MONITORING PLAN
FOR THE
PURECELL 400 FUEL CELL
AT
ROCHESTER INSTITUTE OF TECHNOLOGY
IN
ROCHESTER, NY

Draft

April 23, 2013

Submitted to:

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Introduction

This plan describes our approach to monitoring the performance of the fuel cell systems installed at Rochester Institute of Technology (RIT) in Rochester, NY. The Clear Edge Power PureCell® Model 400 fuel cell provides clean and efficient electric power and thermal output to the facility. This fuel cell is expected to supply electricity in addition to standby power in the event of a power grid failure. The facility will also recover heat from the fuel cells to use for space and Domestic Hot Water (DHW) heating.

System Description

The PureCell® Model 400 unit is installed on the RIT campus. The fuel cell (FC) has separate electrical feeds for parallel operation with the utility or to provide backup power when isolated from the grid. The fuel cell is able to provide 400 kW of electrical power and up to 1.7 million Btu/h of heat. If fully utilized, the fuel cell can obtain a thermal efficiency near 90%.

Power Output:	400 kW 480V, 3ph
Heat Output:	1.55 MMBtu/h (low temp)
	0.59 MMBtu/h (high temp)

Figure 1. PureCell 400 Unit

Most of the thermal output from the FC is used to provide space conditioning and water heating for the university. The low temperature loop supplies 130°F water to meet Domestic Hot Water (DHW) loads (see Figure 3). The high temperature loop supplies 180°F water to meet space heating and other building loads.

Heat Recovery Monitoring System

The heat recovery monitoring system (HRM) has been designed to capture the electrical and thermal performance of the system. Table 1 summarizes the measurements that will be captured at the site.

Figure 3 shows where the measurements will be made in the thermal loops. Flow and temperature sensors are installed for three thermal loops: low temperature, high temperature, and cooling water.

Data are extracted from the Power Plant Controller (PPC) via MODBUS TCP and from the Shark Power Meter via MODBUS 485/serial connections.. The Obvius AcquiSuite datalogger logs the required data.

Table 1. Summary of Measured and Collected Data at the Site

Channel / Source	Data Pt	Description	Instrument / Meter	Signal / Register	Eng Units	Wire	Notes
Main-1	TLS	Low Temp Supply Temp (from FC)	10k Thermistor, Type 2	ohm	°F	6	
Main-2	TLR	Low Temp Return Temp (to FC)	10k Thermistor, Type 2	ohm	°F	5	
Main-3	THS	High Temp Supply Temp (from FC)	10k Thermistor, Type 2	ohm	°F	4	
Main-4	THR	High Temp Return Temp (to FC)	10k Thermistor, Type 2	ohm	°F	3	
Main-5	TCWS	Cooling Module Supply Temp (from FC)	10k Thermistor, Type 2	ohm	°F	1	
Main-6	TCWR	Cooling Module Return Temp (to FC)	10k Thermistor, Type 2	ohm	°F	2	
EXP-1	FL	Low Temp Water Flow	Onicon F-1211	4-20 mA	gpm	4/7	2.5" Sch 40 Steel, 50 gpm
EXP-2	FH	High Temp Water Flow	Onicon F-1211	4-20 mA	gpm	M1/M2	2.5" Sch 40 Steel, 50 gpm
EXP-3	FCW	Cooling Module Flow	Onicon F-1111	4-20 mA	gpm	F/G	2" Copper Type L, 60 gpm
Modbus Dev 2	WREC_pos	Energy Output through Grid Independent Loop	Shark 100	1100	kWh		
Modbus Dev 2	WREC_neg	Energy Input through Grid Independent Loop	Shark 100	1102	kWh		
Modbus Dev 2	WREC	Power through Grid Independent Loop	Shark 100	900	Watts		
Modbus TCP	FG	Instantaneous Fuel Flow	PPC	7173	kg/h	Float	page 12 of FCFR
Modbus TCP	FGcum	Cumulative Fuel Consumption	PPC	7191	m³	Float	page 12 of FCFR
Modbus TCP	WFC	Instantaneous Power Output	PPC	10535	kW	Float	page 12 of FCFR
Modbus TCP	WFCcum	Cumulative Power Produced	PPC	7217	MWh	Float	page 12 of FCFR
Modbus TCP	EFF_ELEC	Instantaneous electrical efficiency (LHV)	PPC	7505	%	Float	page 12 of FCFR
Modbus TCP	FC_STATE	Fuel Cell Mode/State Number	PPC	5	Number	Unsigned Int	page 12 of FCFR
Modbus TCP	RTIME	Cumulative "Load" Time	PPC	7205	hrs	Float	page 12 of FCFR
Modbus TCP	NALARM	Total number of alarms	PPC	21	Number	Unsigned Int	page 12 of FCFR
Modbus TCP	FC_ISTATE	Fuel Cell Inverter State Number	PPC	13	Number	Unsigned Int	page 12 of FCFR
Modbus TCP	SWV	Make-up water tank fill valve status	PPC	763	On/Off	Boolean/Int	page 12 of FCFR
Modbus TCP	SGI	Grid independent status	PPC	60	On/Off	Boolean/Int	page 12 of FCFR
Modbus TCP	SGC	Grid connect status	PPC	59	On/Off	Boolean/Int	page 12 of FCFR

