Fuel Cell Backup Power for the Telecommunications Base Stations

Session 2:
Market status, End-user Requirement and Supporting Facilities incl. Regulatory Framework

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Company Overview

- Headquartered: Folsom, California (suburb of Sacramento)
- Established: in 2001 – Occupying 35,000 sq. ft. HQ & Manufacturing Plant
- Revolutionary design enables world's first and only automated, robotic fuel cell assembly line
- Recognized by experts as a world-class leader developing cutting-edge PEM technology systems
- All product are designed & engineered in-house;
  - Components sourced from worldwide supply chain
  - In-house manufacturing, assembly, and test
- Robust and proven—reliable and cost-effectively replacing batteries and generators in mission critical applications, world wide
  - More than 8.3 million watts deployed (2.5 & 5kW)
  - Field operating hours exceeds 32 Million

Applications and Markets

- Designs and Manufacturers the *Freedom Power* Series of Fuel Cell Products for Mission Critical Power Applications;
- **Primary Power Market is Wireless Backup Telecommunications/Cell Towers…$20B plus Global Market**
  - Follow-On Applications:
    - Military / Homeland Security / Emergency Response
    - Demand Response Management / Peak Shaving
    - Data Centers
- **US and Global Markets:**
  - Built the largest single deployment of fuel cells. Total installed nationwide for this one carrier alone is 482 sites, when build out is complete total will be 1,955 sites
  - Worldwide deployments; North & South America, Europe, Asia, African Continent (both North and South), Pacific Rim
  - Example: Successful deployment in India; Installing telecom sites in remote locations having no electricity but using solar, batteries and fuel cells for base load in a 24/7 hour operation.

Technology / Product Description

10kW 24/48 Dual Voltage

15 kW Applications

Indoor Rack Mount

Various Fuel Storage Apps.

2.5 kW Railroad Backup

Methanol Reforming

Portable Equipment

Technology / Product Description

Fuel cell engines

- 1 kW, 2.5 kW, 5 kW, and 7.5 kW
- Dual voltage capable

Power cabinets

- All weather, formed and welded aluminum construction (-40c to +50c)
- Single and dual engine configurations
- Integrated Base Transceiver Station (BTS)

Fuel storage cabinets

- Steel tank enclosures (8hr – 48hr storage)
- Composite tank enclosures (8hr – 120hr storage)

Portable power systems

- Wheeled generators/Light trailers

System Approval | Gas Approval | FCC Approval | System Approval

- Altergy's Fuel Cell products are fully tested, certified, and listed by OSHA approved testing labs
- Altergy's products meet or exceed all industry standards with strong committee participation in defining industry standards for mission critical applications
- Each system is installed through the permitting and zoning requirements of a given local municipality, commonly referred to as Authorities Having Jurisdiction (AHJ's)
- Certified by the California Air Resources Board (CARB) as zero emission power generators and as such are exempt from the permit requirements of all air pollution control and air quality management districts

Regulatory Framework

Stationary Fuel Cell Power Systems are evaluated for safety according to an internationally approved document:

- **IEC 62282-3-100 - Fuel Cell Technologies - Part 3-100: Stationary Fuel Cell Power Systems – Safety Edition 1.0, Feb. 2012**

  IEC 62282-3-100 - Addresses significant safety concerns, including mechanical, electrical, thermal, fire, toxins, radiation, environmental, and operator-induced hazards. The standard also defines product safety tests, documentation for the user and service personnel, warning labels, and other methods to assure safe use and prevent injury.

  The International Electrotechnical Commission (IEC) has approved this document for use within all the member nations. Each nation within the IEC uses this standard and adopts it for national use with deviations for local law.

  Note: It was adopted and approved in the USA as ANSI/CSA FC 1-2014; the US version meets all the requirements of IEC 62282-3-100 and adds US-specific code requirements to the IEC standard.

