



June 5th, 2017

File: 18040-02-02
Mine No.: 0300010

Teck Highland Valley Copper
P.O. Box 1500,
Logan Lake, BC
V0K 1W0

Dear Mr. Greg Brouwer,

Re: May 9th-11th MEM Inspection Report 75277

Please have this report posted in a conspicuous place on the property accessible to the workers in accordance with Section 30(1) of the Mines Act.

From May 9th to 11th Ergonomic Inspector Aaron Unger and Health and Safety Inspector Blythe Golobic conducted an inspection at Highland Valley Copper (HVC). The purpose of the inspection was to address multiple complaints which had been brought to the ministry regarding road conditions, back injuries to equipment operators, and the investigation of injuries on site. At the onset of the inspection on the morning of May 9th the inspectors met with Mine Manager Greg Brouwer to outline the intention of the inspection. Throughout the day on May 9th and 10th Inspector Golobic and Unger conducted an inspection on site. To wrap up the inspection, a closeout meeting was held on May 11th.

The inspection targeted haul truck drivers and in pit haulage roads. As part of the inspection, Inspectors conducted ride alongs with Mine Operations personnel. Inspectors observed current haul road conditions, collected feedback from operators, and took whole body vibration (WBV) samples. In addition a variety of documentation was collected and reviewed as discussed in the report for Inspection #75277.

This report is a follow-up to the initial report as Inspectors Unger and Golobic have completed analysis of the information provided at this time.

Response to Inspection Report 75277

4.9.4 Truck 86 - Loose Seat

It was noted during the inspection that the seat in truck 86 was not properly secured. Since the issuance of this report, in response to report #75277, HVC stated that: 'The seat in haul truck 61-

86 has been replaced.’ This is a proactive step and is in accordance with part 4.9.4 of the HSRC which states:

All mobile equipment shall have, maintained in working condition, the following:

- (a) a firmly secured seat for the operator and any authorized passenger, well maintained in a comfortable, shock absorbing condition;*

1.9.1 Truck 67 - Loose Box

It was noted during the inspection that the box in truck 67 was loose. Since the issuance of this report, in response to report #75277, HVC stated that: ‘The box in haul truck 61-67 has been shimmed.’ This is a proactive step and is in accordance with part 1.9.1 of the HSRC which states:

The manager shall

- (1) take all reasonable and practicable measures to ensure that the workplace is free of potentially hazardous agents and conditions which could adversely affect the health, safety, or well-being of the workers*

Whole Body Vibration

During the inspection six WBV measurements on five haul trucks at HVC. The haul trucks were selected from multiple haul routes at random by Inspector Unger.

Exposure to WBV is reliant on multiple variables. Vibration exposure can change based on variables such as load on the equipment, road conditions, tire conditions, make and model of equipment, maintenance of vehicle components such as shocks and struts, how aggressive the driver operates the vehicle, weather conditions, and many others. All WBV samples taken at HVC demonstrated exposure to WBV with potential risk to operators. Conditions are frequently changing at Highland Valley Copper and workers should be made aware of this hazard.

Exposure to WBV can contribute to the development of chronic back pain in addition to other signs and symptoms of injury, including: abdominal pain, chest pain, nausea, loss of balance, spinal disc degeneration and spinal disc displacement. If any workers experience these signs or symptoms of injury, consideration must be given to vibration being one of several potential contributing factors to their injury.

The WBV tests were conducted with a *HVM200 human vibration meter*, serial #0001088, calibrated on April 26th, 2017 and an ICP Triaxial Accelerometer seat pad calibrated on April 27th, 2017. In the absence of specific WBV limits being in the Health Safety Reclamation Code (HSRC), the vibration sample results measured were compared against article 3 of ‘DIRECTIVE 2002/44/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL’. This directive sets a WBV Exposure Action Value (EAV) of 0.5 m/s² and an Exposure Limit Value (ELV) of 1.15 m/s², which were used to evaluate the level of potential risk. Should HVC wish to compare the sampling results against another WBV standard, multiple others standards exist, such as: the ACGIH TLVs, IS02631-1:1997, and ANSI Standard S3.18-2002.

Detailed below are relevant definitions regarding WBV, as well as summaries of the vibration results.

