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Annual Report of Studies Being Considered and Conducted by
West Virginia Department of Environmental Protection
Office of Explosives and Blasting
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This report is being submitted by the Office of Explosives and Blasting (OEB) to the Joint Committee on Government Finance in accordance with the requirement of Chapter 22, Article 3A, Section 10(b). Below is a summary of the various research projects the OEB is currently working on or may work on in the future. There have been staffing shortfalls in the OEB research group which have limited the progress of projects. The status of various research projects is discussed below.

Finalized Research

Comparing Seismographs of Different Manufacturers

The Appalachian Blaster Certification Delegation (ABCD) began a study in July of 2012 to compare seismographs from different manufacturers. The last site test was conducted on October 31, 2013. OEB is a participant in this group and performed a critical role in data collection and final report findings. For this study, seven to nine seismographs from four different manufacturers were mounted approximately two feet apart in the preferred method of burying the geophones. This data has the benefit of establishing a baseline for variance of vibration values from surface mine blasts, as recorded from multiple seismographs from both same and different manufacturers. Controlled side-by-side installation scenarios will be used for the comparisons. The data from all six test sites has been analyzed and a report has been drafted by a multi-state working group. This blasting research indicated that 39% of the vibration recordings when compared to each other, were outside of the expected range of +/- 5% of the median, and 16% of the airblast recordings measured levels outside the expected range of +/- 1 decibels (dB). The study did not identify the source of the variability but concluded that there can be differences in blasting seismographs when compared in side-by-side deployments. The International Society of Explosives Engineers (ISEE) seismograph and standards committees will be considering this research as they review and revise established guidelines for the blasting industry. The final report with overview of the data was submitted to the ISEE Technical Committee and the research findings for presented at the ISEE Annual Conference in February 2015. The final report was published with the conference proceedings and on the OEB web page.

Ongoing Research

Microphones in Protective Enclosures

The placement of microphones in protective permanent enclosures has been a topic of concern to regulators for some time, with respect to the validity of airblast readings. This practice is very common in West Virginia due to accessibility problems caused by West Virginia topography. The seismograph used for monitoring a house may not always be easily accessible by mine personnel, thus requiring a permanent enclosure to contain these expensive and sophisticated instruments with safeguards from weather, tampering, and vandalism. It is common to see the seismographs placed in locked enclosures with the microphone placed inside the enclosure and the geophone buried in the ground below the enclosure.

Some of these enclosures are placed on embedded steel poles that are equipped with satellite transmitters for remote downloading, and a solar panel-battery recharging system to power the entire system. Most of these enclosures have some type of ventilation holes to allow the airblast over pressure to enter the box and allow measurement by an internal microphone. It has been assumed that these various types of ventilation ports provide adequate access to the outside atmosphere for accurate recording of airblast. However, it has never been demonstrated in any published study how the microphones located inside these enclosures compare to a microphone that is mounted unfettered outside any enclosure.

The ISEE Field Practice Guidelines for Blasting Seismographs states: "If practical, the microphone should not be shielded from the blast by nearby buildings, vehicles or other large barriers. If such shielding cannot be avoided, the horizontal distance between the microphone and shielding object should be greater than the height of the shielding object above the microphone."

This research project is designed to address enclosure concerns, by placement of blasting seismograph microphones outside and next to the most common types of active monitoring stations with microphones located within an enclosure. The project will compare the airblast response of the microphones located in various types of enclosures to microphones located outside of any type of enclosure. Site inventory was completed in 2013, but sites were not selected for monitoring until 2014. Preliminary analysis showed only one enclosure of a certain type had been monitored so additional data at a second site for that type is being collected. Data will continue to be collected and analyzed through March of 2016 with the final report in 2016.

If appropriate, the OEB will recommend new guidelines for use of protective enclosures depending on study results.

Monitoring Vibrations at Refuse Impoundments from Nearby Blasting Operations

There is little data on how blasting effects coal refuse impoundments and how the structural component of the impoundment responds to blasting vibrations. The federal Office of Surface Mining and Regulatory Enforcement (OSM), has funded a grant to study blasting effects on impoundments and awarded it to Dr. B. Lusk at the University of Kentucky. OEB has been providing detailed monitoring of vibrations at a coal refuse impoundment in Boone County,

West Virginia, and is working with Dr. Lusk and the UK research team to provide vibration and blast data for the for this research project.

This research will study the generation of water pore pressure excess and particle velocity/accelerations due to dynamic loads produced by the adjacent coal mine blasting activities. The research will provide computational evaluation of coal refuse impoundments subject to dynamic influences due to blasting activities. The data and findings will be useful in determining best practices for blast designs near refuse impoundments and factors to consider when blasting near impoundment type structures.

Unplanned Research Opportunities

These are unplanned research projects where OEB capitalized on the opportunity to monitor and analyze data that could be helpful with analyzing complaints and damage claims. These were not detailed research projects but merely projects of opportunity and will therefore only be finalized as time and budget permits.

Seismograph Consistency

In 2012, the OEB began gathering data for the preliminary stage of a geophone coupling study. This study paralleled some of the aspects of the OSM/Aimone-Martin study, which has not been published to date. OEB attempted a baseline data set for creation of a standard of variability to use when making comparisons of different types of geophone placement. The OEB preliminary study gathered baseline data on five to six same type and brand geophones mounted identically side by side using the ISEE preferred manner of burying and spiking the geophone. This preliminary data was compiled and analyzed in 2013.

Bridge Demolition

The OEB has had multiple opportunities to monitor the blasting effects from the explosives demolition at two bridges in West Virginia. When using explosives for the demolition of structures, a high degree of airblast is generated as a result of the open detonation of blasting charges. These research investigations attempted to study and evaluate the effects of shielding by structures that can dampen the airblast attenuation.

The first bridge demolition monitored was the Dick Henderson Memorial Bridge located at Saint Albans. The second opportunity to monitor a bridge demolition came in August 2014. West Virginia Division of Highways had scheduled the demolition of the Hartland Bridge in Clay County spanning the Elk River. A preliminary review of the data indicated some limited shielding effects around the houses adjacent to the bridge. The other notable effect indicates that airblast, when traveling over open water, does not decay as quickly as it does over land. The Hartland Bridge demolition data is currently being compiled along with the Henderson Bridge data for analysis.

Ground Vibrations at a Residence Structure

In 2014, OEB conducted monitoring at a residential structure near a surface mine in Boone County. The routine monitoring of this structure indicated some dynamic responses normally

not seen at most structures. On rare occasions, there can be a broader range of vibrations at a structure than normal. This provided a unique chance to model these vibrations for documentation purposes, if for nothing else than validating the seismic records, for future research projects or for cases of related compliance issues. The geography, underlying rock strata, alluvial material, or other influences caused more variability in the different seismic readings at this structure than would normally be expected. Blasting near this structure has been concluded and the data has been accumulated.

Power Towers

OEB has provided extensive seismic monitoring at power towers for high voltage power transmission lines. These power transmission towers are routinely a concern for allowable vibrations and the blast design considerations. The protection of these power towers when associated with surface coal mines often results in a temporary rock pinnacle under the tower, which is ultimately backfilled with the final reclamation of the mining activities. There have been questions as to what the vibration response of this rock pinnacle tower support is when exposed to adjacent blasting activities. This site has provided a unique opportunity to monitor vibrations at these transmission towers and develop comparative blast vibration data. This data can possibly be used for future permitting activities, blast designs, or studies.