

Keeping the High-Tech Industry Plugged-In with Onsite Energy

CHP System Provides Reliable Energy for a Verizon Telecommunications Switching Center

In high-tech industries, large amounts of reliable, high-quality power are critical to information processing networks—industry giant Verizon Telecommunications uses over 5.1 billion kWh annually. Because of their concentrated electronics, large cooling loads and high load factors, high-tech facilities could benefit from distributed energy systems that provide clean, reliable, and efficient power and cooling—and Verizon is proving those benefits in its high-tech “central office of the future” in Garden City on New York’s Long Island.



Figure 1. Verizon’s Garden City “central office of the future” gets most of its power, cooling, and heating from onsite engines and fuel cells, absorption chillers, and a HRSG.

The central office is a 292,000 sq. ft. building that houses 900 employees and provides telecommunications services to more than 35,000 customers on Long Island. The facility is served by distributed energy technologies that make use of “waste heat” from onsite generators in a combined heat and power (CHP) system.

CHP systems can recover and utilize heat from fuel cells, engines, turbines or microturbines to provide useful services such as cooling to achieve fuel utilization efficiencies that are much greater than conventional power grid electricity.

The Verizon facility uses seven fuel cells paralleled with the grid, three reciprocating engines, two absorption chillers, and a heat recovery steam generator (HRSG) to provide power, cooling and heating to the facility. It is the largest fuel cell-based CHP installation providing energy services to a Verizon facility

Project Overview

LOCATION

Verizon Central Office Building
Garden City, New York

DATE INSTALLED

2005

FACILITY

292,000 sq. ft.

ELECTRIC & THERMAL

- Seven UTC 200-kW natural gas-fired fuel cells
- Two 70-ton Thermax LiBr absorption chillers
- One unfired heat recovery steam generator
- One Caterpillar natural gas (20%) and diesel (80%) dual-fuel engine
- Two standby Caterpillar diesel engines

ANNUAL ENERGY SAVINGS

\$0.5 million for the first five years

PAYBACK

10-year payback on system

ENVIRONMENTAL BENEFITS

11.1 million pounds of CO₂ offset per year

UNIQUE ASPECTS

Fuel cells and reciprocating engines are used to supply energy to the facility at different times and outputs depending on the facility’s energy needs.



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System Technical Overview

During normal operation, most of the central office’s 2.7-MW building load is met by a combination of a dual-fuel reciprocating engine, two diesel engines, and the seven base-loaded fuel cells. The Long Island Power Authority (LIPA) grid provides the remaining supplemental power as needed.

Switches housed in the central office are “hot spots” that require significant cooling, according to Verizon engineers. High-grade waste heat from the fuel cells is recovered and used by two 70-ton Thermax lithium bromide (LiBr) absorption chillers to cool the central office in the summer. During the winter months, the waste heat is used by the HRSG for heating, as needed, to supplement existing boilers.

System Design

The CHP system was designed to enhance the power reliability of Verizon’s telecommunications facility while providing heating and cooling. The engines and fuel cells are the primary source of electricity for the computerized call-switching system. The absorption chillers are connected to existing chilled water and condensing systems and the HRSG supplements two boilers in the boiler room for space heating purposes.



Figure 2. Seven 200-kW UTC fuel cells at Verizon’s central office of the future in Garden City, NY

The seven fuel cells get their hydrogen supply from natural gas which is steam reformed inside the fuel cell enclosure. Natural gas for both the fuel cells and the dual-fuel engine is provided by KeySpan Energy Delivery.

Per Verizon’s agreement with LIPA, five of the seven fuel cells are permitted to operate during LIPA’s peaking season (10 hours per day, June 1–September 30). This agreement prevents Verizon from potentially feeding too much power back to the grid—a connected generation limit of 3 MVA set by the utility due to local grid network system limitations. All seven fuel cells will operate at all other times. The seven fuel cells are paralleled to the grid from October 1 to May 30, with the utility providing supplemental power. In the summer months during the LIPA peak period, the dual-fuel engine is paralleled to the utility along with the fuel cells in order to reduce LIPA supplemental power requirements to around 100 kW.

