DAIMLERCHRYSLER

HYDROGEN TO THE HIGHWAYS

Controlled Hydrogen Fleet and Infrastructure Demonstration and Validation Project

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April 22nd, 2005

This presentation does not contain any proprietary or confidential information

Project ID #: TV9

PROGRAM OVERVIEW

US Dept. of Energy Fuel Cell Vehicle and Infrastructure Cooperative Program

•Cooperative Agreement signed December 22nd, 2004
•Program duration: 2004 - 2009
•Partners: DaimlerChrysler, BP America, DTE Energy, NextEnergy

•Total budget: $88.8 M
(50% federal share / 50% industry share)
•Planned budget for pre-award: $6,757,601
•Planned budget for 2005: $36,155,547

Barriers and Problems Encountered

- Vehicles
  - Install and enable Fleet Data Acquisition system
    - Sophisticated equipment and data collecting software/hardware
    - Frequent installations and upgrades provide “learning curve”
- Hydrogen Refueling Infrastructure / Maintenance and Training Facilities
  - Complex Relationships: Sub-recipient Contracts encounter difficulties in governmental and corporate policies and legalities
  - Establishment of Ecosystems: Service, Maintenance, Testing, and Hydrogen Infrastructure facilities endure delaying permitting and site approval processes
- Codes and Standards
  - Assurance of safe vehicle and infrastructure operations (ie. Permits, local regulations)

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OBJECTIVES

Overall Program Objectives

The main focus of the ongoing DOE Fleet Validation and Demonstration Project is to identify the technology status of
- the fuel cell powered vehicles (OEMs) and
- the hydrogen infrastructure (energy companies and suppliers).

The program is about data collection and evaluation

Performance Measure	Units	2009 Performance Target	2015 Performance Target
Fuel Cell Stack Durability	Hours	2000	5000
Range	Miles	250	300
Hydrogen Cost at station; On- or Off-site Production	$/kg of H2	$3.00	$1.50

"To meet the goals of the project, the following 2008 performance measures are presented as targets to verify progress towards the 2015 performance targets and are the subject of this Solicitation. The 2015 performance measures will be the subject of subsequent phases."

–Solicitation DE-PS36-03GO93010

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OBJECTIVES

2005 Program Objectives

2005 will focus on the deployment of 30 fuel cell vehicles with complete data acquisition and reporting systems while the hydrogen infrastructure is beginning development.

- To ensure the safe installation of hydrogen fueling stations, fuel cell maintenance and service facilities, and the safe operation of all fuel cell vehicles
  - Emergency response plans including training
- To record, collect, report, and analyze data for the continuing improvement of performance and fueling goals
  - Timely and consistent reporting of raw data to NREL
- To communicate the technology advancements (vehicle and infrastructure)
  - Customer and community interaction and acceptance studies
- To maintain a high standard of program management and responsibility to all partners involved in the DOE Fleet Validation Program
  - Continued communication and development of Program Team Organization and Goals

APPROACH

- **Fuel Cell Vehicle Deployment and Operation**
  - Deploy the vehicles to three different ecosystems
    - Cold Climate –Southeast Michigan
    - Mild Climate –Northern California
    - Warm Climate –Southern California
  - Maintain continued customer operation
    - Day-to-day operation in various driving patterns
  - Collect statistically relevant data using automatic FDA data acquisition system
    - Customer friendly system that allows for engineer analysis for technology improvement
- **Hydrogen Infrastructure**
  - Install the necessary infrastructure to support the vehicles
  - Test infrastructure deployment across a metropolitan area
  - Evaluate technologies which have the potential to achieve the USDOE hydrogen cost targets
- **Safety and Health**
  - Properly address safety issues to improve perception and feasibility of hydrogen and fuel cell utilization

Create a broad database to evaluate status quo of Fuel Cell Vehicles and Hydrogen as alternative fuel.

