

## Performance Enhancements Achieved with High Frequency Switch Mode Power Supplies

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**Abstract:** The PowerPlus can provide kVdc outputs that range from fast IE (low to fractional ON and OFF times) to nearly pure DC as well as numerous operational modes in between these two limits. This provides maximum flexibility in obtaining optimum ash collection from various fossil fuels.

With its high power factor, the PowerPlus unit provides much more kW into the ESP while requiring less kVA from the source when compared to conventional units.

The reduced size and weight and less dielectric fluid of the PowerPlus allows for easier installation and service, less fire and environmental hazard, less field wiring costs, and lower total installed costs.

The PowerPlus represents the future of power supply technology for ESP's, and will soon be the standard solution for powering ESP fields. Any user considering New ESP's or upgrades to ESP's should be fully well aware of PowerPlus technology and its potential for enhancing ESP performance.

**Keywords:** PowerPlus, Switch Mode Power Supply

### 1 INTRODUCTION

Switch Mode Power Supplies (SMPS) have shown considerable promises in many electrostatic precipitator applications. They have been applied to many different ESP applications, including coal-fired boilers producing low and high resistivity fly ash, wood fired boilers, and Wet ESP's. All installations have shown Improvements with some showing significant improvements in Precipitator performance.

Enhanced Collection Efficiency Due To Switch Mode Power Supplies, Electrostatic precipitator suppliers and users have recognized that the Switch mode power supply technology offers many advantages in the operation of ESP's.

- SMPS units offer a smaller; lighter, integrated package that reduces installation and support costs.
- The improved power factor means that less kVA must be provided to a SMPS than a conventional (50/60Hz)

power supply in order to put the same power into a precipitator field.

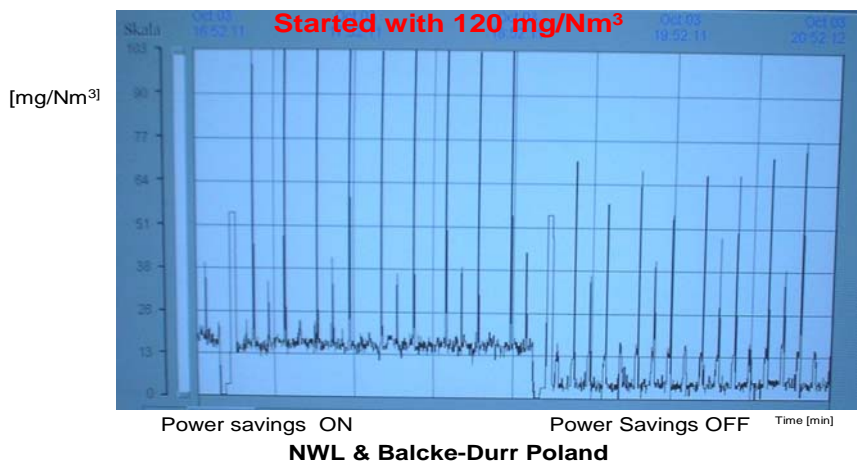
- The SMPS provides a faster control response and better IE control
- Due to their ability to deliver a higher average voltage and current to the ESP load
- Can operate just below the sparking level and/or the back corona level for higher resistivity ashes.

This growing body of evidence is supporting the fact that the new switch mode power supplies provide improved collection for many precipitator applications.

Each of these factors also offer potential cost savings for both new and retrofit installations. Lower power consumption due to the improved power factor will result in direct cost savings.

### 2 POWERPLUS RESULTS

#### Outlet dust concentration after SMPS installation and flow correction on ESP #2, in Poland



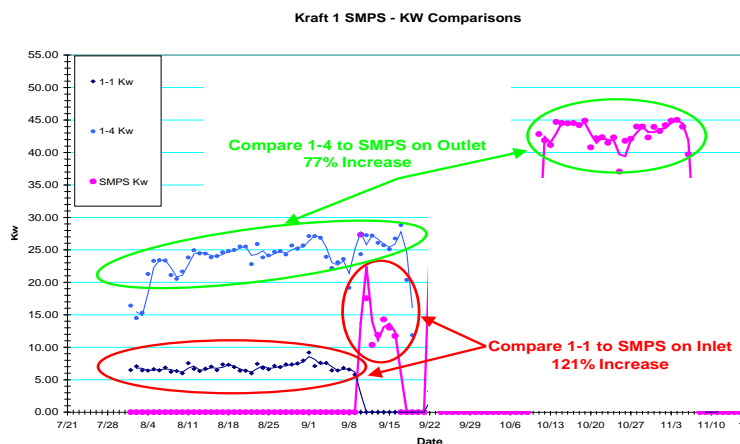
Before modernization of an ESP in Poland  
 the original ESP's supplier guarantee was  
 170mg/Nm3 for gas flow 900 000Nm3/h

Guarantee given before work started at 50 mg/Nm3 at flow 900 000 Nm3/h.  
 base on the same coal quality.

