HFCS TESTING AT THE TRANSLAB

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YREKA, CA

TOPICS

- WHAT IS METS?
- EXISTING BATTERY BACKUP SYSTEM (BBS) TECHNOLOGY
- FUEL CELL LAYOUT
- TESTING THAT WAS PERFORMED
- ALTERNATIVES TO COMPARE TO
- FUTURE POTENTIALS FOR TESTING

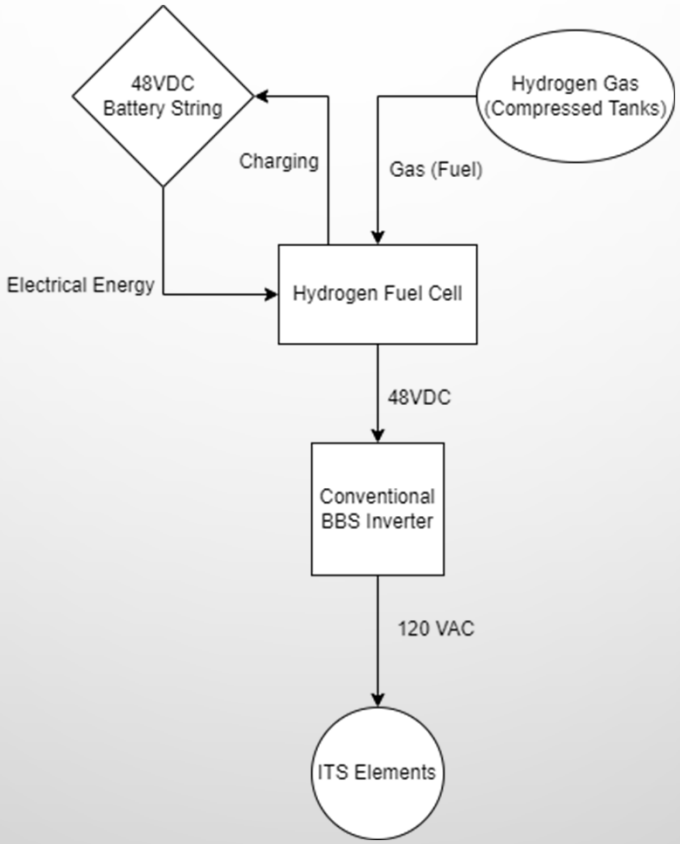
WHAT IS METS

- CALTRANS TRANSPORTATION LABORATORY
- ELECTRICAL QUALITY ASSURANCE AND SOURCE INSPECTION (EQASI)
- RESPONSIBLE FOR ELECTRICAL MATERIAL QUALITY ASSURANCE STATEWIDE
- A SUBDIVISION OF DIVISION OF ENGINEERING SERVICES
- PROJECT DELIVERY

EXISTING BBS TECH

- LEAD ACID
- LITHIUM-ION
- SUPER CAPACITOR
- NICKEL ZINC

FUEL CELL LAYOUT



INITIAL LAB SETUP

- Signage and safety considerations
- Bottle leasing/filling
- Electrical Load system
- Specialty tools (hydrogen sniffer)

TEST PROCEDURE/GOALS

- What does extended runtime mean in Intelligent Transportation Systems (ITS)?
- Utilizing existing Battery Backup System (BBS) inverter expectations
- Typical intersection load
- Potential non-intersection load

Hydrogen Fuel Cell Test Setup

- PURELY RESISTIVE LOAD
- AS CLOSE TO MAX CAPACITY WHILE FACTORING IN INVERTER EFFICIENCY
- MAXIMUM RUN TIME BASED ON A TYPICAL INTERSECTION LOAD (350-400 WATTS)
- ENVIRONMENTAL FACTORS

EQASI HyMax Hydrogen Fuel Cell Testing Procedure:

List of Materials:

- Alpha BBS inverter and transfer switch
- Four 12V AGM Batteries
- Hymax Fuel Cell System
- Variable resistive load bank with switch
- Hydrogen Gas Sniffer (gas detector)

Test Procedure:

Testing will be performed to evaluate the performance of the Western Systems HyMax Hydrogen Fuel Cell System (HFCS). These tests will be based on field connections and potential field conditions. These procedures are written to be used in conjunction with the testing document and testing criteria created by UC Davis and Caltrans.

Step 1: Install the Alpha BBS inverter and transfer switch with a connection to the four 12V AGM batteries in series with a 120V AC line power connection to simulate the field utility service connection.

Step 2: The HyMax HFCS will be commissioned, connected, and started by representatives of Western Systems. Check for gas in the environment with the Hydrogen Sniffer.

