X.4 Use of 72-Hour Hydrogen PEM Fuel Cell Systems to Support Emergency Communications

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Contract Number: EE-0000486

Subcontractors:

- Air Products & Chemicals, Inc., Allentown, PA (Fuel Project Partner)
- Altergy Systems, Folsum, CA (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 (Fuel Cell/A&E Project Partner)

Project Start Date: March 18, 2010
Project End Date: December 31, 2013

Objectives

- Eliminate barriers to siting and permitting 72 hours of hydrogen fuel storage
- Eliminate barriers to refueling 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) fuel cell technology into the market, which will foster job training opportunities:
  - Installation
  - Service
  - Repair

Relevance to the DOE Fuel Cell Technologies Office's 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 fuel cell 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 and lowers unit cost.
  - Cross-industry adoption spurs "services" growth (construction, maintenance, ancillary support) as more units are deployed – costs are lowered 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 this project are summarized as follows:

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

- Siting and permitting: due to variations in the applicable code requirements and versions recognized by the authorities having jurisdiction, each market launch requires time with the local officials (e.g., 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 onsite 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 onsite refillable hydrogen storage solution in the following states:
  - California
  - Louisiana
  - Texas

Accomplishments

To date, our team has:

- Completed the required documentation for National Environmental Policy Act clearance and received the requested comprehensive categorical exclusion on May 12, 2011.
- Thus far, our team has conducted site surveys at 736 candidate sites to support new PEM fuel cell deployments at 260 locations.
- A total of 392 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 79 candidates "fell out" during Phase 2 (site acquisition) due to:
  - Cost
  - Zoning issues
- Commissioned the first new unit on May 11, 2011, in Alloway, NJ. As of June 3, 2013, a total of 259 new PEM fuel cells have been commissioned into service.
- Expect to have 260 new PEM fuel cells commissioned by the end of the third quarter of 2013.

INTRODUCTION

The relevance of this project to the goals of the 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 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 sites' 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 fuel cell 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 was submitted to DOE on July 13, 2010. On January 18, 2011, feedback from the safety panel team at DOE was received. A National Environmental Policy Act comprehensive categorical exclusion was secured on May 12, 2011.

RESULTS

On May 11, 2011, Sprint successfully commissioned the first PEM fuel cell funded by this project. This unit was the first fuel cell system to be deployed in the network which was equipped with the Medium Pressure, Refillable On-Site, Hydrogen Storage Solution. Since that initial installation, a grand total of 259 such devices have been commissioned. When this project completes, 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 736 sites have been evaluated to determine if the locations are suitable for new PEM fuel cell deployment or, if equipped with a PEM fuel cell today, if it can 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 (site survey) activities.

Once the candidate site makes it through Phase 1, it can be dropped from consideration during Phase 2 (site acquisition and zoning). Figure 3 provides a summary of the various reasons a site can be dropped at this stage of deployment. Interestingly, it appears that the education of