Preliminary performance test results (gravimetric measurements)  
 from  
 Plant unit No 7 after modernization  
 (PowerPlus on 1st fields & gas distribution corrections):

Gas flow at 225MW was 960 000Nm3/h wet gas  
 and  
 outlet dust concentration average 18mg/Nm3 dry gas & 6% O2

### Results at Plant Kraft unit # 1 US

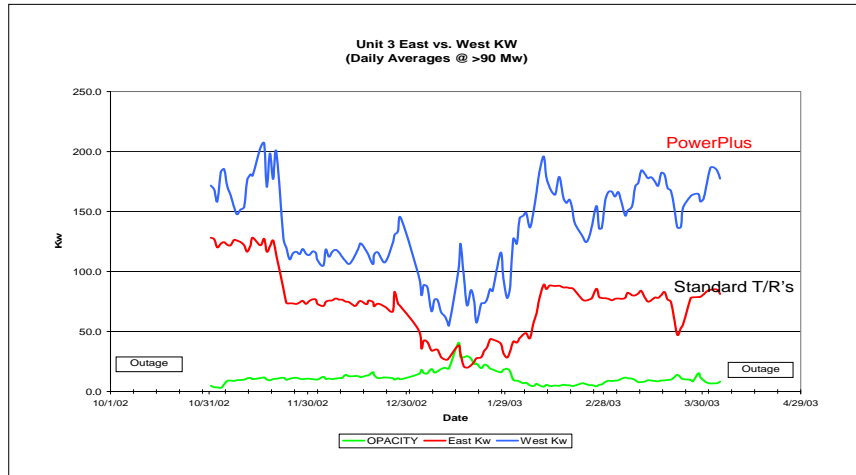


The Purpose of this test was to discern how much more KW could be put into this ESP and at what location would we get the best results When PowerPlus was installed in the first field we did get also better results in the 3 other esp. fields as can be seen below.

### Results of Phase 2 at Plant Kraft Assist applied to downstream T-Rs by SMPS

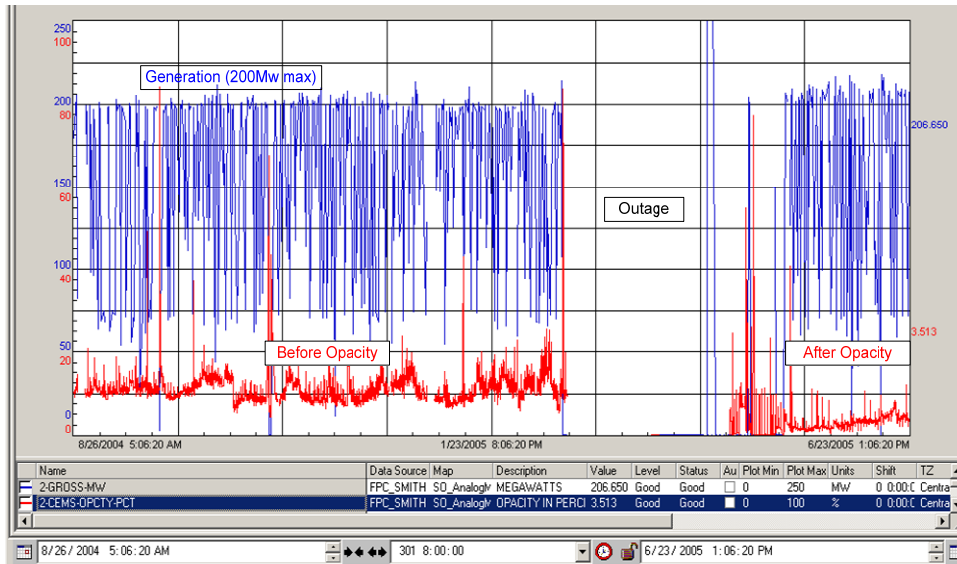
Average KW of T-R 1-2 Before SMPS on Inlet	11.19
Average KW of T-R 1-2 with SMPS on Inlet	14.38
Increase / Decrease (%)	➔ 28%
Average KW of T-R 1-3 Before SMPS on Inlet	17.91
Average KW of T-R 1-3 with SMPS on Inlet	20.34
Increase / Decrease (%)	➔ 14%
Average KW of T-R 1-4 Before SMPS on Inlet	23.38
Average KW of T-R 1-4 with SMPS on Inlet	24.96
Increase / Decrease (%)	➔ 7%

