

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

Primary Investigator: Kevin Kenny  
Sprint – Nextel, Inc.  
June 10, 2010

Project ID: ARRAH2012

## Timeline

- ❖ Start: March 18, 2010
- ❖ End: September 30, 2012
- ❖ 3% Complete

## Budget

Total Project Funding

- ❖ DOE: \$7,295,000
- ❖ Contractor: \$17,248,482

## Barriers

- ❖ Siting & Permitting
- ❖ Hydrogen Refueling Infrastructure
- ❖ HFC Vendor Agnostic Hydrogen Storage Solution

## Partners

A&E Firms

- ❖ Black & Veatch
- ❖ Burns & McDonnell

PEM Fuel Cells

- ❖ Alteryx
- ❖ ReliOn

Hydrogen Fuel Storage & Supply

- ❖ Air Products and Chemicals, Inc.

Deployment Management

- ❖ Ericsson Services, Inc.

- ❖ The goal of this project is to demonstrate the technical and economic viability of deploying Proton Exchange Membrane (PEM) Hydrogen Fuel Cells (HFC) to provide backup power for critical CDMA cell sites on the Sprint Wireless Network. A total of 260 new HFCs shall be deployed. In addition, 70 in-service HFCs shall be converted from a Low Pressure Hydrogen Storage Solution (bottle swap) to the new Medium Pressure Storage Solution (refuel on-site).
  - New sites are slated to be installed in CA (100), CT (30), NJ (65), and NY (65).
  - Seventy (70) total HFCs shall be retrofit to the new MPHSS in LA and / or TX.
  
- ❖ Relevance to ARRA goals
  - This project shall create and retain jobs in numerous industries / professional organizations. A hi-level summary is as follows:
    - HFCs (260) shall be manufactured / assembled by either of two vendors. The direct impact to jobs created / maintained is, at present, difficult to quantify due to the various material / component suppliers involved in the supply chain.
    - At least 330 MPHSS cabinets and 5,280 Hydrogen Tanks (11BC615) shall be provided by our fueling partner. In addition, staff in hydrogen production, distribution logistics, and technicians in the field shall be required to support this initiative in multiple geographic regions.
    - Two A&E firms shall support this implementation requiring personnel in various disciplines (engineering, site acquisition, project management, and construction), as well as Market local tradesmen (construction, electrical) to complete on-site installation, commissioning, and support services.

## ❖ Relevance to ARRA goals (continued)

- Deployment management services shall be provided by another project partner. Teams of individuals trained in Sprint specific systems and processes (lease modification, site acquisition, material procurement, project coordination, and various internal databases) shall have cradle to grave responsibility for this program.
- Finally, members of the Sprint staff shall provide overall project supervision, financial governance, planning direction, incentive management, and all project performance and operational data reporting as required in the contract.

**Please Note:** The direct impact to jobs created / maintained is, at present, difficult to quantify. The final contract with the DOE was executed about five weeks ago (as of this submission). We are working with our project partners to develop processes to capture jobs retained / created (direct labor), as well as the employment impact on the various material / component suppliers and service providers involved in this extended supply chain.

## ❖ Relevance to DOE goals

- This project more than doubles the number of HFCs deployed in Sprint's original field trial (237 units).
  - Our installed fuel cell base, located primarily in the southern US, shall be expanded to include portions of the northeast and west coast. This will aid to introduce HFC technology to new markets which, in turn, will facilitate the training of local tradesmen to install, commission and maintain this technology.
  - AHJ Permitting officials, trained during the DOE sponsored, Sprint supported "Hydrogen Siting / Permitting Workshops" (held in both CA and NJ - metro NY) shall be able to put their knowledge to work as they evaluate our proposed installations and associated permit applications.

❖ Relevance to DOE goals (continued)

- Our fueling project partner has invested in mobile refueling vehicles to support off-road remote applications – thus permitting cell sites, previously inaccessible by tank trucks, to be considered for a backup power solution other than a diesel generator. In addition, Sprint has been assured that medium pressure hydrogen shall be provided through temporary storage at strategic staging centers, if required, to support our project rollout.
- The intent is that this project will serve to demonstrate to the telecom industry, as well as to other industries / commercial entities seeking backup power, that it makes economic and operational sense to use PEM Fuel Cells in lieu of other incumbent technologies.

# Pre-Contract Execution Objectives / Relevance



- ❖ Identify initial candidate pool of sites to be considered for HFC deployment which support specific types of “Critical Infrastructure” traffic. (Complete)
- ❖ Trim site list to account for the removal of sites with landlords not receptive to HFC installations (seen as a competitive threat to “premium” services offered by the landlord). (Complete)
- ❖ Ensure site mix includes both ground based and rooftop deployments – required to support both internal design criteria, as well as demonstrate the ability of the HFC to be utilized in various physical environments. (In progress – Final Site List will take shape as Phase 1 Survey Packages are received)
- ❖ Secure training on HFC operation / installation / commissioning for A&E vendors. (Complete)
- ❖ Develop Excel spreadsheet which is to be populated with data collected during the Phase 1 Site Survey. (Complete)
- ❖ Define HFC operational data collection arrangement to be used to gather and report HFC system performance information. (Hardware definition complete, data collection / manipulation methodology under development)
- ❖ Establish Master Construction Services Agreement with potential installation partners to support Phases 2 and 3 of deployment effort (A&Es and / or HFC vendor, 33% to 50% complete)
- ❖ Ensure Hydrogen Storage Solution (HSS) selected can support 72 hour runtime requirement for site specific power load; can be refilled on-site while HFC is either in operation or in standby; and can be fit out with a standardized, vendor specific, External Fuel Control Module. (Complete)