Definitions:

These definitions are provided to assist in the understanding of the data presented below.

Whole Body Vibration (WBV) – This is vibration that is transmitted to the whole body, most often while standing or sitting on a vibrating surface or object such as a seat or a platform.

Exposure Action Value (EAV) - A WBV exposure level at which it is recommended workplaces introduce control measures to minimize vibration. Exposure risks are low at this level but steps can be taken to minimize exposure as potential for injury exists. This level is of vibration exposure 0.5 m/s^2

Exposure Limit Value (ELV) - A WBV exposure level at which it is recommended that workplaces does not exceed. This level is of vibration exposure 1.15 m/s^2

Root Means Squared Vibration Magnitude (aRMS) - This number represents the average acceleration (expressed in m/s^2) over a measurement period and is the value used to express risk associated with vibration exposure over 8 hours.

X Plane – Seat pan movement in a horizontal plane to the front and rear of the vehicle. This is associated with the seat moving forward and back.

Y Plane – Seat pan movement in a horizontal plane to the sides of the vehicle.

Z Plane – Seat pan movement in the vertical plane. This is associated with the seat moving up and down.

Testing Results

The raw information for these WBV measurements has been provided to the Mine Manager prior to the issuance of this report.

Haul Truck #92 (Sample portion 1) - This vibration sample was taken on the driver's seat of haul truck 92 operating in the Lornex pit, travelling from 19 shovel to crusher 1. This haul truck was operated in a normal manner during the 45 minute, and 46 second sample time, halfway through the sample time the driver was directed to travel to the N5 dump. At this point a secondary sample was taken and the results are captured below in sample portion #2. The aRMS vibration level on this truck seat was measured to be 0.8940 m/s^2 . Under the exact conditions of sample portion #1 (road conditions, route travelled, vehicle, operator, weather conditions, etc.) the operator exceeded the WBV EAV exposure value of 0.5m/s^2 . Review of the vibration report shows the highest acceleration levels in the z plane (0.6430 m/s^2). This movement could be the result of many factors and further exploration is recommended.

Haul Truck #92 (Sample portion 2)- This vibration sample was taken on the driver's seat of haul truck 92 operating in the Lornex pit, travelling from 19 shovel to the N5 dump. This haul truck was operated in a normal manner during the 31 minute, and 33 second sample time. The aRMS vibration level on this truck seat was measured to be 0.8837 m/s^2 . Under the exact conditions of this test (road conditions, route travelled, vehicle, operator, weather conditions, etc.) the operator exceeded the WBV EAV exposure value of 0.5 m/s^2 . Review of the vibration report shows the highest acceleration levels in the z plane (0.6337 m/s^2). This movement could be the result of many factors and further exploration is recommended.

Haul Truck #75 - This vibration sample was taken on the driver's seat of haul truck 75 operating in the Valley pit, travelling from 21 shovel to the crusher 5. This haul truck was operated in a normal manner during the 1 hour, 2 minute, and 43 second sample time. The aRMS vibration level on this truck seat was measured to be 0.6298 m/s^2 . Under the exact conditions of this test (road conditions, route travelled, vehicle, operator, weather conditions, etc.) the operator exceeded the WBV EAV exposure value of 0.5 m/s^2 . Review of the vibration report shows the highest acceleration values in the z plane (0.3778 m/s^2). Although the z plane had the highest reading, vibration in the x and y planes were close in magnitude, which was unique to this truck measurement. This truck had the second lowest measurement measured.

Haul Truck #67 - This vibration sample was taken on the driver's seat of haul truck 67 operating in the Highmont pit, travelling from 18 shovel to the crusher 1. This haul truck was operated in a normal manner during the 1 hour, 1 minute, and 10 second sample time. The aRMS vibration level on this truck seat was measured to be 1.0728 m/s^2 . This vibration level is equal to 1.2 m/s^2 over a 10 hour and 40 minute shift length. Under the exact conditions of this test (road conditions, route travelled, vehicle, operator, weather conditions, etc.) the operator exceeded the WBV ELV exposure value of 1.15 m/s^2 . Review of the vibration report shows the highest acceleration values in the z plane (0.8067 m/s^2). This sample was the highest measured vibration at the time of this testing. This movement could be the result of many factors and further exploration is recommended. It should be noted that truck 67 was stated to have a loose box and several operators noted that this truck shook more than most others on site. Since the time of this inspection, it was reported to MEM that the box in this haul truck was shimmed by HVC.

