DTE Energy®

DTE Energy Experience and Desired Technical Capability for Grid Interconnected Storage

GE Battery Technology Symposium

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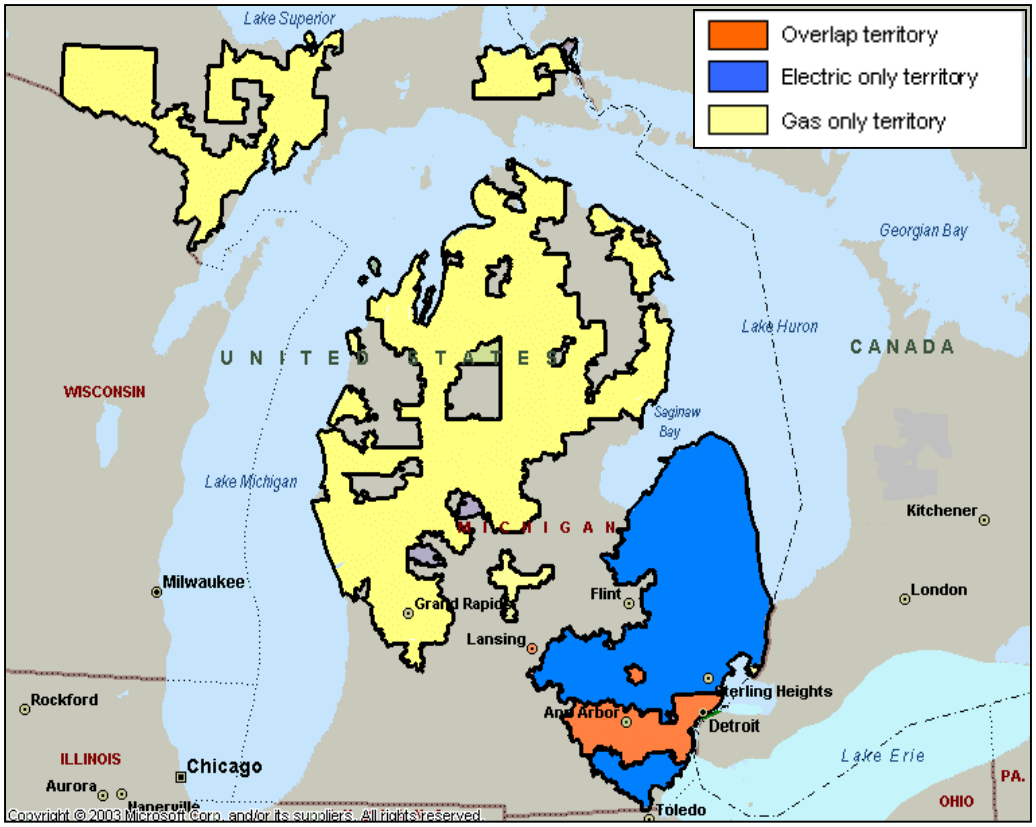
Agenda

- DTE Energy Overview
- Energy Storage Application Experience
- DER Integration for Grid Support
- Virtual Power Plant

DTE Energy Gas & Electric Regulated Businesses



Detroit Edison (Electric)

- **Tenth largest US electric utility with 2.2 million customers**
- **2.63 million meters**
- **7,600 square mile service territory**
- **$4.9 billion in revenue, $13 billion in assets**
- **System Peak Load: 12,762 MW**
- **Annual Sales: 54,000 GWH**
  - **37% Commercial**
  - **31% Residential**
  - **26% Industrial**
  - **6% Wholesale & Interconnection**

Michcon (Gas)

- **Eleventh largest US natural gas utility with 1.3 million customers**
- **1.35 million meters**
- **14,700 square mile service territory throughout Michigan**
- **679 bcf of gas sales**
- **Significant gas storage capacity benefits customers (11% of total Midwest and Northeast capacity)**
- **$1.8 billion in revenue, $3.3 billion in assets**

