

Implementation of an ergonomics process at a US surface coal mine

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Available online 26 December 2006

Abstract

Since 1990 and the publication of the *Ergonomics Program Management Guidelines for Meatpacking Plants* by the US Occupational Safety and Health Administration, numerous reports of companies implementing ergonomics program have been published. However, despite these numerous reports, no examples of implementing an ergonomics program in the mining industry have been reported. In 2000, NIOSH initiated a long-term project to demonstrate the implementation of an ergonomics process designed to identify and reduce exposures to ergonomic risk factors found in mining. The mine selected for this project was the Jim Bridger Mine, a surface coal mine located 35 miles northeast of Rock Springs, Sweetwater County, WY. This paper discusses how a large, surface coal mine implemented an ergonomics program and the lessons learned while doing so.

Relevance to industry

In 1998, the Mine Safety and Health Administration (MSHA) submitted a formal request to NIOSH to investigate musculoskeletal disorders (MSDs) in the mining industry. In response to MSHA's request, NIOSH initiated a project at the Jim Bridger Mine that involved the implementation of an ergonomics process. This manuscript provides examples of successful interventions as well as recommendations and lessons learned from the implementation of an ergonomics process that will be beneficial to those initiating similar efforts.

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Keywords: Ergonomics program; Ergonomics process; Mining

1. Introduction

Prior to 1980, the industrial application of ergonomics in the United States largely focused on defining physical capabilities of workers and physiological responses to various working conditions. Companies supporting these early ergonomic efforts, mainly through applied industrial research activities, included E.I. duPont de Nemours & Company and Eastman Kodak Company (Eastman Kodak Company, 1983). Early research efforts specific to the US mining industry were focused on describing physiological characteristics of miners (muscular strength and aerobic capacity), evaluating physiological responses when performing mining tasks, analyzing injury data and evaluating manual material handling tasks. Many of these

studies were conducted for the Bureau of Mines, United States Department of the Interior (Bureau of Mines, 1981, 1983, 1987).

Not until the United States Department of Labor, Occupational Safety and Health Administration (OSHA) initiated enforcement actions directed at the meat packing industry in the 1980s, did companies located in the United States begin to consider the implementation of formal ergonomics programs or processes as a means of proactively improving worker safety and health through the prevention of musculoskeletal disorders (MSDs). For the purposes of this paper, an ergonomics process is defined as a formal, systematic application of ergonomics principles integrated with management systems and imbedded in the organizational culture. Such a process would be comparable to an occupational safety and health program designed to address health and safety hazards through a systematic method of hazard recognition, identification,

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Another probable explanation could be that existing employees were changing jobs. This could have ergonomic implications if older employees sought jobs with exposures to ergonomic risk factors. For example, the highest paying production position at this mine was dragline operator. This position involved exposure to repetitive motion while operating joysticks or foot pedals for 12 h/day. Several studies have found age to be associated with a higher rate of MSDs (Biering-Sørensen, 1983; Riihimäki et al., 1989; Toomingas et al., 1991; Ohlsson et al., 1994; English et al., 1995; Guo et al., 1995). Additionally, in one study, older workers with less work experience reported more symptoms than younger workers, while older workers with more work experience reported fewer symptoms than younger workers (Ohlsson et al., 1989).

For five years prior to this project, the average incident rate for non-fatal days lost injuries at the Jim Bridger Mine was 1.32 injuries per 100 employees, as compared to the national average of 2.34 for all mines, and as compared to the average of 1.31 for all western US surface coal mines with more than 100 employees. Although, the Mine's average incident rate was well below the national average and injuries related to ergonomic 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. Information on why the Bridger Coal Company decided to implement an ergonomics process can be found in Steiner et al. (2004).

