Sag Fighter™ Case Study

Case Study: Newspaper Publisher Power Problems

Problem: Production interruptions threaten to cause significant financial losses due to missed production deadlines for time-sensitive advertising for a newspaper publisher.

Background: A major daily newspaper publisher in the northern part of Texas, USA, produces pre-printed, time-sensitive advertising material for inclusion in its newspapers. To handle a higher volume of this material, the newspaper decided to build a new facility with new collating equipment. However, the new location was suspected to have power problems.

The newspaper hired a third party to collect data for several months on the power quality at the new location. The recorded data indicated that RMS voltage levels fluctuated within less than ±6%, but random voltage sags of moderate depth were also present.

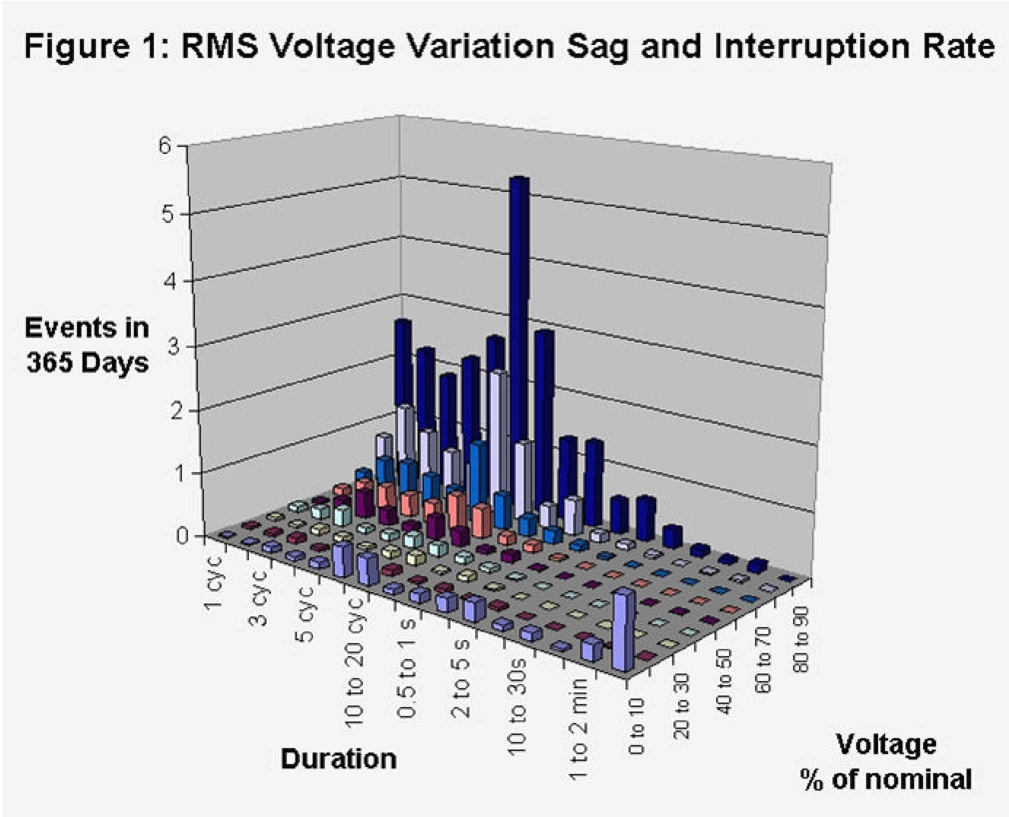
Because of the time-sensitive nature of the new operation, interruptions or delays would increase production costs, risk missed deadlines and lost advertising revenue.

Analysis: Producing nearly 3 million newspapers per week in 2007, the publisher's operation is sensitive to problems that delay production or reduce available maintenance time. The newspaper's conclusion that frequent voltage sags could lead to costly operational problems is reinforced by a description of the local climatology by the U.S. National Weather Service:

"A large part of the annual precipitation results from thunderstorm activity, with occasional heavy rainfall over brief periods of time. Thunderstorms occur throughout the year, but are most frequent in the spring. Windstorms occurring during thunderstorm activity are sometimes destructive."

