PQSoft Case Study

Utility Capacitor Switching Fails
VAX Disk Drive

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Miscellaneous2			
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Abstract:

The application of utility capacitor banks has long been accepted as a necessary step in the efficient design of utility power systems. Also, capacitor switching is generally considered a normal operation for a utility system and the transients associated with these operations are generally not a problem for utility equipment. These low frequency transients, however, can cause problems for low voltage power electronic-based loads.

This case illustrates a situation where a power conditioning device was the weak link in an overall equipment protection scheme. The power conditioner, which was located near the sensitive equipment, was magnifying utility capacitor switching transients that were not very severe in magnitude.

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RELATED STANDARDS

IEEE Std. 1036
IEEE Std. 1159

GLOSSARY AND ACRONYMS

ASD	Adjustable-Speed Drive
LIPC	Low Impedance Power Conditioner
MOV	Metal Oxide Varistor
PWM	Pulse Width Modulation
SMPS	Switch Mode Power Supply
TVSS	Transient Voltage Surge Suppressors
VAX	Virtual Address eXtension

PROBLEM STATEMENT

A data processing company had a critical VAX (a computer-family of Digital Equipment Corporation) computer that had a disk drive failure about once a month. All data not backed up was lost, and the downtime associated with each failure was several hours.

The computer was supplied by a low impedance power conditioner (LIPC) that was designed to filter high frequency transients and to make a local neutral-to-ground bond. These types of power conditioners are specifically designed to interface with electronic equipment, especially computers.

DEVELOPING MONITORING PLAN

Disturbance analyzers were brought in to monitor facility power quality. One monitor was installed at the service entrance 480 volt bus supplying the sensitive equipment. Another monitor was installed on the input and output of the low impedance power conditioner supplying the VAX computer to characterize its performance.

Initial monitoring results revealed that a capacitor switching transient occurred every morning at 8:00 am An example of this transient voltage is shown in Figure 1.

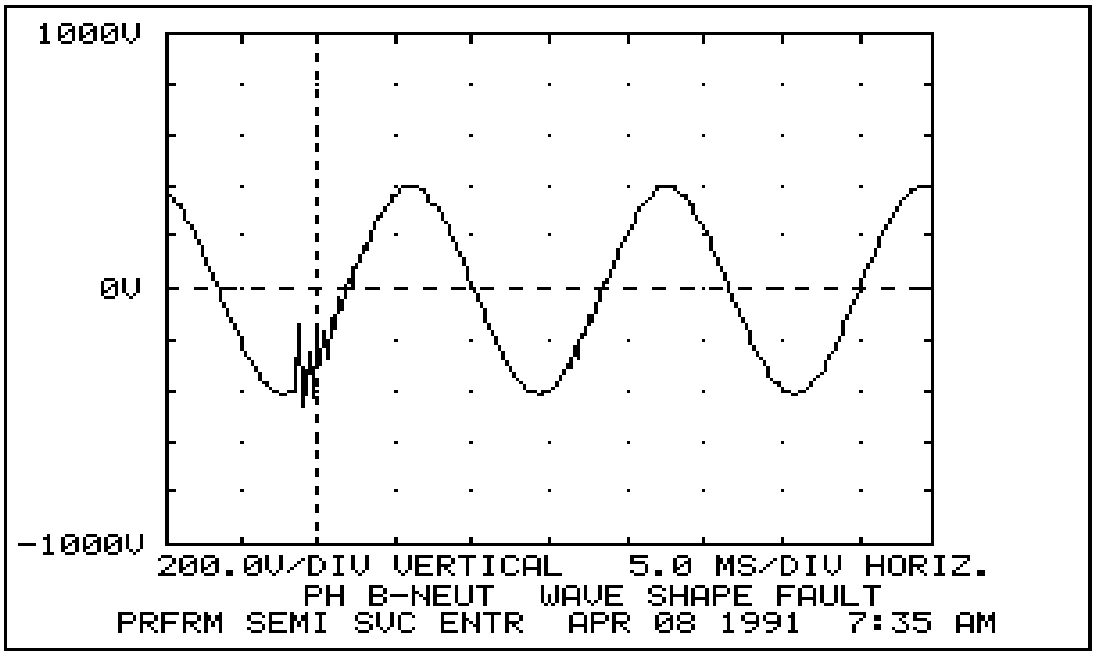

Figure 1 - Capacitor Switching Transient Recorded at the Service Entrance

TRANSIENT OVERVOLTAGE MAGNIFIED BY LOW IMPEDANCE POWER CONDITIONER

The monitor on the input and output of the low impedance power conditioner recorded some interesting waveforms as illustrated in Figure 2. A disturbance was triggered on the input, but as the waveform shows, it was not severe enough to cause any problems. However, the disturbance that was recorded on the output of the power conditioner shows that the transient voltage was magnified considerably.

