Micro-grids and Smart Grid Applications

Working and Future Microgrid Application

MCAGCC 29 Palms

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MCAGCC 29 Palms Microgrid
MCAGCC 29 Palms Energy

- **Base Power Basics**
  - Power production
    - 16.4 MW 2 Cogeneration plants
    - 8.7 MW PV systems 5.2 MW on line
    - 24.4 MW Total production capacity
    - Winter peak 15 MW – Summer 26 MW
    - Lowering minimum import, Inadvertent Export

- **Energy Security**
  - Contingency plans for loss of power and water
  - Electrical grid redundancy
  - Load reduction capabilities
  - Critical buildings and infrastructure backup generators
  - Cogen plants, PV power production, Grid upgrades with switches and substation communication
  - Microgrid operations central control strategy
  - EMCS DDC building monitor and control
  - Leatherneck substation 115KV line upgrade allows for multiple feeds and redundancy
  - 7 day backup fuel supply
  - **Cyber Security**

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### FY 17 Usage 1st - 3rd Qtr

- **Total Generation**: 54,485,404 Kwh
- **Actual**:
  - October: 1,000,000 Kwh
  - November: 2,000,000 Kwh
  - December: 3,000,000 Kwh
  - January: 4,000,000 Kwh
  - February: 5,000,000 Kwh
  - March: 6,000,000 Kwh
  - April: 7,000,000 Kwh
  - May: 8,000,000 Kwh
  - June: 9,000,000 Kwh
  - July: 10,000,000 Kwh
  - August: 11,000,000 Kwh
  - September: 12,000,000 Kwh

- **Estimated**:
  - October: 1,000,000 Kwh
  - November: 2,000,000 Kwh
  - December: 3,000,000 Kwh
  - January: 4,000,000 Kwh
  - February: 5,000,000 Kwh
  - March: 6,000,000 Kwh
  - April: 7,000,000 Kwh
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  - July: 10,000,000 Kwh
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### KWH Used

- **Cogen**: 49,227,538 Kwh
- **Grid Power**: 17,677,973 Kwh
- **PV**: 5,257,866 Kwh

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**Total**

- **8 month total**: 72,163,377 Kwh
Infrastructure

- **Cogen plant 1 $16M (ESPC)**
  7.2MW solar turbine Taurus 70
  Generates 55% of base load
  55,000 + MWH/year
  Collects 35 MBTU/Hr heat for heating and cooling of 60% of the base.

- **Cogen/utility plant 2 - $48M (MILCON)**
  9.2MW/ twin 4.6MW Mercury 50 twin turbine for peak following
  2 - 20 MBTU/hr boilers
  3- 650 ton Chillers 1 – Electric Centrifugal 2 – Absorption
  Expected generation full year 55,000+ MWH

- **PV systems (EIP/ARRA/MILCON)**
  8.7MW/ 54 locations tie to buildings
  Size of systems 20-1250 KW

- **Battery Energy Storage System (ESTCP)**
  654 KW located on 1200 KW system

- **Chiller plants (8 Central plants) (ESPC/MILCON)**
  100,000 tons cooling capacity
  1900 tons absorption cooling

- **Public Works Network (PWN)**
  - Fiber communications system
    - Designed, Installed and Maintained by Public Works Division
    - PWD IT and security requirements (Cyber Secured w ATO on EMCS)
  - Monitor/Control/Metering
    - 60 motorized switches
    - 11 Substations with 34.5 and 12.47 KV remote breaker control
    - 2 Cogeneration plants
    - 3 Chilled water plants + small chillers (10,000 tons cooling)
    - 54 PV systems 8.7 MW
    - 250+ building controls
    - Future Sewage Treatment plant
    - Future Water treatment and Well field operations
Microgrid

- Expectations of power and capabilities
- Decision points on what and how to power
- Back up power still required for critical facilities
- How far do you want to go? Base to building
- Can you Maintain the infrastructure you install?
- Limitations of the system? Turbines, grid
- Coordination studies and load analysis

