AMI Based Load Shed

AMI based load shed utilizes the disconnect devices closest to the load to lessen the impacts of a load shed event to both the public and operations. Instead of utilizing substation-based equipment, AMI load shed reaches out into the distribution system to disconnect self-contained meters that have an internal disconnect. If the load shed goals are not reached with self-contained meters, load shed application can still utilize controllable devices located on the distribution line or in the substation to reach load reduction goals.

What are the potential benefits?

Distributed energy resources (DER) could continue to support generation

- Small exporting DER, behind self-contained meters, would not be disconnected allowing their generation in aggregate to support generation needs.
- Larger DER connected directly to the distribution line would continue to generate since the distribution line will remain energized

Under frequency reserves, which must be maintained during load shed events, can be maintained utilizing the remaining connected load to the distribution feeders.

Public service systems connected to the medium voltage system would remain in service.

- Traffic lights, Streetlights, Public safety cameras

Beneficial loads would continue to be energized

- Gas stations, Grocery stores, Restaurants, Shelters

Distribution protection systems would remain operational.

- Breakers, reclosers and fuses would continue to identify and isolate faults

Restoring at the end of the load shed period would not involve inrush associated with distribution assets such as transformers and capacitors.

The system can be configured to work with the OMS

- AMI meters disconnected would not send power out notifications.
- Other customer outage notifications could also be filtered by account number during the disconnect period

What are the potential concerns to consider?

The number of assets involved in the disconnection would be much greater.

- Is there enough load served through self-contained meters to meet the load shed objectives?
    - Can the AMI system provide an accurate estimate of how much demand will be reduced?
- Can the disconnection occur fast enough to meet reliability requirements?
- Does AMI load shed support rolling disconnections and reconnections?
- The system would be dramatically more complex.
    - What percentage of disconnect meters would fail to open?
    - What percentage of disconnect meters would fail to reconnect? If the reconnection includes a site visit, are there enough resources to respond.

Public response

- How would very large residential services be disconnected?
    - Homes with greater than 400 amp panels?
    - Self-metered apartments or condominiums?
- Would any residential meters be excluded?
- How would the public respond to large commercial and industrial services remaining energized

How can all options work together?

AMI based load shed should be considered an enhancement of the current load shed process. Under frequency relays, which require testing, will remain in service at the substations. The ability to disconnect feeders will also remain and will be utilized if the load served from self-contained disconnect meters does not remove enough load to meet the required margins.

Designing an AMI based load shed

Since the use case of emergency load shed was not the primary driver for purchasing and installing AMI meters with internal disconnects, the industry will have to make modifications to meter applications. This section will highlight some of the functionality required to support an emergency load shed use case.

Speed requirements

One of the primary advantages of the substation SCADA based load shed is the speed that load can be removed. Since there are time constraints associated with lowering the load to reestablish generation margins, an AMI load shed will need to be quickly executed. Before disconnecting customers, balancing authorities will be calling on a list of other generation and load reducing options that are not as impactful to the customers. Since AMI load shed will not be first, the operator will be able to give advanced notice of the potential utilization of the system.

REQUIREMENTS

The total process from initiation to load removal must be less than 5 minutes.

Rotating load shed

AMI load shed should support rolling load shed. To support this use case, meters must have the capability to be placed into groups. The disconnect message would then be group specific. This would enable each group to be disconnected and reconnected independently from the other groups. One group of meters might be considered critical and not part of the load shed process.

REQUIREMENTS

1. ***The AMI system must be able to segment meters into a minimum of 5 groups.***
2. ***The AMI system will send load shed commands to groups independently.***

Determining amount of demand that will be shed

One of the benefits of a substation SCADA based load shed application is the availability of real time load data. Having real time load data keeps the amount of excessive load shed to a minimum while also instilling confidence that the goals of the load shed will be met.

REQUIREMENTS

The AMI system will be able to calculate the estimated demand of each segment

Disconnection excluded if load connected DER is exporting

As distribution sited DER penetration expands, the bulk power system would benefit from disconnecting the load while leaving the DER connected.

REQUIREMENTS

Meters exporting to the grid will not be disconnected

Process for units that do not re-energize when instructed

As with any system that involves operating a large number of devices, there will almost certainly be some units that do not disconnect when commanded and others that do not reconnect when commanded. The units that did not disconnect when commanded can be investigated after the event is over by auditing status and communication logs. The units that successfully disconnect and fail to reconnect will have to be investigated. Failure to reconnect may be lessened by sending a second or third close command which would be ignored by the meters that are already closed. There may also be the option to schedule the reconnection. Eventually, meters that will not close by commands will initiate a site visit by meter personnel.

REQUIREMENTS

1. ***A second automated attempt must be made to close meters that remain open***
2. ***Meters that remain open must be identified.***

Meters that are already disconnected

Any large system will have some meters that are already in a disconnected state due to other business reasons. The load shed firmware must exclude these meters from executing any close command associated with the load shed restoration. These meters must also be excluded from appearing in the list of meters that did not reconnect.

REQUIREMENTS

Meters disconnected for other business purposes, will not be include in demand calculations or reconnected.

Associated distribution outages

There exist the possibility of a distribution outage occurring during the same time period as the load shed event.

REQUIREMENTS

The meters that are open for load shed should report service outages. If the reconnect message is sent while the meter is experiencing an outage, the detection process for meters that did not reconnect must identify the open meters.

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