Blasting Workshop

Oglebay Park - Wheeling, West Virginia
November 18 - 20, 2008

Technical Program

Keynote Address

Technology on the Horizon

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The modern explosives industry is only 200 years old. Demand and technology has resulted in more changes in the past 25 years than in the previous 175. The future of maintaining safe and efficient blasting operations depends on well trained users and well funded R & D in emerging technologies.

Session 1: New Technology I

Digital Blasting System Technology

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The blasting industry has realized significant benefits with the advancement of Digital Blasting System technology. These systems now feature programmable delays with accuracies of 1/10th of a millisecond, computer aided design, advanced safety and system diagnostics. These features not available in pyrotechnic initiation systems give the blast engineer design options that enhance performance and safety. This presentation will discuss the advantages and challenges encountered while introducing this technology.

Seismograph Placement and Technology

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Abstract: Seismographs are being used more than ever, but are they being used correctly? The topic of this presentation is to discuss the proper methods of deploying blasting seismographs in the field. The International Society of Explosives Engineers (ISEE) – New Field Practice Guidelines for the Placement of Blasting Seismographs will be covered.

We will discuss ways to avoid improper placement of blasting seismographs. Examples of improper placement include: (1) installation of a geophone/sensor in contact with the foundation wall or above the footer; and (2) placing the sensor above a buried cistern or septic system.

The use of remote seismograph monitoring stations have been utilized for years, however, new technologies now allow real time data posting to secure web sites. Implementation of these new technologies will also be discussed.

GPS/Mapping uses in Blasting

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Abstract: Mining and blasting are increasingly expanding into areas that until recently were considered remote. With this expansion comes the need to better define the boundaries between that which we regulate and those who we are to protect. With improved accuracy and more inexpensive Geo Positioning Satellite (GPS) data receivers, the task of accurately tracking mining and blasting areas has become much simpler. Today, I will talk about some of the available units and how best to choose between them to optimize benefits to the regulator, to the regulated, and to the community.

Session 2: Blast Planning

Electronic Detonator Use Case Study

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As regulators we are charged with ensuring that blasting regulatory limits are adhered to. When vibration levels are exceeded, or about to be, it is always a good idea for regulatory personnel and explosives industry personnel to communicate. This is necessary to determine if and how blasting can continue without damaging property. In the case described in this presentation, low vibration frequencies caused by the local geology necessitated a blast design that either reduced peak particle velocity or raised the frequency of the resulting vibrations. The mine operator submitted a plan to the Department that included the use of electronic detonators. The plan was approved and the project was able to continue to completion.

Site-specific Blast Plan Conditions

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Abstract: You've probably seen plenty of blast plans that are cumbersome, multi-page documents filled with "cookbook" design formulas, flexible ranges of dimensions, common delay patterns, standard vibration requirements, and lengthy narratives that all sound alike. This presentation will cut through the ordinary paper shuffle and focus on blast plan conditions that are truly site-specific.

It will explore blast plan conditions that address: special vibration limits and blast scheduling, multi-directional monitoring, surface migration of NO_2 (orange fumes), and underground migration of CO. It will end with a case history entitled "Preventing Flyrock along I-70," which illustrates a 27-point blast plan that was successfully implemented to protect the motoring public along a busy section of interstate highway in southeast Ohio.

Surface Mine Blasting Plans

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This presentation considers how some of industry's traditional ways of doing business will need to be modified in order to effectively utilize blasting plans that protect the environment and public while also enhancing coal mining productivity. Mining companies need to regard blasting plans as something more than just means to obtain mining permits. Blasters must appreciate the importance of the plans and be capable of interpreting them and applying them at the mine site. My talk will include a very candid look at how industry has viewed the blasting plans in the past; a review of some of the positive changes being made and areas we need to focus on in the future in order to make the blasting plans a more efficient tool.

Pre-blast Survey Review History

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The pre-blast survey process in West Virginia has been revised with the creation of the Office of Explosives and Blasting. A pre-blast survey policy was established and mandatory forms were developed to make surveys consistent and review of the surveys more efficient. Individuals conducting pre-blast surveys must attend a training session to review and understand the policy, forms and procedures.

Session 3: New Technology II

Blast Log Expectations/Blaster Responsibility

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Using information obtained from actual completed shot reports or blast logs, this talk will discuss the difficulties faced by insurance companies when trying to defend or settle claims arising from blasting activities. The presentation will also address some of the blaster's responsibilities including professionalism and communication.

Ground Vibration and Airblast

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Abstract: The rapid release of energy associated with a blast event typically yields a measure of unwanted negative impacts in the form of vibration energy in the ground and atmosphere. If these levels have sufficient magnitude they will result in public complaints, claims of property damage and potential litigation. This presentation will concentrate on the nature of blast induced ground and air vibrations. It will discuss their development, characteristics and how they can affect neighboring structures. It will provide the participants with the knowledge of fundamental vibration principles that are necessary to correctly monitor blast induced vibrations, to properly identify vibration damage potential and to utilize the techniques developed to control blast induced vibrations. The session will discuss and demonstrate the application of these techniques in several different blasting and mining venues.

