Using the Microgrid Model to Help Meet the Needs of a Medical School Campus

International District Energy Association

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AGENDA

- UMMS – History/Overview
- What are the needs of the campus?
- Why was the power plant expanded?
- How were the expansion needs met?
- How will future expansion of the campus incorporate the Microgrid model?

UMMS HISTORY/OVERVIEW

- **Worcester Campus**
  - 60 acres
  - 3.5MSF of facilities
- **Medical School**
  - $1B Enterprise - 3,000 Full and Part-Time Faculty
  - 1,000 students (Medical Education, Graduate School of Biomedical Sciences and Grad School or Nursing)
  - Over $220M in annual research funding
- **UMass Memorial Healthcare System**
  - Full service healthcare system in central Mass
  - Lake Ave Campus has 400 Registered Beds, Lifeflight, 20 surgery suites, Emergency Department, Radiology, Oncology, Cardio Vascular, Ortho, etc.

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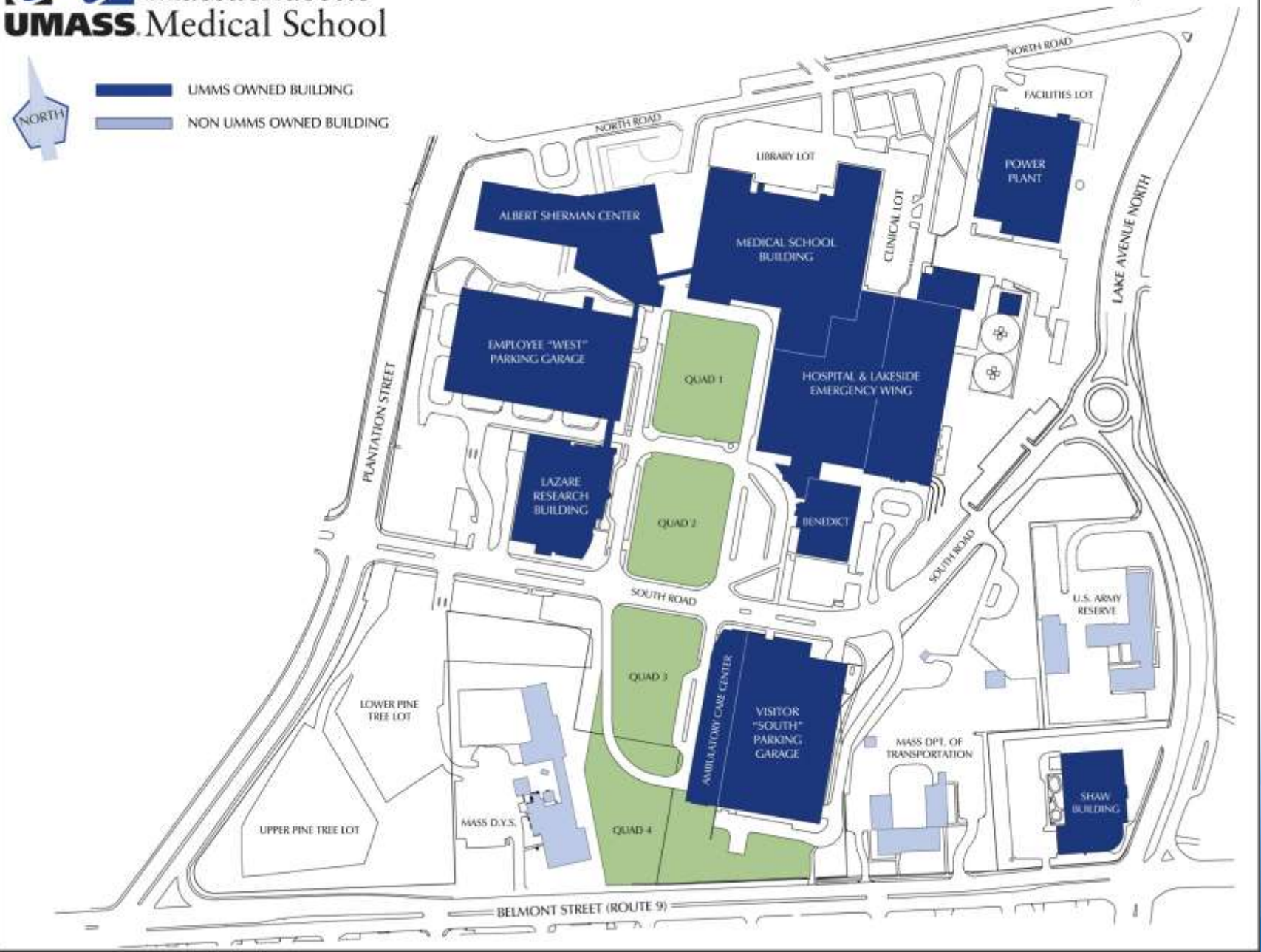
UNIVERSITY OF MASSACHUSETTS MEDICAL SCHOOL
UMASS MEMORIAL - UNIVERSITY CAMPUS