- ❖ This project has been organized into a three (3) phase approach: Site Survey, Pre-Construction (through Notice to Proceed), and Installation/Commissioning/Project Closure.
  - The ultimate goal of this initiative is to demonstrate the technical and economic viability of deploying PEM Fuel Cells to provide telecom backup power for critical facilities. To facilitate this objective, the permitting officials in the municipalities must be educated in the applicable hydrogen codes; construction crews must be trained and certified by the HFC vendor to install and commission the units; service personnel need to be trained in routine service / maintenance / repair to ensure the system is available to provide power when called upon; and finally, the hydrogen fuel supply and distribution infrastructure must be in place to provide fuel when required.
  - Phase 1: Site Survey. Started - 0% Complete
    - Each candidate location shall be visited by the assigned A&E to document the site as detailed in the Site Survey Package (xls format).
    - Prioritized candidate list for each impacted market will be evaluated until the market deployment target is reached.
    - GO / NO-GO criteria for each site includes:
      1. Site accessible by hydrogen refueling vehicle.
      2. Space available within the existing compound to support equipment placement and code required setbacks.
      3. Estimated Phase 2 / 3 costs are within budgeted amount.
      4. Lease cost increase, if required, is within Sprint pre-determined OPEX cap.

➤ Phase 1: Site Survey (continued)

State	Candidate Pool Size	Targeted # of Sites
New HFC - California	331	100
New HFC - Connecticut	131	30
New HFC – New Jersey	137	65
New HFC – New York	155	65
Retrofit - Louisiana	60	70 Total Retrofits
Retrofit - Texas	42	

- The Final Site List will be assembled based upon information collected and sketches provided in the Phase 1 Site Survey Packages.
- Phase 2: Pre-Construction (through Notice to Proceed). 0% Complete
  - Site acquisition – fully executed lease amendment, if required.
  - Secure all required permits (building, electrical, mechanical, or others required by AHJ).
  - Zoning approval.
  - NEPA approval (note – we are pursuing an NEPA Categorical Exclusion (CE) as recommended by DOE. Phase 1 must be complete for sites to be included in the CE application package).
  - Complete all required engineering drawings.



- Phase 2: Pre-Construction. (continued)
  - Order major material (HSM and MPHSS).
  - GO / NO-GO criteria for each site includes:
    1. Lease amendment is fully executed or permission to proceed is provided by landlord.
    2. All necessary permits have been secured..
    3. Zoning approved.
    4. NEPA approved.
    5. All major material has been received at staging facility, or firm scheduled delivery date has been secured from the vendor.
    6. NTP has been loaded in Sprint system.
- Phase 3: Installation/Commissioning/Project Closure. 0% Complete
  - Place pad, and HFC / MPHSS equipment in leased / landlord approved space per details provided on site engineering drawings.
  - Trench (if required), place, connect and leak test all required pipe / hydrogen fuel lines.
  - Run, terminate, label and secure all required ground, electrical, supervisory, and alarm cabling.
  - Once installation of material is complete, coordinate fuel delivery, NOCC notification / maintenance ticket scheduling, and perform test / acceptance / and commissioning tasks per vendor instructions and Sprint provided MOP.
  - Once device is commissioned, complete system handoff to Operations' personnel.

- Phase 3: Installation/Commissioning/Data Acquisition/Project Closure. (continued)
  - Prepare As-Built drawing updates to document equipment installation.
  - Load all necessary information into Sprint systems.
  - Provide ongoing data collection and reporting as contractually committed.

**Please Note:** Throughout the life of this project, ongoing dialog with the Golden DOE Project Manager shall be maintained to keep the DOE apprised of project status. Quarterly and Annual Reports shall be provided by applicable dates due as required per the contract and ARRA mandates. After HFC systems are placed in service, period performance data collection / results sharing shall be reported as required,

# Collaborations (Project Partners)



## Project Partners

### A&E Firms

- ❖ Black & Veatch
- ❖ Burns & McDonnell



### PEM Fuel Cells

- ❖ Alteryg
- ❖ ReliOn



### Hydrogen Fuel Storage & Supply

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### Deployment Management

- ❖ Ericsson Services, Inc.



### End User

- ❖ Sprint - Nextel

## ❖ Relevance

- Implementation plan establishes HFC presence, on the Sprint Network, in three new states thus introducing the technology to numerous AHJs.
- To support these deployments, building officials will need to be educated in the technology to ensure code compliant installations; construction, trade and service personnel will need to be trained / certified on the equipment to install, commission and service these devices.
- Jobs will be created, as well as retained, to support this program in the form of direct employment at all project partners, as well as indirect employment at all levels of the supply chain.

