

# 6 RECOMMENDATIONS

Following this tragedy, many recommendations from all quarters were received. Some were directed to our state agency and legislature while others were directed to the federal agency and Congress.

Attached is a list of these recommendations and status. As the Investigative Team continues to study this incident and additional recommendations are presented, the report will be supplemented with those recommendations.

The Team will initially focus on the following two areas:

## LIGHTNING

Although we have established that lightning was likely the cause of the explosion, our work is not complete until the specific mechanisms which allowed lightning to enter behind the seals at the Sago mine have been identified. We will attempt to build on the considerable base of knowledge acquired at Sago during the investigation. Monitoring at Sago this winter for lightning effects of winter electrical storms as proposed in Section 5.5-3 of this report will be done.

## FORCES ON SEALS

To better-understand the forces that are possible in an explosion in order to design seals that can survive those forces. In this report we have presented the idea that the geometry of mine openings, specifically the effects of selective bottom-mining, may play a role in accelerating the velocity of pressure waves that are developed in an explosion, resulting in forces on seals that are beyond what was previously expected. Additional studies are needed to quantify these effects through experimentation and validated computer modeling.

Issues/Recommendations	Status
Increase number of Inspectors	Under Consideration
Omega Blocks	Studying Options
Hyperbolic chambers for CO poisoning	Studying Options
Operators shall revise all SCSR plans and submit those to the Director no later than 60 days after these amendments become final. (June 9, 2006)	WV 56-4 effective June 9, 2006
Operators shall place at least one cache at a readily available location within five hundred (500) feet of the nearest working face in each working section of the mine and each active construction or rehabilitation site. Distances greater than five hundred (500) feet not to exceed one thousand (1,000) feet, are permitted. However, where miners are provided with personal SCSR's rated for less than sixty (60) minutes, travel to these caches are not to exceed five (5) minutes as determined by the height/travel time chart as specified in Section 5.3.2.	WV 56-4 effective June 9, 2006
Each of these caches (nearest working face in each working section of the mine and each active construction or rehabilitation site) shall hold two (2) SCSR's that will provide at least 60 minutes of oxygen per unit for each miner. When each miner carries an SCSR that is rated for less than 60 minutes, in which case the cache shall hold three (3) SCSR's for each miner. The total number of SCSR's to be cached will be based on the total number of miners reasonably likely to be in that area.	WV 56-4 effective June 9, 2006
Operators shall ensure that caches described above also contain an escape kit containing a hammer, a tagline, a supply of chemical light sticks, and an escape-way map.	WV 56-4 effective June 9, 2006
Beginning at the storage cache located at the working section or active construction or rehabilitation site and beltlines, pumping and bleeder areas, and continuing to the surface or nearest escape facility leading to the surface, the operator shall station additional storage caches containing a number of additional SCSR's equal to or exceeding one each for the total number of persons reasonably likely to be in that area at calculated intervals that a miner may traverse in no more than thirty (30) minutes traveling at a normal pace, taking into consideration the height of the coal seam and utilizing the travel times as specified in Section 5.3.2.	WV 56-4 effective June 9, 2006
Thee Task Force recommends that SB-247 be modified by removing references to "certified intrinsically safe battery-powered strobe lights" due to the concern that damaged strobe lights would create a potential ignition hazard if damaged in an explosion. The Task Force recommends that each SCSR cache have a reflective sign with the words "SELF-RESCUER" or "SELF-RESCUERS" conspicuously posted at each such cache and that reflective direction signs shall be posted leading to each cache. Cache storage containers shall be of such construction as to protect the SCSR's from normal operational damage, be made of a material that is non-combustible, shall be easy to open during an emergency escape, and shall be noted on the escape-way map.	WV 56-4 effective June 9, 2006
Operators shall provide training in the proper use of SCSR's in simulated emergency situations, which may be on the surface, in all required SCSR training. Training should include but not limited to, manufacturer's required daily inspections, donning and starting the SCSR, ways to maximize duration of the unit, changing between SCSR's, communicating without removing the mouth piece, importance and use of goggles, how to know if the device has failed and what to do if it does, and limitations of the SCSR. Until such time as manufacturers offer an operable training SCSR operators are encouraged to save out-of-service units to activate during training as a supplement to currently available training models. All training shall be recorded and made	WV 56-4 effective June 9, 2006

