

CONSTRUCTION, MAINTENANCE, AND REPAIR ACTIVITIES: THE DATA ON INJURIES 1993 – 1997¹

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ABSTRACT

In past years in the mining industry, the focus has been on safety with regard to extraction and production activities. Viewing historical injury data from the 1990s within a broader paradigm, this paper focuses, not on specific injuries linked to extraction and production of minerals, but on mining injuries occurring within the context of worker construction, maintenance, and repair activities. A definition is offered for these activities. Data from all commodities and from both operator and contractor are presented. Overall in the mining industry from 1993-1997, thirty-nine percent of injuries occurred while the employees were performing activities related to construction, maintenance and repair. Implications for safety training are discussed.

INTRODUCTION

As improvement in mining injury statistics “flatlined” in the 1990’s, safety and health personnel, managers and miners began to discuss what the next step might be to reinstate a downward trend in injuries (1). In 1996, Richard Seago (2), Vulcan Corporate Safety Manager, presented a paper based on company data entitled “The Last Big Frontier in Safety” suggesting that activities in construction,

maintenance, and repair were the key to future reduction in injury.

After a panel of experts defined construction activities, maintenance activities and repair activities, an in-house study utilizing MSHA data for the company was undertaken. After analyzing 604 accident narratives, the point was proven – that CMR activities accounted for a large 64% of injuries throughout the company, over the period studied.

The question then became, to what extent is this true throughout the mining industry, in all commodities and at all locations? The Pittsburgh Research Laboratory, NIOSH contracted with Battelle Centers for Public Health Research and Evaluation to design a study and analyze a sample of narrative descriptions over a five year period (1993-1997) with the goal of determining whether an injury incident could be characterized as one involving construction/maintenance/repair (CMR) activity. This paper is based on the findings of that report (3).

A secondary goal of the analysis was to determine the basic weighted frequency distributions of CMR-related cases, comparing mine operators and contractors by primary commodity mined and subunit within each commodity.

CODING THE DATA

“Using the NIOSH field-tested definitions of CMR given below, each record was reviewed and assigned one of the following codes

- 1 - CMR Related Event
- 2 - Activity Other than CMR
- 3 - To Be Reviewed

Classification of construction/maintenance/repair activities was made independent of employee occupation or job title” (3, p. 1).

Cases

A sample of 21,024 injury incidents were selected (1993 -1997) from the Mine Safety and Health Administration (MSHA) database known as the Mine, Accident, Injury, and Illness Database (n=104,108).

Construction/Maintenance/Repair Related Events

“Construction work activities involve the building, rebuilding, alteration, or demolition of any facility or addition to existing facility at a surface mine, surface area of an underground mine or underground mine. These activities would include tasks such as painting, decoration or restoration associated with those facilities or with the land connected to those facilities at the mines. However, it excludes any tasks involved in shaft and slope sinking or work performed on the surface incidental to shaft or slope sinking. Examples of construction activities would include the building of stoppings that control the airflow in the mines or the building or destruction of offices or shops at the surface of a mine.

Maintenance and repair work activities are tasks associated with the construction, installation, setting up, adjusting, inspecting, modifying, or maintaining any servicing machines or equipment. These activities may

include: lubricating, cleaning or unjamming of machines or equipment, making adjustments or tool changes to any equipment or machines used in the mining process.

Other key words that assisted in the determination of a CMR event include welding, grinding, cutting, leveling, examining, splicing, booting, greasing, resetting, greasing, sewing, replacing, “working on”, digging, and checking. Certain types of equipment and materials were typically considered an indicator of a CMR event. These include track, drive or take-up rollers, tail piece, head, stopping, gunnite, overcast, and undercast. Any activity that used mobile or fixed cranes — also called overhead hoist or chain hoist — or the getting in and out of the those cranes, was considered a CMR activity” (3, p. 3). Sample CMR Narratives are illustrated in Figure 1.

