XII.5 Demonstrating Economic and Operational Viability of 72-Hour Hydrogen PEM Fuel Cell Systems to Support Emergency Communications on the Sprint Nextel Network

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Contract Number: EE-0000486

Subcontractors:
- Air Products & Chemicals, Inc., Allentown, PA (Fuel Project Partner)
- Altergy Systems, Folsum, CA (PEM Fuel Cell Project Partner)
- Black & Veatch Corporation, Overland Park, KS (A&E Project Partner)
- Burns & McDonnell Engineering Co., Inc., Kansas City, MO (A&E Project Partner)
- Ericsson Services, Inc., Overland Park, KS (Deployment Management Project Partner)
- ReliOn, Inc., Spokane, WA (PEM Fuel Cell/ A&E Project Partner)

Project Start Date: March 18, 2010
Project End Date: December 31, 2012

Objectives

- Eliminate barriers to siting and permitting 72-hours of hydrogen fuel storage
- Eliminate barriers to re-fueling sites at the required level of performance
- Collect and analyze data sample to evaluate economic and operational metrics

Relevance to the American Recovery and Reinvestment Act (ARRA) of 2009 Goals

Sprint, through this deployment effort, seeks to:

- Support the creation of new jobs.
- Maintain existing jobs.
- Bring proton exchange membrane (PEM) technology into the market which will foster job training opportunities.
  - Installation
  - Service
  - Repair

Relevance to the DOE-Fuel Cell Technologies' ARRA Project Goals

Through the successful deployment of this technology, it is expected that the following goals shall be achieved:

- Demonstrate the operational acceptance and financial viability of using PEM technology to support critical emergency power requirements:
  - Telecommunications.
  - Health care/life support systems.
  - Critical government operations.
- Expanded user community offers many positive market opportunities:
  - Increased demand prompts greater production volume – lowers unit cost.
  - Cross industry adoption spurs "services" growth (construction, maintenance, ancillary support) as more units are deployed – lower costs due to competition.
  - Fueling infrastructure is "pulled" into the market by true demand rather than being "pushed" into the market to support speculative potential.

Technical Barriers

Major barriers being addressed under our project are summarized as follows:

- Higher costs: initial capital cost, as well as operating expenditure (increased site lease costs to support code mandated hydrogen setbacks) than incumbent technology (diesel generator).

- Siting and permitting: due to variations in the applicable code requirements and versions recognized by the authorities having jurisdiction (AHJ), each market launch requires time with the local officials (building, fire) to help them understand the referenced codes and how Sprint interprets/complies with code requirements.
- Fueling infrastructure: this project deploys a new model for stationary hydrogen fuel cells, relying upon an on-site refillable medium pressure storage solution rather than the low pressure hydrogen cylinder exchange model. Our project partner, Air Products, has invested in a small fleet of transport vehicles to deliver bulk compressed hydrogen to small, geographically diverse, remote cell sites.

Technical Targets and Milestones

The following performance targets and associated milestones have been set for this project.

- Install 260 additional PEM fuel cells for backup power by end of December, 2012.
  - California – 100 units
  - Connecticut – 30 units
  - New Jersey – 65 units
  - New York – 65 units
- Retrofit a total of 70 existing Low Pressure Hydrogen Storage Systems with the new Medium Pressure On-Site Refillable Hydrogen Storage Solution in the following states:
  - California
  - Louisiana
  - Texas

Accomplishments

- Completed the required documentation for National Environmental Policy Act (NEPA) clearance and received the requested comprehensive Categorical Exclusion on May 12, 2011.
- Thus far, our team has conducted site surveys at 583 candidate sites to support new PEM deployments at 260 locations.
- A total of 283 of the 583 candidates were removed from consideration for a variety of reasons during Phase 1 (site survey, entitlement review).
  - Space constraints within the cell site compound (real estate and setbacks).
  - Access restrictions for hydrogen fueling vehicle.
- An additional 37 candidates “fell out” during Phase 2 (site acquisition) due to:
  - Cost.
  - Zoning issues.
- Commissioned the first new unit on 05/11/2011 in Alloway, NJ. As of 06/30/2011, a total of 32 new PEM fuel cells have been commissioned into service.
- Expect to have 194 new PEM fuel cells commissioned by the end 2011.