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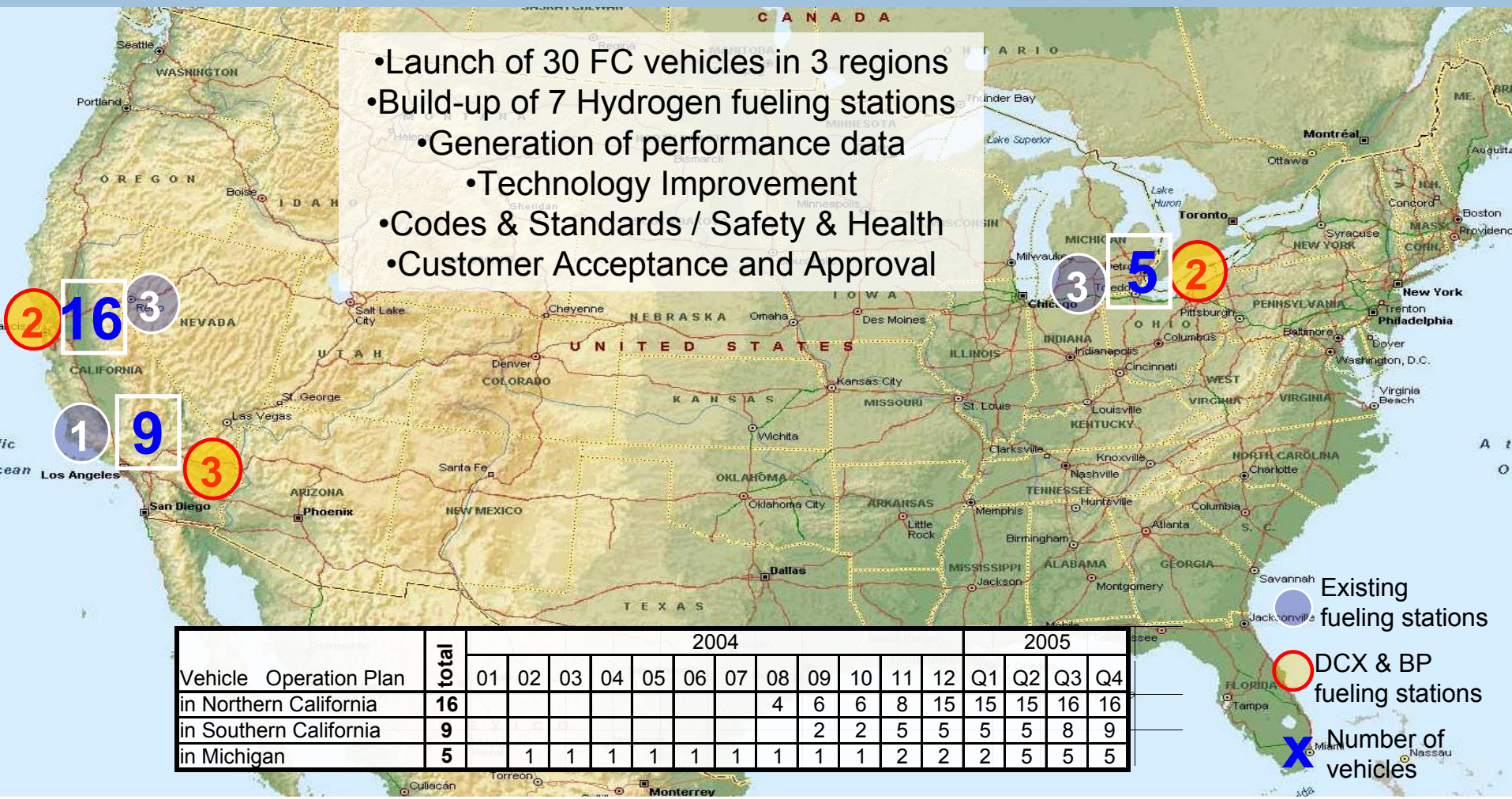
APPROACH



Vehicle Operation Plan	total	2004												2005			
		01	02	03	04	05	06	07	08	09	10	11	12	Q1	Q2	Q3	Q4
in Northern California	16								4	6	6	8	15	15	15	16	16
in Southern California	9									2	2	5	5	5	5	8	9
in Michigan	5		1	1	1	1	1	1	1	1	1	2	2	2	5	5	5