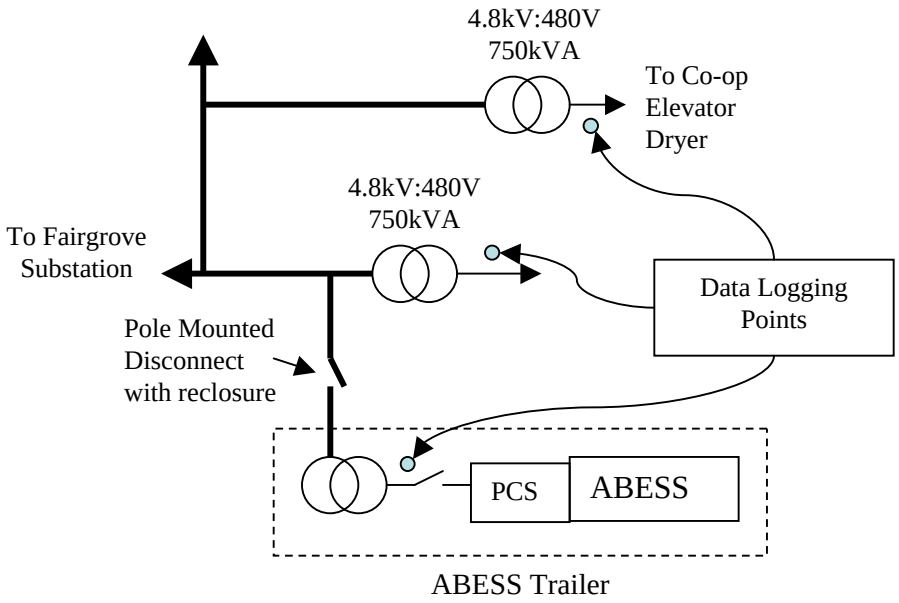
Energy Storage System for Grid Support

- 400 kWh (200 kVA) Zinc/Bromine flow battery
- Project objective is to test battery system at two utility sites
- Site 1 (Fall 2000) - Power quality application in Akron, Michigan
  - Grain elevator with eight 75 HP motors
- Site 2 (Summer 2001 & 2002) - Peak shaving at Lum, Michigan
  - Small overloaded substation
- Inverter based system – self protected
- Limited system fault contribution by inverter
- Utility relaying installed to protect distribution system

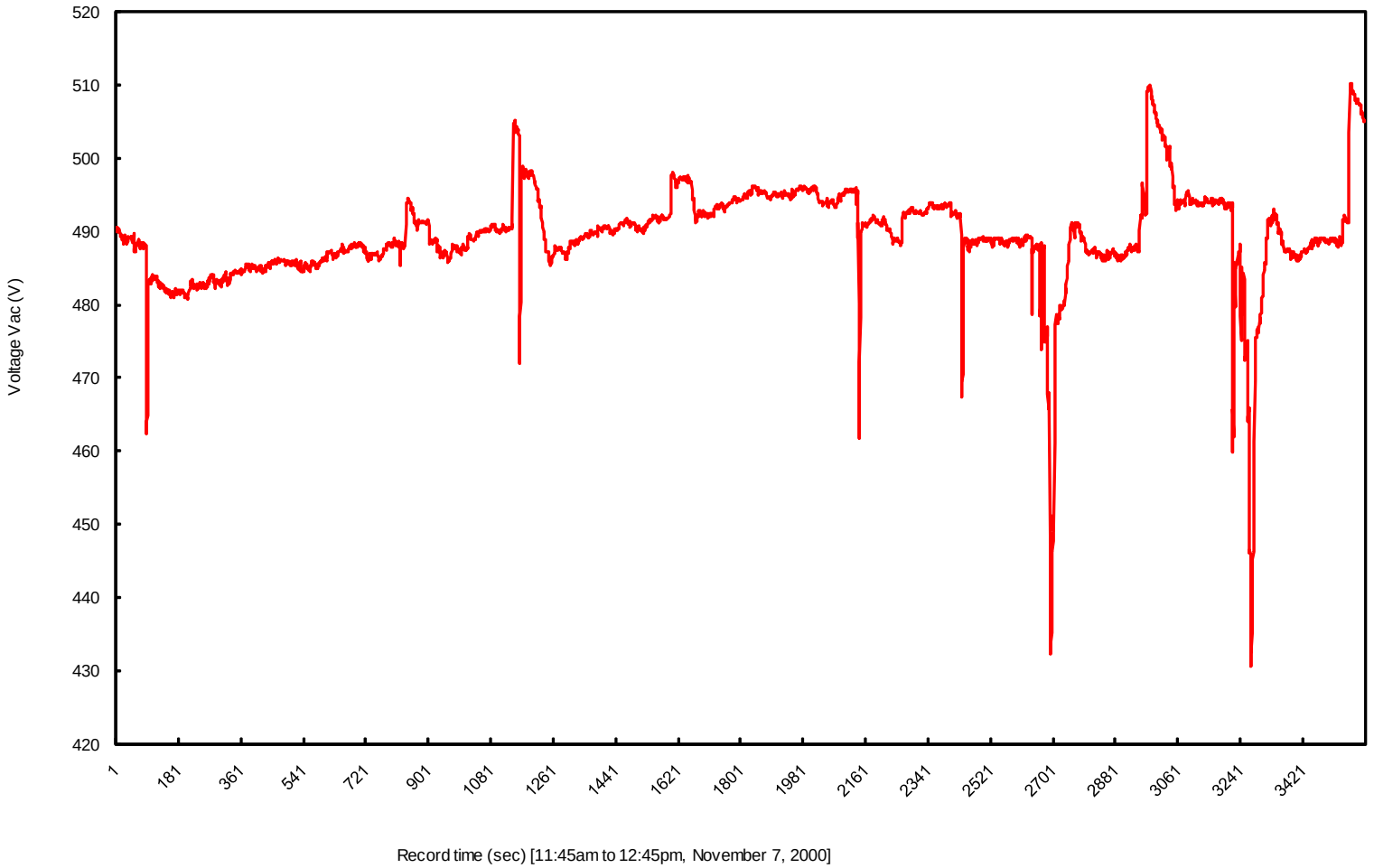
Energy Storage System for Grid Support

- US DOE Office of Power Technologies -Energy Storage Program (Funding)
- Sandia National Laboratories - Cost shared contract
- The Detroit Edison Company - Test sites, transformer, data collection
- SatCon Power Systems Canada, Ltd. - Power conversion system
- ZBB Energy Corporation - Battery system