Haul Truck #86 - This vibration sample was taken on the driver's seat of haul truck 86 operating in the Lornex pit, travelling from 22 shovel to the N5 dump. This haul truck was operated in a normal manner during the 1 hour, 2 minute, and 43 second sample time. The aRMS vibration level on this truck seat was measured to be 0.6371 m/s^2 . Under the exact conditions of this test (road conditions, route travelled, vehicle, operator, weather conditions, etc.) the operator would exceed the WBV EAV exposure. Review of the vibration report shows the highest acceleration values in the z plane (0.4879 m/s^2).

Haul Truck #97 - This vibration sample was taken on the driver's seat of haul truck 97 operating in the Lornex pit, travelling from 22 shovel to the N5 dump. This haul truck was operated in a normal manner during the 1 hour, 3 minute, and 34 second sample time. The aRMS vibration level on this truck seat was measured to be 0.6176 m/s^2 . Under the exact conditions of this test

(road conditions, route travelled, vehicle, operator, weather conditions, etc.) the operator would exceed the WBV EAV exposure. This Review of the vibration report shows the highest acceleration values in the z plane (0.4705 m/s²).

Table 1: aRMS Summary

aRMS Summary - all units in m/s ²							
Truck	Sample #	x	y	z	8 hour - Sum	10 hours and 40 min equivalent	Travel Location
92	WBV170509 - 01 (sample portion 1)	0.3539	0.2674	0.6430	0.8940	1.0	Lornex Pit - 19 Shovel to 1 crusher
92	WBV170509 - 01 (sample portion 2)	0.3356	0.2845	0.6337	0.8837	1.0	Lornex Pit - 19 shovel to N5 dump
75	WBV170509 - 02	0.2910	0.2119	0.3778	0.6298	0.70	Valley Pit - 21 shovel to Crusher 5
67	WBV170510 - 01	0.4050	0.3018	0.8067	1.0728	1.2	Highmont Pit - 18 shovel to Crusher 1
86	WBV170510 - 02	0.2388	0.1692	0.4879	0.6371	0.7	Lornex Pit - 22 shovel to N5 Dump
97	WBV170510 - 03	0.2028	0.2015	0.4705	0.6176	0.7	Lornex Pit - 19 shovel to North 5 Dump

	In exceedance of ELV value 1.15 m/s ²
	In exceedance of EAV value 0.5 m/s ²
	Exposure level below EAV limit < 0.5 m/s ²

If further information regarding the vibration samples is requested please contact Inspector Unger directly.

Haul Truck Seating

It was noted during the inspection that HVC has retrofitted haul truck cabs with seats which are partially adjustable but do not provide adjustable lumbar support. Additionally, operators are able to adjust their seats using the adjustments provided, but do not know how to adjust their chairs to fit themselves ergonomically, nor have they been provided with direction on how to do this. The purchase of new seating was a topic of discussion during the inspection, as HVC plans on replacing some haul truck seats this year. It was noted in the December 2016 Mine Department Monthly Health, Safety & Environment Committee meeting that:

'Mine Maintenance is looking at new seating options and will be looking into a new vinyl seat with a 3-point harness seatbelt. The advantage of this type of seat is that they will be easier to clean, it will be easier to spot operators who aren't wearing their seatbelt and the operator will be more secure in their seat.'

Immediately going forward, upon any new purchase of haul truck seats at HVC, in accordance with Part 1.9.1 of the HSRC, the Mine Manager shall ensure that workers required to sit for extended periods of time are provided with appropriately adjustable seating. Inspector Unger is available to discuss seating options which are available and answer any questions as required.

Equipment operators are in their seats in excess of 10 hours per day and it is the one part of their equipment that they interact with continuously. The provision of an appropriate seat for workers is a significant factor in the prevention of MSDs to workers.

It is my understanding that HVC is currently pursuing guidelines on site for appropriate seat set-up for equipment operators.

