

Residential Fuel Cell Demonstration by the Delaware County Electric Cooperative

2004 DOE Hydrogen, Fuel Cells & Infrastructure Technologies Program Review

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Cooperative, Inc.

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This presentation does not contain any proprietary or confidential information

DCEC Company Overview

- Headquarters: Delhi, New York
- Geographic Area Served:
 - South Eastern portion of New York State
 - Greater Catskill Mountains
- 800 miles of distribution lines
- 5,000 member/customers
- 35 Employees
- “Full Requirements” status with New York Power Authority
- System Load: ~15MW peak
- Member of National Rural Electric Cooperative Association (NRECA)



Vital Utility supplier to the Greater Catskill Mountain Area

Project Objectives

- Validate objectives of propane fueled hydrogen fuel cells for edge-of-grid residences via a field trial demonstration
 - measure and report technical performance
 - provide raw cost data and economic viability analysis
 - document maintenance and operations concept enhancements specific to residential fuel cells
 - share safety related vulnerabilities analysis and lessons learned
 - promote education of state and local consumers

- Total project funding: \$588,646
 - DOE share: \$294,323
 - DCEC share: \$294,323
- Estimated FY03 Expenditures: \$114,000
 - estimate includes project planning, contract administration/reporting, preliminary engineering, and initial educational efforts
 - estimate assumes no fuel cell purchasing expenditures during FY03.

- DOE Technical Barriers for Fuel Cell Validation
 - DOE designation “I”
 - Hydrogen and electricity co-production
 - Cost and durability not statistically validated
 - Permitting, codes, and standards not established for fuel cells in or around buildings
 - Lack of operational and maintenance experience

Field experience required to overcome barriers.

Technical Performance Objectives

- Efficiency with and without thermal recovery
 - Electrical energy efficiency at rated power
 - Combined heat and power (CHP) efficiency
- Cost
- Transient response
- Cold start time
- Survivability
- Durability
- Power quality
- Noise
- Emissions

Controlled experiments and real time measurement and reporting during operating period.

Sensitivity Analysis Parameters

- Temperature
- Humidity
- Propane odorant variations (constituents, odorants, heating value, etc.)
- In-service time

Real-world range of operating conditions and fuel compositions.

- Complete economic model for “typical” rural residential customer
- Extending portions of economic model to other rural electric cooperative load types
 - Peak demand and load profiles
 - Non-residential

Approach

- Install and operate
 - evaluation of alternative fuel cell technologies for rural residential applications
 - propane fueled residential fuel cell
 - thermal recovery for water and space heating
- Rigorous approach to parametric control and monitoring throughout 12 -18 month operating cycle
- Analyze 12 to 18 months of logged data
 - technical performance, economic viability, safety, operations a maintenance concepts

All activities managed utilizing Six Sigma tollgate approach.

Project Safety Vulnerabilities

- Customer safety regarding operation of switching mechanisms in support of independent (off-grid) operations of fuel cell
- Customer and cooperative personnel safety regarding siting, storage, and access to batteries
- Compliance with and evaluation of fuel cell vendor's safety recommendations
- Environmental vulnerabilities related to fuel cell, batteries and propane storage

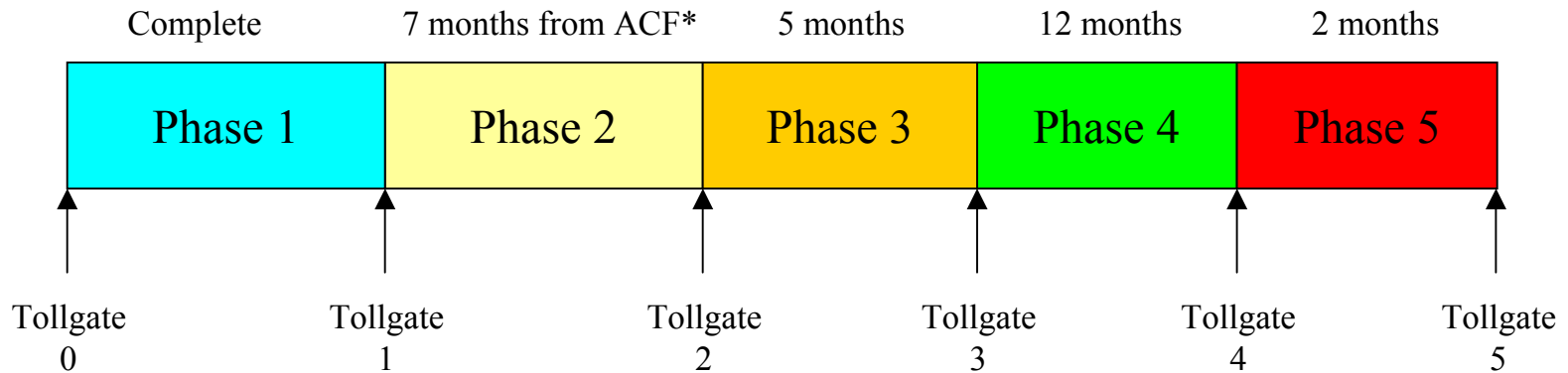
Each safety vulnerability reviewed at tollgates 3, 4, and 5 of Six Sigma process.

