Station Operational Status System (SOSS) 3.0 Implementation, SOSS 3.1 Upgrade, and Station Map Upgrade Project

2016 DOE Hydrogen and Fuel Cells Program Review

June 9, 2016

PI: Ben Xiong, California Fuel Cell Partnership
Operated by BKi
Overview

**TIMELINE**
- Start: October 1, 2015
- End: September 30, 2016*
- 75% complete

**BUDGET**
- Total project funding: $200,000
- DOE share: $155,000
- Contractor share: $45,000
- Funding received in FY15: $155,000

**BARRIERS (D)**
- Integration of complex systems
- Lack of Hydrogen Refueling Infrastructure Performance and Availability Data

**PARTNERS**
- Funders
  - See CaFCP members slide
- Collaborators
  - See Collaborations slide
- Developers
  - ImageX Media

* Funded project end date
Relevance

**OBJECTIVE:**
Consistently and reliably report hydrogen station operational status information to FCEV customers to increase customer satisfaction and station demand. 
Provide the most recent, realistic and accurate hydrogen station information to FCEV customers, station implementers and AHJs to address stakeholder station information needs.

**IMPACT:**
Automated station information improves user experience and satisfaction. People considering FCEV purchases have more confidence in availability and reliability of fueling network.
## Approach - SOSS Steps/Phases

### PROJECT PHASES

<table>
<thead>
<tr>
<th>Phase</th>
<th>Duration</th>
<th>SOSS Version</th>
<th>Status</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1</td>
<td>2010-2014</td>
<td>SOSS 1.0 and SOSS 2.0</td>
<td>Completed</td>
<td>Manual and automatic reporting of station status, Small number of station participation</td>
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<tr>
<td>Phase 2</td>
<td>2014-2015</td>
<td>SOSS 3.0</td>
<td>Completed</td>
<td>All automatic reporting of station status, Consistent and defined criteria, 15 minutes or less reporting intervals</td>
</tr>
<tr>
<td>Phase 3</td>
<td>2015-2016</td>
<td>SOSS 3.1</td>
<td>Current</td>
<td>Implement SOSS at newly built stations, Improve SOSS usability features, Drupal content management system update, Develop Disaster Recovery Plan</td>
</tr>
<tr>
<td>Phase 4</td>
<td>2017-beyond</td>
<td>SOSS 4.0</td>
<td>Future</td>
<td>Real-time reporting, Hardware upgrades</td>
</tr>
</tbody>
</table>
Approach - Overview
Station Operational Status System (SOSS)

HOW IT WORKS

About every 15 minutes, stations send information to CaFCP’s database.

Authorized applications receive data from CaFCP to provide drivers with real-time station information.

CaFCP’s secure server and station database

www.cafcp.org
Approach - Overview (2)

Station Status Criteria

**ONLINE**
- Station can deliver SOC > 95%
- Boost compressor online
- High pressure storage online
- Chiller online
- H2 source online
- POS online

**LIMITED**
- Station can still deliver fuel but SOC<=95%
- Boost compressor offline
- High pressure storage offline
- Chiller online
- H2 source offline
- POS online

**OFFLINE**
- Station cannot deliver fuel
- Boost compressor offline
- High pressure storage offline
- Chiller offline
- H2 source offline
- POS offline

**Acronyms**
SOC: State of charge
POS: Point of sale
H2: Hydrogen
Approach - Components

- Web server based on Linux OS, Apache HTML Server, MySQL database management system, and PHP server-side scripting language.
- User interface
  - Google map interface
  - Mobile online interface
  - SMS/Email notification
- System at each station to transmit operational status

Station Operational Status System (SOSS)
Accomplishments (1)

- Improved user interface
  - Station list sorting
  - Public Retail/Other Non-retail stations
  - User preference
  - “Unknown” status
  - Show current available capacity

http://m.cafcp.org
Accomplishments (2)

• Implement SOSS at newly built hydrogen stations *(by September 30, 2016)*
  ▪ 17 new retail stations added to SOSS
  ▪ 3 retail stations in progress
  ▪ All stations under construction will have SOSS
  ▪ California Energy Commission requires SOSS on future state-funded stations

• Maintain SOSS operational status at hydrogen stations
  ▪ 7 existing non-retail stations on SOSS

