Penn State Health Milton S. Hershey’s Medical Center

CHP Implementation Challenges

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Agenda

- Overview of Activities on Campus
- Physical Plant to Support
- Energy Profiles
- Project Objectives
- Introduction to HMC CHP Plant
- HMC Distribution System & CHP Interconnection Challenges
- Existing Switchgear Replacement
- 69kV Substation Existing Protection Upgrade
- CHP Electrical Design
Penn State Health Milton S. Hershey Medical Center

- **Academic Medical Center**
  - **Hospital**
    - Level 1 Trauma Center Adult & Pediatric
    - 548 Beds
  - **College of Medicine**
    - Medical Students (150 students/class)
    - Physicians Assistants
    - Graduate Degrees in medical research
    - $100 million in external research support
Milton S. Hershey Medical Center

- 4.5M square feet of buildings
- 3.6M square feet of conditioned space
- 550 Acre Campus
- 112,000,000 kWh annually
- 573,000 MMBtu natural gas annually
Electric Demand
Daily Max/Min

PSHMC - LP5 Account
Calendar Year 2016

July 25, 2016
21.9 MW
HR Ending 13:00

April 6, 2016
6.5 MW
HR Ending 2:00

Date

Hourly Electrical Demand (MW)
PSHMC Natural Gas

Month

Jan-15
Feb-15
Mar-15
Apr-15
May-15
Jun-15
Jul-15
Aug-15
Sep-15
Oct-15
Nov-15
Dec-15

mmbtu

60,209
70,191
60,500
62,419
47,491
36,872
31,702
30,887
32,697
31,613
39,935
44,491

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CHA
Hourly Steam Load Profile – 2015

Notes:
1. Total Boiler Steam Production is based on hourly boiler steam flow data for Boilers 1, 2, and 3
2. Steam supplied to campus is based on typical estimated deaerator steam consumption of 7.5%
Load Management System
Project Goals

• Reduce Annual Operating Costs
• Increase Resilience & Reliability
• Reduce Campus Carbon Footprint
Built CHP Plant

Project Overview
- 7.9 MW natural gas fired Solar Turbine Taurus 70 combustion gas turbine
- Heat Recovery Steam Generator 80,000 lb/hr fired
- 10,500 SF Building
HMC Distribution System &
CHP Interconnection Challenges

• Main 69kV substation feeding the central utility building, stepped down to 13.8kV to campus wide distribution system
• Central Plant existing switchgear, had no spare breaker to connect the CHP
• Existing protection in the 69kV switchgear and central plant 13.8kV switchgear protection not enough
• 69kV substation utility requirements to be implemented. 59N3V0 to be implemented thus requiring new PTs
• New protection panel incorporated to provide relays to implement IEEE 1547-2018 requirements
• Redundant CTs required by PPL in the 69kV switchgear
Central Plant new switchgear clearance requirements

Space constraints and clearances made the switchgear one high

Switchgear replacement done in phases, by replacing half of the 13.8kV switchgear and making use of the tie breakers downstream at the 480V level

The switchgear was commissioned once installation was complete

Replacement of the switchgear helped achieve dynamic loadshedding using a Load Management System

The relay programming logic was very complicated to cover all the protection, synching scenarios
69kV Substation Existing Protection Upgrade

- Multiple paths to synchronize
- Inclusion of 59N3V0 using a Y Y Gnd transformer
- Utility substation using older and standard distribution protection technology requiring CHP interconnection to be set very sensitively
- New protection panel installed with appropriate protective relays to satisfy utility requirements
- Load shedding by the Load Management System (LMS)
A power system model was created to study the HMC distribution system and CHP interconnection. Load flow analyses were used to verify existing system voltage performance issues during CHP trips and then evaluate the effectiveness of potential remedies. Key issues to address were:

- Arc flash levels and coordination at the new Central Plant switchgear
- Ground Fault Protection

Corrective measures to study:

- Made use of modern solid state protective relays
- Made use of NGR (Neutral grounding Resistor) to mitigate ground faults
CHP Design Takeaways

• Get the Utility involved in earlier stage of the project probably during design process

• Commissioning and testing to be carried out thoroughly prior synchronization of the generator and energization of switchgear

• CHP Interconnection Protection – Utilize direct transfer trips/directional/differential line protection to provide better selectivity
Thank you.