



Case Study: Fort Bragg Microgrid



Presented by:
Joshua Meyer, Encorp

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..... Fort Bragg Overview

Project Objectives

- ✓ Energy security
- ✓ Generator reliability
- ✓ Full parallel interconnection with bi-directional power flows inside the microgrid
- ✓ Reduce total energy costs
- ✓ Retrofit emergency standby generators for DG operations
- ✓ Integrate generators into a central network for remote operations & management

Value to Fort Bragg

- ✓ Increased generator reliability
 - ✓ Testing under load
 - ✓ Automation
 - ✓ Remote communications & controls
 - ✓ Maintenance diagnostic software
- ✓ Cost savings through the reduction of utility peak demand charges
- ✓ Cost savings through reduction of expensive commodity electricity purchases

..... Project Scope

The Fort Bragg microgrid was completed in 3 phases. Each generator was interconnected with the grid for bi-directional power flows.

Facility	# of Gensets	MW
SOTF	3	3.0 MW
USASOC	1	1.2 MW
JSOC	11	3.84 MW
Total	15	8.04 MW

Acronyms:

SOTF	Special Operations Task Force
USASOC	US Army Special Operations Command
JSOC	Joint Specialized Operations Command

..... Project Scope

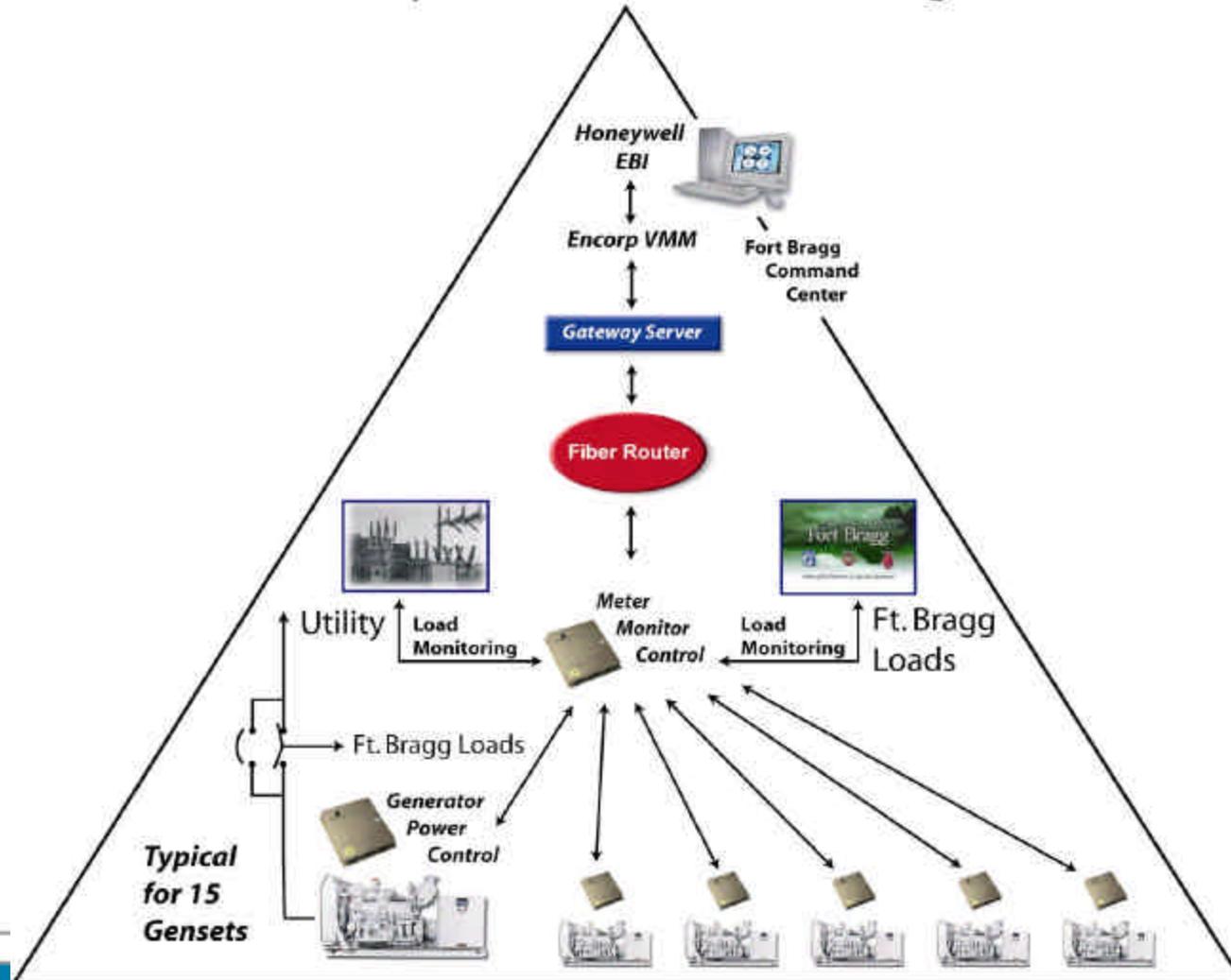
The creation of a microgrid required the networking & interoperation of multiple generators with multiple substations and multiple feeders.

