The Solutions Network

Rochester, New York

Energy Security and DG / CHP Communication and Control

Joshua Meyer
Encorp

Key objectives for today's presentation

Objective #1	**Illustrate goals for DG & CHP communication & control technologies relative to energy security**
Objective #2	**Review "best of breed" commercial technologies in brief case studies**
Objective #3	**Demonstrate that sophisticated DG & CHP communication and controls technologies are proven and commercially available**

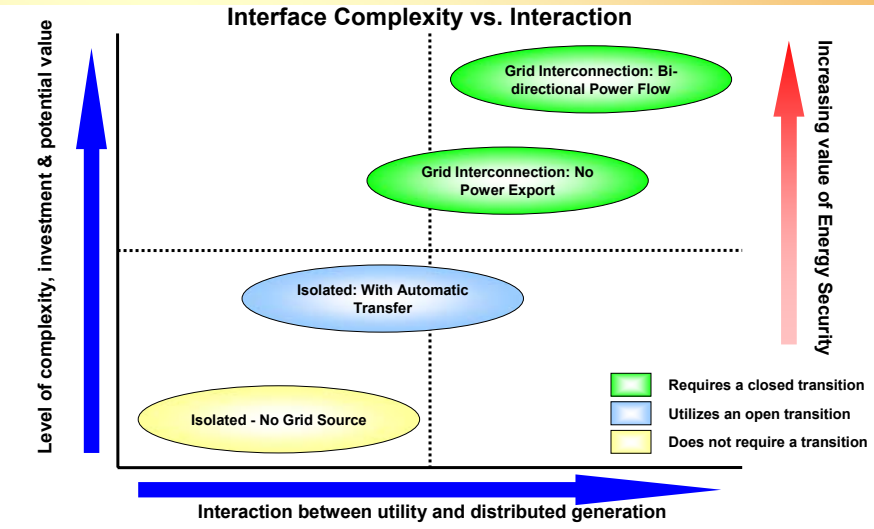
About Encorp

- ✓ Total MW controlled by Encorp product 700+
- ✓ Number of Generator Power Controls[1] shipped 1,450+
- ✓ Total number of customers 240+
- ✓ Grid interconnected projects 95%+
- ✓ Breakdown of projects by application
  - CHP
  - Renewables / Non-pipeline fuels
  - Standby power
  - Peak shaving
  - Merchant/IPP
  - Demand response programs
    - Interruptible rates
    - Time of use rates
    - Peak sharing

Communication & control ideals

Key Objectives in no particular order	
1)	Full synchronous grid interconnection
2)	"Black start" and "islanding" capabilities
3)	Connected to all emergency loads
4)	Automated monitoring, testing, alarming & reporting (i.e. continuous commissioning process)
5)	Access to multiple generation or energy storage sources within a few cycles (preferably with multiple fuel sources)

Grid interconnection – position of technologies



Source: Arthur D. Little & Encorp

Fort Bragg Microgrid: project overview

The Fort Bragg microgrid was completed in 3 phases. Each generator was interconnected with the microgrid for bi-directional power flows on the post's distribution system. No power is exported outside the facility.

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

Fort Bragg: project vs. ideals

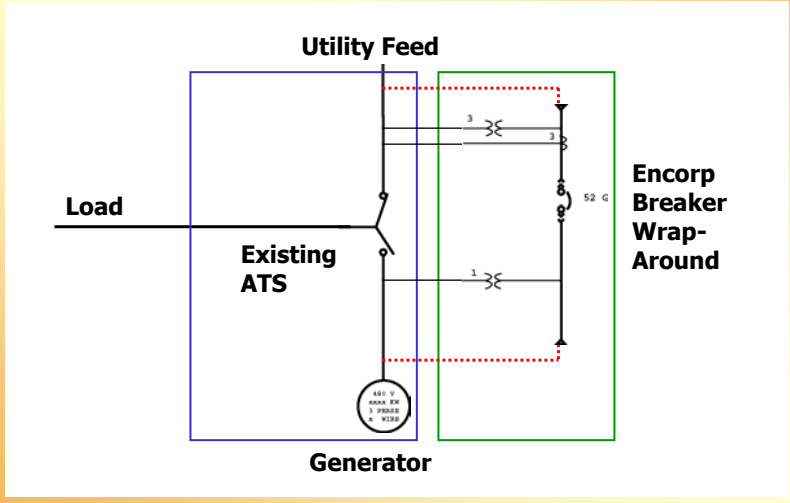
Ideals	Reality
1) Full synchronous grid interconnection	Yes
2) "Black start" and "islanding" capabilities	Yes
3) Connected to all emergency loads	Yes
4) Automated monitoring, testing, alarming & reporting (i.e. continuous commissioning process)	Yes
5) Access to multiple generation sources within a few cycles	Yes

