MSHA
Office of Standards, Regulations and Variances
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Comments on Sealing of Abandoned Areas Rule
RIN 1219-AB52

After the Sago disaster and the media frenzy in 2006, I became interested in coal mine seals, coal mine gas explosions, the science of gas explosions, the design of explosion-resistant structures and MSHA's recent emergency temporary standard (ETS). After spending several hundred hours reading MSHA's accident reports, MSHA's internal reviews, numerous technical papers, scientific reports, engineering texts and speaking with numerous practitioners, researchers and technical experts, I respectfully submit the following comments on this proposed rule.

This ETS is fatally flawed, if major changes are not made to this ETS, the coal industry will be burdened with substantial costs for a regulation that will only marginally decrease the likelihood of future explosions associated with sealing abandoned areas. Specific problems include:

- The monitoring strategy is unworkable and it would not have prevented the Sago disaster
  - Samples should be collected on a more frequent basis
  - Broader action ranges are needed to protect the miners
- The 14-day baseline sampling requirement has no benefit
- To only sample when seals are out-gassing is ill-conceived
- The seal strength requirements are inconsistent, inadequately defined and unfounded
- Seal strength requirements greater than 120-psi are arbitrary and capricious
- Existing 20-psi alternative seals should be reinforced, replaced or phased-out within a reasonable time
- All seals should be designed with a suitable safety factor
- A comprehensive lightning protection system is needed to protect underground coal miners

Enclosed are additional comments on other problems that appear to be associated with this disastrous program. The approach that MSHA appears to be taking with this ETS suffers from exactly the same shortcomings that doomed the 1992 seal regulation. The deadly 1992 seal standard directly resulted in the loss of seventeen coal miners in 2006. If significant changes are not made to this ETS, another seal-related disaster is likely. Let me remind MSHA that its mission is to protect miners, not to provide cheap and easy seals for the coal mining industry.

MSHA requests comments on sampling, the frequency of sampling, and only sampling when a seal is out-gassing: The chemical and petroleum industries routinely utilize monitoring, inerting and purging techniques to prevent gas and vapor explosions. However, the key to this approach is maintaining a non-explosive atmosphere at all times. The weekly, or longer (depending on the barometric pressure), ETS sampling interval for seals is inadequate to manage and maintain an inert atmosphere in sealed areas. The ETS monitoring requirements, 30 CFR § 75.335(b), would not have prevented the Sago explosion. At Sago, "...on December 28, 2005...a mine examiner found 1.2% methane exiting the sample pipe at the No. 10 seal".[1] Five days later, this sealed area exploded and killed 12 miners. Weekly sampling of sealed areas is too great of an interval to provide any reasonable level of protection. MSHA obviously didn't read, or understand, the NIOSH draft report on seals.[2] NIOSH recommended 50-psi seals for use where continuous monitoring and inert gas injection is used to ensure that **NO** explosive mixture exists in the sealed area. The current Queensland, Australia regulation[3] requires "a regular sampling regime such that a maximum change in methane concentration of 0.5% CH_4 absolute can be detected between samples". NIOSH further states that "a sampling frequency of every few hours is common practice"[4]. NIOSH describes and has photographs of the tubing bundles and automated gas analysis equipment that is used to monitor these critical sealed areas.

Inadequate examinations are frequently listed as a root-cause in fatal MSHA accident investigations. MSHA cannot be naïve enough to think that the results of these "alleged" examinations are actually measured, accurately recorded and properly

[1] GATES, RICHARD A, et al, *Sago Mine Fatal Explosion Investigation Report*, MSHA (January 2, 2006).
[2] ZIPF, KARL, SAPKO, AND BRUNE, *Draft Explosion Pressure Design Criteria for New Seals in U.S. Coal Mines* (Draft Report), NIOSH (2007).
[3] LYNE, BRIAN, *Approved Standard For Monitoring Sealed Areas,* Queensland DME, QMD 98-7433 (1998).
[4] Zipf, *Supra*, at p 25.

mitigated. At a recent ETS hearing, Tony Oppegard said "history clearly shows that the coal industry, especially small-mine operators, cannot be trusted to vigorously monitor existing seals and the air behind them."[5] Surely MSHA can do better than rely on a highly subjective and easily manipulated system to protect miners from such a critical hazard. I am surprised that the U.S. coal industry does not seem to have the expertise to institute automated sampling and monitoring that has been proven to be both practical and highly effective in Australia.[6] To effectively monitor and maintain a sealed area inert, an automated monitoring system that records an hourly methane and oxygen level is required for atmospheres near the explosive range. The mine operator must take positive actions to inert the sealed atmosphere before it approaches the explosive range. For sealed areas that remain near the explosive range and many newly sealed areas, the mine operator will have to obtain and install inert gas generators.

The "only sample when the seals are out-gassing" requirement is absurd. There is no scientific or practical rational that supports sampling when the seals are out-gassing. Methane permeates most sealed areas continuously as methane diffuses from the gob and surrounding strata. For most sealed areas the most dangerous time is when the barometer is rising because it forces fresh air into this methane-rich mixture creating zones of explosive methane-air mixtures. On average, the barometric pressure rises for approximately the same amount of time that it falls. Therefore, this "sample only while out-gassing" approach would eliminate protections for the miner approximately 50% of the time. Years ago, Rex Music, former District Manager of District 10, had his people run 500-600 feet of tygon tubing into some of the sealed areas in western Kentucky and they found explosive mixtures at least 500 feet inby most the seals when the barometer was rising. Why did MSHA not consider this information in this rulemaking? Do roof falls, lightning, and human error ignitions only occur when the barometer is falling? Ignoring these potential time bombs while in-gassing is a gross dereliction of MSHA's duty to protect miners.

MSHA's definition of an inert atmosphere and the gas concentrations used to define the action plan are improvident. The Queensland standard states "Gases monitored in a sealed area can only represent a small part of a large volume. It is therefore necessary to place a factor of safety around the traditional Coward Triangle methane/air explosive zone and define it as an explosion risk buffer zone"[7]. The Queensland explosive risk buffer zone is no more than 8% oxygen and methane between 2.5% and 22%[8] for continuous sampling. MSHA has adopted oxygen greater that 10% and methane between 4.5% and 20% for weekly sampling (at best, due to that silly out-gassing requirement). Factors that require substantial buffers around the true explosive range include single point samples, non-optimal sample locations, sample intervals and reasonable response times. Irrespective of the ETS preamble, instrument accuracy is a minor factor in establishing protective action ranges. MSHA should adopt the Queensland explosive risk buffer zone for sealed areas that are continuously monitored and maintained inert. Don't American coal miners deserve the same protection afforded miners downunder? Another Queensland requirement that should be incorporated in an effective rule would be to require that all monitoring data be displayed to the entire workforce and be updated at least once each shift.[9]