Akron Grain Drying Facility



Line Voltage Without Compensation



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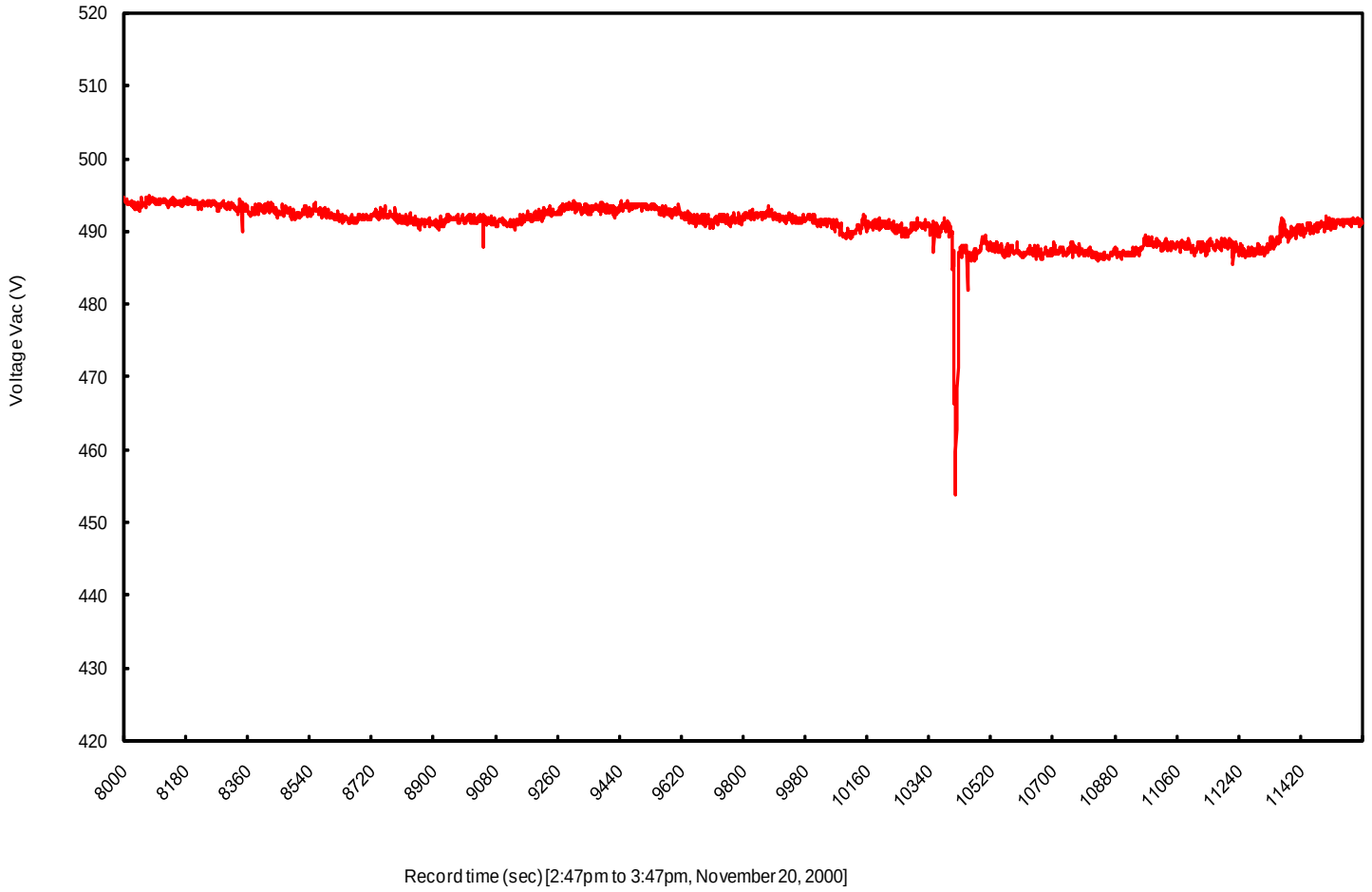
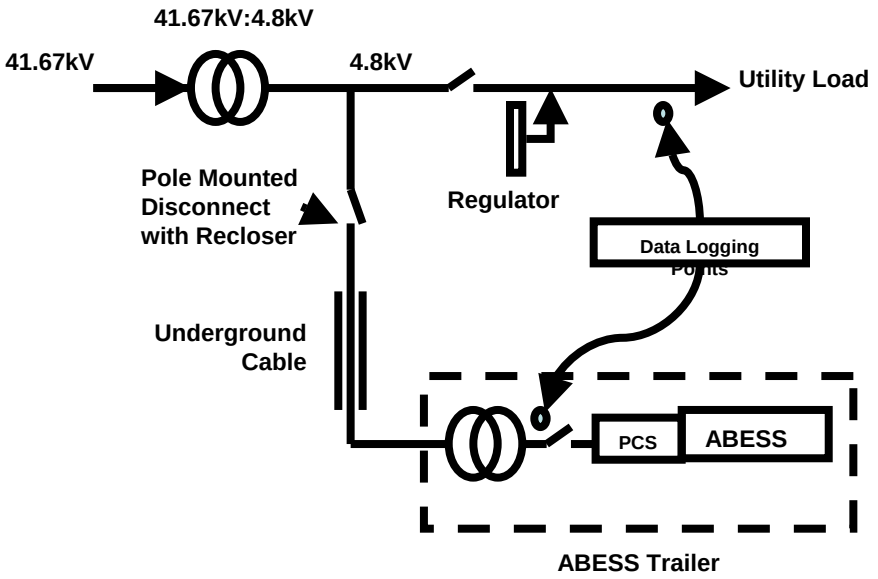


