PureCell® Model 400 GEN I Stationary Fuel Cell System with Rotary UPS at a Data Center

A HyAxiom White Paper

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Overview:

This Paper discusses the design and operation of a PureCell® Model 400 Stationary Fuel Cell Installed with a Rotary UPS to provide critical uninterruptable power to a Data Center. This application depicts the capability of PureCell® Model 400 unit with energy storage to provide uninterruptable power.

This Critical Power Fuel Cell Installation was commissioned in 2008 and successfully ran until 2021 when it was decommissioned.

There were two- PureCell® Model 400 fuel cells that powered four 200KW UniBlock Rotary UPS units.

Critical Load system Overall Design

Critical Load Distribution: The local Utility Grid supplies the data center's Main Switchboard MSB. This Main Switchboard MSB supplies an uninterruptable power (Rotary UPS) distribution system for the Data Center's critical loads. This uninterruptable power distribution system consists of four 200 kW UniBlock Rotary UPS supplies that are connected in parallel to supply the Data Center critical load with four redundant UPS power supplies.

Each "UniBlock" has a Transfer Switch (ATS) at its input that has two sources: the Grid from MSB and the Grid Independent (GI) output of one of two 400KW fuel cells. Therefore, the ATS at UPS units 1 & 2 are supplied by Fuel Cell #1 and the ATS at UPS units 3 & 4 are supplied by Fuel Cell #2—Please refer to Figure One electrical diagram.

The Data Center employed four Piller "UniBlock" rotary UPS units in parallel to supply redundant UPS power to their Data Center loads. These Piller rotary UPS units (flywheels) were normally supplied with input Power from the local Electric Utility, but when there was a Utility outage the fuel cells provided input power to the rotary UPS units. During the transition from Grid Power to Fuel Cell Power, the UPS units provided the Data Center loads with uninterruptable power. Once they transitioned to grid-independent mode, the fuel cells would recharge to Piller flywheels.

OPERATION:

Fuel Cell Operation: The two fuel cells normally operate in Grid connected mode and supply power to the Data Center's electrical system. When the Utility Grid is lost, the fuel cells disconnect from the Grid (at MSB) and begin the transition to Grid Independent mode where they supply the UniBlock via its ATS.

UniBlock operation: Each UniBlock rotary UPS supplying the critical load is normally powered by the Grid. If the Grid supply is lost, the ATS at the input of the UniBlock transfers to the GI output of the fuel cells. During switching from Grid to fuel cell, the rotary UPS continues to supply Uninterruptable power to the critical load.

Fuel Cell GI Operation: When the fuel cell's GI output initially connects to the UniBlock, it is running at zero power then it ramps up power at 10KW/sec to recharge the UniBlock flywheel. The UniBlock input charging controls determine how much power is absorbed from the fuel cell.

Grid Return: When Utility power returns, the fuel cell returns to Grid connected mode. The UniBlock also switches to grid power when its input ATS switches back to grid power.

Omaha Utility Grid supply bus

Pure Cell model 400 Fuel Cell

INVERTER

800a

400a

GI output

GC terminals

3W

4W

400a

400a

FNBO Sure Power Block Diagram

400a

Transfer Switch

400a

Transfer Switch

PowerBridge (Rotary UPS)

Converter

Rectifier

Thyristor Disconnect Switch

Rectifier

Thyristor Disconnect Switch

Inverter

Inverter

Motor/ Generator

Motor/ Generator

Uniblock

Uniblock

Data Center Critical Load

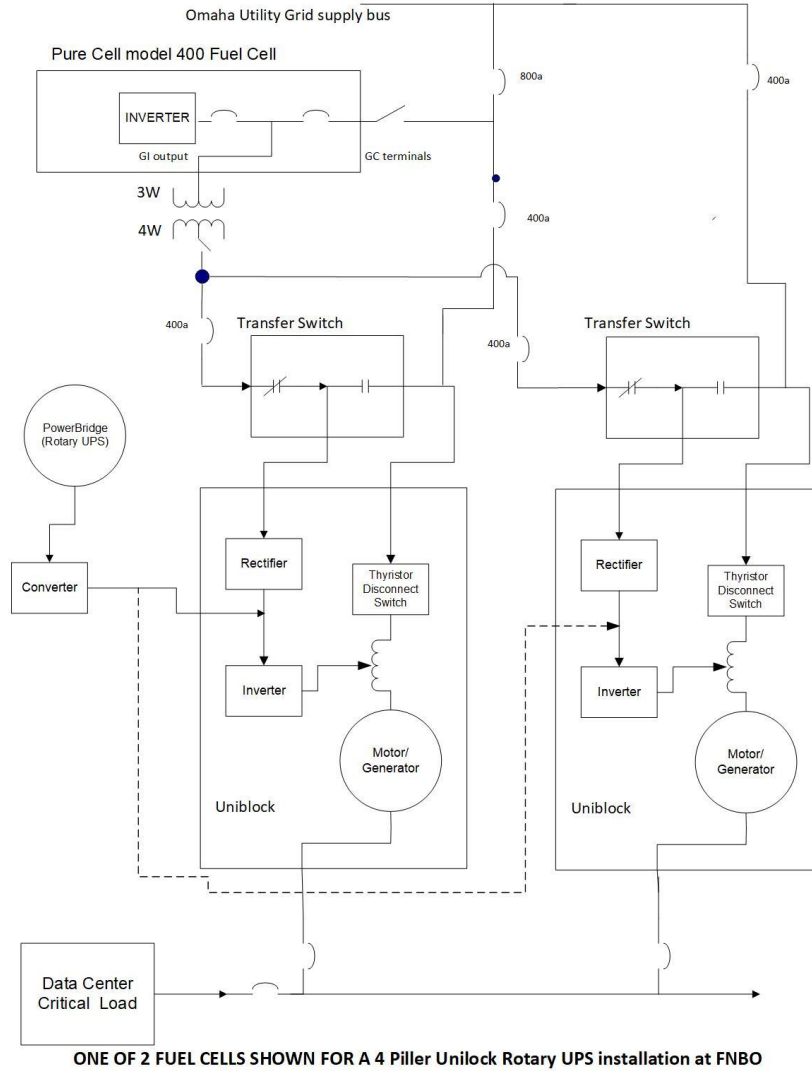**ONE OF 2 FUEL CELLS SHOWN FOR A 4 Piller Unilock Rotary UPS installation at FNBO**

FIGURE 1: ONE FUEL CELL WITH 2 ROTARY UPS UNITS AT THE DATA CENTER