Activity Other Than CMR

The accidents not coded as construction, maintenance, and repair would include activities directly involved with the mining or extraction process, such as

- roof or rock bolting
- shooting, drilling, or blasting for a commodity
- operating machines or equipment directly involved in the extraction of a commodity, such as the conveyor, scoop, shuttle car, tractor, miner, or trucks
- setting up jack legs or any other temporary roof support
- scaling, adding I-beams, hauling, hanging cable, etc.

Sample "CMR" Narratives

- Injured was welding on the shear drum at face of the 16e mn longwall section a piece of roof coal fell from top, striking injured on right shoulder, neck and right hand.
- The EE was using a pry bar to unwedge a board from the D.A. Ram. He cut his right palm. He went to the emergency room after his shift. The cut required four stitches.
- Moving a track rail with a bar. Rail slipped causing bar to fly out of his hands and the bar struck him on the right cheek. Laceration and fracture to right cheek.
- Injured stated he was helping coworker make a belt splice in #3 entry on the belt line. His knife slipped and hit the inside of his left leg above the knee, causing a laceration to his left leg.
- EE was jacking the track jeep back onto the track when the bar for the jack slipped from the jack causing the EE to fall catching his fingers between the bar and the track rail, thus fracturing his left middle finger and ring finger. Actual cause of the injury was probably due to be in a hurry no rules or regulations being broken
- Shoveling on belt line bottom belt caught shovel carrying back through tailpiece between bottom and bottom belt. Shovel blade was sticking out from under tailpiece guard. Started to reach for shovel splice came through & knocked shovel blade into right cheek

Figure 1. Sample "CMR" Narratives

There were also activities not related to CMR activities or the mining process. These would include

- tripping, falling, or lifting that was not within
- the performance of CMR work
- water or coal sampling and/or testing
- the basic cleaning of facilities, such as garages, offices, shops or other various rooms
- getting in and out of trucks or other vehicles, except mobile or fixed cranes, which stated earlier are classified as CMR.

The moving or removing of boxes or equipment from trucks or other locations would not be CMR related unless the items being moved or removed were engines or any other parts that were or would be used to repair machines or equipment. In addition, the use of hand tools without the clarification of the use at the time of the accident was coded as not CMR related. Sample "Activity Other Than CMR" Narratives are illustrated in Figure 2.

Sample: “Activity Other Than CMR” Narratives

- Employee was roof bolting and wrench slipped causing him to hit his finger on a roof bolt plate that was laying on the bolter.
- A piece of draw slate way laying on top of and hanging over side of the continuous miner. As the miner operator walked around the miner he brushed against the slate with his left arm causing a laceration.
- EE was doing quality control sampling of limestone. She was taking material out of a mechanical shaken to weigh. She bent over and strained lower back.
- EE was bending over sorting parts in a box. He stood up and back went out.
- Employee was hanging line curtain, started back to operator’s side, stepped on rock covered with hydraulic oil. Employee states he strained left leg.
- Lifted one end of a cross arm that resulted in a strain (hernia) of the right side groin.

Figure 2. Sample “Activity Other Than CMR” Narratives

Third Category: To Be Reviewed

The third category to be coded was primarily events that did not give any narration or stated the injury was a reoccurrence of a prior injury. These events were too unclear as to the activity performed at the time of the accident. NIOSH subject matter experts reviewed these

items prior to the final report. All events coded as a “3” were reviewed and assigned as a CMR activity or as an Other than CMR activity in the final report. A total of 166 cases were returned to NIOSH coded as a “3”. Only 1 of these was subsequently coded by NIOSH reviewers as “1” (a positive CMR case). “To Be Reviewed” Narratives are illustrated in Figure 3.

Sample: "To Be Reviewed" Narratives

- Reoccurrence of injury from 2-13-92. Please see 7000-1 no. 2-7-92.
- EE cut his leg with a knife.
- Employee stated that he slipped in a wider hole & sprained his left knee.
- Employee tried to lift a rock. He pulled his groin area causing him severe pain.
- The injured does not know when or how he hurt his knee. At 11:00 am he told the supt. that his knee was hurting & he wanted to go to the hospital for medical treatment. No witnesses to the injury & no equipment involved.