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TECHNICAL ACCOMPLISHMENTS

Vehicle Production and Operation:

- 30 Fuel Cell Vehicles (within the DOE program) are ready for operation
  - 10 F-Cells are currently in internal qualification processes
  - 18 F-Cells and 2 Fuel Cell Sprinter vans are currently operating in the U.S.
- 2 vehicles are being operated by UPS
  - Positive feedback received

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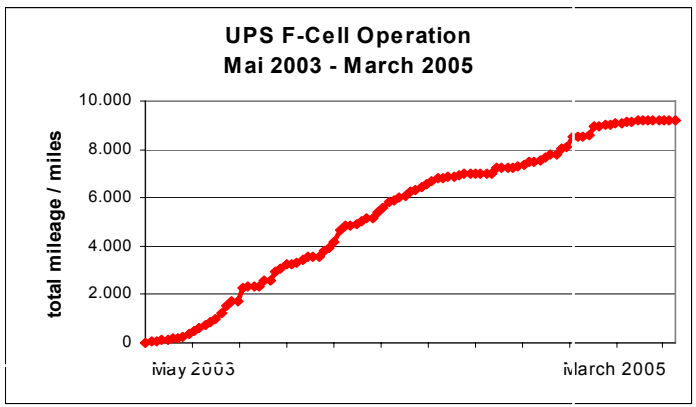
TECHNICAL DATA

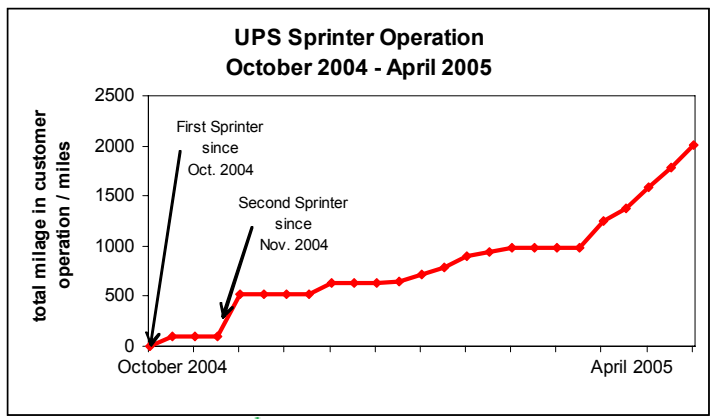
F-Cell Mercedes Benz A-Class

Technical Data	
Fuel Cell System	PEM, 72 kW (97hp)
Fuel	Compressed Hydrogen (350 bar / 5000 psi)
Traction Battery	NiMH, air cooled Capacity: 6.5Ah
Vehicle	Max. speed: 87 mph Range: 100 miles

Fuel Cell Sprinter II (US)

Technical Data	
Fuel Cell System	PEM, 72 kW (97hp)
Fuel	Compressed Hydrogen (350 bar / 5000 psi)
Traction Battery	NiMH, air cooled Capacity: 6.5Ah
Vehicle	Max. speed: 80 mph Range: 155 miles





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FUEL CELL VEHICLES
SERVICE FACILITIES

Service Facility at CaFCP
West Sacramento

Service Facility at MBUSA
Emissions Lab in Ann Arbor

Service Facility at MBUSA
Emissions Lab in Long Beach

DaimlerChrysler Engineers and Technicians Provide:

- Hotline Service
- Failure analysis, Troubleshooting
- Data Analysis
- Feedback to Development
- Special on-site FCS repairs
- Local service personnel training
- Softwareupdates, „running changes“
- Documentation