Note: EXP = Obvius expansion board, device 003
Main = Obvius main board, device 250

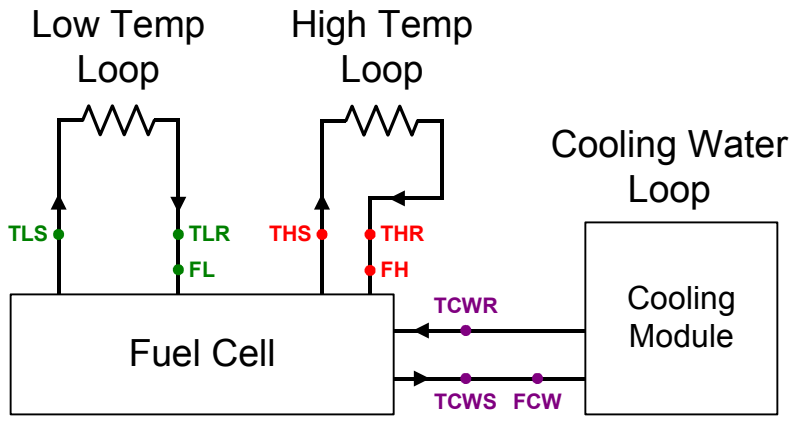

Figure 3. Schematic of Heat Transfer Loops in Fuel Cell System

The monitoring system is based around the Obvius AcquiSuite data logger. The layout of the HRM and the connections with other network components of the Fuel Cell system are shown in Figure 7. A Babel Buster gateway device reads MODBUS data from the PPC and makes that data available to the Obvius data logger.

