XI.12 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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Vendors:
- Air Products and Chemicals, Inc., Allentown, PA (Fuel Project Partner)
- Altergy Systems, Folsum, CA (PEM Fuel Cell Project Partner)
- Black & Veatch Corporation, Overland Park, KS (Architectural and Engineering 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 Project Partner)

Project Start Date: March 18, 2010
Project End Date: June 30, 2012

Introduction

The relevance of this project to the goals of the American Recovery and Reinvestment Act (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 proton exchange membrane (PEM) hydrogen fuel cells (HFCs), to provide emergency power to our critical wireless network facilities, will truly benefit our nation's long-term economic growth.

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

Technical Barriers

The overarching goal of this project, as stated in our application originally, is to support the DOE Fuel Cell Technologies ARRA project goal of accelerating the commercialization and deployment of fuel cells. In order to accomplish this goal, specific barriers that were encountered during our initial HFC deployment need to be overcome.

One major barrier involves the difficulty associated with the siting and permitting required for the installation of an HFC. With the vast number of local municipalities that need to be engaged, and the fact that they may recognize various code authorities, as well as different issues of the same code, a fact-based presentation, citing specific code interpretations, must be crafted to educate the authorities having jurisdiction (AHJ).

Another barrier we must overcome deals with the difficulties associated with refueling the HFC. In our earlier deployment, low-pressure hydrogen storage tanks were utilized. Based upon the site loads, we were able to provide backup power for a period of 14–20 hours before refueling was required. This refueling methodology requires the replacement (bottle swap) of the low-pressure bottles – a slow, cumbersome process that is impractical, as well as unmanageable during a widespread power outage event (i.e. hurricane). In addition, the runtime provided by this low-pressure solution comes nowhere close to the 72-hour runtime available from the incumbent technology, the diesel generator.

Finally, the success of this effort cannot be determined until the HFC, with the medium-pressure hydrogen storage solution, is installed and placed in service. The unit's performance in real world situations, based on financial and operational performance data collected, analyzed and reported, shall be the confirmation or denial of its ability to provide a cost-

effective, operationally accepted option for providing backup power at critical sites.

Technical Targets

This project is demonstrating the economic and operational viability of using PEM fuel cells to provide emergency power at critical code division multiple access sites on the Sprint Nextel Network. We plan to more than double the number of PEMs deployed in our network. In addition, we plan to retrofit approximately 25% of our current installed base with a new hydrogen storage solution to extend PEM runtime by a factor of three. The data collected from these newly deployed and/or modified units will, it is hopes, provide supporting documentation to create a "market pull" within the telecom space, as well as across various industries, for additional PEM fuel cell deployments. Project targets as follows (Figure 1):

- PEM sites currently in-service: 237
- Additional PEMs to be deployed: 260
- Low-pressure hydrogen storage runtime: 14–20 hours
- Medium-pressure hydrogen storage runtime: ~72 hours
- Deployment will expose three additional states, and impacted local municipalities, to the use of hydrogen fuel for backup power purposes:
  - Connecticut
  - New Jersey
  - New York
- Existing PEMs to convert to refillable on-site medium-pressure hydrogen storage: 70

These targets dovetail very well with the objectives stated under the ARRA. By doubling our installed base of HFCs, numerous jobs shall be created and maintained. From jobs within the equipment manufacturing facilities, to personnel engineering, constructing, maintaining, and refueling these devices, the ripple effect is enormous. Our expansion into three additional states, and our increased footprint in another, shall permit Sprint to interface with the AHJ personnel which will help acquaint them with the use of hydrogen as a fuel, and the associated codes to which we must adhere.

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 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,

