AGENDA

- Organizational roles
- Comprehensive Energy Master Plan (CEMP) goals
- Metering program
- Enterprise Energy Management (EEM) System
- Benchmarking buildings
- Project identification
**ORGANIZATIONAL ROLES**

**THE TEAM**

- ARC FLASH
- BLDG CONTROLS
- ADACENT PROJECTS
- BLDG OCCUPANTS
- BLDG DEPUTIES
- Maintenance
- ENGINEERING
- HIGH VOLTAGE
- LOW VOLTAGE
- UTILITIES DISTRIBUTION
- PM & C

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**ORGANIZATIONAL ROLES**

- Maintain meters
- Add points and validation
- Maintain users
- View Screen creation
- Set up alarms for points
- Create/maintain predictive analytics models
- Manage Web Configuration
- History maintenance

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Malcolm Drane, Purdue University
Jason Kutch, Purdue University
CEMP GOALS

• Plan was developed in 2012
• Analyze production, distribution, and demand
  – Included metering all campus buildings
  – Controls optimization of building automation systems (BAS)
  – System wide review of chilled water
    • i.e. chiller operation, building pumps

CEMP GOALS

• Effective Energy Management
• Energy Savings Opportunities
• Fiscally sustainable plan system wide
• Education and Collaboration
• Energy-Conscious and Environmentally responsible culture
• 10 year recurring energy and cost savings
METERING PROGRAM

- Purdue Produced utilities
  - Chilled Water
  - Electricity
  - Domestic Water
  - Steam Condensate
- Easily identify issues
  - Broken valve
  - Control deficiencies
  - Low delta T, high flows
  - Simultaneous heating and cooling

Purdue University

METERING PROGRAM

2012
- $2.3M, 43 Buildings
- Master plan developed

2013
- $2M
- Approx. 40 buildings

2014
- $2M
- Approx. 40 buildings

2015
- $1M
- Over 140 buildings by 2015
METERING PROGRAM

ARCHITECTURE

- Supply & Return Temperature
- Chilled Water
- Power
- Lighting
- DCCP
- Domestic Water Main
- Domestic Water Irrigation
- Steam Condensate
- Temperature
- Ethernet

METERING PROGRAM

METER SELECTION CRITERIA

- High accuracy
- Low maintenance
- Low pressure drop
- Smart meter verification
Utility Metering at Purdue

**METERING PROGRAM**

**MECHANICAL METERS**

- **Chilled and Domestic Water meters**
  - Inline electromagnetic
  - +/- 0.5 % accuracy
  - No moving parts or obstructions
  - No mechanical maintenance

- **Steam Condensate meters**
  - Vortex Shedding
  - +/- 1 % accuracy
  - No moving parts
  - No mechanical maintenance

- **Highly accurate RTD’s**
  - Chilled Water
  - Steam Condensate

**INSTALLATION GUIDELINES**
## Metering Program

### Installation Guidelines

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### Metering Program

#### Data Points

<table>
<thead>
<tr>
<th>Chilled Water</th>
<th>Domestic Water</th>
<th>Steam Condensate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow</td>
<td>Flow</td>
<td>Flow</td>
</tr>
<tr>
<td>Total Gallons</td>
<td>Total Gallons</td>
<td>Total Gallons</td>
</tr>
<tr>
<td>Supply Temp</td>
<td>Daily Total Gallons</td>
<td>Daily Total Gallons</td>
</tr>
<tr>
<td>Return Temp</td>
<td></td>
<td>Temperature</td>
</tr>
<tr>
<td>BTU/HR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tons</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total TNHR</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**METERING PROGRAM**

**ELECTRIC METERS**

**Selection Criteria**
- Low Maintenance
- Revenue Grade Metering
- High Precision Meter
  - Minimum of 0.06% accuracy
- Metering Form Selection
  - (Form 5 vs. Form 9)
- Waveform capture
- Advanced Trending and data storage
- Modbus Communication

**ELECTRIC METERS**

**COMPONENTS**

- Current Transformers (CT’s)
  - Revenue Grade Accuracy
    - 0.3% Accurate
  - Core Selection
    - Split vs. Solid
  - Sizing Considerations
    - Physical Size
    - CT Ratio
    - CT Rating Factor
      - Low end Current
Utility Metering at Purdue

**METERING PROGRAM**

**DATA POINTS**

<table>
<thead>
<tr>
<th>Electrical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
</tr>
<tr>
<td>Current</td>
</tr>
<tr>
<td>Power (kVA)</td>
</tr>
<tr>
<td>Energy (kWh)</td>
</tr>
<tr>
<td>Demand Power (kVA/kW)</td>
</tr>
<tr>
<td>Peak Demand Power</td>
</tr>
<tr>
<td>Power Factor</td>
</tr>
</tbody>
</table>

**DATA CONCENTRATOR CONTROL PANEL (DCCP)**

- Centralized data
- No manual meter reads
- Ease of maintenance
- Less traffic on BAS
- Simple integration into EEM
- Flexibility
**METERING PROGRAM**

**DCCP**
- Design / Fabrication Process
- Components
- Benefits
  - Flexibility
  - Expandability
  - Maintainability

**METERING PROGRAM**

**UNIQUE IDENTIFIERS**

- Building Number
  - 1085 – ELLT
- Service
  - DW – domestic water
- Unique Instrument Number
  - 01 – meter one of domestic water meters
- Instrument Type
  - ME – mechanical type
- Size (inches x 100)
  - 0200 – 2 inch meter
**METERING PROGRAM**

- **DCCP**

**Commissioning process:**
- Custom program
- Validate Installation
- Custom Spanning

**EEM SYSTEM**

- Enterprise Energy Management System - What is it?
  - Real-time performance management and predictive analytics software

- EEM System software
  - Data historian
  - Predictive analytics
  - Electronic billing
EEM SYSTEM

• Connected systems to EEM
  – Power plant
  – Building Automation System (BAS)
  – Data Concentrator Control Panel (DCCP)
  – Legacy Meters

ARCHITECTURE

Interfaces

Power Plant

BAS

Utility Meters

Legacy Meters

EEM Historian

Web Server

PC application

Web application
BENCHMARKING BUILDINGS

July 2014 EUI

EUI (Btu/sf/month)

Elec. Steam CW

JNSN KCTR KNIV LAMB LWSN LYNN MACK MANN MCUT ME MGL MRGN MITHW
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QUESTIONS?