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Improving Reliability by Enabling Fuse Saving Mode on Distribution Automation Devices

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SUMMARY

Energy demands are increasing, which means that customer focus and expectations are changing. ComEd has invested billions of dollars into Smart Grid and system infrastructure improvements. ComEd has more than 5,000 Distribution Automation (DA) devices on the system. With all the system investments, ComEd's SAIFI improved by 44% and CAIDI improved by 48% in 2016. To further improve SAIFI and CAIDI, ComEd looked at additional solutions to optimize the usage of DA devices already installed on the system. Normally, DA devices are set in the fuse clearing mode. This ensures, in the event there's a fault downstream of any fuse in series with the DA device, that it is cleared by the fuse without causing the DA device to operate. Alternately, these devices offer a functionality called "Fuse Saving Mode", which when enabled would prevent lateral line fuses from blowing on transient faults downstream from the DA device during inclement weather. ComEd has implemented fuse saving mode 35 times in 2017, resulting in over 1,000 avoided fuse outages and best on record SAIFI through July.

KEYWORDS

Fuse Saving mode, Fast Trip, Distribution Automation, Avoided Truck Rolls, SAIFI – System Average Interruption Frequency Index, CAIDI – Customer Average Interruption Duration Index, Smart Grid

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INTRODUCTION

ComEd has been installing reclosers on its 4/12kV distribution system since the early 2000's. The initial Distribution Automation (DA) strategy consisted of installing reclosers at circuit mid-points as standalone devices. These devices only operated to isolate a fault that occurs downstream of the device. Approximately 300 devices were installed prior to 2007. In 2007, ComEd increased the number of devices installed. This included implementing the next phase of DA device installation which incorporated a loop scheme. A loop scheme allows restoration of the back-half of the feeder should a fault occur upstream of the device, provide more details on loop scheme and how the back half is restored by an adjacent circuit.

More complex DA schemes were utilized and implemented in 2012. With these complex schemes, multiple normally closed DA devices were installed in conjunction with multiple tie reclosers, reducing customer exposure when a fault occurs. During this time, ComEd also decided to pursue a 500-750 customer segmentation strategy with a goal of not having feeders with segments serving more than 750 customers.

ComEd system has three types of DA devices: Coopers, G&W Vipers, and S&C Intellirupters, all of which are capable of loop schemes. Intellirupters are also capable of Intelliteam logic (specifically IT2), which allows for DA devices to communicate with each other. Coopers and Vipers have been retro-fitted with IntelliNode (ITN) to allow them to speak the IT2 language for communication.

The primary goal for installing these DA devices is to automatically reroute electricity around problem areas so customers experience fewer and shorter power outages. During this time period, ComEd system SAIFI improved by more than 44% and CAIDI improved by more than 48%. To further improve SAIFI and CAIDI, ComEd looked at additional solutions to optimize the usage of DA devices already installed on the system.

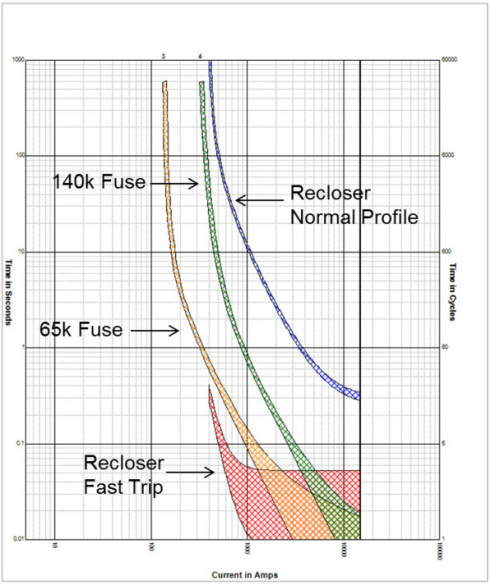
FUSE SAVING MODE

Normally, DA devices are set in the fuse clearing mode. This ensures, in the event of a fault downstream of any fuse in series with it, that the device is cleared by the fuse without causing

the device to operate. In addition, DA devices can also be set to "fuse saving or fast trip" mode. When enabled, this feature would prevent lateral line fuses from blowing due to transient faults downstream from the fuse. ComEd estimates approximately 50-80% of lateral line fuses blown are from transient faults. These types of faults typically impact 50 customers on average, and have a CAIDI of more than 200 minutes during inclement weather.

Since all DA devices can be accessed remotely through SCADA, ComEd has the ability to change settings on the device at any time. When the setting on the DA device is modified to fuse saving mode, the DA device operates faster than a fuse, trying to clear a momentary fault without blowing the fuse. If the fault is not transient and still present, the DA device operates more slowly than the fuse, enabling the fuse to clear. This can save expensive fuse replacement and reduce extended customer outage times. More importantly it avoids truck rolls, enabling operation crews to get to the next outage sooner.

The following graph shows an example of fuse clearing mode versus fuse saving mode. When the device is in fuse clearing mode (Normal Profile), the recloser uses the slow curve allowing the fuse to clear the fault. When fuse saving mode is activated, the recloser uses the fast trip curve and operates before the fuse allowing for a transient to clear.



ENABLING FAST TRIP

Although the benefits of fuse saving mode are identified, these DA operations result in a momentary outage for all the customers downstream of a DA device. Thus, the challenge was to limit the use of fuse saving mode during inclement weather and then reconfiguring the DA devices back to fuse clearing mode. This strategy would avoid many of the momentary outages we would see on blue sky days if a fast trip was enabled; it also would minimize the mechanical impact on the DA devices due to excessive usage. To implement this, we needed the ability to change the settings by establishing criteria depending on the weather by geographical area. ComEd uses different color codes for weather alerts based on the probability of inclement weather. A study was performed to determine and establish the criteria based on the number of days in a year specific weather alerts were issued and the number of fuse outages the system experienced per day during those days. The study also calculated the SAIFI and CAIDI impact on an annual basis due to enabling the fuse saving

mode for various weather alerts. The results were then used to establish a weather criterion for when to enable the fuse saving mode.

Once the criterion was established, the solutions were to create a procedure to execute the sequential controller via SCADA. Each of ComEd's four regions has multiple procedures that are run based on the weather forecast. When the weather no longer meets the established criteria, the procedures are run again to return the DA devices to fuse clearing mode. The procedures go through a communications validation prior to changing modes.

BENEFITS OF FAST TRIP

Year to date through July 2017, fuse saving mode has been implemented 35 times based on our criteria between January and July of 2017. This resulted in avoiding approximately 1,100 transient fuse outages, avoiding approximately 55,000 customer interruptions and resulting in an average CAIDI reduction of 2.9 minutes. This resulted in estimated avoided truck rolls of 1,100; which equates to a cost savings of approximately $500,000. These results reduced customer outages and outage durations, which ultimately improve customer satisfaction.

FINAL REMARKS

Energy demands are increasing, which means that customer focus and expectations are changing. ComEd has invested significantly in Smart Grid and system infrastructure improvements. These investments have provided the opportunity to gather data and leverage more control over the system. The installation of Distribution Automation (DA) and the ability to utilize fast trip functionality allows for a DA device to operate and potentially eliminate a fuse related outage if a fault is cleared. This technology along with other investments has contributed to ComEd's improved SAIFI in 2016 and best on record SAIFI, CAIDI and reduced truck rolls. As system performance continues to improve year to year, it is imperative to use solutions such as fast trip in order to support continuous reliability improvement.