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Tutorial Title

Underground Mining Fleet Electrification: Challenges and Opportunities

Instructor Team

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Co-Speakers:

Abstract

Battery electric vehicles (BEVs) are an attractive solution to help the mining industry decarbonise operations while reducing costs. The mining industry contributes approximately 4-7% of greenhouse gas emissions globally, with around 40% of mine site energy use related to diesel-powered mining vehicles. IBEVs offer additional advantages for underground mines of reducing exposure of personnel to diesel exhaust fumes, reducing required air ventilation levels and reducing operational costs. While BEVs present a pathway to reduce CO2 emissions and operating costs on the mine site and create world-class ESG outcomes, an in-depth understanding of their performance capability and access to detailed operational data are required for their successful implementation in underground mines. This tutorial presents results from the Mine Operational Vehicle Electrification (MOVE) project led by the University of Adelaide, funded by the Australian Future Battery Industry Cooperative Research Centre (FBICRC) involving a number of mining industry partners, including BHP and IGO. This project involves case studies on two existing Australian underground nickel mines examining the optimisation of the energy storage sizing and charging infrastructure approach for vehicles. It also covers the renewable energy microgrid design taking into account the electrified fleet charging requirements. This seminar will consist of four parts: 1) Motivation, challenges and opportunities of electrification of mine vehicles: the main advantages include reduced emissions and costs and improved health/safety and monitoring. The main challenges include the size/weight/life of energy storage, the cost/location/power requirements of the charging infrastructure, and effect on mining productivity. 2) Design principles for electrification of mine haul trucks: haulage cycles, physical energy requirements, mine vehicle drivetrain configurations, energy storage types, charging technologies, and example commercial electric mine trucks 3) Haul truck onboard storage sizing and charging technology design: analysis approach, sizing optimisation for different charging technologies, example results for different haul profiles, demonstration of design software 4) Mine renewable energy microgrid design including electrified mining fleet charging needs: mine electric loads and generation, integration of renewable energy, effect of vehicle electrification on loads, optimisation of scheduling of vehicle charging to maximise use of renewable energy.

Instructor Team Biographies

Wen Soong is one of the chief investigators in the Mine Operational Vehicle Electrification (MOVE) project whose industry partners include major mining companies such as BHP and IGO. He has a Bachelor degree from the University of Adelaide, Australia, and a PhD from the University of Glasgow, UK, both in electrical engineering. He worked for four years for General Electric in New York, USA

before joining the University of Adelaide where he is an Associate Professor. His technical expertise includes electric machines and drives, power electronics, renewable energy and energy storage.

Some of the MOVE project outcomes include:

- Provisional Patent Application with IP Australia on the charging infrastructure design and onboard battery sizing
- A public report on the status of mining vehicle electrification in Australia
- Two articles published in the March 2024 issue of IEEE Electrification Magazine
    - o Toward underground mobile fleet electrification: Three essential steps to make a real change.
    - o Industrial internet of things in mine electrification: Necessity or luxury?