Key element: grid interface

Interaction with Grid

- ✓ 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 (i.e. black start & island from the grid)
- ✓ Interconnected with transfer switches with breaker-around solution

Retrofitting a non-parallel interface for grid export



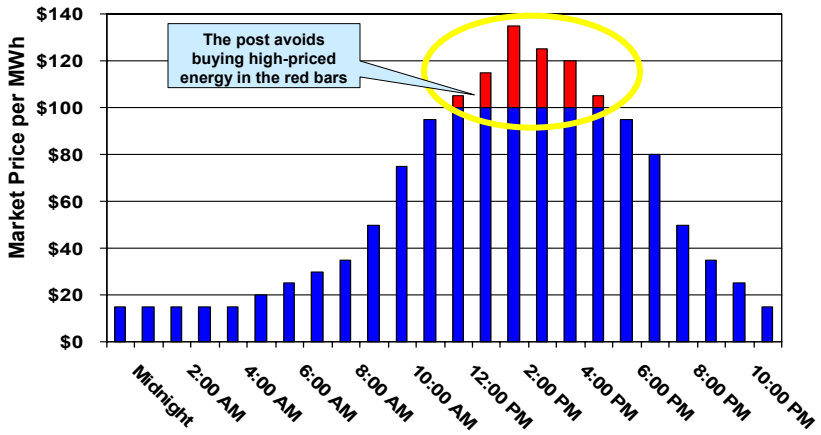
Key element: continuous monitoring

Enterprise Level	Honeywell ENTERPRISE Buildings Integrator Fort Bragg VPP Control Center
DG Network Level	*en*telligent-VMM Virtual Maintenance Monitor
Site Level	Gensets with Encorp Controls Information Flows Sub-Metering System

Economic payback – time of use tariffs

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

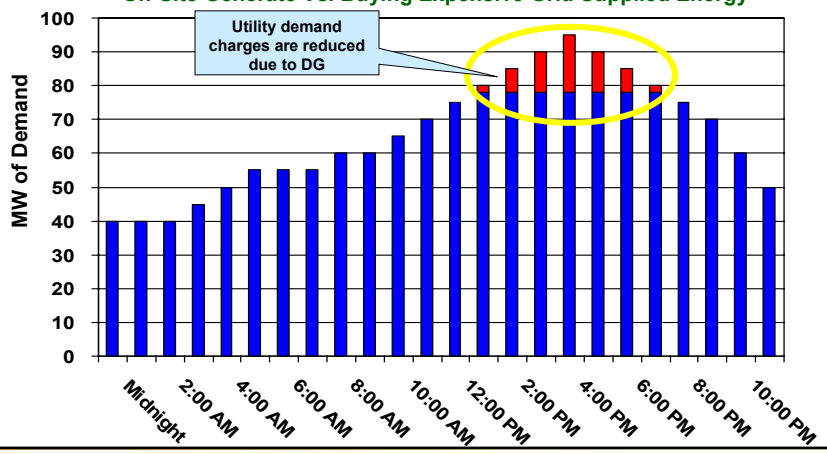
On-Site Generate Vs. Buy



Economic payback – demand management

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

On-Site Generate Vs. Buying Expensive Grid Supplied Energy



Savanna (Illinois) Depot Microgrid: project overview

A former military depot is being converted into a network of data warehouses. Data storage equipment is being sited in 1500 square foot "igloos"

The current project status: in final design stage for first two igloos.

Generation Technology Line Up – Phase One

# of Gensets	Gensets per igloo	Total kW per igloo
Elliott microturbines	2	200 kW
Baldor diesel generator	1	300 kW
Utility feed	1 for the entire facility, may be upgraded in the future	

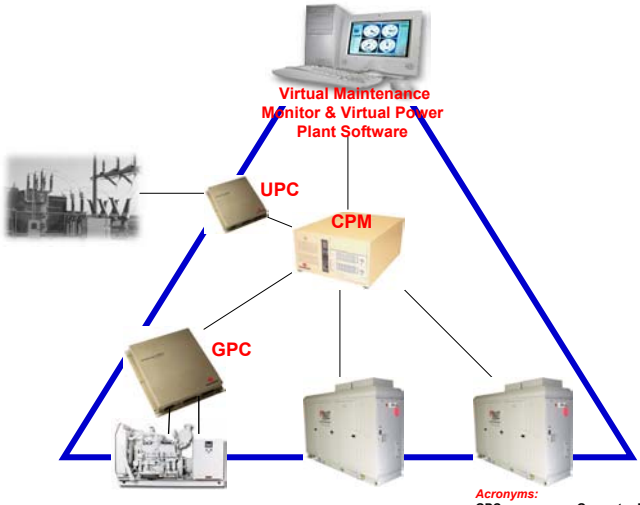
The microturbines are the primary source of energy.