Figure 3. Sample "To Be Reviewed" Narratives

RESULTS

The data is presented in the following tables.

Frequency Distribution Tables:

Table 1. Observed Number of Injuries Related to Construction, Maintenance, and Repair Activities for Mine Operators and Contractors by Major Commodity Group in Sample Dataset (n = 21,024).

Table 2. Observed Number of Injuries Related to Construction, Maintenance, and Repair Activities for Mine Operators and Contractors by Type of Operation in Sample Dataset (n = 21,024).

Extrapolated Estimates:

Table 3. Extrapolated Number of Injuries Related to Construction, Maintenance, and Repair Activities for Mine Operators and

Contractors by Major Commodity Group (n = 104,108).

Table 4. Extrapolated Number of Injuries Related to Construction, Maintenance, and Repair Activities for Mine Operators and Contractors by Type of Operation (n = 104,108)

Table 5. Extrapolated Number of Nonfatal Injuries Related to Construction, Maintenance, and Repair Activities for Mine Operators and Contractors by Major Commodity Group (n = 103,649).

Table 6. Extrapolated Number of Nonfatal Injuries Related to Construction, Maintenance, and Repair Activities for Mine Operators and Contractors by Type of Operation (n = 103,649).

Table 7. Extrapolated Number of Nonfatal Injuries Related to Construction, Maintenance, and Repair for Mine Operators and Contractors by Degree of Injury (n = 95,958).

Frequency Distribution Tables for a Mine, Accident, Injury, and Illness Database Sample Dataset (n = 21,024)

Table 1. Observed Number of Injuries Related to Construction, Maintenance, and Repair Activities for Mine Operators and Contractors by Major Commodity Group in Sample Dataset (n = 21,024).

Operators and Contractors by Major Commodity	CMR Related Activities		All Other Activities	
	Number	Percent	Number	Percent
Operators	5,336	39.0	8,338	61.0
Coal	1,778	37.1	3,015	62.9
Metal	985	37.4	1,652	62.6
Nonmetal	714	36.6	1,238	63.4
Stone	849	39.6	1,297	60.4
Sand & Gravel	1,010	47.0	1,136	53.0
Contractors	2,872	39.1	4,478	60.9
Coal	1,253	37.6	2,080	62.4
Metal	877	40.2	1,304	59.8
Nonmetal	192	37.2	324	62.8
Stone	501	41.2	714	58.8
Sand & Gravel	49	46.7	56	53.3

(Note: Numbers and percents are not to be extrapolated to entire mining population.)

Table 2. Observed Number of Injuries Related to Construction, Maintenance, and Repair Activities for Mine Operators and Contractors by Type of Operation in Sample Dataset (n = 21,024).

Operators and Contractors by Type of Operation	CMR Related Activities		All Other Activities	
	Number	Percent	Number	Percent
Operators	5,336	39.0	8,338	61.0
Underground Operation	652	27.6	1,712	72.4
Surface at Underground	1,119	36.0	1,991	64.0
Surface	1,279	42.8	1,712	57.2
Auger	45	37.5	75	62.5
Culm Banks	80	43.5	104	56.5
Dredge	764	45.7	909	54.3
Other Surface	53	41.4	75	58.6
Independent Shops or Yards	232	53.7	200	46.3
Mill or Preparation Plant	1,067	45.8	1,262	54.2
Office	45	13.1	298	86.9
Contractors	2,872	39.1	4,478	60.9
Underground Operation	379	25.9	1,085	74.1
Surface at Underground	202	36.7	349	63.3
Surface	1,304	43.2	1,716	56.8
Auger	8	24.2	25	75.8
Culm Banks	7	50.0	7	50.0
Dredge	5	38.5	8	61.5
Other Surface	4	30.8	9	69.2
Independent Shops or Yards	5	27.8	13	72.2
Mill or Preparation Plant	952	44.4	1,193	55.6
Office	6	7.6	73	92.4

(Note: Numbers and percents are not to be extrapolated to entire mining population.)