Introduction

The relevance of this project to the goals of ARRA of 2009 is threefold. First, Sprint seeks to support the creation of new jobs, as well as maintain existing jobs, to successfully complete this deployment effort. Second, Sprint intends to spur economic activity through the positive impact to various industries and service providers at all levels of the supply chain. And finally, Sprint is confident that this investment in PEM hydrogen fuel cells, to provide emergency power to our critical wireless network facilities, will truly benefit our nation’s long-term economic growth.

Approach

After reviewing the Code Division Multiple Access (CDMA) Network Site Inventory, a master candidate site list was created based upon the restoration priority of the facility, and whether or not the site was equipped with a fixed generator. Sprint focused on specific markets to exploit the site’s proximity to the hydrogen distribution facility (within 200 miles), as well as to concentrate on market clusters to minimize site acquisition, siting/permitting, installation, commissioning, and training expenditures. In addition, this cluster approach helps to minimize costs associated with the maintenance of a PEM spare parts inventory. Finally, this concentration permits a consistent presentation to the local building officials, which in turn helps to clarify applicable code (Uniform Building Code, National Fire Protection Association, etc.) interpretations. In theory, all of these efforts should help to facilitate a rapid, safe, and successful deployment in the market.

Our Hydrogen Safety Plan (HSP) was submitted to DOE on 07/13/2010. On 01/18/2011, feedback from the Safety Panel team at DOE was received. Additional work is required on the HSP to ensure that the issues identified by DOE are satisfactorily addressed prior to resubmission. In reality, modifications to the HSP were put on the “back burner” as our efforts to demonstrate progress on new PEM deployments required our team’s full time and attention – now targeting delivery of the revised HSP to DOE by end of calendar year 2011.

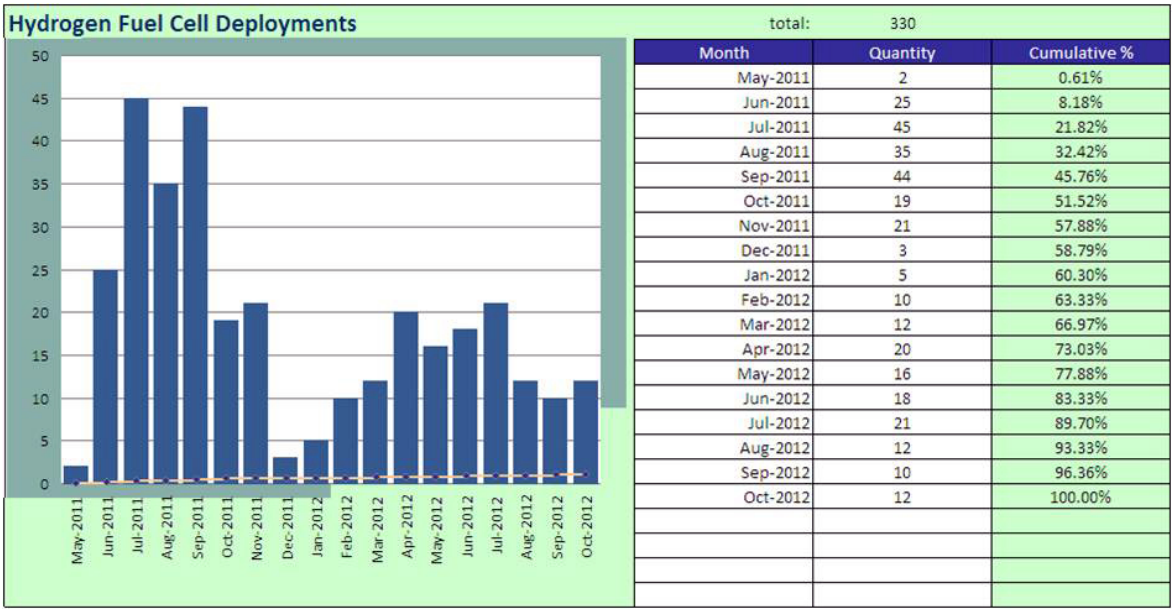
A NEPA comprehensive Categorical Exclusion was secured on May 12, 2011.

Results

At long last, Sprint has successfully commissioned the first of many PEM fuel cells equipped with the Medium Pressure, Refillable On-Site, Hydrogen Storage Solution. Since the initial installation under this DOE/ARRA funded project on May 11, 2011, a total of 32 systems have been brought into service (as of 06/30/11). These installations, coupled with our original stand-alone deployment effort (243 systems in the 2005–2007 timeframe), provide a grand total of 275 PEM fuel cells providing backup power for critical cell site locations on the Sprint Network. When the planned 260 new and 70 retrofits (fuel storage converted from low pressure tanks to the medium pressure refillable solution) are completed, we will have more than doubled the number of sites in our Network with emergency power provided by PEM fuel cells. Figure 1 provides the deployment schedule for this project.