2.2. Process effectiveness

To assess the effectiveness of the process, two approaches were followed. First, reports of employee discomfort were obtained using a discomfort survey adapted from the Standardized Nordic Questionnaire (Kurionka et al., 1987). The survey was administered in 2001 by NIOSH researchers and again in 2004 by Bridger Coal Company management. Although 225 employees completed the survey in 2001 and 116 completed it in 2004, only 41 surveys could be matched for both years. The lower response rate in 2004 was attributed to a significant change in personnel (both turnover and reassignments) when the mine began converting its operations from surface to underground. Because of the limited number of matched pairs, statistical analyses were not performed and only trends are reported.

Secondly, employee reports of risk factor exposures and intervention efforts were documented and tracked by the Ergonomics Committee. The risk factor exposure data were obtained from employees who submitted concerns to the committee.

2.3. Getting management buy-in

It was essential to have the support of Bridger Coal's top management for the ergonomics process to be successful at

the Jim Bridger Mine. The key to a successful implementation is a senior management with a strong understanding and support of the programmatic concepts and elements (Cohen et al., 1997). Two meetings were held to introduce this project to top management of the Bridger Coal Company and PacifiCorp and also to the Western Energy Workers Union, the union representing Bridger Coal Company employees.

The initial meeting, attended by mine management and union officials, was held in Rock Springs, WY to discuss the objectives of the project and to define expectations and commitments. One expectation discussed was that the Bridger Coal Company needed to designate a "champion" for the project who would promote the implementation of the process and ensure that the process moved forward. Information on ergonomic principles, risk factors and approaches used by other companies in successfully addressing ergonomic risk factors was also provided. The second meeting, held in Salt Lake City, UT, was with senior safety administrators from within PacifiCorp's Generation Business Unit. NIOSH again presented approaches used by other companies and then defined the benefits of implementing an ergonomics process. Providing information on how ergonomics benefited these other companies was absolutely necessary to get complete buy-in and support from these senior management officials. These meetings resulted in corporate awareness of the ergonomics process to be implemented at the Jim Bridger Mine, and also additional champions for ergonomics.

2.4. Ergonomics committee

Bridger Coal's management decided that the best approach to implementing an ergonomics process was to establish an ergonomics committee within the Safety Department, but separate from the existing safety and health committee. This approach allowed Bridger to more easily commit resources specific to ergonomic interventions. The committee, chaired by an ergonomics coordinator who reported to the safety manager, included eleven representatives from labor and management. Specific departments represented were medical, engineering/environmental, safety, human resources, production and maintenance. Mine management was kept informed of committee activities and needs through the ergonomics coordinator and safety manager who reported to the mine manager. The union was kept abreast of committee actions by the union representatives appointed to the committee.

One of the first actions taken to move the committee forward was to help the committee gain an understanding of ergonomics. The Committee received training at the mine on the principles of ergonomics, risk factor identification, job prioritization, intervention recommendations, and cost/benefit analysis. During follow-up training sessions, the Committee received instructions on using tools to document interventions, task analyses, and interviews; conducting interviews; videotaping/photographing tasks;

