BEV RISK MITIGATION: EXAMINING MACLEAN SUPPORT AND TRAINING

January 20, 2021 WSN symposium: Battery Electric Vehicle Safety in Mines



Presentation overview

- Exciting news from Cambrian and MacLean
- Introduction of Cambrian
- Introduction of MacLean & MacLean technology
- MacLean battery electric vehicle overview
- MacLean risk approach
- Cambrian College training
- Q&A



Cambrian College and MacLean news

- MacLean is partnering with Cambrian College to support skills and technology development for the electric, automated, and digitalized mine of today and tomorrow.
- The MacLean Research and Training Facility in Greater Sudbury, Ontario, is set to host the practical component of Cambrian's Industrial Battery Electric Vehicle Maintenance Course.
- Cambrian's curriculum, compiled in part with MacLean technical input, is designed for Heavy Duty technicians currently working in the mining sector.
- The partnership will also support the development of the next generation of mechatronic workers as automation and digitalization projects also ramp up globally in the mining sector.







About Cambrian's Centre for Smart Mining

- Technology Access Centre (TAC) is a specialized R&D centre affiliated with a college or cégep that provides Canadian businesses with applied research and innovation
- Provides services to produce new prototypes, scale-up manufacturing, solve unique business challenges, and provide customized training on the latest equipment and emerging technologies.
- As one of Canada's preeminent mining-focused colleges, Cambrian concentrated on smart mining for its new TAC





NDUSTRIAL BATTERY ELECTRIC VEHICLE MAINTENANCE COURSE



MacLean Intro & technology



In MacLean

In MacLean

Performance. Reliability. Innovation.

History

- Founded in 1973 in Ontario, Canada, remains privately held
- 900+ employees globally (600+ in Canada)
- 2000+ units commissioned to date
- Canada's largest mining OEM

Value proposition

- Extensive hard rock mining experience
- Multi-discipline engineering
- Integrated design, manufacturing and assembly
- International sales, customer service and support

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Utility Vehicles & Attachments

- Material and Personnel Transport
- Elevated Work Platforms

Ground Support

- Bolters
- Shotcrete

Ore Flow

- Drill & Blast
- Scalers & Rockbreakers

Advanced Vehicle Technology

- Remote Operation
- Digital Products
- Battery Electric Vehicles

TECHNOLOGY ROADMAP

MacLean Critical Technologies

Automation

- Remote Inputs
- Safety System
- Communications
- Machine Vision
- Sensing & Encoding
- Machine Control

Digital Systems

- Vehicle Telemetry
- Human Machine Interface
- Customer Portal
- Data Analytics & Security
- 3rd Party Integration
- VR Training Simulator

Electric Vehicles

- Equipment Design
- Powertrain Design
- Re-design Duty
- Smart Power Management

Interoperability in Production Automation

- Epiroc LHD's and MacLean Secondary Reduction equipment (BH3's and WC3's) all operated from surface, each with their respective OEM system
- MacLean tele-operation and vehicle location tracking compatible with Epiroc Production Automation
 - One traffic management system
 - One safety gate system
 - Production and Secondary Reduction work safely and productively together!

MacLean Telemetry

- Purpose of the MacLean's telemetry system is to provide the operators and mechanics with useful information to improve their job performance and equipment availability.
- The system features:
 - Intuitive gauge cluster to provide the operator with valuable information
 - Remote machine monitoring
 - Heads-up warnings and reminders to the operator
 - Onboard diagnostics page for service technicians
 - Onboard live reminders and warnings for operators
 - Onboard manuals and schematics viewer

Mine Connectivity

- The MacLean telemetry system will connect via WiFi to the underground network; or can be equipped with a LTE Modem.
- Data can also be sent to a customer maintenance system.

