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Cryogenic Energy Storage in Conjunction with Mine Chilling a Co-generation System (I)

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Cryogenics is a mature yet growing industry and cryogenic liquids are in increasing demand as global industrialisation continues to expand, especially with the increase in liquid natural gas projects, which is providing mutually beneficial advances in cryogenic equipment. In this paper we discuss the use of cryogenic liquids as an energy storage vector, which has implications on the energy profile of the mine especially if renewable energy sources are involved. The generation of electricity in an underground facility simultaneously produces chilling in a two stage process. The liquid delivered from the surface plant to the underground site firstly undergoes a change of state, which absorbs heat from the mine air, next the air expands, absorbing more heat, through a turbine to generate electricity. In a 1 MWe generator the chilling is variable depending on the temperatures and configuration, but a continuous supply of approximately 1.5 MWr would be typical. The use of cryogenic chilling is complimentary to the increasing aspiration of the industry to replace diesel powered vehicles with electric vehicles. The use of electric vehicles introduces a potential for a substantial reduction in ventilation airflow, which increases the susceptibility of the airflow to injected heat during charging and operation of electric vehicles. The ability of large scale chilling systems to respond to variations in heat load on a given level is limited or non-existent unless the entire mine is affected. The cryogenic systems are capable of chilling on demand because a liquid flow can be delivered to individual levels and temperatures on a given level can be adjusted by changing the liquid flow rate. The thermodynamics of the electrical/chilling co-generation system will be discussed and the implications of standalone systems for remote off grid applications will be outlined.

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