

VI.B.4 NextEnergy Center Microgrid and Hydrogen Fueling Facility*

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Start Date: September 30, 2003
Project End Date: April 30, 2008 (capital
installation), July 13, 2008 (3 years of
operation)

*Congressionally directed project

- Potential for dedicated vehicles (fleet demos) and public transit opportunities.
- An economic development site for companies and government entities interested in co-locate opportunities.

Technical Barriers

The NextEnergy Hydrogen Station will contribute to alleviating the DOE listed barriers related to:

- Technology Validation: directly in the areas of Hydrogen Refueling Infrastructure and Codes and Standards (Section 3.5 Barrier C and E).
- Hydrogen Production: directly through our methanol-to-hydrogen reformer project, indirectly by providing a flexible validation platform for all forms of hydrogen generators (Section 3.1 Barriers A, C and F).
- Safety: directly by providing safety data based on real construction and operating experiences of this multi-use, multi-feedstock platform (Section 3.7 Barriers A through I).
- Education: directly through our public outreach program (Section 3.8 Barriers A through E).

See Table 1 for specific contribution details.

Objectives:

- Support the DOE “Controlled Hydrogen Fleet and Infrastructure Demonstration and Validation Project” in the greater Detroit area.
- Integrate, within a core urban environment, critical hydrogen infrastructure components and systems for multi-use operations.
- Optimize integrated, system-based solutions to advance hydrogen infrastructure for vehicular and stationary distributed power generation use.
- Provide a flexible “test” platform to advance the development and validation of commercial-type on-site generation technologies.
- Beyond delivery of the physical facilities, NextEnergy Center will contribute to:
 - Advancement of hydrogen-related codes and standards within a core urban center.
 - Site safety studies and plans.
 - Use by industry and government as a learning, validation and demonstration platform.
 - Use by institutions as a teaching and research site.
 - Public education and outreach center for the demonstration and understanding of hydrogen and related alternative energy technologies.

Contribution to Achievement of DOE Technology Validation Milestones:

The NextEnergy Hydrogen Station will contribute to achieving the DOE Technology Validation milestone from the Technology Validation section of the Hydrogen, Fuel Cells and Infrastructure Technologies Program Multi-Year Research, Development and Demonstration Plan:

Milestone 23: Total of ten stations constructed using advanced sensor systems and operating procedures. The NextEnergy station is constructed to comply with the most recent published codes and standards. The vehicle fueling station (VFS) utilizes a gas and flame detection system and the most recent requirements for the dispenser (see Figure 1). The entire alternative fuels platform (including the VFS) employs the most recent innovations in sensors and actuators integrated into a complete hydrogen monitoring and control system (see Figure 2). NextEnergy’s operating procedures will be state-of-the-art and will be developed within the frame work of an integrated management system that is being created to be ISO 9001, ISO 14001 and ANSI Z10 compliant.

TABLE 1. NextEnergy Contribution to DOE Barriers

Program	Barrier	Barrier Description	NextEnergy Contribution
3.1 Hydrogen Production	A	Reformer Capital Costs	Methanol-to-Ultra Pure Hydrogen Reformer Test
	C	Operations and Maintenance	Detailed Data from Test
	F	Control and Safety	Detailed Data from Test
3.5 Technology Validation	C	Lack of Hydrogen Refueling Infrastructure Performance and Availability Data	Detailed Records from Facility
	E	Codes and Standards	Participation in NREL / SNL Hydrogen Infrastructure QRA Modeling. Voting member of NFPA 2 TC
3.7 Safety	A	Limited Historical Database	O&M Reports from Facility
	C	Validity of Historical Data	O&M Reports from Facility
	D	Liability Issues	Actual Experience from Facility
	E	Variation in Standard Practice of Safety Assessments for Components and Energy Systems	FMEA & HIRA Assessments of Facility
	F	Safety Is Not Always Treated as a Continuous Process	Safety Management System compliant with ANSI Z10 and associated Actual Records
	G	Expense of Data Collection and Maintenance	Actual Data from Facility
	H	Lack of Hydrogen Knowledge by Authorities Having Jurisdiction	AHJ Training Package Delivered to Michigan Jurisdictions. Permitting Databases & Guide
	I	Lack of Hydrogen Training for Emergency Responders	EFR Training Package Delivered to Michigan Jurisdictions
	3.8 Education	A	Lack of Readily Available, Objective and Technically Accurate Information
B		Mixed Messages	NextEnergy deals in all forms of AET and provides balanced comparisons of technologies and economics
C		Disconnect Between Hydrogen Information and Dissemination Networks	NextEnergy helped create and implement an AET curriculum that has been adopted by universities and colleges throughout the State. Use of media specialists to craft and deliver the AET message in all forms of media.
D		Lack of Educated Trainers and Training Opportunities	NextEnergy technical staff delivers our AET message. Proactive development of opportunities through NextEnergy sponsored events.
E		Regional Differences	NextEnergy concentrates on the Michigan market while providing a global message.