MacLean Battery Electric Vehicle overview

Borden

Thompson

New Afton

Laronde

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Equipment available in EV

Available to order today	Available in 2021 & 2022
975 – Platform Bolter	SSB – Small section bolter
AC3 – Anfo loader	CB3 – Cable Bolter
AG3 – Agitator truck	WC3 – Water Cannon
BH3 – Blockholer	RB3 – Rock Breaker
BT3 – Boom truck	RS3 – Mobile scaler
CS3 – Cassette carrier	LR3 – Platform truck
DT3 – Deck truck	GR5 – New MacLean grader
EC3 – Emulsion loader	Low profile product line
FL3 – Fuel/lube truck	
FT3 – Fuel tanker	To complement all BEV equipment:
PC3 – Personnel carrier	- Additional battery options
SL3 – Scissor lift	- Chiller package for hot mines
SB12 – Hang-up drill rig	
SS5 – Shotcrete sprayer	
TM3 – Transmixer	
WS3 – Water sprayer	

Note: Machines in bold have been built

Current battery configuration

Battery Electric Vehicle (BEV)

1 Battery Assembly/BEV

15 Modules/Tray

3 Trays/Assembly

Basics of BEV Design

Standards & guidelines

- Participating in drafting GMG BEV guidelines Rev3
- Participating in updating CSA standard M424.0. CSA is now including and developing standards for BEV and BEV hybrid equipment for the Canadian market

MacLean risk approach

In MacLean

Risk Assessment - Layers

MacLean BEV design safety layers

BATTERY CELL SAFETY LAYER

Note: This is a high-level overview, additional details available upon request

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BATTERY MODULE SAFETY LAYER

BATTERY TRAY SAFETY LAYER

BATTERY ASSEMBLY SAFETY LAYER

VEHICLE SAFETY LAYER

Note: This is a high-level overview, additional details available upon request

Performance. Reliability. Innovation.

Administrative controls

- Contingency planning:
 - Transporting batteries
 - Towing vehicles
 - Resources in case of emergency
- Outlining trade qualifications
- Training

Emergency Response – Battery Transportation

Faulty battery removed from vehicle and connected to portable monitoring system

Faulty tray placed into fire containment system (FCS) and prepared for delivery to surface Battery loaded into cage or transported via ramp to surface for pickup

Battery awaits pick up on surface and shipped from site via 3rd party transport company to MacLean

Emergency Response - Towing Procedure

MacLean - MAINTENANCE BULLETIN BEV TOWING PROCEDURE Title: Battery Electric Vehicle (BEV) Towing Procedure Number: MB-GEN3205 PROCEDURE Part Number(s) Affected: 1070616, 1133010, 1220820, 1233901 Machine Model(s) Affected: MacLean EV SeriesTM Vehicles PLACE WHEEL CHOCKS ON BOTH SIDES OF MACHINE TIRE ENSURE HVDC PANEL DISCONNECT SWITCH IS IN THE 'OFF' POSITION ENSURE 24VDC BATTERY DISCONNECT SWITCH IS IN THE 'OFF' POSITION Parts Manual Section: Drive Train PPR References: 37069 FCN References: N/A PSB References: PSB20-014EN CONNECT THE TOWING STRAPS TO THE FRONT BUMPER TOW POINTS OF THE BEV 4. Revision: B Creation Date: 23-Sept-2020 Revision Date: 13-Jan-2021 REMOVE THE HYDRAULIC HOSE LABELED 'TKOS' OR 'TK45' FROM THE 'T' OR 'TK' PORT ON THE BRAKE MANIFOLD 5. CONNECT A HYDRAULIC HAND PUMP TO THE 'T' OR 'TK' PORT 6. 1.0 Scope: APPLY A PRESSURE OF 300 TO 500 (MAX) PSI IN ORDER TO RELEASE The purpose of this Maintenance Bulletin (MB) is to provide a detailed explanation for the THE BRAKES steps to safely tow a MacLean Engineering EV Series™ vehicle TIGHTEN ANY SLACK IN THE TOW STRAPS AND REMOVE THE WHEEL CHOCKS FROM THE WHEEL THE BEV MAY MOVE AT THIS TIME 8: This document is supplied as a service. The information provided was known to be up to TOW THE DISABLED BEY AS REQUIRED WITHOUT EXCEEDING 4KM/H. FOLLOWING MINE SITE PROCEDURE ABOVE 4KM/H MAY CAUSE DAMAGE TO THE TRACTION MOTOR AND MOTOR CONTROL UNIT date at time of printing. If any discrepancies occur, please contact MacLean Engineering 9. as soon as possible. Up to date information will be sent where possible. WHEN YOU ARE FINISHED TOWING THE BEV, PLACE WHEEL CHOCKS ON BOTH SIDES OF MACHINE TIRE DISCONNECT THE HAND PUMP FROM PORT 'T' OR 'TK' ON THE BRAKE THE FOLLOWING PROCEDURE MUST ONLY BE PERFORMED BY TRAINED AND QUALIFIED MAINTENANCE PERSONNEL AILURE TO COMPLY MAY RESULT IN SERIOUS DAMAGE TO 11. THE VEHICLE AND/OR DEATH TO PERSONNEL. MANIFOLD 12. RECONNECT THE HYDRAULIC HOSE THAT WAS REMOVED IN STEP 5 AND CLOSE THE BRAKE MANIFOLD COMPARTMENT DOOR ALWAYS FOLLOW ALL MINE SITE AND/OR GOVERNMENTAL RULES AND REGULATIONS REGARDING VEHICLE TOWING Figure 7: BEV Towing Procedure Label