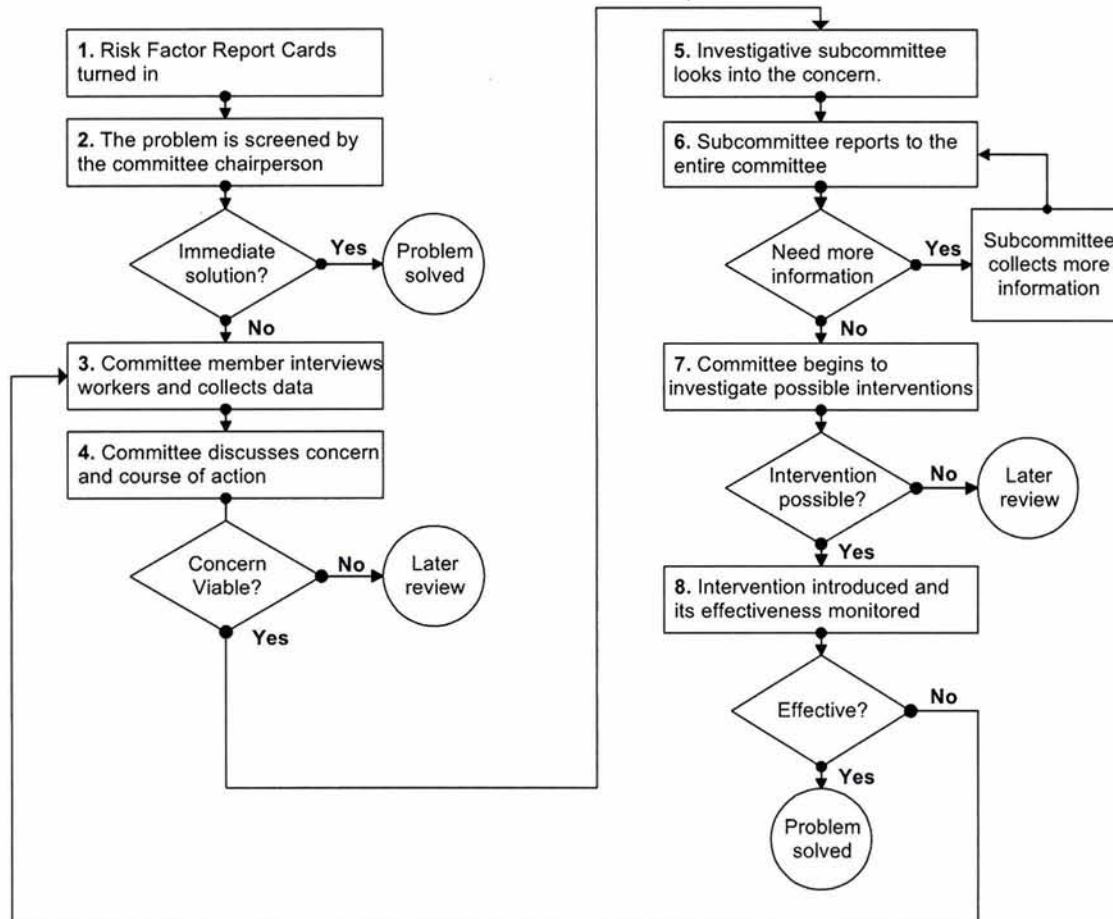


Fig. 2. Ergonomics process flow diagram. (Concerns considered not viable included ones that did not currently have a practical solution or the solution was beyond the scope of the committee.)

stickers also provided a continuing reminder to employees about the importance of ergonomics.

For the most part, the training was well received by the employees. Employees participated in the interactive exercises, and seemed quite knowledgeable regarding identifying risk factors at the conclusion of the training. In fact, 27 employees submitted report cards to the Ergonomic Committee immediately following the training. The effectiveness of the training was further demonstrated with the implementation of an intervention in a surface drill. According to the documentation for this intervention, the drill operator had tried several times to have a foot pedal moved to a more comfortable position but was not successful. However, the general knowledge gained from the training by both employees and management allowed them to understand how the problem with the foot pedal could be resolved, which was then corrected by the Maintenance Department.

2.7. Communications and recognition

The Ergonomics Committee established a bulletin board in the ready room, an area that all employees passed

through when reporting to work. The bulletin board included information about the committee, instructions for reporting a concern, and a status report of concerns submitted by employees. Posters were periodically displayed on this bulletin board and at other meeting areas at the mine. The posters focused on introducing the ergonomics committee to the employees, reporting risk factor exposures, promoting ergonomic interventions completed by the committee, and identifying risk factors for specific tasks.

PacifiCorp's quarterly safety newsletter, *Safety Times*, twice featured the success of Bridger Coal's ergonomics process. This newsletter was made available to all Bridger Coal employees, and served as recognition to not only the committee members for their efforts, but also to the employees submitting concerns for actively participating in the process.