Site Plan as of April 2015



UMMS HISTORY/OVERVIEW

- **Original Plant Constructed in 1970**
  - Served approximately 2MSF of hospital and medical school
  - Campus has an underground steam, chilled water and electricity distribution system.
- **First CHP Expansion in 2000**
  - Increased NIH Funding and Healthcare Delivery needs MSF
  - New Equipment:
    - 5MW Topping Cycle Turbine (1100psi to 250psi)
    - Two 1100psi, 115,000pph boilers
    - 5,000 Ton Chiller, powered by 50psi steam
    - Cooling Towers and Accessories

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CAMPUS NEEDS

- **Reliable Sources of Energy**
  - Electrical
  - Steam
  - Chilled Water

- **Critical Loads**
  - Two Independent Sources of Electrical Power
    - Onsite Generation
    - Utility

2010 Plant Expansion

Reasons for the 2010 Power Plant Expansion

- **Campus Expansion, 1MSF**
  - Albert Sherman Center
  - Hospital Bed Tower in planning
  - Ambulatory Care Facilities
- **Energy and Economic Efficiencies**
- **Reliability and Redundancy – N+1 minimum**
  - Equipment
  - **Island Mode**
- **Fuel Diversity**
- **96 Hour Utility Operations on Site**
- **Sustainability – Green House Gas Impact**

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2010 Plant Expansion

How Campus Expansion Needs Were Met

- **Nominal 7.5 MW Combustion Turbine**
  - Natural Gas, No. 2 Fuel Oil Back-Up
- **Nominal 60,000 lb/hr Heat Recovery Boiler**
  - Duct-Fired With Natural Gas
  - SCR Type Emissions Control System
- **4,000-ton Electric Driven Chiller**
- **Supporting Equipment & Systems**
- **Operating Efficiency >66.3%**

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2010 Plant Expansion

Microgrid Model - IDEA

"……a microgrid is not just back-up generation but should be a robust, 24/7/365 asset that provides primary energy services to a market. A microgrid can provide back-up generation, but it offers additional, more intricate services as well." Quote extracted from Think Microgrid, A Discussion Guide for Policymakers, Regulators and End Users sponsored by IDEA and others *

Rob Thornton, President and CEO of IDEA, says that Microgrids are
".. More than diesel generators with an extension cord." *

*. Think Microgrid: a Discussion Guide for Policymakers, Regulators and End Users", Energy Efficiency Markets, LLC , © 2014, pg. 5

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Microgrid Model - IEEE

"Microgrids can disconnect from the traditional grid, operate autonomously, help mitigate grid disturbances, serve as a grid resource for faster system response and recovery, and hence strengthen grid resilience." **

** IEEE POWER & ENERGY Magazine, May/June 2015, MICROGRIDS, pg. 37

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2010 Plant Expansion

Microgrid Model - Application

- **Waldron Engineering and Construction, Inc. Designed the 2010 expansion.**

- **The design included an integrated load shed, protection and Islanding system entitled *Plant Master Electrical Controller (PMEC).***
  - The Load Shed system selected was ETAP Intelligent Load Shed (ILS) system by Operation Technology, Inc.