To date, a total of 583 sites have been evaluated to determine if the cell site location is suitable for new PEM deployment or, if equipped with a PEM today, can it support the use of the new hydrogen fuel storage solution. Figure 2 provides a summary of the various reasons so many sites are dropped from consideration following the completion of Phase 1 activities.

Once the candidate site makes it through Phase 1, sites can be dropped from consideration during Phase 2. Figure 3 provides a summary of the various reasons a site



Month	Quantity	Cumulative %
May-2011	2	0.61%
Jun-2011	25	8.18%
Jul-2011	45	21.82%
Aug-2011	35	32.42%
Sep-2011	44	45.76%
Oct-2011	19	51.52%
Nov-2011	21	57.88%
Dec-2011	3	58.79%
Jan-2012	5	60.30%
Feb-2012	10	63.33%
Mar-2012	12	66.97%
Apr-2012	20	73.03%
May-2012	16	77.88%
Jun-2012	18	83.33%
Jul-2012	21	89.70%
Aug-2012	12	93.33%
Sep-2012	10	96.36%
Oct-2012	12	100.00%

FIGURE 1. EE0000486 Deployment Schedule

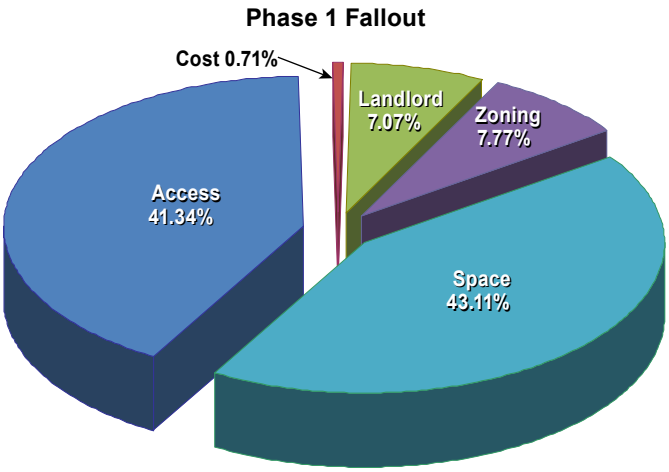


FIGURE 2. Phase 1 (Site Survey/Entitlement Review) Fallout Summary

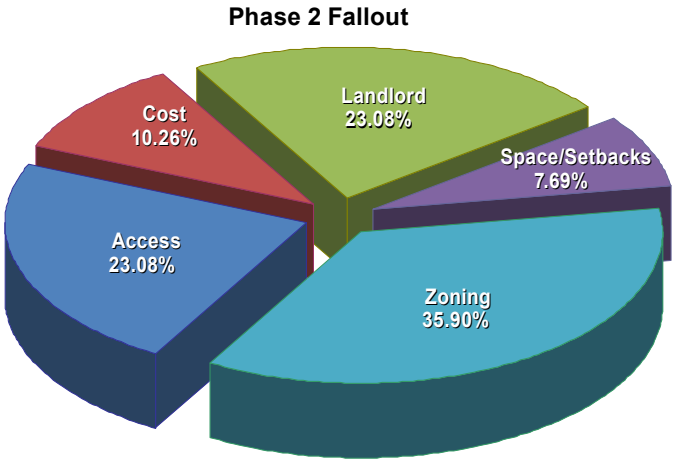


FIGURE 3. Phase 2 (Site Acquisition/Zoning) Fallout Summary

can be dropped at this stage of deployment. Interestingly, it appears that the education of property owners (landlords, tower aggregators), municipal officials, and/or the zoning board might permit more sites to remain in consideration.

Conclusions and Future Directions

We recognized going into this project that the fallout rate for candidate sites would be in the 40% range due to the limited amount of space available in the cell site compound. Limited real estate, in the case of PEM deployment, can be a double edged sword. There may be physical space to permit the placement of the equipment on-site, however, code mandated setback distances may or may not be able to be supported at the facility. Without uniform AHJ recognized hydrogen/fire codes, it appears that PEM deployment will continue to require more time/effort/money to deploy versus the incumbent diesel generator solution.