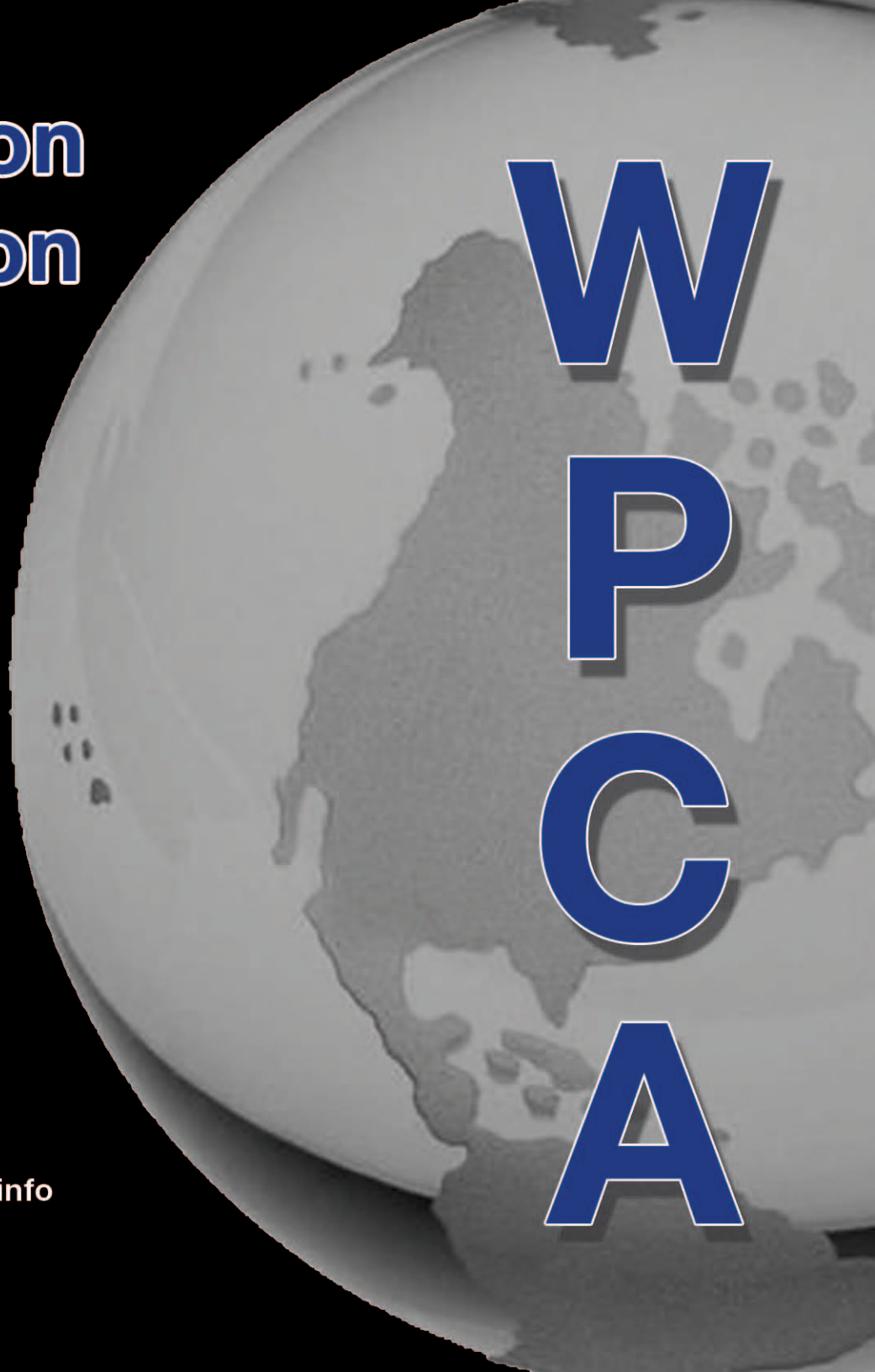
Worldwide Pollution Control Association



Duke Energy Seminar

September 3 – 5, 2008

