal employees doing specific mining tasks. Unfortunately, other video clips taken at the Jim Bridger Mine did not necessarily demonstrate multiple risk factors, and because of time limitations, the number of clips shown had to be minimized while maximizing the lesson learned from each clip. Some employees were critical that all the video clips were not specific to work done at the Jim Bridger Mine. For future training, more video clips from the mine where employees are working, or from very similar mines, should be used.

- ***Supervisory Training:*** Awareness training was primarily focused on employees and did not address the responsibilities of supervisors. Supervisors should receive additional training that specifically addresses their role in the ergonomics process. This training should demonstrate management's support for the process and should be done prior to the employee training so the supervisor can express support for implementation of the process. Supervisory training is particularly critical for supervisors who may have employees who are reluctant to participate. The concerns of these employees may never be addressed unless their supervisor initiates an action with the Ergonomics Committee. In addition, it is imperative that supervisors be fully aware of the way the company plans to conduct business related to ergonomic concerns.

Summary

The ergonomics process implemented at the Jim Bridger Mine has produced an active Ergonomics Committee backed by strong employee participation. The training received by both the committee members and employees has led to improved interactions among employees and management regarding their thoughts on injury prevention. Employees are using their knowledge of risk factors to report concerns about their jobs and the jobs of their peers. The committee has made an effort to respond to each employee within a reasonable time frame. During the first 3 years of using this process, the committee has implemented over 20 job improvements.

In addition to responding to employee reports of risk factors, the committee is also applying its ergonomic knowledge and awareness to other processes, such as purchasing equipment, implementing new procedures, and developing new training. For example, when Bridger Coal decided to purchase a new drill, committee members were asked to evaluate the new drill prior to purchase to ensure operators would not be exposed to MSD risk factors. Committee members also review reported injuries and illnesses to determine if an ergonomic risk factor was associated with the injury or illness.

Employees are initiating actions to improve their jobs and reduce exposure to risk factors. In one instance, mechanics took action by constructing a counterbalance for a 25-pound, 1-½-inch impact wrench used to change-out the cutting edges on a dozer blade. Instead of the worker holding the impact wrench, which resulted in sore hands, arms and shoulders, the impact wrench was suspended from a crane. Figure 8 illustrates how the mechanics reduced their exposure to risk factors.

It is a better way to hold the impact wrench. You only have to guide the wrench, and there is less stress on your shoulders. Before this intervention, you had to be built like a bull to use the impact wrench.

Stan Masters
Shop Mechanic

Mechanics also apply their knowledge of ergonomics when evaluating new equipment. For example, when a new lube truck arrived at the mine, the truck was inspected to ensure that it met specifications. Several items were identified on the truck as needing improvement, many of which were ergonomic in nature. The truck was returned to the manufacturer for modification.

Figure 8.—Mechanic using a support to hold an impact wrench when changing the cutting edges on a dozer blade. The support is attached with a strap to an overhead crane.

As part of a corporate-wide initiative, Bridger Coal Company was tasked with completing a health risk assessment designed to identify health hazards for each job classification at the mine. The health hazards initially included in the assessment were chemical and biological hazards; however, with the ergonomics knowledge gained during the past few years at the Jim Bridger Mine, the ergonomics coordinator added risk factors associated with MSDs. Consequently, the risk assessment tool was modified at the corporate level to include these risk factors. This risk

assessment provided an upper-level analysis defining the scope of exposures for risk factors associated with MSDs for all mining tasks performed at the mine.

In just 3 years, Bridger Coal Company has implemented an effective, proactive process to reduce exposure to MSD risk factors. As conditions change at the Jim Bridger Mine, the process is being modified to ensure continuing improvement and effectiveness. Instead of waiting for an injury or illness to occur prior to making changes, Bridger Coal is relying on an employee-based participative process to implement interventions that promote the well-being and comfort of its employees and to incorporate ergonomics into many other processes affecting employee safety and health.