Step 3: Configure the variable resistive load to the proper calculated watt load (assuming an 82% inverter efficiency) based on which test is to be performed ensuring that the switch connecting the load is off (note: all backup power readings will be observed from the fuel cell user interface. This will ensure that power provided by the fuel cell is within the range of the fuel cell unit and efficiencies of the inverter are taken into consideration). The load should be as close to a purely resistive load as possible.

Step 4: Turn the switch for the load on and allow the BBS unit to apply power to the load. Once the load is connected and being powered by the 120V utility feed, remove the AC power cord from utility power and allow the Alpha BBS unit to go into backup mode. This should send a signal to the HFCS to begin providing energy. Check for gas in the environment with the Hydrogen Sniffer.

Step 5: Monitor the power load from the HFCS interface to ensure that the power being provided is within the manufacturer's specifications. Once the test is completed, re-energize the 120V utility power connection and the unit should return to idle condition.

DATA COLLECTED

HFC Testing

Run time	Watt Load	Environmental Conditions	Temperature	Humidity	Voltage (DC)	Current (A) (DC)	Power Displayed by Unit (W)
2 hours	250W (232W)	74 degrees	Inside: N/A Outside (Exhaust): N/A	Inside: N/A Outside (Exhaust): N/A	52.7	4.3 to 8.1	222 to 425
2 hours	500W (472W)	81 degrees	Inside: N/A Outside (Exhaust): N/A	Inside: N/A Outside (Exhaust): N/A	52.6	7.5 to 15.0	407 to 780
2 hours	750W (720W)	73 degrees	Inside: N/A Outside (Exhaust): N/A	Inside: N/A Outside (Exhaust): N/A	52.6	12.1 to 23.9	642 to 1258
2 hours	1000W (952W)	82 degrees	Inside: N/A Outside (Exhaust): N/A	Inside: N/A Outside (Exhaust): N/A	52.6	16.6 to 31.0	857 to 1588
Full Run Time:	500W		Inside: N/A Outside (Exhaust): N/A	Inside: N/A Outside (Exhaust): N/A			

STATE FIRE MARSHAL FEEDBACK

1. VEHICLE IMPACT PROTECTION IS REQUIRED AS WE DISCUSSED PER CFC 312. THIS CAN BE BY APPROPRIATELY SPACED BOLLARDS OR GUARDRAIL, DEPENDING ON THE SITE LOCATION AND DISTRICT SAFETY EVALUATION.

2. THE SFM SUPERVISORY TEAM ADVISED THAT A FIRE ACCESS LANE IS NOT REQUIRED FOR A HYDROGEN FUEL CELL SYSTEM AS A SINGLE CABINET USED IN THE MANNER OF POWER BACKUP FOR A TRAFFIC SIGNAL, CAMERA SYSTEM, OR OTHER SIMILAR USES AT THIS TIME. IF THESE WERE TO BE HOUSED IN A STRUCTURE, SUCH AS A SMALL BUILDING, THIS ALLOWANCE WOULD NOT APPLY.

3. BASED ON THE CUT SHEETS THE SYSTEM APPEARS MEET CFC 1206 CSA FC 1 REQUIREMENTS. BECAUSE IT'S HYDROGEN, NFPA 2 AND THE CA ELECTRICAL CODE WILL APPLY. NFPA 853, SECTION 6.4 WILL APPLY AND CHAPTERS 7 AND 8 MAY BE APPLICABLE AS WELL AS THEY ARE REFERENCED IN CFC 1206.11 AND 1206.12. SOME OF THESE SECTIONS MAY BE AS SIMPLE AS "CHECKING A BOX" BUT NEED TO BE FULLY REVIEWED.

4. FOR SFM SUBMITTAL, A SITE PLAN AND ASSOCIATED DETAILS THAT PROVIDE SETBACKS AND DIMENSIONS MEETING THE REQUIREMENTS OF CFC 1206.8 WILL BE REQUIRED. DETAILS FOR THE VEHICLE IMPACT PROTECTION WILL BE NEEDED, ALONG WITH FOUNDATIONS AND ASSOCIATED ATTACHMENTS FOR THE CABINETS, BOLLARDS/GUARDRAILS, ETC. DETAILS THAT ADDRESS THE OTHER REQUIREMENTS IN CFC 1206 WILL NEED TO BE SHOWN ON PLANS, SPECIFICATIONS, AND/OR CUT SHEETS AS APPROPRIATE.

FUTURE POTENTIAL TEST THAT CAN BE PERFORMED BY THE TRANSLAB

THE TRANSLAB IS RESPONSIBLE FOR TESTING NEW PRODUCTS THAT ARE SUBMITTED THROUGH THE NEW PRODUCTS EVALUATION PROGRAM (PEP). A CURRENT PROJECT THAT METS IS DEVELOPING IS A BACKUP POWER SYSTEM EVALUATION. THIS PROGRAM WILL COMPARE AVAILABLE BACKUP POWER SYSTEMS FOR ITS APPLICATIONS