To coordinate all these energy parameters Verizon employs a state-of-the-art monitoring system which allows the engines and fuel cell-based CHP system to remain operating at optimized conditions while avoiding high demand charges from the utility.

The system is also capable of going into island mode by completely disconnecting itself from the grid in case of a grid power outage. In this situation, two standby Caterpillar diesel engines provide the reference voltage and standby power requirements.

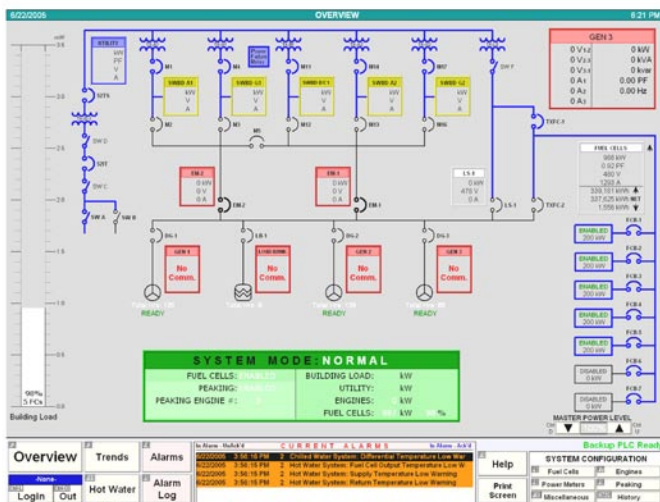


Figure 3. Verizon’s monitoring system allows energy managers to optimize their onsite power production and use grid power as a “buffer zone” to avoid high demand charges.

System Performance

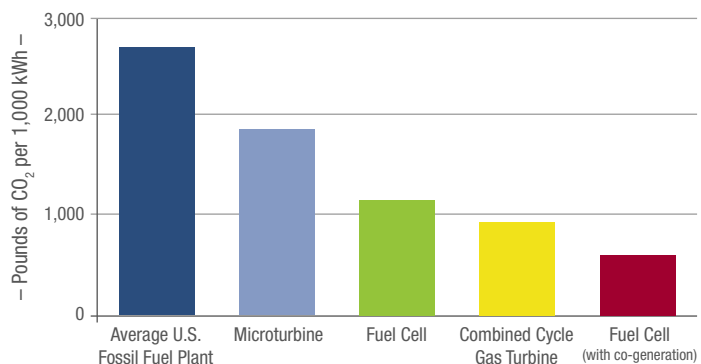
The CHP system became operational in June of 2005. On an annual basis, the facility will produce nearly 16 million BTU (MMBTU) of useful thermal energy, 38,000 MMBTU of useful electrical energy, and will require around 105,000 MMBTU (LHV) of fuel. The resulting fuel utilization efficiency is over 50 percent. Useful waste heat and related cooling is expected to increase over time as the electrical efficiencies of the fuel cells decrease with age.

In the summer, peak cooling demand is about 750 tons, and minimum demand is less than 50 tons. The waste heat available supports 140 tons of total absorption chiller capacity, but in summer months the available heat is reduced since only five fuel cells are in operation.

The two 70-ton Thermax chillers offer flexible operation to meet part-load conditions in off-peak cooling seasons, and the avoided operation of the existing electrical chillers provides energy cost savings.

The HRSG that reclaims waste heat from the seven fuel cells in the winter displaces approximately 1/3 of boiler fuel usage, significantly reducing NO_x emissions. These reduced emissions plus the reduced emissions of the co-fired engine allow the peak shaver to operate longer without going over NO_x emissions caps, resulting in more savings from peak-shaving.

