Hybrid Underground Loader

2010 Project Update
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Objectives *(at start of project, ~2005)*

- Ventilation demand reduction
- Progressive step to zero emissions design
- Comply with expected more stringent emissions regulations
- Maintain and promote mechanization in narrow vein and other challenging mining conditions

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Project participants:

- MTI
- Climate Change AP 2000
- SOREDEM
- NRC-IRAP
- CANMET-MMSL
- CANMET-Energy Technology (IERD)
- DEEP-Camiro
- Hydro-Quebec
- Participating mines (in kind) - 4 mines

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Summary of Activities

- Basic research, concept development at CANMET – 2001 – 2005
- Machine project active at MTI since 2005
- Issue resolution and optimization phase, 2009
- Comparative Study, CANMET test mine, Jan-2010
- Long term testing at an actual Mine site, 2010

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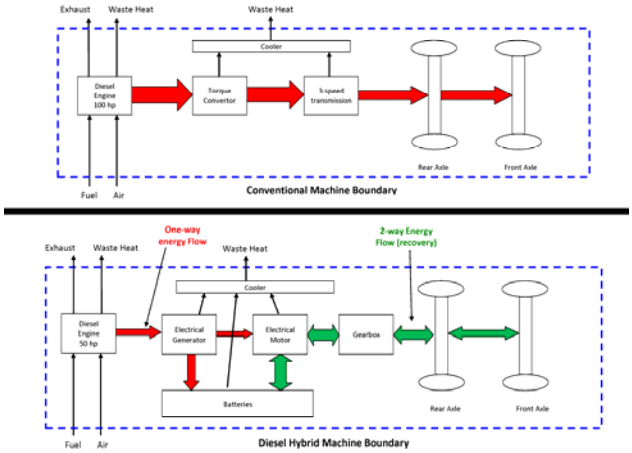
Selected solution: Diesel electric hybrid



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Diesel electric hybrid: Advantages

- Small engine continually operating at peak efficiency
  - Reduction of exhaust emissions (cleaner burning, better DPF performance)
  - Increased fuel efficiency (engine operates at peak efficiency)
- Electrical motor supplies power equivalent to conventional (larger) diesel engine (draws extra power from batteries when needed)
- Energy recovery capability (e.g.. operating down ramp)

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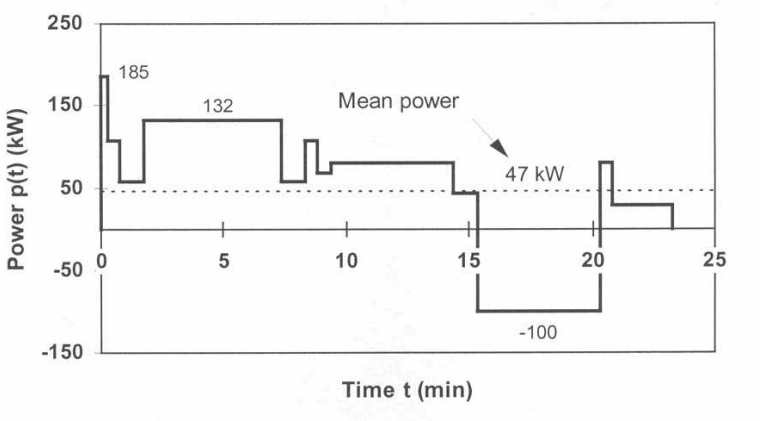
Typical LHD Engine Power vs. Time in Operating Cycle



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Test program:

- Comparative test
  - @ CANMET test mine (Val d'Or)
  - Detailed data acquisition of vehicle emissions and operating parameters and ambient air monitoring
- Long term test
  - Operation in working mine to validate 'real world' performance
  - @ IAMGOLD Mouska Mine, Rouyn-Noranda

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Findings and Results to date (1):

- Emissions (ventilation impact) – compare actual to expectations
  - "Amount" of emissions
  - Emissions of specific compounds (12% to 64% reduction)
- Fuel efficiency – compare actual to expectations
  - Testing indicates 15% lower fuel consumption (CANMET lab test) vs. expected 40% reduction

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Findings and Results to date (2):

- Positives:
  - overall machine performance better than expected, excellent mucking capability
- Negatives:
  - battery capacity (need to stop for recharge);
  - electrical system 'challenges" (grounding problem, now solved);
  - fuel consumption higher than expected
  - engine to generator mechanical connection (coupling failures… load characteristics)

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Future plans:

- Improved battery (longer run time)
- Improve powertrain efficiency (reduce losses)
- Improve hydraulic system efficiency

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QUESTIONS

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