Project Safety Documentation

- Safety findings documented in site selection report, installation report, commissioning letter report, and Hydrogen Safety Review Panel report.
- In-house safety review process focused on fuel cell vendor safety documentation, propane vendor safety documentation, and the cooperative's governing safety manual
- Review comments and updated documents (where appropriate) to be provided to NRECA's Cooperative Research Network and DOE.

Safety findings formally documented in tollgate deliverable documents.

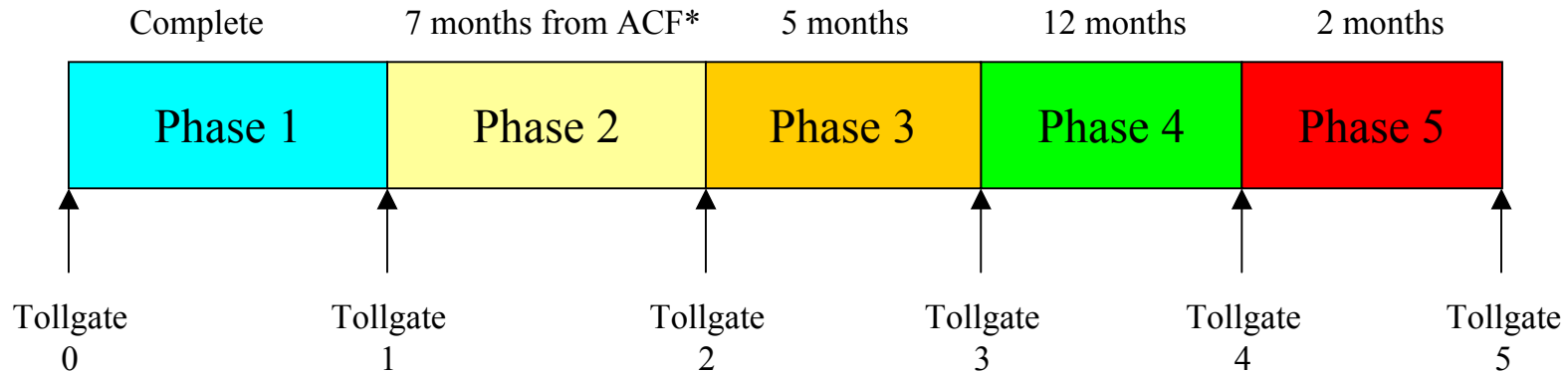
Project Timeline



ACF = After Contract Finalization

- Phase 1 - Project Planning and Stakeholder Definition
- Phase 2 - Preliminary Engineering
 - 1 Contract finalization
 - 2 Site selection (Site Selection Report)
 - 3 Fuel Cell Vendor Contracting
 - 4 Interconnect engineering

Project Timeline



ACF = After Contract Finalization

- **Phase 3 - Detailed Engineering, Installation, and Startup**
 - 5 Site work (Installation Report)
 - 6 Operational verification and startup (Commissioning Letter Report)
- **Phase 4 - Operating Period**
 - 7 System operation and data collection (Project Tollgate Reports)
- **Phase 5 - Analysis and Closeout**
 - 8 Data analysis and final reports (Final Report on Technical Performance Measures, Economic Viability, and Operations and Maintenance Procedures)
 - 9 Decommissioning activities

Interactions and Collaborations

- National Rural Electric Cooperative Association's Cooperative Research Network –
 - integral component of national research program
 - providing research methodologies and consolidating results with other cooperative demonstrations
- New York Power Authority
 - providing engineering, permitting, and interconnection support
- Fuel Cell Vendor
 - providing fuel cell plant, technical resources, and data acquisition analysis and reporting
- 1st Rochdale Electric Cooperative
 - potential involvement with NYSERDA (New York State Energy Research and Development Authority) in urban residential application
 - joint data analysis and peer review