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Completion of a Prototype Cryogenic Energy Storage and Deep Mine Chilling Co-generation System, Construction of Prototype and Results from Testing.

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Chilling a deep underground mine is costly and energy intensive. The temperature of the air increases as it descends due to the adiabatic lapse rate (called auto-compression in mining), the host rock, equipment and processes are additional sources of heat. There is an expectation that battery powered vehicles may allow for less air flow due to reduced airborne particulates, legislation changes pending, that increases the susceptibility to any additional heat. Battery powered vehicles and the charging process both add heat. A reduced air flow reduces the heat needed to raise the temperature to unacceptable levels, which may only require the operation of a few large machines. This paper discusses results from a prototype, a cryogenic co-generation system that stores energy and provides chilling, effectively the heat from the mine is converted to electricity (5 MWe electrical power absorbs 8 MWr of chilling). Additionally compressed air can be produced simultaneously producing chilling (5000 cfm produces 1.2 MW chilling) and motive force, engines for equipment would produce cool clean air as exhaust with about 1/3 motive power to 2/3 chilling. Results obtained from a bench scale prototype system, demonstrates the rapid response of the air flow to chilling. Using a cryogenic fluid to chill a deeper mine only requires a longer pipe when the mine depth is increased and the liquid is piped so the system can provide chilling where it is needed, which is cost effective.

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