In addition to providing appropriate seating, and in accordance with part 1.11.1, the mine manager shall ensure that workers are trained on how to properly use and adjust and set up their seats for their body type and task.

Road Conditions

One of the complaints brought to MEM was poor road conditions, and control measures being limited to “driving to the conditions.” While on site, Inspector Golobic toured haulage roads to review current road conditions. During the inspection, the inspector did not note any contraventions to the HSRC regarding the haul road conditions and construction.

During this tour, workers commented:

- Roads were in the best condition than they have been in a long time
- Support equipment is not always mechanically available when needed
- Acquiring DLR operators for A crew in particular is problematic
- 2016/17 was a particularly bad year for winter conditions and freshet

The inspector did observe rough portions of haul roads, where trucks had to noticeably slow down during their cycles. These sections, associated with geological features, softer ground, and water management, have the potential to be problematic in different weather conditions.

Areas of note were:

- Highmont Pit haul road
 - Ramp above Lornex (fault area)
 - “Old Highmont Fueling Station” section
- Lornex bench

Tire Life Information and Support Fleet Availability

To better understand conditions on site, and if there have been any significant changes, tire life data and support equipment data was requested. The data provided to MEM is summarized below.

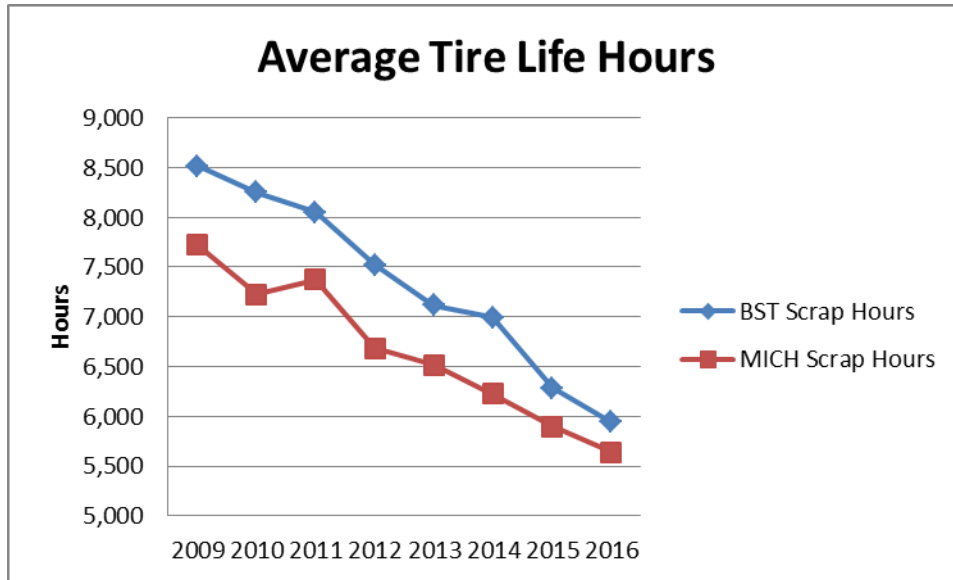


Figure 1: Average Tire Life Hours

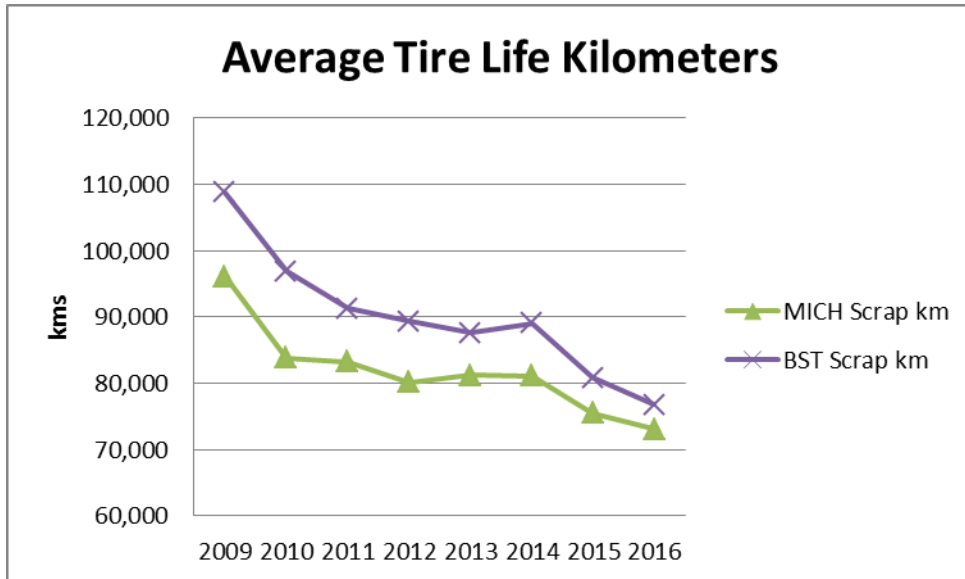


Figure 2: Average Tire Life Kilometers

Table 2: Availability Data

Availability Data (Wenco)				
Equipment	# Units	2016 Jan - April	2017 Jan - April	Δ Jan - April
16M	5	89%	68%	-21%
24M	4	75%	70%	-5%
TRACK DOZER	12	79%	75%	-4%
R/T SHOVEL CLEAN UP	2	91%	60%	-31%

Tire life, which can be used as a road condition indicator, has declined most notably in the last two years. Mechanical availability for the 16M graders decreased 21% and the rubber tired loaders decreased 31% from 2016 to 2017 (January – April).

Average Speed Report with Events

“Average Speed Report with Events” maps were also supplied to the inspectors. These maps are distributed weekly.

