PQSoft Case Study

MG Set Provides Voltage Sag Support
Voltage Sag Ride-Through

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References			

Abstract:

Today's high-tech computer and multi-media equipment require "clean" electric power protected against normal split-second voltage variations. A technology that has recently received much attention for providing this ride-through is the written-pole motor-generator set.

The written-pole motor generator, also known as the Roesel Motor Generator (RMG®) is a continuous-duty device, which provides essential electrical loads with a continuous source of clean, regulated, and isolated 60-cycle power. When a loss or variation of input utility power occurs, the Roesel Motor-Generator is designed to supply constant frequency 60 cycle power within a specified voltage range for a minimum of 15 seconds with full rated load on the unit. At reduced loads it will supply power for up to 45 seconds.

TABLE OF CONTENTS

LIST OF FIGURES

GLOSSARY AND ACRONYMS

MG Set	Motor-Generator Set

INTRODUCTION

For many years it has been the goal of utilities to supply their customers with the "best" power possible. The utility involved in this case study has implemented many research and development projects over the years to achieve this goal. These projects are used as demonstration projects that evaluate new technologies and their feasibility in solving power related issues for utility customers.

This case study describes one demonstration project that the utility implemented in an effort to supply two customers with uninterruptible power. Two sites were selected based on their sensitivity to voltage variations. One site is located in downtown Manhattan, New York and the other site is located in Westchester County, New York.

Site Selection

Manhattan Location

Customers served from the underground network in Manhattan will rarely if ever see a service interruption. The building selected for the project is one of the few buildings in the world to offer satellite accessibility, single- and multi-mode fiber optics, high-speed category 5 copper wire, and video conferencing facilities. Due to the critical nature of the tenant's operations within this building, power quality is an important concern. A five-transformer 125/216-volt spot network supplies the building's electrical service.

Westchester Location

A second location was selected to take part in the demonstration project. This location serves as a headquarters building for a large corporation with critical computer loads. The building's electrical service is supplied via an automatic loop scheme on the 13.4 kV distribution feeder. The feeder supplies a pad-mounted transformer whose secondary voltage is 277/480 volts. Due to system operating procedures, this location experienced interruptions on occasion.

Building managers at both locations wanted to ensure that the customers in their facilities would never experience any interruptions. Con Edison engineers performed a study to determine the best approach to supplying uninterruptible power to this customer. This paper presents the approach used and the findings of the study performed by Con Edison.

Site Characterization

As part of the research project, the utility installed monitoring equipment to characterize the power quality at the Manhattan and Westchester locations. The monitors were configured to capture events ranging from normal capacitor switching transients to more severe long duration voltage variations and in the rare case, interruptions. The event type of most concern for this project was voltage variations and therefore, will be the only event type discussed.

After approximately three years of monitoring at both locations, the utility was able to accurately characterize the voltage variations that occurred at both facilities. Information on the magnitude and duration of voltage variations was summarized for each monitoring location.

Manhattan Location

Figure 1 illustrates the monthly sag rate that can be expected for the network involved in the project. No interruptions were recorded on the network during the monitoring period. As seen in Figure 1, 50% of the events have a sag depth of less than 25% of nominal. The monitoring instruments were configured to record voltage variations outside the limits of 90% to 110% of nominal.

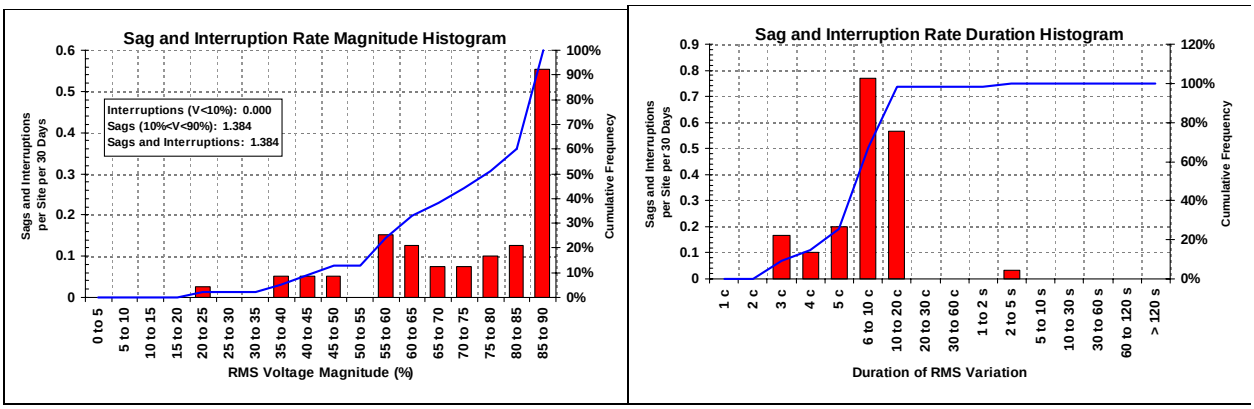

Figure 1 - Sag and interruption rate and duration histogram for measurements taken on the input of the RMG at the Manhattan facility.