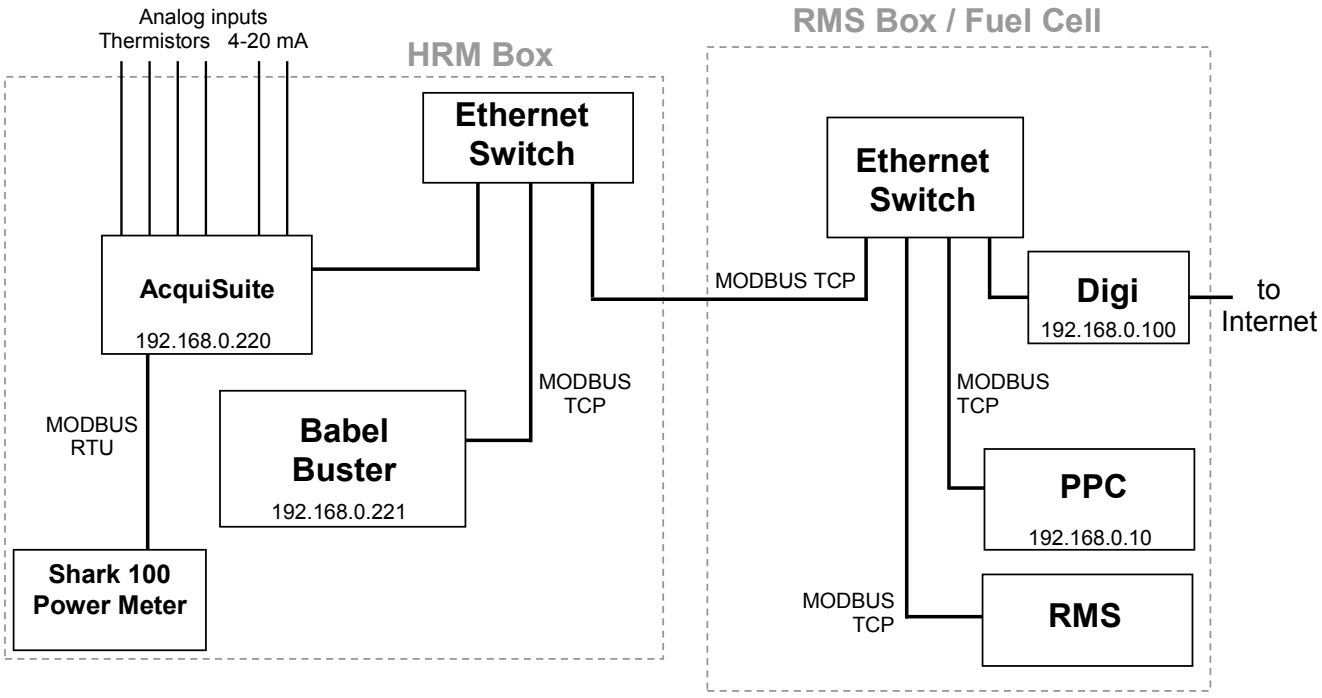

Figure 7. Layout of HRM, RMS and PPC Network

Calculated Quantities

Heat Recovery Rates

The data to determine the delivered heat recovery energy and the delivered cooling will be collected by the datalogger at each scan interval and then averaged for each 15-minute recording interval. The calculations listed below will be completed before the data are displayed on the web site:

$$Q_{lo} = \frac{1}{n}\sum_{i=1}^{n} k_{lo} \cdot FL_i \cdot (TLS_i - TLR_i)$$

$$Q_{hi} = \frac{1}{n}\sum_{i=1}^{n} k_{hi} \cdot FH_i \cdot (THS_i - THR_i)$$

$$Q_{cw} = \frac{1}{n}\sum_{i=1}^{n} k_{cw} \cdot FCW_i \cdot (TCWS_i - TCWR_i)$$

where: Q_{xx} - Delivered heat recovery for loop *xx* (Btu/h)
(*xx* :: *lo* = low temp, *hi* = high temp,
cw = cooling water)
k_{xx} - density specific heat product constant for fluid in loop *xx*
i - i^{th} scan (or read)
n - number of scans in the averaging period

The loop fluid is expected to be water with propylene glycol (e.g., DowFrost). The factor *k* is equal to:

Low Temp Loop: k_{lo} = 456.6 Btu/h·gpm·°F for 40% glycol at 130°F
High Temp Loop: k_{hi} = 459.3 Btu/h·gpm·°F for 40% glycol at 180°F
Cooling Water Loop: k_{cw} = 457.7 Btu/h·gpm·°F for 40% glycol at 150°F

The Useful and Unused heat recoveries will be:

$$Q_{useful} = Q_{lo} + Q_{hi}$$

$$Q_{unused} = Q_{cw}$$

Power and Energy

Generally power meters can provide a host of data points, many of them redundant. Our approach, where possible, is to grab the register value associated with energy (kWh) and from that value determine the average power for each 15-minute interval. This average power value is defined as:

$$\mathrm{kW}_{\mathrm{avg}} = \frac{\mathrm{kWh}}{\Delta t}$$

This average Power over a short time interval (15 minutes) is usually indistinguishable from the "demand" or instantaneous power data reported by most meters (most utilities use a sliding 15-minute interval). The fuel cell PPC and the Shark meter are both given as instantaneous kW. Cumulative reads are in kWh.

Efficiency Calculations

The electrical and total efficiency of the Fuel Cell, based on the lower heating value of the fuel, will be calculated using:

$$\eta_{electrical} = \frac{WFC}{LHV \times FG \times \frac{1}{3600}}$$

$$\eta_{total} = \frac{WFC + (QL + QH) \times \frac{1}{3412.8}}{LHV \times FG \times \frac{1}{3600}}$$

where:

QL, QH	-	Useful heat recovery – low, high temperature loops (Btu/h)
WFC	-	Power output (kW)
FG	-	Generator gas input (kg/h)
LHV	-	Lower heating value for natural gas (~48,667 kJ/kg)

Project Web Site

CDH will create a web site for RIT that provides access to all the historic data collected at the site. The website will provide custom, detailed plots and tables of the collected data from the site that will be updated once a day.