The proposed S-MINER Bills in the house (H.R. 2768) and senate (S. 1655) require that all sealed areas in coal mines be monitored and maintained inert to eliminate the potential for an explosion in sealed areas. The UMWA also supports this approach to protect miners from the hazard of sealed areas[10]. MSHA should either require that all sealed areas be monitored and maintained inert or it should promulgate seal strengths that are truly protective (rather that the ineffective strengths in the current ETS). Each sealed area should be monitored on a continuous basis at intervals timed so that the maximum change in methane or oxygen levels is equal to or less than 0.5% between readings. In addition, the mine operator has to pre-determine the appropriate action levels to start injecting inert gas into sealed areas so that explosive levels are never approached. These action levels would be based on the volume of the sealed area, the leakage into and out of the sealed area and the inert gas injection rate. The monitoring should include at least one sample pipe in each set of seals and would be supplemented by boreholes spaced on 40 acre centers (1/4-mile spacing) throughout the sealed areas. Although the mining industry complains that surface property ownership often precludes bore holes, modern directional drilling technology allows these holes to be drilled from over two miles away. These holes may even be drilled from within the mine. MSHA recently testified that surface ownership, geology and lightning strikes through well casings precluded these monitoring boreholes.[11] As previously explained, surface ownership may be addressed through new drilling technology and some flexibility in the location of the

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[5] DUNLOP, R.G., *Witnesses Split on New Mine Safety Regulations,* Louisville Courier-Journal (July 13, 2007).
[6] Zipf, *Supra*, p 25.
[7] Lyne, *Supra*, p 2.
[8] *Id.*
[9] *Id*, p 13.
[10] *Public HEARING ON ETS - SEALING OF ABANDONED AREAS*, Tim Baker testimony, Morgantown, WV (July 10, 2007).
[11] WORKFORCE PROTECTIONS SUBCOMMITTEE HEARING: *The S-MINER Act (H.R. 2768),* Kevin Stricklin testimony (July 26, 2007).

holes, there are no geology problems with drilling holes in sedimentary coal formations, and lightning is no problem if the sealed area is monitored and maintained inert. The primary issue is cost to the mine operators. I am sure that if the mine operator wanted to drill a hole for a power drop or rock dust, there would be no problem at all. Keep in mind that a 40-acre worked-out area of 10% methane in a 6 foot coal seam, assuming 50% extraction ratio, has an explosive energy that is equivalent to 1.32 tons of TNT.

The coal industry is loudly arguing that the entire sealed area has to be explosive or that a few explosive zones within a sealed area is no cause for alarm[12]. Well, the coal industry is wrong (again)! In the recent Sago seal tests at Lake Lynn, the chamber that contains the explosive gas mixture was about 70-feet long. This small amount of methane was sufficient to develop the 93-psi pressure in the October 19, 2006 test that demolished the seals that were located approximately 320-feet from this small gas chamber. [13] Even 120-psi seals may not be sufficient to contain the dynamic components of an explosion of a small accumulation of methane. The addition of coal dust to this hellish mixture increases the potential for higher pressures. The possibility of lightning directly triggering a detonation (with a 654-psi reflected pressure) virtually precludes the safe use of 120-psi seals.

The Secretary asks for comments about the agency's approach to the strength requirement for seals:
Although the three strength criteria specified in 75.335(a) seem to emulate the NIOSH criteria[14], close examination shows that the MSHA criteria are distinct, different, arbitrary, and significantly less protective. The NIOSH 50-psi requirement requires continuous monitoring and the maintenance of an inert atmosphere behind these seals at all times versus MSHA's sample every week approach. The 120-psi criterion that MSHA adopted is wrong. The NIOSH 120-psi seal is for constant volume combustion that does not include any significant flame acceleration and dynamic pressure (i.e., a slow-burn). Since MSHA does not impose any limitations on the conditions of the sealed area for their 120-psi seal, potential explosions in sealed areas could easily exceed the strength of this 120-psi MSHA seal. The NIOSH 120-psi seal criterion is based on a limited open area in the sealed area to eliminate the need for detonation-level strength. The MSHA 120-psi seal may be used to seal any size area. MSHA does require seals with strengths greater than 120-psi under very limited conditions.

In combination with the earlier recommendation to continuously monitor and maintain all sealed areas inert, the minimum recommended seal strength required for all new seals would be 50-psi for a direct blast. Existing 20-psi alternative seals should be reinforced, replaced or supplemented with additional seals to obtain the minimum 50-psi strength. This 50-psi design should incorporate appropriate safety factors and strict quality control measures to ensure that the 50-psi design strength is reliably achieved in coal mines when constructed by typical coal miners. Although the coal industry would like to seal and forget abandoned areas, the doomed 20-psi "seal it and forget it" regulation was based on the same lack of science as MSHA's current 120-psi standard.

The Secretary requests comment on the appropriateness of the strategy in this ETS for addressing seal strength greater than 120-psi.
The preamble to the ETS states "MSHA has no empirical or other data, at this time, demonstrating mine conditions exist that will necessitate seals stronger than 120-psi. I suggest that MSHA hire someone who is literate to read the published literature. I have never shot myself in the foot, but I don't need "empirical or other data" to realize that it is probably not a good thing to do. Specifically, refer to:

> *MSHA IR 1119:* "Dust explosion pressures in open entries exceeding 150 psig have been developed during explosion tests in the Experimental Mine [Bruceton]."[15]
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> *U.S. Bureau of Mines RI 7581:* "In the Bureau's Experimental Mine, for example, propagating explosions have developed from 1 to 127 psig, and in a few trials pressure piling caused higher, unrecordable pressures and considerable damage."[16]
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> *U.S. Bureau of Mines Bulletin 627:* "...the distance required for a deflagration to transit to a detonation depends on the flammable mixture, temperature, pressure, the enclosure and the ignition source. With a sufficiently powerful ignition source, detonation may occur immediately upon ignition, even in the open."[17]

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[12] *Supra*, Public HEARING ON ETS, R. Henry Moore testimony (July 10, 2007).
[13] *Supra*, Gates, Appendix X.
[14] *Supra*, Zipf at p 51.
[15] NAGY, JOHN, *The Explosion Hazard In Mining,* IR 1119, MSHA (1981) p 59.
[16] MITCHELL, D.W., *Explosion-Proof Bulkheads: Present Practices,* U.S. Bureau of Mines, RI 7581 (1971) p 2.

Cybulski: "...pressure not less than 4,100 kiloNewtons/square meter (595 psi) ... the detonation of coal dust"[18]

Baker: "The propagation of flames through complex structures is itself complex, and can lead to both locally super adiabatic pressures [in excess of 132 psi] and to local transition to detonation [654 psi]"[19]

Baker: "...enclosures which have a large L/d [long length compared to width and height] or contain a large number of obstacles such as large pieces of equipment or internal partitions [like a coal mine with equipment, stoppings, cribs and cans]...generates turbulence and large scale eddy folding...which causes a rapid rise in pressure and further turbulent eddy/flame interactions...lead to gas-phase detonations...internal pressures can become very high (ca 1.5 MPa)"[20]

MSHA: "...experienced pressures on the order of 200 psig..."[21]

U.S. Bureau of Mines RI 7196: "The characteristics of gas-phase detonations were observed in 20 firings in ...earthen tunnels, 100 detonations in a 24-inch steel pipe, and in about 200 smaller-scale firings."[22]

Contrary to the official MSHA conclusion, there is absolutely no doubt in my mind that the Sago explosion was a detonation that generated extreme pressures. Is MSHA too dumb to recognize a detonation or is this part of a larger pattern of denial, misdirection and deception?

