Storage Integration into Hybrid Diesel-Renewable Microgrids in Northern Mines

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Presentation Outline

• Remote mine microgrids with renewable power
• Raglan Mine #2 Wind-storage Pilot Project
  – Overview
  – Energy Storage
  – Microgrid Controls
• Conclusion
Top 100 Exploration and Deposit Appraisal Projects in Canada Vs. Wind Resource Data

Source: Natural Resources Canada
Business Case for Renewable Power

Remote Mining Energy Cost:

**With Diesel Gensets**
- Energy represents 20-30% of mining project CAPEX
- Energy represents >25% of OPEX, 30+ cents/kWh

**With Renewable Power**
- Cost of electricity: 15 to 22 cents/kWh (with good resource)
- Price certainty for 20 to 25 years

**Investment Needed for Renewable Power – CAPEX**
- 2.5 M$ to 4.0M$ per Installed MW
- Typical return on Investment around 7 years
Glencore Raglan Mine

- Located ~2000 km North of Toronto
- Accessible only by sea or air
- Several mines spread over a 70 km area with legacy distributed diesel generation
- Good wind resource
Raglan Mine 2 Wind-Storage Pilot Project Overview

Annual Savings = 2.4 Million Liters of Diesel Fuel
Storage Application

Excess Energy
300 kW

Opportunity to stop a Genset of 1.5 MW
Backup Power needed the time to restart the Genset
FESS-Pretested and Installed in Pre-Fabricated E-House
Microgrid Control System (HμGrid) – Generic Form
HµGrid Hardware-In-The-Loop Testing with RTDS (Real-Time Digital Simulator) at University of Toronto
Wind Power Smoothing – RTDS HIL Test Results

HuGrid Control, WTG Smoothing

WTG Power + Storage [kW]

Time [s]

E_{FW}
E_{BESS}
P_{WTG}
P_{WTG+STOR}
Wind Power Smoothing – Site Test Initial Results

Raglan Wind-Storage Smoothing: Sept 24, 2015

- With HuGrid
- Wind Power Without HuGrid-Storage

Wind Ramp rate 130 kW/S
HuGrid controlled ramp rate 11 kW/s
Closing Remarks

Importance of planning for Northern mine constraints: site logistics and construction season:
- Modularized systems
- Full integrated testing of energy storage and controls before site deployment
- Remote monitoring, diagnostics and tuning

Looking ahead:
- Compare actual performance of various energy storage types under similar loading conditions
- Evaluate the effect of energy storage on fuel consumption reduction
- Increase the utilization of renewable/load forecast in conjunction with storage use