Extrapolated Estimates for All Injuries 1993-97 (n=104,108): Tables for the Mine, Accident, Injury, and Illness Database

Table 3. Extrapolated Number of Injuries Related to Construction, Maintenance, and Repair Activities for Mine Operators and Contractors by Major Commodity Group (n = 104,108).

Operators and Contractors by Major Commodity	CMR Related Activities		All Other Activities	
	Number	Percent	Number	Percent
Operators	36,772	38.0%	59,986	62.0
Coal	14,019	31.1%	31,034	68.9%
Metal	5,197	40.0%	7,787	60.0%
Nonmetal	2,467	37.9%	4,040	62.1%
Stone	10,849	46.0%	12,737	54.0%
Sand & Gravel	4,240	49.1%	4,389	50.9%
Contractors	2,872	39.1%	4,478	60.9%
Coal	1,253	37.6%	2,080	62.4%
Metal	877	40.2%	1304	59.8%
Nonmetal	192	37.2%	324	62.8%
Stone	501	41.2%	714	58.8%
Sand & Gravel	49	46.7%	56	53.3%

(Note: Table 3 contains the estimated number of injuries related to construction, maintenance, and repair activities for mine operators and contractors by major commodity and the type of operation. Percent of injuries for each type of operation is given as a function of the major commodities. Percent of injuries in each major commodity is given as a function of either all operator or contractor injuries.)

Table 4. Extrapolated Number of Injuries Related to Construction, Maintenance, and Repair Activities for Mine Operators and Contractors by Type of Operation (n = 104,108).

Operators and Contractors by Type of Operation	CMR Related Activities		All Other Activities	
	Number	Percent	Number	Percent
Operators	36,772	35.3%	59,986	57.6%
Underground Operation	9,598	26.4%	26,721	73.6%
Surface at Underground	1,119	36.0%	1,991	64.0%
Surface	12,582	44.0%	15,982	56.0%
Auger	45	37.5%	75	62.5%
Culm Banks	80	43.5%	104	56.5%
Dredge	764	45.7%	909	54.3%
Other Surface	53	41.4%	75	58.6%
Independent Shops or Yards	232	53.7%	200	46.3%
Mill or Preparation Plant	12,254	47.3%	13,631	52.7%
Office	45	13.1%	298	86.9%
Contractors	2,872	2.8%	4,478	4.3%
Underground Operation	379	25.9%	1,085	74.1%
Surface at Underground	202	36.7%	349	63.3%
Surface	1,304	43.2%	1,716	56.8%
Auger	8	24.2%	25	75.8%
Culm Banks	7	50.0%	7	50.0%
Dredge	5	38.5%	8	61.5%
Other Surface	4	30.8%	9	69.2%
Independent Shops or Yards	5	27.8%	13	72.2%
Mill or Preparation Plant	952	44.4%	1,193	55.6%
Office	6	7.6%	73	92.4%

Extrapolated Estimates for Nonfatal Injuries 1993-97 (n=103,649): Tables for the Mine, Accident, Injury, and Illness Database

Table 5. Extrapolated Number of Nonfatal Injuries Related to Construction, Maintenance, and Repair Activities for Mine Operators and Contractors by Major Commodity Group (n = 103,649).

Operators and Contractors by Major Commodity	CMR Related Activities		All Other Activities	
	Number	Percent	Number	Percent
Operators	36,667	38.0%	59,734	62.0%
Coal	13,967	31.1%	30,916	68.9%
Metal	5,189	40.1%	7,753	59.9%
Nonmetal	2,458	37.9%	4,032	62.1%
Stone	10,826	46.1%	12,677	53.9%
Sand & Gravel	4,227	49.2%	4,356	50.8%
Contractors	2,837	39.1%	4,411	60.9%
Coal	1,240	37.6%	2,056	62.4%
Metal	871	40.2%	1,293	59.8%
Nonmetal	186	36.6%	322	63.4%
Stone	494	41.8%	688	58.2%
Sand & Gravel	43	45.3%	52	54.7%

(Note: Table 5 contains the estimated number of injuries related to construction, maintenance, and repair activities for mine operators and contractors by major commodity and the type of operation. Percent of injuries for each type of operation is given as a function of the major commodities. Percent of injuries in each major commodity is given as a function of either all operator or contractor.)