- **IEC Member Nations (83 total):** Albania, Algeria, Argentina, Australia, Austria, Bahrain, Belarus, Belgium, Bosnia & Herzegovina, Brazil, Bulgaria, Canada, Chile, **CHINA**, Columbia, Croatia, Cuba, Cyprus, Czech Republic, Denmark, Egypt, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, India, Indonesia, Iran, Iraq, Ireland, Israel, Italy, Japan, Jordan, Kazakhstan, Kenya, Democratic People's Republic of Korea, Republic of Korea, Latvia, Libya, Lithuania, Luxembourg, Malaysia, Malta, Mexico, Moldova, Montenegro, Morocco, Netherlands, New Zealand, Nigeria, Norway, Oman, Pakistan, Republic of the Philippines, Poland, Portugal, Qatar, Romania, Russian Federation, Saudi Arabia, Serbia, Singapore, Slovakia, Slovenia, South Africa, Spain, Sri Lanka, Sweden, Switzerland, Thailand, Macedonia, Tunisia, Turkey, Ukraine, United Arab Emirates, United Kingdom, United States of America, Vietnam

Supporting Facilities & End-User Requirement

- A stationary fuel cell power system consists of the power generator (typically within a protective enclosure), the fuel source, the connecting gas plumbing, and any supporting structures (e.g.; electrical disconnect devices, pressure relief devices, structural supports, etc.).
- The site is chosen to rigidly mount the fuel cell power generator and the fuel storage, away from vegetation, open flame, and building ventilation inlets as defined in the Installation Manual (required per IEC 62282-3-100 Clause 7.4).
- The fuel cell power system is installed in accordance with the provided Installation Manual, and in compliance with local laws and code requirements. Installation and connection to local power distribution systems typically requires certified installers or trained personnel depending on the national or local codes, including permits and inspections of local enforcement personnel.
- The fuel cell requires unimpeded air flow for ventilation and thermal management. The fuel cell typically produces small amounts of water as the only by-product. Plumbing into a local drain is sufficient if drainage is needed.
- The end-user is provided with options for remote monitoring and operation of the fuel cell power system. The fuel level may also be reported remotely to allow the user to maintain fuel supply.
- Periodic maintenance as described in the provided Operators and/or Maintenance Manual (required per IEC 62282-3-100 Clause 7.4.4 & 7.4.5). Typical maintenance includes clearing debris from around the system and cleaning or replacing the air inlet filters.

Fueling using Fill-in-Place Applications

- **What is Fill-in-Place?**
  - Industry Reference – “Bump-in-Place”
  - Filling either steel or composite hydrogen cylinders on-site
  - Eliminates “Cylinder Swapping”
  - Eliminates loss in Fuel
- **Fill-in-Place Application:**
  - Used in both –
    - Ground Sites Installations
    - Or Rooftops
- **Installation:**
  - Ground applications
    - Has in cabinet connection
  - Roof Applications
    - Simple 3/8” stainless piping from roof to ground fill port access box

Roof-top ground mount port

In-cabinet ground sites

Site Deployment Pictures – Ground & Rooftop

Before with Battery Cabinet

After installation of Fuel Cell

Altergy has classroom trained ~1,100 Building / Plan Examiners, Fire Inspectors, other AHJ's throughout the nation

~21% of sites installed have been rooftop applications from 5 – 50kW / refueling is done by either cylinder swap or fill-in-place

Majority are ground based applications ranging from 1 – 60kW / using either cylinder swap or fill-in-place above & below ground

Examples of the Fuel Delivery

Air Products – Micro Bulk Straight Truck

The Micro Bulk holds 120kg of hydrogen

Compressed hydrogen is dispensed at 150, 350 and 500 bar pressure

Small Independent Companies now entering the Market

The GTM 1350 holds 33,600 scfm or 81kg of hydrogen

Can be purchased as a "cube" (less trailer) and permanently set for stationary applications

Methanol Blending Specifications

- Poor water quality can have adverse effect on reformer longevity
- Poor delivery methods can also effect longevity
- Filter media needs to be designed for regional deployment
- Batch Plants can add commerce to local region and insure on time delivery

Blend Methanol Fuel to 62%-38% Methanol to Water Mixture

- Appearance Clear and Free of Visible particulate
- Methanol Blended 61.0% to 63.0%
- Specific gravity 0.889 – 0.893 at 20 deg C +/-2 deg C ASTM Std D 1298
- Conductivity 0.00 - 0.25 micro siemens uS/cm
- Silica < 0.5 mg/L
- Total Dissolved Solids < 0.3 mg/L
- Aromatic Hydrocarbons Free of Hydrocarbons

Water Specification (*Strongly* Recommend Reverse Osmosis)

Parameter	Method	Limit
Conductivity	ASTM 1125	<1.0 uS/cm
Total Suspended Solids	ASTM D5907	< 1.0 mg/L
Total Dissolved Solids	ASTM D5907	< 0.5 mg/L
Aromatic Hydrocarbons	IMPCA 004-08	Free of Hydrocarbons
Total Silica	ASTM D 4517	< 0.5 mg/L

Thank You !

Altergy *Freedom Power*™

For More Information Please Contact

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