<u>Voltage Sags</u>

The American "sag" and the British "dip" are both names for a decrease in voltage to between 10 and 90% of nominal voltage for one-half cycle to one minute. The Electric Power Research Institute (EPRI) has identified the voltage sag as the cause of 92% of all distribution and transmission power quality problems (EPRI's Distribution Power Quality study). A typical electric customer in the U.S. experiences 40 to 60 sag events per year with those events resulting in the voltage dropping to between 60 to 90% and lasting several cycles to more than a second (See Figure 1).



While voltage sags occur with fairly high frequency, power interruptions (voltage < 10% of nominal) are relatively rare. The EPRI DPQ study indicates that a typical customer experiences about two interruptions per year compared to about 50 voltage sags.

Voltage sags on the distribution system are primarily caused by transmission and or distribution system automatic fault clearing operations in response to line-ground, line-line or equipment faults. A high percentage of these faults are initiated by random weather events like lightning and wind.

<u>Voltage Sag Protection Products</u>

While electric utilities are incapable of preventing voltage sags, several types of products are available to help the electric customer correct voltage sags. Such products fall into two types: those that use energy storage and those that do not. The energy storage types are mainly uninterruptible power supplies (UPS) using battery, capacitor or flywheel as the energy storage media. Devices without energy storage convert extra current into an appropriate boost voltage to raise the reduced voltage levels during the sag event.

Energy storage devices have the advantage of being able to provide stored energy during power interruptions as well as voltage sags. This interruption protection can be designed for periods ranging from several seconds to 30 minutes, or more. The downside is that energy storage devices require a lot of space, are very expensive to purchase and operate and require frequent and expensive maintenance.

Sag protection products that do not store energy can be equally or more effective in correcting voltage sags as their energy-storing counterparts. While such products provide no interruption protection, the tradeoff is smaller size, lower purchase and operating costs and very low maintenance. Some products even have electrical efficiencies as high as 99%.

Analyzing Protection Options

It was clear that the newspaper required voltage sag protection, so the real issue was to determine whether the incremental protection provided by an energy storage device justified the higher costs.

In this situation, the equipment to be protected was a collating (newspaper assembling) system. Stoppage of the collating system can result in significant overtime costs and the potential loss of tens of thousands of dollars in advertising revenue.

Based on the recorded power quality data, the newspaper could expect to see and average, or higher number of voltage sags per year at new facility. There was no data or reason to believe that the number of interruptions would be more than average. The expected protection from power quality events was:

	Energy Storage Device	Device Without Energy Storage
Voltage Sags Avoided	50	50
Interruptions Avoided	2	0
Total Problems Avoided	52	50

The next step was to determine the costs for each type of device. Figure 2 shows typical costs for various types of protection from power quality problems.