<table>
<thead>
<tr>
<th>Station (Station Developer/Owner)</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burbank <em>(H2 Frontier), Emeryville</em> (Linde), Fountain Valley* (APCI), Harbor City* (APCI), Newport Beach* (Shell/Powertech), Richmond* (UCB/Powertech), Torrance* (Shell/APCI), Costa Mesa (First Element Fuel), Diamond Bar (APCI), Fairfax – LA (APCI), Harris Ranch (FEF), Hayward (FEF), La Canada Flintridge (FEF), Lake Forest (FEF), Long Beach (FEF), San Jose (FEF), San Juan Capistrano (Linde), Santa Barbara (FEF), Santa Monica (APCI), Saratoga (FEF), South San Francisco (FEF), UC Irvine (APCI), West LA (APCI), West Sacramento (Linde)</td>
<td>Complete</td>
</tr>
<tr>
<td>CSULA, Riverside (ITM Power), Campbell (FEF)</td>
<td>In progress</td>
</tr>
</tbody>
</table>

*Non-retail stations*
Accomplishments (3)

• Disaster Recovery Plan
  • Components completed and implemented
    ▪ Identify and train primary disaster recovery staff
    ▪ Identify disaster classification (hardware and software)
    ▪ Identify direction control and administration procedures
    ▪ Identify procedures for internal and external communications
  • Components in progress
    ▪ Identify procedures for resuming and recovering operations (hardware and software)
    ▪ Identify procedures for restoring facilities and normalizing operations (hardware)
Accomplishments (4)

Implement Station Map Upgrade

• Completed transition from Drupal 6 to Drupal 7 content management system
• Transition to a standalone site in progress
  ▪ Start upgrade: May 1, 2016
  ▪ Upgrade completion: August 31, 2016
Response to Reviewers’ Comments (3.0 Upgrade)

• **Reviewer comment**: It seems that the potential impact of this initiative may be competing to some extent with activities being undertaken in parallel by other organizations (e.g., individual original equipment manufacturers [OEMs]) that have similar and/or related objectives.

• **Response**: Automakers, station operators and station developers have agreed to provide CaFCP with station status data and make it the central clearinghouse of station status information for H2 stations in California. While other organizations may introduce similar products, the guarantee and likelihood that they will provide data from all H2 stations in CA is what sets this system apart from the others. The data the OEMs display will be a direct result of data from SOSS. The car companies may develop a front end system geared specifically for their customers but the backend (the data from the stations) will be coming from CaFCP’s SOSS and then pushed to the automakers.

• **Reviewer comment**: To fully reflect the hydrogen coverage available in the area, all public stations should be included. The team needs to do everything possible to gain access to all stations.

• **Response**: Our goal is to have 100% of retail stations on SOSS. Not all stations are public retail stations accessible by all customers which can make getting access to SOSS data from those stations impossible and not necessary.
Collaborations

• **CaFCP member partners**
  • Car manufacturers (Customer interface and definition dev’t)
    ▪ Daimler, Toyota, GM, Honda, Hyundai, Nissan, VW
  • Station operators/Developers (SOSS integration & definition dev’t)
    ▪ Air Liquide, H2 Frontier, Hydrogenics, ITM Power, Linde, First Element Fuel

• **Other partners**
  • Powertech, Shell, Stratos Fuel, Air Products, HyGen
Remaining Barriers and Challenges

- Delayed station implementation/rollout
- Hardware standardization
- Security protocol at station
- Knowledge of station operator
- Point of Sale
- Funding for labor & equipment
- Number of stations expected to come online
Proposed future work

- Implementation at new stations (*by Dec 2017*)
  - Fremont
  - Thousand Oaks
  - Newport Beach (Upgrade)
  - Rancho Palos Verdes
  - Encinitas
  - Santa Clarita
  - Oakland (Emeryville)
  - North Hollywood
Proposed future work (2)

- Solicit new hydrogen stations to participate on SOSS
- Include stations outside California
- FCEV user interaction and feedback system
- Mobile native app capabilities
- Real-time reporting
- Include additional data fields
  - Price, user comments, etc.
  - Update to SOSS will be needed to have capability to include additional fields
- Analysis reporting capabilities
Summary

• SOSS implemented at 17 new hydrogen stations
• 100% station participation in California
• Multiple partners committed
• Station implementation/rollout delays create barriers
• Station Map upgrade in progress
• Disaster Recovery Plan in progress
• CaFCP to continue including additional stations
• Next: additional data collection opportunities
Station Operational Status System (SOSS) 3.0 Implementation, SOSS 3.1 Upgrade, and Station Map Upgrade

Questions & comments?