2.8. Medical management

The Bridger Coal Company maintained a medical clinic at the Jim Bridger Mine that was staffed by a full-time physician assistant (who was also a physical therapist) and

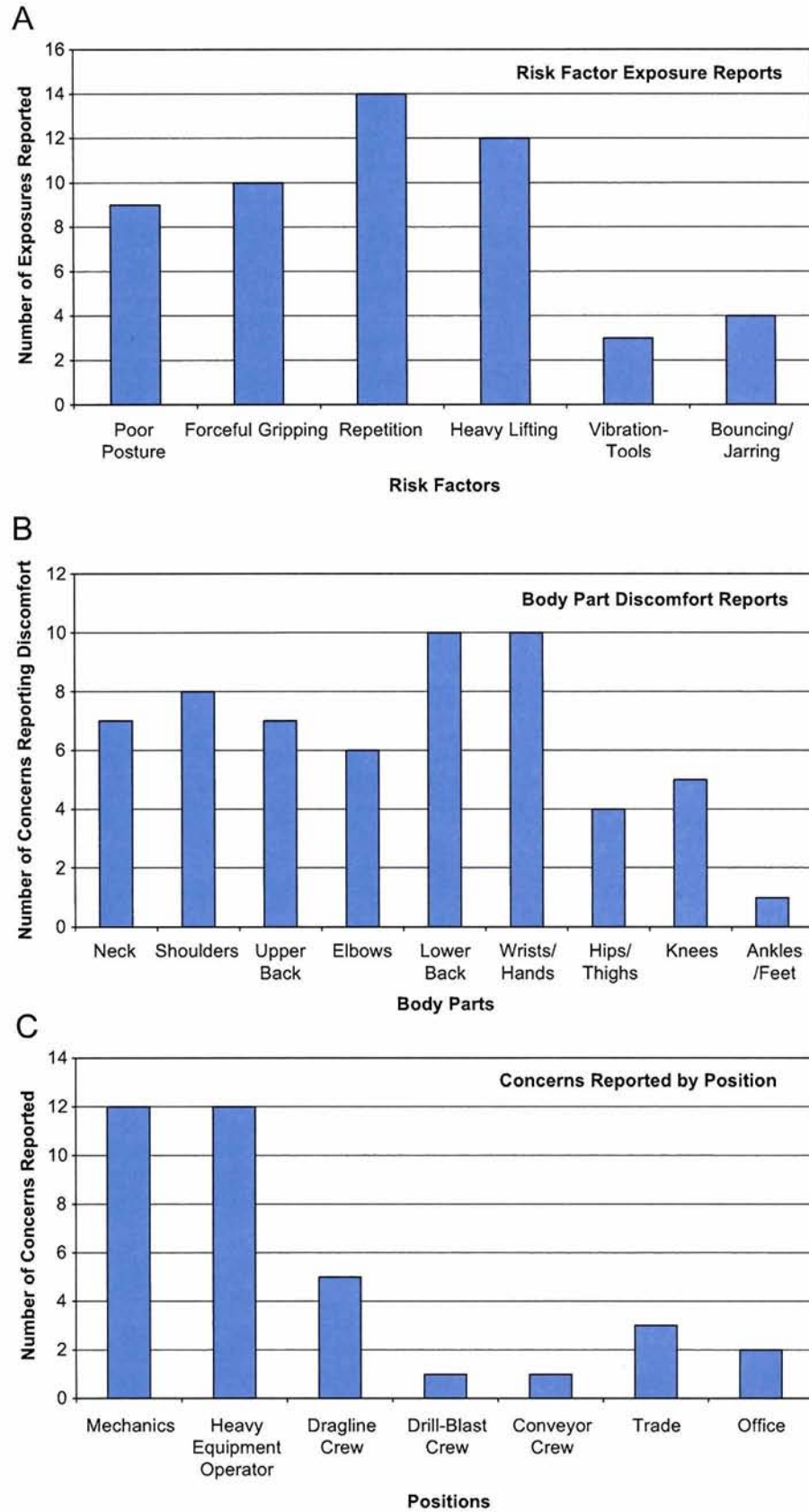


Fig. 3. Information submitted by employees using the Risk Factor Report Card (A—risk factor exposure reports, B—body part discomfort reports, and C—concerns reported by position).

