APPENDIX AL

SUMMARY OF EXAMINATION OF THREE REFUGE ALTERNATIVES

U.S. Department of Labor

Mine Safety and Health Administration
Approval and Certification Center
765 Technology Drive
Triadelphia, West Virginia 26059

November 22, 2011

MEMORANDUM FOR NORMAN G. PAGE
Accident Investigation Team Leader

FROM: JOHN P. FAINI
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SUBJECT: Summary of Examination of Three Refuge Alternatives Located at Performance Coal Company's Upper Big Branch Mine-South

The Approval and Certification Center (A&CC), as requested by Upper Big Branch Mine Accident Investigation Team Leader, Norman Page, conducted an investigation of three Strata Portable Fresh Air Bay refuge alternatives placed into service prior to a fatal mine explosion on April 5, 2010 at the Upper Big Branch Mine-South. Although not part of the actual accident investigation, the purpose of these examinations was for fact finding and to determine the functionality of the refuge alternative, post event. On March 31, 2011, the examination of the three Strata Portable Fresh Air Bay refuge alternatives that are located at the Upper Big Branch Mine was conducted.

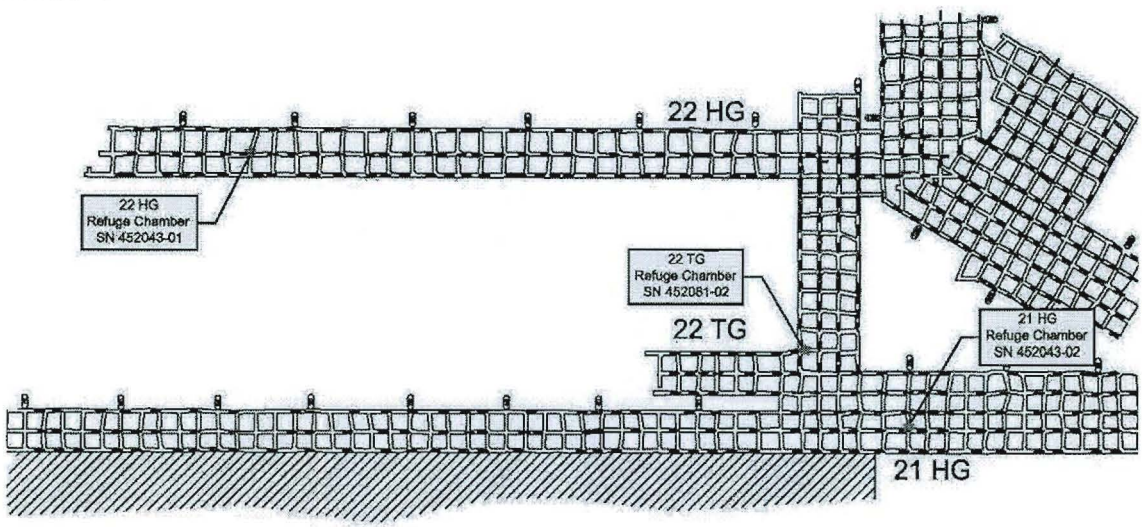
Background:
A refuge alternative is intended to provide a life-sustaining environment for persons trapped underground when escape is impossible. Refuge alternatives also can be used to facilitate escape by sustaining trapped miners until they receive communications regarding escape options or until rescuers arrive. MSHA considers refuge alternatives as a last resort to protect persons who are unable to escape from an underground coal mine in the event of an emergency.

The four "components" of a refuge alternative are 1) Structural, 2) Breathable Air, 3) Atmosphere Monitoring, and 4) Harmful Gas Removal. The *Structural Component* creates an isolated atmosphere and contains the other integrated components. Each refuge must be designed and made to withstand 15 pounds per square inch (psi) overpressure for 0.2 seconds and exposure to a flash fire for 3 seconds prior to deployment. The *Breathable Air Component* provides the breathable air to sustain each person for 96 hours. Breathable air shall be supplied by compressed air cylinders, compressed breathable-oxygen cylinders, or boreholes with fans installed on the surface or compressors installed on the

surface. Only uncontaminated breathable air shall be supplied to the refuge alternative. The *Atmosphere Monitoring Component* provides persons inside the refuge alternative with the ability to determine the concentrations of carbon dioxide, carbon monoxide, oxygen, and methane, inside and outside the structure, including the airlock. The *Harmful Gas Removal Component* removes toxic gases from explosions and fires through purge air and also removes carbon dioxide produced by the occupants. The Strata Portable Fresh Air Bay utilizes an air motor powered by the compressed air and compressed oxygen to entrain airflow through soda lime cartridges, which removes the miners' exhaled carbon dioxide from the interior atmosphere.