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DATA COLLECTION

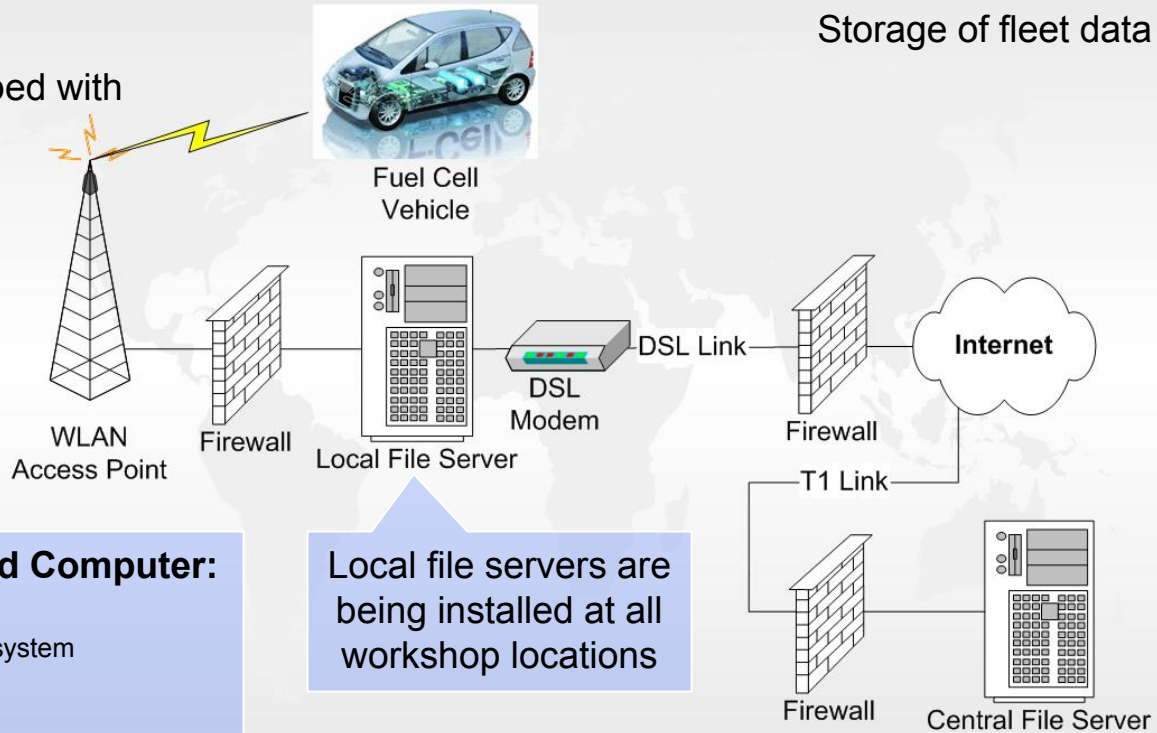
On-Board System:
Recording of fuel cell system and vehicle parameters

30 Fuel Cell vehicles have been equipped with FDA systems

On-Board Computer:
600MHz
Embedded system
GPS
CAN-Bus
Mass storage

On-Board System:
Integrated with existing navigation unit
Powerflow display
Technician displays