Issues/Recommendations	Status
available upon request.	
Operators and contractors shall report to the Director all SCSR's in service by manufacturer, model, serial number, mine/contractor ID#, service dates, and results of required inspections. This information shall be submitted electronically as defined by the Director, updated quarterly and will include information on any units removed from service along with reasons. The Director shall compile and analyze the results of this information and distribute a report within 30 days by posting the report on the MHS&T web page, <a href="http://www.wvminesafety.org">www.wvminesafety.org</a>	WV 56-4 effective June 9, 2006
The Director shall require, in each underground mine, an emergency shelter/chamber, it shall be located in a crosscut no more than 1,000 feet from the nearest working face and shall be accurately located on mine maps.	WV 56-4 effective June 9, 2006
The Director may approve, as an alternative to a shelter/chamber, an additional surface opening located no more than 1,000 feet from the nearest working face and accurately located on mine maps.	WV 56-4 effective June 9, 2006
The Director shall acquire, no later than July 1, 2006, the necessary technical/engineering support needed to evaluate the performance of emergency shelter/chamber components/systems, and to review the effectiveness of emergency shelter/chamber plans.	WV 56-4 effective June 9, 2006
The Director shall acquire, no later than July 1, 2006, the necessary technical/engineering support needed to evaluate the performance of emergency shelter/chamber components/systems, and to review the effectiveness of emergency shelter/chamber plans.	WV 56-4 effective June 9, 2006
The applicant is to submit documentation including a certification by an independent licensed professional engineer that its unit meets the requirements.	WV 56-4 effective June 9, 2006
The Director shall maintain a current list of approved emergency shelter/chambers on the West Virginia MHS&T web site <a href="http://www.wvminesafety.org">www.wvminesafety.org</a>	WV 56-4 effective June 9, 2006
After an emergency shelter/chamber has been approved, any modifications must be submitted for approval by the Director.	WV 56-4 effective June 9, 2006
The Director shall convene the Mine Safety Technology Task Force not less than once per month through June 30, 2007 for the purpose of reviewing progress by manufacturers, regulators, and operators toward achieving the goals set forth in SB-247 and to review the functional and operational capability of necessary mine safety and health technologies. The Task Force shall submit a report to the Director of its findings and recommendations.	WV 56-4 effective June 9, 2006
No later than April 15, 2007 all underground mine operators shall submit an emergency shelter/chamber plan for approval by the Director. The design, development, submission, and implementation of the shelter/chamber plan shall be the responsibility of the operator of each mine.	WV 56-4 effective June 9, 2006
Within thirty (30) calendar days after submission of the emergency shelter/chamber plan, the Director shall either approve the emergency shelter/chamber plan or shall reject and return the plan to the operator for modification and resubmission, stating in detail the reason for such rejection. If the plan is rejected, the Director shall give the operator a reasonable length of time, not to exceed fifteen (15) calendar days, to modify and resubmit such plan.	WV 56-4 effective June 9, 2006

