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Annual Report of Studies Being Considered and Conducted by West Virginia Department of Environmental Protection Office of Explosives and Blasting December 31, 2014

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. During 2013, 2014, and at the time of this report there have been significant staffing vacancies in the OEB research group; these vacancies have limited the progress of several projects. The status of various research projects is discussed below.

Ongoing Research

Influences of Geophone Coupling on Seismograph Monitoring

In 2008, the OEB assisted Dr. Cathy Aimone-Martin in an OSM-sponsored study monitoring surface mine blasts at multiple mine sites in various states including West Virginia. The purpose of this study was to investigate the influence of geophone placement and orientation on seismograph recordings. OSM has not yet published a report of findings on this project. Once these findings are published by OSM they will be considered for inclusion on the OEB web page.

Seismograph Consistency

In 2012, the OEB gathered data for the preliminary stage of a geophone coupling study. Before attempting to duplicate aspects of the Aimone-Martin study, OEB wanted to create 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 geophones mounted identically side-by-side using the International Society of Explosives Engineers (ISEE) preferred manner of burying and spiking the geophone. This analysis of the initial data sets for vibrations predominately lower than 0.4 inches per second (ips), of peak particle velocity indicated there is some variability in vibration levels when; the brand of instrumentation and setup variables is basically constant. Should the OEB continue to pursue this as a research project, the next step in this consistency study would be to monitor higher levels of vibration above 0.7 ips. This preliminary data has been compiled, analyzed and the draft report of those findings has been completed. Due to staffing shortages and unfilled vacancies this report has not been finalized for publication. The goal is to have the final report published in 2015.

Comparing Seismographs of Different Manufacturers

The Appalachian Blaster Certification Delegation (ABCD) began a study in July of 2012 to compare seismographs from different manufacturers. 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. The OEB selected the first monitoring location at a West Virginia surface coal mine. The ABCD group has continued this study with monitoring of additional surface mine blasts in Ohio, West Virginia, and Maryland. The OEB has been compiling and analyzing this ABCD data in a collaborative effort with individual delegation members from the federal Office of Surface Mining Reclamation and Enforcement, Ohio Department of Natural Resources, and Alabama Surface Mining Commission. 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; using controlled side-by-side installation scenarios. The group has also installed two units in a cluster configuration, with different sensors deployed only a few inches apart for additional comparative data.

This was achieved by placing the geophone units on four to six inch spacing, all placed and buried in the same monitoring hole. The draft data results were briefly discussed and presented to the February 2014 ISEE Seismograph Committee for discussion and consideration in the development of standards and guidelines for blasting seismographs. The last site test was conducted on October 31, 2013. The data from all six test sites has been analyzed and a report has been drafted by a multi-state working group. A summary report with overview of the data has been submitted to the ISEE Technical Committee for consideration of presentation at the February 2015 ISEE Annual Conference.

Bridge Demolition

The OEB worked with the West Virginia Department of Highways (DOH) and the West Virginia Fire Marshal Office to monitor the blasting effects from the explosives demolition at two bridges in West Virginia. Typically, 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. The OEB developed a plan to monitor these blasts by placing multiple seismographs at strategic locations to evaluate the attenuation of the airblast concussion wave. These research investigations attempted to study and evaluated 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. In March 2013, the DOH with its contractor formulated a plan to blast the two separate end structures of the bridge, one at a time with one week between the demolitions. This provided two separate opportunities for the OEB to assist in monitoring and collect some unique airblast data for OEB research. The Henderson Bridge demolition site provided the unique opportunity to measure and compare airblast attenuation over open bodies of water and over land. The data indicated that airblast concussion waves have lower rates of decay over water than over land. The final report on the Henderson Bridge research investigation has been drafted with analyzed data and the findings will be published in 2015.

The second opportunity to monitor a bridge demolition came in August 2014. WVDOH had scheduled the demolition of a bridge in Clay County spanning the Elk River. Several seismographs were deployed to monitor the airblast generated from the explosives demolition of this highway bridge. The topography of the area and river below this bridge provided some opportunity to get airblast attenuation rates over water. A preliminary review of the data indicated effects of some limited shielding around the houses adjacent to the bridge. This data is currently being compiled along with the Henderson Bridge data to be analyzed, with a draft report available in 2015.

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. OEB increased the concentration of instruments around this structure and also installed a seismograph inside the residential structure. OEB required the mine site to also monitor at the house to document the level of vibrations by a third party. There were at one time as many as five different seismographic monitoring units distributed around the outside of the house. Surface mine blasting was conducted for approximately six months in the range of 1500 to 2000 feet from the house on a weekly basis. The geography, underlying rock strata, alluvial material, or other influences caused more variability in the different seismic readings than would normally be expected. This was an unusual situation that provided a unique opportunity to document the variability in ground vibration near a structure. Blasting near this structure has been concluded and the data has been accumulated. OEB is analyzing the data to see if it is significantly different than previous findings of this type of situation. Should it be warranted, an independent report will be drafted in 2015.

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. Sites were selected and monitoring began in 2014. Data will continue to be collected and analyzed in 2015 with a draft report to follow.

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