Off-Board System:
Local Servers and Central Storage of fleet data



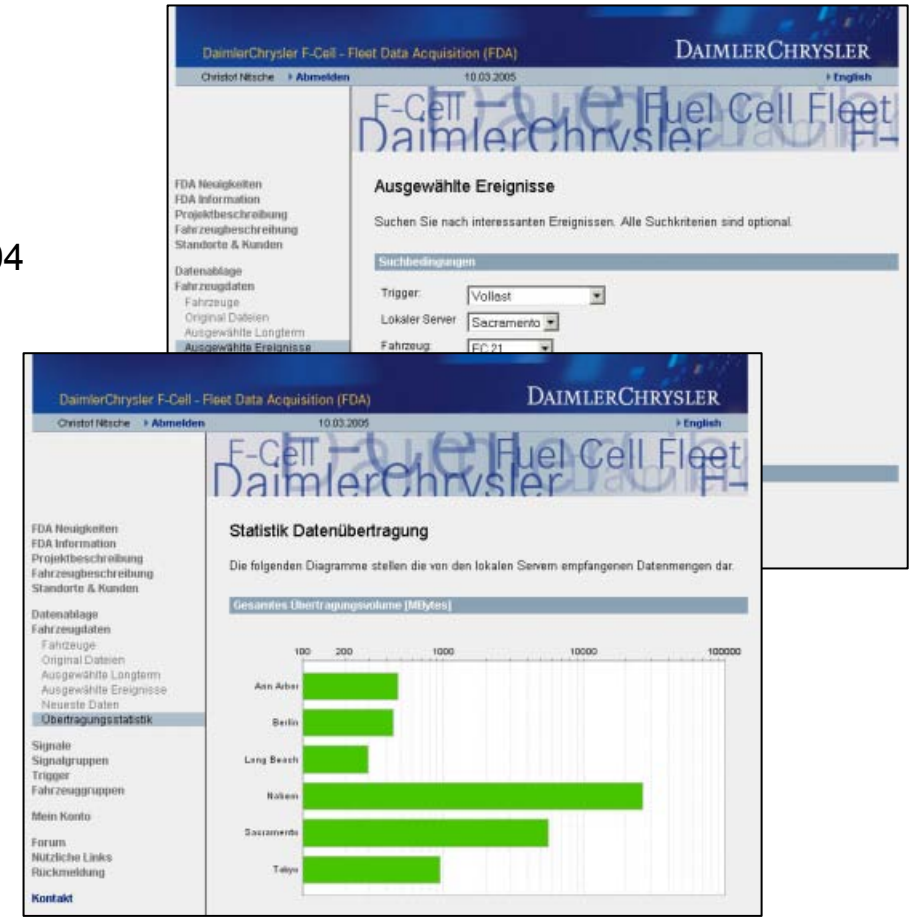
Local file servers are being installed at all workshop locations

Central File Server in Nabern, Germany

DATA COLLECTION

Vehicle Data Reporting

- Central file server and webpage set-up and operational
- First fleet data set has been provided to NREL
  - Four CDs/DVDs delivered from November 2004 through February 2005
  - Data files from daily vehicle operation
  - Constructive discussion with NREL regarding data format and reporting process

