



*State of West Virginia*  
**Joe Manchin III, Governor**

**WV Office of Miners' Health, Safety & Training**  
**Ronald L. Wooten, Director**  
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March 9, 2007

Modern Mine Safety Supply, LLC  
P. O. Box 480  
Huntington, UT 84528

Subject: Approval of the Emergency Refuge Shelter™ under WV Legislative Rule Title 56, Series 4 Emergency Rules Governing Protective Clothing and Equipment

Sirs,

After the evaluation of the documentation submitted and with the recommendation of our technical reviewers the Office of Miner's Health Safety and Training approves Modern Mine Safety Supply's Emergency Refuge Shelter™ for use in meeting the Emergency Shelters/Chambers requirements outlined in the West Virginia Emergency Rule Governing Protective Clothing And Equipment, §56-4-8 effective upon receipt of confirmation of approval of your battery powered scrubbing system or your substitution of a non-electrical system.

Upon receipt of the above, the Emergency Refuge Shelter™ will be approved for application in underground mines for use by 16 miners when built and provisioned as designed and providing a minimum of 96 hours life support.

Modern Mine Safety Supply shall, upon request, provide this office with verification of valid orders, delivery dates, and status of delivery as required for this office to enforce §56-4-8.

Any changes required or enhancements to the approved design affecting the ability to meet any provision of §56-4-8 shall require approval of this Office prior to any affected Emergency Refuge Shelter™ being placed into operation.

A handwritten signature in black ink, appearing to read "Ronald Wooten".

Ronald Wooten  
Director  
Office of Miners' Health and Safety

**Review of the Emergency Refuge Shelter™ Manufactured by Modern Mine Safety Supply, LLC for Adherence to WV Legislative Rule Title 56, Series 4 Emergency Rules Governing Protective Clothing and Equipment**

**March 8, 2007**

WV Requirement	Consensus	Justification
<p>§8.4.1. 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>-----</p> <p>In addition shelters were reviewed against the recent MSHA PIB 07-03 that makes a federal standard for refuge chambers that has different assumptions than used for the WV standard. The major items are --</p> <ul style="list-style-type: none"> <li>• 96 hours breathable air</li> <li>• 25 ppm instead of 50 ppm on the maximum CO;</li> <li>• 4 gasses to be detected in the chamber (O2, CO2, CO, and CH4);</li> <li>• 0.62297 LPM oxygen per man, not 0.5;</li> <li>• 0.5097 LPM CO2 scrubbing capability, not 0.4;</li> <li>• 3 fold chamber volume purge air requirement.</li> </ul> <p><a href="http://www.msha.gov/regs/complian/PIB/2007/pib07-03.asp">http://www.msha.gov/regs/complian/PIB/2007/pib07-03.asp</a>Some.</p>	<p>Meets all WV requirements except waiting MSHA approval of a sub-system</p>	<p>The independent professional engineer, Lloyd M. English, PhD, PE (10347WV) and the manufacturer presented reviewers with documentation and addressed inquiries such as to demonstrate that the Emergency Refuge Shelter™ met individual elements contained in §8.4.2. through §8.4.15. Meeting these requirements satisfies §8.4.1.</p> <p>The Emergency Refuge Shelter™ design reviewed was for 16 persons and provided life support for at least 96 hours. The independent professional engineer and manufacturer presented detailed computational analysis and evidence from testing supporting their claims that the units met or exceeded all applicable Title 56, Series 4 requirements and those applicable from MSHA PIB 07-03.</p> <p>It is the consensus judgment of the reviewers that the Emergency Refuge Shelter™ design reviewed met applicable requirements in Title 56, Series 4, §8.4.1. through §8.4.6 and §8.4.8. through §8.4.6. §8.4.7. is pending an action by MSHA on approval of Intrinsic Safety for the battery powered CO2 scrubber. When proof of approval is provided the judgment is that the approval by the Director is warranted.</p>
<p>§8.4.2. Be capable of surviving an initial event with a peak overpressure of 15 psi for 3 seconds and a flash fire as defined by National Fire Protection Association standard NFPA-2113 of 300 degrees Fahrenheit for 3 seconds;</p>	<p>Meets Requirement</p>	<p>The independent professional engineer and the manufacturer presented reviewers documentation and addressed inquiries regarding the results of detailed computational modeling of the Emergency Refuge Shelter™ that demonstrated their ability to sustain a 15 psi overpressure for 3 seconds without failure of structural components or deformation that would affect the operation of the unit. The computational analysis for the Emergency Refuge Shelter™ was done by Steve Dowden, PE of Peterson Inc, Ogden UT.</p> <p>The demonstration of survivability of flash fire requirement was accomplished through review of detailed construction drawings and the</p>

