Development of a Dockable, Hybrid Self-Contained-Self-Rescuer for Use in Mines

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Short Summary of project: Early mining history in the United States holds many counts of mine fires and explosions where thousands of miners lost their lives. "Bloody December" in 1907 saw a series of explosions that resulted in the deaths of 692 miners. Additional disasters in 1908 and 1909 resulted in the passage of Public Law 61-179 which went into effect on May 16, 1910, forming the United States Bureau of Mines. This early organization was tasked with not only preventing fires and explosions in mines but also to improve mine rescue. One of the many results of these efforts was various apparatus to enable miners to survive the toxic atmosphere found in post-disaster mines.

Events over the ensuing years saw a dramatic decrease in miner deaths and a series of additional laws enacted in 1941, 1947, 1952, 1961, 1966, 1973 and 1977. The improvement of respirators for use in mines was one of the important innovations demanded by this string of legislation. Over this time, filter self rescuers (FSR) that converted poisonous carbon monoxide to non-poisonous carbon dioxide were introduced as self-rescuing devices. Miners used these FSR's to save themselves on many occasions. However, theses devices require that the mine atmosphere contain enough oxygen to support life. This was often not the case. Further research produced devices that provide breathable air that is not dependent on the mine atmosphere. These devices are known as Self-Contained-Self-Rescuers (SCSR).

Today, Federal Mine regulations (30CFR 75.1714) require that every person who goes into an underground coal mine in the United States be supplied with a SCSR and be trained in its use. These required SCSR's are emergency breathing apparatus designed for the purpose of mine escape. They must be capable of providing a breathable atmosphere for one-hour and must be approved by the Mine Safety and Health Administration (MSHA) and the National Institute for Occupational Safety and Health (NIOSH).

SCSR's were first introduced into coal mines in 1981 where they proved to be life saving devices. However, the size and weight (typically over 8 lbs.) of these devices largely prohibited their being carried by miners on a regular basis. Rather, these devices were stored near where miners work. Studies completed by a government, industry, and labor taskforce in 1986 concluded that SCSR's need to be worn on the miners' belts and that they should be substantially smaller than the devices of that time. These smaller devices (about 5.7 lbs) were introduced into mines in 1991.

SCSR technology was recently revisited by three NIOSH-sponsored workshops held at the National Technology Transfer Center in 2005 and 2006 to explore the feasibility of developing a 3rd generation device. Two new approaches to SCSR design included a modular device where additional units of oxygen supply could be "plugged" into the device without exposing the wearer to the surrounding air. A second new

approach combined a self-contained unit with a carbon monoxide filtering device, much like but improved over the earlier FSR's.

A recent mine explosion at the ICG Sago Mine, near Buchanan, WV highlighted the potential usefulness of longer duration self-rescuer technology. Miners perished there due to carbon monoxide poisoning after barricading for a duration requiring far more oxygen than the capacity of their SCSR's. Additional oxygen supplies may have allowed them to remain in the barricade until mine rescue teams reached them or perhaps even to have escaped after waiting for the dust and smoke to clear. In addition, at the recent mine disasters of Sago, Alma no.1, and Darby mines, all the miners who perished after the initial impact of the explosion, died of carbon monoxide poisoning.

The recently enacted Mine Improvement and New Emergency Response Act of 2006 (MINER Act) addresses this problem by requiring additional supplies of breathable air for individuals trapped underground during a mine escape. However, if a miner can not successfully make transfers from one SCSR to the next while in poisonous air, the additional oxygen will be of little use. Transferring from one device to the next may be very difficult in the high stress situation found after a mine fire or explosion. The dockable/ hybrid SCSR being developed in this project will greatly simplify that transfer process.

Mission Relevance: Providing additional safe, breathable air to miners attempting to escape and survive a mine fire or explosion will improve their chance to live.

Problem: Miners need longer duration respiratory protection in the event of a mine fire or explosion where the atmosphere is incapable of supporting life or contains high levels of carbon monoxide.

Who is affected? The coal miners of the world are affected.

Solution: Provide a person wearable breathing device that will enable miners to safely change out oxygen cartridges, extending the duration of their SCSR's. In addition, to produce a carbon monoxide filter that can be used to protect miners where appropriate air conditions exist. Finally, produce a breathing air monitor that will measure the oxygen and carbon monoxide content of the mine atmosphere.

What has been accomplished thus far: A contract has been awarded to Technology Products Inc. to design and produce a person wearable dockable and hybrid SCSR that will meet the requirements of 42 CFR Part 84 and Federal Mining Regulations, including the newly enact MINER Act. A design has been completed and prototypes are expected to be delivered in May 2007.