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2010 Plant Expansion

Microgrid Model - Application

- **Enhanced existing load shed system**
  - Static to Dynamic
  - Eliminates over shedding
  - Reduces minimum spinning reserve requirement
  - Easily expandable
  - Extremely fast

- ***Microgrid Model applies to campus critical loads***

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Load Shed Status

Load Shed Amount -5875 kW E-Bus to N-Bus 5210 kW

Selected Load Shed List ← Exported

Preset Load Shed List Selection

Winter | Shoulder | Summer

Current Active Load Shed List

1:	MCC #7, Sub Station 1	52 kW	RESET
2:	Flue Gas Recirculation Fan #3	52 kW	RESET
3:	Cooling Tower Fan #5	60 kW	RESET
4:	Cooling Tower Motor #2	140 kW	RESET
5:	Cooling Tower Motor #3	0 kW	RESET
6:	Cooling Tower Motor #4	0 kW	RESET
7:	Cooling Tower Fan #6	4 kW	RESET
8:	Flue Gas Recirculation Fan #4	52 kW	RESET
9:	MCC4 -CHP 1-5 Block Shed	312 kW	RESET
10:	#4Chiller Condenser Water Pump	233 kW	RESET

Current Active Load Shed List Modification

No Item Selected

No Item Selected

No Item Selected

No Item Selected

No Item Selected

No Item Selected

No Item Selected

No Item Selected

No Item Selected

No Item Selected

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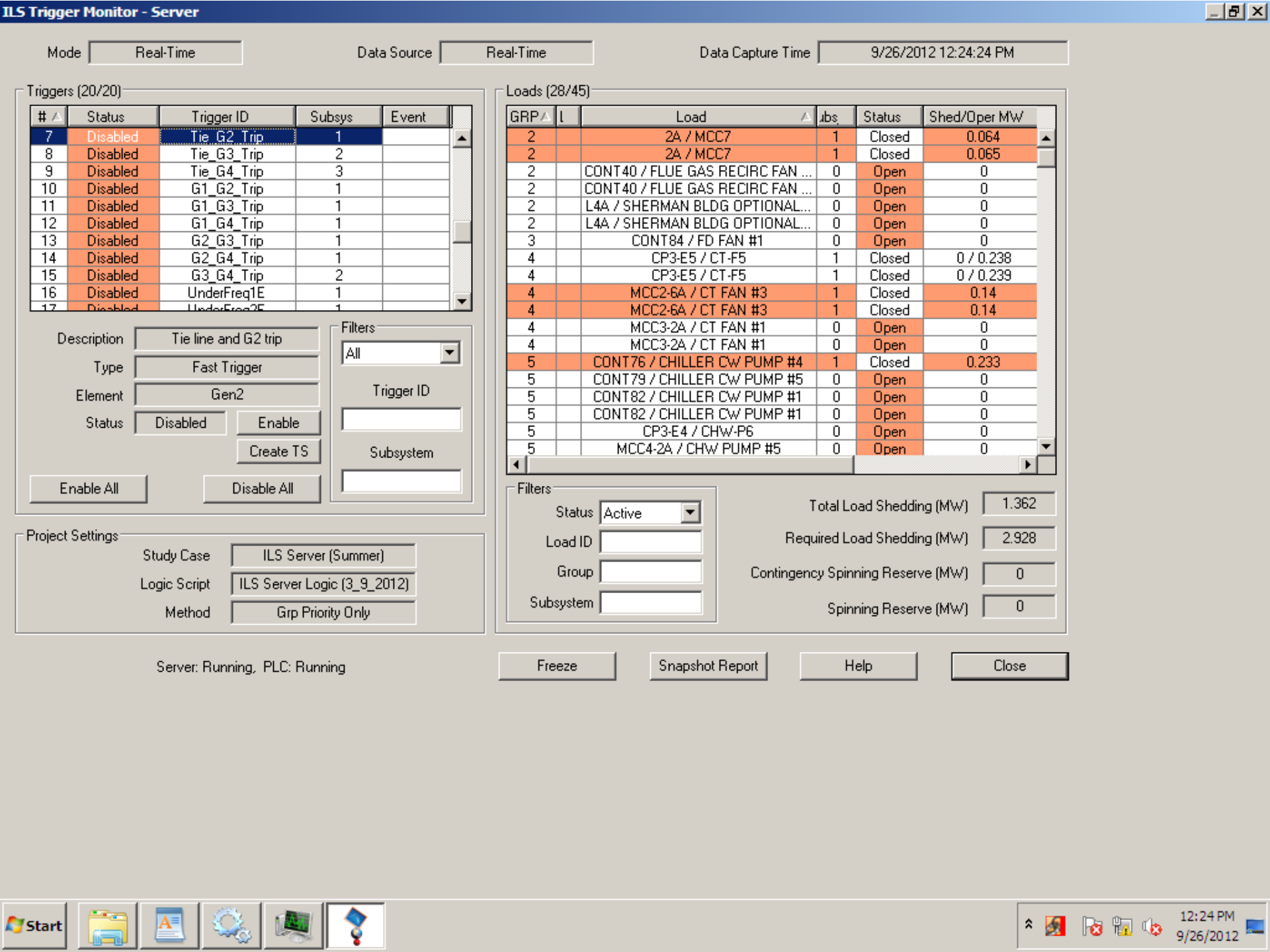
Overview | Load Shed Configuration | 810D Meter Status | SR750 Meter Status | Alarm Status