INTEGRATING ERGONOMICS

To maximize the effectiveness of the ergonomics process, it should be fully integrated into other processes that affect workers and their workplaces. In addition to being integrated with safety and health programs, examples of other processes that could benefit from ergonomic input include—

- Purchasing new equipment and tools for mining and maintenance activities
  - Surface: Drills, prill trucks, loaders, haul trucks
  - Underground: Rock drills, dump trucks, continuous mining machines, scoops, longwalls, scaling machines, scaling bars, roof bolting machines
  - Maintenance: Pneumatic tools, hand tools, maintenance shop setup
- Purchasing personal protective equipment
  - Respirators, welding hoods, gloves, and kneepads
- Modifying facilities, production lines, or workstations
  - Dragline workstations
  - Equipment seats
  - Equipment controls
- Determining work shifts and schedules
  - 4/12, 4/10, and 5/8
  - Frequency and duration of breaks
- Modifying work practices or procedures
  - Using joystick controls and remote controls
  - Loading blast holes
  - Moving cable
  - Moving supplies
  - Building stoppings

Applying ergonomics to these processes at the planning stage will not only prevent the introduction of risk factors into the workplace that could result in MSDs, but it will avoid costly reengineering efforts to correct situations. Incorporating ergonomics into planning moves an ergonomics process from a reactive to a truly proactive mode.

ACKNOWLEDGMENTS

The authors would like to thank the Bridger Coal Company and its management, in particular, Pat Akers and Pat James, for being leaders in the mining industry when addressing the ergonomic concerns of its employees. Their actions demonstrate a proactive culture that places the well-being of its employees as its first priority. We would also like to thank the members of the Jim Bridger Mine Ergonomics Committee, the many mine employees who offered their time and effort to ensure the success of this endeavor, and the following current and former NIOSH employees whose efforts also contributed to the success of the Bridger ergonomics process: Albert Cook, Kim Gavel, Timothy Matty, Mary Ellen Nelson, E. William Rossi, Fred Turin, Richard Unger, Charles Vaught, and William Wiehagen.

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SUGGESTED WEB SITES

http://www.osha.gov/SLTC/ergonomics/index.html

http://www.cdc.gov/niosh/topics/ergonomics/

http://www.ergoweb.com/resources/

http://hfes.org/ (Human Factors and Ergonomics Society)

http://chppm-www.apgea.army.mil/ergopgm/ (U.S. Army ergonomics program)

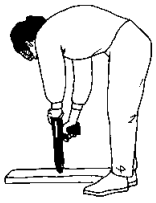
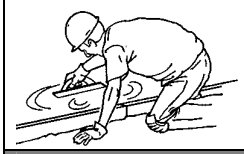
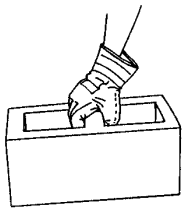
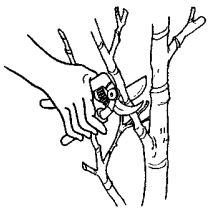
http://www.office-ergo.com (ergonomics information)

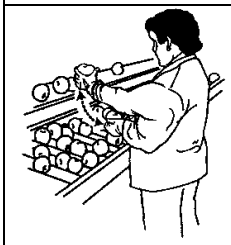
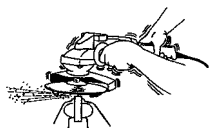
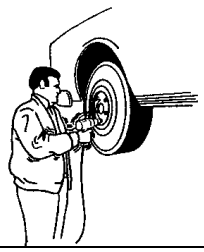
http://ergonomics.ucla.edu/ (University of California – Los Angeles)

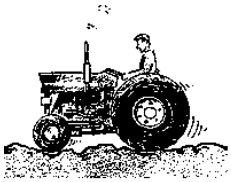
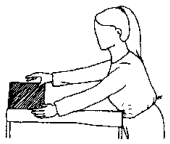
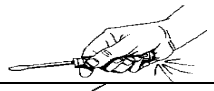
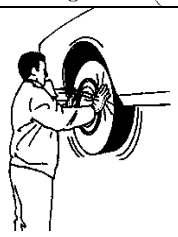
http://www.hsc.usf.edu/~tbernard (Tom Bernard, University of South Florida)

