Office of Surface Mining
Reclamation and Enforcement

Ken Eltschlager, Mining/Explosives Engineer
Blaster Certificate Coordinator
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OSM Responsibilities

• Balance Nation’s Energy Needs vs. Environmental Needs

• Regulate Active Mines – Surface effects
  – Reclamation/Land Productivity, Protect Water, Slope Stability, **Blasting**

• Passes Responsibility to the States
  – OSM conducts oversight
  – Provides funding at 50%

• Fix Abandoned Mine Problems
  – Backfilling, Subsidence, Fires, Landslides, Water
## Coal Mining States

<table>
<thead>
<tr>
<th>State/Coal</th>
<th>2005 (million tons)</th>
<th>2006 (million tons)</th>
<th>2007 (million tons)</th>
<th>2008 (million tons)</th>
<th>2009 (million tons)</th>
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<tbody>
<tr>
<td>WY</td>
<td>404</td>
<td>447</td>
<td>454</td>
<td>468</td>
<td>431</td>
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<tr>
<td>WV</td>
<td>154</td>
<td>152</td>
<td>154</td>
<td>158</td>
<td>137</td>
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<td>KY</td>
<td>120</td>
<td>121</td>
<td>115</td>
<td>120</td>
<td>107</td>
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<td>Total</td>
<td>1131</td>
<td>1163</td>
<td>1147</td>
<td>1172</td>
<td>1075</td>
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</table>

<table>
<thead>
<tr>
<th>State/Explo.</th>
<th>2005 (tons x1000)</th>
<th>2006 (tons x1000)</th>
<th>2007 (tons x1000)</th>
<th>2008 (tons x1000)</th>
<th>2009 (tons x1000)</th>
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<td>WY</td>
<td>582</td>
<td>628</td>
<td>638</td>
<td>676</td>
<td>378</td>
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<tr>
<td>WV</td>
<td>474</td>
<td>530</td>
<td>489</td>
<td>425</td>
<td>349</td>
</tr>
<tr>
<td>KY</td>
<td>370</td>
<td>357</td>
<td>368</td>
<td>388</td>
<td>293</td>
</tr>
<tr>
<td>Total</td>
<td>3200</td>
<td>3160</td>
<td>3,150</td>
<td>3420</td>
<td>2270</td>
</tr>
</tbody>
</table>
SECTION 515(b) General performance standards shall be applicable to all surface coal mining and reclamation operations and shall require the operation as a minimum to --

(15) insure that explosives are used only in accordance with existing State and Federal law and the regulations promulgated by the regulatory authority, which shall include provisions to -

(A) provide adequate advance written notice to local governments and residents who might be affected by the use of such explosives by publication of the planned blasting schedule in a newspaper of general circulation in the locality and by mailing a copy of the proposed blasting schedule to every resident living within one-half mile of the proposed blasting site and by providing daily notice to resident/occupiers in such areas prior to any blasting;
(B) maintain for a period of at least **three years** and make available for public inspection upon request a log detailing the location of the blasts, the pattern and depth of the drill holes, the amount of explosives used per hole, and the order and length of delays in the blasts;

(C) limit the type of explosives and detonating equipment, the size, the timing and frequency of blasts based upon the physical conditions of the site so as to **prevent (i) injury to persons, (ii) damage to public and private property outside the permit area, (iii) adverse impacts on any underground mine, and (iv) change in the course, channel, or availability of ground or surface water outside the permit area;**
SMCRA

(D) require that all **blasting operations be conducted by trained and competent persons** as certified by the regulatory authority;

(E) provide that upon the request of a resident or owner of a man-made dwelling or structure within one-half mile of any portion of the permitted area the applicant or permittee shall conduct a **pre-blasting survey** of such structures and submit the survey to the regulatory authority and a copy to the resident or owner making the request. The area of the survey shall be decided by the regulatory authority and shall include such provisions as the Secretary shall promulgate.

- Blast Plans (780.13)
- General requirements (816.61)
- Preblasting surveys (816.62)
- Blasting schedules (816.64)
- Blasting signs, warnings, and access control (816.66)
- Control of adverse effects (816.67)
- Records of blasting operations (816.68)
- Certification of blasters (850)
Adverse Effects

• Standards for ground vibrations and airblast, USBM based
  – 4 tier ground vibration standard
  – 4 airblast levels based on sensitivity of the microphone
  – Adopted by most regulatory authorities, IME and NFPA
• Flyrock is distance or property based
• Fumes and dust as an imminent danger
Blasting Basics

Assume Explosive = 40 lb. ANFO

(a) B = 15'
Completely contained, only failure is pulverisation near the charge and radial tensile failure running out from it.

