PEM Fuel Cell Systems Providing Backup Power to Commercial Cellular Towers and an Electric Utility Communications Network

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Overview

Timeline

- Start: August 2009
- End: December 2011
- 70% Complete

Barriers

- Site Selection
- Site Acquisition
- Fueling Infrastructure

Budget

Total Project Funding

- DOE: $8,458,431
- Contractor: $9,644,178

Partners

- AT&T
  - Host Sites / End-user
- PG&E
  - Host Sites / End-user
- Air Products and Chemicals, Inc.
  - Fueling Storage and Supply

Objectives – Relevance

- The goal of this project is to install and operate hydrogen fuel cells as critical emergency reserve power for cell sites operated by AT&T and as back-up power equipment for communications sites in use by Pacific Gas & Electric (PG&E), a California utility. Up to 189 sites will be served.
- The goals of the most recent year were to ramp up site acquisition, accelerate deployments, begin bulk refueling, and collect operating data.
- This project's relevance to the goals of ARRA:
  - the manufacture and installation of up to 189 fuel cell systems creates and retains direct and indirect jobs at ReliOn and indirect jobs through the service supply chain, and develops growth in new service industries to install and refuel these systems.
  - Air Products has developed a new fueling vehicle, and a new Hydrogen Storage Module (HSM)
    - The vehicle allows access to more sites, expanding the potential served market for compressed hydrogen; multiple outlet pressures serve multiple markets
    - The HSM is being leveraging as an alternative storage solution for other compressed gas applications
  - Multiple sub-contractors have gained experience installing fuel cells, increasing their product offerings
    - Advertising Fuel Cell Installation expertise

Objectives (con't) – Relevance

- This project's relevance to U.S. DOE goals:
  - by stimulating wider deployments, the benefits of fuel cells as a back-up solution has higher visibility within the industry, builds a critical mass for advanced refueling infrastructure using compressed hydrogen, and provides broad experience to installers and jurisdictions, reducing barriers to siting.
    - A parallel ARRA program will be deploying additional fuel cells in a different carrier's network
    - Follow-on deployments outside of any DOE-funded program are in planning phases
    - Product development in parallel has integrated lessons learned into new systems being deployed commercially in 2011.
    - HSM and bulk refueling are integral product offerings for applications previously un-served due to limitations of cylinder-exchange
    - Lessons learned integrated into next-generation product
      - Cost reduction, architecture simplification, >2x power density, 10% fuel efficiency improvements
  - Reduced operational cost of delivered hydrogen and longer run-time are accomplished by implementing bulk refueling in place of packaged gas exchange.
    - First deployments during this program have established early demand, either validating or enhancing assumptions for delivery models
    - These validated/enhanced models are being put to immediate use in planning for subsequent deployments outside of this program

Past Year Objectives – Relevance

- Complete all site acquisition
- Deploy second phase of fuel cells and hydrogen storage systems
- Commission first and second phases of installed systems
- Deliver initial bulk fuel to first and second phases of installed systems
- Transition operation of any commissioned sites to end-user
- Collect and report installation and operational data

Approach

- The project is structured in three phases:
- Site Selection & Permitting, Equipment Installation, and Data Collection & Reporting.
  - The emphasis is on commercial processes and procedures to validate the readiness of the mainstream stakeholders (end-users, construction vendors, fuel providers, permitting officials) to quickly adopt fuel cell backup systems.
  - Originally a serial process for the program
  - Reality; serial for any one site; overlapping parallel by site & geographic region
  - *Risk is managed* by pursuing sites in multiple regions, multiple jurisdictions, in a parallel process

Approach - Phase 1

- Phase I: Site Selection & Permitting/Site Acquisition (80% complete)
  - Site Selection & Surveys : 100% complete
    - Identify final sites from a candidate list of 740 sites
    - GO/NO-GO criteria for each site
      - Power requirements
      - Site space availability
      - Site Access for refueling
    - Milestones
      - AT&T surveys – 100% complete, including reserve sites
      - PG&E surveys –100% complete
  - Permitting and Site Acquisition: 80% complete
    - Building/Electrical/Fire permits
    - Site Acquisition and Lease/Zoning Amendments (NEPA clearance 100%)
    - GO/NO-GO criteria: all permits and amendments secured
    - Milestones
      - AT&T Permits and Site Acq 140 of 180 sites – 78% complete
        - » 61 sites fell out of Site Acq for various reasons
        - » Average time to approval = 6 months (assumed 3 months at program launch)
      - PG&E Permits and Site Acq 8 of 9 sites – 89% complete
        - » One site fell out of Site Acq due to landlord issues