Akron Site Results

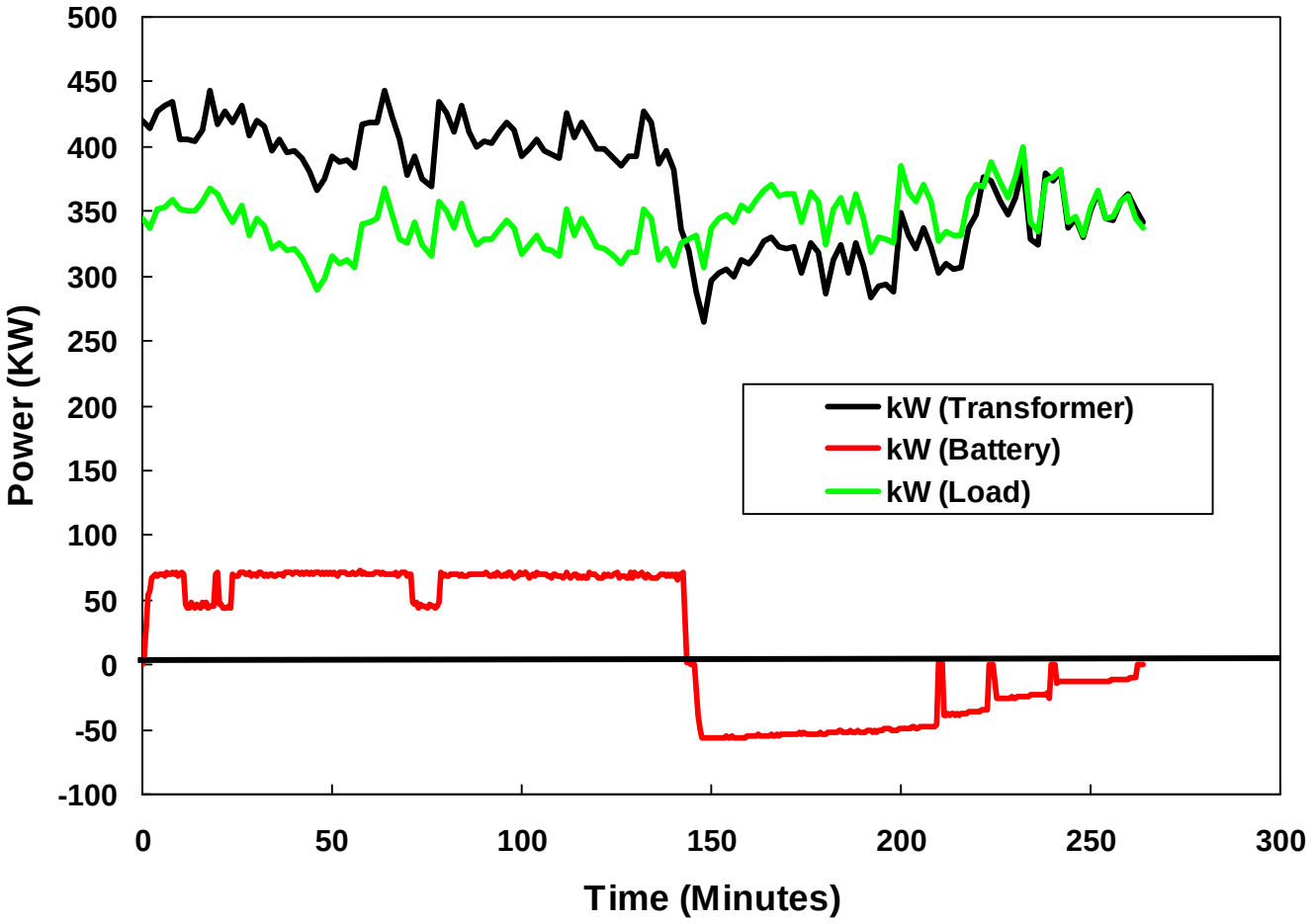
- Energy Storage System responded to system needs
  - Grain dryer caused 850 kVA spike
  - Spike was higher than unit capability
  - Energy storage system reduced voltage drop
  - Energy storage system eliminated voltage overshoot when dryer turned off

Circuit Peak Load Management Site
Lum Michigan (Rural area)

