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Scheduled Remote Disconnect AMI Meters

A More Targeted and Precise Approach to Load Management During Load Crises

Executive Summary

Upgrading their advanced metering infrastructure (AMI) with remote reconnect/disconnect meters (RD) that can schedule disconnects and reconnects, will provide electric utilities with more granular control over their load management and help reduce financial and operational disruptions for their customers.

The more frequent scenarios where RD meters can be used for load control include disconnects for:

- Customer move-outs
- Non-payment, repair, or maintenance
- Scheduled load control
- Emergency load management

Rolling blackouts during emergency or non-emergency load management can leave customers without power, regardless of status. This can include customers who are dependent upon a consistent flow of power for life support equipment and critical safety devices.

RD meters with scheduling capabilities can be used in conjunction with, or in place of, rolling blackouts, allowing the electric utility to meet load control targets without disconnecting life support customers or other critical load facilities. They also extend the use for remote disconnect/reconnect beyond traditional practices.

Beyond the meter itself, no additional infrastructure from the electric utility is required. Vendors can supply the robust communication network, headend software enhancements, and RD meter firmware needed to begin deploying this technology across service regions.

A robust communication network: a fast, reliable, and flexible point-to-multipoint network to communicate directly or indirectly with multiple meters simultaneously and effectively.

Headend software enhancements: the ability to create multiple schedules, cancel and modify messages, and include features such as priority messaging, which allows for expedited message delivery during emergencies.

RD meter firmware: software that allows RD schedules to be implemented, along with a random restore feature to prevent the distribution system from becoming too overloaded after reconnection and an armed feature to schedule the use of the automated disconnect function.

With a more targeted and precise approach to load management and control, electric utilities can increase revenue and improve public perception while providing a more reliable and safe distribution system for their customers.

Leading Through Crisis with AMI

After a deadly tornado ripped through Western Kentucky just before the December 2021 holiday season, survivors described the destruction as beyond the scope of imagination. Homes and businesses leveled, vehicles mangled, transmission and distribution lines downed.

Once the threat had passed, line personnel from West Kentucky Rural Electric Cooperative rushed into service.

"It was the first time in my career that I heard the words 'tornado emergency,'" said David Smart, the president and CEO of West Kentucky Rural Electric Cooperative. "The level of destruction was unlike anything I've ever seen, a path 38 miles long and a mile wide in our service territory."

An emergency response

The cooperative's team geared up to serve their neighbors in need—more than 30,000 customers without power mostly in Graves and Marshall Counties. The electricity provider had the advantage of remotely-managed, resilient infrastructure to aid in outage restoration. Five years earlier, West Kentucky had deployed the Sensus FlexNet® communication network, a reliable, point-to-multipoint system that enables near real-time meter data monitoring.

Experts from Xylem traveled to the region to confirm the FlexNet system had survived the storm. They found that all

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>
> DAVID SMART *President and CEO, West Kentucky Rural Electric Cooperative*

network gear withstood the catastrophe and showed which properties still had power and which did not.

"The network helped us determine if there was still a meter without power in the field, as opposed to us sending out a truck," said Smart. "It allowed us to pinpoint outages quicker and we restored power to all our co-op members in almost a week's time." It also helped identify the 218 homes destroyed beyond repair in the co-op's service area.

The resilient infrastructure enabled a targeted restoration effort. Mutual aid crews from other Kentucky cooperatives and Tupelo, Mississippi, along with contractors across the Bluegrass State, worked diligently to replace more than 250 transformers and stand up nearly 500 poles to help resolve service interruptions.

Lessons learned: proximity and safety net

Smart shares an important lesson involving the proximity of operations. The co-op's operations center in Graves County sustained partial roof damage. Its main office was structurally fine but lost communications. By contrast, the tornado leveled a candle factory across the street from the cooperative's Mayfield operations center, killing nine people.

"Our main office and our operations center are only two miles apart," said Smart. "We were dangerously close to losing all of the trucks and equipment that make the emergency recovery efforts possible."

Due to the near loss of all the cooperative's local data systems, Smart is now considering a second data network center far from Mayfield. Thanks to Xylem technology, he felt reassured that, should he ever need it, their smart meter data is always backed-up at a secure location. This hosted solution creates data redundancy—an insurance policy for the data that empowers the recovery of resilient communities.