Approach – Phases 2 & 3

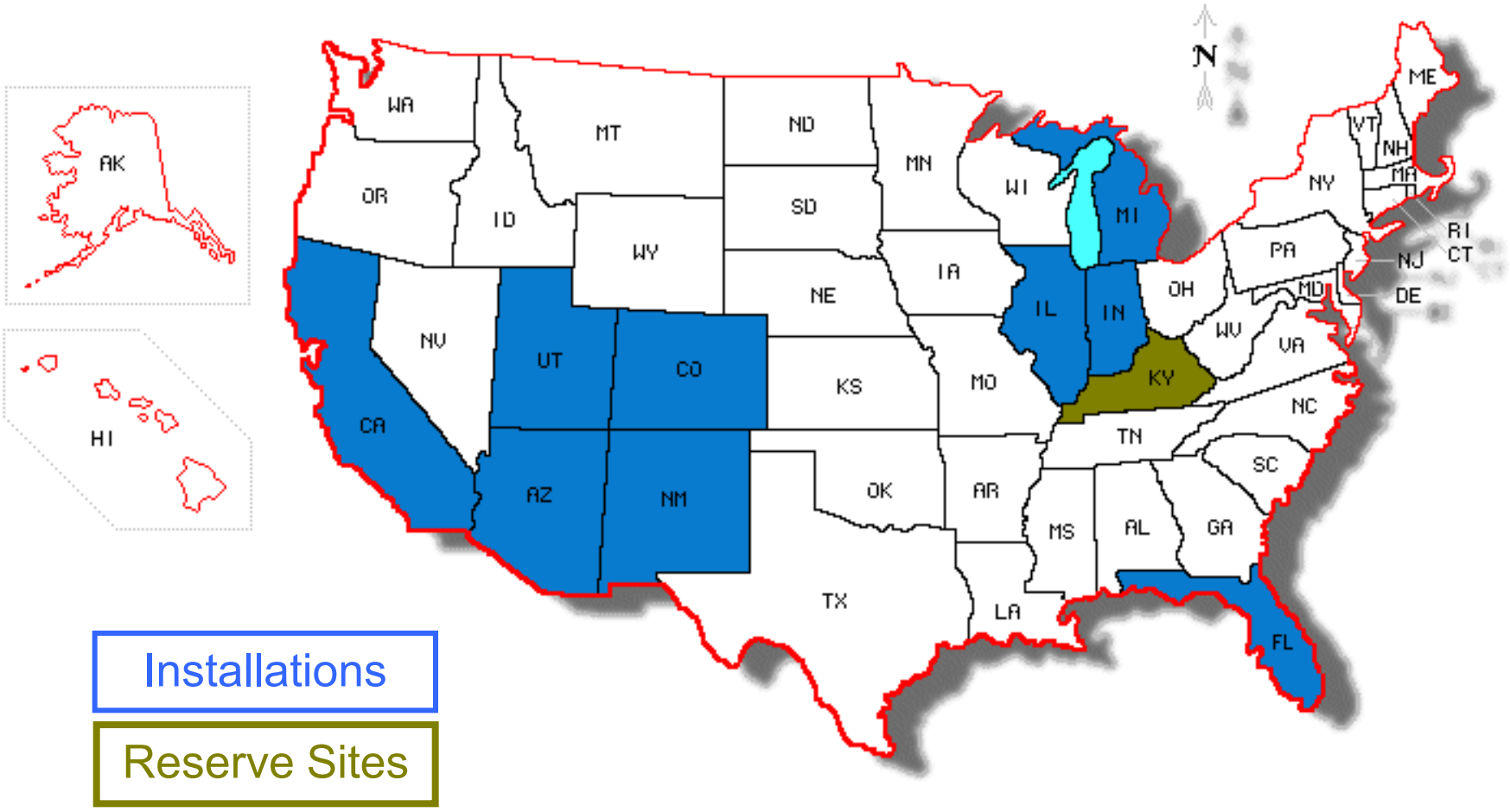
- Phase II: Equipment Installation (65% complete)
  - Site Construction
  - Fuel Cell System Installation
  - System Commissioning
    - Milestones
      - AT&T sites – 63% complete
        - » 114 of 180 sites (259 fuel cells installed, of 376 total)
      - PG&E sites – 89% complete
        - » 8 of 9 sites (8 fuel cells installed, of 9 total)
- Phase III: Data Collection and Reporting (ongoing)
  - Data Collection
  - Project Management and Reporting
    - Milestones Completed
      - Safety Plan
      - Quarterly Reports
      - Quarterly Data Collection