Interaction with Utility

- ✓ 3 Carolina Power & Light substations interact with the microgrid & are integrated with DG automation software.
- ✓ Each generator responds to utility price signals
 - ✓ Peak shaving
 - ✓ Time of use tariffs
- ✓ Each generator exports power when dispatched for economic purposes
- ✓ If utility power fails, generators serve emergency loads & are isolated from the grid
- ✓ Interconnected with transfer switches with breaker-around solution

..... Communication & Control Technologies

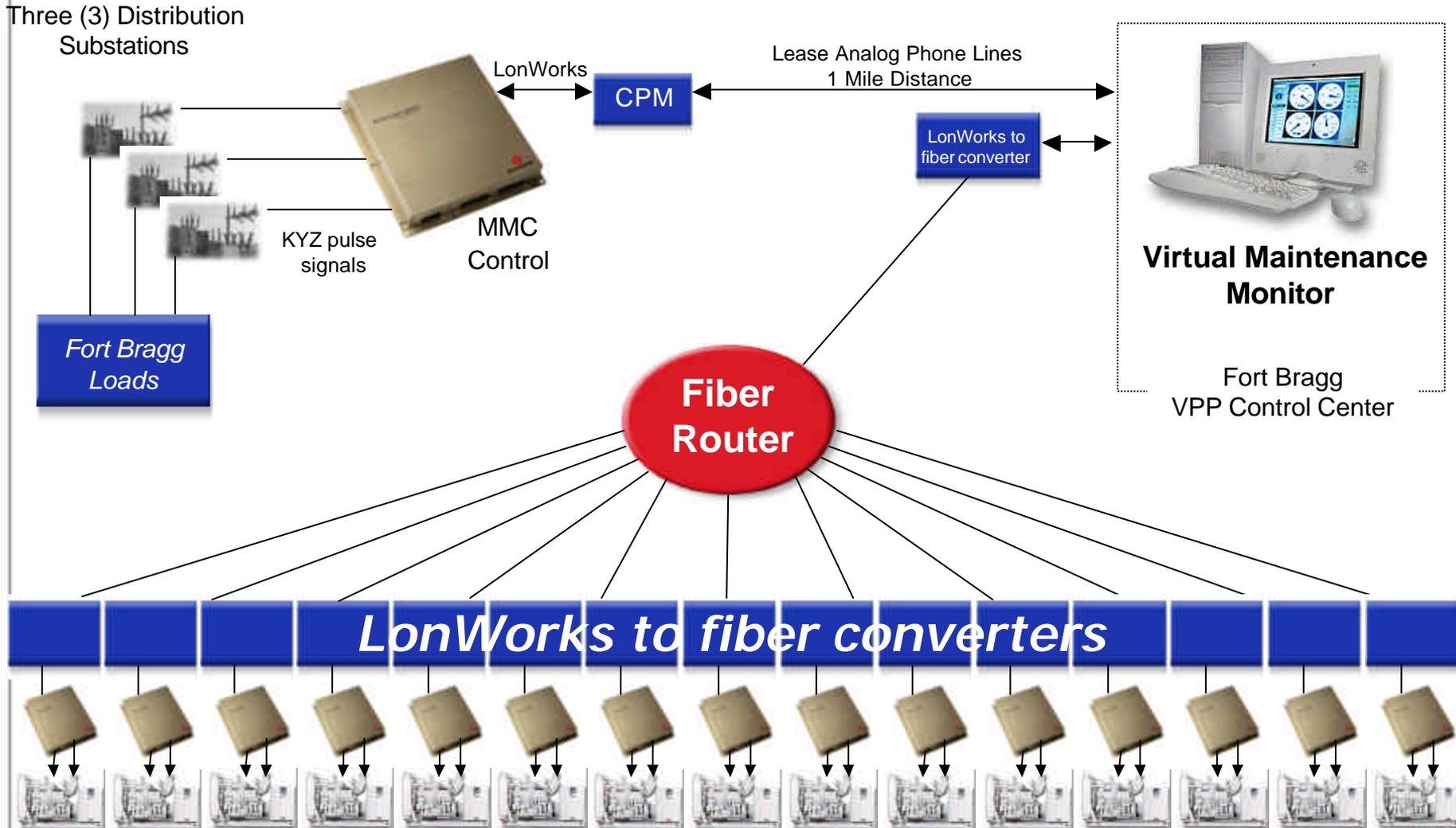
Hierarchy of Controls on the Microgrid



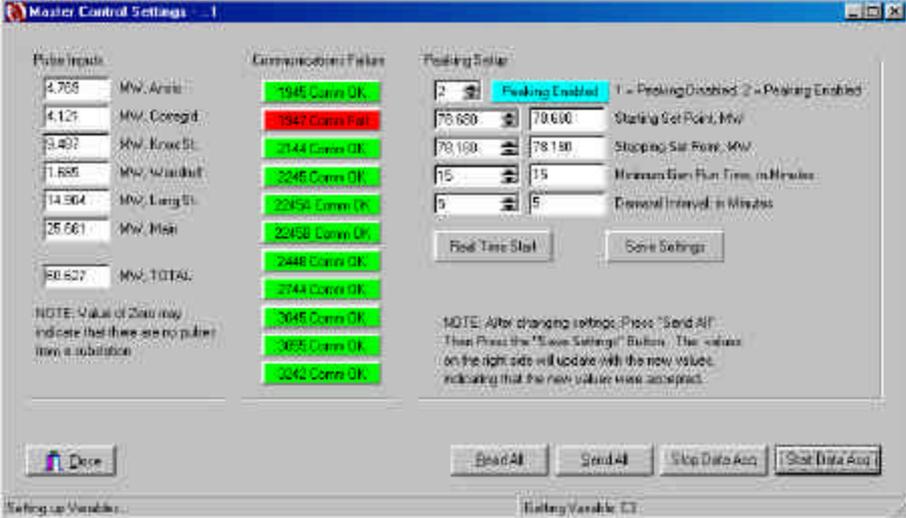
Fort Bragg Control & Communication



Architecture



Software Applications



Master Control Settings - 1

Pulse Inputs:

4.768	MW_Ansis
4.125	MW_Coregid
5.497	MW_KnoxSt
1.685	MW_Wardbur
14.904	MW_LiangSt
25.561	MW_Masi
80.527	MW_TOTAL

Communications Filter:

1945	Comm OK
1947	Comm Fail
2144	Comm OK
2245	Comm OK
2245A	Comm OK
2448	Comm OK
2744	Comm OK
3045	Comm OK
3055	Comm OK
3242	Comm OK

Peaking Setup:

Peaking Enabled 1 - Peaking Disabled 2 - Peaking Enabled

78.600 Starting Set Point, MW

78.100 Stopping Set Point, MW

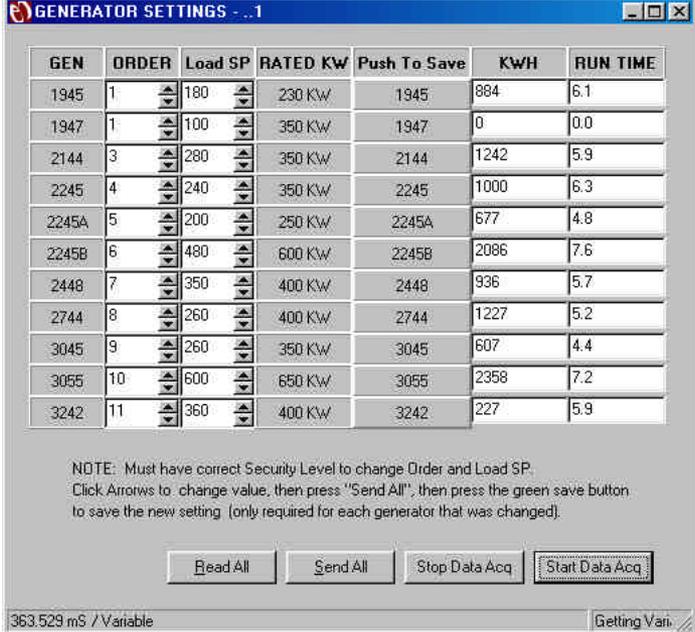
15 Minimum Gen Run Time, in Minutes

5 Demand Interval, in Minutes

Read Test Stat Save Settings

NOTE: After changing settings, Press "Send All" Then Press the "Save Settings" Button. The values on the right side will update with the new values indicating that the new values were accepted.

Read All Send All Stop Data Acq Start Data Acq



GENERATOR SETTINGS - ..1

GEN	ORDER	Load SP	RATED KW	Push To Save	KWH	RUN TIME
1945	1	180	230 KW	1945	884	6.1
1947	1	100	350 KW	1947	0	0.0
2144	3	280	350 KW	2144	1242	5.9
2245	4	240	350 KW	2245	1000	6.3
2245A	5	200	250 KW	2245A	677	4.8
2245B	6	480	600 KW	2245B	2086	7.6
2448	7	350	400 KW	2448	936	5.7
2744	8	260	400 KW	2744	1227	5.2
3045	9	260	350 KW	3045	607	4.4
3055	10	600	650 KW	3055	2358	7.2
3242	11	360	400 KW	3242	227	5.9

NOTE: Must have correct Security Level to change Order and Load SP. Click Arrows to change value, then press "Send All", then press the green save button to save the new setting (only required for each generator that was changed).