Lum Substation Site with 400 kWh Energy Storage System



Lum -Battery Charge/Discharge Sequence



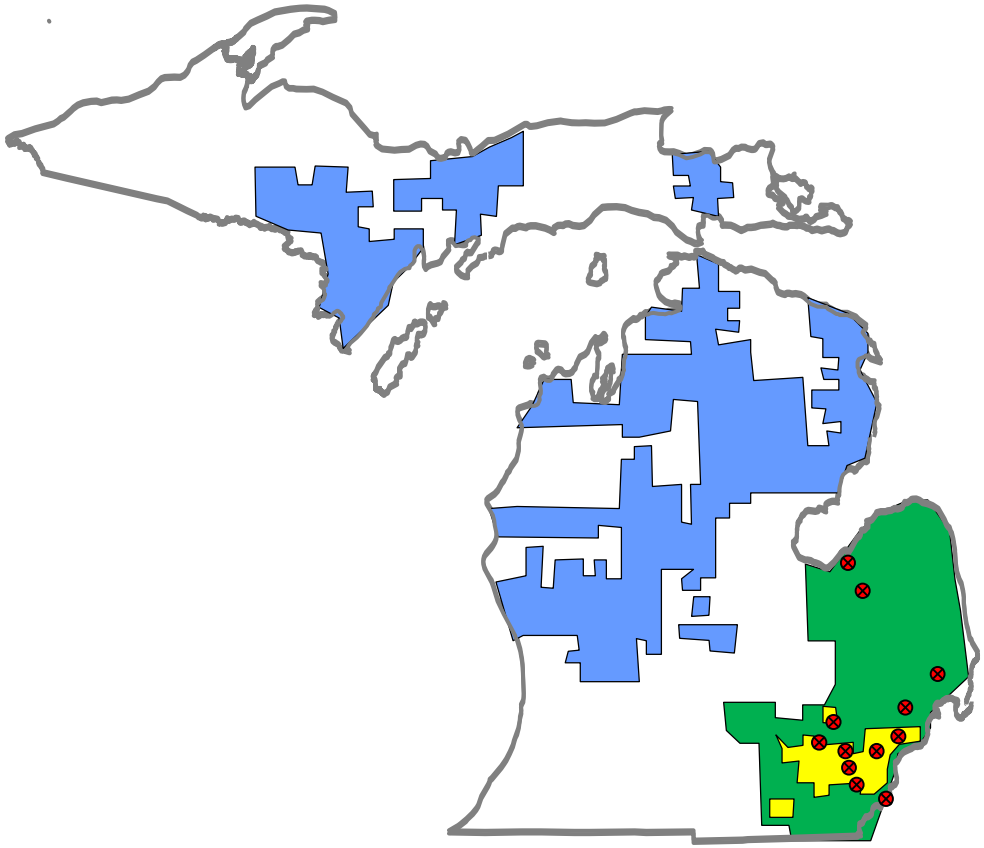
400 kWh/200 kVA Energy Storage System Summary

- Successfully demonstrated at two DTE Energy sites.
- Akron Site Summary (Power Quality)
  - Reduced the line voltage drop associated with start-up of the grain dryer to under 5%
  - Eliminated overvoltage observed during grain dryer shut-down
- Lum Site Summary (Peak Shaving)
  - Demonstrated capability to control Energy Storage System for Peak Shaving application

Lessons Learned

- Next project step was to automate the Energy Storage System
- Energy resources on distribution must be autonomous, i.e be able to operate automatically and respond to system conditions
  - Respond to support load (real & reactive) and voltage
  - Respond to system disturbance
- System Operators are only interested in responding to abnormal conditions
- Project concept evolved into the use of DG to support distribution circuits

