Power Monitoring and Energy Management Solutions

Challenges configuring Metering and Reporting systems: Effective Considerations
PowerCore Engineering

**COMPANY INTRO**


- PowerCore is a team of skilled Electrical Engineering specialist with experience in leading edge technology solutions that enable our clients to optimize their power distribution system assets and generate sustainable results in Energy Cost Reduction.

- *We deliver services and products to commercial, institutional and industrial establishments and have the capacity to provide solutions ranging from limited scope to very complex projects.*
Electrical Energy

What makes up the cost?

Peak Demand charges

"Peak kW Draw"

- kW Demand ("Rate or power flow") is typically calculated as the facility’s draw averaged over 15 min window (SD: "Sliding Demand"). The SD value changes every 15 minutes, and is typically synchronized on top of the hour.
- The maximum 15min kW Demand throughout a month will be selected as a Peak Demand ("Billing Demand").
- The kW charges for the entire month are derived from one 15min Peak Demand throughout the month.
- There are number of charges related to the kW on the electrical bill.

Consumed Energy charges

"Electricity kWh consumed"

- kWh is the amount of Electrical Energy used in the facility.
- Energy is usually tied to the requirements of the bldg operation, processes, machinery, facilities req’s etc.
- The kWh is the kW demand integrated (i.e. totalized) over the course of the entire month.
- The kWh charges on the electrical bill are derived from the monthly Energy Total.
- There are number of charges related to the kWh on the electrical bill.
**Peak Demand Calculation**

--- EXAMPLE

**15 min kW Average Calculation**

**kW Demand** calculated as an average value of Real Time kW over 15 minute period

*NOTE 1: Instantaneous peaks have negligible effect on the 15min Demand*

*NOTE 2: a term “Sliding Demand” is used where the kW demand is calculated across 15 min window that continuously “slides” along the Time axis in defined increments (e.g. 15 or 5 minute “jumps”)*
**Power Factor**: \( \frac{kW}{kVA} \) => a measure of Real Power vs. the Reactive Power; the closer to one the better => 100% PF means no reactive energy is drawn

*NOTE 1*: Only PF at peak demand is taken into consideration for utility billing purposes

*NOTE 2*: PF of less than 90% results in low PF penalty

**Load Factor**: Total kWh / (kW_{PEAK} \times \text{# of Days} \times 24 \text{ Hours}) => a measure of “flatness” of the demand curve the closer to one the better => 100% LF means perfectly flat demand

*NOTE*: Low load factor results in higher kW Peak Demand Charges.
## What makes up Electrical Bill

### Electricity Charges Components - Example

<table>
<thead>
<tr>
<th>Charge</th>
<th>Fixed</th>
<th>kW based</th>
<th>kWh based</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Electricity Charge</strong></td>
<td></td>
<td>2.058 ¢/kWh</td>
<td></td>
</tr>
<tr>
<td><strong>Global Adjustment Charge</strong></td>
<td></td>
<td>8.718 ¢/kWh</td>
<td></td>
</tr>
<tr>
<td><strong>Distribution Fixed</strong></td>
<td>$150.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Distribution Variable</strong></td>
<td></td>
<td>1.6995 $/kW</td>
<td></td>
</tr>
<tr>
<td><strong>Transmission Connection Charge</strong></td>
<td></td>
<td>2.3902 $/kW</td>
<td></td>
</tr>
<tr>
<td><strong>Transmission Network Charge</strong></td>
<td></td>
<td>2.9550 $/kW</td>
<td></td>
</tr>
<tr>
<td><strong>Regulatory Charges</strong></td>
<td></td>
<td>0.560 ¢/kWh</td>
<td></td>
</tr>
<tr>
<td><strong>Debt Retirement Charge</strong></td>
<td></td>
<td>0.700 ¢/kWh</td>
<td></td>
</tr>
<tr>
<td><strong>Trfm Discount</strong></td>
<td></td>
<td>-0.6000 $/kW</td>
<td></td>
</tr>
<tr>
<td><strong>Interval Meter Charge</strong></td>
<td>$5.50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Energy Efficiency Strategies

— How can Electricity Cost be Reduced?