Issues/Recommendations	Status
Within 15 days of approval by the Director, the underground mine operator shall submit as an addendum to its emergency shelter/chamber plan a copy of any contract, or purchase order, or other proof of purchase of any equipment required to complete the emergency shelter/chamber and for installation and ongoing maintenance.	WV 56-4 effective June 9, 2006
After the Director has approved an operator's emergency shelter/chamber plan, the operator shall submit revisions to the emergency shelter/chamber plan at any time that changes in operational conditions result in a substantive modification. In addition, at any time after approval, the operator may submit proposed modifications or revisions to its plan along with reasons therefore to the Director. Within thirty (30) days after receipt by the Director of any proposed revisions or modifications to the emergency shelter/chamber plan, the Director shall either approve or reject the revisions, stating in detail the reasons for such rejection.	WV 56-4 effective June 9, 2006
If the Director, in his sole discretion, determines that an operator has failed to provide an emergency shelter/chamber plan, has provided an inadequate emergency shelter/chamber plan, has failed to comply with its approved emergency shelter/chamber plan, or has failed to provide a copy of any contract, purchase order or other proof of purchase required under this section, in an effort to delay, avoid or circumvent compliance with subdivision (2), subsection (f), section fifty-five, article two, chapter twenty-two-a of the Code or these rules, the Director shall issue a cessation order to the operator for the affected mine.	WV 56-4 effective June 9, 2006
In developing the emergency shelter/chamber plan and any revisions, the operator shall take into consideration the physical features of the particular mine, emergency plans, advances in emergency shelter/chamber technologies and any other aspect of the particular mine the operator deems relevant to the development of the emergency shelter/chamber plan.	WV 56-4 effective June 9, 2006
A copy of the approved emergency shelter/chamber plan shall be provided to the mine rescue teams providing coverage for the mine. Copies of the most recent version shall be available at the mine for emergency responders. As changes are made to the system, updated versions shall be submitted to the above parties.	WV 56-4 effective June 9, 2006
<p>The proposed emergency shelter/chamber plan shall:</p> <ul style="list-style-type: none"> <li>describe the structure and operations of the emergency shelter/chamber and its role in emergency response;</li> <li>ensure that emergency shelters/chambers are included in initial mine hazard training in such a manner that it is in compliance with all manufacturer's requirements and is provided yearly in addition to annual refresher training. All training shall be recorded and made available upon request;</li> <li>ensure weekly inspections of emergency shelters/chambers and contents shall be conducted by a certified mine foreman/fireboss and recorded in weekly ventilation examination book;</li> <li>ensure that weekly safety meetings review the current location of applicable emergency shelters/chambers and results of the latest inspection;</li> <li>ensure that emergency shelters/chambers shall be equipped with easily removable tamper-proof tags such that a visual indication of unauthorized access to the emergency shelter/chamber can be detected; and</li> <li>ensure that the mine's communication center shall monitor any communication systems associated with the emergency shelter/chamber at all times that the mine is occupied.</li> </ul>	WV 56-4 effective June 9, 2006
The proposed emergency shelter/chamber shall include the ability to:	WV 56-4 effective

Issues/Recommendations	Status
<p>provide a minimum of 48 hours life support (air, water, emergency medical supplies, and food) for the maximum number of miners reasonably expected on the working section;</p> <p>be capable of surviving an initial event with a peak overpressure of 15 psi and a flash temperature of 300 degrees Fahrenheit;</p> <p>be constructed such that it will be protected under normal handling and pre-event mine conditions;</p> <p>provide for rapidly establishing an internal shelter atmosphere of</p> <p>O2 above 19.5%,</p> <p>CO2 below 0.5%,</p> <p>CO below 50 ppm, and</p> <p>an 'apparent-temperature' of 95 degrees Fahrenheit;</p> <p>provide the ability to monitor carbon monoxide and oxygen inside and outside the shelter/chamber;</p> <p>provide a means for entry and exit that maintains the integrity of the internal atmosphere;</p> <p>provide a means for intrinsically safe power if required;</p> <p>provide a minimum eight quarts of water per miner;</p> <p>provide a minimum of 4000 calories of food per miner;</p> <p>provide a means for disposal of human waste to the outside of the shelter/chamber;</p> <p>provide a first aid or EMT kit in addition to a section first aid kit;</p> <p>have provisions for inspection of the shelter/chamber and contents;</p> <p>contain manufacturer recommended repair materials;</p> <p>provide a battery-powered internal strobe light visible from the outside indicating occupancy;</p> <p>provide a means of communications to the surface; and</p> <p>only contain MSHA approved materials where applicable.</p>	June 9, 2006
<p>The Director may require modifications to an emergency shelter/chamber approval or an emergency shelter/chamber plan at any time following the investigation of a fatal accident or serious injury, as defined by Title 36, Series 19, Section 3.2, if such modifications are warranted by the findings of the investigation.</p>	WV 56-4 effective June 9, 2006
<p>The Director shall require, in each underground mine, an integrated communication/ tracking system, a component of which shall be a communication center monitored at all times during which one or more miners are underground.</p>	WV 56-4 effective June 9, 2006
<p>The Director shall acquire, no later than July 1, 2006, the necessary technical/engineering support to evaluate the performance of individual communication/tracking systems and review the effectiveness of communication/tracking plans.</p>	WV 56-4 effective June 9, 2006
<p>The Director shall convene the Mine Safety Technology Task Force not less than once per month through June 30, 2007 for the purpose of reviewing progress by manufacturers, regulators, and operators toward achieving the goals set forth in SB-247 and other mine health and safety technology to promote the availability, functional and operational capability of necessary mine safety and health technologies. The Task Force shall submit a report to the Director of its finding and recommendations.</p>	WV 56-4 effective June 9, 2006
<p>No later than August 31, 2007 all underground mine operators shall submit a communication/tracking plan for approval by the</p>	WV 56-4 effective