Accomplishments

The NextEnergy Hydrogen Station construction is complete. The project is divided into five phases:

- Phase 1 addressed the supply of hydrogen to the NextEnergy Microgrid and was completed in June 2005.
- Phase 2 addressed the construction of the VFS. The VFS was constructed in cooperation with our partners DaimlerChrysler Corporation, BP America

and BP's equipment provider Air Products and Chemicals. The VFS was completed in January 2006.

- Phases 3 and 4 addressed the construction of the remainder of plant and the delivery and testing of an "alpha" version of a methanol to ultra-pure hydrogen reformer. The remainder of plant was completed in June 2007. The reformer is behind schedule. The reformer is scheduled for delivery in October 2007.



FIGURE 1. NextEnergy Vehicle Fueling Station

- Phase 5 is the delivery of the “beta” version of the reformer. It is scheduled for delivery in April 2008.
- NextEnergy has committed to operate the hydrogen station for a minimum of 3 years under the current DOE award. The 3 year period ends in July 2008.



Introduction

In October 2002, NextEnergy was organized as an independent Michigan 501(c)(3) non-profit corporation. Shortly thereafter, the Michigan Economic Development Corporation provided a \$30 million seed grant to NextEnergy to build an alternative energy technology facility, energy infrastructure, and associated programs. Subsequently, NextEnergy was approached by partners in industry (predominantly automotive companies) with interest in utilizing a hydrogen fueling station at the site to serve their needs for hydrogen-related demonstration and validation. This opportunity resulted in a DOE award that envisioned a site capable of generating, storing and distributing hydrogen for vehicle fueling, distributed generation assets and use in R&D applications.

Through interactions with alternative fuel technology developers the original design has evolved to accommodate the ability to install and test a wider array of alternative fuel technologies. NextEnergy is currently developing projects with many of these proponents to utilize its physical assets to demonstrate the performance of technologies ranging from fuel cell vehicles to large, stationary fuel cell distributed generators to reformers

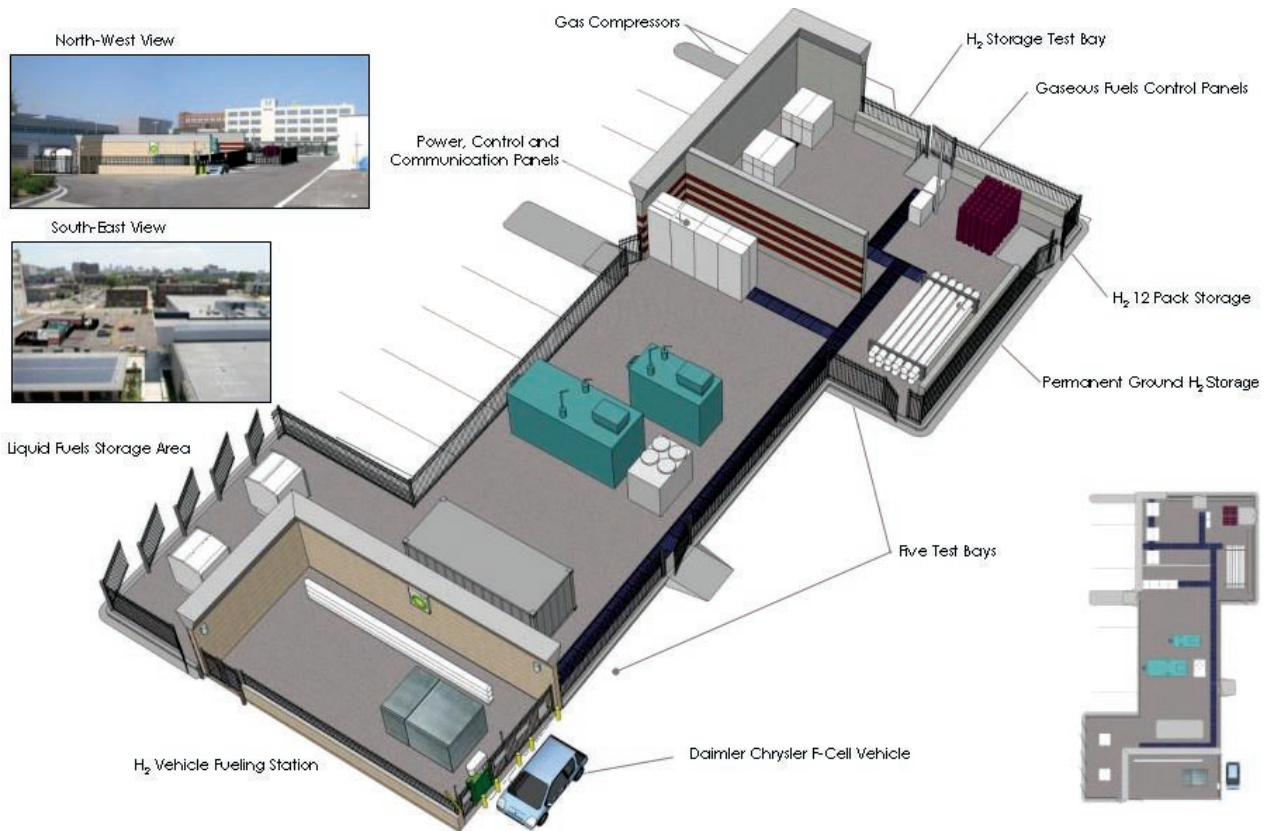


FIGURE 2. NextEnergy Alternative Fuels Platform

utilizing higher energy density liquid fuels for ultra-pure hydrogen generation.

