Transforming The Future Of Power Technology

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PowerPlus Tech Note #300

PowerPlus™ and Power Consumption

The primary design goal of PowerPlus was to put more power into the precipitator fields in order to collect more particulate. In addition to lowering opacity, a number of PowerPlus installations have also realized significant cost savings from reduced energy consumption.

This concept is counter-intuitive to some prospective customers. They logically ask, "How can a product use less power when it's designed to put more power into the precipitator?"

This technical note will explain how PowerPlus uses less power when compared to a linear T/R set of similar secondary voltage and current rating while still improving particle collection.

Table comparing Standard T/R and PowerPlus Operating Parameters and Energy Usage

Parameter	Linear T/R	PowerPlus
ESP Capacitance (nF)	100	100
V AC	480	480
I AC	196	86.8
kVDC	55	61.5
mADC	1000	1000
kW DC	55	61.5
kW increase	n/a	11.8%
kW losses	3.5	3.8
Power Factor	0.6	0.9
KVA in	92.9	69.5
kVA decrease	n/a	25.2%
kVA saved	n/a	23.4

The table on the left shows primary and secondary readings for a conventional transformer/rectifier set and a comparably sized PowerPlus.

The output power (kW DC) from PowerPlus is indeed greater than the T/R. However, the power delivered to the ESP fields is not equivalent to the energy consumed by the system. In order to get an accurate indication of the energy consumed by the respective power supplies, it is necessary to compare the kVA delivered to the T/R set and PowerPlus.

As you can see, PowerPlus delivers almost 12% more power into the ESP while using 25% less electricity. How is this possible?

For a more detailed technical explanation of this savings, please refer to our white paper "Analysis of kVA Savings with PowerPlus under Certain Conditions" which can be found at http://www.nwl.com/contents/view/121

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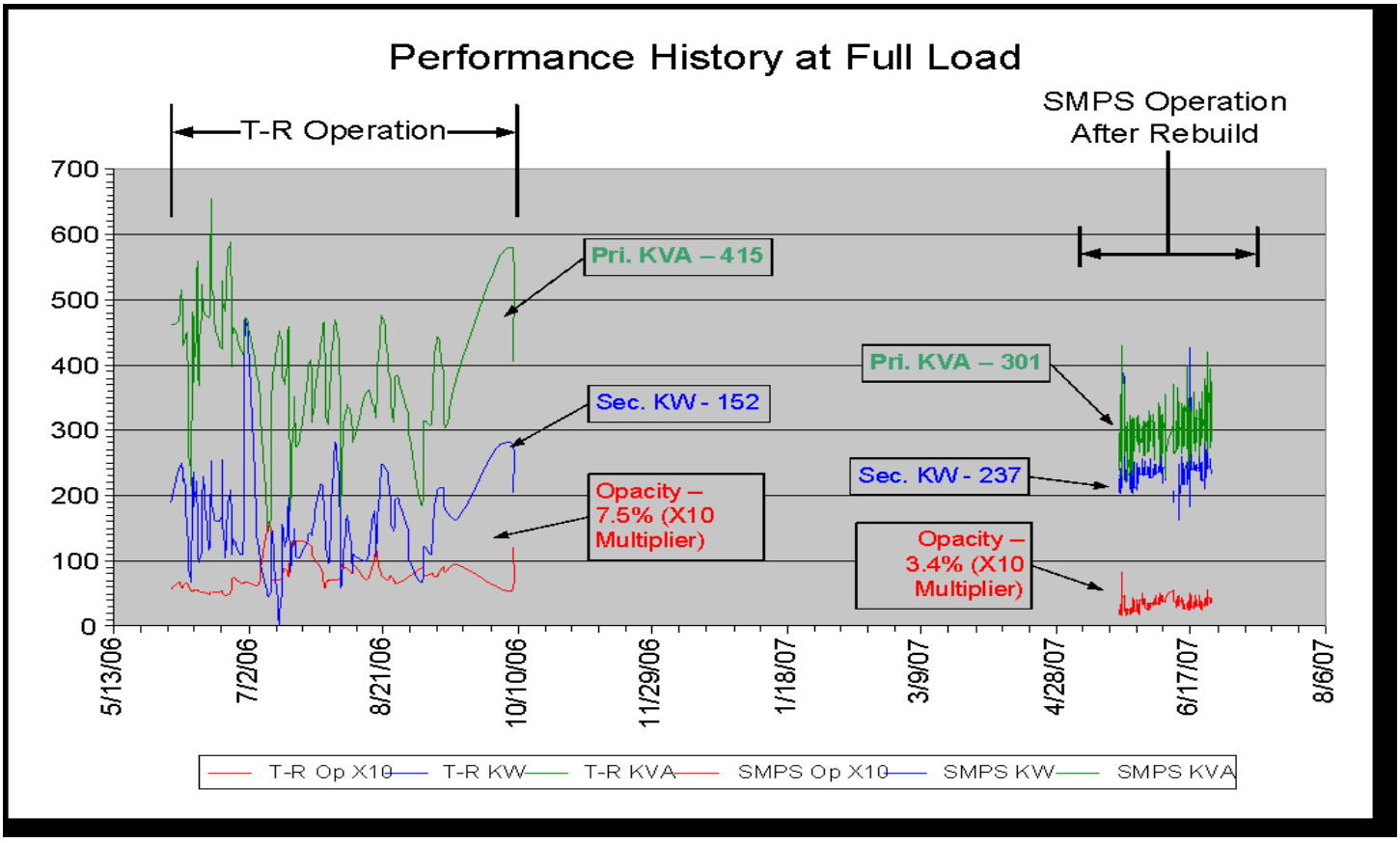
The answer is the difference in power factor between the two systems. There are three electrical reasons for low power factor in a linear T/R set:

1. The lagging current due to the 50% system inductive reactance of the CLR and transformer.
2. Due to the capacitive nature of the ESP load and the distorted waveforms produced by SCR operation, the rms value of the IAC is much higher than the IAVG.
3. SCRs operate by delaying the time at which they turn on following the zero crossing of the incoming voltage waveform. This phase delay makes the system even more inductive and reduces the power factor further.

For a standard T/R set operating at rated kVDC and mADC, the power factor is approximately 0.63. In real-world operation, a T/R set rarely runs at full rated output. Inlet fields tend to operate at high kVDC with suppressed mADC levels. As the exhaust gas moves to the ESP outlet, the kVDC levels tend to drop and fields tend to run at mADC current limit levels.

The disparity between PowerPlus and T/R power factors becomes even more pronounced at less than full rated output. For example, at 67% kVDC and 100% mADC, the T/R delivers 37.2 kW and PowerPlus 44.0 kW. The T/R input kVA is 98.4; the PowerPlus is 50.7. This is a kVA reduction of almost 50%!



Conclusion

The chart above is actual operating data from a customer who upgraded their ESP power supplies with PowerPlus. The readings on the left are from their T/R sets; the readings on the right show PowerPlus results. PowerPlus improves opacity (3.4 vs 7.5%) while putting more power into the ESP (237 vs 152 kW) and using less kVA (301 vs 415).

DISCLAIMER This tech note does not imply that every customer will achieve collection improvement AND reduce their power consumption; it states simply that it is possible to do so.