Figure 4.
Comparative carbon dioxide emissions of different energy generation and delivery systems



Financing

The cost to Verizon of the entire project is about \$13 million. This number includes required parking lot upgrades, replaced transformers, and total switchgear modernization to go from analog to PLC-based controls. Without these extra improvements, the CHP plant cost Verizon \$10 million. Verizon received performance contracts from the federal government of about \$3.2 million, and a \$0.425 million cost-share grant from NYSERDA.

Economic Analysis

Including tax and CO₂ credits, Verizon projects annual energy savings to be about a \$0.5 million for the first five years. However, this figure does not take into account positive public relations and customer retention. Each of these factors was estimated to be about \$0.25 million annually. If both factors are included in the calculation, payback time is slightly less than ten years.

End-User Perspective

The key lessons learned here will involve interconnecting the grid with distributed energy and standby power systems. New PLC-based switchboard technology and software are being used to facilitate fuel cell-generated power used in parallel with the grid as well as existing standby power systems. These same systems are being used in peak-shaving activities to reduce NO_x emissions, which allows the facility to participate in future peak energy reduction and/or curtailment programs.

Verizon hopes that their projects become the catalysts for a major paradigm shift in how the telecommunications industry powers its networks. In Verizon Corporate Real Estate Team Energy Consultant Jon Chestnut's words, "Many industries are experiencing ever-increasing energy demands in a customer satisfaction-driven environment. Energy costs are rising, imported resources are becoming less reliable, and businesses simply must become more energy self-reliant and cost-effective to maintain that competitive edge. With this project, Verizon will be there to demonstrate the technical and environmental benefits of our CHP system; increased efficiency resulting in cost-effectiveness will be the bonus."

Replicability

The Distributed Energy (DE) Program selects projects that are highly replicable or that can be duplicated in applications with characteristics similar to DE Program-supported projects.

Replication potential can be assessed by looking at various factors of the market and the site, including:

- Industry growth and drivers
- Barriers and incentives
- Load profiles, e.g., electricity and thermal energy utilization patterns
- Technical and economic feasibility of the DE/CHP system
- Capital investment payback requirements

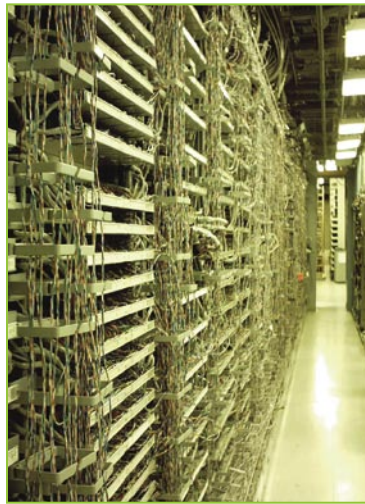


Figure 5. Main Distribution Frame (MDF) where phone lines enter the central office.

High-tech telecommunications exhibits several factors that would indicate high replicability potential. The industry is growing, despite the downturn in recent years past. NAICS describes the “Information sector” as having three types of establishments: “(1) those engaged in producing and distributing information and cultural products; (2) those that provide the means to transmit or distribute these products as well as data or communications; and (3) those that process data.” Combined, the three types of establishments increased in number from 30,012 to 42,937 from 1997 to 2002. Receipts during that same time period went from \$260,500,898 to \$355,097,734.

Verizon hopes to replicate their CHP system within their portfolio of central offices, using lessons learned. According to Jeremy Metz, Energy Team Leader, Verizon Strategic Sourcing, Verizon hopes to “learn all about operating and maintaining fuel cells now so when their prices come down, we can install them efficiently and cost-effectively.”

Metz notes that there are “literally thousands of central offices across the country, each serving tens of thousands of customers. If we can provide reliable service, at reasonable prices, with minimal environmental impact to our customers by replicating our Garden City CHP project on a grand scale, we all come out winners.”

Helpful Web Sites

- **Distributed Energy Program**
www.eere.energy.gov/de/
- **Oak Ridge National Laboratory**
www.ornl.gov/sci/eere/der/index.htm
- **Northeast CHP Application Center**
www.northeastchp.org/nac/
- **Verizon**
www.verizon.com

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