DG Distribution Solutions



Utility Service Territory

Detroit Edison

MichCon

Overlap

DG Circuit Installations

12 Different Installations
6 Operating DGs in 2007
2 New Installations in 2008
Intentional Islanding 4 times

DG for peak load management

Internal to Distribution Circuits

Substation Applications

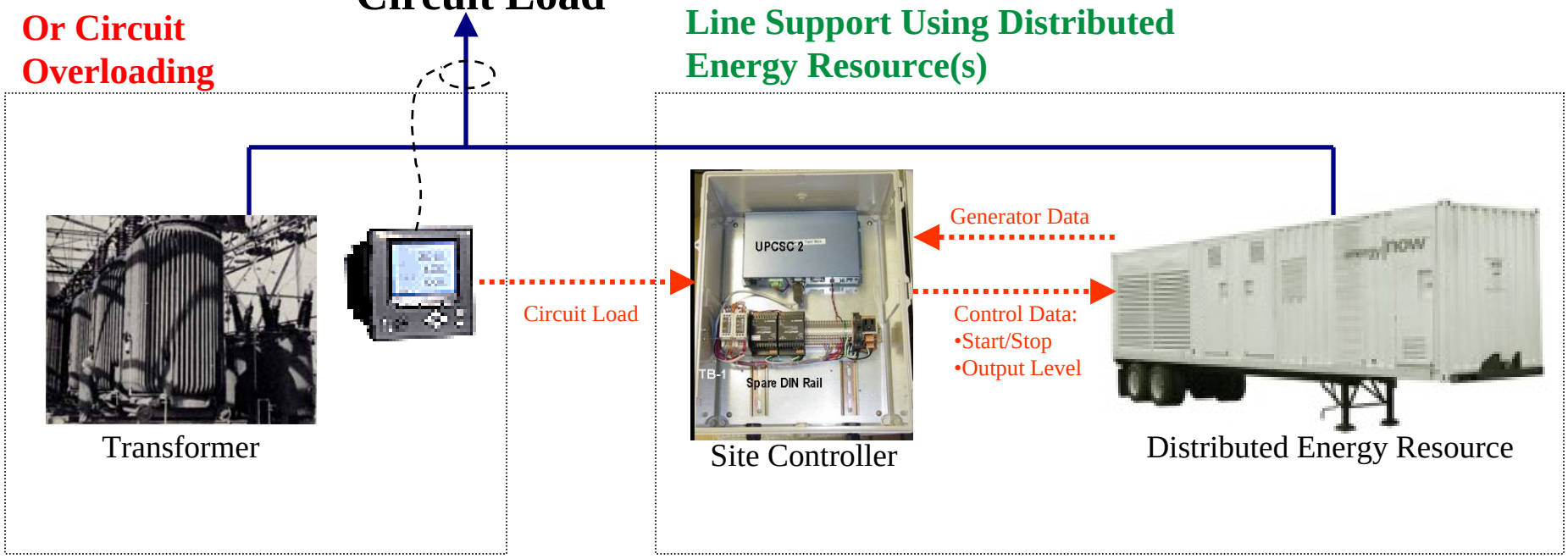
Peak Shaving Application

Problem:

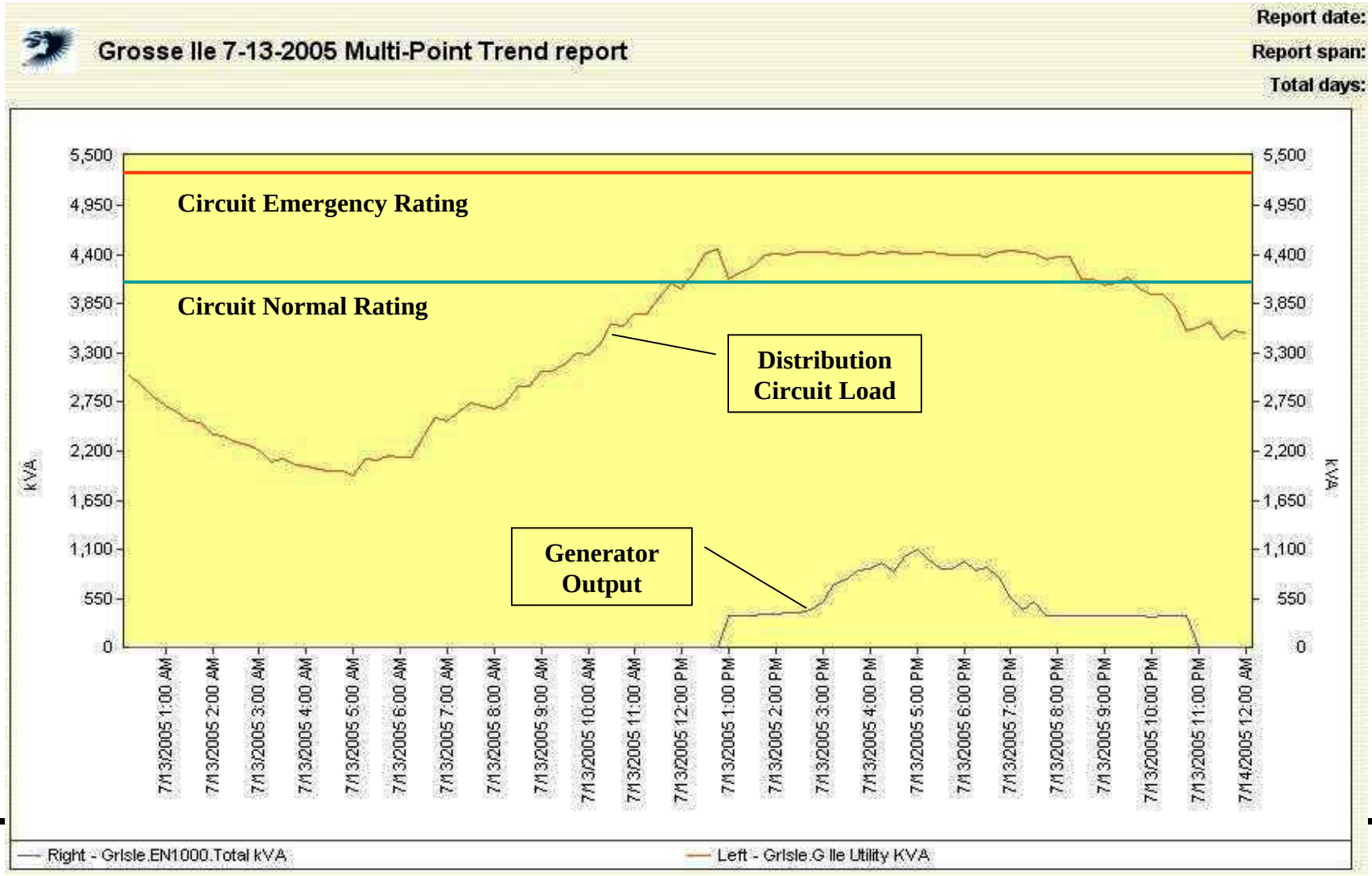
Transformer Or Circuit Overloading

Solution:

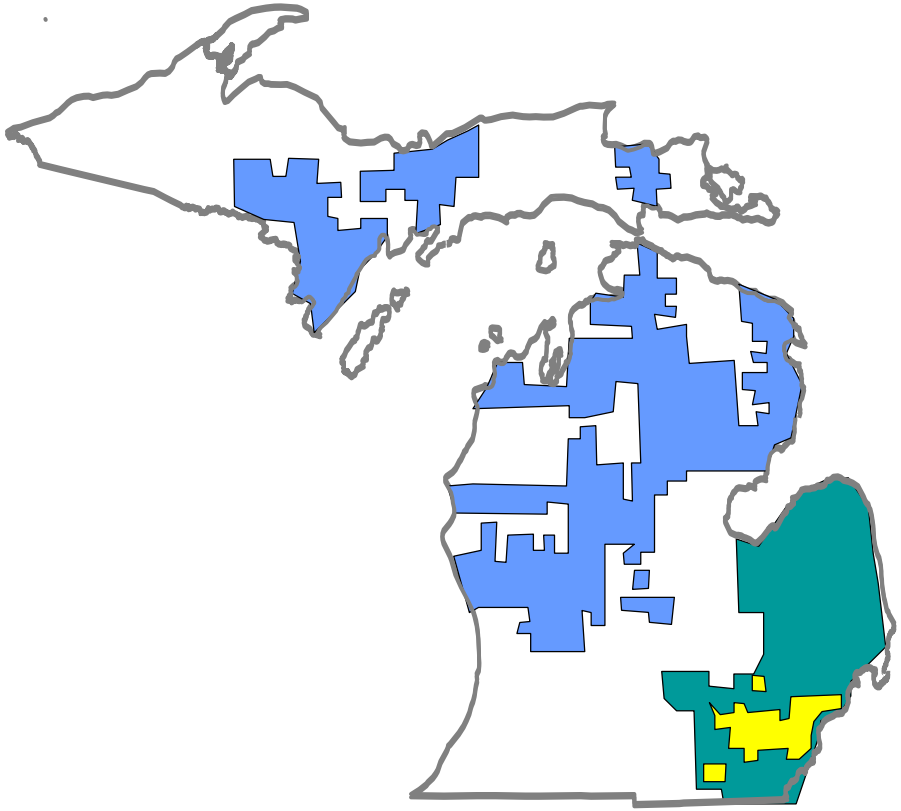
Line Support Using Distributed Energy Resource(s)