These maps plot average haul truck speed as well as Road Analysis Control (RAC) events. RAC calculates the stress that is present on major components, as a way of monitoring the condition of haul roads and wear and tear on vehicles. Currently 5 trucks in the fleet are reporting RAC events, and these events are based on CAT Priority 2 settings. There are three priority groups, Group 1 (factory design guidelines), Group 2 (trigger values 1.35 time the settings for Group 1) and Group 3 (trigger values are 1.7 times the settings for Group 1). These groups allow operations to set the system to a level that is appropriate to current site conditions.

These maps are a visual aid for the mine operations and maintenance departments. There is more work being done to develop these tools. Currently maps that show changes in average speed over a time period are being developed, which will aid in identifying changes in the haul road system.

Occupational Health and Safety Committee

The occupation health and safety committee (OHSC) has the responsibility, under the HSRC, to conduct workplace inspections, and discuss inspection findings and health and safety concerns. In accordance with Part 1.6.3 of the HSRC, meeting minutes that include descriptions of conditions found during inspections, shall be displayed in a conspicuous location, forwarded to local unions, and filed with the manger.

Mine operations conducts 8 workplace inspections a month. “A” Crew Safety Inspections for 2016-2017 were collected by MEM. These inspections are conducted monthly by a supervisor and safety rep (OHSC member). Health and Safety department staff, indicated it is the responsibility of the safety reps to bring forward issues identified during inspections to the monthly OHSC meetings.

“A” Crew Safety inspections for 2016-2017 were complied, and safety issues related to road conditions are summarized below:

Date	Crew	Area Inspected	-Safety Issue	Corrective Action
2016-01-24	A	Haul Road	Lots of narrow roads in Lornex	All have signs
2016-04-20	A	Haul Road	Large divot down from 5 way loaded side	Will get fixed on NS
2016-05-28	A	Haul Road	Rough roads due to rain	None
2016-09-01	A	Traffic Control	Turning Areas around ICR are rough	None

2016-10-28	A	Haul Road	"NWW" (Hard to read writing) Bunching up	Mud to be loaded out
2016-11-14	A	Dumps	Highmont West Dump rough shape	None
2017-01-01	A	Haul Road	Rapid melting conditions causing lots of run off.	Swales put in place to direct water
			Hauls rough, trucks slowing down.	None
2017-02-01	A	Traffic Control	Haul trucks slowing down for rapid melts on roads.	None
2017-03-31	A	Haul Road	Narrow Road Area	Signs Up
2017-04-24	A	Traffic Control	Swales Muddy	None

Haul road conditions are being identified as a safety concern during workplace inspections. Corrective actions are not always taken.

