LARGE HAUL TRUCK MUFFLERS 'THAT WORK'

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1. INTRODUCTION

The Genesee Coal Mine, in operation since 1989, is located approximately 55 kilometers south west of the city of Edmonton, Alberta. Operated by Fording Coal Ltd., the operation is a joint venture between Fording Coal Limited and EPCOR Generation Inc. The average production per year is 3.5 million tonnes of sub-bituminous coal and approximately 23 million BCM's of waste material resulting in an average strip ratio of 6.5 BCM/tonne. The mine is found south of the North Saskatchewan River within the county of Leduc. The mine site is adjacent to the existing EPCOR Generating Station east of Secondary Road 770. The Genesee Mine Permit Boundary covers approximately 7,300 hectares while the actual mine encompasses approximately 1,700 hectares. Lands within the mine permit boundary are mostly owned by the City of Edmonton. Approximately 90 rural residences are located within 1 to 6 km of the power generating station and the mining operations.

Genesee Power Project Advisory Committee (GPPAC) has fulfilled many functions since its inception. Besides keeping local residents informed about project activities, GPPAC has also provided a forum through which local residents, Fording Coal Limited: Genesee Operations, and EPCOR Generation Inc.: Genesee Generating Station discuss issues of importance to them. During 2000, one issue that GPPAC members dealt with was the exhaust noise emitted by the mine's three Komatsu 510E, 150 ton, coal haul trucks. Committee members asked if there was anything that could be done to reduce the truck noise. During a conversation between Whitewood mine manager, Al Brown, and Genesee mine manager, Brad Johnston, a possible solution was discussed and brought forth for the committee's consideration. Noise Solutions Inc. (NSI) of Calgary was identified as the company who had helped Whitewood Operations reduce the noise emitted by the 8200 dragline. Rod MacDonald of NSI was contacted and the company was hired to begin a pilot project to design and install an enhanced muffler system on the mine's trucks.

2. MINING OPERATIONS

Two Marion draglines are used for all waste rock removal and coal production. The larger M8750 model is used in higher strip ratio areas while a M8200 is used in areas of shallower cover. The waste rock mined is spoiled with the draglines into waste piles as part of the regular mining sequence. Exposed coal is lifted with the draglines and placed in piles onto constructed bench floors. The coal is then hauled to the generating station using a 510E Komatsu truck fleet at a rate of approximately 10,000 tonnes/day.

3. MEASUREMENTS AND MODELLING

In order to determine what noise sources at the mine were significant, NSI commissioned Faszer Farquharson to conduct a noise impact assessment (NIA) of the mining operations to the surrounding community. One of the first steps in a NIA is to undertake detailed sound level measurements of all the significant noise sources at the mine. Mining equipment is not the easiest type of equipment to measure because it is always moving. A combination of close-in measurements of various equipment components as well as further away sound propagation measurements were undertaken. The information obtained was reviewed and calculations undertaken to determine sound power levels of the equipment, some as a unit and some as various components of the units.

The sound power levels were used as input parameters for ENM, a sound propagation model along with the terrain and the location of the residences. Detailed mine plan information and locations of the equipment during mining were required as the bench heights with respect to the surrounding topography can create significant sound barriers. Factors such as topography, vegetation and prevailing wind direction needed to be combined with linear distance from the noise source to determine the most affected residences and which noises were the most significant at those points. The topographical features of the North Saskatchewan River valley were examined with particular care: predicting the effects of water and meandering valleys on the acoustics of the area proved to be particularly complicated. The mobile nature of mining also needed to be considered to determine the most significant noise impacts. In the short term, the equipment moves as its working thus creating moving 'point sources' of noise. In the longer term, the mine advances over a period of years thereby changing the distance between individual residences and the mining activities.