APPENDIX A.—PROCESS IMPLEMENTATION TOOLS

General Risk Factor Checklist

Movements, postures, or conditions that are a regular and expected part of the job, occurring more than *one day per week*, and more frequently than *one week per year.*	If done in this job ✓the box	Job evaluated: Date:	Number of workers who do this job?
Poor Posture		**Measures/Comments**	
 **1.** Working with the hand(s) above the head, or the elbow(s) above the shoulders more than **2 hours** total per day.	☐	Up to how many hours per day: _____ Up to how many days per week: _____	
 **2.** Working with the neck bent more than 30 degrees (without support) more than **2 hours** total per day.	☐	Up to how many hours per day: _____ Up to how many days per week: _____	
 **3.** Working with the back bent more than 30 degrees (without support) more than **2 hours** total per day.	☐	Up to how many hours per day: _____ Up to how many days per week: _____	
 **4.** Kneeling or squatting more than **2 hours** total per day.	☐	Up to how many hours per day: _____ Up to how many days per week: _____	
Forceful Gripping		**Measures/Comments**	
 **5.** Pinching an unsupported object weighing 2 or more pounds, or pinching with a force of 4 or more pounds per hand, more than **2 hours** per day (comparable to pinching half a ream of paper).	☐	Typical weight or force used: _____ Up to how many hours per day: _____	
 **6.** Gripping an unsupported object(s) weighing 10 or more pounds per hand, or gripping with a force of 10 or more pounds per hand, more than **2 hours** per day.	☐	Typical weight or force used: _____ Up to how many hours per day: _____	

Highly Repetitive Work		Measures/Comments
	**7.** Repeating the same motion with the neck, shoulders, elbows, wrists or hands (excluding keying activities) with little or no variation every few seconds, more than **2 hours** total per day. ☐	Up to how many hours per day: _____ Up to how many days per week: _____
	**8.** Performing intensive keying more than **4 hours** total per day. ☐	Up to how many hours per day: _____ Up to how many days per week: _____
Heavy or Frequent Lifting		**Measures/Comments**
	**9.** Lifting object weighing more than 75 pounds once per day or more than 55 pounds more than 10 times per day. ☐	Typical weight handled: _____ Up to how many times per day: _____
	**10.** Lifting object weighing more than 25 pounds above the shoulders, below the knees or at arms length more than 25 times per day. ☐	Typical weight handled: _____ Up to how many times per day: _____
	**11.** Lifting object weighing more than 10 pounds if done *more than twice per minute*, more than **2 hours** total per day. ☐	Typical weight handled: _____ Up to how many hours per day: _____
Vibrating Tools (Hand-Arm Vibration)		**Measures/Comments**
	**12**. Using grinders, sanders, jigsaws or other hand tools that typically have moderate vibration levels more than **2 hours** total per day. ☐	Up to how many hours per day: _____ Up to how many days per week: _____
	**13.** Using impact wrenches, carpet strippers, chain saws, percussive tools (jack hammers, scalers, chipping hammers) or other tools that typically have high vibration levels, more than **30 minutes** total per day. ☐	Up to how many hours per day: _____ Up to how many days per week: _____

Bouncing or Jarring	Measures/Comments
 **14.** Traveling in mobile equipment over rough ground or flooring, more than **2 hours** total per day. ☐	Up to how many hours per day: _____ Up to how many days per week: _____
Contact or Impact Stress	**Measures/Comments**
  **15.** Contacting hard or sharp objects like work surface edges or narrow tool handles, more than **2 hours** total per day. ☐	Up to how many hours per day: _____ Up to how many days per week: _____
 **16.** Using the *hand* (heel/base of palm) or *knee* as a hammer more than 10 times per hour, more than **2 hours** total per day. ☐	Up to how many hours per day: _____ Up to how many days per week: _____
Other Risk Factors (Please provide a brief description of each risk factor)	**Measures/Comments (Please record relevant measures)**
☐	
☐	
☐	

Derived from Caution Zone Checklist (WAC 296-62-05105)
Washington State Department of Labor and Industries (2001)

What are the physically demanding duties of this job?