OHSC meeting minutes from 2016 to 2017 indicate road conditions being brought to attention of the committee. Since the start of 2017, there have not been discussions in regards to freshet melt, or rough haul roads, although these issues have been noted in workplace inspections without corrective actions taken.

A summary of comments, and action items pertaining to road conditions from meeting minutes are listed below. Items addressing intersection designs were excluded.

Action Item Number	Date	Category	Topic
	2016-03-23	Comment	Roch Joly encouraged union members to help each other out and drive at safe speeds based on road and weather conditions.
	2016-03-23	Comment	Dave Court explained that the roads around the mill and in the pit have deteriorated in recent months and are in bad shape. Ross Wilson said that Mine Operations has recently increased the number of permanent DLG operators on each crew. There was a lack of manpower in the last few months, which will now be addressed going forward.
	2016-06-29	Comment	Kirk also asked about work on the bypass road behind the dewatering crew area. Kirk commented that the road was very steep and might not be safe in winter conditions. Chris Hercun said that the grade and turning radiuses were considered when it was redesigned recently. Larger equipment should be able to use the road and it should be smooth
016-07-07	2016-07-13	New Business	Kirk Everard mentioned that the haul road near #20 shovel in the L-Pit is in bad shape with lots of water and deep swales. Kirk would also like to see old road building practices brought back, such as digging several feet down and using hard aggregate on top. Bill Primrose said that there are not enough DLGs to properly maintain the roads. Hans said that there were initially 3 culverts on that road, but they were mistakenly buried over time. He mentioned that the weather has caused a lot of the problems with the roads this year and urged operators to drive to conditions. Hans noted that there is a plan to install some more culverts in the L-Pit and said Mine Operations will remind operators of the importance of keeping culverts clear. H. Tischler August 10.

	2016-08-10	Item Complete	Hans said that a new culvert has been installed at the lower section of the Lornex Pit and there is a plan to install a second culvert near south end in order to keep water off the roads. While Mine Operations was previously field fitting culverts, they are now being inclu
	2016-07-27	Item Complete	Andrew Baker said that Mine Operations will have about 15 employees working in the pit and will be focusing on improving the roads.
016-09-04	2016-09-14	New Business	Steve Schmutz mentioned that road widths have gotten significantly narrower with the rain over the last few months. Hans suggested that employees bring it up to their supervisor, since it is hard to tell whether a road is the proper width from a pickup. Kirk asked if there could be an audit of road widths like what was done for berm heights last year. Ross Wilson suggested that Steve and Hans should go on a tour to identify any problems with road widths. H. Tischler/S. Schmutz October 12.
	2016-10-12	Old Business	Ross said that Steve was supposed to go on a tour with one of the supervisors, but hadn't heard anything back. Ross will follow-up on this. R. Wilson November 9.
	2016-11-09	Item Complete	Ross said that he has had discussions regarding this issue and the expectation will be that an equipment supervisor and a safety rep will tour the pits each month and examine road widths on their safety tours. Jared reminded employees to call in any narrow or bad roads so that they can be addressed. COMPLETE
017-03-08	2017-03-08	New Business	Neal said that the Highmont Access Road has a few corners that are very narrow and funnel in. Neal asked if they could be pushed back to allow for wider turns. Brad said that he is aware of the problems and said that 30km/hr speed limit and sharp turn signs have been installed there. Brad and Hans acknowledged that they need improvement but said that due to a lack of equipment time, it will likely be the summer before the work can be done. B. Steane/H. Tischler July 12.
017-03-02	2017-03-29	New Business	Kirk said that several areas of the Light-Vehicle Access Road need attention. Hans said that a lot of road maintenance has been done recently, but there is still more work to be done. Hans said that Site Services is looking at installing ditching in some areas and a culvert near #4 overhaul. Additional improvements and road maintenance will be done in the coming months. H. Tischler – June 28, 2017
	2017-04-12	Comment	Dave Court said that Glen Gustafson will be putting together an information package on the damage that can be done to haul trucks from driving too fast on bad roads or being overloaded. Dave said that if employees think they are overloaded, they can call the maintenance dispatcher who can check the data and confirm whether they are or not.

