VITREK

Major Metropolitan Transit System Uses Vitrek Power Analyzer to Monitor High-Power DC Feeders

CASE STUDY

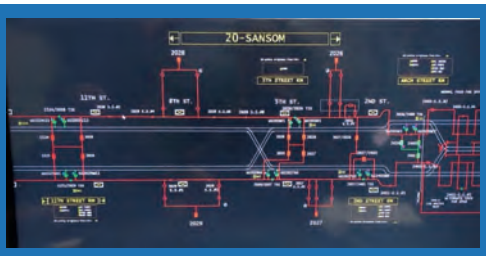

Figure 1. A computer monitor displays the power distribution from the SEPTA 20-Sansom Substation.

Challenges

Personnel needed a reliable, portable instrument to accurately measure and record the current on each feeder over a selected time period.

Overview

The Southeastern Pennsylvania Transportation Authority (SEPTA) operates the transit system throughout the city of Philadelphia, extending into the surrounding counties in Pennsylvania and across the Delaware River into New Jersey.

A major component of this system is the network of subways and commuter trains. Power for the operation of these trains is provided by an array of substations distributed throughout the region. One such substation identified as 20-Sansom is located proximate to the busy Jefferson Station on East Market Street in downtown Philadelphia (Figure 1.)

The subway system is powered by a series of "third rail" feeders supplying 700 VDC at currents up to 4000A. The power for this system is derived from a 4160 VAC, 3-phase input via transformers and 12-pulse rectifier array. The power is then distributed to individual segments of the system via a series of feeders (Figure 2.)

Vitrek Power Analyzers allowed SEPTA to evaluate load profiles during peak operating periods.

Measurement of the current is performed utilizing a low-resistance direct shunt producing a 0-50 mV signal proportional to 0-4000 A (Figure 3a) that is then displayed on the front panel (Figure 3b.)

The substation electrical personnel needed a reliable, portable instrument to accurately measure and record the current on each feeder over a selected time period in order to evaluate load profiles, particularly during peak operating periods.

Figure 2. A view behind the control panel reveals the array of feeders each capable of handling 4000A.

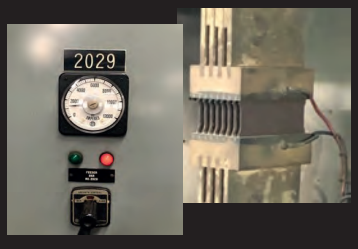

Figure 3. A shunt on each bus produces a 0-50mV output that is connected to an analog meter.

Figure 4. The front panel of the XT2640 displaying the voltage and current on one of the 20-Sansom feeders.

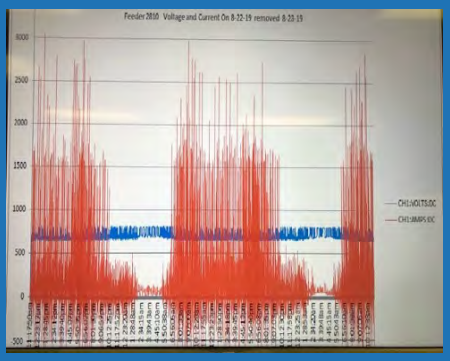

Figure 5. The dynamic nature of the feeder current is captured by the Vitrek XT2640 power analyzer. Currents range from over +3000A to -1000A (due to regenerative breaking)

After attempting to use a number of different manufacturers' portable power analyzers without success, they ultimately selected the Vitrek XiTRON brand model XT2640. While many of these other instruments are well suited for analyzing AC power systems, the Vitrek analyzer was uniquely capable of handling this application. The unit has the accuracy and dynamic range required to measure these rapidly changing DC current loads and also has the capability to handle the very high DC common mode voltage. It turns out that making an accurate 0-50 mV measurement floating on a 700 VDC bus requires the exceptional isolation only found in Vitrek power analyzers (Figure 4.)

The information gathered from the XT2640 is stored in the device and can be displayed on the instrument's high-resolution front panel color screen. The data can also be exported via rear panel Ethernet or RS-232 or front-panel USB drive access. In this particular case, the data is typically transferred via USB and then displayed on a large monitor in the substation (Figure 5.) This display depicts a particular feeder over a period of time to confirm that the current remains within expected levels.

TROUBLESHOOTING A FEEDER PROBLEM

Type 43 DC Overcurrent Relays are the most commonly used protective overcurrent devices used in the transit industry. The overcurrent relay provides maximum protection for trolley wires, third rails, feeder and substations from intermediate or remote overload conditions such as bolted faults, arcing faults and severe overloads. Type 76 relays are deployed throughout the SEPTA system.

The XT2640 was pressed into service to determine why the Type 76 on one particular feeder was tripping off. After measuring and recording the currents as shown in Figure 5, it was determined that when a tripping event occurred, the actual currents were well within accepted operating range. The relay was taken out of service and repaired.

CONCLUSION

The Vitrek power analyzer has provided this metropolitan transit authority with a valuable tool to evaluate and manage the distribution of high-voltage/current DC feeders powering its subway system. An especially important benefit is the Vitrek instrument's ability to accurately measure current data from a 0-50mV shunt riding on 700 VDC common-mode voltage, something with their ease-of-use and superior operational performance provided SEPTA engineers with the right tool for the task.

ABOUT VITREK

Vitrek has provided innovative global solutions for high voltage test and measurement since 1990. All Vitrek products are designed and manufactured in the USA. Our products are used worldwide to provide testing solutions for industries including calibration, R & D and testing labs, photovoltaic, lighting, appliance, machinery, medical equipment, power conversion, electrical component, metrology automotive, military/aerospace and energy industries.

For complete information on Vitrek's products, or to request a FREE product demonstration, visit www.Vitrek.com or call (858) 689-2755.

Vitrek Test & Measurement Equipment

Vitrek Test Equipment The Right Tool for the Job

Vitrek has continued to further enhance the performance of its power analyzer family. The new PA920 Series Ultra-High Accuracy Power Analyzer (packaged in the same portable design as the XT2640 in this case study) sets the new standard for accuracy (0.024% of reading) in the graphical power analyzers market. It integrates an ultra-high accuracy, wide bandwidth waveform digitizer with advanced computation-al capability, a large high-resolution display and a full color touchscreen user interface. The multi-channel PA920 offers unprecedented 0.024% power measurement accuracy for all channels (1-4 channel cards available per unit), innovative VPA architecture, 100 full precision readings per second and measurement bandwidth sufficient to handle 5 MHz signals - all at a cost far lower than less capable, competi-tive models.