FUEL CELLS IN LOCOMOTIVE APPLICATIONS

Potential Railroad Energy Saving
- Railroad large energy user
  - Approximately 4 billion gallons of diesel annually
- In 2005, the cost of fuel was approximately twice annual profits
- Fuel cell in locomotive
  - Replace conventional diesel engines
  - Implementation depends on application

Focus on Solid Oxide Fuel Cell (SOFC)
- Compared to proton exchange membrane (PEM)
  - More flexible fuel choices
  - Higher temperature better for application
  - No expensive metal catalyst
  - Lower activation losses
  - Higher current efficiencies
- Compared to molten carbonate fuel cell (MCFC)
  - Solid electrolyte: compact
  - Higher operating current and power density

Electrical Power Distribution
- Fuel Cell
- DC/DC Converter
- Motor Drive
- Traction Motor
- Battery (ASU)
- Bi-directional Converter

Locomotive Application 1 – Switcher
- High dynamic power swings
- Low average power: 50 Hp

Fuel Choice -- Bio-Diesel
- Advantages
  - Higher energy density than hydrogen
  - Renewable
  - Minimal safety impact
- Disadvantage
  - Soy diesel: high phosphorous content
  - Needs cleanup
  - Gasification required

Gasification Analysis
- Concern about reduction of CO

Balancing Energy and Power Needs

Locomotive Application 2 – Pusher
- Aid up hill
- Short range
- High power for long periods

Locomotive Application 3 – Long Haul
- Long range
- High power for extended periods
- Few starts and stops

Continuing Work
- Optimizing between fuel cell and ASU
- Coordinating power flow
  - Between fuel cell and ASU (switcher and pusher)
  - Between multiple fuel cells (pusher and long haul)
- Developing fuel cell models
  - Accurate analysis of system
  - Better understanding of thermodynamic balance of plant

Summary Table

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