The OHSC is where safety issues are to be discussed, including findings in workplace inspections. At HVC, supervisors and safety reps are auditing haul road conditions. Additionally the site is developing new and more effective ways, to monitor changing road conditions (Speed/RAC maps). It is also indicated in the OHSC minutes that more operators were hired mid-year 2016. The OHSC, as part of its mandate, has a responsibility to follow up on corrective actions taken after road conditions are identified as a safety concern on worksite inspections, and at OHSC meetings.

Injury Investigation

During the inspection, records of injury investigations were requested from HVC and samples were provided. The samples provided show inconsistent follow-up, dependant on the supervisor conducting the investigation. There is no evidence that an ergonomic assessment has been completed regarding back injuries to haul truck drivers on site. As such, investigation reports include remedial actions directing drivers to drive to conditions, and to brace for impact. The MSD risk factors associated with these injuries have not been objectively or quantitatively evaluated.

During an audit conducted in 2016 at HVC (File #18040-02-XX), inspector Unger addressed MSD occurrences to workers stating that:

'the only investigations [into these first aid reports] did not offer in-depth analysis as to the cause of those 11 injuries, or any constructive solutions on how to prevent further injuries which were similar in the future.'

The above statement remains accurate. At the time of this inspection, it is the understanding of MEM that back injuries to haul truck operators have been identified as a potential concern on site, and that Greg Brouwer has tasked Aaron Wylie with developing a plan to identify the nature of these injuries and any related claims. Mr. Wylie was able to demonstrate that last year a similar initiative had been completed regarding slips trips and falls, and that HVC was able to effectively investigate these occurrences and implement effective controls. This approach could be useful in addressing the current issues. At the time of the inspection the first aid reports from site were collected. The first aid records indicated that in 2015 at HVC there were 12 reported First Aid (FA) cases in which a haul truck operator had back pain, and 5 additional cases in of equipment operators in mine operations with reported back pain. In 2016, 12 cases of back pain in haul truck drivers were reported to first aid, while 6 additional cases for equipment operators in mine ops were reported. Finally, at the end of April in 2017, there had been 7 reported cases of back pain in first aid reports to haul truck drivers, and 4 reported cases for equipment operators in mine ops. To summarize, from 2015 to 2017 over a 28 month period, HVC haul truck operators reported a total of 31 cases of back pain to first aid, and there were a total of 46 total back pain reports to first aid for equipment operators in mine operations. These results may suggest a trend on site and warrants further exploration in accordance with Part 1.9.1 of the HSRC.

MSD Prevention Plan

It was noted during the inspection that HVC has provided training to JOHSC members regarding the recognition, evaluation, and prevention of Muscuoskeletal disorders. In addition, on site, it was noted that two tasks on site (shovel seat, and fast fuel arm) had been assessed with ergonomics being a factor in those assessments. Although HVC has provided training to the JOHSC, and has completed 2 ergonomic assessments on site, there is currently only a draft of a written preventative training program regarding musculoskeletal disorders in place.

This contravenes Part 1.6.9(1)(h) of the Health and Safety Reclamation Code for Mines in British Columbia. Comply with the code requirement within the next 60 days by implementing the Musculoskeletal Disorder prevention program on site.

Conclusion

The development of musculoskeletal disorders (MSD) is a result of many risk factors. Two of the major risk factors for the development of MSD present in haul truck drivers on site are prolonged durations of sustained postures, and vibration exposure. Additionally, after speaking with workers on site, reviewing injury statistics, reviewing road maintenance staffing levels, and observing the task of haul truck driving, it is apparent that duration of vibration, and sustained and potentially awkward postures are present during the task of haul truck driving. In accordance with Parts 1.9.1, 2.9.1, and 1.1.2, the mine manager shall develop an action plan to address the occurrence and handling of back injuries to equipment operators (specifically haul truck drivers), and relate that plan to MEM within 60 days of issuance of this report.

Regards,



Aaron Unger, B.Sc.
Mines Inspector - Ergonomics
Health, Safety and Permitting Branch, MEM

cc. Blythe Golobic, Inspector of Mines
Al Hoffman, Chief Inspector of Mines
Dave Court, HVC Employee JOHSC Co-chair
Aaron Wylie, HVC Superintendent, Health and Safety