Another concern is the duration of the event. Figure 1 also illustrates the sag and interruption rate duration histogram for the Manhattan facility. The duration of approximately 98% of the events was less than 20 cycles (333 mS) with the majority of the events lasting between 6 and 20 cycles as illustrated in Figure 1.

Westchester Location

Figure 2 illustrates the sag and interruption rate for the input to the RMG on the radial distribution feeder. Notice that the interruption rate has increased from zero for an underground network to approximately 1 per 30 days for the radial feeder. A majority of these interruptions are of the momentary type, and are due to recloser operations on the supply feeder.

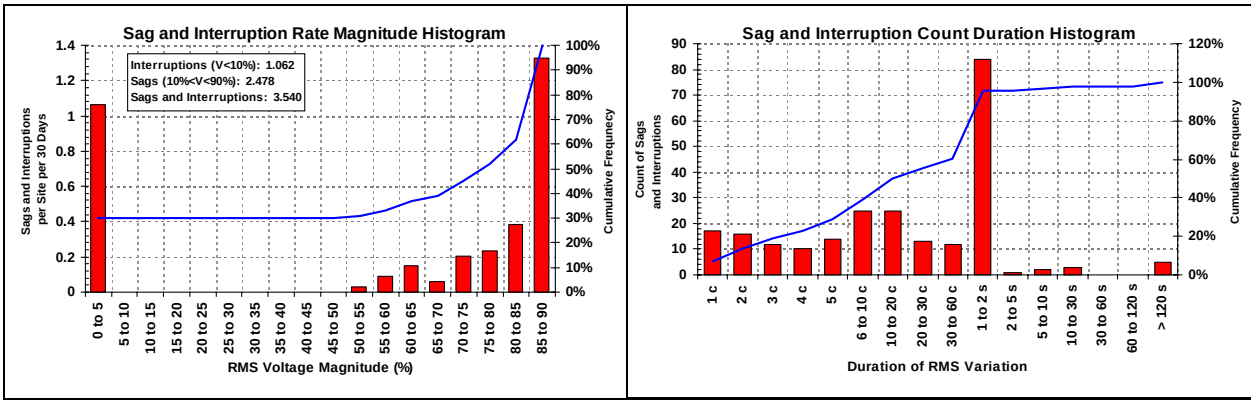

Figure 2 - Sag and interruption rate and duration histogram for measurements taken on the input to the RMG fed from a radial feeder at the Westchester facility.

Figure 2 illustrates the duration of the same measured. A majority of the events measured on the input to the RMG were between 1 and 2 seconds. Approximately 95% of the events were less than 2 seconds in duration.

Both locations proved to be acceptable for the installation and demonstration of the written-pole RMG technology. The written-pole RMG is capable of providing ride-through for up to 15 seconds at full load. As can be seen from the data, the majority of voltage sags and momentary interruptions are less than 100 cycles (1.6667 seconds) in duration.

Using the measurement information, the utility determined that both customers could benefit from the installation of the RMGs. Given the fact the RMGs could supply 15 seconds of ride-through for a complete loss of power and that 98% of the events experienced by the customers lasted less than 15 seconds, the RMG would be a good choice for voltage sag and interruption protection.

Ride-Through Performance

After the installation of the RMGs, Con Edison continued to monitor at both locations. This data would be used to verify that the RMGs operated as expected during voltage sag and interruptions.

Manhattan Location

On January 28, 1997, the network feeding the Manhattan location experienced a voltage sag where the voltage dropped 52% below the nominal 125 volts rms for 11 cycles (0.183 seconds) to 48.4%. Under normal conditions this event was severe enough to cause unprotected office and computer equipment to drop off-line, causing loss of data. Figure 3 illustrates the input and output voltages of the RMG during the voltage sag.