MSHA does specify that a seal that is able to withstand more than a 120-psi overpressure is needed for three specific conditions.

1.) The first condition is that a homogeneous explosive atmosphere is present throughout the entire area. This is impractical because there is no way to make this determination on homogeneity without putting a large array of sample points throughout the sealed area. Mine operators and litigators will love this ambiguous requirement. I am unaware of any research that indicates that a homogeneous mixture is necessary for detonation. In the deflagration to detonation transition (DDT), the turbulence needed to accelerate the flame front to sonic velocity will help mix layered gases. Once a detonation has begun in a gas cloud, non-homogeneous mixtures and mixtures that exceed the upper explosive limit at atmospheric pressures will propagate the detonation. The pressures and temperatures developed in advance of a detonation front will ignite methane levels in excess of 15.0%.[23] In addition, homogeneity is not an important issue because both theory and experiments show that layered or inhomogeneous gases in sealed areas rapidly intermix due to diffusion according to Frick's law.[24] The first U.S. mining engineer's handbook states "the Prussian Firedamp commission made some tests admitting methane through a top inlet into a compartment of a gallery...diffusion...was complete in 4 hours. When diffusion is complete, gases do not again separate."[25] The Blacksville #1 shaft explosion that occurred on March 19, 1992 killed four miners, seriously injured two miners and had an MSHA-estimated explosion pressure of 1000-psi[26] illustrates the fallacy of this layering and non-homogeneous mixture misconception—this 800-foot deep shaft should have been layered with non-explosive methane and no detonation should have occurred, if this theory was correct.

2.) The second condition of pressure piling and change in mining height is absurd. MSHA obviously does not understand the concept of pressure piling--as well as gas explosions in general. Pressure piling occurs any time that the pressure in

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[17] ZABETAKIS, MICHAEL G. *Flammability Characteristics of Combustible Gases and Vapors,* U.S. Bureau of Mines, Bulletin 627 (1965).
[18] CYBULSKI, W. *Coal Dust Explosions and Their Suppression,* Translated by U.S. Bureau of Mines (1975) p 284.
[19] BAKER, W.E., et al, *Explosion Hazards and Evaluation,* Elsevier (1983), p 74.
[20] *Id,* p 187.
[21] CHIRDON, D., AND S. LUZIK, Investigation of Longwall Controller...North River No. 12 Mine, MSHA (October 13, 1995) p. 18.
[22] BURGESS, DS, et al, *Large-Scale Studies of Gas Detonations,* RI 7196, US Bureau of Mines (1968) p 1.
[23] KISSELL, FRED, *Handbook for Methane Control In Mining,* NIOSH, IC 9486 (2006) p 6.
[24] SMITH,WF, *Foundations of Materials Science and Engineering 3rd ed,* Mcgraw-Hill (2004); FRICK, A, Poggendorff's Annel. Physik, (1855) v 94, p 59.
[25] PEELE, ROBERT AND JOHN A. CHURCH, EDS., *Mining Engineers' Handbook,* Wiley, 3rd Ed (1941) p 23-07.
[26] RUTHERFORD, JAMES W., et al, *Blacksville No. 1 Mine Fatal Explosion Investigation Report,* MSHA (March 19, 1992).

front of the flame compresses the unburned gas. If the pressure in front of the flame front rises to 14.7-psig (2 atmospheres, absolute), the explosion will be approximately twice as powerful as it would with no pressure piling. According to Boyle's law, each unit volume of gas at 2 atmospheres pressure (14.7-psig) contains twice as many molecules of methane and oxygen to react as that same volume did at normal atmospheric pressure. At higher levels of pressure piling, more energy is released and the flame accelerates and increases of pressure piling, and so on, until the DDT is reached. Refer to Figures 8 and 9[27] in the NIOSH draft report. While changes in cross-sectional area may contribute to pressure piling, the confinement and roughness in typical coal mine entries are sufficient to generate extreme turbulence and pressure piling. Normal mine objects such as cribs, timbers, power cables, mine equipment and piles of coal and/or rock may further accelerate the developing turbulence by tearing at the flame front and creating additional eddies and vortices. MSHA argued incorrectly for years that pressures could not increase beyond 5-psi in coal mine explosions due to stoppings blowing out and limiting the explosion pressure. Sago and Darby (and probably several other poorly investigated mine explosions) disprove this theory. As the explosion front accelerates, the flame front will propagate well beyond a crosscut before the stopping is blown out. In fact, the bursting of ventilation stoppings may promote turbulent acceleration due to rapid variations of the pressures driving the flame.[28] In all likelihood, a detonation developed in Sago well before the infamous ramps that decreased the entry height prior to the seals. In this scenario, the decrease in cross-sectional area would increase the detonation pressure to approximately 500 psi which would have exerted well over 1000 psi reflected pressure on the seals for some infinitesimal period of time before those seals failed.

3.) The other conditions encountered, such as the likelihood of a detonation in the proposed seal area requirement is extremely ambiguous. The NIOSH report[29] and the scientific literature[30] suggests that any open sealed area in the mine that is greater that a critical run-up distance (50 – 100 meters) may be subject to a detonation. Numerous studies have shown that the side-on pressure of a methane detonation is 256 psi and the reflected head-on pressure is 654 psi.[31] Based on the well-researched criteria needed for DDT, many sealed areas in coal mines are susceptible to this detonation hazard. Unmonitored seals used to isolate these areas should be designed accordingly. In fact, Richmond[32] stated that test explosions in the Bruceton experimental mine achieved sonic velocity (detonation) within 10 diameters of the mine entry (about 200 feet) in a stoichiometric mixture of methane.

The ETS "greater than 120-psi" criterion seems to be specifically targeted to virtually eliminate any mine having to install these seals. Is this just regulatory eye-candy? MSHA should abandon this ill-conceived and inadequate approach to seal strength. There appears to be no scientific or practical basis for MSHA's arbitrary choices for seal strengths—a situation that is disturbingly reminiscent of the disastrous 1992 rule.

The Secretary asks for comments on the appropriateness of open flames associated with welding, cutting and soldering within 150-feet of a seal and the feasibility of this requirement.

The prohibition of welding, cutting and soldering with an open flame within 150-feet of a seal is a reasonable requirement that will help prevent another Darby-type explosion. Many seals are located in areas of low ventilation air velocity and studies have show that flammable layers of methane may develop that can "wick" ignitions of methane over long distances under these conditions.[33] Most chemical industrial facilities restrict or prohibit the use of open flames in critical areas. I understand that the United States is the only major coal producing nation that allows the casual use of torches, grinding and open flames in underground coal mines. There are various tools and techniques that are commercially available and

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[27] Zipf, *Supra*, pp 92-93.

