Mission Critical Infrastructure for Installations

*Environment, Energy Security & Sustainability Symposium*

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Is your critical infrastructure protected?

- Have you identified critical missions and corresponding critical facilities?
- Are all the mission critical equipment connected to the auxiliary generators?
- Are your auxiliary generators capable of long-term continuous operation?
- Can they be grid connected and operate in parallel?
- Do you have large prime power generators on site? Are they connected to the distribution system?
- Can the installation distribution system be operated independently from the commercial electric utility supply?
Purpose

• Provide an overview and capabilities of the Mission Critical Utility Infrastructure
  – CTC contracted to produce methodology for self-sustaining military installations to ensure continuity of critical mission operations
  – Developed conceptual designs for three installations
    ▪ Joint Base Lewis-McChord, WA
    ▪ Fort Bragg, NC
    ▪ Fort Detrick, MD
Energy Security Drivers

• Military operations dependent on an aging and sometimes unreliable electric utility systems

• Supports DoD goals:
  – Integrate renewable energy technologies
  – Reduce fossil fuel consumption
  – Decrease greenhouse gas emissions
Energy Security Drivers

- Global Trends
- Unreliable Supply
- Policy
- Cost

Accomplish Mission
Energy Security Drivers

- Mission Priorities
- Security
- Renewable Resources
- Future Expansion

Mission Critical Infrastructure Design
Accomplish Mission

- Energy Security
- Resilience and Adaptability
- Reduced Risk
- Justify and Implement Projects
- Reduction in Energy Demand
- Improved Environmental Compliance
Technical Approach

• High Reliability Generation and Distribution System
  – Intelligent Distribution System (Smart Grid)
  – Self Sustaining Electric Infrastructure
  – Onsite Electric Generation
  – Demand Response Control
Determine Critical Facilities and Define Critical Infrastructure

• Energy Security Assessments identify mission critical facilities/functions/components

• Define the Critical Infrastructure
  – Identify operation needs based upon the Mission and Catastrophe
  – Create various operation scenarios from different situations
  – Prepare a hierarchy of loads
Determine Energy Requirements

• Review the Energy Profile of the Selected Critical Facilities
  – Electrical requirements
  – Distribution capabilities

• Critical infrastructure
  – Water/wastewater treatment
  – Boiler plants
  – Fuel points

• Mission critical assets
  – C4ISR
  – Headquarters & administrative
  – Logistics and deployment

• Prioritizing energy requirements can allow for lower priority facilities to be shed during operational disturbances
Example Design – Circuit map
Generation Requirements

• UFC for prime-power diesel generating plants
  – Capacity ≥125% peak demand
  – Individual generator unit capacity 25-50% max rated load
  – Two spare units are required, one for maintenance and the other for spinning reserve

• Renewable energy resources can be incorporated based on local availability
  – Proposed biomass plant could provide 100% of power requirements at JBLM-Lewis
  – Solar photovoltaic can be used to supplement fossil fuel generation at Fort Bragg and Fort Detrick
Generation Requirements

• Interconnect to new and existing generation sources
  – Existing grid connected generation supply
  – New generation assets
  – Renewable generation
  – Bio fuel generation
Distribution

- Utilizing existing distribution reduces capital investment
- Installations must communicate and coordinate with off-post energy supplier
- Installations must familiarize themselves with local regulations regarding distribution and interconnection requirements
  - E.g. local requirements may prohibit backfeeding into outside utility
- Smart grid technology integrated to facilitate automated operation
Modeling and Simulation

- Design modeled using PSCAD or other simulation software to assess load flow, fault currents and steady state stability
Utility Monitoring & Control System (UMCS)
Monitoring and Control

• Control the Mission Critical Utility Infrastructure
  – Monitor the generation assets
  – Control the distribution based upon the load needed
  – Isolate non essential loads when generation is over tasked
  – Control power flow to maintain the operation and mission
## Monitoring and Control Options

<table>
<thead>
<tr>
<th>Control type</th>
<th>Description</th>
<th>Pro</th>
<th>Con</th>
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<tbody>
<tr>
<td>Manual</td>
<td>All switching and load control operations are accomplished by a crew at the physical location of the device.</td>
<td>Least expensive, easiest to implement</td>
<td>Very slow to respond to system changes, longer downtime</td>
</tr>
<tr>
<td>Remote</td>
<td>Centralized control station allows user to view system status and issue commands to devices either wirelessly or over communication wire.</td>
<td>All operations can be controlled by one user, operations can occur quickly</td>
<td>More expensive to implement, requires communications and control hardware and software</td>
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<tr>
<td>Automatic</td>
<td>Control devices automatically respond to system status with no user input required</td>
<td>System can “self-heal” during disturbances with no user input required, operations occur quickly</td>
<td>Expensive and technically challenging to successfully implement</td>
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Implementation

• Procedures in the event of a utility outage
  – Isolate distribution substations from utility
  – Disconnect all facilities
  – Adjust relay and regulator settings
  – Energize and synchronize local generation resources
  – Systematically reconnect critical facilities according to priority

• Standard Operating Procedure (SOP)
  – Developing and practicing SOP with base electrical personnel necessary for safe, reliable and efficient operation
ROM Cost

Energy Security = $

- Need to determine the value of Energy Security as it relates to Continuity of Operations to justify the investment.
- Potential savings can occur if system is used for Peak Shaving.
- Example: JBLM Lewis Main
  - Power plant, generation equipment – $44M
  - Distribution system upgrades – $2M
  - Engineering – $5M
  - Total – $51M
Lessons Learned

• Must have open source interoperability between components and systems for optimal operation and redundancy
• Specifications for systems must be developed and integrated for Resilient Energy System operation
• Need tight coordination and cooperation between ALL parties involved in design, plan, construction and operation phases
• Since installation/mission priorities change over time, System will need review periodically
Conclusions

• Critical missions maintained during long term utility outage
• Energy security assessments identify, categorize and prioritize critical mission facilities
• Generation equipment largest contributor to project cost
  – Taking steps to decrease demand in critical facilities can pay off with lower generation requirements
• Automated control strategies decrease downtime and increase operational stability but at greater cost in hardware and engineering
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Thank You!!
Questions??