Table 1
Description and type of interventions completed

Type of intervention	Number of concerns received	Brief description of intervention
Existing equipment modified	4	Handle added to chocks (19) ^a Loader foot pedal angle modified (5) Drill pedal moved to a more accessible location (11) Drill truck ladder handrail modified (11)
Workstation rearranged	5	Pump switch location changed (27) Loader seat aligned with controls (5)
New workstations purchased	2	Adjustable office workstations purchased (2)
New equipment purchased	9	Light weight welding helmets replaced heavier helmets (14) Wooden hammer handle with rubber guard replaced fiberglass handles (14) Nylon tie-down straps replaced heavier chains (9) Small table placed outside tool room for holding tools when entering access code (29) Floor mats installed in warehouse (2) J-hook bar obtained to pull dragline cable (16) Tractor purchased to move trailing dragline cable (16) Dragline workstation improved with larger, more adjustable armrests and a footrest (15)
New seats purchased	6	Seats changed in draglines, loaders and blades (47)
Availability of PPE improved	1	Additional knee pads stocked in warehouse (45)

^aEstimated number of employees affected by intervention.

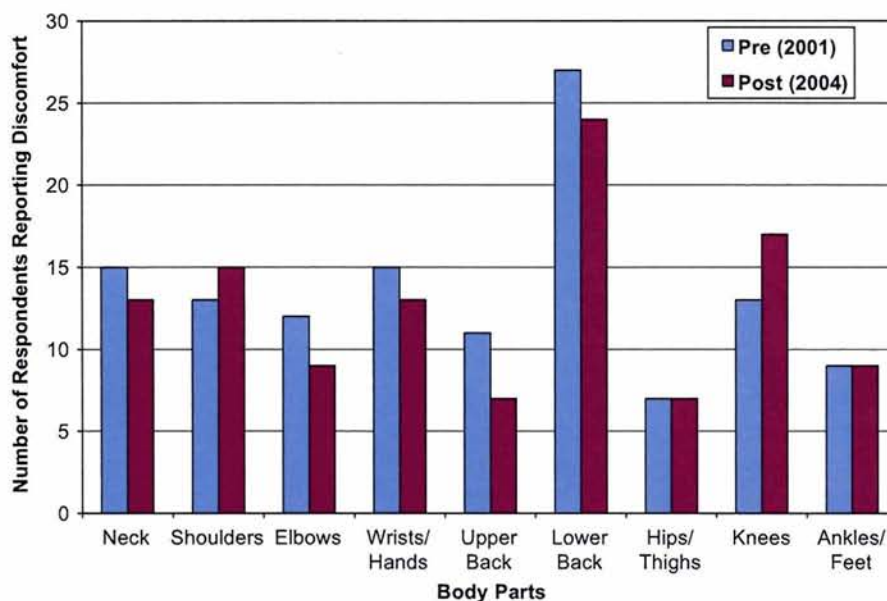


Fig. 4. Number of body part discomfort reports during the past 12 months for 2001 and 2004.

3.4. Lessons learned

When implementing new processes, there are always lessons to be learned. Lessons identified by NIOSH and the Bridger Coal Company with implementing the ergonomics process at the Jim Bridger Mine included:

- *Committee participants:* Early on in the implementation phase, a number of replacements in the leadership and

committee members occurred. 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 participant changes 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 duties.