"This time we were able to access our own data, but it's nice to know Xylem can provide a safety net," said Smart. "You can never have enough redundancy when it comes to resilient operations."

The resilient infrastructure allowed West Kentucky Rural Electric Cooperative and mutual aid crews from neighboring states to kick off a targeted restoration effort following the weather emergency.

AMI Defined

AMI operates much like the human body. It's an organization of several systems working together to exchange vital information. The building blocks of AMI include:

- Smart meters
  - Meter firmware
- Communication network and infrastructure
- Headend system

At the heart of AMI is the smart meter, which enables two-way communication between the customer and the electric utility. The smart meter not only measures electricity consumption, but also measures voltage levels and monitors the operational status of the service. Data from these functions is then sent to the electric utility to analyze, process and distribute time-based billing, energy use data and more. The electric utility can also detect tampering, monitor voltage levels and outages, and remotely connect and disconnect. The ability to remotely monitor outages and restorations is the function most responsible for accelerating the restoration efforts during crises.

If smart meters are the heart, then the communication network is the circulatory system, "pumping" data from the smart meter to the headend, the "brain," where data is received, stored and distributed. This data is shared throughout the network with other integrated systems, such as customer information systems, outage management systems, and so forth.

While AMI has provided significant value for electric utilities, it is not without challenges. These challenges can be overcome with simple behind-the-scenes enhancements to the AMI network, which will be discussed later in this paper. First, we will look at a few of these challenges and how they can impact emergency events and operations.

Busy signals

A robust AMI network needs to be fast, reliable and flexible, especially before, during and after extreme weather events or other crisis situations. Electric utilities need swift and accurate data to make timely decisions. The network needs to communicate directly or indirectly with multiple collectors or access points and must do so simultaneously and effectively.

"With on-demand disconnects, you press a button and then expect something to happen on the other end," explained Derl Rhoades, Xylem's Director of Electric Metrology . "If I don't have enough network infrastructure or if there is a lot of network traffic on the infrastructure, it's like getting a busy signal on your cell phone," said Rhoades. "You have to keep trying until you no longer have a busy signal."

These multiple attempts can present time delays that, especially during an emergency event, could prevent customers from getting power turned on when and where it's needed.

Total load control

Another concern is the practice of total load control for emergency or non-emergency load management, where rolling blackouts can require all customers on a particular substation or distribution feeder to be disconnected for longer periods of time, regardless of status. This could present financial disruption to customers, especially those who require consistent power flow for critical life safety equipment and may be displaced by these blackouts until reconnected.

A Smarter Solution: Scheduled Remote Disconnects

Upgrading remote RD meters with a scheduling feature will provide utilities more granular control during emergency events and other times when a disconnect period is predefined. No new infrastructure is required for this feature which can be added to AMI meters by enhancing the headend software and downloading new firmware to existing meters that support the new feature. These enhancements will allow the electric utility to create up to eight outage schedules and then set these schedules to be executed on a predetermined date and time.

No more busy signals

Unlike on-demand metering, which requires a disconnect command and then a reconnect command to be sent, scheduled remote disconnects will allow schedules to be downloaded and acknowledged minutes to days in advance so there are no surprises. With scheduled RD, a time limit would be established and tested to ensure the network can accomplish scheduling in the time required. Schedules can also be set to execute at times when network traffic is low, thus granting utilities complete management of the process from beginning to end.

"I can say, 'Hey, tomorrow from 1 o'clock to 4 o'clock, I need these meters to disconnect and then reconnect. It doesn't depend on communication at that exact time to make it work," explains Rhoades. "It's a much bigger leap in controlling things."

Additional features can also be added to further improve the functionality of scheduled RD meters.

1 Additional feature #1: Priority messaging

Schedules will need to be disseminated quickly during emergency events. The ability to broadcast and multicast to all meters and devices on the network is critical for meeting the minimum time requirements. One way that scheduled RD will accomplish this is through priority messaging. With priority messaging, a priority option is added to the calendar message, ensuring expedited delivery during an emergency event. The priority can be assigned early on when the calendar is created or later during modifications or cancellations.