(b) B = 12'

(c) B = 9'
Surface and subsurface failure almost meet. There will be a shelf of unbroken rock between the two. Dom-ing or surface bulging.

(d) B = 6'
Full crater, burden completely broken out. Surface and subsurface failures run through to the surface.

(e) B = 3'
Full crater, lower volume than optimum fine fragmentation. Noise, flyrock, bowl shaped crater.

Figure 7.17.  Schematic of the Effect of Decreasing the Burden on Charges Fired in Rock.
Spatial Relationships

Coal Mine Terms

Blast Site

Blast Area

Permit Area

House 2

Blast

House 1

Complainant

Compliance House
Ground Vibration Limits

Based on Structure Response

Pre 1980 – 2.0 in/s
Annoyance
- Rattling Windows
- Wall Hangings Misaligned
- Trinkets Moved
- Startle
- Fear

Damage
- Broken Trinkets
- Cracks in Plaster & Sheetrock
- Broken Windows
- Cracks in Masonry Joints
- Cracks in Block & Brick
- Cracks in Concrete
Two modes of structural response:

- Midwall or Bending response
- Racking or Shear response

**FIGURE 11.** Idealized racking and midwall responses of a low-rise structure.
FIGURE 14. Natural frequencies of homes as reported in USBM RI 8507 (Siskind et al., 1980b). Corners represent racking of whole-structure response, and midwalls represent membrane-type flexure with associated secondary noises and rattling. The lighter and more flexible walls have higher natural frequencies and relatively large motions.
Damage Levels

Figure 54—Velocity versus Frequency summary, set 7 mean and variance analysis.
Figure B–1.—Safe levels of blasting vibration for houses using a combination of velocity and displacement.
OSM Blasting Level Chart

RI 8507 APPENDIX B. -- ALTERNATE BLASTING LEVEL CRITERIA

<table>
<thead>
<tr>
<th>FREQUENCY, Hz</th>
<th>PARTICLE VELOCITY, in/sec</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.003 in</td>
</tr>
<tr>
<td></td>
<td>0.5 in/sec, Plaster</td>
</tr>
<tr>
<td></td>
<td>0.75 in/sec, Drywall</td>
</tr>
<tr>
<td></td>
<td>0.008 in</td>
</tr>
<tr>
<td></td>
<td>2 in/sec</td>
</tr>
</tbody>
</table>
### Ground Vibration Limits

<table>
<thead>
<tr>
<th>Distance</th>
<th>SD</th>
<th>PPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 300</td>
<td>50</td>
<td>1.25</td>
</tr>
<tr>
<td>301 – 5000</td>
<td>55</td>
<td>1.00</td>
</tr>
<tr>
<td>5001 and beyond</td>
<td>65</td>
<td>0.75</td>
</tr>
</tbody>
</table>

** Distance is used to account for frequency!!
** Modified scaled distance, 4th option
Air blast
Damage / Injury Levels

- 133 dB generate the same structure response as 0.5 in/s
- 0.03 psi or 140 dB - windows may break
- 2-4 psi, ear drum rupture (Hirsch, 1968)
- The pressure of the wind at 40 mph is equal to about 140 dB
<table>
<thead>
<tr>
<th>Lower frequency limit of measuring system, in Hz (+/- 3 dB)</th>
<th>Maximum level, in dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1 Hz or lower -- flat Response</td>
<td>134 peak</td>
</tr>
<tr>
<td>2 Hz or lower -- flat Response</td>
<td>133 peak</td>
</tr>
<tr>
<td>6 Hz or lower -- flat Response</td>
<td>129 peak</td>
</tr>
<tr>
<td>C-weighted -- slow response</td>
<td>105 peak dBC</td>
</tr>
</tbody>
</table>
Air blast Limits

• 2 Hz microphone  133 dB

• No Scaled Distance counterpart.

• All seismographs manufactured today have 2 Hz lower frequency response range.

• 0.1 Hz, 6 Hz and C-Weighted scale type microphones are not appropriate with today’s technology
Compliance and Damage

• Compliance with ground vibration and airblast numerical limits

• **If necessary to prevent damage,** the regulatory authority shall specify lower maximum allowable airblast levels than those in 816.67(b)(1) for use in the vicinity of a specific blasting operation.