Examination:
The Structural, Breathable Air, and Harmful Gas Removal Components of the Strata Fresh Air Bay refuge alternatives were examined for their ability to function after an emergency event. None of the units were deployed on April 5, 2010, the date of the explosion, and remained in the pre-event condition. The Atmosphere Monitoring Component was not expected to function during these examinations since battery life on the hand-held Solaris™ gas detectors would have expired, and the detectors had remained in place and not charged since the explosion.

A team of 16 individuals from Strata Safety Products, MSHA, the State of West Virginia, the UMWA, and Massey travelled to each of the three refuge chamber locations to examine and deploy the chambers. The intent was to check the functionality of the chambers following the event of April 5, 2010. The units examined by the team were located in Headgate 21, Headgate 22, and Tailgate 22 sections.

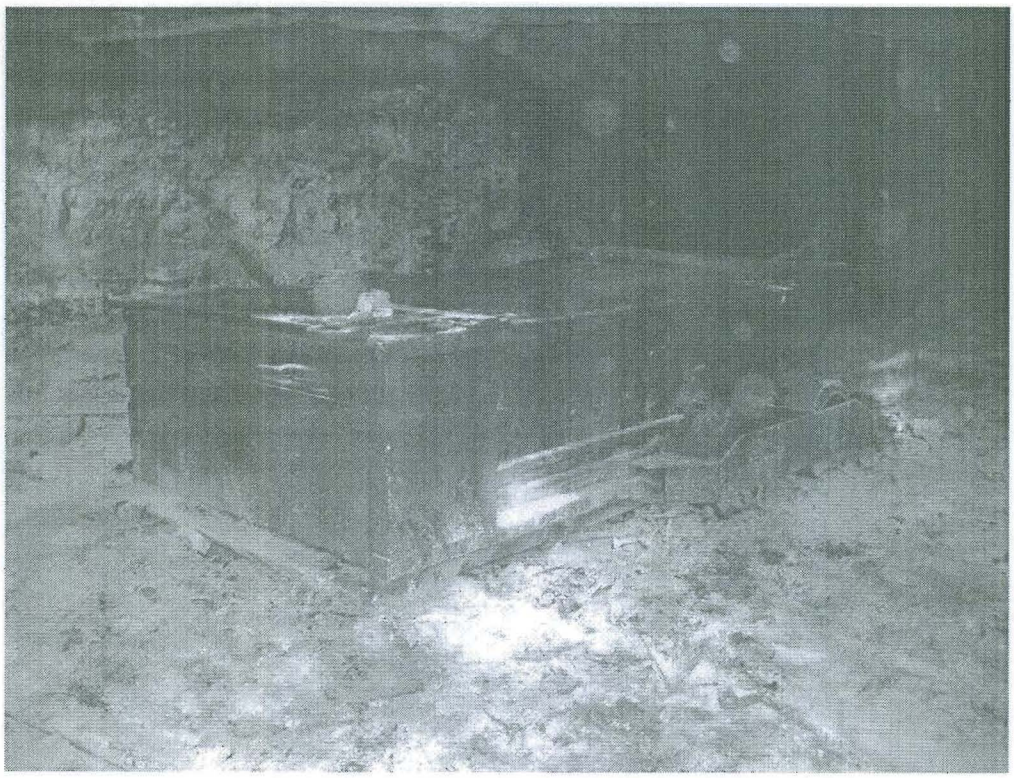


Each refuge was first examined for physical damage to the exterior and representatives from Strata Safety Products conducted an inspection of the compressed gas systems which was observed by the team. After these

inspections, Strata then performed a step by step procedure to deploy each unit which was observed by the team. The deployment included inflating the tent, activating the purge air system in the airlock, and activating the Breathable Air and Harmful Gas Removal components. The team then entered through the airlock into the tent. The air driven fan motor to the scrubber was turned on and adjusted without the chemical scrubbing agents being opened and used. The supply and provision caches which included chemical scrubbing cartridges, water, food, and spare parts were verified and checked for any damage.