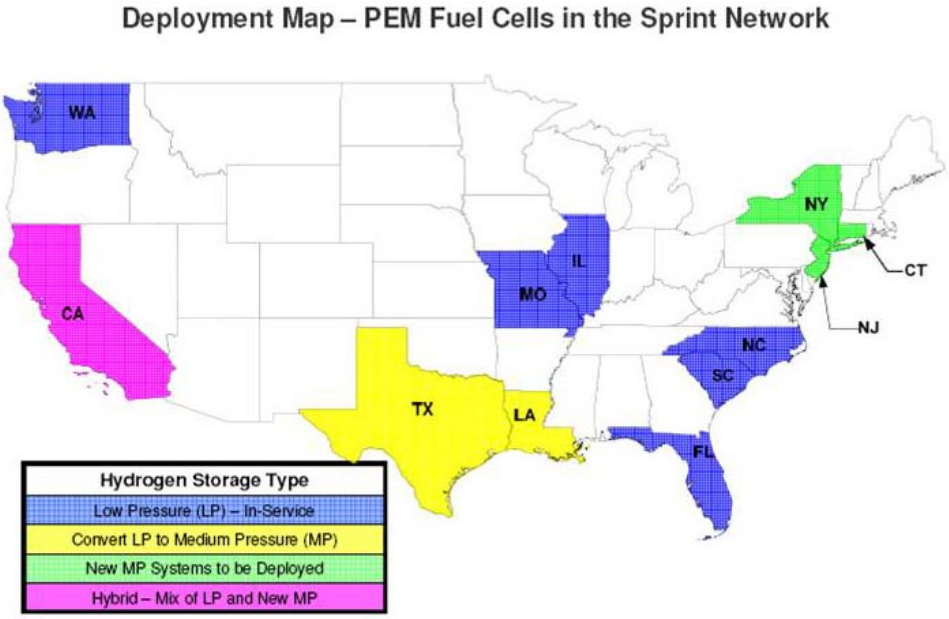

FIGURE 1. Deployment Map – PEM Fuel Cells in the Sprint Network

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.

Accomplishments

Following the execution of the contract with the Department of Energy on March 18, 2010 purchase orders (260 orders with a total value of $335,510) were generated to our architectural and engineering (A&E) project partners for Phase 1 (lease review and site assessment) work. Phase 1 progress, by state, is as follows:

- New York – 65 sites targeted; 155 in pool; 66 site surveys completed; as of this report, Phase 2 (site acquisition, permitting, pre-notice to proceed) orders are being prepared for 20 sites.
- Connecticut – 30 sites targeted for deployment; candidate pool consists of 131 sites; sites surveyed - 65 sites. Site surveys are being reviewed for determination of next steps.
- California - 100 targeted; pool of 331; sites surveyed - 81 sites. Uploaded site surveys are being reviewed.
- New Jersey – 65 targeted; 137 in pool. Site surveys began on Monday, July 12, 2010.

Design of the medium-pressure hydrogen storage solution is well underway with final drawings scheduled for completion by July 30, 2010.

Sprint is working internally to create purchase orders for equipment (fuel cells, as well as hydrogen storage modules). Our intent is to have orders in the pipeline so that material delivery can coincide with the start of Phase 3 (installation/commissioning).

Working with our project partners, on July 13, 2010, the Sprint Hydrogen Safety Plan was provided to our DOE Project Officer.

We are continuing to assemble the required information/documentation to request a National Environmental Policy Act Categorical Exclusion for this project – targeting a mid-August, 2010 submission.

Per our calculations, 6.5 jobs have been created/maintained during this portion of the Phase 1 activities completed to date.

Future Directions

Complete Phase 1 (Site Survey) work to identify the final site list for deployments. Once a site is selected for the final list, a purchase order is generated to our A&E project partner for Phase 2 work. In Phase 2, the A&E will perform all required site acquisition work, as well as secure all permits required by the AHJ. Also during Phase 2, purchase orders are generated to procure all required material (PEM, hydrogen storage, etc.). Phase 2 is considered complete when Sprint issues a notice to proceed to the A&E.

When the notice to proceed is issued, Phase 3 (installation and commissioning) purchase orders are generated to the A&E. The release of Phase 3 purchase orders shall coincide with the delivery date of all required material to the site.

After the PEM is commissioned on-site, two things happen. First, project closure activity is initiated to permit the shutdown of the project within the various impacted Sprint systems. Second, the newly commissioned PEM is added to our remote data collection/performance monitoring system to ensure contractually mandated operational reporting requirements are captured and delivered to the National Renewable Energy Laboratory.

FY 2010 Publications/Presentations

1. Presentation deck from the Department of Energy Project Kickoff Meeting conducted at the Sprint Executive Briefing Center in Reston, VA, on May 20, 2010.

2. Presentation deck from the 2010 American Resource and Recovery Act Annual Merit Review and Peer Evaluation Meeting conducted in Washington, D.C., on June 10, 2010.