• The maximum allowable ground vibration shall be reduced by the regulatory authority beyond the limits otherwise provided 816.67(d)(5), **if determined necessary to provide damage protection.**
ISEE Recommendations

• Standards Committee
• Seismograph Section to NFPA
• Blasters’ Handbook
BLASTING SEISMOGRAPHY

• Establish Compliance with Rules
• Evaluate Blast Performance
• Provide Liability Protection
Recordings are controlled by:

• How the seismograph is made

• How the seismograph is placed in the field
  – ISEE Field Practice Guidelines for Blasting Seismographs (2009)

• For specifications on each, go to: http://www.isee.org/sections/blast.htm
Ground Vibration Recommendations

RI 8507 Alternate blasting level criteria

- Drywall 19 mm/sec. (0.75 in./sec.)
- Plaster 12.7 mm/sec. (0.5 in./sec.)
- 0.2 mm (0.008 in.)
- 0.76 mm (0.03 in.)
- 50.8 mm sec. (2 in./sec.)

Peak particle velocity (mm/sec.) vs. Frequency (Hz)
# Scaled Distance Equations

<table>
<thead>
<tr>
<th>Distance From the Blast Site (R) meters [feet]</th>
<th>Allowable Charge–Weight per delay (W) kilogram [pounds]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 91 m [0 to 300 ft]</td>
<td>[ W = \left( \frac{R}{22.6} \right)^2 ] [ W = \left( \frac{R}{50} \right)^2 ]</td>
</tr>
<tr>
<td>92 to 305 m [301 to 1000 ft]</td>
<td>[ W = \left( \frac{R}{24.9} \right)^2 ] [ W = \left( \frac{R}{55} \right)^2 ]</td>
</tr>
<tr>
<td>305 m and over [1001 ft and over]</td>
<td>[ W = \left( \frac{R}{29.4} \right)^2 ] [ W = \left( \frac{R}{65} \right)^2 ]</td>
</tr>
</tbody>
</table>
Air overpressure shall not exceed the maximum limit of 133 decibel (0.9 millibars or 0.013 pounds/square inch) at the location of any building. The limit of 133 decibels is primarily based on perception and has no potential to cause damage to buildings.
Other Limits

Higher vibration limits for buildings, man-made structures or utilities other than those described above may be independently established based on technical justifications by engineers or qualified personnel familiar with blasting related projects.
<table>
<thead>
<tr>
<th>Organization</th>
<th>Standard</th>
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<tbody>
<tr>
<td>Institute of Makers Of Explosives</td>
<td>Safety Library Publication 17 Safety In The Transportation, Storage, Handling, and Use Of Explosive Materials</td>
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<tr>
<td>(IME)</td>
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<tr>
<td>National Fire Protection Association</td>
<td>NFPA 495 Explosive Materials Code, Chapter 11</td>
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<tr>
<td>(NFPA)</td>
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</table>
Flyrock

Material that is ejected from a blast that travels through the air or along the ground.
Regulatory Limits

Flyrock shall not be cast:

- More than half the distance to the nearest dwelling or occupied structure
- Beyond the boundary of the protected blast area
- Beyond the permit area.
Blasting: The Most Likely Activity that can Cause an Off-site Fatality!!!

- Flyrock can travel thousands of feet from a blast site
- Particularly difficult to control at steep slope mines,
Federal Blaster Certificate

OSM BLASTER CERTIFICATE
IDENTIFICATION CARD

NAME OF BLASTER

SIGNATURE OF BLASTER

ADDRESS

BIRTH DATE | HEIGHT | WEIGHT

COLOR HAIR | COLOR EYES | ISSUE DATE

[Image of a man's photo]
Blaster Certificates

• OSM policy: qualified and competent personnel
• Experience, Training and Testing
• Mentoring is the primary source of trainee education
• Testing is the only tool available to the RA to gauge competency
• Better blasters will:
  – Facilitate coal production
  – Reduce complaints and liability
Federal Blaster Certificates

• National in scope for mining
• Demonstrate knowledge
• Second tier Certificate
• Establish higher level of competence
• Good credential for regulatory and legal purposes
• Facilitate state reciprocity
• Recognized by AL, IN, KS, KY, MD, MO, MT, OH, PA, UT, VA, WV, WY
Benefits

• States
  – Less testing
  – Minimize application processing
  – Cost reduction!

• Blasters
  – Less testing
  – Facilitate multiple state certifications
  – Better perception
  – More authority
  – Justify promotions
Examination and Question Pool

- Currently 1200+ questions
- Multiple choice
- 14 categories per 30 CFR 850
- The test is 70% Technical and 30% Regulatory
- Blast log problems
- Blast Design problems to test critical thinking skills
- Blaster has control of all blasting parameters
- 80% pass
Blaster Certificate Tracking

Main Menu
- Add New Information
- Modify Existing Information
- Delete a Record
- Queries and Reports
- About this system
### Blaster Certification - Add Blaster -