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§8.4.3. Be constructed such that it will be protected under normal handling and pre-event mine conditions;	Meets Requirement	<p>material specification of all external components.</p> <p>The independent professional engineer and the manufacturer presented reviewers documentation and addressed inquiries concerning the detailed construction drawings and material specifications for the Emergency Refuge Shelter™ that demonstrated to the reviewers the ability of the units to survive normal handling conditions in an underground mine and the ability of the manufacturer to address mine-specific operational capacity.</p>
<p>§8.4.4. Provide for rapidly establishing and maintaining an internal shelter atmosphere of oxygen above 19.5%, carbon dioxide below 0.5%, carbon monoxide below 50 ppm, and an apparent-temperature of 95 degrees Fahrenheit;</p> <p>-----</p> <p>In addition shelters were reviewed against the recent MSHA PIB 07-03 that makes a federal standard for refuge chambers that has different assumptions used for the WV standard. The major items are --</p> <ul style="list-style-type: none"> <li>• 96 hours breathable air</li> <li>• 25 ppm instead of 50 ppm on the maximum CO;</li> <li>• 4 gasses to be detected in the chamber (O2, CO2, CO, and CH4);</li> <li>• 0.62297 LPM oxygen per man, not 0.5;</li> <li>• 0.5097 LPM CO2 scrubbing capability, not 0.4;</li> <li>• 3 fold chamber volume purge air requirement.</li> </ul> <p><a href="http://www.msha.gov/regs/complian/PIB/2007/pib07-03.asp">http://www.msha.gov/regs/complian/PIB/2007/pib07-03.asp</a>Some.</p>	Meets Requirement	<p>The independent professional engineer and the manufacturer presented reviewers with documentation and addressed inquiries that demonstrated the ability of the Emergency Refuge Shelter™ to comply with applicable requirements in WV 56-4 and the MSHA PIB 07-03.</p> <p>The 96 hour supply of oxygen and removal of CO2 were demonstrated both computationally and through experimentation. The CO2 scrubber utilizes a battery that is pending MSHA Intrinsic Safety approval.</p> <p>The maintenance of CO was addressed through the design of the airlock and through the use of purge air for which computational analysis was supplied. The manufacturer agreed to add additional purge air capacity and a mechanically powered CO scrubber in addition to that presented.</p> <p>The maintenance of an apparent temperature below 95 F for all reviewed configurations of the Emergency Refuge Shelter™ were demonstrated through computational modeling completed was done by Steve Dowden, PE of Peterson Inc, Ogden UT.</p>

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<p>§8.4.5. Provide the ability to monitor carbon monoxide and oxygen inside and outside the shelter/chamber;</p> <p>-----</p> <p>In addition shelters were reviewed against the recent MSHA PIB 07-03 that requires monitors for 4 gasses to be detected in the chamber (O2, CO2, CO, and CH4);</p> <p><a href="http://www.msha.gov/regs/complian/PIB/2007/pib07-03.asp">http://www.msha.gov/regs/complian/PIB/2007/pib07-03.asp</a>Some.</p>	Meets Requirement	The independent professional engineer and the manufacturer presented documentation and addressed inquiries demonstrating the ability of monitoring applicable gases inside and outside the Emergency Refuge Shelter™
§8.4.6. Provide a means for entry and exit that maintains the integrity of the internal atmosphere;	Meets Requirement	The independent professional engineer and the manufacturer presented documentation and addressed inquiries that demonstrated the ability to enter and exit the Emergency Refuge Shelter™ without violating the integrity of the internal atmosphere through computational and experimental means. The manufacturer agreed to provide additional purge air and a mechanical CO scrubber in addition to that presented.
§8.4.7. Provide a means for MSHA certified intrinsically safe power if power required;	Meets requirements except waiting MSHA approval of a sub-system	The independent professional engineer and the manufacturer provided documentation and addressed inquiries from reviewers on the their electric blower in their CO2 scrubber. They provided documentation that the device had been submitted to MSHA for Intrinsic Safety approval. Once that is verified, the reviewers concur that the requirements will be met.
§8.4.8. Provide a minimum eight quarts of water per miner;	Meets Requirement	The independent professional engineer and the manufacturer presented documentation that sufficient water would be provided for 96 hours – 16 quarts per miner

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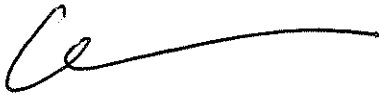
WV Requirement	Consensus	Justification
§8.4.9. Provide a minimum of 4,000 calories of food per miner;	Meets Requirement	The independent professional engineer and the manufacturer presented reviewers with documentation that 96 hours of food would be provided – 8000 calories per miner.
§8.4.10. Provide a means for disposal of human waste to the outside of the shelter/chamber;	Meets Requirement	The independent professional engineer and the manufacturer presented reviewers with documentation and addressed inquiries demonstrating that a means would be provided to meet this requirement.
§8.4.11. Provide a first aid kit as defined at W. Va. Code Chapter 22A Article 2-59(3)(b) independent of the section first aid kit required by W. Va. Code Chapter 22A Article 2-59(3) and 2-60(f);	Meets Requirement	The independent professional engineer and the manufacturer presented reviewers with documentation that required first aid materials would be provided.
§8.4.12. Have provisions for inspection of the shelter/chamber and contents;	Meets Requirement	The independent professional engineer and the manufacturer presented reviewers with documentation and addressed inquiries that demonstrated that sufficient provisions had been made for inspecting the Emergency Refuge Shelter™
§8.4.14. Provide a battery-powered occupant-activated strobe light of a model approved by the Director that is visible from the outside indicating occupancy;	Meets Requirement	The independent professional engineer and the manufacturer presented reviewers with documentation and addressed inquiries regarding the battery powered CO2 scrubber. The devices is currently awaiting MSHA approval for Intrinsic Safety. When proof is provided of the MSHA approval the Emergency Refuge Shelter™ will have meet this requirement.

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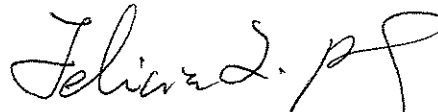
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<u>WV Requirement</u>	<u>Consensus</u>	<u>Justification</u>
§8.4.15. Provide provisions for communications to the surface; and	Meets Requirement	The independent professional engineer and the manufacturer presented reviewers with documentation and addressed inquires that demonstrated the ability to of the Emergency Refuge Shelter™ to support existing and emerging communication options and that each would be equipped to support the mine's communication system.

Reviewers:



Randall Harris, Engineering Advisor to  
Director OMHS&T



Felicia Peng, Ph.D., Associate  
Professor, Department of Mining  
Engineering, West Virginia University



Keith Heasley, Ph.D., Associate  
Professor, Department of Mining  
Engineering, West Virginia University