Data Collection & Analysis for ARRA Fuel Cell Projects

Recovery Projects Kick-Off Meeting
New Cumberland, PA

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Overview

• Objectives
• Data Flow
• Data Collection
  – Reporting, templates, considerations
• Composite Data Products (CDPs)
• Questions
Data Analysis Objectives

- Independent assessment of technology, focused on fuel cell system and hydrogen infrastructure: performance, operation, and safety.
- Leverage data processing and analysis capabilities from the fuel cell vehicle Learning Demonstration project and DoD Forklift Demo.
- Establish a baseline of real-world fuel cell operation and maintenance data and identify technical/market barriers.
- Support market growth of fuel cell technologies by reporting on technology features relevant to the business case.
- Report on technology to fuel cell and hydrogen communities and stakeholders.

Detailed Data Products (DDPs)
- Individual data analyses for each FC system and site
- Identify individual contribution to CDPs
- Only shared with partner who supplied data

Composite Data Products (CDPs)
- Aggregated data across multiple systems, sites, and teams
- Publish analysis results without revealing proprietary data
Data Flow

Project Team Partner/Site
Operation Data

NREL HSDC
Data Processing & Analysis

Results
Data Products

Evaluating secure data transfer options such as mail and secure FTP

CDPs every 6 months*; used for CDP review

CDPs every 6 months**

*Bundled data delivered to NREL quarterly

*Internal analysis completed quarterly

*Data exchange may happen more frequently based on data, analysis, & collaboration

**Via conferences, reports, and NREL Tech Val Website
Data Reporting & Collection

• Site Summary Report
  – Overview (Reported once*)
  – Operation Log (Monthly)
  – Maintenance Log (Monthly)
• Site Cost Report
  – Installation Cost (Reported Once*)
  – Operation Cost (Monthly)
• Site Hydrogen Report
  – Hydrogen Production Data** (Monthly
  – Usage (Monthly)
• Operation Data
  – Vehicle, system, or facility operations (Monthly)
  – On-board data acquisition for any operation (CSV files preferred)

*Updates needed for any significant changes
**Only for on-site production

• All data bundled and delivered to NREL HSDC quarterly.
  • Data details are dependent on the application.
  • Data templates are created for each different application & report.
  • Data templates are common to all partners in an application.
Example of CDPs

Other Likely CDPs
Operation Hours & Durability
Efficiency
H₂ Fill Rate, Frequency, & Production
Power, Voltage, Energy
Safety
Maintenance
Cost (install, op, life)
Market Application Comparisons
Comparable Fuel Cell Vehicle CDPs

Fuel Cell System Efficiency at ~25% Net Power.

All OEMs

1. Gross stack power minus fuel cell system auxiliary, per DRAFT SAE J2615.
2. Ratio of DC output energy to the lower heating value of the input fuel (hydrogen).
   Excludes power electronics and electric drive.

Efficiency (%)

5 minute fill of 5 kg at 350 bar

3 minute fill of 5 kg at 350 bar

16623 Events

Average = 0.78 kg/min

24% >1 kg/min

2006 MYPP Tech Val Milestone

2012 MYPP Tech Val Milestone

Primary Factors of Infrastructure Safety Reports Through 2008 Q4

Number of Reports

Severity

Incident

Near Miss

Non-Event

Tank Levels: DOE Fleet

Median Tank Level (At Fill) = 40%

Total refuelings = 22053

1. Some refueling events not recorded/detected due to data noise or incompleteness.
2. The outer arc is set at 20% total refuelings.
3. If tank level at fill was not available, a complete fill up was assumed.

Fuel Cell Vehicle Maintenance Events and Labor Hours

Fuel Cell Vehicle Labor (10216 hours)

Vehicle (non-powertrain)

Fuel Cell System

Powertrain

Battery

Vehicle System

Controls, Electronics, Sensors

Fuel System

Fuel Cell Stack

Other

Fuel Cell System Events (3175)

11%

49%

13%

24%

26%

Fuel Cell System Labor (5035 hours)

< 1%

49%

10%

24%

14%

Total refuelings = 22053

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All published results can be found at: http://www.nrel.gov/hydrogen/proj_tech_validation.html
## What Others Are Saying About NREL’s FC Analysis

### Partner Collaboration and Confidence
- "NREL team has gained the highest credibility with both industry and DOE"
- "Outstanding collaborative interactions"
- "have earned the complete confidence of industry during the course of this project"
- "Close collaboration with industry partners providing data is a primary contributor to project success"

### Communication of Results
- "comprehensive and needed summary of hydrogen fuel cell vehicle testing"
- "Public results have been widely and proactively disseminated through numerous conferences, reports and publications"

### Approach and Methodology
- "superb system for collection, storage, securing, analyzing, and reporting on sensitive performance and other data submitted by industry"
- "Strong analysis methodology"
- "strong, experienced, flexible team, which is committed to achievement of challenging project and hydrogen program objectives"
- "Excellent approach to maximize useful information from a massive amount of data"

### Importance and Relevance
- "vital to determining whether the Program's hydrogen and fuel cell activities are on course to achieve established research and development targets"
- "the most important and critical element of the Technology Validation Sub-program"

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