### Plant Kraft Unit # 3 PowerPlus Verse Standard T/R

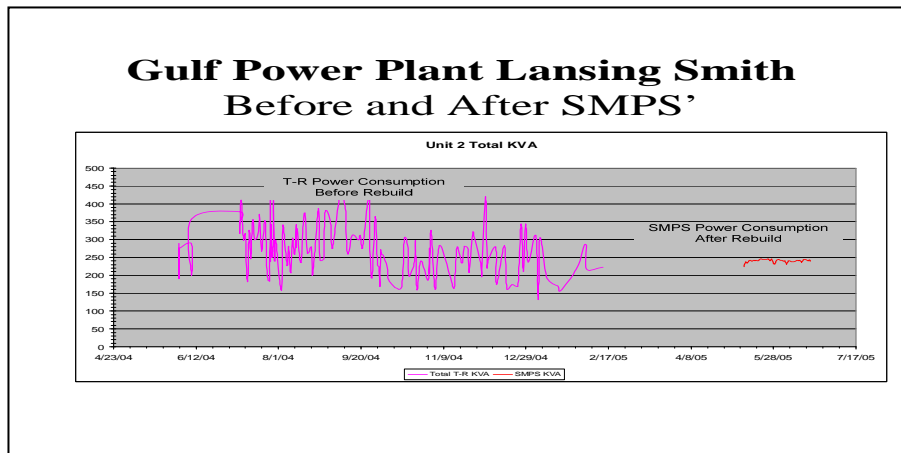


Test over a 6 month period under different load condition proved that PowerPlus always produced more KW into the ESP

### Gulf Power Plant Lansing Smith



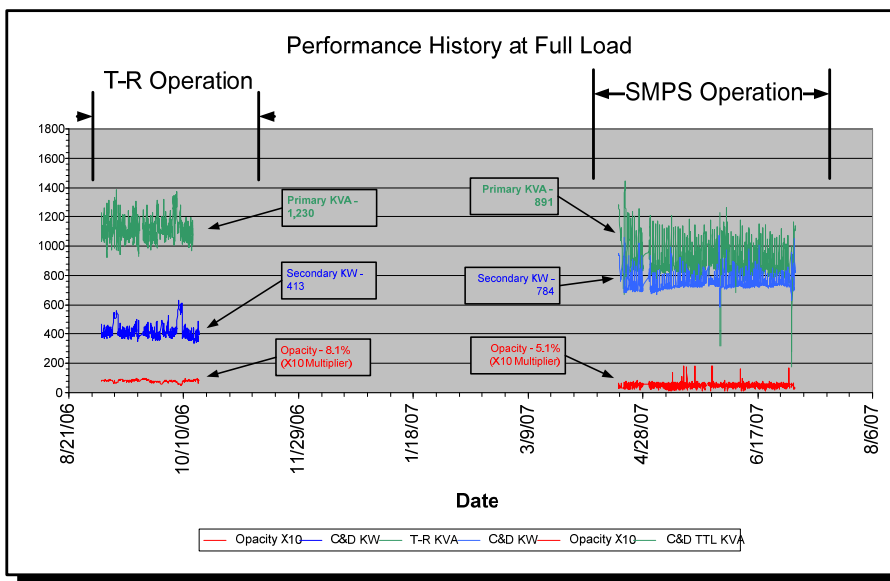
After installation of PowerPlus achieved 70% opacity reduction







## Plant Barry 5C&D



## Cost savings Barry 5C&D

Barry 5 Performance Summary											
Performance Comparison											
T-Rs					SMPS'						
Test Period	Cdtn	Op	KW	KVA	Test Period	Cdtn	Op	KW	KVA		
9/6-/10/16/06	Base		8.1	413.4	1129.8	5/21/-6/24/07	Base	5.1	784.0	891.0	
Change (%)								-59%	-47%	-27%	
Change (Pt)								-3.0	370.6	-238.8	
KW										224.499	
Savings (\$/yr)											\$58,190.22

### General PowerPlus Benefits

We have seen the following general improvements on ESP's per formant's after PowerPlus was installed.

#### Rebuilds

- 10-15 % more KV
- 20-30 % more ma for coal up to 5Ex10<sup>10</sup> ohms centimeter

#### New units

- 15-18% more KV
- Up to 50 % more ma for coal up 5Ex10<sup>10</sup> ohms centimeter