ILS Trigger Monitor - Server
Mode
Real-Time
Data Source
Real-Time
Data Capture Time
9/26/2012 12:24:24 PM
Triggers (20/20)
| Status | Trigger ID | Subsys | Event
7 | Disabled | Tie_G2_Trip | 1
8 | Disabled | Tie_G3_Trip | 2
9 | Disabled | Tie_G4_Trip | 3
10 | Disabled | G1_G2_Trip | 1
11 | Disabled | G1_G3_Trip | 1
12 | Disabled | G1_G4_Trip | 1
13 | Disabled | G2_G3_Trip | 1
14 | Disabled | G2_G4_Trip | 1
15 | Disabled | G3_G4_Trip | 2
16 | Disabled | UnderFreq1E | 1
Description
Tie line and G2 trip
Type
Fast Trigger
Element
Gen2
Status
Disabled
Enable
Create TS
Enable All
Disable All
Filters
All
Trigger ID
Subsystem
Loads (28/45)
GRP | L | Load | Subs | Status | Shed/Oper MW
2 | | 2A / MCC7 | 1 | Closed | 0.064
2 | | 2A / MCC7 | 1 | Closed | 0.065
2 | | CONT40 / FLUE GAS RECIRC FAN ... | 0 | Open | 0
2 | | CONT40 / FLUE GAS RECIRC FAN ... | 0 | Open | 0
2 | | L4A / SHERMAN BLDG OPTIONAL... | 0 | Open | 0
2 | | L4A / SHERMAN BLDG OPTIONAL... | 0 | Open | 0
3 | | CONT84 / FD FAN #1 | 0 | Open | 0
4 | | CP3-E5 / CT-F5 | 1 | Closed | 0 / 0.238
4 | | CP3-E5 / CT-F5 | 1 | Closed | 0 / 0.239
4 | | MCC2-6A / CT FAN #3 | 1 | Closed | 0.14
4 | | MCC2-6A / CT FAN #3 | 1 | Closed | 0.14
4 | | MCC3-2A / CT FAN #1 | 0 | Open | 0
4 | | MCC3-2A / CT FAN #1 | 0 | Open | 0
5 | | CONT76 / CHILLER CW PUMP #4 | 1 | Closed | 0.233
5 | | CONT79 / CHILLER CW PUMP #5 | 0 | Open | 0
5 | | CONT82 / CHILLER CW PUMP #1 | 0 | Open | 0
5 | | CONT82 / CHILLER CW PUMP #1 | 0 | Open | 0
5 | | CP3-E4 / CHW-P6 | 0 | Open | 0
5 | | MCC4-2A / CHW PUMP #5 | 0 | Open | 0
Filters
Status
Active
Load ID
Group
Subsystem
Total Load Shedding (MW)
1.362
Required Load Shedding (MW)
2.928
Contingency Spinning Reserve (MW)
0
Spinning Reserve (MW)
0
Project Settings
Study Case
ILS Server (Summer)
Logic Script
ILS Server Logic (3_9_2012)
Method
Grp Priority Only
Server: Running, PLC: Running
Freeze
Snapshot Report
Help
Close
Start
12:24 PM
9/26/2012