[28] FÖRSTNER, HANS, AND CHRISTOPH KERSTEN, *Deflagrations in Closed and Vented Pipes – An Experimental Study,* 20th International Colloquium on the Dynamics of Explosions and Reactive Systems, McGill University, Montreal (2005).

[29] Zipf, *Supra*, p 52.

[30] BULL, DC, *Gas Detonation Hazards*, Proceedings of Control and Prevention of Gas Explosions Conference, Oyez Scientific, Ltd., London (Dec. 1983).
LEE, J.H.S. AND I.O. MOEN, *The Mechanism of Transition from Deflagration to Detonation in Vapor Cloud* Explosions, Prog. In Energy and Comb. Sci., v 6, n 4 (1980) pp 359-389.
FICKETT, W AND WC DAVIS, *Detonation,* Univ. of CA Press, Berckeley (1979).
BAKER, WE, et al, *Explosion Hazards and Evaluation*, Elsevier Scientific Publishing, New York (1983).
MOEN, IO, *Pressure Development Due to Turbulent Flame Propagation in Large-Scale Methane/Air Explosions,* Combustion and Flame, v 47 (1980) pp 31-52.

[31] Zipf, *Supra*, pp 36-38.

[32] RICHMOND, JK AND I LIEBMAN, *A Physical Description of Coal Mine Explosions,* 15th Int. Symp. On Combustion, US Bureau of Mines and The Combustion Institute (1974) p 117.

[33] RAINE, EJ, *Layering of Firedamp in Longwall Mining,* Trans Inst of Min Engr, v 199, n 10 (1960) pp 579-597.

commonly used to remove stuck bolts, cut metal and pull apart stuck components that do not use open flames. MSHA should also prohibit the operation of non-permissible equipment, grinders, and prohibit electrical cables within this area critical area. Numerous mines have high-voltage and other electrical cables hung near mine seals.

Even though 30 CFR 75.1106 ostensibly addresses welding and burning issues, the sad fact is that welding and burning it still the third most common source of reportable fires in underground coal mines.[34] The Darby[35] and McElroy[36] disasters underscores the common lack of compliance with 30 CFR 75.1106 and the potential tragedy that can result when open flames and sparks are allowed near seals.

MSHA seeks comments on the feasibility of including in the final rule a requirement that existing seals be removed and replaced with a higher strength seal.

As the ETS is currently written, the atmosphere behind new, carefully designed, and correctly constructed 50-psi seals must be monitored and maintained inert. The ETS also allows miners to work around existing and often poorly constructed, 20-psi alternative seals. These legacy seals have already killed 17 miners. When the 14,000 legacy seals[37] are considered, along with the flawed construction history[38] of these seals, and the abovementioned problems with MSHA's monitoring regulations, more catastrophic failures of existing 20-psi seals are inevitable. Even if MSHA adopts a stricter monitoring and inerting protocol, the risk to miners from these legacy seals is much higher than the risk for new seals for the next 5 to 10 years. I strongly disagree with MSHA's assumption that reinforcing or replacing the existing 20-psi alternative seals is impractical and may create safety hazards. Surely the technology exists to reinforce or replace these seals in a safe manner. A reinforcement material called "BlastSeal"™ has been successfully tested to resist 61-psi at Lake Lynn. [39] This, or similar, reinforcement should be installed on every existing 20-psi seal or new, stronger seals may be built in front of these existing seals.

MSHA requests comments concerning the establishment of a baseline ... establishment of equilibrium and trends.

As previously explained, the seal area must be maintained totally inert, 24 hours per day/seven days per week/and 52 weeks per year to protect miners. These baselines, trends, and equilibria are mere fluff that are meant to impress the ignorant and confuse the bureaucrats.

Lightning

"The Sago Disaster might not have happened if regulators and the coal industry had heeded the warnings from Oak Grove and from a series of other lightning induced explosions dating back more than 30 years."[40] Lightning or a sufficiently energetic explosive detonator may directly initiate a detonation in an explosive gas cloud without a DDT[41]. This is the principle behind the fuel-air bomb.[42] "With a sufficiently powerful ignition source, detonation may occur immediately upon ignition, even in the open."[43] MSHA's finding that lightning was the likely ignition source at Sago[44] and the 12 other explosions in sealed areas with lightning as an ignition source[45] make the hazard of a directly initiated detonation triggered by lightning a distinct possibility. South Africa adopted several measures to minimize the hazard of lightning-initiated methane explosions in sealed areas in the early 1980's.[46] These measures include: electrically cross-bonding of conductive structures

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[34] CONTI, RONALD S., *Responders to Underground Mine Fires,* proc of 32nd Conf on Mining, Health, Safety and Research, Salt Lake City, UT, Aug 5-7 (2001) p 111.
[35] LIGHT, THOMAS E, *et al, Darby Mine No. 1 Fatal Explosion Investigation Report,* MSHA (May 20, 2006).
[36] OAKES, JAMES, *et al, McElroy Mine Fatal Explosion Investigation Report,* MSHA (January 22, 2003).
[37] _____, *Internal Review of MSHA's Actions at the Darby Mine No. 1*, MSHA, (June 28, 2007) p 66.
[38] WARD, KEN, JR, *Feds Find Hundreds of Unsafe Mine Seals,* Charleston Gazette (February 25, 2007).
[39] TERRY, JULIET A., *BlastSeal Shown to Improve Coal Mine Seal Strength,* WOWK-TV (May 17, 2007).
[40] WARD, KEN, JR, *Lightning and Seals: No New Problem,* Charleston Gazette (January 2, 2007).
[41] Burgess, *Supra*, p 52.
UL'YANITSKII, VY, *Closed Model of Direct Initiation of Gas Detonation,* Combustion, Explosion and Shock Waves, Springer, New York (July 1980) v 16, n 4, p 427.
FISHER, BD, et al, *Implications of a Recent Lightning Strike to a NASA Jet Trainer,* AIAA (1988) 11 p.
NETTLETON, MA, *Gaseous Detonations,* Chapman and Hall (1987) p 77.
[42] CARLSON, G.A. *Studies of Spherical Detonations in Fuel-Oxygen Systems- Application to Fuel-Air Munitions*, SC-RR-70-0086; Sandia National Laboratories, Albuquerque, NM (May 01, 1970).
[43] ZABETAKIS, *Supra.*
[44] Gates, *Supra,* p 172.
[45] *Id* p 156.
[46] GELDENHUYS, HJ, et al, *Research Into Lightning-Related Incidents in Shallow South African Coal Mines,* Proceedings of the 21st Int Conf of Safety in Mines Research, Sydney, Australia (Oct. 1985) pp 775-779.

in the mine at 600 meter intervals, electrically bonding conductive structures to roof bolts or other earth grounds at regular intervals, remove all long metal structures, pipes, cables and telephone wires from sealed areas, metallic borehole casings and cables down boreholes should be removed from sealed areas. Most importantly, miners are withdrawn from the mine while thunderstorms that trigger an electronic lightning warning system are in the vicinity of the mine. The South Africans have developed a reliable lightning detection and warning system that has proven to be effective in reducing the lightning-related hazard to underground miners during thunderstorms.[47] This South African research was published in 1985, MSHA investigated three lightning-initiated explosions in a large sealed area at a mine in Alabama in the mid-1990's, and NIOSH published a warning about lightning-initiated explosions in sealed areas in 2001.[48] On Wednesday, June 27, 2007, a lightning-initiated methane explosion seriously injured four underground miners in Alabama.[49] Why has MSHA done almost nothing to directly address this known lightning hazard?