Summary of the Examination / Deployment:

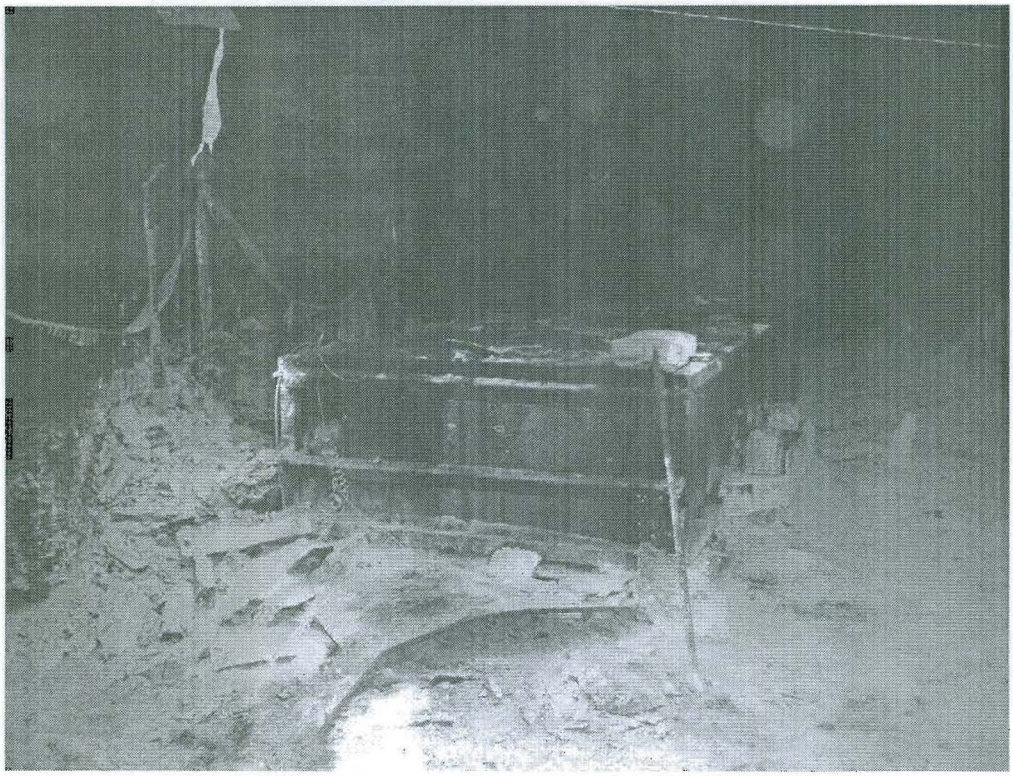
Location: **Headgate 21**
Strata Fresh Air Bay Model M2624-3.5
Serial Number 452043-02



- Side access door showed no visible damage.
- Solaris™ gas detector was located inside this side access door.
- Compressed gas cylinder pressures were within the manufacturer's specifications (4400-4600 psi).
- No corrosion or moisture in cylinder storage compartment.
- The tent inflated (approximately 4 minutes).
- Purge air system was functional.

- The CO2 scrubber fan motor started and ran. No scrubbing chemicals were used.
- The oxygen system functioned.
- The supplies were intact.