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
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<tr>
<td>Certification Number</td>
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<td>Reciprocal State Card ID</td>
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<td>Reciprocal Card Exp. Date</td>
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<tr>
<td>Performance History:</td>
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</table>

**Notes:**
- *Required fields
- **Optional fields
Technology Transfer

• Help the states use the best technology currently available for active mine reclamation and enforcement
  – Training
  – Applied Science
  – Technical Assistance
  – Technical documents (clearing house)

• Blasting Download Page
  www.ARblast.osmre.gov
Blasting Download Page

Office of Surface Mining Reclamation and Enforcement

Rules, Regulations, Research and Resources
Updated: 12/15/09

Contact: Ken Eltschlager or 412.937.2169

The Federal Surface Mining Control and Reclamation Act of 1977 requires that blasting shall be conducted to prevent injury to persons, damage to public or private property outside the permit area, adverse impacts on any underground mine, and change in the course, channel, or availability of surface or ground water outside the permit area. This page is provided as a resource to the people responsible for meeting this mandate.

OSM Blasting Regulations

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
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<tbody>
<tr>
<td>1977</td>
<td>Surface Mining Control and Reclamation Act of 1977 - Blasting Authority</td>
</tr>
<tr>
<td>1982</td>
<td>Proposed Blasting Rule Preamble, Part 1, Part 2, Part 3</td>
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<tr>
<td>1983</td>
<td>Final Blasting Rule Preamble, Part 1, Part 2, Part 3</td>
</tr>
<tr>
<td>1983</td>
<td>Surface Blasting Rules: Blast Plans (Sec 780) and Performance Standards (Sec 816)</td>
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<tr>
<td>1983</td>
<td>State Blaster Certification Template Rule Preamble and Template Rule (Sec 850)</td>
</tr>
<tr>
<td>1986</td>
<td>Federal Blaster Certification Program Preamble and Federal Rule (Sec 955)</td>
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<tr>
<td>2009</td>
<td>Old Blasting Webpage</td>
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Federal Blaster Certificates

<table>
<thead>
<tr>
<th>Date Posted</th>
<th>Description</th>
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<tbody>
<tr>
<td>12/17/08</td>
<td>OSM-74, Application for an OSM Blaster Certificate - Recognized for reciprocity in KY, MD, OH, PA, WV, WY</td>
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<tr>
<td>5/18/09</td>
<td>Directive, Reg-33, Federal Blaster Certification Program and Blasting Enforcement</td>
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<tr>
<td>12/14/05</td>
<td>Training and Potential Testing Topics</td>
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<tr>
<td>11/26/07</td>
<td>Federal Examination Instructions</td>
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<tr>
<td>11/26/07</td>
<td>OSM Blast Design Rules of Thumb</td>
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<tr>
<td>11/26/07</td>
<td>Excel Blast Design Estimator based on the Rules of Thumb</td>
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<tr>
<td>12/22/08</td>
<td>Blaster’s Training Modules Link</td>
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Training

• National Technical Training Program
  – Blasting and Inspection
  – Advance Blasting: Investigation and Analysis of Adverse Effects
  – Coal Field Communications
  – Developing a Mine Gas Class

• Technical Innovations and Professional Services (TIPS)
  – Blast Log Evaluation Program
  – Introduction to GPS

• [http://www.tips.osmre.gov](http://www.tips.osmre.gov)
Applied Science Projects

• 2007 Acoustic Response of Structures to Blast Vibrations, B. Lusk, UK
• 2007 Seismograph Geophone Coupling Protocols, C. Aimone-Martin
• 2009 Advance Detonator Applications in Surface Coal Mine Blasting, B. Lusk
• [http://www.techtransfer.osmre.gov](http://www.techtransfer.osmre.gov)
• Anticipate 2011 RFP (request for proposals)
Technical Assistance

• Appalachian Region – Pittsburgh, PA
  – Ken Eltschlager, Mining/Explosives Engineer
  – keltschlager@osmre.gov or (412) 937-2169

• Mid-Continent Region - St. Louis, MO
  – Kevin Garnett, Civil Engineer
  – kgarnett@osmre.gov or (618) 463-6463 x5135

• Western Region – Denver, CO
  – Gene Hay, Mining Engineer
  – ghay@osmre.gov or (303) 293-5036
Questions?
Imminent Danger - 30 CFR 843.11

If an inspector finds any condition or practice that creates an imminent danger to the health or safety of the public

– Potentially relates to Flyrock or Fumes
Imminent Danger – 30 CFR 701.5

• The existence of any condition or practice which could reasonably be expected to cause substantial physical harm to people outside the permit area.

• A reasonable expectation of serious injury exists if a rational person, subjected to the same conditions giving rise to the peril, would avoid exposure to the danger.