The ETS requirement that insulated cables be removed prior to sealing an area[50] is a fair start on a much-needed lightning regulation, but more work is needed to adequately protect the miners from this potential disaster. Sealed areas are not the only sources of potential explosions—many active gobs and unsealed worked-out areas contain significant accumulations of explosive methane.[51] This hazard is further compounded by the many natural gas and coal bed methane wells with conductive casings that penetrate both active and sealed areas in the coal mines. Conductive well casings were associated with more than one-half of reported explosions in sealed areas.[52] Shafts were associated with 5 of the 12 lightning-related explosions listed in MSHA's Sago report.[53] Before an area is sealed, all shafts within that area should be backfilled. Keeping all sealed areas inert is probably the only way to address the lightning hazard in abandoned areas. Withdrawal of miners when severe lightning storms occur is probably the only way to protect miners from potential explosions in active gobs and bleeders.

Explosion Testing of Seals

This should not be a simple pass-fail test like the atrocious 1992 seal program. Enough tests should be conducted to establish a confidence interval of the seal strength so that the approved seal can reliably withstand the explosive design load at least 99% of the time. Strict quality control of the materials to be tested and the construction methods is necessary to make sure that the tested seals are representative of the seals that will be installed in coal mines. There were accusations that the seals tested in Lake Lynn prior to January 2, 2006, were often the manufacturer's best or non-typical products. Appropriate safety factors must be applied to the tested strengths. All seals should be tested to failure.

Safety Factors

There is no mention of safety factors in this ETS. Any agency that is tasked with worker safety can adequately address engineering designs for critical structures without even mentioning safety factors. For those of you who are not engineers, a safety factor is the ration of design strength divided by the expected load. Typical safety factors for civil engineering project range from 2 to over 10. If there is no specific safety factor for seal design, mine operators will be able to install seals with a safety factor of 1.0. A structure with a safety factor of 1.0 has a 50% chance of failure when subjected to the maximum design load. Since there are no safety buffers built into the MSHA seal strengths in this ETS, the likelihood of future seal failures is extremely high unless these deficiencies are resolved. MSHA requires a safety factor of up to 7.0 for wire hoist ropes (30 CFR § 75.1431). Would it not be prudent to specify reasonable safety factors for these critical mine seals?

Professional Engineer (P.E.) Certification

The P.E. certification requirements in this ETS are confusing, impractical and in violation of many state laws for the registration of engineers.

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[47] *Id* p 780.

[48] ANON, *Reducing the Danger of Explosions in Sealed Areas (Gobs) in Mines,* NIOSH Technology News, n 489 (May 2001) 2 p.

[49] MCCAULEY, C, AND R. HUBBARD, *UMWA Team Works To Restore Mine To Full Operation,* The Birmingham News (June 29, 2007).

[50] 30 CFR § 75.337(a)(1).

[51] TISDALE, JACK E. AND J, UROSEK, *Examinations of Bleeder Systems*, MSHA (1984) p. 2.

[52] Gates, *Supra*, p 156, Table 10.

[53] *Id.*

General Comments

At 6:26 a.m., January 2, 2006, an explosion ripped through Wolf Run Mining Company's Sago Mine. This inauspicious event triggered a sweeping reform of many of the nation's mining laws and practices. One of the most controversial issues that has surfaced in the aftermath of this terrible tragedy concerns mine seals and the all too common practice of sealing--and forgetting--worked-out areas of coal mines. The Sago explosion occurred behind "explosion-proof" mine seals that were totally destroyed by the explosion. Twelve miners died as the results of carbon monoxide poisoning caused by the combustion by-products of the methane explosion—the explosion that should have been contained by the explosion-proof seals.[54] [55] [56]

In the aftermath of the Sago mine rescue debacle, the Mine Safety and Health Administration (MSHA) did nothing to address the real problem at Sago—explosion-proof seals that did not function. Six months later, five more miners were needlessly lost when another blast occurred behind explosion-proof seals at the Darby Mine No. 1.[57] The seals that failed at Darby were constructed of the same Omega blocks as the seals that had failed at Sago Construction on the seals at Darby was started on March 18, 2006.[58] If MSHA had issued a simple warning on these seals during the 74 days that elapsed since Sago, there may not have been a Darby disaster. Why did this powerful Federal agency that is charged with protecting the nation's miners do nothing? Dennis Roddy and Steve Twedt, journalists with the Pittsburgh Post-Gazette, realized the problem with alternative seals and published two insightful articles on the hazards of alternative 20-psi seals on March 12, 2006—about a week prior to the construction of the Darby seals—and MSHA was still asleep at the wheel.[59] Even more disturbing is that MSHA admits that its Senior Management knew of the problems with seals as soon as January 23, 2006, about three weeks after the Sago explosion.[60]

Why did 17 miners die last year when "explosion-proof" seals failed? A reasonable person would certainly expect that "explosion-proof" seals could easily resist mine explosions. The American Heritage Dictionary defines "proof" as "fully or successfully resistant; impervious."[61] Clearly, MSHA's concept of "explosion-proof" does not correspond to the normal usage of this term. MSHA's interpretation also appears to be at odds with 1977 Federal Mine Safety and Health Act:[62]

> Sec 303(z)(3) ...as each working section of the mine is abandoned, it can be isolated from the active workings of the mine with explosion-proof seals or bulkheads.

How did MSHA get from this simple directive specified in the 1977 Mine Act to what Davitt McAteer, former Assistant Secretary of MSHA, aptly described as "every sealed area in every underground coal mine ...should be considered a potential time bomb—and treated accordingly"?[63]

MSHA's 20-psi alternative seal regulation[64] was promulgated in the 1992 revision of the coal mine ventilation regulations.[65] This is a substantial decrease in the protection afforded miners from the previous 30 CFR § 75.329-2 which states "that pending the development of specifications for explosion-proof seals or bulkheads, seals or bulkheads may be constructed of solid, substantial and incombustible materials sufficient to prevent an explosion that may occur on one side of the seal from propagating to the other side." The 1988 proposed rule required that a seal be constructed of noncombustible material at least 16 inches thick with mortar or equivalent fire-resistant material between all joints.[66] Alternate construction methods or materials could be used if they provide at least equivalent protection and are specified in a ventilation plan.[67] The 1992 final rule defines "explosion-proof" as being able to withstand a 20-psi static explosion pressure.[68] There was no notice of this 20-