Table 6. Extrapolated Number of Nonfatal Injuries Related to Construction, Maintenance, and Repair Activities for Mine Operators and Contractors by Type of Operation (n = 103,649).

Operators and Contractors by Type of Operation	CMR Related Activities		All Other Activities	
	Number	Percent	Number	Percent
Operators	36,667	38.0%	59,734	62.0%
Underground Operation	9,560	26.4%	26,603	73.6%
Surface at Underground	1,115	36.0%	1,980	64.0%
Surface	12,545	44.1%	15,888	55.9%
Auger	44	37.0%	75	63.0%
Culm Banks	79	43.2%	104	56.8%
Dredge	761	45.8%	900	54.2%
Other Surface	53	41.4%	75	58.6%
Independent Shops or Yards	232	53.7%	200	46.3%
Mill or Preparation Plant	12,233	47.3%	13,611	52.7%
Office	45	13.1%	298	86.9%
Contractors	2,837	39.1%	4,411	60.9%
Underground Operation	377	25.8%	1,082	74.2%
Surface at Underground	199	36.6%	345	63.4%
Surface	1,283	43.4%	1,676	56.6%
Auger	8	25.0%	24	75.0%
Culm Banks	7	50.0%	7	50.0%
Dredge	5	41.7%	7	58.3%
Other Surface	3	25.0%	9	75.0%
Independent Shops or Yards	5	29.4%	12	70.6%
Mill or Preparation Plant	944	44.5%	1175	55.5%
Office	6	7.6%	73	92.4%

Table 7. Extrapolated Number of Nonfatal Injuries Related to Construction, Maintenance, and Repair for Mine Operators and Contractors by Degree of Injury (n = 95,958).

Degree of Injury by Operators and Contractors	CMR Related Activities		All Other Activities	
	Number of Injuries	Average Days Lost	Number of Injuries	Average Days Lost
Operators	34,408	26	54,828	31
(2) Permanent Disability	511	24	574	39
(3) Days away from work only	12,626	27	28,697	34
(4) Days away & restricted activity	1,753	26	3,481	28
(5) Days of restricted activity only	3,675	-	6,144	-
(6) Injuries w/o death, days away, or restricted activity	15,843	-	15,932	-
Contractors	2,681	25	4,041	28
(2) Permanent Disability	51	21	68	26
(3) Days away from work only	1,064	26	2,014	29
(4) Days away & restricted activity	134	18	288	18
(5) Days of restricted activity only	230	-	412	-
(6) Injuries w/o death, days away, or restricted activity	1,202	-	1,259	-

OBSERVATIONS AND CONCLUSION

The CMR injury rates for operators and contractors were similar. Thirty-nine percent of all injuries were attributed to CMR activities for each group. The difference between the groups was found in the commodity. Contractor employee CMR-related injuries were highest in coal and metal, with sand and gravel the lowest. For operator employees the CMR-related injuries were highest in coal and sand and gravel.

Extrapolated numbers indicated that there were a substantial number of injuries over the five-year period - 39,644 - attributed to CMR-related activities. This finding documents the importance of the issue.

Overall 39% of the sample narrative descriptions were attributed to CMR activities. This is a significant finding for an industry that has focused much of their health and safety training attention on extraction and production.

Partly in response to this data, the Pittsburgh Research Laboratory, NIOSH has developed a Construction, Maintenance, and Repair Training

Program (4) (5). The exercise utilizes 3-D slides and depicts various CMR work activities in degraded (hazy, muted, less than clear) scenes. (6) The use of degraded visual materials has been shown to improve miner's hazard recognition abilities (7). The program focuses on specific activities and behaviors relating to CMR at a sand and gravel surface operation.

<http://www.cdc.gov/niosh/mining/training/default.htm>

The data presented supports a need to incorporate construction, maintenance, and repair activities in mine safety training. Further analysis of the data will lead to specific interventions in various commodities and at different locations.

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