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**MILITARY & PROFESSIONAL OPERATIONS DIVISION**

TO: Mine Safety and Health Administration (MSHA)  
FROM: David K. Stancil  
Vice President  
Military & Professional Operations  
DATE: 20 March, 2006  
RE: **Comments to RIN 1219-AB44**

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The purpose of this document is to offer our comments on issues relative to mine rescue equipment. Specifically, we will comment on a proposed new Self-Contained Self-Rescuer (SCSR) from Aqua Lung/U.S. Divers. We estimate that this proposed belt-worn SCSR from Aqua Lung can deliver 40-50 hours of duration to the user.

**Background**

Aqua Lung/U.S. Divers has been in the business of designing and manufacturing of compressed air breathing devices for the professional and recreational SCUBA diving market since 1957. We are the world's leader in the diving business. In addition to recreational products, we also manufacture closed and semi-closed oxygen rebreathers for underwater use.

Aqua Lung/U.S. Divers is also the world's leader in small egress devices used by helicopter pilots for self-rescue from a downed aircraft in water related accidents. Recently, we have evolved this compressed air technology to an oxygen system to be used by helicopter crews for high altitude use in the mountains of Afghanistan.

When our company heard of the Sago Mine accident, we discussed within our Engineering department how we could adapt our current technology to develop a new type of SCSR. We have tentatively assembled a team of established industry partners to bring together existing technology to build the new SCSR.

**Prototype SCSR design**

Aqua Lung/U.S. Divers is proposing a new type of SCSR we call the Prototype Mine Rescue Device (PMRD). It is best described as a belt mounted system comprised of five (5) main components. Reference is made to Exhibit A -the attached drawing of part number 105000 Mine Rescue Device-Proto.

**A. The oxygen cylinder/regulator system-** we are proposing our existing and time-proven technology of a 6 cubic foot cylinder with our integrated pressure-reducing valve,

an on/off knob and an indicator gauge. This design is simple, safe, and very robust and has been approved by numerous military agencies such as the U.S. Army and the U.S. Navy for compressed air use. However, all components will operate safely with oxygen substituted for the compressed air.

**B. The oxygen pulse regulator**-In order to gain the 40-50 hours of estimated duration, we are proposing the patented technology of an electronically controlled pulse-demand regulator (EDS) as an oxygen conservation device in-line between the oxygen supply and the mouthpiece. The EDS is manufactured by a member of the proposed Aqua Lung SCRS development team. As the miner inhales from the mouthpiece, he will orally inhale not only CO scrubbed ambient air but also a pulse of pure oxygen to maintain his/her oxygen saturation at a safe level.

Pilots and other oxygen users worldwide have learned to depend on this patented EDS electronically controlled pulse-demand oxygen technology. The EDS makes the best use of available oxygen by adjusting automatically to their individual breathing rhythms and supplying exactly the amount of oxygen needed. Whatever the altitude, no adjustment is necessary and the oxygen supply is automatically delivered.

The EDS monitors micro-pressure changes in human breathing, delivering a precise pulse of oxygen at the instant each inhaling cycle is detected. It is connected to either a nasal cannula or an oxygen mask, and in the case of the PMRD, to the special mouthpiece. The small and lightweight EDS control unit connects via a soft tube to a regulator on the oxygen cylinder.

By utilizing the Pulse-Demand technology for the mine rescue market, the quantity of oxygen saved is considerable as compared to other constant flow systems, resulting in our ability to estimate the 40-50 hours of duration. This design also eliminates the need to change over from one SCRS to another, thus reducing risks. The anticipated simplicity of the system is also expected to reduce donning training requirements.

**C. The catalyst cylinder**-We are proposing to place a cylinder of catalyst in the breathing loop to scrub the ambient air. The catalyst stage consists of two to three pounds of precious metal type low temperature catalyst that does not require the removal of humidity to facilitate proper conversion of Carbon Monoxide into Carbon Dioxide. Catalyst consists of an alumina-based substrate impregnated with palladium, copper and nickel compounds to create the exothermic reaction:  $2\text{CO} + \text{O}_2 = 2\text{CO}_2$ . Catalyst is manufactured by another Aqua Lung team member and is currently used in compressed air purification for supplied air respirators. Testing in this application indicated that at 2 SCFM airflow rate the catalyst would reduce 1000 ppm of incoming Carbon Monoxide to 50 ppm or below during a 50-hour test period.

**D. The mouthpiece**-We are proposing a modified mouthpiece that is similar to the model of Aqua Lung's emergency egress devices used by the Royal Navy in England for passengers of helicopters. The concept is simple. The miner inserts the mouthpiece in his/her mouth and bites down on the traditional SCUBA regulator mouthpiece. The design of this mouthpiece is a proven design to provide a secure fit and ease of use.

When the miner inhales, he/she gets a breath of ambient CO scrubbed air as well as a pulse of oxygen from the EDS. In addition, the mouthpiece has been fitted with a nose closure device, identical to the model used by the Royal Navy.