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[54] Gates, *Supra.*
[55] RODDY, DENNIS B, *Sago Inquiry Focuses on Blocks*, Pittsburgh Post-Gazette (March 12, 2006).
[56] TWEDT, STEVE, *Safety Wall Standards Higher Elsewhere*, Pittsburgh Post-Gazette (March 12, 2006).
[57] LIGHT, *Supra.*
[58] *Id* at p 30.
[59] Roddy, *Supra.*
[60] Darby Internal Review, *Supra*, p 63.
[61] PICKETT, JOSEPH P., ET AL, ED, *The American Heritage Dictionary of the English Language*, Fourth Ed., Houghton Mifflin, (2000).
[62] Federal Mine Safety and Health Act of 1977, Public Law 91-173.
[63] MCATEER, J. DAVITT, et al, *Preliminary Report on the Sago Mine Disaster,* West Virginia (July 19, 2006).
[64] 30 CFR 75.335(a)(2), *pre-ETS.*
[65] Final Safety Standards for Underground Coal Mine Ventilation, Fed Reg, vol 57, no 95 (May 15, 1992), p 20868.
[66] Proposed Safety Standards for Underground Coal Mine Ventilation, Fed Reg, vol 53, no 17 (January 27, 1988) p 2417.
[67] *Id.*
[68] Fed Reg, *Supra,* v57, n95, p 20887.

psi criterion in the proposed rule and no reference to any comments on this 20-psi criterion in the preamble to the final rule. The 1992 preamble states that the 20-psi "explosion-proof" definition is based on a U.S. Bureau of Mines Report of Investigations No. 7581.[69] However, this referenced report states "In the Bureau's Experimental Mine, for example, propagating explosions have developed from 1 to 127 psig, and in a few trials pressure piling caused higher, unrecordable pressures and considerable damage."[70] A prudent mine safety agency should have promulgated a much stronger seal regulation based on this single sentence. A casual review of the Bureau's explosion research in the Bruceton experimental mine shows that the Bureau was very careful to limit the size of the explosive gas zone or amount of coal dust to prevent damage to their instruments and the experimental mine itself.[71] MSHA published a report in 1981 that discusses measured, coal mine explosion pressures far in excess of 20 psi for mine explosions.[72] This report states that "Dust explosion pressures in open entries exceeding 150 psig have been developed during explosion tests in the Experimental Mine [Bruceton]."[73] Did anyone who worked on the 1992 ventilation rule even read this MSHA report? How could MSHA possibly consider that a 20-psi seal would be sufficient to withstand coal mine explosions?

Professor Patrick C. McGinley states:[74]

> When analyzing a federal agency interpretation of its' enabling statute courts and agencies are bound to adhere to the principle first delineated by the Supreme Court of the United States in Chevron v. N.R.D.C., 467 U.S. 837, at 842-843 (1984). Chevron instructed that "[w]hen a court reviews an agency's construction of the statute which it administers, it is confronted with two questions. First, always, is the question whether Congress has directly spoken to the precise question at issue. If the intent of Congress is clear, that is the end of the matter; for the court, as well as the agency, must give effect to the unambiguously expressed intent of Congress."
>
> Section 863 (z) of the MSHA of 1969 contains a mandatory, not a discretionary standard, by which MSHA is to determine the adequacy of mine seals:
>
> > When sealing is required, such seals shall be made in an approved manner so as to isolate with explosion-proof bulkheads such areas from the active workings of the mine.
>
> The legislative history of the Mine Act makes clear that § 863 (z)'s mandate of "explosion-proof" mine seals is intended to provide coal miners a very high level of protection from explosions:
>
> > Under the conference substitute, paragraph (2) of section 303(z) provides that, . . . abandoned areas, shall be ventilated . . . or be sealed. . . . The determination of which method is appropriate and the safest at any mine is up to the Secretary or his inspector to make, after taking into consideration the conditions of the mine, particularly its history of methane and other explosive gases. The objective is that he require the means that will provide the greatest degree of safety in each case.[75]
>
> In sum, it is apparent that the 20 psi standard of 30 C.F.R. §75.335 is inconsistent with the unambiguous statutory mandate of the Mine Act that coal mine seals be "explosion proof." When construed in accordance with the Supreme Court's instruction in Chevron v. N.R.D.C., it is clear that MSHA's regulation failed to "give effect to the unambiguously expressed intent of Congress." See, 467 U.S.837, 842, 843.
>
> MSHA's adoption of the 20 psi standard relied upon Report 7581 which was guided by a historic consensus rather than the very high standard of safety intended by the Mine Act's "explosion proof" mandate --- thus relying on factors Congress did not intend for the agency to consider and ignoring foreseeable explosion

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[69] MITCHELL, *Supra.*
[70] *Id* at p 2.
[71] RICHMOND, *Supra.*
[72] NAGY, *Supra*.
[73] *Id* p 59.
[74] MCGINLEY, PATRICK C., Memorandum for the File, MSHA 20 psi Seal Standard, *Preliminary Report on the Sago Mine Disaster,* West Virginia (July 19, 2006).
[75] H.R. REPORT NO. 91-761, 91ST CONG., 1ST SESS., (DEC. 16, 1969) AT 81-82, U.S. House of Reps., Conference Report, Federal Coal Mine Health and Safety Act of 1969 (*emphasis added*).

pressures that its own research identified. The explanation offered by the agency --- that it relied exclusively on Report 7581 --- ignored the contradictory evidence in the report itself that explosion proof seals could be constructed to withstand foreseeable explosive pressures. Finally, MSHA's meager explanation for choosing the 20 psi standard is totally implausible, given the fact that stronger seals have been designed to withstand foreseeable mine explosion pressures substantially in excess of 20 psig.

The authors of this ETS should carefully review Professor McGinley's findings and modify the final rule to adhere to the unambiguous mandate of the Mine Act.

Until the introduction of cheap, insubstantial, and non-protective 20-psi alternative seals in 1992, there were relatively few seals installed in the nation's coal mines. Mitchell states "The few seals (bulkheads) built since World War II were principally in areas having potential for spontaneous combustion."[76] Prior to the 1992 alternative seal fiasco, virtually all coal mines ventilated and examined worked-out areas of the mine. Now, MSHA states that there are approximately 14,000 seals[77] in the nation's coal mines. How many of these 14,000 seals are "time-bombs" and how many of these "bombs" are ticking?

There is no technical reason that abandoned areas of coal mines have to be sealed. The only compelling reason to seal worked-out areas seems to be cost savings. These worked-out areas have to be ventilated and examined (30 CFR §75.334 and § 75.364) if not sealed. Underground coal mines with spontaneous combustion problems may need seals as part of a spontaneous combustion plan (30 CFR §75.334(f)); however, there are only a few mines in the U.S. with documented spontaneous combustion problems. Seals could easily be eliminated from U.S. coal mines without any significant incremental cost if they were phased out over a period of time. Do cheap seals protect the miner or the mine operator's pocketbook?

If MSHA promulgates a final seal regulation that truly protects the miner, sealing abandoned areas in the nation's coal mines will probably revert to the pre-1992 practice when seals were relatively uncommon. The large number of seals built since 1992 will have to be continuously monitored and maintained inert, reinforced, or replaced to protect the miners. When looking at the potentially large costs of doing what is right with seals, keep in mind that MSHA gave the mining industry an extremely cheap alternative in 1992 and the industry has probably more than recouped the cost of retrofitting existing seals since 1992. As for new seals, there is no true incremental cost to the industry since MSHA is merely withdrawing its alternative, and ill-fated, cost-saving approach.