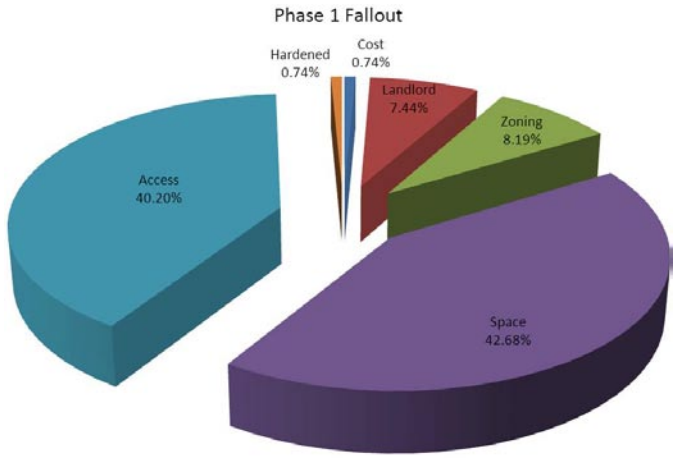
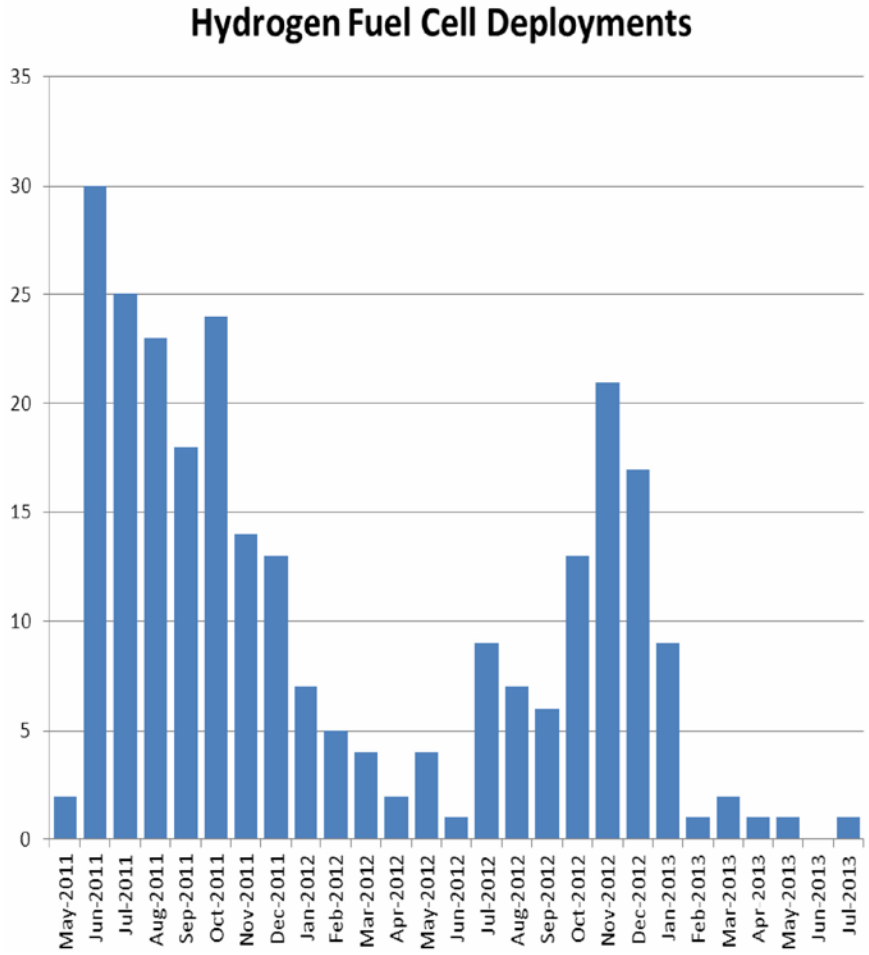


FIGURE 2. Phase 1 (Site Survey/Entitlement Review) Fallout Summary



Month	Quantity
May-2011	2
Jun-2011	30
Jul-2011	25
Aug-2011	23
Sep-2011	18
Oct-2011	24
Nov-2011	14
Dec-2011	13
Jan-2012	7
Feb-2012	5
Mar-2012	4
Apr-2012	2
May-2012	4
Jun-2012	1
Jul-2012	9
Aug-2012	7
Sep-2012	6
Oct-2012	13
Nov-2012	21
Dec-2012	17
Jan-2013	9
Feb-2013	1
Mar-2013	2
Apr-2013	1
May-2013	1
Jun-2013	0

FIGURE 1. Deployment Schedule

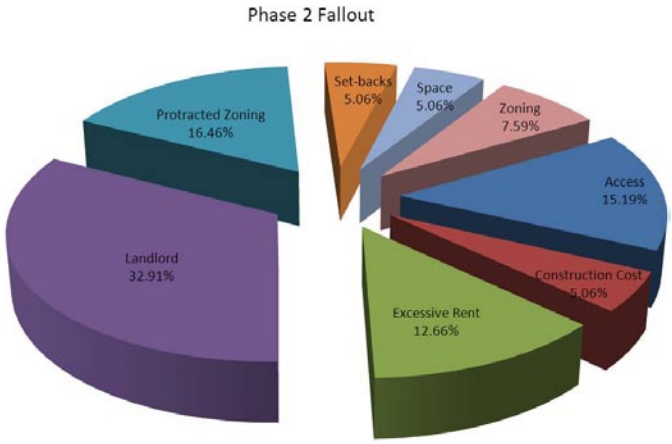


FIGURE 3. Phase 2 (Site Acquisition/Zoning) Fallout Summary

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 typical cell site compound. Limited real estate, in the case of PEM fuel cell deployment, can be a double-edged sword. There may be physical space to permit the placement of the equipment onsite; however, code-mandated setback distances may or may not be able to be supported at the facility. Without uniform, recognized hydrogen/fire codes, it appears that PEM fuel cells will continue to require more time/effort/money to deploy versus the incumbent diesel generator solution.