Flywheel Energy Storage
Solutions to improve the efficiency of the world’s electricity infrastructure

Islanded Grid Wind Power Conference
Anchorage, AK
March 6, 2015
Who We Are

Global leader in flywheel energy storage systems

• Develop, design, build, and operate flywheel energy storage systems

• Highest energy commercially available composite flywheel

• Designed, built, and operate world’s largest grid-connected flywheel plants

• Proven technology. > 400 flywheels & 40 MW in commercial operation

• Equipment supplier focus

Owner: Rockland Capital
Market Position: Critical short duration segment

Discharge Duration

- <30 sec
- Seconds to 15 min
- >15 min

Technology

- Low Energy Flywheels & Ultracaps
  - 1-2kWh for 8-30 seconds in UPS applications
- Li-Ion Batteries
  - Best suited for 15 min to 1 hour with lower cycle-needs

Key Applications

- Frequency Regulation
- Remote Grids & Microgrids
- Renewable Integration
- Industrial Load Management
Commercial Experience and Performance

Tyngsboro, MA
0.5MW in ISO-NE
Operating since 2008

Stephentown, NY
20MW in NYISO
Operating since Q1 2011

Hazle, PA
20MW in PJM
Initial COD Sep 2013
Full COD July 2014

Over 8 million flywheel operating hours & 300 GWh of energy throughput

Current Projects

• Remote grid wind/diesel system

• FESS/BESS hybrid on high penetration wind grid
  Ireland, 320 kW FESS, 50 Hz, summer 2015
Beacon Flywheel
High power and energy composite flywheel

Specs and Performance
• ~7’ tall, 3’ in diameter
• 2,500 pound rotor, magnetically levitated, spins at up to 16,000 rpm in a strong vacuum
• +/- 160 kW, 30 kWh per full charge
• Lifetime throughput up to 5,000 MWh
• Over 60 US & international patents

Flywheel Value Proposition
• Very high energy throughput = low lifetime costs
• No degradation in energy or power
• Full state of charge is useable at all times
• Symmetrical charge and discharge rates
• Accurate state of charge always known
Current 160 kW Product Layout
Modular design and reduced footprint

- Modular design enables installations from one unit to multi-MW’s
- Distributed architecture facilitates rapid permitting and siting
- Footprint reduced significantly to ~20MW per acre
- Next generation in 2017, twice the output
Fully Integrated AC to AC System

Storage device
- Bidirectional 2 stage power electronics and 480V AC connection interface for each flywheel
- Allows stored energy to be coupled quickly and seamlessly to the AC power grid

Flywheel

Power Control Module
- Manages flywheels as a single resource
- Monitors the status of critical operating parameters
- Accurately reports SOC

Control System
- System operators able to monitor system performance and control remotely

Graphic User Interface
- Ready to accept real and reactive power control signals
Application: Remote Grid Microgrid and Industrial

**Diesel Power Bridge**
- Bridge start-up duration of diesel and recip engines
- Reduce starts/stops & run time

**Lower System Production Costs**
- Units that were smoothing renewables and providing regulation can operate at higher, more efficient output
- Reduces repeated fast-ramping and cycling related O&M
- Demand charge reduction

**Spinning Reserve**
- Instantaneous response enables system to carry less synchronous spinning reserves and enables greater diesel-off operation
Beacon Flywheel Energy Storage
Summary

**Safe**
- Excellent safety record
- No harmful chemicals or hazardous materials
- No emissions

**Durable**
- 20+ year design life
- No degradation
- No SOC limits to manage cycle life

**Proven**
- Over 40 MW and 8.0 million hours in commercial operation

**Cost Effective**
- Competitive capital cost
  + greater durability
  + low operating costs
  = lowest lifetime cost
Thank you