Beyond AMI – Solving Problems before they become Problems

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Dakota Electric Association

- 500 MW utility
- 108,000 members
- Mostly Dakota County (Minnesota)
- Suburban / Rural
- Great Engineering!
Dakota Electric Service Point Locations
Visits with other utilities

- Visited 9 utilities, across the US (large and small)
- Often 50% or more of the benefits of the system were not being recognized
  - Integrations were not complete
  - Spent lots of effort to install the meters and get meter-to-cash working, exhausted
  - Everyone had great ideas how to use the data, but existing systems were limiting the use
AGi Project

• Implementing three systems at once

• Purchase all three under one contract

• Get systems integrated before installing lots of equipment in the field
Selected Vendor(s)

Delivery Partner
- Project Management Support

Meters
- Aclara (GE) meters

AMI System
- Communication Network
- Connects Edge Devices
  - Meters / Load Control / SCADA

Meter Data Management
- Central Hub of Information
- Reporting & Analysis

Load Management System
- True Cycle A/C controls
- Familiar software application
AGi = Advanced Grid Infrastructure
Investment
Information
Intelligence
Why are we doing the project?

➢ “Solving Problems before they become Problems”

➢ Changing how we interact with our Members
  ▪ How do members interact with our services today?
    • They have a problem
    • They call (complain) and tell us about it
    • We drive out and fix the problem

➢ How many business would continue to exist with this business model?
AGi Project – Member’s Perspective
Member Benefits

TODAY VS TOMORROW
Meter Reading - Today
Meter Reading – with AGi
Lights Out Response - Today

- Your lights go out ........
  - Get out of your chair
  - Find the phone number (in the dark)
  - Dial Dakota Electric

- Get a busy signal ?
- Get frustrated
- Dial again ......
Lights Out Response with AGi

➢ Your lights go out……..
  ▪ You stay sitting in your chair
  ▪ Your meter calls in for you

▪ The outage app on your phone, reports
  • Dakota Electric knows about your outage
  • a crew is on the way

▪ You continue to get text messages, updating you about the restoration progress
On Vacation – Today

➢ Your Home has a Power Outage….
  ▪ You don’t know
  ▪ You come home a week later
  ▪ You open the freezer, yuck!

▪ Hopefully your neighbor called in the outage or checked on your home?
On Vacation – with AGi

➢ Your Home has a Power Outage……
   ▪ The meter calls Dakota Electric
   ▪ Your outage App, tells you the power is out
   ▪ You continue to get text messages letting you know about the restoration progress!!

▪ Nice!
Outages – with AGi

- When we have the new meters installed
  - If you hear or see something - CALL IN! and tell us what you heard or saw.
  - Information helps the restoration process

- But with AGi
  - less chance of a busy signal
  - Dakota Electric’s has more information
  - From this we can respond better
High Bill Surprise

➢ Today vs Tomorrow
High Bills - Today

➢ Your Monthly bill is higher than normal
  ▪ Call up Dakota Electric to find out why?
  ▪ Dakota Electric wants to help
    • But, there is only a single reading for the month?
    • Did you do anything different?

Month
High Bills – with AGi

➢ Your monthly bill is higher than normal
  ▪ You can call Dakota Electric
    • They will review your 15 minute and daily usage

➢ Or, You can go on-line
  • Your usage is there to review

➢ You can set up to receive notification for high usage
  • If Monthly usage is above user defined threshold
  • If Daily usage is above user defined threshold
Power Quality
Blinking Lights - Today

➢ Your lights are blinking
  ▪ You call Dakota Electric
  ▪ Dakota Electric sends out a Crew
  ▪ They may install a voltage monitor?
  ▪ They might find nothing if the problem is intermittent

➢ Hopefully they find the cause and fix it
  ▪ They have limited information
  ▪ They may need multiple trips
Blinking Lights – Tomorrow

- Your lights are blinking
  - So you call Dakota Electric to find out why

- Dakota Electric may already know about the issue
  - The new AGi meter automatically reports short outages or sags in the voltage
  - So hopefully Dakota Electric has already identified and maybe fixed the issue
  - if not.....
  - The System Operator can look at the historical voltages which are saved in the AGi database
  - The System Operator can review the alarms supplied by the meter

- So, when a crew is dispatched, they will have information which will help guide them to a quick solution.
Meter Voltage Data

Data every 15 Minutes
* Average voltage,
* Min and Max voltage
Transformer Overload Analysis

• Today
  – Get kwhr reading each month (maybe kW)
  – Convert each monthly kWhr reading to kW
    • Assume some load factor
  – Sum up all the meters kW values
  – Compare that kW to the transformer kVA rating

  – Does not provide coincident kW !!!
  – No knowledge about power factor

  – Results in using larger transformer sizes
    • Greater Electrical Losses
    • High transformer costs
Transformer Loading Issues

- We estimate peak kW from monthly reading
  - Based on a “typical household user”
- DER generation reduces monthly reading value
  - So calculated kW is smaller than actual demand (kW)
- Need AMI interval data to see actual peak demands
  - DER creates “non-typical” user
Transformer Loading - Tomorrow

• AMI Data provides
  – Interval data from all meters
  – Have concurrent kW from all meters
  – Know the actual peak kW on the transformer

• AMI data supports
  – Using the right size transformer
    • Lower losses
    • Lower Transformer costs
    • Avoid Transformer overloads and failures!
Operations - Today

➢ House Fire reported - need electricity turned off
  ▪ Fire fighters are standing by
  ▪ Dispatch crew to disconnect
  ▪ Takes time to get there