The sound criteria used in a given jurisdiction must also be fully understood. Average sound levels as compared to statistical or peak sound levels can significantly change the sound power levels used in the model. The Alberta criteria, outlined in the EUB ID-99-8 Noise Control Directive are 50 and 40 dBA Leq, an energy average, for the daytime and nighttime periods respectively. Thus truck sound power levels were adjusted to reflect the mobility of the trucks in relation to the receivers and number of trips that would be completed during a typical nighttime shift.

3. RESULTS

The results of the model provide both octave band sound pressure levels as well as overall dBA sound levels order ranked by sound level from highest to lowest at the receiver locations. The following dBA sound level order ranked table is extracted from the NIA report.

Order Ranked Sound Pressure Levels
Residence 1, Year 1999 Night Shift

Source	Source Contribution (dBA)
Electric Shovel Ventilation	38.6
Marion 8750 Dragline Bleed Tubes	34.7
Komatsu Dozer	32.5
510 Haul Trucks	32.1
Marion 8750 Dragline Inlet Air House	31.0
Electric Shovel Mechanical Noise	28.8
Genesee Power Plant	28.4
Marion 8750 Dragline Ventilation	24.4
Caterpillar D11 Dozer	23.5
Marion 8750 Dragline House	23.5
Marion 8750 Dragline Vent Fan Casing	20.9
Elk Point Telfordville Gas Plant	14.8
Sum	39.5

The significant noise sources can be readily seen from the order ranked tables, however different sources have different rankings at the modelled residences. Noise modelling was consistent with the resident's testimonials in that the closest residences were not necessarily the most affected with respect to noise from the mine. In this case, the one residence that had a predicted sound level over 40 dBA was to be purchased before that year of mining, thus there was no exceedance of criteria.

4. MUFFLER DESIGN

Based on the sound propagation results indicating no exceedance of the criteria, Fording Coal was able to make a decision to attack the coal haul truck mufflers rather than the highest order ranked source. This decision was based on the haul trucks landing in the top five most significant noise sources source as well as being flagged by the residences as having a high annoyance factor. If there had been an exceedance of the criteria it may have been necessary to attack another source along with the truck mufflers such as the dragline ventilation fans or shovel ventilation fans in order to reduce the overall sound level to meet the criteria.

The noise measurements had indicated that the engine exhaust was the most significant source on the haul trucks and thus this source would receive noise control. Other sources that had been measured were the engine casing noise and radiator fan.

The next step was designing a muffler for the trucks that would provide the required noise attenuation, fit the chassis of the truck and not exceed the engine back pressure requirements.

An NSI muffler designed by Faszer Farquharson that had proved successful for large stationary engines was modified into a dual exhaust design and squished and squeezed to fit the available space under the box of the truck. One unit was manufactured for test purposes. This unit was connected to the existing exhaust outlets using flexible hose. This test was very successful indicating a high attenuation level and low pressure drop. The next step was to install the unit in the truck and undertake a trial period. This again proved successful and the all three trucks have had the mufflers installed. The actual attenuation results were not indicative of the performance of the muffler by itself. To obtain more definitive data, a test was conducted that isolated the exhaust noise from the rest of the truck noise. This was accomplished by parking the truck in the workshop, closing the shop doors and running the exhaust out of the shop with flexible pipe.

The before and after overall sound level results for a truck pass-by including all truck sources indicate a 4 dBA reduction. The engine exhaust source indicated a 31 dBA reduction. Subjectively, the muffler has drastically reduced the engine "bark" that was heard by the surrounding residences and very positive comments have be received regarding the reduced coal haul truck noise levels.

An expansion in the output capacity of the Genesee Generating Station from 800 MW (gross) to 1295 MW (gross) has been approved. The expansion requires a 50% increase in the output capacity of the mine. The mine expansion would be accomplished through the addition of a truck and shovel fleet. Noise control programs being considered for the post-expansion era include, bleed tubes on the 8750 and 8200 draglines, house pressurization fans on the 8750 and 8200 draglines and the waste shovel, and the exhaust noise of the waste haul trucks.

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