**E. The mounting belt** (belt not shown in drawing)-We are proposing a one-size fits all webbing belt that is easily adjustable. The oxygen cylinder, the EDS regulator, and the catalyst cylinder would be contained in nylon pockets and attached to this belt. By mounting these elements on a webbing belt, the miner should have good freedom of movement and be able to maintain a comfortable sitting position as he/she waits for rescue or conducts self-rescue. The final configuration for wearing the system will be in accordance with the requirements of the user.

### **Status of the PMRD**

Aqua Lung has conceptualized the combination of elements as described above and has resourced certain engineering data from our potential industry partners on the performance of the EDS and the catalyst. However, Aqua Lung has not built a prototype of the PMRD and our estimate of 40-50 hour duration is based on data from each of our potential team members. We have estimated the ROM cost of each PMRD at less than \$2,000 each.

### **Requested Action Plan from MSHA**

It is our hope that the MSHA will have interest in this proposed combination of existing technology. If this were the case, Aqua Lung would like to explore a relationship with MSHA whereby we obtain funding for the research and development needed to validate, test, and potentially obtain the required government approvals for this product concept.

### **Additional Comments**

Aqua Lung has limited experience in specific equipment for the mine safety industry. However, we have years of experience in building compressed air breathing devices and have the expertise and willingness to bring together a team of industry partners to commercialize the PMRD.

### **Points of Contact**

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Respectfully Submitted,



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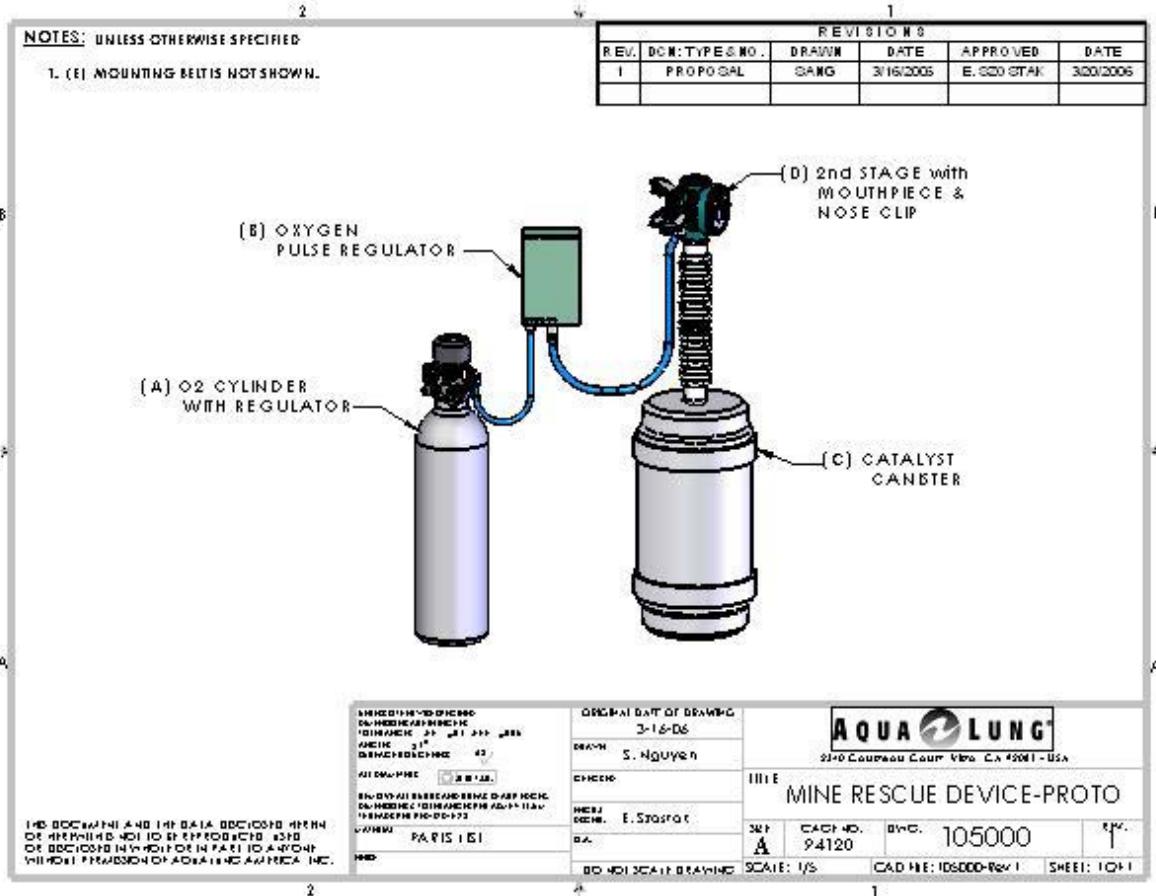


Exhibit A. Drawing of Aqua Lung Prototype Mine Rescue Device part # 105000.