What are the reasons for risk factors identified?

What improvements would you like to see for this job?

Interview Notes:

Bridger-NIOSH Ergonomics Initiative
Musculoskeletal Discomfort Survey

The purpose of the survey:
You have been selected to participate in a National Institute for Occupational Safety and Health (NIOSH) study of musculoskeletal pain in the mining industry. We wish to determine the musculoskeletal risk factors that exist at this mine and across the mining industry. We are interested in the type and location of the discomfort symptoms you may be experiencing. This survey should take no more than 5 minutes to complete. Thank you for your cooperation.

How to answer the discomfort questionnaire:
***Picture*:** In this picture you can see the approximate position of the parts of the body referred to in the questionnaire. Limits are not sharply defined, and certain parts overlap. You should decide for yourself in which part you have or have had your trouble (if any).

***Table*:** Please answer by putting an "X" in the appropriate box - one "X" for each question. You may be in doubt as to how to answer, but please do your best anyway. Note that column 1 of the questionnaire is to be answered even if you have never had trouble in any part of your body; columns 2 and 3 are to be answered if you answered yes in column 1.

Demographics:

Initial of first name: __ Initial of last name: __ Last 4 digits of Social Security number: __ __ __ __

Immediate Supervisor: _____ Date:____/____/____ Department:_____

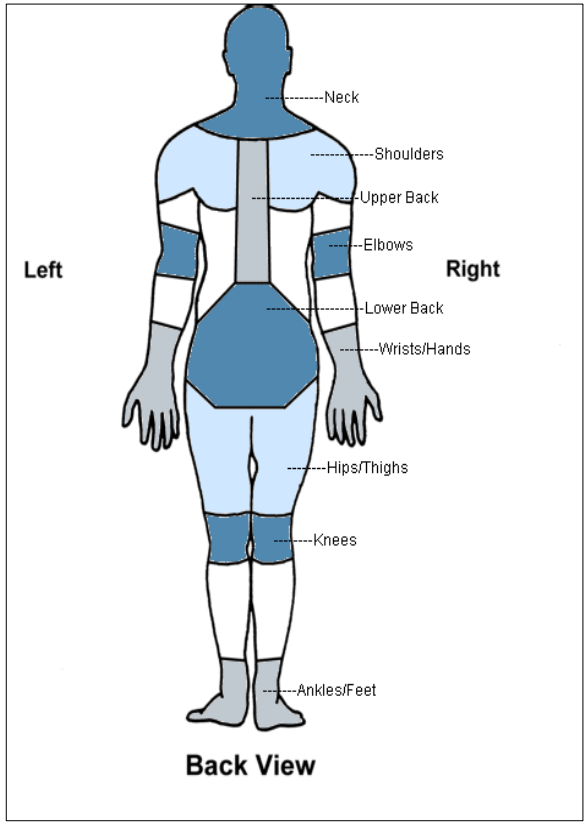
Job Title: Please check one of the following:

Administration & Clerical	Technical Services Dept	Medical Services	Safety Dept.
Production Foreman/Super.	Drag Line Operator	Dragline Oiler	Ground Person Dragline
Hauler Operator	Heavy Equip. Operator	Mine Services Operator	
Driller/Shooter	Powder Person	Field Helper	
General Maint. Foreman/Super. (shop, field, conveyor)		Shop or Field Planner (coordinator, planner, clerical)	
Shop Journeyman Mechanic	Machinist	Shop Helper	Shop Welder
Equipment Oiler	Field Journeyman Mechanic	Elect. Journeyman	
Field Welder	Crane Operator	Conveyor Person	Light Equipment Mechanic
HVAC Mechanic	Utility Person	Janitor	

(Based on Nordic Discomfort Survey, Kuorinka et al., 1987)