Reduce Peak Demand

=> decrease kW charges

- Improve Power Factor
- Reduce the Peak Demand
  - Control Monthly Peak Demand through implementation of Peak Demand Control system
- Demand Response Program (DR3 - “SaveOnEnergy”)
  - through implementation of Peak Demand Control

Reduce Consumed Energy

=> decrease kWh charges:

- Increase efficiency
- Reduce losses
- Shift energy consumption

Some of the Strategies:

- Lighting retrofits
- VFD retrofits
- Equipment efficiency improvements
Power Monitoring and Energy Management Systems

WHAT’S THE PURPOSE?

Real Time Monitoring

- R/T WAGES
- System Load Demand
- Power Quality
- Abnormal Events

Energy / Usage Reporting

- WAGES Cost
- Energy Usage trends
- Energy usage Transparency
- Cost Allocation
- Cost-per-occupant (commercial & institutional) or Cost-per-unit (Industrial)
- Baseline for Energy efficiency retrofit programs (e.g. “SaveOnEnergy”)

Shared Infrastructure
Facility Managers, Engineers and Operators

- Real Time Data
  - Dashboard Overview (via local or remote PC or Mobile App)
  - Instant information on loading and capacity.
  - Alarms and Warnings
  - Feedback on Demand Control performance (for Peak Demand control or DR3 Events)
  - Remote System Control

- Logs and Historic Data Analysis
  - loading and power quality trends
  - Analyze disturbances
  - Root cause Analysis for abnormal events affecting operation or production

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Energy Usage Reporting

Cost Centers & Energy Managers

- Energy usage Reports & Logs
  - Energy Usage and Cost Reports in form of
    - Profile Charts
    - Usage Tables
  - Cost-per-unit analysis, cost allocation
  - Utility billing verification
  - Baseline & Usage data logs to monitor performance following energy saving retrofits
  - Energy usage transparency to drive conservation
EXAMPLE: Simple Power Monitoring System

ALARM: V L-L Unbalance
9:15AM August 13th, 2013
Phase A-B -> 8.4% Over Voltage
EXAMPLE:

Full Scale PM Application

Transient Waveform Capture in Time and Frequency Domain

Time: 8/19/2004 03:32:43.346 PM
EXAMPLE:

Energy Reporting

Load Profile Trending

EMC London - Plant Total Load Profile - Oct-12

From: October 12, 2006 00:00:00
To: October 13, 2006 00:00:00

kW Load Profile

kVAR Load Profile

kVA Load Profile
Fully Integrated Commercial/Institutional Power Monitoring System

Wilfrid Laurier University
Energy Monitoring System

Brantford Campus  Kitchener Campus  Waterloo Campus
Utility Monitoring System Mobile Application

Real-Time

Interactive Dashboard

Responsive

Daily Consumption

Comprehensive R/T

Location Details

System Alerts
Demand Control Basics

- **Demand Control** is a process of understanding where, when and why high cost kW demand spikes occur and taking measures to reduce them.

- The goal is to reduce the **kW Peak Demand** and thereby:
  - Reducing Billable kW Demand charges which can make up to 40% of the total Electricity bill
  - Allow optimum participation in Ontario’s Demand Response Program (DR3) for maximum sustainable payoff.

- Demand Control can be problematic to manage manually in facilities with multiple equipment types and process demands.
Establishing Demand Control Setpoints:

February 2013

Max Day-time kW
Demand: 4,456

Max Day-time kW
Setpoint: 4,050
Average kW Demand for this 15m interval trends higher than 850kW Setpoint. Curtailment action will need to be taken...

Demand Control Strategy

Curtailment Action is taken within the last 2 minutes of the 15m interval to keep average kW Demand within limits.

Starting with the next 15m interval, the system will allow sizeable peaks well over the setpoint, while monitoring the average kW Demand...