Excel Tools for Blasting

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MicroSoft Excel can be used to evaluate blast designs, blast records, and blasting seismograph data. When represented graphically, the data assess blaster competence, evaluate compliance, predict vibrations and resolve complaints. Examples of Excel applications will be discussed that include the Blast Log Evaluation Program, blast design rules of thumb and specialty graph development.

Crack Gauge Evolution

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All cracks in buildings experience daily and seasonal dimensional changes. These dimensional changes are caused by numerous factors, but particularly fluctuations in environmental conditions such as

temperature and humidity. Human beings are generally unaware of these changes until an event such as blasting or construction encourages closer inspection. In the past, pre-blast surveys and seismograph readings were the only tools available to evaluate claims of alleged damage. Compounding this problem, people generally have a difficult time grasping concepts related to the use of a seismograph, particle velocity, and the U.S. Bureau of Mines "Z Curve." Now new technological advances allow direct measurement and permanent documentation of changes in crack width for any instant in time. The data collected has supported other industry research giving investigators and regulators another tool to address property damage issues and homeowner concerns. The results and benefits of a 2007 case study at an Ohio coal mine will also be presented.

Crack Response Substantiates Conservatism in Vibration Control Limits

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Micro-meter crack response data substantiate the conclusion that vibratory excitation below 12 mm/s (0.5ips) cannot induce cosmetic cracking. Field measurements show that long-term, climatological crack response overwhelms vibratory crack response not only at ordinary but also at high vibration levels. This response of cracks to natural phenomena provides the base level of response, below which vibratory effects become insignificant. This presentation describes the technology that allows both long-term and vibratory crack response to be measured with the same sensor. In addition the response of some 30 cracks in over 20 structures will be compared in summary form. Measuring crack response in addition to ground motions has several advantages: cracks, the source of homeowner anxiety, are directly involved in the measurement; complexities of ground motion can be avoided; finally crack response to vibratory events can be compared directly with responses to long term, but silent and un-sensed factors such as weather.

Session 4: Complaint Investigations and Public Relations

Linear and Circular Seismic Arrays to Measure Surface Coal Blast Wave Propagations

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Circular seismic arrays can be used to determine directional effects of surface coal mine blasts. Blasting parameters, such as confinement and timing, influence peak particle velocities (PPV) differently in different directions from a blast. Linear seismic arrays are used to measure the attenuation rates of seismic peak particle velocities (PPV) over various distances. Theory holds that PPV values will decrease over distance, but this is not always the case. Both of these complications should be considered when attempting to use linear regression to predict blast vibrations. Various geophone orientations and waveform comparisons were conducted to determine the quality of seismic data when recording blasts in a linear array.

Pennsylvania's Blasting Complaint Protocol

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If mining blasting (or any blasting in Pennsylvania) causes damage to a home whose owner does not have a specific relationship to the entity conducting the blasting it is a violation of both federal and state regulations. Making a determination if blasting did or did not cause the damages requires a methodical investigation.
A prudent method of making those determinations is outlined in Pennsylvania's Blasting Complaint Protocol, a regulatory program Technical Guidance Document specific to these types of investigations. Pennsylvania's Blasting Complaint Protocol lays out how, through narrative and a flow chart, an investigation can be conducted to determine whether that blasting is a possible cause of damage to a home. Following the protocol may include: the examination of pre-blast surveys; structure response studies; ground vibration and airblast studies; and a thorough examination of the damages. If damages are not identified on a pre-blast survey or are not otherwise determined to have occurred prior to blasting, the vibration levels that affected the homes must be determined. This determination may be a result of direct seismograph monitoring at a home or studies done to determine past vibration levels that affected the home. The vibration levels are then compared to threshold levels known from widely accepted research to damage homes. If vibrations are below those threshold levels, but there is still reasonable suspicion that blasting may have caused damage, a structural response and/or structural engineering study of the home needs to be conducted.

Applying Science to the Human Perception Problem

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"If the blast rocks my house, it must be causing damage!" In one case, learn how a crack gauge study by a third-party consultant supplemented the state's investigation of a blasting damage claim, and revealed a huge gap between human perception and reality. In a second case, learn how low-level ground vibrations were amplified by a modern modular house, and how the homeowner's fear of damage was aggravated by the sights and sounds of the refrigerator, curio cabinet and entertainment center "rocking" back-and-forth during blasts. The second case will include actual video clips and seismographic measurements of the rocking motions, relative to the recorded ground vibrations and upper-corner house responses.