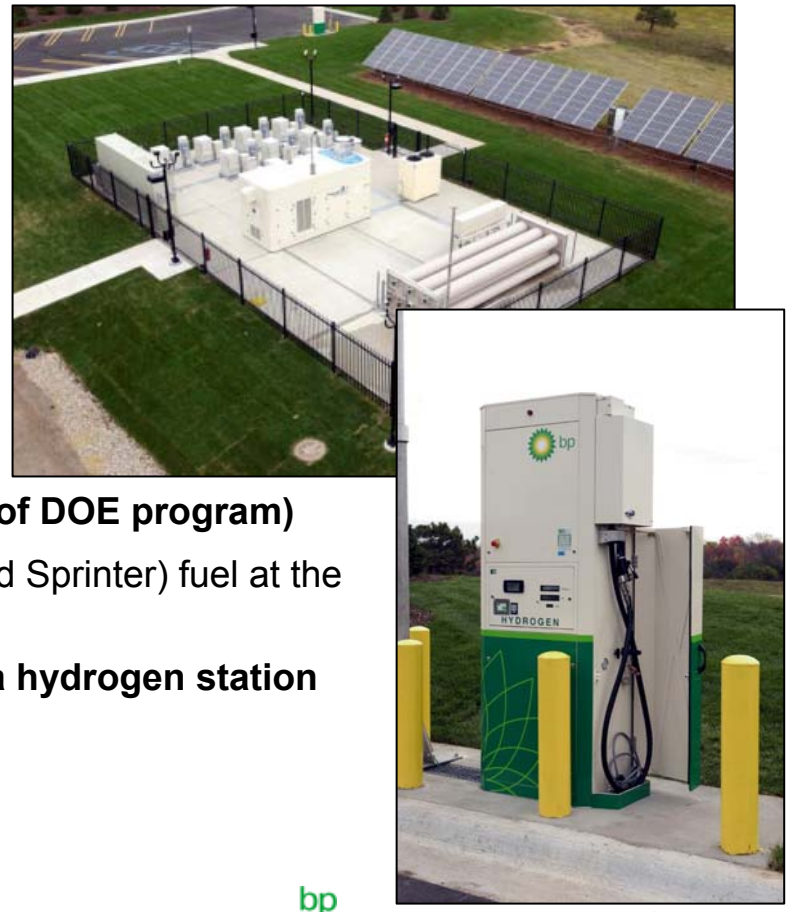


HYDROGEN INFRASTRUCTURE

Southeast Michigan

DTE Energy / BP Hydrogen Technology Park in Southfield, MI

- Technical data
  - Hydrogen produced by electrolysis
  - Vehicle Capacity: 15 kg Hydrogen per day
- Operation of Fueling station
  - Opening ceremony October 19th, 2004
  - Both DaimlerChrysler and Ford have already used the station
  - DaimlerChrysler customer will use consistently



EPA Hydrogen Fueling Station in Ann Arbor, MI (outside of DOE program)

- DaimlerChrysler customer fleet at UPS (F-Cell and Sprinter) fuel at the station on a regular basis

BP is undergoing negotiations with NextEnergy to build a hydrogen station

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HYDROGEN INFRASTRUCTURE

Northern California

BP Mobile Hydrogen Refueler in Sacramento and in San Francisco Bay Area

- Technical data
  - 5,000 psi Dispenser
  - Usable capacity: 110 kg Hydrogen
- Fueling station
  - No Fuel Cell Vehicle operation at DaimlerChrysler customers until refueler in place
  - Mobile refueler will be delivered to the CaFCP in West Sacramento in April, 2005
  - BP finalizing agreement with CaFCP to allow refueling at West Sacramento facility

BP has identified sites and negotiations are underway for hydrogen stations in Sacramento and San Francisco (suppliers of equipment and technology evaluated for permanent stations)

Southern California

SCAQMD Fueling Station in Diamond Bar (outside of the DOE program)

- DaimlerChrysler customer fleet at UPS in Ontario, CA
  - Fueling on a regular basis

LAX Fueling Station (outside of DOE program)

- Dedicated October 22nd, 2004

BP is evaluating potential sites for a permanent station in Los Angeles area (suppliers of equipment and technology evaluated for permanent stations)

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SAFETY PLAN

Project Safety Plan

Correlated with individual fueling station, local government, and corporate standards

Cooperative efforts with energy partners in progress

- FMEA
- Risk Mitigation
- Site Acceptance Testing
- Emergency Response Plans
- Standard Operating Procedures
  (Maintenance plans, operational manuals)
- Training and Education
  (customer training, vehicle service)

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CUSTOMER ACCEPTANCE STUDY

Kick-Off Meeting:

February 2nd, 2005

Core question:

- *What can be learned for future development and marketing of alternative drive train vehicles out of first user experiences with F-Cells?*

Deliverables:

"It is critical to understand the customer expectation and acceptance of fuel cell vehicles." (SOW)

- ***Customer Expectations***
- ***Market Analysis***
- ***Business Environment Trends***

Main components in 2005

	Title	Content	Comments
1	In-depth interviews with F-Cell partner organization (main contact person)	• Semi-structured about motivation, usage of vehicle, expectations É • Organizational profile • Working basis for future research activities	STRG Palo Alto only
2	Market analysis of innovation and new technology	• Learn about peoples view on new technology within established products • T.b.d. (group discussion likely)	In co-operation with UC Berkeley
3	Future scenarios	• Future business environment scenarios for fuel cell vehicles (identification of key factors; regulation, fuel pricesÉ)	Update of Market Diffusion Scenarios through 2020 (1998)
4	Information Acceleration (IA)	• Modification of IA test tool used in Germany • Built upon Future scenario work and first results of market analysis (steps 1 and 2)	In co-operation with UC Berkeley

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COMMUNICATIONS

Publications and Presentations

DOE Signing Ceremony

March, 29th, 2005

- Media Coverage by CNN, CNBC, and ABC
- Other Coverage
  - USA Today
  - Michigan Radio
  - AP
  - Bloomberg
  - Business Week
  - Business Week TV
  - Auto Tech
  - Detroit Free Press
  - The Toronto Star