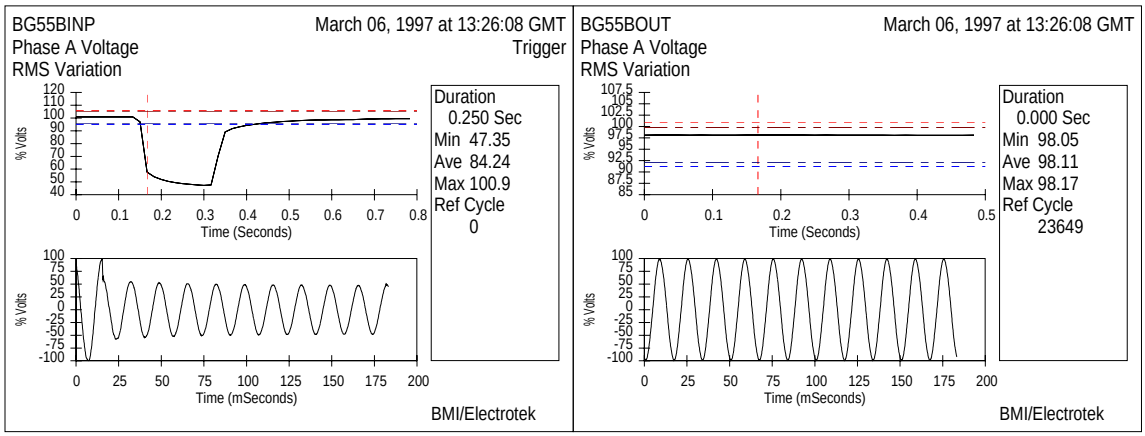

Figure 3 - Input and output voltage of the RMG serving the Manhattan facility during a voltage on January 28, 1997.

As seen from the measurements, the RMG provided 100% voltage ride-through for the connected load during the utility event.

Westchester Location

On October 31, 1996, the feeder that serves the Westchester facility experienced an interruption. The event lasted for approximately 1.2 seconds and the voltage on the input of the RMG went to zero (as expected with an interruption). Figure 4 illustrates the input and output voltages of the RMG during the interruption.

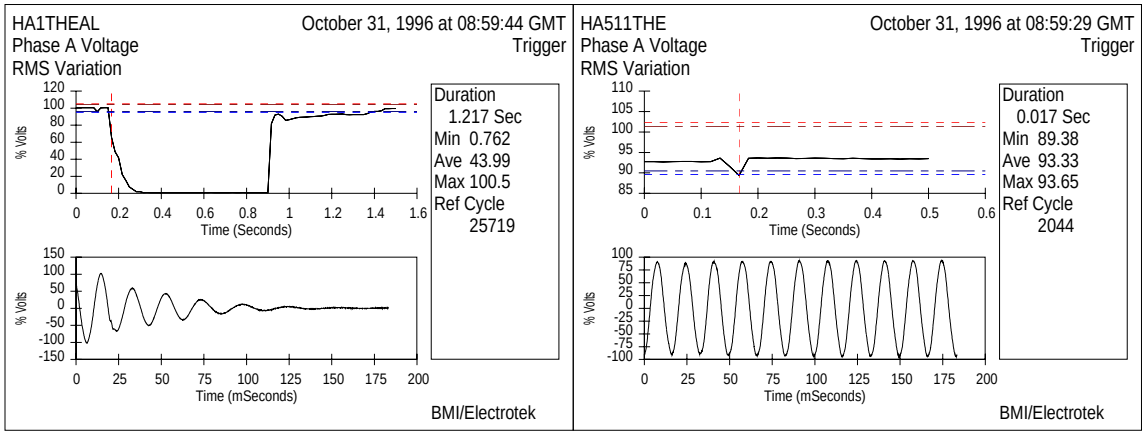

Figure 4 - Input and output voltage of the RMG serving the Westchester facility during an interruption on October 31, 1996.

As seen from the measurements, the RMG provided 100% voltage ride-through for the connected load during the utility event.

SUMMARY

Power quality can be improved by using RMGs at customer locations. Due to the design of the utility's system, a large percentage of power quality events experienced by customers are less than 100 cycles in duration. Since the written pole motor generator system is designed to provide 15 seconds of energy storage under full load conditions, it is an appropriate technology to evaluate for use by customers within the utility's service territory. For sustained interruptions, the written-pole RMGs can be integrated with a backup emergency generator to provide a seamless transfer to the protected load.

The demonstration project has shown that critical customer loads may be successfully protected by the written-pole RMGs from misoperation due to these power quality events. The project has also identified several areas of concern, including voltage oscillations, which will be investigated as the project continues forward.

Installation and ongoing evaluation at the two sites has also allowed for documentation of critical issues to be considered during system specification, installation, startup and operation. These will be documented in an application guideline, which will be completed as part of this project.

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