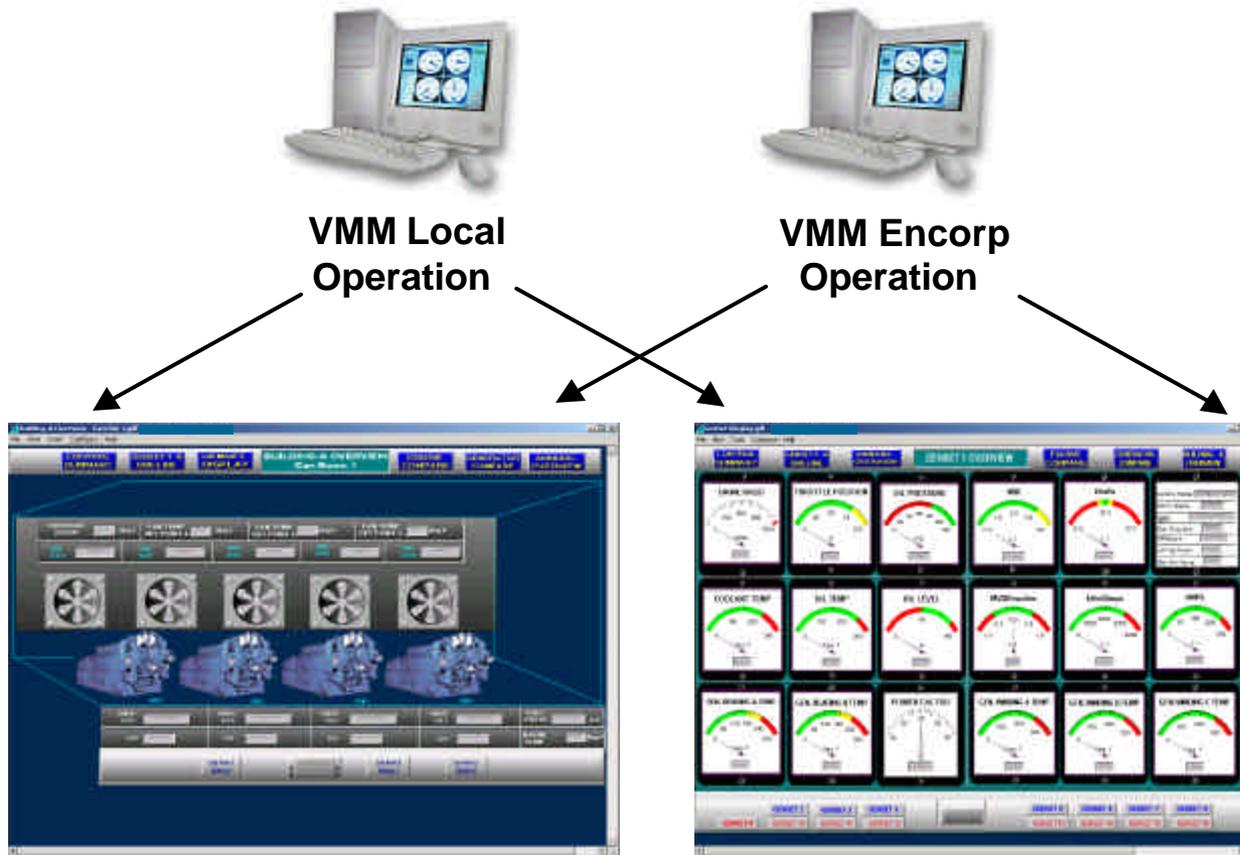
Read All Send All Stop Data Acq Start Data Acq

363.529 mS / Variable Getting Vari...

- ✓ **Metering 3 KYZ Pulse Signals w/Totals**
- ✓ **Communications Detection Of Genset Sites – Reliability**
- ✓ **Peak Shaving on Load Demand – Start/Stop Set Point**
- ✓ **Genset Start/Stop Sequence Selection Order**
- ✓ **Manual Load Test Dispatching from Local Workstation**
- ✓ **Remote Capability for O&M and Dispatching**

Virtual Maintenance Monitor™ Software

The VMM provides O&M capabilities with trending, event capture, & alarm notification. Information & reports are integrated seamlessly into Honeywell's enterprise level energy management system.