➢ Circuit having voltage issues
  ▪ Need to temporally disconnect several DER systems
  ▪ Dispatch field crew to disconnect DERs
  ▪ Takes time to get there
Operations - Tomorrow

➢ House Fire reported need electricity turned off
  ▪ Send signal to meter to open internal switch
  ▪ Power disconnected at meter
  ▪ Dispatch Field crew to disconnect at transformer
  • Gets electrical energy disconnected quickly (safety)

➢ Circuit having voltage issues - need to temporally disconnect several DER systems
  ▪ Remotely send signal to several DER Production meters to temporally disconnect
  • No need to dispatch crews
  • Allows for quicker restoration of the DER – after issue is resolved.
During AMI Installation
New Digital AMI Meters

➢ Report problems - right away
  ▪ Not next month

➢ Partially dead and fully dead meter
  ▪ Memory (RAM) or CPU failure
  ▪ Water in the meter
  ▪ Lightning / baseball bat

➢ Loss of PT or CT
  ▪ In the past this might be caught by low usage flag or in a couple of years when the meter installation was tested.

➢ Hot Socket alarm

➢ Bad Connections – Via Momentary Blinks
System Failures

- Identify failure of Voltage controls
  - Hi/Low Voltage Alarms on all meters

- Faster Identification of Voltage issues
  - Distribution transformer windings shorting
    - Hi voltage alarm
  - Back feeding a portion of the system
    - Can remotely read a meter to check voltages
    - Instead of sending a crew out to check voltage
Compliance

➢ Identify system back-feeding
  ▪ Unknown DER interconnection?
    • Improve Safety / Reliability

➢ Identifies usage on disconnected services

➢ Application of Rates
  ▪ Is the consumer on the correct rate?
  ▪ In the past we had to install a more expensive demand meter to monitor
  ▪ Now we have demand meters on ALL services!
Best Rate for the Consumer

➢ Interval meter data provides DATA - allows consumer to analyze their usage, using the portal

➢ Are they on the most economical rate?
  ▪ They can play what if analysis using historical data
  ▪ Look at Normal Rate vs TOU rate
System Analysis

- 15-minute interval data from meter provides
  - Better data for Rate analysis
  - System Loss Analysis
    - Identifies the areas with greatest losses
Engineering Modeling

➢ Have coincident data for every part of the system
  ▪ Can create a model using the 15 minute or hourly data

➢ Use voltage data to show where there are voltages issues
  ▪ GIS displays of near real – time voltages
  ▪ Use data to benchmark the distribution models
  ▪ Are the models too conservative?
Using the Meter Data

➢ Meter socket overloads
  ▪ Compare peak usage with meter socket rating
  ▪ 200-amp vs 320-amp metering

➢ Significant Phase imbalance (service)

➢ Harmonic Injection monitoring
  ▪ How does we identify cause?

  ▪ Example:
    • Elevator motors causing huge harmonics
    • Data Center also on the circuit
    • Voltage at the substation was so impacted, LTC control would not operate correctly, had to add harmonic filter
Consumer Savings

➢ Knowledge of energy usage and coupling that with feedback to the member helps them conserve

➢ AMI system with Member Portal provides the consumer with information about how they are using energy
  ➢ Members do not normally access the portal
  ➢ With Pre-pay there is a PUSH of information to the member to inform them about their usage

➢ Meter’s internal switch supports Pre-pay

➢ Across the nation – consumers which enroll in Pre-pay use less energy. (8.5% for an average customer\(^{(1)}\))

➢ Also – Pre-pay creates No Deposits / No Late fees

• (1) value from 2018 MN Department of Commerce report
Communication Platform

➢ The RF mesh communication system which supports the reading of the meters can be used for much more.

- Fault Location
- Line Monitoring, (amps, temp, volts, vars etc.)
- Street Lighting Control and Verification
- Traffic Counting / Parking Monitoring
- Water or Gas meters
- Small Point Count SCADA
- Substation Security
- Etc.

➢ Communication cards have software defined radios
  - WiFi, Zigbee,
Demand Management

➢ Existing Demand Management system uses one-way pager signal
  ▪ Is the device is working?
    • Bypassed, filled with water, struck by lightning

➢ With RF Mesh there is two-way communication with each field device.
  ▪ Operational confirmation
  ▪ Data - Run time for each appliance
    • Allows better forecasting of load shedding kW

➢ Use AMI meter data to confirm control operation
Internal Meter Switch

➢ Use when informed of a house fire
  ▪ Disconnect power to house before crew arrives

➢ Remote Disconnect Operation
  ▪ MN Rules require sending a person to the site to allow for payment before disconnection is allowed
  ▪ Use remote disconnect after visit for safer disconnecting

➢ Remote Reconnect Operation
  ▪ Remotely reconnect
  ▪ Saves overtime and drive costs for crews driving to site to reconnect
  ▪ Faster response to member requests
  ▪ Lower charges for the member
DER Integration

- Reduces need to replace meters for DER integration
  - AMI meters can be remotely reprogrammed

- Identifies reverse power flow

- Monitors Service voltages – identifies operating problems

- AMI / MDM systems provide field measurements needed to operate a dynamic distribution system
DER Production Meter

- Installing Production Meters on DER installations
  - Allows Dakota Electric ability to turn off DER through the use of the internal meter switch.
  - Do we need anything more for small DER installations?

- Latest IEEE 1547-2018 requires DER communication interface
  - Provides information exchange (settings, control, etc.)
  - Do we install an expensive radio to talk with inverter?
  - Or, is there a lower cost option

  - Lower cost idea – use Meter to talk WiFi or Zigbee with DER communication interface
    - RF Mesh can already with the meter
    - Remotely read and/or set DER operational values