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Back-up Slides
CaFCP Members

Air Liquide
Alameda-Contra Costa Transit District (AC Transit)
Automotive Fuel Cell Cooperation
BAE Systems
Ballard Power Systems
Bay Area Air Quality Management District
California Air Resources Board
California Department of Food and Agriculture
California Energy Commission
California State University - Los Angeles
CALSTART
The Center for Energy Efficiency and Renewable Technologies (CEERT)
Center for Transportation and the Environment (CTE)
Daimler
Energy Independence Now
FirstElement Fuel, Inc.
General Motors
H2 Logic
Honda
Hydrogenics
HydrogeNXT
Hyundai
ITM Power
Institute of Transportation Studies, UC Davis
Linde North America, Inc.
National Fuel Cell Research Center, UC Irvine
National Renewable Energy Laboratory (NREL)
Nissan
Office of Governor Edmund G. Brown Jr.
Sandia National Laboratories
South Coast Air Quality Management District
Southern California Gas Company
SunLine Transit Agency
Toyota
U.S. Department of Energy
U.S. Environmental Protection Agency
University of California, Berkeley
Volkswagen
## SOSS Implementation (1)

<table>
<thead>
<tr>
<th>Station Name</th>
<th>SOSS Status</th>
<th>Station Developer</th>
<th>Expected Open Date</th>
<th>Development Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Sacramento - S. River Rd.</td>
<td>Completed</td>
<td>Linde</td>
<td>2015 June</td>
<td>1. Open - Retail</td>
</tr>
<tr>
<td>Diamond Bar - SCAQMD</td>
<td>Completed</td>
<td>Air Products</td>
<td>2015 August</td>
<td>1. Open - Retail</td>
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<tr>
<td>West LA</td>
<td>Completed</td>
<td>Air Products</td>
<td>2015 October</td>
<td>1. Open - Retail</td>
</tr>
<tr>
<td>UC Irvine</td>
<td>Completed</td>
<td>Air Products</td>
<td>2015 November</td>
<td>1. Open - Retail</td>
</tr>
<tr>
<td>San Juan Capistrano</td>
<td>Completed</td>
<td>Linde</td>
<td>2015 December</td>
<td>1. Open - Retail</td>
</tr>
<tr>
<td>Harris Ranch</td>
<td>Completed</td>
<td>FirstElement Fuel</td>
<td>2015 December</td>
<td>1. Open - Retail</td>
</tr>
<tr>
<td>Long Beach</td>
<td>Completed</td>
<td>FirstElement Fuel</td>
<td>2016 February</td>
<td>1. Open - Retail</td>
</tr>
<tr>
<td>South San Francisco</td>
<td>Completed</td>
<td>FirstElement Fuel</td>
<td>2016 February</td>
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<tr>
<td>Santa Monica - Cloverfield Blv.d.</td>
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<td>Air Products</td>
<td>2016 February</td>
<td>1. Open - Retail</td>
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<tr>
<td>San Jose</td>
<td>Completed</td>
<td>FirstElement Fuel</td>
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<td>La Canada Flintridge</td>
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<td>Lake Forest</td>
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<td>Fairfax - LA</td>
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## SOSS Implementation (2)

<table>
<thead>
<tr>
<th>Station Name</th>
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<th>Station Developer</th>
<th>Expected Open Date</th>
<th>Development Status</th>
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<tr>
<td>Cal State LA</td>
<td>In progress</td>
<td>CSULA / EPC</td>
<td>2016</td>
<td>2. Commissioning</td>
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<tr>
<td>Campbell</td>
<td>In progress</td>
<td>FirstElement Fuel</td>
<td>2016 June</td>
<td>2. Commissioning</td>
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<td>Riverside</td>
<td>In progress</td>
<td>ITM Power</td>
<td>2016 June</td>
<td>2. Commissioning</td>
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<td>Truckee</td>
<td>Planned</td>
<td>FirstElement Fuel</td>
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<td>2. Commissioning</td>
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<td>Air Products</td>
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<td>2016 Q3</td>
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<td>-</td>
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<td>Shell / Linde</td>
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