Technical Accomplishments and Progress

- Site surveys completed on 465 sites
  - The applicability of fuel cells in a variety of sites and environments was assessed
  - Access for bulk fuel delivery was assessed at every site. This information was significant in enhancing the fuel company's ability to serve smaller, more restricted sites.
- Site Acquisition completed on 148 sites
  - Coordination with local authorities and landlords was accomplished in multiple regions, educating stakeholders of the benefits and requirements of siting fuel cells. Each subsequent site approval within a region was significantly easier.
- Construction and commissioning completed on 122 sites (267 fuel cells)
  - Installation data reported on all sites
  - Operational data reported on 15 sites configured with wireless modems
  - Monitored sites carried numerous outages
    - Ancillary benefit: data revealed site-specific issues unrelated to fuel cell (e.g. bad batteries)

Accomplishments – Multi-state

- Sites across 10 states



Accomplishments – Typical Site Installations

Ancillary accomplishments (funded independently)

- Development of enhanced vehicle for hydrogen delivery to broader population of sites
  - Smaller vehicle
  - Lighter weight
  - Better fuel economy
  - Better payload utilization

- Development of hydrogen storage solution
  - (prior to ARRA effort)
  - Commercial, multi-cylinder module
  - U.S.DOT 3AA 3000, 80L cylinder
  - Meets requirements of 72 hours capacity

Collaborations

- ReliOn
  - DOE Prime Contractor
  - Fuel Cell System Manufacturer
  - Installation Prime Contractor
- AT&T
  - Customer / Host Sites / End-User
  - Up to 180 sites with hybrid cylinder exchange/bulk refueling solution
  - Extensive involvement in site selection and development
- PG&E
  - Customer / Host Sites / End-User
  - 9 sites with cylinder exchange
- Air Products & Chemicals, Inc.
  - Partner / Supplier
  - Hydrogen Storage / Bulk Fueling Service / Vehicle Development
  - Extensive involvement with storage development and fueling infrastructure

Future Work

- FY 2011
  - Complete remaining site acquisition
  - Complete remaining installations
  - Report installation data on commissioned sites
  - Report operational data on 20 sites
- Remainder of program (ends 12/31/2011)
  - Report operational data throughout duration of program
- Risks to this program were front-loaded, primarily on site selection/acquisition
- Risks going forward:
  - Site Acquisition (moderate risk, based on experience)
  - Refueling (moderate risk; limited trucks, weather)
  - Data collection (low risk; wireless modem functionality)
  - Fuel cell installation (minimal risk; weather)
  - Fuel cell operation (minimal risk; commercial systems)

Summary

- Relevance
  - The deployment of 189 fuel cell systems in two networks, across 9-10 states, with a new fueling solution has already begun to transform the market by raising awareness in multiple stakeholders, and has resulted in direct and indirect employment at ReliOn, and indirect employment up and down the supply chain which will continue after the program is completed.
  - New Products (fuel cells, hydrogen storage, and hydrogen delivery) were developed in parallel, without DOE funding, based on lessons learned from this program.
  - Multiple telco regions, installers, and a major gas supplier are enhancing their product portfolios and solution sets with fuel cell experience.
- Approach
  - Focusing on commercial processes and industry standards, the deployment moves beyond traditional “demonstration” programs to reach a critical mass necessary to engage a supply chain and a fueling infrastructure, and touch a broad spectrum of stakeholders.
  - A broad geographic installation base extends the reach to myriad markets, installation firms, and permitting districts, raising awareness through actual deployments.
- Technical Accomplishments & Progress
  - All site surveys are completed.
  - 148 sites have completed all pre-construction documentation (“site acquisition”)
  - 122 sites have completed equipment installation and commissioning and are operational
  - New fueling storage and infrastructure solutions have been deployed.
- Collaboration
  - The team brings together a leading fuel cell system manufacturer (ReliOn) with the nation’s largest wireless telecommunications carrier (AT&T), a California utility (PG&E), and a major industrial gas supplier (Air Products), to field commercial systems in real-world installations across a broad range of environments.
  - The critical mass of systems enables the program team to penetrate nation-wide regions with corporate level attention, and catalyze non-DOE-funded activities in fuel storage and delivery.
- Future work
  - Complete all installations in FY 2011 and collect operational data through Q4 2011