Savanna: project vs. ideals

Ideals	Reality
1) Full synchronous grid interconnection	Yes[1]
2) "Black start" and "islanding" capabilities	Yes[1]
3) Connected to all emergency loads	Yes
4) Automated monitoring, testing, alarming & reporting (i.e. continuous commissioning process)	Yes
5) Access to multiple generation sources within a few cycles	Yes

[1]The diesel generators have black start and full synchronous capabilities.

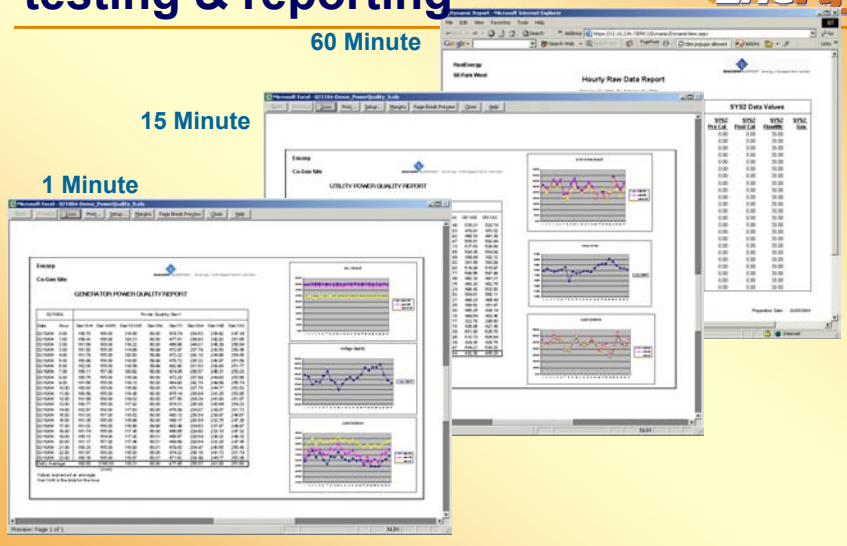
Hierarchy of controls



Acronyms:

GPC	Generator Power Control
CPM	Communication Processor Module
UPC	Utility Power Control

Automated & continuous testing & reporting



Economics of Energy Security Communication & Control

Objectives	Costs	Economic Benefits
Synchronous grid interconnection	$50 to $200 per kW	Value of seamless transition & utility export are driven by local tariffs and the value of uninterrupted power
"Black start" and "islanding" capabilities	Driven by prime mover OEM	The value of emergency power. In other words, without these capabilities, you could be sitting in the dark.
Connected to all emergency loads	Driven by facility design	See the note directly above.
Automated monitoring, testing, alarming & reporting	Hardware from $2,000 & up. Software from $2,000 & up. Costs increase with complexity.	Reduced labor and maintenance costs, increased reliability and flexibility.
Access to multiple generation or energy storage sources within a few cycles	Driven primarily by prime mover & interconnection costs.	Ability to possibly select fuels on the basis of price along with greater reliability benefits.

Conclusions: Ideal objectives vs. reality

Objectives	Reality
1) Full synchronous grid interconnection	1) Unless net metering programs or PUPRA designations are available, it is hard to export to utility. If you are on a network grid, synchronous interconnection is possible – just ask.
2) "Black start" and "islanding" capabilities	2) The capabilities of the prime mover often govern black start and islanding. The value is in the controls technology.
3) Connected to all emergency loads	3) Not all CHP installed for emergency power.
4) Automated monitoring, testing, alarming & reporting (i.e. continuous commissioning process)	4) Automated monitoring & testing is inexpensive, especially compared to the alternative.
5) Access to multiple generation or energy storage sources within a few cycles (preferably with multiple fuel sources)	5) Requires a combination of of money, robust communication and controls and good design.

Final thoughts

Going Forward Advice	
1)	Access to grid interconnection – if the federal government does not govern the grid, you will have to play by another party's rules.
2)	Financial – It is usually cheaper to do it right the first time than it is to retrofit.
3)	Emissions – not a large barrier, especially when working with natural gas fired technologies.
4)	Technical – an array of technologies are available, thus make your selections wisely.

Thank you

Thank you for your interest – may I respond to your comments & questions?

Joshua Meyer
Encorp
9351 Eastman Park Drive
Windsor, Colorado 80550

773-991-3696
joshua.meyer@encorp.com