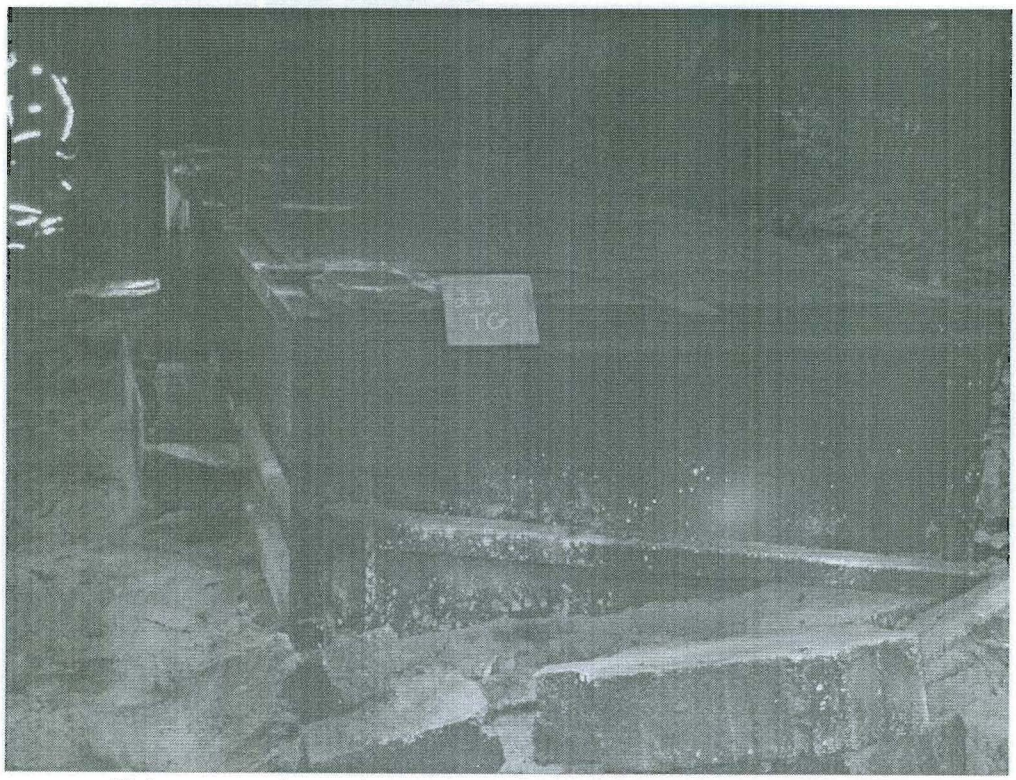
Location: **Headgate 22**
Strata Fresh Air Bay Model M2624-3.5
Serial Number 452043-01



- The unit appeared to have been under up to 20 inches of water. The water reportedly built up following the explosion and while the mine's pumps were not operated. The water was eventually pumped and the area was dry during the inspection.
- Side access door showed no visible damage and there was no evidence of moisture.
- There was evidence of heating on a plastic bag containing the hand-held gas detector stored in this compartment.
- Solaris™ gas detector was located in this compartment. It could not be determined if the detector would operate from the affects of the flash fire and heating due to the battery status. The detector had remained in place and had not been charged since the explosion. There was no visible evidence of damage or heat effects to the detector.

- A test was conducted at A&CC that exposed a similar Solaris™ gas detector stored in a plastic bag to 300° F for three seconds. The results of the test indicated that the plastic bag would deform, but the gas detector functioned as designed.
- Compressed gas cylinder pressures were within the manufacturer's specifications (4400-4600 psi) as read on gauges on the manifold.
- No corrosion or moisture was evident in cylinder storage location.
- A slate bar was required to assist in opening the tent deployment door because of debris on and around the unit, It was not determined as to when the material may have fallen from the adjacent rib either before or after the explosion.
- There was evidence of heating on the top corners of the tent storage compartment door. The seal showed no sign of heat damage.
- The tent inflated (approximately 4 minutes).
- Purge air functioned.
- The CO2 scrubber fan motor started and ran.
- The oxygen system functioned.
- The supplies were intact.

Location: **Tailgate 22**
Strata Fresh Air Bay Model M2624-3.5
Serial Number 452081-02



- Side access door showed no visible damage.

- No Solaris™ or other gas detector was located on this unit.
- Compressed gas cylinder pressures were within the manufacturer's specifications (4400-4600 psi).
- No corrosion or moisture was evident in cylinder storage location.
- The tent inflated. (approximately 4 minutes).
- Purge air system functioned.
- The CO2 scrubber fan motor started and ran..
- The oxygen system functioned.
- The supplies were intact.
- The tent deployment door would not open fully due to a rib roll. The tent was able to inflate and deploy around the door with no compromise.

Conclusion:

The three Strata Safety Products Portable Fresh Air Bays deployed as expected during the tests conducted on March 31, 2011. No tests were conducted beyond approximately 10 minutes of deployment and operation of the scrubber system without the chemicals being used. The systems were shut off and the tents were deflated following the examinations. The ability of the Strata refuge alternatives at the Upper Big Branch Mine to function as designed for 96 hours when occupied by the 20 miner maximum occupancy (as per the ERP) was not determined during these examinations.