As the average for this 15m interval settles well within the 850kW Setpoint, no curtailment action is taken.
Demand Control Challenges

Demand Control Solution must address these concerns:

- **Load Shedding** can be risky *(or non-feasible)*
- **Manual Load Control** may be unreliable *(or non-feasible)*
- Ability to determine exact curtailment needs
- Intuitive End User control
- Adaptive setpoints
- Tap into existing Control and Automation infrastructure
- Prioritize loads
- Provide **Tools for performance Analysis**
- **Achieve savings large enough to justify the investment**
Intelligent Operator Interface

- **Power**
  - Setpoint: 11500 kW
  - Power: 3450 kW
  - Projected Diff: 137199.6 kW
  - Reduction: 0 kW

- **Energy Consumption**
  - Setpoint: 5750 kWh
  - Current Period: 140 kWh
  - Previous Period: 0 kWh
  - Daily: 140 kWh
  - Weekly: 140 kWh
  - Monthly: 140 kWh

- **Previous Period**
  - Length: 30 min
  - Time Left: 150 sec
  - Subinterval: 55
  - Subintervals: 60

- **Load Dashboard**
  - RTU #1
    - Base power: 75 kW
    - Current power: 75 kW
    - Status: Running
    - Priority: 1
  - Air Comp #1
    - Base power: 94 kW
    - Current power: 94 kW
    - Status: Reduced
    - Priority: 1
  - Evap. #1
    - Base power: 15 kW
    - Current power: 15 kW
    - Status: Running
    - Priority: 1
  - Furnace #1
    - Base power: 4000 kW
    - Current power: 4000 kW
    - Status: Running
    - Priority: 1
“Post-mortem” Performance Analysis

Demand Power Distribution by Load
# Demand Control Impact

An effective and responsive *Peak Demand Control System* is crucial to maximize the Demand Reduction impact while maintaining Facility Priorities!

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Monthly Billable Peak Demand Reduction</th>
<th>DR3 Program Participation</th>
<th>Global Adjustment Class A - PDF Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>$ / kW Savings</td>
<td>$6 /kW /month</td>
<td>$38 /kW /year</td>
<td>$63 /kW /year</td>
</tr>
<tr>
<td><strong>Pros</strong></td>
<td>- No Contract required</td>
<td>- Open to Class A &amp; B customers</td>
<td>- No Contract required</td>
</tr>
<tr>
<td></td>
<td>- Payoff is immediate</td>
<td>- Contract can be tailored</td>
<td></td>
</tr>
<tr>
<td><strong>Cons</strong></td>
<td>- Payoff is low in many instances</td>
<td>- Contract is required</td>
<td>- Payoff is a year away</td>
</tr>
<tr>
<td></td>
<td>- Payoff is several months away</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Notes</strong></td>
<td>If the load Factor is close to 1.0, Payoff may not justify the cost of Demand Control Measures.</td>
<td>Proper analysis should be done to determine the optimum level of DR commitment.</td>
<td><em>Every kW counts</em></td>
</tr>
</tbody>
</table>

DR 3 Assumes 5 DR Events a year, OPA DR3 Program Option C (Call Hour Window: 12:30 PM - 6:30 PM)
Additional INFO
Global Adjustment Strategies

Reducing the Peak Demand Factor – the $ IMPACT:

- If the customer is able to reduce the demand during the Coincidental Peaks, it will directly impact the PDF for next year.

  - Example: Base Period 2012 – Customer ABC - Reducing Demand:
    - Customer ABC reduces the demand during the 5 Coincidental Peaks by 100 kW in each instance to: 5.9, 6.9, 7.9, 6.9 & 4.9 [MW] (Combined demand reduction of 500 kW)
    - The Provincial Load during 5 Coincidental Peaks was: 24.46, 23.8, 23.87, 23.81, 23.47 [GW]

  - Customer’s reduced PDF will be: \[
  \frac{\sum (5.9, 6.9, 7.9, 6.9, 4.9)}{\sum (24.46, 23.8, 23.87, 23.81, 23.47) \times 1000} = 0.0272172\%
  \]

  - The IESO Set GA cost for October 2013: $ 634.3M ***
  - Customer’s Reduced GA Cost for Oct 2013 will be: 0.0272172% \times $634.3M = $172,611.17
  - Resulting in monthly savings of: $ 2,655
  - Projected yearly savings: $ 31,866

  - Savings per kW reduced: $\frac{31,866}{500\ kW} = $ 63.73/kW / year