2010 Plant Expansion

Microgrid Model – Results and Benefits

- **PMEC's success has demonstrated the strength of the Microgrid model**
  - Verified that UMMS can add non-critical portions of the campus into the ILS system (ASC)
  - Maximized UMMS critical load reliability
  - Improved resiliency from external events (Utility Loss – Natural Disaster)

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2015 and Future Plant Expansion

Expanding the Microgrid Model

Relocating the PCC provides enhanced Campus Reliability and Resiliency

- **Increase** *Campus* **Reliability and Resiliency to external events**
  - Natural Disasters no longer jeopardize all the Campus loads
  - Adding more of the campus onto the PMEC's ILS system
  - Maximizing campus on-line reliability

- **Match Campus load to the onsite generation**
  - Maintain NFPA 99 requirement for the Campus Critical Loads

2015 and Future Plant Expansion

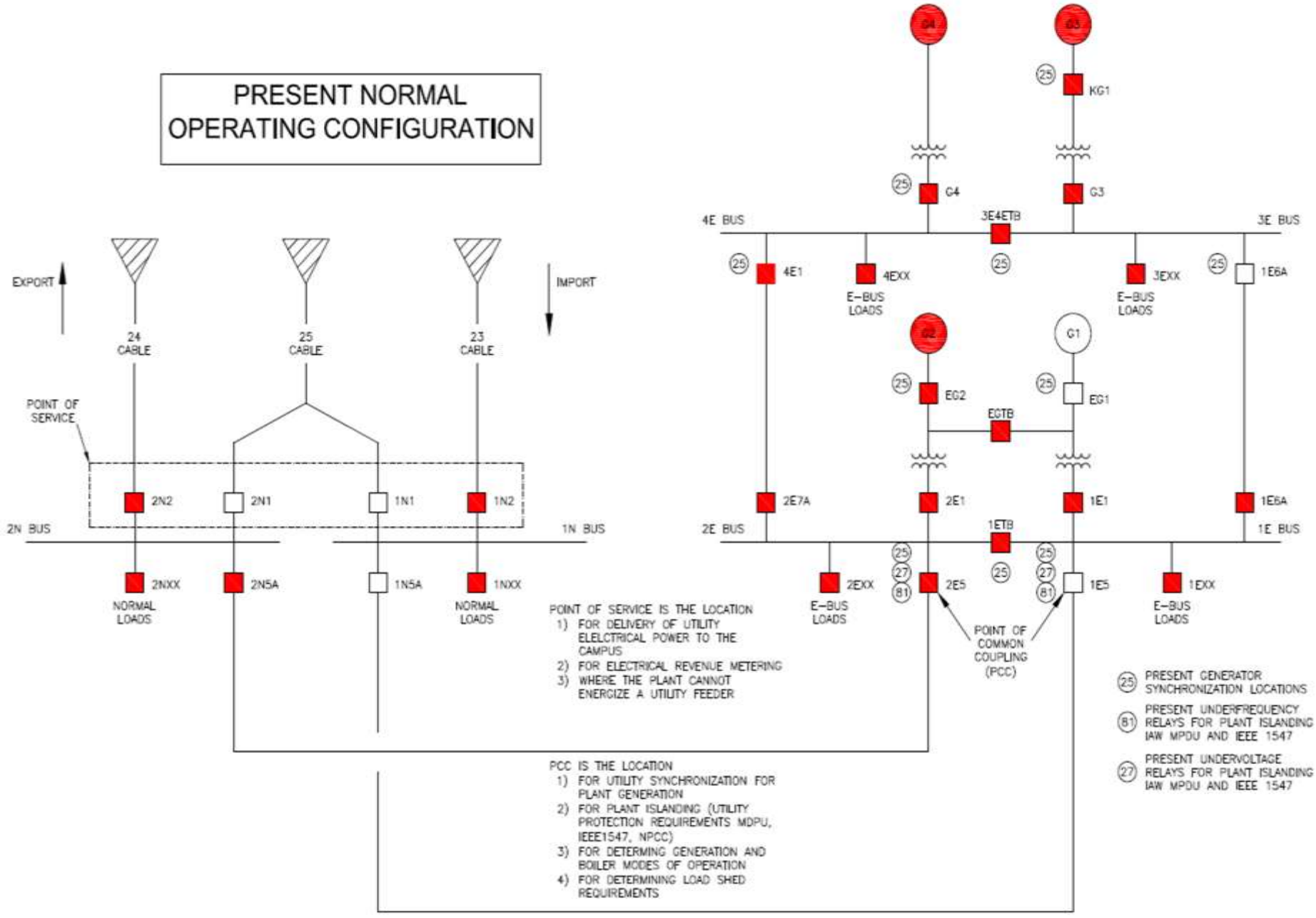
Point of Common Coupling

Point of Common Coupling (PCC) in a plant's electrical system can be defined as a location point for:

- **Utility Synchronization for Plant Generation**
- **Plant Islanding**
- **Determining Generating Modes of Operation**
- **Determining Load Shed Requirements**

This location can be different than the Electrical Utility's Point of Service

PRESENT NORMAL OPERATING CONFIGURATION



2015 and Future Plant Expansion

Point of Common Coupling - Present Location

PCC is presently at the interconnection between the Emergency (Critical Loads) and Normal (non-Critical) Buses

- Plant Islanding does not supply power to the Normal Bus
- Plant Spinning reserve is significant and not available Normal Bus

An electrical load survey has shown:

- Spinning reserve is capable of supplying most, if not all, of the UMMS Campus Normal Winter load
- Spinning reserve is capable of supplying much of the UMMS Campus normal Summer loads with limited Load Shedding interruptions

2015 and Future Plant Expansion

Point of Common Coupling - Relocated

PCC Relocated to the Point of Service

- **When Islanding the Normal Bus is now powered by the Plant**
- **Expand PMEC ILS to the Campus Loads (Normal Bus)**
  - Improves matching of the Campus load to the onsite generation
  - Onsite generation is capable of supplying all of the Campus Peak Winter loads
  - Generators are capable of supplying over 70% of the UMMS Campus Peak Summer Loads
  - Maintains the NFPA 99 requirement for Critical Loads
- **The NGRID Power Utility is used as a backup power source**