FUTURE WORK

Plans for 2005

- **Fuel Cell Vehicle**
  - Deliver remaining vehicles to customers in Michigan and California
  - Fully establish the data acquisition system
    - Begin analysis of performance data to meet DOE targets
- **Hydrogen Infrastructure**
  - Install and utilize two mobile refuelers in California
  - Continue site preparation and permitting process for four stationary hydrogen refueling stations (two in Northern California, one in Southern California, and one in Michigan)
- **Safety**
  - Maintain project safety through continued FMEA updates, vehicle and infrastructure training, education, and emergency response drills, emergency responders training
- **Communications and Customer Relations**
  - Communicate technology advancements to press and public and perform extensive customer acceptance studies

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SUPPORT

Supplemental Slides

HYDROGEN SAFETY

The most significant hydrogen hazard associated with this project is:

Hydrogen Release in a maintenance garage due to fire

Our approach to deal with this hazard is:

- Safety Measures:
  - Vehicles are not to be driven into the workshop with hydrogen if there are integrity concerns (such as warning lights in dashboard)
  - Conventional Building Code: Fire Suppression System
  - Fire & Smoke detection connected to hydrogen mitigation system
  - Hydrogen Leak Detection and Mitigation System at every DaimlerChrysler maintenance Facility

HYDROGEN INFRASTRUCTURE

Air Products Mobile Hydrogen Refueler in California

AIR PRODUCTS

Technical Data Sheet

EQUIPMENT: AIR PRODUCTS HYDROGEN FUELER

Design Parameters	Specification	Units of Measure
Service Pressure	6600	PSIG
Total Capacity	150	kg
Usable capacity @ 5,000 psig dispensing	110	kg
Dispensing Pressures	5,000 (standard) 3,600 (optional, not included)	PSIG
Trailer Length	27	FEET
Trailer Width	8	FEET
Total Weight	~42,000	LBS.
Utilities Required	None	

DISPENSER DETAILS:

Item	Details
Vehicle Interface	SAE J2600 Compliant, Drive away / Breakaway Protection
Wireless Telemetry	Standard
Vehicle Interface	Per California Fuel Cell Partnership I/O Standard Revision 6
Fill Types	California Fuel Cell Partnership Compliant – Type3 Standard, Type 1 Optional
Fill Method	PLC Automated Eight Tube Cascade
User Interface	Controlled Personnel Access

EQUIPMENT DETAILS:

Description	Material	Details/Comments
Storage Vessels	Carbon Steel	Per DOT requirements
Valves	Stainless Steel	Per ASME B31.3
Relief Vent	Stainless Steel	Minimum 8' above grade
Pressure Relief Devices	Stainless Steel	Per ASME B31.3 and DOT

SITE REQUIREMENTS:

Item	Details
Foundations Required	None – Can be sited on Macadam Surfaces, but need support for landing gear
Electrical	None – Self Contained Power
Water	None Required
Phone	None – Wireless Communications included
Grounding Rod	Required when not parked on concrete
Siting Distances	Per NFPA 50A – See Air Products for Site Evaluation

TRANSPORTATION REQUIREMENTS:

Item	Details
CFR 49	Compliant
Transport Requirements	Commercial Drivers License with Hazmat Certification
Hitch Requirements	Fifth Wheel, Dual Axle Tractor

AIR PRODUCTS ADDITIONAL SERVICES

- HYDROGEN REPLENISHMENT
- USEAGE TRACKING
- DELIVERY AND PICKUP
- KNOWH2OW® HYDROGEN SAFETY TRAINING

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CUSTOMER ACCEPTANCE STUDY

Basic Concepts and Methods

2005		2006		2007		2008	
	Phase 1: *Preparatory & Future Scenarios*		***Phase 2:*** *Empirical Studies I* ***Phase 3:*** *Mid-project Results & Integration*		***Phase 3:*** *Mid-project Results & Integration* ***Phase 4:*** *Empirical Studies II*		***Phase 5:*** *Final Analyses & Outlook*

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