MSHA Investigations:
Having read many of the MSHA investigation reports on seal failures, it is obvious that there has been a clear and consistent bias where seal failures were blamed on faulty construction, explosion pressures were routinely under-estimated, and problems with seals were systematically concealed or understated. MSHA has failed to "connect the dots" on seal failures since the 1992 seal rule. I am less than impressed with MSHA's misrepresentations of facts and MSHA's limited technical grasp of gas explosions and seal strengths as demonstrated in the Sago and Darby fatal accident investigation reports of 2006. Although Davitt McAteer's Sago report was only 101 pages in length, and was released within six months of the disaster; it is decidedly superior to the bloated, 8 pound MSHA tome that was not released until approximately 16 months after the disaster. Mr. McAteer's report contained all of the pertinent facts, identifies what was not known, what required additional research or investigation, and clearly identifies the bigger issues that must to be addressed to protect miners from this type of disaster. The MSHA Sago report is technically biased, deliberately deceptive, and does not address some of the key issues associated with this disaster. This consistent pattern shows that MSHA has been aware of grave problems with the 1992 coal mine seal regulations and knowingly chose to ignore these problems prior to the Sago and Darby explosions. NIOSH documented the problem with seal strength and lightning initiation in 2001.[78] Even the Sago explosion, with its needless loss of twelve miners, was cavalierly dismissed by MSHA; i.e. no policy or guidance on seals was issued for six months (six days after the Darby disaster).[79] In all likelihood, MSHA would have done little if anything to address their bungled seal rule if the Darby disaster had not have occurred. MSHA could easily have issued a seal moratorium shortly after Sago and circumvented the needless loss of life at Darby. The evidence is clear that MSHA was not cautious in key judgments leading up to the 1992 seal rule, was negligent when investigating seal failures between 1992 and 2006, and has been derelict when

[76] MITCHELL, *Supra,* at p 1.
[77] Darby Internal Review, *Supra,* p 66.
[78] NIOSH, *Supra* 2001.
[79] MCKINNEY, RAY, *Moratorium on Future Use of Alternative Seal Methods and Materiala Pursuant to 30 CFR 75.335 and Assessment of Existing Sealed Areas in Underground Bituminous Coal Mines,* MSHA, Program Information Bulletin No. P06-11 (June 1, 2006).

drafting the current seal ETS. MSHA's consistent pattern of ineptitude, incompetence and malfeasance should be thoroughly investigated by Congress.

MSHA cites several estimated pressures for explosions behind seals that were always less than 20-psi until the third seal failure at Oak Grove. However, there is no explanation in any of these reports on how these pressures are determined. I submit that because MSHA foolishly promulgated a 20-psi regulation in 1992, it would not recognize any pressures in excess of 20 psi prior to Sago. What is especially incriminating is that several of these reports have different explanations of why there is no "conclusive proof" of explosive forces over 20-psi prior to Sago. No one can say with any certainty what pressures were developed in any of these explosions.

The Sago report blithely obfuscates the issues of detonations, the pressure explosions in sealed areas and seal strength issues. Rarely has the taxpayers dollars been wasted on such astounding legerdemain. The Sago report says that the pressure that obliterated the seals was "in excess of 93 psi."[80] What this report does not say is that this pressure may have been much closer to 930 psi. Tests were not done at greater than 93 psi because MSHA did not want to know the true extent of this hazard. MSHA does state that "...the damage to the seals at the Sago Mine was more extensive."[81] Limiting the Lake Lynn explosion tests to 93-psi and then using this as a measure of the forces involved at the Sago disaster is akin to using a teacup to measure the volume of water in the ocean—and concluding that it is "in excess of one teacup."

I wonder if the roof bolt bearing plates that were pictured on pg. 108, referenced in the Lake Lynn tests on pg. 140, and the damages to the plates extensively mapped in appendices H-4 and H-5 to the Sago report[82] showed similar damages in the Lake Lynn tests versus the Sago explosion. The MSHA Sago report states "Physical evidence observed ... includes the deformation of structural materials, including belt hangers, roof support plates and wire mesh."[83] Since MSHA and NIOSH went to the trouble to photograph, map and test these roof bolt bearing plates, the omission of any reference to the degree of damage seems highly duplicitous.

MSHA seems confused on the basic physics of gas explosions. The Sago report states that "the total height of the opening through which the explosion was propagating became increasingly restricted ... resulted in pressure piling. The increase in pressures was not on the order of magnitude necessary to cause a deflagration to detonation transition (DDT). "[84] If this was a rather benign explosion that was limited by an excess of methane, a non-homogeneous gas cloud and a methane rich mixture as intimated on page 105 of the Sago report, the explosion would have been a confined volume, slow-burn (which would support the 93 psi theory). No excessive flame speeds would have been developed, the mining height restrictions near the seals would have had little or no effect on the explosion pressure, and pressure-piling would not be an issue. However, if pressure-piling was an issue, then this explosion was a fast deflagration or a detonation and the gas cloud was probably near a stoichiometric mix (the most likely interpretation based on the published information).

In the Sago report,[85] MSHA tries to retract a prior MSHA finding that the explosion pressure that destroyed mine seals at the Oak Grove mine in 1997, "the propagating forces that destroyed the No. 29 seal were estimated to be greater than 20 psi."[86] MSHA is now saying:

> ...three seals were partially or completely displaced. The compressive strength of two of the three seals were found to be below the minimum acceptable limit of 20-psi. The information that the third seal had a compressive strength in excess of 20-psi lead the investigators to indicate that the explosive forces required to damage the seal was in excess of 20-psi. Subsequent opinions by MSHA determined that the number of samples subjected to compressive strength testing was inadequate to fully support this conclusion.[87]

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[80] Gates, *Supra*, p 2.
[81] *Id*, p 186.
[82] *Id.*
[83] *Id*, p 173.
[84] *Id*, p 185.
[85] *Id*, p 45.
[86] SCOTT, DONIECE S. AND CLETE STEPHAN, *Non-Injury Methane Explosion Investigation Oak Grove Mine,* MSHA (July 9, 1997) p 14.
[87] Gates, *Supra*, p 45.

MSHA's subsequent opinion that not enough samples were tested for compressive strength is irrelevant because the average of the tested samples exceeded the minimum required strength. The number of samples only relates to the variance of the strength. Elementary statistical theory may be used to conclude that it is more likely that that strength of the seal material exceeds the minimum required design strength. Therefore, the explosive force that destroyed this seal did exceed 20-psi. MSHA's "subsequent opinion" reeks of deliberate misrepresentation.