2 Additional feature #2: Cancellations and modifications

Cancellations and modifications are permitted through the application programming interface and headend user interface and can be scheduled to take place either during or preceding the calendar execution. Cancellation is accomplished with a simple command and modifications can be made without the need to upload a new schedule. Acknowledgment of the meter accepting, canceling or modifying the schedule will be stored and presented to the user. If the calendar is not acknowledged within three attempts, a notification will be issued.

3 Additional feature #3: Arming and disarming the automatic disconnect

Smart meter firmware will introduce an armed feature to permit scheduling of the automatic disconnect feature. This schedule may be independent of the scheduled RD feature. Confirmation of the disconnect will be stored and if a confirmation is not received, an alert will be sent to the user and the meter will need to be manually reconnected. For meters that do not have the automatic disconnect feature, a module will be created to simulate the automatic disconnect.

To prevent the distribution system from becoming overloaded upon reconnection, the meter firmware will implement a random restore and maximum time as received from the headend.

4 Additional feature #4: Additional schedules and current demand display

The headend will also allow for additional RD schedules to be created. The schedule calendar will be fixed like a standard time-of-use (TOU) schedule. TOU schedules allow utility customers to save money on their electric bills by shifting their energy use to off-peak hours. The new RD schedule would be designed not to impede the operation of the meter or supersede any TOU billing schedule that may be currently operating in the meter.

An additional feature of the headend will facilitate the transmitting, receiving and displaying of the current load demand at the time of the disconnect and reconnect. The meter firmware will transmit a message along with the current demand prior to disconnecting, immediately after reconnecting and then five minutes after reconnecting.

Together these features will allow utilities to take more granular control over load management during both emergency and non-emergency events. The reduced downtime offered through scheduled RD meters can lead to increased revenue and improved public perception of electric utilities.

Reduced downtime

Scheduled disconnects will allow utilities to keep more meters running throughout load management operations. As a result, revenue can be expected to increase. Prior to AMI, complete blocks of load would have to be disconnected to make the system safe for utility personnel to operate.

"If I needed, for example, 10 megawatts–I would have to cut off 12 megawatts just because the blocks I'd have to cut them off in were so massive," says Rhoades. "Well, today with AMI meters, I would only have to cut off 10 megawatts because I can selectively get 10 megawatts. I can get really close to 10 megawatts versus going 20% or 30% over."

Happier customers

Perhaps an even greater advantage is the improved public perception and increased customer satisfaction that can arise from using scheduled RD meters. Previously, total load control meant that some customers would have to be disconnected for much longer periods of time. Critical loads, such as those from life safety equipment, gathering facilities and processing plants would have to be cut off for long periods of time, with residential customers often needing to relocate in order to access power. Because scheduled RD meters can be used in conjunction with, or in place of, rolling blackouts, the electric utility can meet their load control targets while reducing downtime for critical and essential loads.

"Nobody wants their power cut off but if you can tell them that they're going to be without power for a day versus a week, I think they're a lot happier and they can manage through that," said Rhoades.

A look ahead

As far as what the future holds for scheduled RD meters, Rhoades believes that they will proliferate and become widely implemented by electric utilities.

Future items may allow the meter to schedule or manage load by connecting or disconnecting devices in the home in conjunction with the ability to disconnect all load when required. The meter will use either a schedule to manage the loads or a demand threshold that will trigger the meter to act.

Final word

The value of scheduled RD meters cannot be understated as their benefits must be and can be realized sooner than later. Recent events, such as the Texas power crisis of 2021, where more than 4 million people were left without power during one of the coldest winters in the history of the Lone Star state, provide a real-world opportunity for scheduled RD meters to be implemented at scale. Following that crisis, the Federal Energy Regulatory Commission made several recommendations to the Texas grid operator to prevent future occurrences. Among those recommendations was a call to improve the coordination of scheduled outages, both in terms of the total amount of scheduled outages at a given time and their locations. Electric utilities and grid operators can take advantage of the advanced features offered through scheduled RD meters to improve their response to these emergencies in the future and ensure a safe, reliable grid for their customers.

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