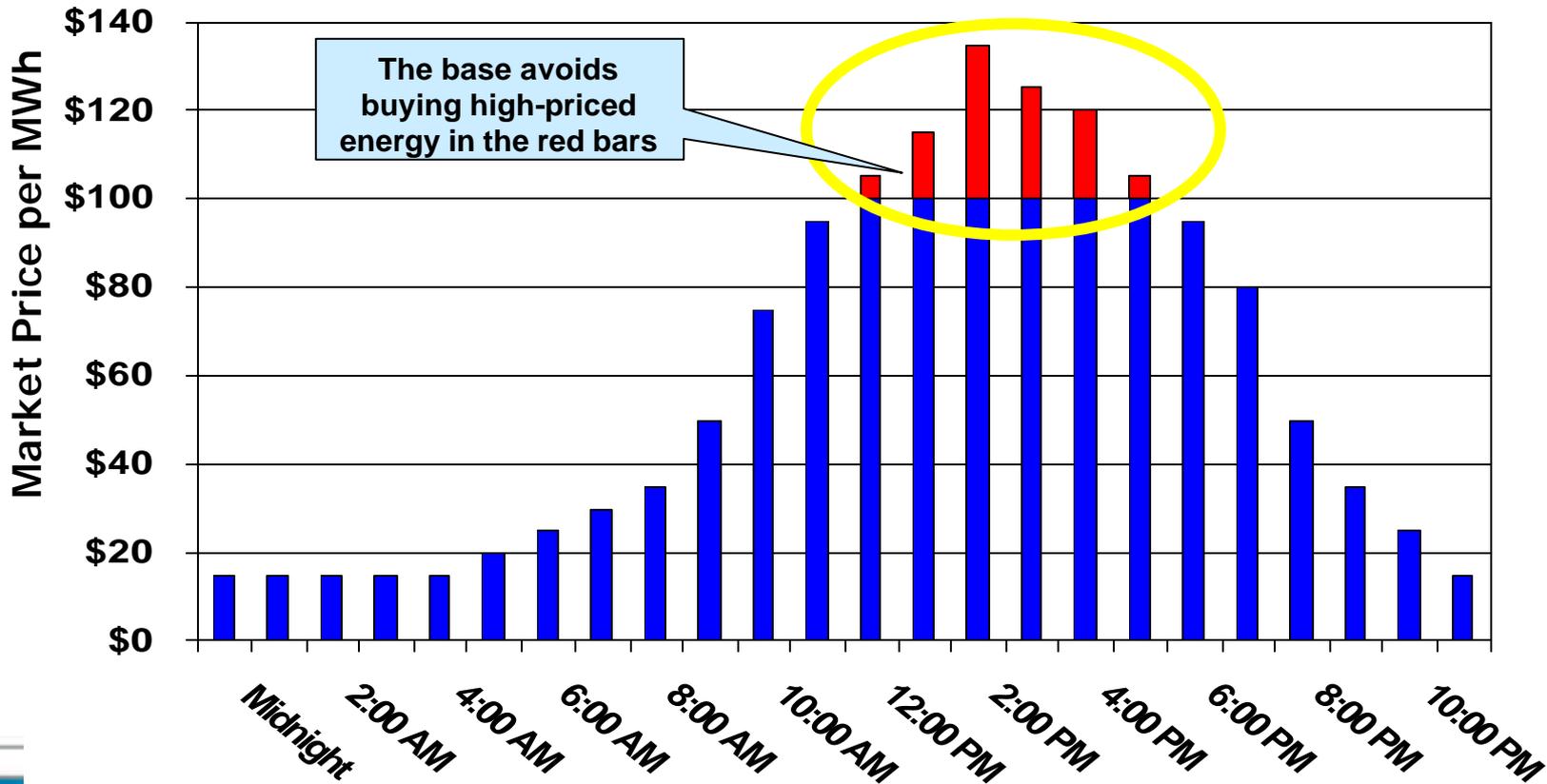


Automated Economic Savings –

Application #1: Offsetting Expensive Commodity Purchases

Fort Bragg buys electric energy on a time of use rate with hourly prices. When prices exceed \$100/MWh, the base automatically self-generates.