- Complication of system and controls
  - Operations – How many people understand how the system works and how it is programmed?
  - Add on projects – New buildings and new electrical require more attention to specs and coordination studies
  - Maintain – How does the Govt Maintain the system and repair it once there is an issue? (support contracts)
  - Grid redundancy – Does switching affect operations and coordination? Yes requires active mapping and programs when changing loads

- Initial Microgrid test with ESTCP 2011
- MCAGCC has a working 10 MW Microgrid
  - Cogen plant (7MW) plus PV systems
  - Islanding functions
    - 2003 -Initial function had plant idle and then pick up loads. 3.5MW initial 1MW
      - 2006 Loads increased on 4 feeders 2MW which required changes
    - 2008-Comparison of generated power to loads on circuits
    - Upon loss of power if loads are more than generation then circuits will open until loads are less than generation
  - 1.2 MW PV system can be energized to aid in power
  - Segmentation controls installed (pass 2)
  - P 1232 MILCON
    - Base wide effort tying both plants and all substations into control efforts
    - 15 MW Cogen + 8.7MW PV = 24MW
    - Adding Battery energy storage for stability due to PV instability when islanded
**P-1232: MicroGrid Expansion**

- **Infrastructure Upgrades**
  - Gillespie Substation (~$3.2M)
    - (2) New, larger transformers
    - (2) New 34.5KV Breakers
    - Grounding upgrades
  - “AA” Substation (~$750K)
    - New 34.5KV Breaker
    - Grounding upgrades
  - “N” Substation (~$1.2M)
    - (2) New 34.5KV Breakers
  - SCADA System (~$750K)
    - (6) Additional SCADAMate switches
    - Update communication lines/pathways
    - New Graphics/Interfaces

- **Upgrades and reconfiguration of electrical grid communications & programming**
- **Upgrades to turbine control packages at each Cogen Plant**

Majority of the *effort* consists of programming and logic rather than building/installing equipment.
Microgrid Basic Design

**Microgrid Features**
- Bulk Grid Connected or Islanded
- Tri-Gen System
- CHP, Diesel & PV
- Building Loads as a Resource
- Fiber network to substations
- Load as a Resource
- Control loads substation/switch level

**Base has islanded 14 Hrs on one Cogen plant in winter Manual ops**

**Microgrid Basic Design**

- Substation level controls to manage loading
- fiber network to substations

**Cogen Plant 1 – 7MW**
- Building Loads/PV

**Cogen Plant 2 - 8MW**
- Co-Gen PLC
- Microgrid Controller
- Ethernet Switch
- RF Antennae

**Islanded Loads/PV 10 MW**
- 1.2 MW PV
- Building Loads/PV

**Islanded Loads/PV 4 MW**
- Fiber Network

**13 Substations**

**Existing Fiber Network**
- Ocotillo Switching
- Station Protection / Metering Relay

**SCE Grid Tie**
- Cisco 2960C
- Substation level controls to manage loading

**Building Loads**
- SCE Grid Tie
- LTC
- OCTILLO Switching Station Protection / Metering Relay
- Existing Fiber Network
- Cisco 2960C
- Ethernet Switch
- RF Antennae

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Cogen Plant 1 Breakers
Electrical Grid 34.5KV
Switches and Substations
Electrical Grid 12.47KV
Switches and Substations
Control and Communications Equipment
Lessons Learned

• Keep it simple
  – Simple design
  – Simple operations
  – Redundancy
  – Ongoing process

• Personnel
  – Training
  – Technical
  – Supervision

• Maintenance
  – Contracts support
  – No M no work!
  – Govt. cannot maintain these complex systems.

• Cyber security!!!!!

• Maximize generation and lower costs. $.13/Kwh grid vs $.06/Kwh

• Watch how your operators, Operate!

• Installation of equipment
  – MILCON
  – Local funding

• Communications
  – Critical for functionality
  – Electrical grid control speed
  – Communication protocols

• Personnel
  – Experience counts! Power and grid
  – No experience or training
  – IT background required

• Support tools DOE

• Involve local utilities!
  – No tariffs
  – New controls strategies

• Cogeneration makes it larger and easier. The more systems the more complex
PV Generation
• Effort was over 15 years over multiple projects
  – Had a great power and grid engineer
  – Energy side working controls and generation
  – Coordination and cooperation!

• Questions?