Appendix A - Fuel Cell HRM at RIT

Internet address: <166.143.94.237>

Table 1. Summary of Major HRM Components

Obvius **AcquiSuite** A8812	This datalogger includes thermistors and flow meters to measure thermal loads. It also reads MODBUS registers from the **Babel Buster**. All data are stored in the **AcquiSuite** memory and transferred to the CDH Energy servers from this device.
Control Solutions **Babel Buster** BB2-7010-01	This gateway device reads data from the **PPC** (via MODBUS TCP) and makes it available as MODBUS data to the **AcquiSuite**.

Table 2. Summary of Data Sensors

Power Plant Controller **PPC**	This fuel cell controller provides data as MODBUS registers to the **Babel Buster**.
Onicon F-1111 Flow Meter	This high accuracy, insertion-style, impeller flow meter measures water flow through each of the heat loops and provides a 4-20mA signal to the **AcquiSuite**.
Onicon F-1211 Flow Meter	Like the **Onicon F-1111**, this is a highly accurate, insertion-style, impeller flow meter. The **F-1211** is designed to handle a shorter straight length of pipe.
Veris TIG series **Thermistor**	This 10kΩ Type 2 **Thermistor** reacts to temperatures in the heat loops. The resulting resistances are measured and stored by the **AcquiSuite**.
Shark 100 Power Meter	This power meter is revenue grade will measure the electrical output of the fuel cell. This meter will communicate with the Acquisuite via MODBUS RTU.

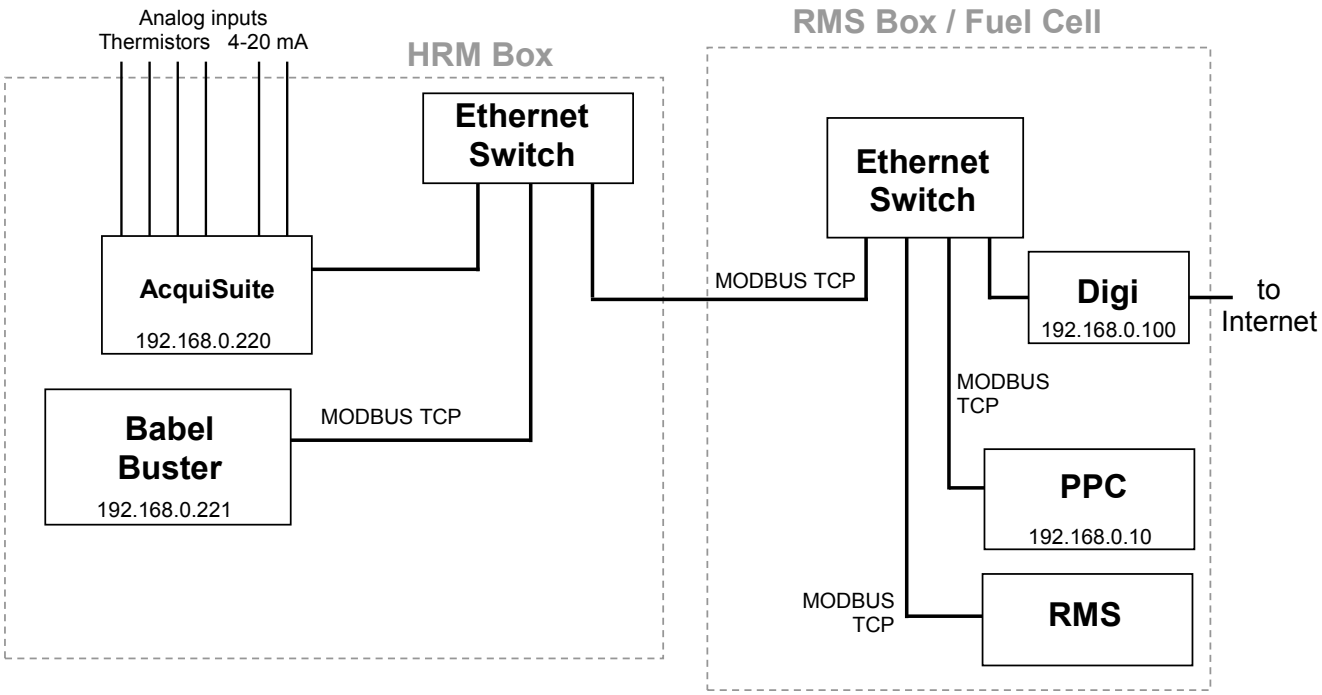

Figure 1. Layout of HRM and RMS Network

The Babel Buster provides all the communications (i.e., reads) between the devices on the network. It reads data from the PPC device and makes the data available for the Obvius AcquiSuite datalogger to read. The AcquiSuite logs all the data.