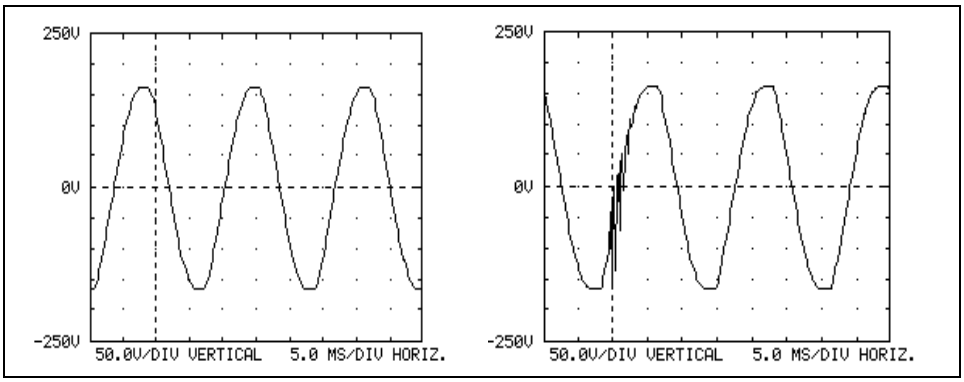

Figure 2 - Low Impedance Power Conditioner Input/Output Waveforms

LOW IMPEDANCE POWER CONDITIONER

Low impedance power conditioners are used primarily to interface with the switch-mode power supplies (SMPSs) commonly found in power-electronic equipment. These power conditioners have lower impedance than isolation transformers, and a filter as part of their design (shown in Figure 3). The filter is on the output side and protects against high-frequency transients. However, low-to-medium frequency transients (including utility capacitor switching transients) have been know to cause problems for these devices.

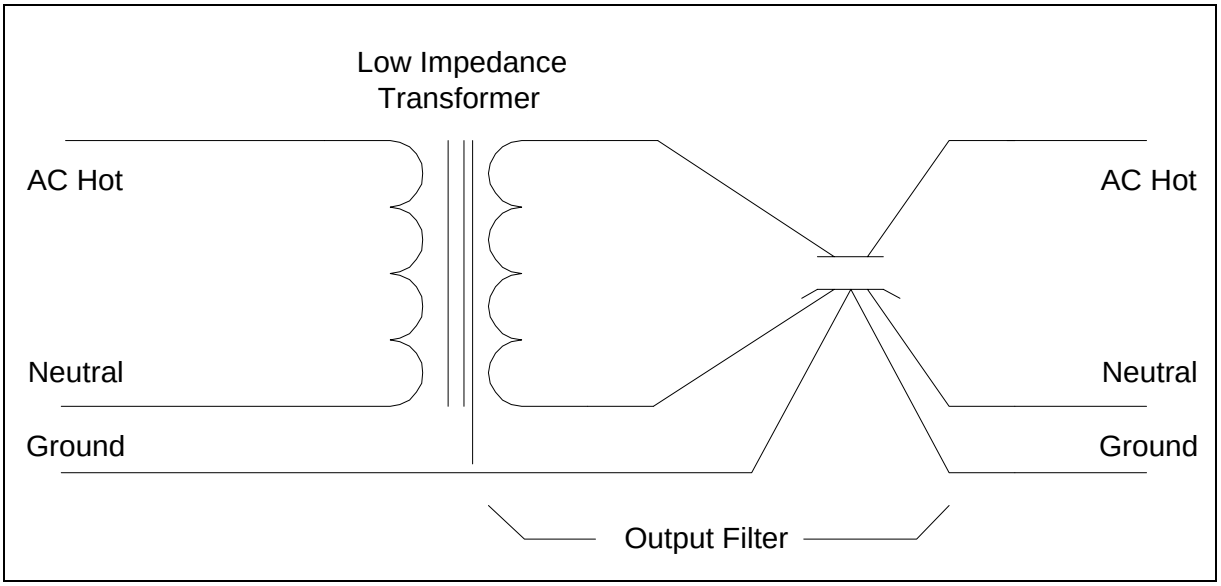

Figure 3 - Schematic of a Low Impedance Power Conditioner

The VAX disk drive never seemed to fail as a direct result of the magnified transient. However, since the disk drives on older VAX machines such as this one are connected directly across the line with no internal protection, it was felt that over time this daily transient caused the disk drive to fail approximately once per month.

SOLUTION

Power conditioning devices should not be the weak link in the overall equipment protection scheme. In this case, the power conditioner was magnifying a transient overvoltage, which was not very severe, near the location of the sensitive equipment.

Replacing the low impedance power conditioner with a standard isolation transformer provided enough impedance to sufficiently reduce the transient overvoltage while maintaining a neutral-to-ground bond.

REFERENCES

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