Automatic Load Following



Virtual Power Plant – Dispatchable Customer Generation (DCG) Program

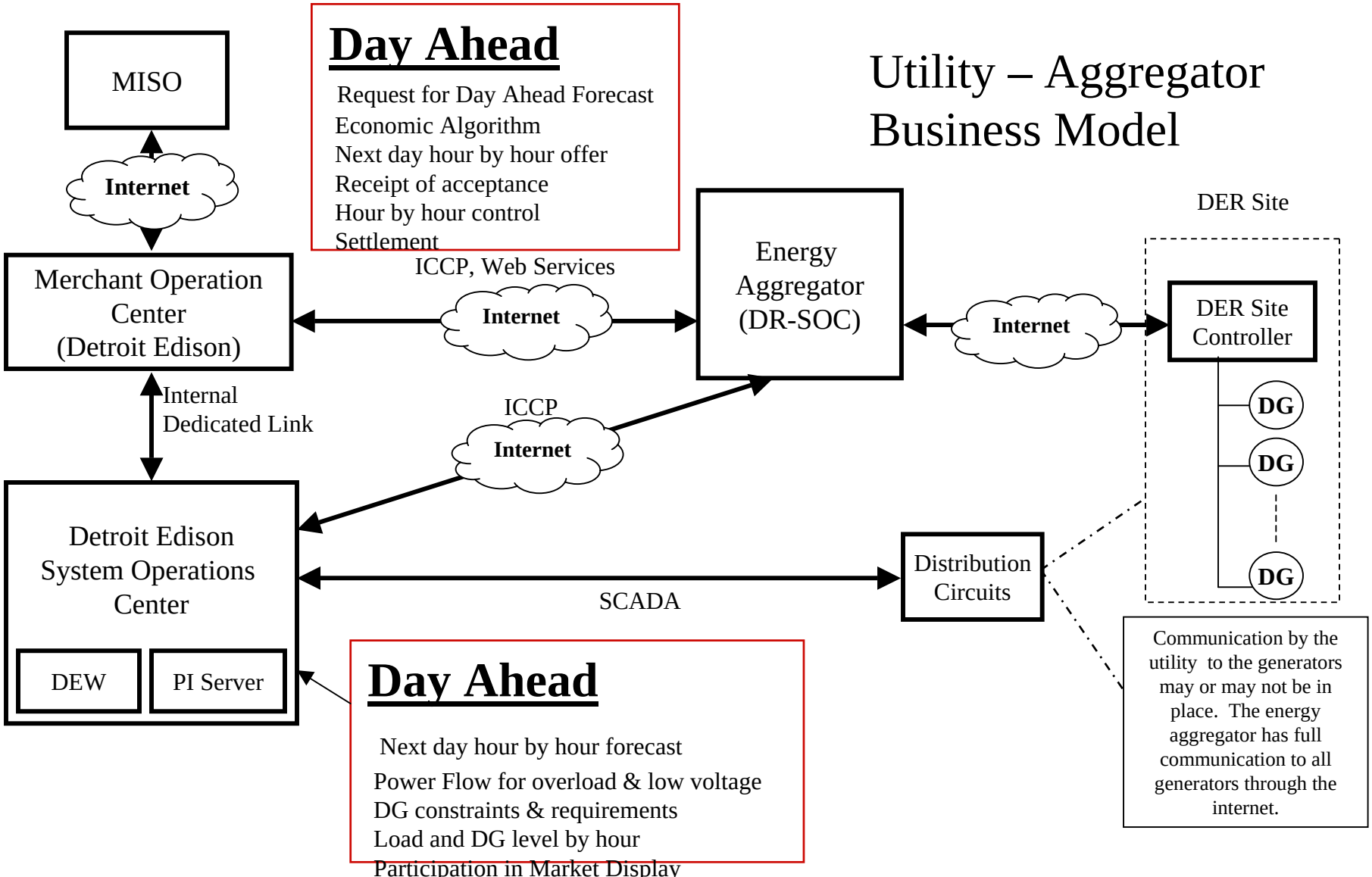


Utility Service Territory

Detroit Edison MichCon Overlap

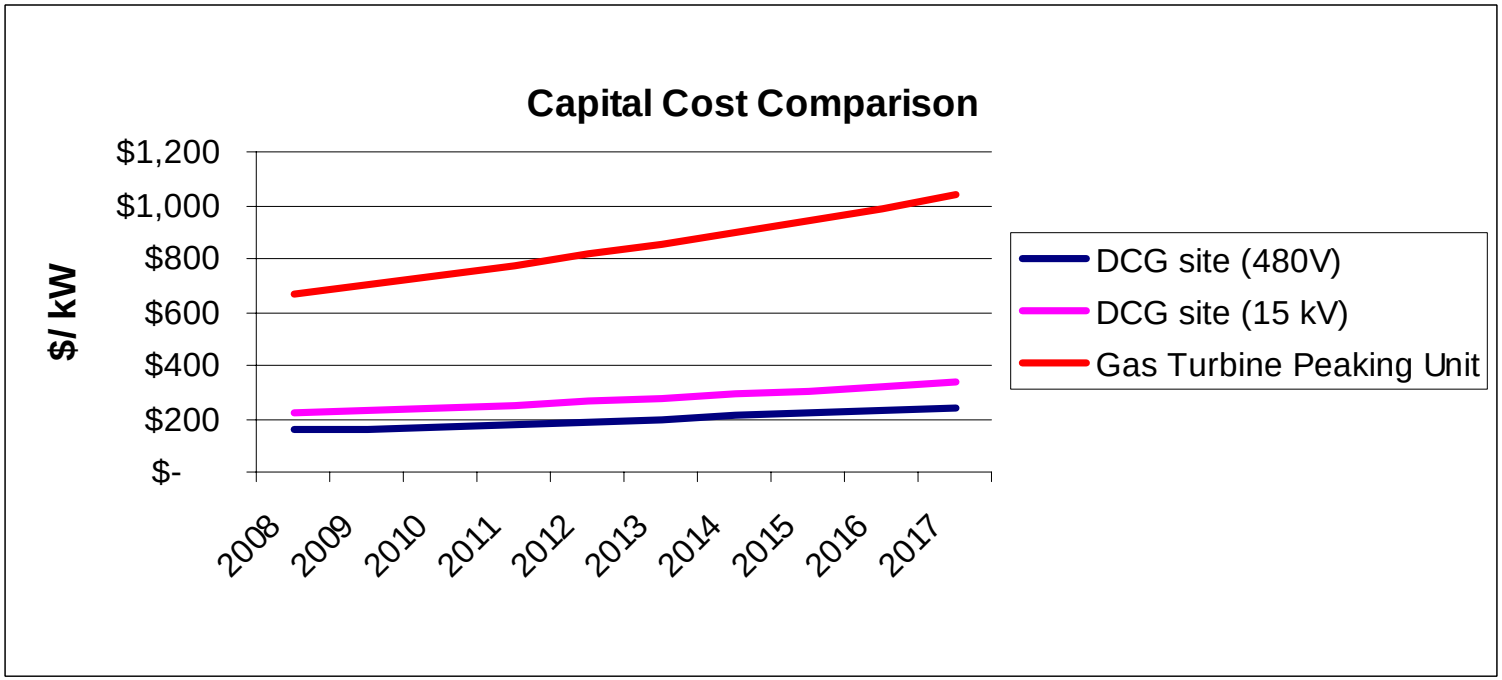
- Create a 300 MW Virtual Power Plant over the next 10 years using customer generation
- Approximately 200 customers
- 20 MW in 2009
- 30 MW/year beginning in 2010
- Low cost peaking plant
- Provide maintenance, fuel cost, paralleling switchgear and monitoring

Communication Architecture
Aggregating for Day Ahead – DOE OE funded



DCG capital costs compared to a new peaking unit

As a source of DG, investing in customer-owned generation is significantly Less expensive than investing in new peaking capacity.



Questions