Table 3. Network Devices and Addresses

Network Layout

Label	Device	Protocol	IP Address
AcquiSuite	Obvius AcquiSuite	Modbus TCP	192.168.0.220
Babel Buster	CSI Babel Buster 2 Multi-network Interface	Modbus TCP BACnet	192.168.0.221 192.168.0.221
PPC	UTC Power Power Plant Controller (PPC)	Modbus TCP	192.168.0.10
Shark	Shark 100 - REC Power Transducer	Modbus RTU	

Table 4. Listing of Data Points Collected from all Devices

Babel Buster Variable	Source	CDH Name	CEP / Obvius Variable Name	Description	Native Units	Babel Buster MODBUS Address	Source Data Address	Source Data Type	Notes	Babel Buster Data Type	Eng Units
AI-1	PPC	FG	FUEL	Fuel flow rate	kg/h	1	7173	Float		Float	kg/h
AI-2	PPC	FGcum	CUMFUEL	Cumulative fuel consumed at standard temperature	m^3	3	7191	Float		Float	m^3
AI-3	PPC	WFC	KW	Electrical power output	kW	5	10535	Float		Float	kW
AI-4	PPC	WFCcum	MWH	Cumulative electrical power output	MWh	7	7217	Float		Float	MWh
BI-1	PPC	SWV	WTRVLV	Make-up water tank fill valve status	On/Off	3001	763	Boolean/Int		Boolean	On/Off
AI-5	PPC	EFF_ELEC	EFFELEC	Instantaneous electrical efficiency	%	9	7505	Float		Float	%
AI-6	PPC	FC_STATE	STATE	Fuel cell state Number	Number	11	5	Unsigned Int		Float	Number
BI-2	PPC	SGI	GISTATUS	Grid independent status	On/Off	3002	60	Boolean/Int		Boolean	On/Off
BI-3	PPC	SGC	CGSTATUS	Grid connect status	On/Off	3003	59	Boolean/Int		Boolean	On/Off
AI-7	PPC	RTIME	LOAD	Cumulative load time hr	hrs	13	7205	Float		Float	hrs
AI-8	PPC	NALARM	NUMALARMS	Total number of alarms	Number	15	21	Unsigned Int		Float	Number
AI-12	PPC	FC_ISTATE	ISTATE	Inverter State Number	Number	23	13	Unsigned Int		Float	Number
AI-9	SHARK	WREC_pos	WREC_pos	Energy Output through Grid Independent Loop	kWh	17	1100	Double		Float	kWh
AI-10	SHARK	WREC_neg	WREC_neg	Energy Input through Grid Independent Loop	kWh	19	1102	Double		Float	kWh
AI-11	SHARK	WREC	WREC	Power through Grid Independent Loop	Watts	21	900	Float		Float	Watts
	Main-1	TLS	TEMPLGOUT	Temperature – low grade heat supply	°F	39	ohm		10k, Type 2	Float	Ohms
	Main-2	TLR	TEMPLGIN	Temperature – low grade heat return	°F	41	ohm		10k, Type 2	Float	Ohms
	Main-3	THS	TEMPHGOUT	Temperature – high grade heat supply	°F	43	ohm		10k, Type 2	Float	Ohms
	Main-4	THR	TEMPHGIN	Temperature – high grade heat return	°F	45	ohm		10k, Type 2	Float	Ohms
	Main-5	TCWS	TEMPCWOUT	Temperature – cooling module supply	°F	47	ohm		10k, Type 2	Float	Ohms
	Main-6	TCWR	TEMPCWIN	Temperature – cooling module return	°F	49	ohm		10k, Type 2	Float	Ohms
	EXP-1	FL	FLOWLG	Flow rate – low grade heat	gpm	55	4-20 mA (0-100)		Onicon F-1211	Float	mA x 1000
	EXP-2	FH	FLOWHG	Flow rate – high grade heat	gpm	57	4-20 mA (0-100)		Onicon F-1211	Float	mA x 1000
	EXP-3	FCW	FLOWCW	Flow rate – cooling module	gpm	59	4-20 mA (0-150)		Onicon F-1111	Float	mA x 1000