Gender: M F Age: _____ Height: ____ ft.____ in. Weight: _____

How long have you been doing this job? _____ years _____ months On average, how many hours do you work each week? _____



To be answered by everyone	**To be answered by those who have had trouble**	
Have you at any time during **the last 12 months** had trouble (ache, pain, discomfort, numbness) in:	Have you at any time during the **last 12 months been prevented from doing your normal work** (at home or away from home) because of the trouble?	Have you had trouble at any time during **the last 7 days?**
Neck o No o Yes	o No o Yes	o No o Yes
Shoulders o No o Yes, right shoulder o Yes, left shoulder o Yes, both shoulders	o No o Yes	o No o Yes
Elbows o No o Yes, right elbow o Yes, left elbow o Yes, both elbows	o No o Yes	o No o Yes
Wrists/Hands o No o Yes, right wrist/hand o Yes, left wrist/hand o Yes, both wrists/hands	o No o Yes	o No o Yes
Upper Back o No o Yes	o No o Yes	o No o Yes
Lower Back (small of back) o No o Yes	o No o Yes	o No o Yes
One or Both Hips/Thighs o No o Yes	o No o Yes	o No o Yes
One or Both Knees o No o Yes	o No o Yes	o No o Yes
One or Both Ankles/Feet o No o Yes	o No o Yes	o No o Yes

Sample Decision Matrix

Work Group	# of Employees	Incident Data	Nordic Survey	Supervisor Interviews	Mgmt. Concern	Final Score*
Supervisors	3	Low	High	Low		5
Haul Truck Ops	15	Med	Med	Low		5
Driller Ops	5	Med	Low	Low		4
Blasting Crew	4	High	Med	High	x	**9**
High Lift/Loader Ops	4	Med	Med	Med		6
Mechanics	4	High	High	High		**9**
Scaling Machine Ops	3	Med	High	Med	x	**8**
Water Truck Op	1	Low	High	Low		5
Laborers	4	Low	High	High	x	**8**
Welders	3	Low	Med	Med		4

*For scoring purposes, a rating of High = 3 points, Medium = 2 points, and Low = 1 point. One additional point was awarded if management expressed concern regarding a work area.

APPENDIX B.—EXAMPLES OF ERGONOMIC INTERVENTIONS IMPLEMENTED BY THE ERGONOMICS COMMITTEE

CONCERN	SOLUTION	
Welders had experienced several back and neck injuries. Risk factor evaluations and interviews of welders indicated that the weight of the welding helmet, combined with awkward postures required when performing certain jobs contributed to the problems.	Light-weight helmets (on the right) were purchased to replace the existing, heavier helmets (on the left).	
To operate the water truck pump switch, employees were required to reach forward while rotating their arms (top photo). This action was sometimes performed every few seconds when spot watering some sections of the haul roads.	The switch was moved to the shift pedestal (bottom photo). This location now allows the employee to rest his arm on the pedestal while operating the switch.	 
Employees working in the warehouse complained of leg and foot pain from walking on concrete floors.	A rubber mat was placed on the floor in the high traffic areas.	

CONCERN	SOLUTION	
Placing and removing chock blocks tied together with a rope (top photo) resulted in excessive stooping and bending. This created a problem for employees who had to chock their vehicles several times a day. There were also other issues that occurred during muddy and wet conditions.	A handle made from conduit was attached to the chock blocks (bottom photo). This modification allowed employees to place the chock blocks in front and behind the tire, and to remove the chock blocks with little or no stooping. This handle also helped alleviate the issues during extreme weather conditions.	 
The throttle pedal on a loader was in an upright position. To release the pedal, the operator had to lift his foot completely off the pedal and then place his foot on the floor adjacent to the pedal. Because this movement was done repeatedly throughout the shift, operators experienced ankle and leg pain.	After obtaining approval from the manufacturer, the pedal was set at a lower angle. This position allowed the operator to rest his foot on the pedal when the pedal was not engaged.	
To enter the tool room, employees were required to remove their safety glasses for an eye scan. If employees were returning tools, they had to place the tools on the floor in order to remove their glasses. This often resulted in excessive stooping.	A small table was placed next to the eye scan so employees could place their tools on it. This eliminated any stooping.	