Approach

The NextEnergy Center Microgrid and Hydrogen Fueling Facility is comprised of 13 test bays that are supported by interconnections for both fuel delivery and power generation. It is interconnected to the local electric utility grid and can operate in a grid connected mode, a grid parallel mode and an islanded mode. The test bays are designed to accommodate the demonstration and testing of pre-commercial alternative energy technologies. It also offers a gaseous hydrogen vehicle fueling facility that can accommodate varying hydrogen purities and fueling pressures.

NextEnergy is committed to complementing the existing national testing infrastructure for alternative energy technologies by offering a unique testing and validation facility. NextEnergy is currently participating in several projects and is actively seeking other opportunities.

Results

The build-out of the Hydrogen Station has provided many insights into the development of this type of facility:

Safety Reviews - The construction of the facility entailed a significant effort dedicated to the analysis of the design and construction methods from both a functional perspective (failure mode effects analysis) and a hazard operability perspective (hazard identification analysis). NextEnergy continues to use, refine and disseminate this work.

Gas and Flame Detection System – The vehicle fueling station incorporates the latest detection equipment and meets the letter of the code. It will provide an excellent test of how a system designed to fulfill this requirement under NFPA 52 will perform under real world conditions.

Vehicle Fuel Cell Hydrogen Purity - The ability to economically supply high purity hydrogen for fuel cell vehicle fuel is still being addressed from the perspectives of the acquisition of high purity hydrogen in gaseous form from Industrial Gas Suppliers and in-line filtration that will allow industrial grade hydrogen to be purified on site to meet SAE J2719.

Utilization of NextEnergy Facilities

NextEnergy is participating in the following projects (awarding entity noted in parentheses) that utilize the NextEnergy facilities:

- Develop, install and test “alpha” and “beta” methanol to ultra-pure hydrogen reformer (DOE).
- Collect and report facility O&M incident data (DOE).
- Work with the National Renewable Energy Laboratory and Sandia National Laboratories (Livermore) on hydrogen infrastructure “setback distance” Quantitative Risk Analysis model validation (DOE).
- Evaluate performance of a new 250 KW inverter design (DOE).
- Contribute construction and operating experience to the development of national hydrogen codes & standards, permitting guidelines and emergency first responder training (DOE).
- Quantify the performance of a diesel 60 KW internal combustion engine genset utilizing various fuels including clean diesel, bio-diesel, JP-8 and S-8 (State of Michigan).
- Demonstrate performance of a new electronic power control and conditioning system prior to deployment (DoD).
- Demonstrate performance of a new waste-to-energy (gasification) system prior to deployment (DoD).

Conclusions and Future Directions

NextEnergy will continue to seek participation in opportunities that involve the testing and validation of alternative energy technologies utilizing the NextEnergy facilities. Known future opportunities include:

- Continuation of some of the previously noted projects through additional phases.
- Testing of bio-diesel B20 formulations in a vehicle demonstration format (DOE).
- Demonstrate performance of a new waste-to-energy (digester) system (DOE).
- Qualification of load management technologies for electrical grid peak day demand reduction demonstration (DOE).
- Demonstration of a portable utility system complete with renewable energy generation (solar & wind) and an associated DC energy management system (DoD).
- Pursue the development and testing of the in-line hydrogen purifier.

FY 2007 Publications/Presentations

NextEnergy has referred to the Microgrid and Hydrogen Fueling Facility in several overview-type presentations to a variety of audiences including:

- Authorities Having Jurisdiction and Emergency First Responders.

- Federal, State and Municipal government departments.
- National laboratories such as Oak Ridge National Laboratory, the National Renewable Energy Laboratory, the National Energy Technology Laboratory and Sandia National Laboratories (Livermore).
- National organizations such as the Society of Automotive Engineers, the Institute of Electrical and Electronic Engineers, the National Association of State Fire Marshals and the National Fire Prevention Association (NFPA 2 Technical Committee).
- Several educational institutions.
- Delegations from foreign governments and organizations such as the government of Singapore, trade delegations from France and South Korea and the Japanese Automotive Research Institute.
- Companies that are interested in working with NextEnergy on future alternative energy development projects.

NextEnergy has used the specific design parameters of the facility in presentations to the State of New Mexico and the State of Oklahoma in an attempt to develop joint projects with them.

NextEnergy has developed an Emergency First Responders presentation that utilizes some of the Center's features. NextEnergy has delivered this presentation throughout the State of Michigan.

NextEnergy has used its experience to participate in national forums addressing permitting of hydrogen station infrastructure.

NextEnergy has not released any detailed operating data about our facility but the project with National Energy Technology Laboratory and Sandia National Laboratories is utilizing the detailed design information of the facility.