On-Site Generate Vs. Buy

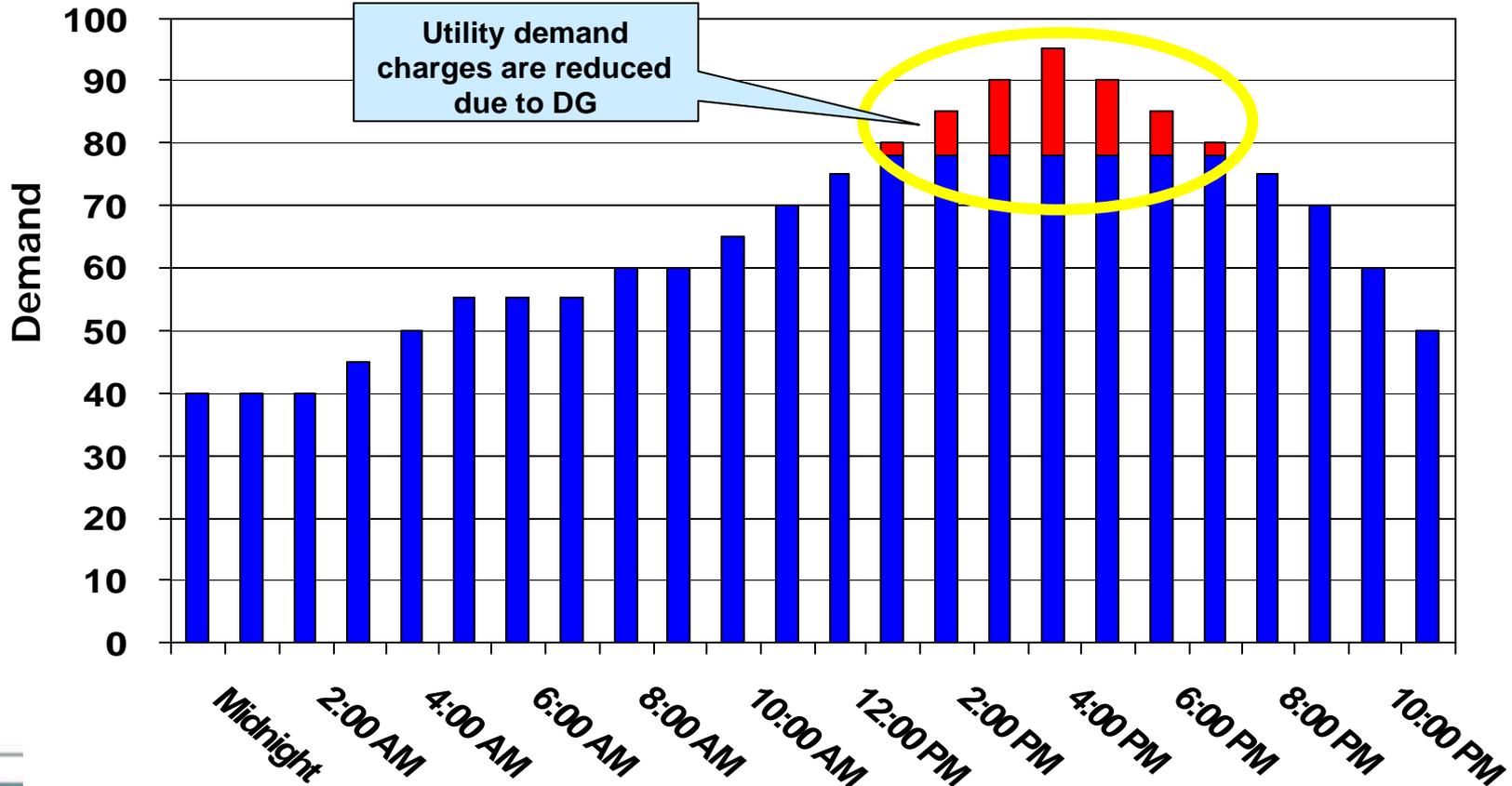


Automated Economic Savings –

Application #2: Demand Management

Fort Bragg has economic incentives to keep utility metered demand below 78 MW. When demand exceeds 78 MW, DG is automatically dispatched to reduce utility purchases.

On-Site Generate Vs. Buying Expensive Grid Supplied Energy



..... Conclusion: Fort Bragg Microgrid

On-Site Generation Has

- ✓ **Enhanced energy security**
- ✓ **Lowered utility-supplied energy costs**
- ✓ **Created bi-directional power flows on the distribution system**
- ✓ **Created value for the host utility, Carolina Power & Light**
- ✓ **Been networked & automated for optimization of dispatch sequences**

Next Steps

- ✓ **Future phases are in the planning stages to add a 5 MW gas turbine, a fuel & additional backup generators to the microgrid**
- ✓ **As Virtual Power Plant™ functionality is in place, additional generation components are easily networked at a low cost (i.e. imbedded scalability)**
- ✓ **Demonstrate microgrid value at other DOD & campus facilities**