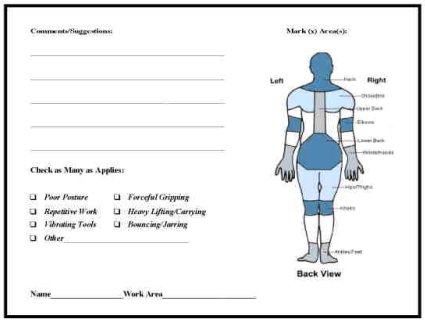
TAKE ACTION!!

Report *any* Concerns to Your Ergonomics Committee

Jesse Abney, Dan Allen, Ruth Bess, Val Fieseler, Paul Gust, Mike Hesse, Kean Johnson, Jerry Lamberth, Kerry McKenzie, Ricky Olson, Carl Persinger

Ergonomics Coordinator: Kean Johnson

Ergo Report Card



Reporting risk factors as soon as you are aware of them can prevent loss of function and serious injury.

Bridger Ergo website coming soon: http://merits.niosh.cdc.gov/bridger/

ERGONOMICS COMMITTEE

What We're Working on With NIOSH.....

DRAGLINE OPERATOR
Using Controls

RISK FACTORS

- Bent wrists
- Prolonged sitting
- Repetitive hand & arm work
- Contact stress - wrist & forearm

POWDER PERSON
Measuring Blast Holes

RISK FACTORS

- Repetitive wrist, arm & shoulder motions
- Twisting and turning of ankles and knees
- Exposure to extreme weather conditions

Remember....

Report any signs or symptoms from your job to an Ergonomics Committee Representative!

Bridger Coal Company Ergonomics Program

Samples of what we are working on...

Welding Hoods

Concern: Welders reported neck and back pains.

Cause: Heavy weight of welding hoods

Fix: Committee found lightweight welding hoods with same protection value. Welders feedback has been positive and the new hood will be standard issue.

Water Truck Pump Switches

Concern: Drivers reported having to lean over while holding their arms in an elevated and extended position to operate pump. In winter, the problem is worse and more frequent.

Cause: Poor location of switch

Fix: Move switch closer to gearshift lever to reduce repetitive motion in an awkward position.

Warehouse Floors

Concern: Warehouse workers reported foot and ankle problems.

Cause: Standing and walking on hard surfaces

Idea: Anti-fatigue mats and shoe insoles are two things that can reduce this problem.

Remember - It's up to *you* to *Take Action*!

Report any problems or concerns to your Ergonomics Committee

PEOPLE ENVIRONMENT MACHINES METHODS ENVIRONMENT
ENHANCING SAFETY THROUGH ERGONOMICS

NIOSH - November, 2002

Be Aware of Risk Factors!

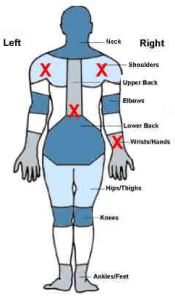
Dozer Blade Changeout

Risk Factor Report Card

Comments/Suggestions:

Hands feel numb after I use this tool. Shoulder and back are sore after I get done.

Mark (x) Area(s):



Back View

Check as Many as Applies:

- ☑ Poor Posture
- ☑ Repetitive Work
- ☑ Vibrating Tools
- ☐ Other
- ☑ Forceful Gripping
- ☑ Heavy Lifting/Carrying
- ☐ Bouncing/Jarring

Name NIOSH Sample Work Area Maintenance shop

Changing out dozer and scraper blades.

Take Action!

Turn in a Risk Factor Report Card to your Ergonomics Committee!

NIOSH - October 2003

Delivering on the Nation's Promise:

Safety and health at work for all people through research and prevention

For information about occupational safety and health topics contact NIOSH at:

1–800–35–NIOSH (1–800–356–4674)
Fax: 513–533–8573
E-mail: pubstaft@cdc.gov
www.cdc.gov/niosh

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