Seismological Discrimination of Blasts and Natural Earthquakes

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Abstract: The discrimination of the various types of mining related seismic events and natural earthquakes is an important seismological problem in the eastern United States. This problem is acute in the Appalachian basin region where earthquake monitoring is complicated by surface mine and quarry blasting activity, combined with induced seismic activity related to underground mining operations. In this region, catalogs of earthquakes containing natural events in the magnitude range 2.5 to 4.0 are a vital data set for seismic hazard assessment. From the perspective of the seismological community, the adverse effect of poor seismic event discrimination is twofold. First, man-made events are introduced into the seismicity catalogs, biasing estimates of earthquake recurrence rates.

Second, in seismically active areas that also host industrial blasting activity, the detection threshold for natural events is artificially limited because small natural earthquakes occurring during daylight hours are often ignored, or misidentified as blasts. From the perspective of the mining community, poor seismological discrimination causes several problems, but chief among them is the occasional misidentification of routine surface mine blasts as induced events associated with underground mining operations. In a few cases this has lead to erroneous reports of "mine-collapse" events. On the other hand, accurate seismological identification and analysis of mining-related events can provide much useful information for the mining industry concerning the timing of these events and the energy levels involved.

Public Meeting Guide

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A public meeting guide was developed by the International Society of Explosives Engineers Public Education and Public Relations committee as a general template for conducting public meetings when blasting near people. Professionals conducting the meeting should be knowledgeable in the technical aspects of blasting, seismology, acoustics and structural engineering. Know your audience! Each presentation must be tailored to the site specific conditions of the project.

The presentation was developed by Ken Eltschlager, U.S. Office of Surface Mining Reclamation and Enforcement, and Dave Harrison, Dr. Ed Walters and Associates.

Session 5a: New Technology III

Laser Profiling Technologies

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The progression of reflectorless lasers to document front row burdens can be traced to Great Britain regulatory requirements in the 1980's. This technology was introduced to the U.S. markets in 1987 and spurred the development of two dimensional laser profilers in 1992. These two laser profile systems vary greatly in complexity and require different operator attributes. Newer technologies for determining face burdens include the use of digital images with photogrammetric software. All three systems have been recently compared with each device having their own benefits and detriments.

Utilizing Digital Images

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Personnel in the industry and government agencies routinely use photographs as proof of conditions in enforcement actions, for analyzing existing conditions, and as illustrations of best management practices. Digital cameras are becoming the norm today for capturing images.
By its nature 'digital' creates issues that must be properly addressed when digital images will be used in court. This presentation is a DVD (previously shown at the 2007 International Society of Explosives Engineers conference) which describes those issues. I will conclude with a short interactive session with the workshop to answer questions.

Session 5b: Flyrock Case Studies

KY DNR's Flyrock Prevention Program

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Flyrock violations on surface mines in Eastern Kentucky are on record pace in 2008, with a total of 12 being recorded as of 9/1/08. Some of these events were minor in impact and threat to public safety, but several have caused property damage and potentially endangered human lives.

Kentucky's Department of Natural Resources (DNR) has initiated a new program that works both proactively and reactively to change the old ways of conducting blasting operations in the coal industry. DNR has challenged industry leaders to allow blaster's to take time necessary for quality blasting training and also to give blasters real control over blasting operations with emphasis on blasting safety. This presentation will detail KY DNR's multi-faceted approach, both proactive and reactive, to flyrock prevention.

Post Blast Examination after an Accident

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MSHA has concerns about the elevating incidence of flyrock and other fatal accidents. This talk is an overview of these and other concerns about explosives safety that I see during my travels. I will review some recent blasting accidents resulting in fatalities. I will include an incident that occurred on September 15, 2006, involving a bulk transport vehicle that caught on fire and then later exploded at an open pit copper mine in Arizona. Finally, I will bring up some of the ways in which that I carry out post blast Inspections.

Flyrock Incidents at WV Surface Coal Mines

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Flyrock is responsible for most of the fatalities and serious injuries resulting from blasting at surface mines. This presentation will describe site-specific details of several flyrock events that have occurred at West Virginia surface coal mines. We will identify factors and practices that were contributors to these events. Preventive measures and awareness of proper blast design concepts associated with these events will also be discussed.

FLYROCK Forensic Investigations

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Surface coal mining blasting operations result in a number of adverse effects but the most serious is a fly-rock event. Fly-rock causes more property damage, more injury and more deaths than any other single type of event from a blasting operation. What do you as an inspector look for on the ground, in the blast logs, drill records, and seismic records to assist you in any investigation concerned with actual or probable fly-rock occurrences? An outline of some of the more common malpractices that result in fly-rock will be discussed as well of how the industry (with regulatory authority inputs during the permitting process) can reduce the probabilities of fly-rock occurrences.