= Data provided or received from PPC via MODBUS TCP

= Data from sensors on Obvius AcquiSuite

= Data received from the Shark 100 Power Meter

Babel Buster XML File

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<!-- Babel Buster BB2-7010-01 v2.34.5 (db:2) configuration file -->
<configuration>

<bacnet_objects>
   <obj id="1" name="FUEL" units="95"/>
   <obj id="2" name="CUMFUEL" units="95"/>
   <obj id="3" name="KW" units="95"/>
   <obj id="4" name="MWH" units="95"/>
   <obj id="5" name="EFFELEC" units="95"/>
   <obj id="6" name="STATE" units="95"/>
   <obj id="7" name="LOAD" units="95"/>
   <obj id="8" name="NUMALARMS" units="95"/>
   <obj id="12" name="ISTATE" units="95"/>
   <obj id="13" name="SERIAL" units="95"/>
   <obj id="3001" name="WTRVLV" units="95"/>
   <obj id="3002" name="GISTATUS" units="95"/>
   <obj id="3003" name="CGSTATUS" units="95"/>

   <obj id="20" name="AcquiSuite TLS" units="95"/>
   <obj id="21" name="AcquiSuite TLR" units="95"/>
   <obj id="22" name="AcquiSuite THS" units="95"/>
   <obj id="23" name="AcquiSuite THR" units="95"/>
   <obj id="26" name="AcquiSuite TCWS" units="95"/>
   <obj id="27" name="AcquiSuite TCWR" units="95"/>

   <obj id="28" name="AcquiSuite FL" units="95"/>
   <obj id="29" name="AcquiSuite FH" units="95"/>
   <obj id="31" name="AcquiSuite FCW" units="95"/>
</bacnet_objects>

<modbus_devices>
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   <dev id="2" ipaddr="192.168.0.220" unit="250" rate="1.000000" name="AcquiSuite Main Board"/>
   <dev id="3" ipaddr="192.168.0.220" unit="3"   rate="1.000000" name="AcquiSuite Exp Board"/>
   <dev id="4" ipaddr="192.168.0.220" unit="2"   rate="1.000000" name="Shark 100 Power Meter"/>
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   <rule localreg="1"    remtype="hold_reg" remreg="7173"  remfmt="float"  dev="1" scale="0.000000" offset="0.000000" poll="1.00" bipunits="96" name="FUEL"/>
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   <rule localreg="3"    remtype="hold_reg" remreg="10535" remfmt="float"  dev="1" scale="0.000000" offset="0.000000" poll="1.00" bipunits="96" name="KW"/>
   <rule localreg="4"    remtype="hold_reg" remreg="7217"  remfmt="float"  dev="1" scale="0.000000" offset="0.000000" poll="1.00" bipunits="96" name="MWH"/>
   <rule localreg="5"    remtype="hold_reg" remreg="7505"  remfmt="float"  dev="1" scale="0.000000" offset="0.000000" poll="1.00" bipunits="96" name="EFFELEC"/>
   <rule localreg="6"    remtype="hold_reg" remreg="5"     remfmt="uint"   dev="1" scale="0.000000" offset="0.000000" poll="1.00" bipunits="96" name="STATE"/>
   <rule localreg="7"    remtype="hold_reg" remreg="7205"  remfmt="float"  dev="1" scale="0.000000" offset="0.000000" poll="1.00" bipunits="96" name="LOAD"/>
   <rule localreg="8"    remtype="hold_reg" remreg="21"    remfmt="uint"   dev="1" scale="0.000000" offset="0.000000" poll="1.00" bipunits="96" name="NUMALARMS"/>
   <rule localreg="12"   remtype="hold_reg" remreg="13"    remfmt="uint"   dev="1" scale="0.000000" offset="0.000000" poll="1.00" bipunits="96" name="ISTATE"/>
   <rule localreg="13"   remtype="hold_reg" remreg="20"    remfmt="uint"   dev="1" scale="0.000000" offset="0.000000" poll="1.00" bipunits="96" name="SERIAL"/>
   <rule localreg="3001" remtype="coil"     remreg="763"   remfmt="int"    dev="1" scale="0.000000" offset="0.000000" poll="1.00" bipunits="96" name="WTRVLV"/>
   <rule localreg="3002" remtype="coil"     remreg="60"    remfmt="int"    dev="1" scale="0.000000" offset="0.000000" poll="1.00" bipunits="96" name="GISTATUS"/>
   <rule localreg="3003" remtype="coil"     remreg="59"    remfmt="int"    dev="1" scale="0.000000" offset="0.000000" poll="1.00" bipunits="96" name="CGSTATUS"/>

