Overview

• A brief history of TSRC FCV research
• Latest FCHV-adv driver response study
• FCHV-adv program stats
• Experience with the Richmond Field Station 700-bar station (30 mo. since 5/11)
• FCV bus driver study
• Planned metrology testing
Hydrogen Fueling Facility at RFS

TSRC FCV Research

• 2006-07: Daimler F-Cell “longitudinal” (multi-month) study
• 2007: F-Cell “drive clinics” at RFS (Richmond) and at CAFCP (~200 participants)
• 2008-2010: Sequential HEV/PHEV/FCV study under AB1811 (replicated in N./S. Cal)
• 2010-present: FCHV-adv study (8-9 vehicles)
• 2011-present: Operation of 700-bar station
• 2008-present: Ongoing H2 infrastructure studies
FCV Drive Clinic in 2007

2012-13 FCHV-adv Study

– Each participant completes 2 online surveys:
  • Initial – completed before driving the FCHV-adv and receiving driver training
  • Final – completed at the end of the four-week driving period

– Initial survey collects data about driver:
  • vehicle ownership and preferences, driving habits, exposure to alternative-fueled vehicles, attitudes toward environmental subjects, and demographics.

– Final survey collects data about driver:
  • FCHV-adv driving habits, fueling experience, safety perceptions, use of HOV stickers, etc.
Expected and Actual Overall Impression of the FCHV-adv

Four of the five survey respondents believed FCHVs were safer than gasoline vehicles at the end of the 4-week driving period.

The one respondent without an improved perception preserved his/her view that FCHVs would be safer than gasoline vehicles.
Perceived H₂ Fueling Safety

- One survey respondent adjusted fueling safety perception from “safer than gasoline fueling” to “as safe as gasoline fueling.” Three of five adjusted their “less safe than gasoline” perception to “as safe” after driving and fueling FHCVs.

FCHV-Adv Program Stats

- ~50,000 miles driven as of 7/1/13 (7 of 8 cars reported below)
- Goal is 75,000+ miles by end of 2013

<table>
<thead>
<tr>
<th>FCHV #</th>
<th>Vin #</th>
<th>License Plate</th>
<th>Miles Driven</th>
<th>H₂ Consumed (kg)</th>
<th>Fuel Eff.</th>
</tr>
</thead>
<tbody>
<tr>
<td>109</td>
<td>JTNGX0CA0BA000182</td>
<td>6REL690</td>
<td>5366</td>
<td>101</td>
<td>52.96</td>
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<td>111</td>
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<td>6708</td>
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<td>57.61</td>
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<td>53.94</td>
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<td>6UNI655</td>
<td>12163</td>
<td>207</td>
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<td>6UNI654</td>
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<tr>
<td>130</td>
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<td>6TAF246</td>
<td>4873</td>
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<td>54.85</td>
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<td>131</td>
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<td>6UNK742</td>
<td>4022</td>
<td>68</td>
<td>59.50</td>
</tr>
</tbody>
</table>

Total Miles: 45820
Total H₂ (kg): 814
Agg. Fuel Eff.: 56.30
Preliminary Station and Vehicle Performance Data

- Full fills (4-5 kg) take from approx. 12 min. to ~20 min. with pre-cooling
  - Higher ambient temperatures increase fueling times
  - Sequential fills increase fueling times

- “Estimated Ranges” and actual ranges on vehicles fluctuated
  - 260 miles/full-tank to 340 miles/full tank
  - Variations due to individual driver style are evident
  - Vehicle to vehicle variations have also been observed to some extent

Hydrogen Fuel Dispensed

- Individual fill data are logged and stored
  - From 6/9/2012 – Present
  - Provides complete fill profile information

- Over 250 successful fills
- Over 1,000 kg of fuel dispensed across all vehicles

- H2 Dispensed:
  - Avg. of 3.39 kg / fill
  - Max fill = 5.3 kg

- Fuel economy varied somewhat by driver
  - Est. 49 miles/kg to 59 miles/kg
FCV Bus Driver Study

- Survey conducted of AC Transit and Golden Gate Transit fuel cell bus drivers during Summer 2013
- Approximately 140 surveys issued and 47 returned (total “n”=47) for 33% response rate
- 3-page written survey with last page for “open ended” responses
- No incentive except drivers paid 15 minutes of overtime for completing survey
- Questions asked about bus performance, perceived safety, and demographics / attitudes
Fuel Cell Bus Characteristics

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Number of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handling (n=46)</td>
<td>Excellent: 15, Good: 10, Average: 10, Fair: 5, Poor: 5</td>
</tr>
<tr>
<td>Ride Quality (n=46)</td>
<td>Excellent: 12, Good: 8, Average: 12, Fair: 5, Poor: 5</td>
</tr>
<tr>
<td>Quiet Operation (n=47)</td>
<td>Excellent: 36, Good: 10, Average: 8, Fair: 5, Poor: 2</td>
</tr>
</tbody>
</table>

Fuel Cell Bus Characteristics

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Number of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceleration (n=47)</td>
<td>Excellent: 18, Good: 14, Average: 12, Fair: 6, Poor: 2</td>
</tr>
<tr>
<td>Braking (n=46)</td>
<td>Excellent: 12, Good: 8, Average: 10, Fair: 6, Poor: 2</td>
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</tbody>
</table>
Overall, how do you like the new fuel cell bus compared to other buses you have driven? (n=47)

<table>
<thead>
<tr>
<th>Number of Responses</th>
<th>5: Much Better</th>
<th>4</th>
<th>3: The Same</th>
<th>2</th>
<th>1: Not as Well</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>14</td>
<td>6</td>
<td>14</td>
<td>6</td>
<td>1</td>
</tr>
</tbody>
</table>

I feel as safe driving the fuel cell buses as I do driving the standard diesel buses. (n=46)

<table>
<thead>
<tr>
<th>Number of Responses</th>
<th>1: Strongly Disagree</th>
<th>2: Neutral</th>
<th>3: Agree</th>
<th>4: Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7</td>
<td>12</td>
<td>16</td>
<td>3</td>
</tr>
</tbody>
</table>
Planned Metrology Testing

Thanks! Questions?

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