Issues/Recommendations	Status
Director. The design, development, submission, and implementation of the communication/tracking plan shall be the responsibility of the operator of each mine.	June 9, 2006
No later than August 31, 2007 all underground mine operators shall submit a communication/tracking plan for approval by the Director. The design, development, submission, and implementation of the communication/tracking plan shall be the responsibility of the operator of each mine.	WV 56-4 effective June 9, 2006
Within 15 days of approval by the Director, the underground mine operator shall submit as an addendum to its plan, a copy of any contract, or purchase order, or other proof of purchase of any equipment required to complete the communication/tracking system and for installation and ongoing maintenance.	WV 56-4 effective June 9, 2006
After the Director has approved an operator's communication/tracking plan, the operator shall submit revisions to the communications plan at any time that changes in operational conditions result in a substantive modification in the communication/tracking system. In addition, at any time after approval, the operator may submit proposed modifications or revisions to its plan along with reasons therefore to the Director. Within thirty (30) days after receipt by the Director of any proposed revisions or modifications to the communications/tracking plan, the Director shall either approve or reject the revisions, stating in detail the reasons for such rejection.	WV 56-4 effective June 9, 2006
If the Director, in his sole discretion, determines that an operator has failed to provide a communications/tracking plan, has provided an inadequate communications/tracking plan, has failed to comply with its approved communications/tracking plan, or has failed to provide a copy of any contract, purchase order or other proof of purchase required under this section, in an effort to delay, avoid or circumvent compliance with subdivision (2), subsection (f), section fifty-five, article two, chapter twenty-two-a of the Code or these rules, the Director shall issue a cessation order to the operator for the affected mine.	WV 56-4 effective June 9, 2006
In developing the communication/tracking plan and any revisions, the operator shall take into consideration the physical features of the particular mine, emergency plans, existing communication infrastructure, advances in communication/tracking technologies and any other aspect of the particular mine the operator deems relevant to the development of the communication/tracking plan.	WV 56-4 effective June 9, 2006
The proposed communication/tracking plan shall describe the structure and operations of the separate or integrated communication/tracking system(s) and its role in emergency response specific to the mine shall be detailed and submitted to the Director and, once approved, to the mine rescue teams providing coverage for the mine. Copies of the most recent version shall be available at the mine for emergency responders. As changes are made to the system, updated versions shall be submitted to the above.	WV 56-4 effective June 9, 2006
The proposed communication/tracking system shall include the ability for: a communication center monitored at all times during which one or more miners are underground. This center shall be staffed by persons holding a valid underground miners certificate, and trained and knowledgeable of the installed communications/ tracking systems, monitoring and warning devices, travel ways, and mine layout. Individuals not possessing a valid underground miner's certificate but working full-time as a communication center operator on or before May 25, 2006 shall be allowed to continue as communications center operators at that mine provided they will have successfully completed	WV 56-4 effective June 9, 2006

