Vibration Energy Harvesting
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The Solution Works

Shell - Ormen Lange
Major New Gas Field

GE Bently Wireless Condition Monitoring
Powered by Vibration Energy Harvesters
Vibration Energy Harvester
Wasted Vibrations -&gt; Usable Electrical Power

- Low vibration levels (25mg)
- ATEX Zone 0 Certified
- High reliability design
- MTTF – 892 years
“Insight.mesh”
Wireless Condition Monitoring System

• 4 Sensors per node
• “Power for Life with Energy Harvester”
• “Target of three years with batteries”

GE Bently Nevada
Power Generation Plant

- Wireless Sensor Node
- Harvester
Power Station Pump

Indicating Power Output >23mW
Pruftechnik GmbH

Vibnode RFA Wireless Condition Monitoring System

Blackburn Meadows Water Treatment Plant
On typical induction motors:
- 75% > Produce 0.5 mA @5V
- 90% > Produce 0.25mA @5V
Perpetuum Design Flexibility

- Harvested Energy
- Choose Mass -> determines energy harvested
- Detune to Capture wider frequency range
- Choose centre Frequency
Vibration Harvesting from Rail Wagons

- Rail Wagons – Very High Levels of Vibration
- Frequency pattern and train speed change require wide bandwidth
- Mounting locations affect power output
- A maintenance free power source while train is in motion
- High levels of power for
  - Sensing
  - Wireless Communications
- Typical Power Levels from trials
  - Express 12-15mW
  - HST 30-50mW
Real Harvester Output on Train.

Average output over one hour: 10mW
FFT Results @ 13.3 m/s

10-second FFT at 13.3 m/s.

FFT Amplitude

Frequency (Hz)

48.05Hz
96.3Hz
144.2Hz
192.3Hz
240.6Hz
288.7Hz
336.8Hz
385.0Hz
433.0Hz
485.0Hz

Sensor 1
Sensor 2
Sensor 4
Summary

- Energy Harvesting is key to massive potential for wireless sensing/monitoring/tracking without batteries
- Perpetuum has practical working solution for billions of locations using vibration sources
- Other energy harvesting solutions exist but vibration – optimum when available
- Rail has great power potential
- Robust, reliable, “Fit and Forget” - Economic, fast installation
- Improve safety, reliability, maintenance and operating costs