   <rule localreg="20"   remtype="hold_reg" remreg="1"     remfmt="double" dev="2" scale="0.000000" offset="0.000000" poll="1.00" bipunits="96" name="Acquisuite TLS"/>
   <rule localreg="21"   remtype="hold_reg" remreg="3"     remfmt="double" dev="2" scale="0.000000" offset="0.000000" poll="1.00" bipunits="96" name="Acquisuite TLR"/>
   <rule localreg="22"   remtype="hold_reg" remreg="5"     remfmt="double" dev="2" scale="0.000000" offset="0.000000" poll="1.00" bipunits="96" name="Acquisuite THS"/>
   <rule localreg="23"   remtype="hold_reg" remreg="7"     remfmt="double" dev="2" scale="0.000000" offset="0.000000" poll="1.00" bipunits="96" name="Acquisuite THR"/>
   <rule localreg="26"   remtype="hold_reg" remreg="9"     remfmt="double" dev="2" scale="0.000000" offset="0.000000" poll="1.00" bipunits="96" name="Acquisuite TCWS"/>
   <rule localreg="27"   remtype="hold_reg" remreg="11"    remfmt="double" dev="2" scale="0.000000" offset="0.000000" poll="1.00" bipunits="96" name="Acquisuite TCWR"/>
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   <rule localreg="28"   remtype="hold_reg" remreg="3"     remfmt="double" dev="3" scale="0.000000" offset="0.000000" poll="1.00" bipunits="96" name="Acquisuite FL"/>
   <rule localreg="29"   remtype="hold_reg" remreg="1"     remfmt="double" dev="3" scale="0.000000" offset="0.000000" poll="1.00" bipunits="96" name="Acquisuite FH"/>
   <rule localreg="31"   remtype="hold_reg" remreg="5"     remfmt="double" dev="3" scale="0.000000" offset="0.000000" poll="1.00" bipunits="96" name="Acquisuite FCW"/>

</client_read>

<rtu_read>
   <rule localreg="9" remtype="hold_reg" remreg="1100" remfmt="double" unit="1" scale="0.000000" offset="0.000000" poll="0.00" name="MWHREC_POS"/>
   <rule localreg="10" remtype="hold_reg" remreg="1102" remfmt="double" unit="1" scale="0.000000" offset="0.000000" poll="0.00" name="MWHREC_NEG"/>
   <rule localreg="11" remtype="hold_reg" remreg="900" remfmt="float" unit="1" scale="0.000000" offset="0.000000" poll="0.00" name="KWREC"/>
</rtu_read>
<rtu_device>
   <dev baud="9600" slave="1" unit="3"/>
</rtu_device>