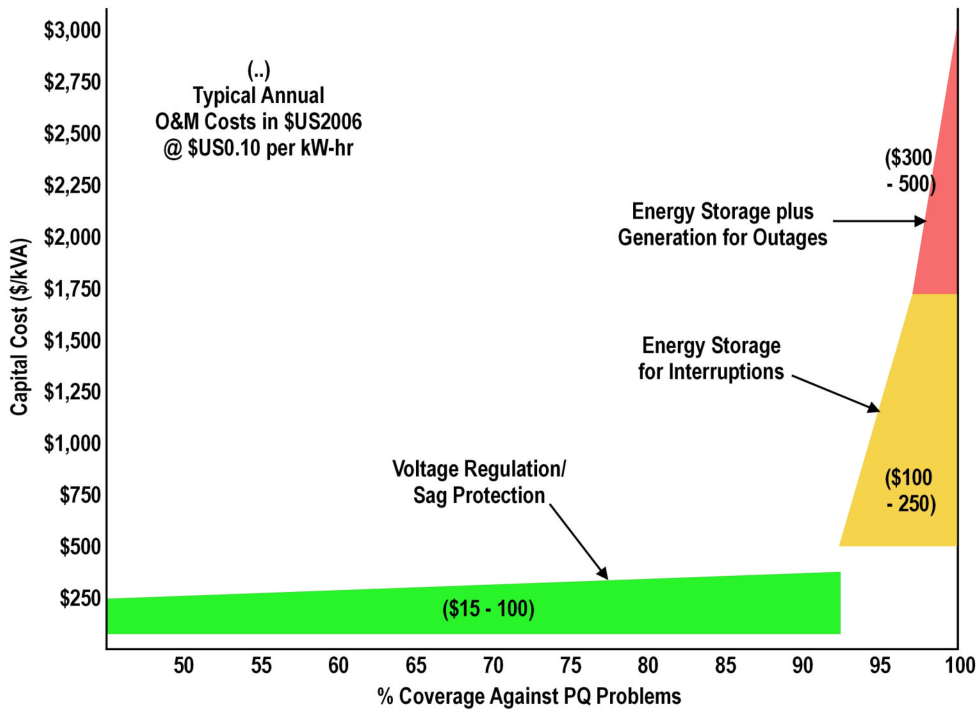


Figure 2. Costs of Typical Power Quality Protective Devices

In current dollars, the 10 year the owning costs (installed cost plus O&M) for 2 x 500 kVA capacity devices and the incremental cost of interruption protection could be projected:

$US (2006)	Energy Storage Device	Device Without Energy Storage
Installed Cost ($)	1,000,000	250,000
10 Year O&M Cost ($)	1,500,000	100,000
10 Year Owning Cost ($)	2,500,000	350,000
10 Year Owning Cost Difference ($) (A)	2,150,000	--
Power Quality Problems Avoided in 10 Years	520	500
Difference in PQ Problems Avoided in 10 Years (B)	20	--
Cost Per Incremental Problem Avoided ($) (A÷B)	107,500	--

This shows that over 10 years, the newspaper would pay an additional $US215,000 per year to avoid an average of 2 interruptions per year ($US107,500 per interruption).

Some other factors that could have been included in this analysis:

1) The time value of money
2) The future costs of labor, materials, batteries, battery disposal, electricity, etc.
3) Adjustment of average number of voltage sags and interruptions for northern Texas
4) Availability and reliability
5) Cost of building and floor space

The question is whether any of these factors would significantly change the simple cost analysis.

Including factors 1) and 2) would be expected to increase the cost of the energy storage device, perhaps substantially. Including factor 3) would very likely show an increase in the number of voltage sags, but not in the number of interruptions, and therefore not change the analysis. Factor 4) would work against the energy storage device because of the higher maintenance requirements. Including factor 5) would definitely increase the cost of the much larger energy storage device.

Clearly, the overall effect of these additional factors would simply increase the costs of the energy storage device.

The Result

In the end, the newspaper purchased 2 x 500 kVA Sag Fighter™ units through the collating equipment OEM. These devices correct deep voltage sags without energy storage. Including installation, the Sag Fighter™ units cost approximately $250/kVA, as predicted.

In the first few months of operation of the Sag Fighter™ units, north Texas was struck with very severe weather events almost daily. May and June, 2007, saw the area receive almost 20 inches of rain (11 inches above normal) and thunder/lightning storms on 30 days. Even though the newspaper's facility was subject to an unusually high number of sag events during this period, production was never interrupted by a voltage sag.

After 8 months of operation, there has been no loss of production due to voltage sags.

Conclusion:

The key to the analysis came down to a simple question, "Is the value of having protection from a few additional power quality events worth the additional cost?"

Based on this simple analysis, the best choice for the newspaper was the Sag Fighter™ for the following reasons:

1. Both devices were assumed to be equally effective for correcting voltage sags
2. The first cost of the Sag Fighter™ was substantially lower ($US250,000 versus $US1,000,000)
3. The annual O&M costs of the Sag Fighter™ were substantially lower ($US10,000 versus $US150,000)
4. The cost to avoid a shutdown caused by one interruption was not worth $US107,500.

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