igure 7. DEV Towing Procedure Laber

Emergency Response – Vehicle Information

- MacLean in collaboration with one of our customers are piloting emergency response information sheets to be used by the control group in an underground emergency as a resource
- Will be provided to all customers once pilot is completed

BEV Service Layers – Trade Qualifications

Qualified Personnel:

Mechanic: A licensed/certified mechanic authorized by site.

- 421A Heavy Duty Equipment Technician
- 310S Automotive Service Technician
- 310T Truck and Coach Technician

Electrician: A licensed/certified electrician authorized by site.

- 309A Electrician Construction and Maintenance
- 442A Industrial Electrician

MacLean Only: Only a MacLean Employee can complete the task.

Trade names as per <u>www.collegeoftrades.ca</u>

Example of maintenance task mapping

Cambrian College Training

In MacLean

New Technology Adoption: BEVs

- Provide services to produce new prototypes, scale-up manufacturing, solve unique business challenges, and provide customized training on the latest equipment and emerging technologies.
- A large part of the technology adoption problem for mines is often overlooked. It deals with ensuring end-users have the proper training in place to receive new technology.
- BEVs are being adopted at an increasing rate. There is a skills gap among equipment maintainers associated with working on BEVs.

Cambrian's Industrial Battery Electric Vehicle Maintenance Course

- Targeted at in-service heavy duty technicians
- Developed with input from MacLean Engineering
- Vetted with input from end-users and OEMs
- Currently booking registrations
- Expert trainers that have work at OEMs and Mine sites

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INDUSTRIAL BATTERY ELECTRIC VEHICLE MAINTENANCE COURSE

Program Structure

College Certificate Program- 60 total hours

- Module 1: Fundamentals of Battery Electric Vehicle Safety
- Module 2: Introduction to Battery Electric Components
- Module 3: Introduction to Battery Electric Vehicle Communications and Troubleshooting

Module 4: Practical Battery Electric Vehicle Training

Practical BEV Training with MacLean Engineering

- Practical BEV Training
- Partnership between Cambrian College and MacLean Engineering
- Trainees enrolled in the certificate program will have an intensive practical training experience with real BEV components and full-size BEVs
- Delivered at MacLean's Research and Training Facility
 - common components, troubleshooting, safety features, vehicle demo in the underground centre
- R&D partnership with a focus on vehicle technology and mechatronics

In summary..

- Safety systems continue to mature as more EV machines are deployed.
- For BEV to be successful you need training for the people to support the technology.
- As highlighted in the last symposium, we are now collaborating to build the BEV Heavy Duty Technician skillset that is required in the industry.
- Adoption of technology in the mining industry is happening. These conversations and collaborations drive progress & alleviate friction points.

Musselwhite EV Bolter – longest running MacLean EV machine

Q&A + contact info

Please do reach out for any questions, requests for documentation or discussions on how this could work for your project/operation

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https://cambriancollege.ca/BEV/

https://www.macleanengineering.com/products/mining/electric -vehicle-series