Not satisfied with their original mis-reinterpretation, MSHA outdoes itself in the Sago and Darby internal reviews:

> ...the accident report indicated that the pressure exceeded 20-psi. This conclusion was based solely on a limited number of samples of material from one of the failed seals having tested at the required minimum compressive strength. However, samples tested from two other failed seals were found to have low compressive strengths, and one of these seals was found to have an empty 5-gallon can embedded inside the seal. These conditions bring the adequacy of the construction practices for this set of seals into question and raise an issue about whether the seals necessarily were subjected to an overpressure of at least 20-psi. In summary, with the exception of the Sago Mine explosion, there was no conclusive evidence in the other investigated cases that the explosion pressures had exceeded 20-psi[88] [89]

What a pompous, overblown half-truth. It would be equally valid to say that there was no conclusive evidence in the other investigated cases that the explosion pressures were less than 20-psi. MSHA does not have any scientific evidence on which to make these self-serving proclamations. In fact, MSHA does not have a clue what the true pressure was in any of the seal explosion accidents that they have investigated. MSHA has been negligent or deceptive in its investigations of seal failures and now finds itself trying to defend this house of cards. Ten of the explosions listed in Appendix F of the Sago internal review were initiated in the sealed area.[90] Of these ten explosions, seven resulted in damaged or destroyed seals. MSHA always blamed seal failures on "improper construction" why did this Agency not take actions to address this problem?

Recent testing at Lake Lynn shows that failed seals still contain and attenuate much of the explosion pressure.

> The maximum pressure increased to 50-psi at the location of the seal in Drift C, which was 320 feet from the face. When the pressure wave reached 403 feet from the face, the pressure had dropped to only 5-psi. This drop is very significant in that pressures decreased 90%, from 50-psi to 5-psi, in a distance of only 80 feet [across the seal].[91]

Although there is no clear explanation of MSHA's pressure determination process in the various investigation reports, the reports imply that the estimates of 2 to 6-psi were based on whether or not ventilation stoppings were destroyed. The MSHA reports frequently state that ventilation stoppings have a 5-psi nominal strength. Although all of the MSHA seal failure investigation reports find some reason to attribute the failure to improper seal construction, the recent Lake Lynn tests show that omega block seals that were horribly constructed had a strength of at least 18-psi.[92] Recent Lake Lynn tests show that explosion pressures may have greatly exceed the 20-psi nominal strength of the seals and still not have been sufficient to damage the nominal 5-psi stoppings outside the sealed area. MSHA has systematically underestimated explosion pressures that have developed in sealed areas for many years. Still, MSHA persists in defending these obviously incorrect conclusions and furthermore uses this erroneous data as a key foundation for the ETS.

An MSHA press release on August 3, 2006 touted an agreement for the U.S. Army Corps of Engineers (ACE) to digitally reconstruct the Sago explosion to help determine overpressures of the explosion and the factors contributing to seal failure. There is no mention of this study in either the Sago accident report or the Seal ETS. There was a rumor earlier this year that the ACE study showed extremely high pressures at the Sago seals. Why has the results of this study been hidden from the American public?

The ETS is remarkably void of any reference to any of the numerous studies and peer-reviewed reports and papers that the mining, explosive, chemical, petroleum and military communities have carefully researched and published related to gas

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[88] ____ *Internal Review of MSHA's Actions at the Sago Mine* (June 28, 2007) p 58.
[89] Darby Internal Review, *Supra,* p 58.
[90] Sago Internal Review, *Supra*, pp F1-F2.
[91] Gates, *Supra*, p 184.
[92] Gates, *Supra*, Appendix X, p 3.

explosions, explosion-resistant structures and explosion pressures. MSHA was arbitrary and capricious in its drafting of this ETS because it includes no exploration of the scientific literature, no discussion of alternative approaches and no evidence that the grave danger afforded by seals was adequately addressed.

MSHA's pattern of minimizing seal problems has been remarkably consistent. Forgetting the preponderance of published data that contradicted the 20-psi alternative seal rule in 1992, a reasonable person could infer that MSHA should have examined its seal requirements after the third Oak Grove explosion. A reasonable person could also argue that MSHA should have taken positive steps to protect miners from seal hazards after the Sago explosion. Again, a reasonable person must conclude that this ETS on sealing abandoned areas is not sufficient to protect miners from explosions in sealed areas. Coal miners, victims, families of the victims, the survivors of the Sago and Darby disasters, the general public and Congress should demand an independent review of these findings. "Policy makers have a right to their own opinion, but not their own set of facts."[93] The Army Corps of Engineers, Lawrence Livermore Laboratories, Sandia Laboratory, NASA or a private forensic engineering group should take an objective look at this seal issue. An advisory panel should be formed to help MSHA re-examine this seal issue and develop broader, consensus approaches that will protect the miners from this proven hazard. MSHA does not appear to have the experience, expertise, understanding and inclination to develop an unbiased, effective rule on seals.

MSHA's accident reports and internal reviews on the Sago and Darby seal problems go beyond ordinary negligence and should be thoroughly investigated by a knowledgeable, independent, review board. Congress should exercise its oversight authority to investigate the obvious pattern of obfuscation, incomplete disclosure and deception that are shown in MSHA's Sago and Darby accident reports, the Sago and Darby internal review reports and this ETS. When viewed *in toto*, these incomplete, inaccurate and incorrect reports, the fatally-flawed 1992 alternative seal regulation, the "disappearance" of the Army Corps report on explosion modeling, and this weak, deceptive ETS, all point to Federal cover-up of Nixonian proportion. The American public, the families and friends of these accident victims and the nation's miners deserve clear, complete and undistorted information on these accidents, MSHA's actions related to these disasters, and the true hazards of sealed areas.

These investigative problems illustrate the reasons why an independent organization should be established to investigate all fatal and serious non-fatal mining accidents in the United States. This independent investigative agency should be modeled after the National Transportation Safety Board. MSHA has repeatedly proven that they are not capable of objectively examining these critical incidents, truthfully reporting all of the results to the victims, their families and the public and objectively using this information to correct deficiencies in MSHA's policies, procedures and regulations. Moreover, MSHA should not conduct its own internal reviews. That is like asking the fox to provide oversight on the henhouse.

The American people depend on Federal agencies to promote good scientific research and develop unbiased science-based policies to protect the nation's miners. Under the current Administration, MSHA has manipulated the scientific process, distorted results and suppressed key findings. Congress and the American people should not allow this sacrifice of scientific integrity at MSHA to continue.

In a more perfect world, MSHA would not have introduced cheap, ineffective coal mine seals in the 1992 ventilation regulation. In that same world, here would not be over 14,000 time potential time bombs in the nation's coal mines. And most importantly, seventeen coal miners would still be alive to enjoy this more perfect world with their family and friends. The Federal government must promulgate new seal regulations that will reliably contain the force of an explosion and will be reliably monitored and truly maintained inert in order to protect the nation's miners. MSHA used to refer to these brave men and women as the nation's most precious resource—of course, that was before the "hostile corporate take-over of MSHA."[94]

Sincerely,

A. C. Anderson

A.C. Anderson

Cc: Select Mine Safety Advocates
Select Journalists
Select Members of Congress

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[93] TENET, GEORGE, *At the Center of the Storm: My Years at the CIA,* Harper-Collins (2007) 576 p.

[94] REPRESENTATIVE GEORGE MILLER, *Protecting the Health and Safety of America's Mine Workers,* Committee on Education and Labor (March 28, 2007).