Table 2
Number of employees reporting discomfort in 1–4 different body parts
(n = 41)

	Number of body parts with discomfort				Number of employees reporting any discomfort
	1	2	3	4	
2001	7	5	10	8	37
2004	6	5	7	5	31

Table 3
Percentage of employees reporting discomfort by age

	All body parts			Back		
	Age (years)			Age (years)		
	31–40	41–50	> 50	31–40	41–50	> 50
2001	100	89	100	86	65	100
2004	83	73	72	83	53	56

This later 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. Additionally, 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 Jim Bridger Mine was willing to put ergonomics ahead of other required duties.

- *Process development:* There is no single method when developing a process that will work for all companies. Although the Ergonomics Committee was given a lot of information and ideas on how to proceed with the process, it was necessary for the 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 then for ensuring its success, it was critical to have employees on the Committee who were dedicated to a successful process.
- *Process implementation:* Although the employees received training after the Ergonomics Committee developed a procedure for submitting concerns, sufficient time was not allowed for the members to become thoroughly familiar with this procedure. Because the employee training resulted in the submittal of numerous employee concerns, the members were overwhelmed with addressing these concerns while they were still getting comfortable with their procedure. Committee

members were apprehensive about the amount of time needed to address all the concerns and how the delay in responding would impact 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.

- *Supervisory training:* The awareness training provided was primarily focused on employees, and did not address specific 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 be done prior to the employee training so the supervisor can support implementation of the process. Supervisory training is particularly critical for supervisors who may have employees who are reluctant to participate in the process. The concerns of these employees may never be addressed unless their supervisor initiates a report to the ergonomics committee. Additionally, it is imperative that supervisors be fully aware of the way the company plans to conduct business related to ergonomic concerns.

4. Conclusions

The ergonomics process implemented at the Jim Bridger Mine produced an active ergonomics committee backed by strong participation. The training received by management, committee members and employees led to improved interactions between employees and management regarding their thoughts on injury prevention. Employees used their knowledge of risk factors to report concerns about their jobs and their peer's jobs.

In addition to responding to employee reports of risk factors, the committee also applied its ergonomic knowledge and awareness to other processes, such as purchasing equipment, implementing new procedures, and developing new training. Committee members also reviewed reported injuries and illnesses to determine if ergonomic risk factors were associated with the injury or illness.

Employees also took the initiative to improve their jobs and reduce exposure to risk factors. For example, mechanics took action by constructing a counter balance for a 25-pound, 1½-inch impact wrench used to change out the cutting edges on a bulldozer blade. Rather than holding the impact wrench, which resulted in sore hands, arms and shoulders, the impact wrench was suspended from a crane. In addition, mechanics applied their ergonomic knowledge when evaluating new equipment. When a new lubrication truck arrived at the mine, the truck was inspected to ensure it met specifications, including ergonomic design features. 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 before it was accepted by the mine.

As part of a corporate-wide initiative, the 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 this assessment were chemical and biological hazards; however, with the ergonomic 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, and served as a baseline for identifying tasks with exposures to ergonomic risk factors.

In just three years, the Bridger Coal Company implemented an effective, proactive process to reduce exposure to ergonomic risk factors. As conditions change at the Jim Bridger Mine, the process is also being modified to ensure continuing improvement and effectiveness. Instead of waiting for an injury or illness to occur prior to making changes, the Bridger Coal Company is relying upon 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. Kean Johnson, Coordinator for the ergonomics process at Bridger Coal, stated:

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 those 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.

Acknowledgments

NIOSH would like to thank the Bridger Coal Company and its Management for being leaders in the mining industry when addressing the ergonomic concerns of its employees. Their actions demonstrated a proactive culture that places the well-being of its employees as its first priority. NIOSH would also like to thank the members of the Ergonomics Committee and the many Bridger Coal Company employees who offered their time and effort to ensure the success of this process.

The authors also wish to thank several current and former employees of the NIOSH Pittsburgh Research Laboratory who supported this project in many different

ways. They include: Kim Cornelius, Bill Rossi, Fred Turin, Richard Unger, Charlie Vaught, and William Wiehagen.

Disclaimer: The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the National Institute for Occupational Safety and Health.

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