## ❖ Approach

- Phased approach shall facilitate project success (demonstrated positive track record in previous major product rollouts) while minimizing financial impact to the project (GO/No GO decision points help preserve limited capital funds).

## ❖ Technical Accomplishments and Progress

- Five weeks into the project and the candidate site lists, hydrogen storage solution, refueling methodology, and full engagement of all project partners has already been achieved.

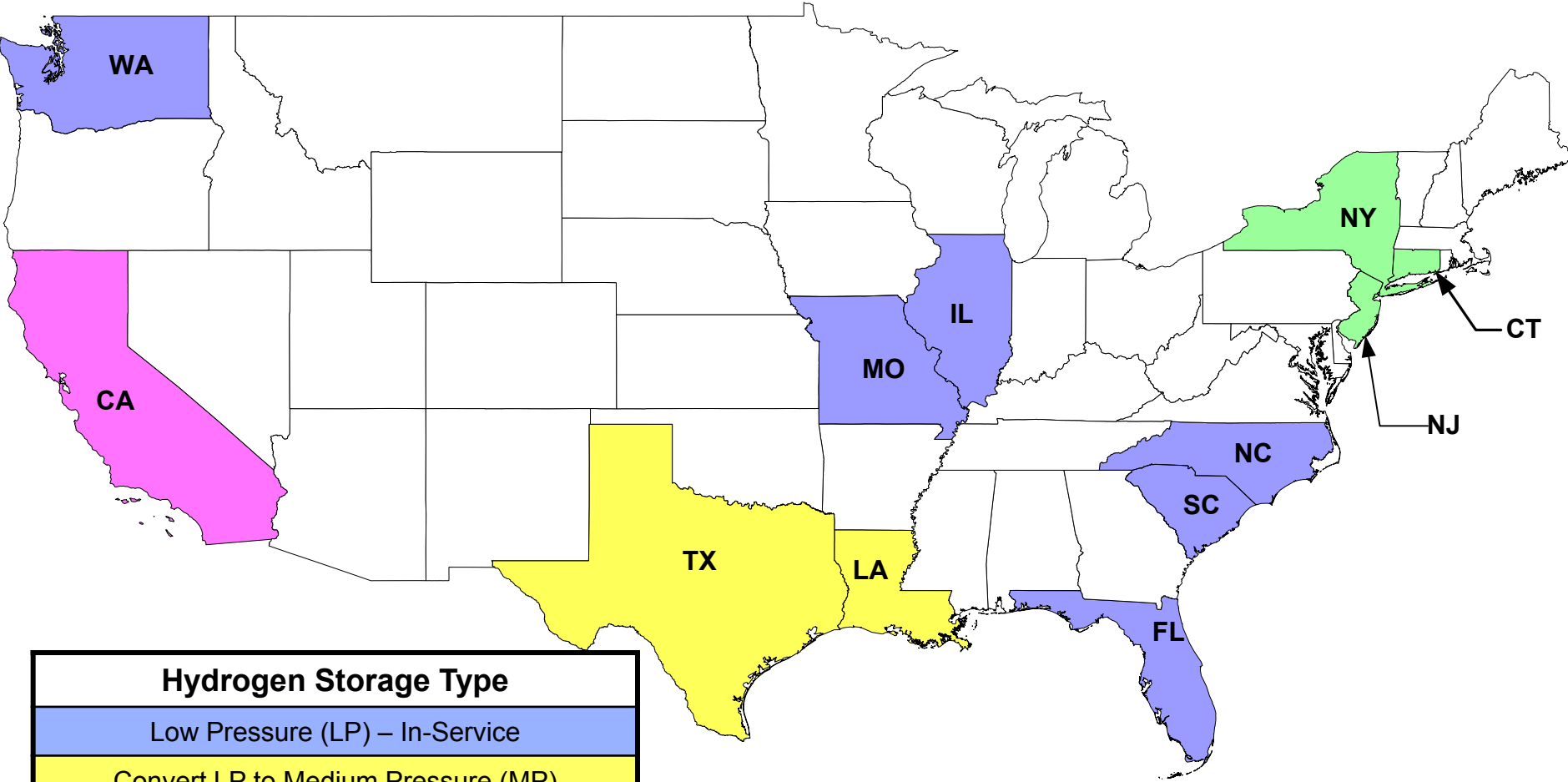
## ❖ Collaborations

- The foundation has been set – it is now time to build / solidify our Project Partner collaboration.

## ❖ Future Work

- “Safety Plan” is currently under development and will be completed and released to the Department of Energy by the June 16, 2010 required date due.
- Complete the planned HFC deployment / hydrogen storage solution conversions as specified in the project scope, on-schedule, within budget, with open communication and results sharing with our DOE sponsor.

# Deployment Map



Hydrogen Storage Type
Low Pressure (LP) – In-Service
Convert LP to Medium Pressure (MP)
New MP Systems to be Deployed
Hybrid – Mix of LP and New MP