Issues/Recommendations	Status
<p>no later than December 31, 2006 a certified 80 hour underground miners apprentice training program and documentation is available for inspection;</p> <ul style="list-style-type: none"> <li>knowing the location of all miners immediately prior to an event by tracking/locating in the escape-ways, normal work assignments, or notification of the communication center;</li> <li>knowing the location of miners in the escape-ways after an event providing the tracking system is still functional;</li> <li>check-in and check-out with the communication center by persons prior to entrance and exit from bleeders and remote or seldom used areas of the mine (all times shall be logged);</li> <li>allowing two way communications coverage in at least two separate air courses and at least one of which shall be an intake;</li> <li>maintaining communication/tracking after loss of outside power and maintain function both inby and outby of the event site with suitable supply of equipment for rapid reconnection;</li> <li>maintain a surface supply of communication/ tracking devices for use by emergency rescue personnel;</li> <li>allow for communication to surface at all required shelters/chambers;</li> <li>all miners and likely emergency responders shall be trained in the use, limitations and inter-operability of all components of the communication and tracking/locating system. This shall be incorporated into required training. All training shall be recorded and made available upon request;</li> </ul>	
<p>The operator shall provide a schedule of compliance for the communication/tracking plan, which shall include:</p> <ul style="list-style-type: none"> <li>a narrative description of how the operator will achieve compliance with above requirements;</li> <li>a schedule of measures, including an enforceable sequence of actions with milestones, leading to compliance; and</li> <li>a statement indicating when the implementation of the proposed plan will be complete.</li> </ul>	WV 56-4 effective June 9, 2006
<p>The operator shall provide as attachments to its communication/tracking plan:</p> <ul style="list-style-type: none"> <li>a statement of the analysis and evaluation required in developing its plan;</li> <li>a statement indicating the initial training dates for implementation of the communication/ tracking system and how the communication/tracking system will be incorporated in other required training;</li> <li>a statement regarding how the communications/tracking system will be tested and maintained; and</li> <li>the name of the person or persons representing the operator, including his or her title, mailing address, email address and telephone number, who can be contacted by the Director for all matters relating to the communication/tracking plan and weekly testing of the system.</li> </ul>	WV 56-4 effective June 9, 2006
<p>The Director may require modifications to a communication/tracking plan at any time following the investigation of a fatal accident or serious injury, as defined by Title 36, Series 19, Section 3.2, if such modifications are warranted by the findings of the investigation.</p>	WV 56-4 effective June 9, 2006
<p>Definitions of terms in Submitted legislative rule</p>	WV 56-4 effective June 9, 2006
<p>Research, development and adopt emergency measures to enhance protection against explosions from lightning entering underground mines and sealed areas; review and enhance equipment performance specifications for mine power stations</p>	Studying

Issues/Recommendations	Status
Permanently ban the use of Omega Block as seals, because the current 20 psi standard is inadequate and because they may not even meet that standard	Effectively Done
Require mine operators to strengthen existing alternative seals by preparing, within 90d days, a plan to construct solid concrete block or comparable seal structures in front of (outby) Omega block seals, or take other appropriate precautions such as ventilating or inerting gases in the sealed abandoned areas, within reasonable deadlines clearly stated in the operator's plan for completing the task.	Studying Options
Evaluate the existing seal standards and consider, at a minimum, upgrading to the 50 psi standard adopted in other mining countries	MSHA Action
Require refuge chambers: Mine operators must develop a plan, by January 2, 2007, to purchase or construct refuge chambers, subject to state and federal approval of the design, number, and locations of such refuges, with the aim of having them installed by Jan 2, 2008	WV Approvals Pending for April 2007 implementation
Conduct a statewide review of all Self-Contained Self-Rescuers (SCSRs) currently in use to determine operability and detect damage, and require ongoing in-mine testing of SCSRs by miners volunteering to don and breathe through them to assess performance	State Inventory started – taken different approach to testing
Develop comprehensive emergency plans. Every West Virginia mine must have a comprehensive mine emergency plan integrated with federal, state and operator roles and tested periodically by the state for effectiveness	Plans were required still need regular review an practice
Ensure that miners have two-way communications: Aggressively accelerate the testing, approval and adoption of robust, redundant, wireless two-way communication systems in all underground mines	Working on solutions for August 2007 implementation
Require implementation of tracking systems via the 'default option' of installing currently available one-way electronic personal emergency and tracking devices	Working on solutions for August 2007 implementation
Undertake a comprehensive review of West Virginia mine rescue systems, including regulations, training, equipment and coordination with West Virginia's Office of Homeland Security and Emergency Management	Underway
Require installation of lifelines in all primary escape ways in underground mines, equipped with directional cones to guide miners to safety	Done
Improve OMHS&T emergency response capabilities.	Some actions taken not all
Better plan and communicate mine rescue and other event participation needs to Inspectors at Large that disrupt the inspection process to allow better planning to ensure completion of mandated inspections.	Action Needed
Have the state office of technology perform a communications and computing technology assessment including the Mine Inspection Support Environment description with recommendations for improvement and cost estimates for implementation.	Done
Hire five additional safety instructors and provide vehicles necessary to visit mine sites with a focus on accident prevention	In Budget



Issues/Recommendations	Status
through education and training	
Mine Rescue Team Rule	In Force
Electricians Rule	In Force
Mine & Industrial Accident Rapid Response System	Under way