</configuration>
```

Table 5. Sensor and Wiring Details for AcquiSuite

Channel / Source	Data Pt	Description	Instrument / Meter	Signal / Register	Eng Units	Wire	Notes
Main-1	TLS	Low Temp Supply Temp (from FC)	10k Thermistor, Type 2	ohm	°F	6	
Main-2	TLR	Low Temp Return Temp (to FC)	10k Thermistor, Type 2	ohm	°F	5	
Main-3	THS	High Temp Supply Temp (from FC)	10k Thermistor, Type 2	ohm	°F	4	
Main-4	THR	High Temp Return Temp (to FC)	10k Thermistor, Type 2	ohm	°F	3	
Main-5	TCWS	Cooling Module Supply Temp (from FC)	10k Thermistor, Type 2	ohm	°F	1	
Main-6	TCWR	Cooling Module Return Temp (to FC)	10k Thermistor, Type 2	ohm	°F	2	
EXP-1	FL	Low Temp Water Flow	Onicon F-1211	4-20 mA	gpm	4/7	2.5" Sch 40 Steel, 50 gpm
EXP-2	FH	High Temp Water Flow	Onicon F-1211	4-20 mA	gpm	M1/M2	2.5" Sch 40 Steel, 50 gpm
EXP-3	FCW	Cooling Module Flow	Onicon F-1111	4-20 mA	gpm	F/G	2" Copper Type L, 60 gpm
Modbus Dev 2	WREC_pos	Energy Output through Grid Independent Loop	Shark 100	1100	kWh		
Modbus Dev 2	WREC_neg	Energy Input through Grid Independent Loop	Shark 100	1102	kWh		
Modbus Dev 2	WREC	Power through Grid Independent Loop	Shark 100	900	Watts		
Modbus TCP	FG	Instantaneous Fuel Flow	PPC	7173	kg/h	Float	page 12 of FCFR
Modbus TCP	FGcum	Cumulative Fuel Consumption	PPC	7191	m^3	Float	page 12 of FCFR
Modbus TCP	WFC	Instantaneous Power Output	PPC	10535	kW	Float	page 12 of FCFR
Modbus TCP	WFCcum	Cumulative Power Produced	PPC	7217	MWh	Float	page 12 of FCFR
Modbus TCP	EFF_ELEC	Instantaneous electrical efficiency (LHV)	PPC	7505	%	Float	page 12 of FCFR
Modbus TCP	FC_STATE	Fuel Cell Mode/State Number	PPC	5	Number	Unsigned Int	page 12 of FCFR
Modbus TCP	RTIME	Cumulative "Load" Time	PPC	7205	hrs	Float	page 12 of FCFR
Modbus TCP	NALARM	Total number of alarms	PPC	21	Number	Unsigned Int	page 12 of FCFR
Modbus TCP	FC_ISTATE	Fuel Cell Inverter State Number	PPC	13	Number	Unsigned Int	page 12 of FCFR
Modbus TCP	SWV	Make-up water tank fill valve status	PPC	763	On/Off	Boolean/Int	page 12 of FCFR
Modbus TCP	SGI	Grid independent status	PPC	60	On/Off	Boolean/Int	page 12 of FCFR
Modbus TCP	SGC	Grid connect status	PPC	59	On/Off	Boolean/Int	page 12 of FCFR

Table 6. Forwarded Addresses on Digi Modem

Forward TCP/UDP/FTP connections from external networks to the following internal devices:

Enable	Protocol	External Port	Forward To Internal IP Address	Forward To Internal Port
☑	UDP	47808	192.168.0.51	47808
☑	TCP	3389	192.168.0.199	3389
☑	TCP	8081	192.168.0.220	80
☑	TCP	8082	192.168.0.221	80
☑	FTP	8083	192.168.0.220	21
☑	TCP	8084	192.168.0.220	23
☑	FTP	0	0.0.0.0	0

Obvius AcquiSuite

The AcquiSuite data logger produces a separate file of 1-minute data for each device. The read map for the data logger is given below.

Chan Name	Device	Column
FG,	mb-001,	0
FGCUM,	mb-001,	1
WFC,	mb-001,	2
WFCCUM,	mb-001,	3
SWV,	mb-001,	4
EFF_ELEC,	mb-001,	5
FC_STATE,	mb-001,	6
SGI,	mb-001,	7
SGC,	mb-001,	8
RTIME,	mb-001,	9
NALARM,	mb-001,	10
WREC_pos	mb-001,	13
WREC_neg	mb-001,	14
WREC	mb-001,	15
ISTATE,	mb-001,	16
FL,	mb-003,	1
FH,	mb-003,	6
FCW,	mb-003,	11
TLS,	mb-250,	1
TLR,	mb-250,	6
THS,	mb-250,	11
THR,	mb-250,	16
TCWS,	mb-250,	21
TCWR,	mb-250,	26

Notes: mb-001 – MODBUS Reads
mb-003 - AcquiSuite Expansion Board
mb-250 – AcquiSuite Main Board

Sensor Calibrations:

Thermistor #	Name	Wire	Input Channel	Mult	Offset
4-167	TLS	6	Main-1	0.99176	1.04
4-171	TLR	5	Main-2	0.99340	0.89
4-173	THS	4	Main-3	0.99192	0.95
4-166	THR	3	Main-4	0.99155	0.95
2-37	TCWS	1	Main-5	0.98871	0.90
2-36	TCWR	2	Main-6	0.98836	0.97