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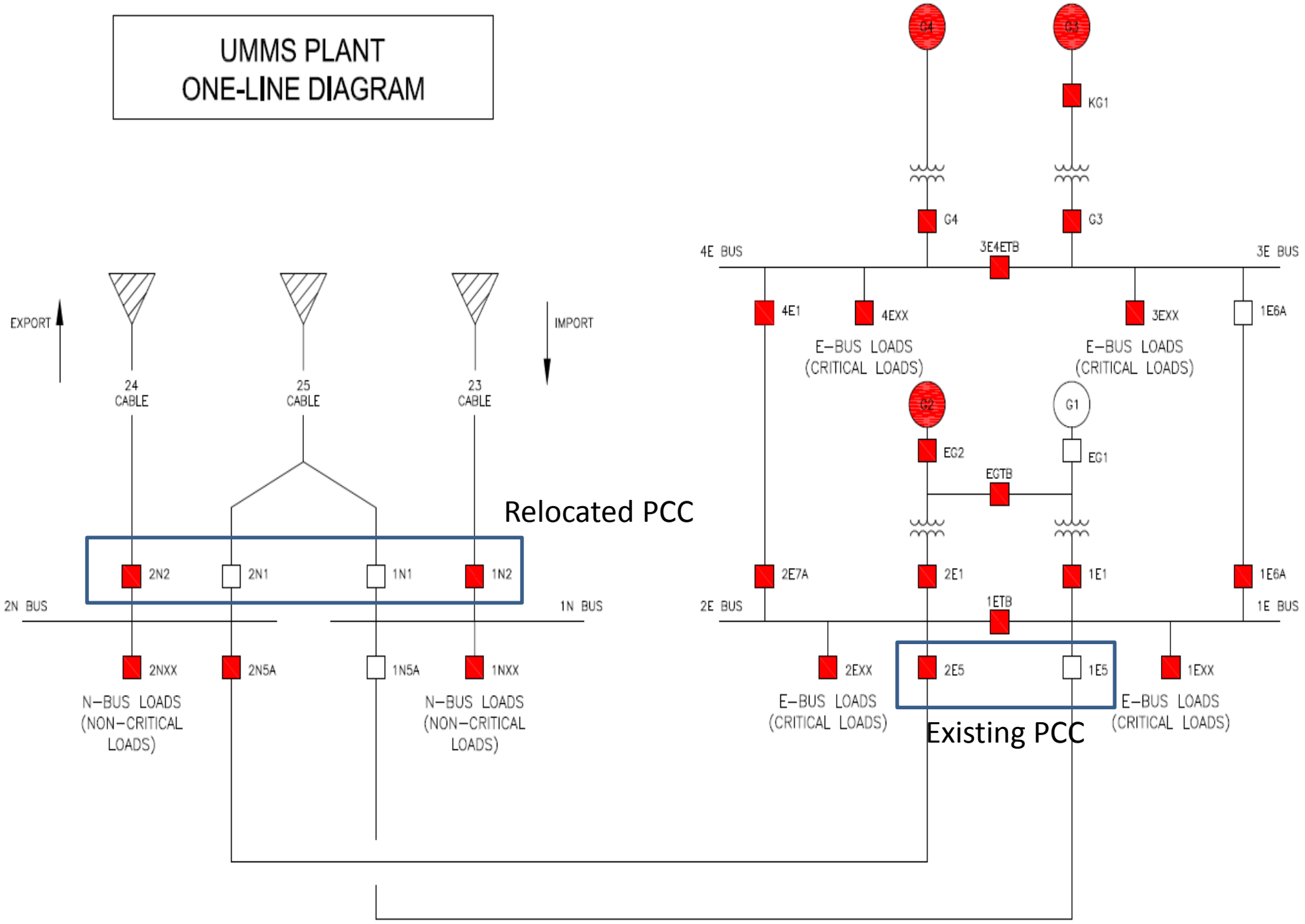
UMMS PLANT
ONE-LINE DIAGRAM
EXPORT
IMPORT
24 CABLE
25 CABLE
23 CABLE
2N2
2N1
1N1
1N2
2N BUS
1N BUS
2NXX
2N5A
1N5A
1NXX
N–BUS LOADS (NON–CRITICAL LOADS)
N–BUS LOADS (NON–CRITICAL LOADS)
Relocated PCC
G4
G3
KG1
4E BUS
3E4ETB
3E BUS
4E1
4EXX
3EXX
1E6A
E–BUS LOADS (CRITICAL LOADS)
E–BUS LOADS (CRITICAL LOADS)
G2
G1
EG2
EG1
EGTB
2E7A
2E1
1E1
1E6A
2E BUS
1ETB
1E BUS
2EXX
2E5
1E5
1EXX
E–BUS LOADS (CRITICAL LOADS)
E–BUS LOADS (CRITICAL LOADS)
Existing PCC

2015 and Future Plant Expansion

Point of Common Coupling - Relocated

Expectations and Goals

- **Provide a Campus-wide Microgrid model**
- **Reduce Island mode transients**
- **Allow the plant to remain connected to the utility for most inclement conditions**

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SUMMARY

UMMS Microgrid

Using the full power of the PMEC's Intelligent Load Shed system along with the planned PCC move:

The UMMS Microgrid is more than just generators with an extension cord; it is a robust, 24/7/365 asset that provides a resilient, primary energy service to the Campus.

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Questions & Thank You