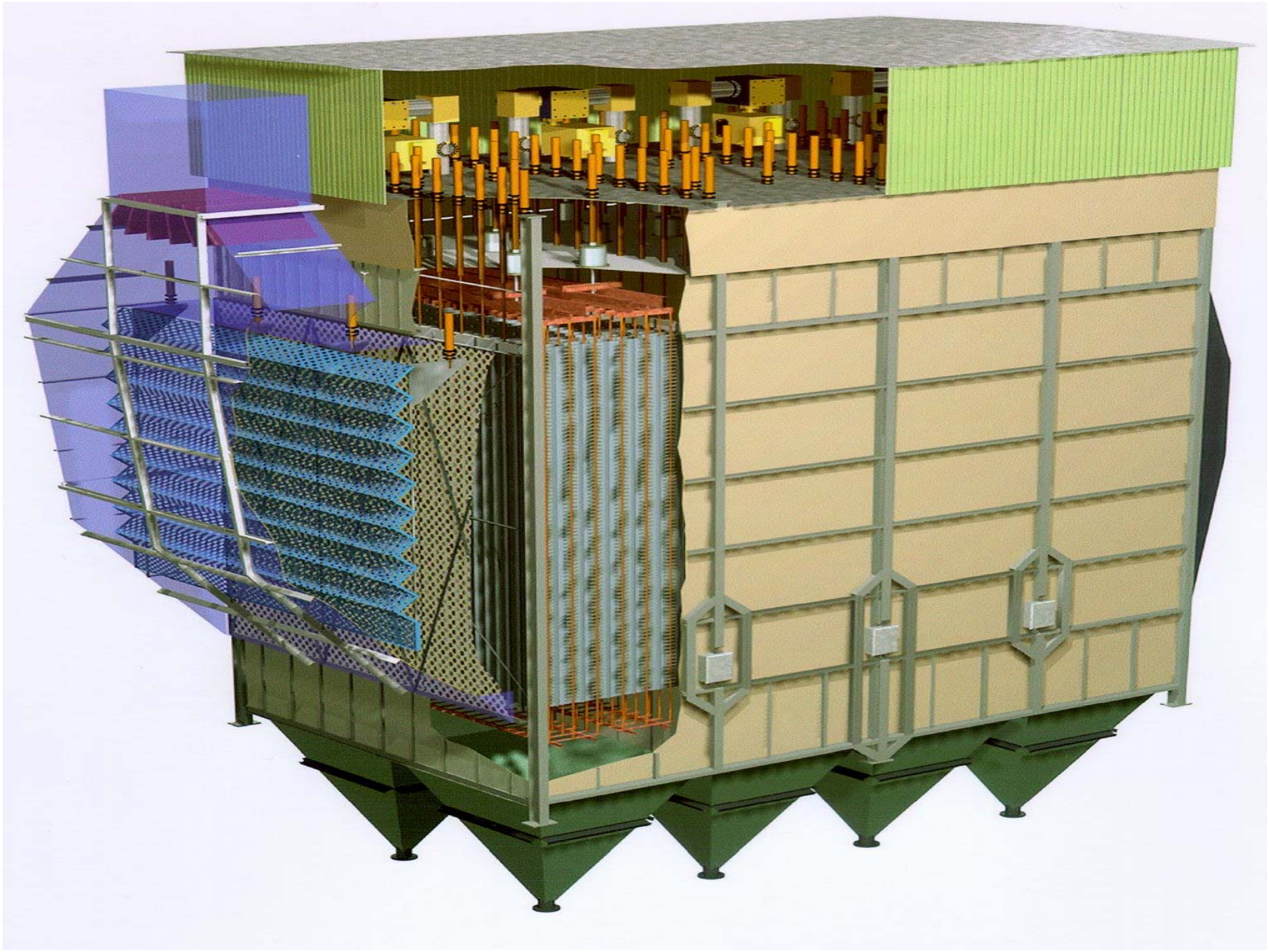
Concord, NC

WPCA

Vist our website at www.wpca.info

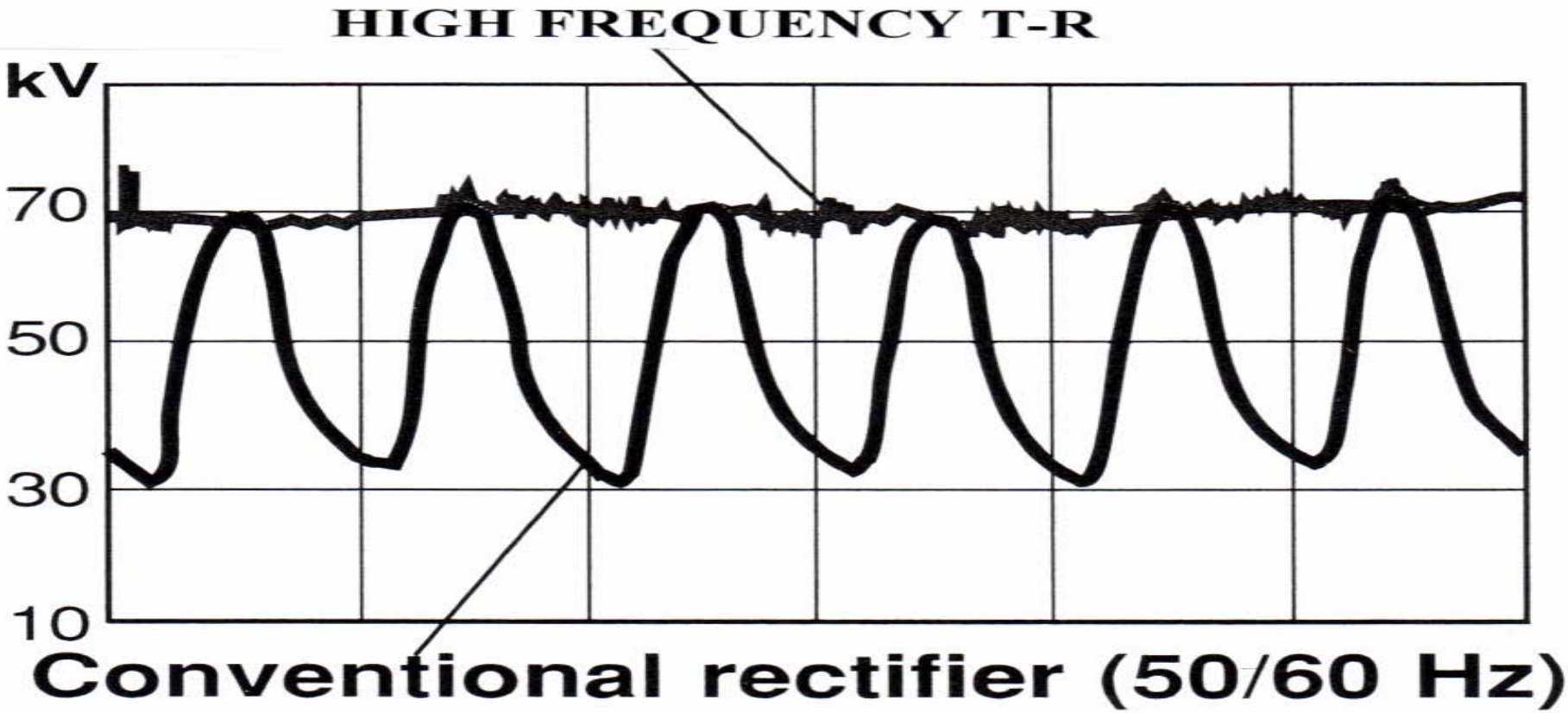
APPLICATION CALCULATIONS ON THE IMPACT OF HIGH FREQUENCY T-Rs ON ESP SIZING

ROBERT MASTROPIETRO
LODGE-COTTRELL INC.

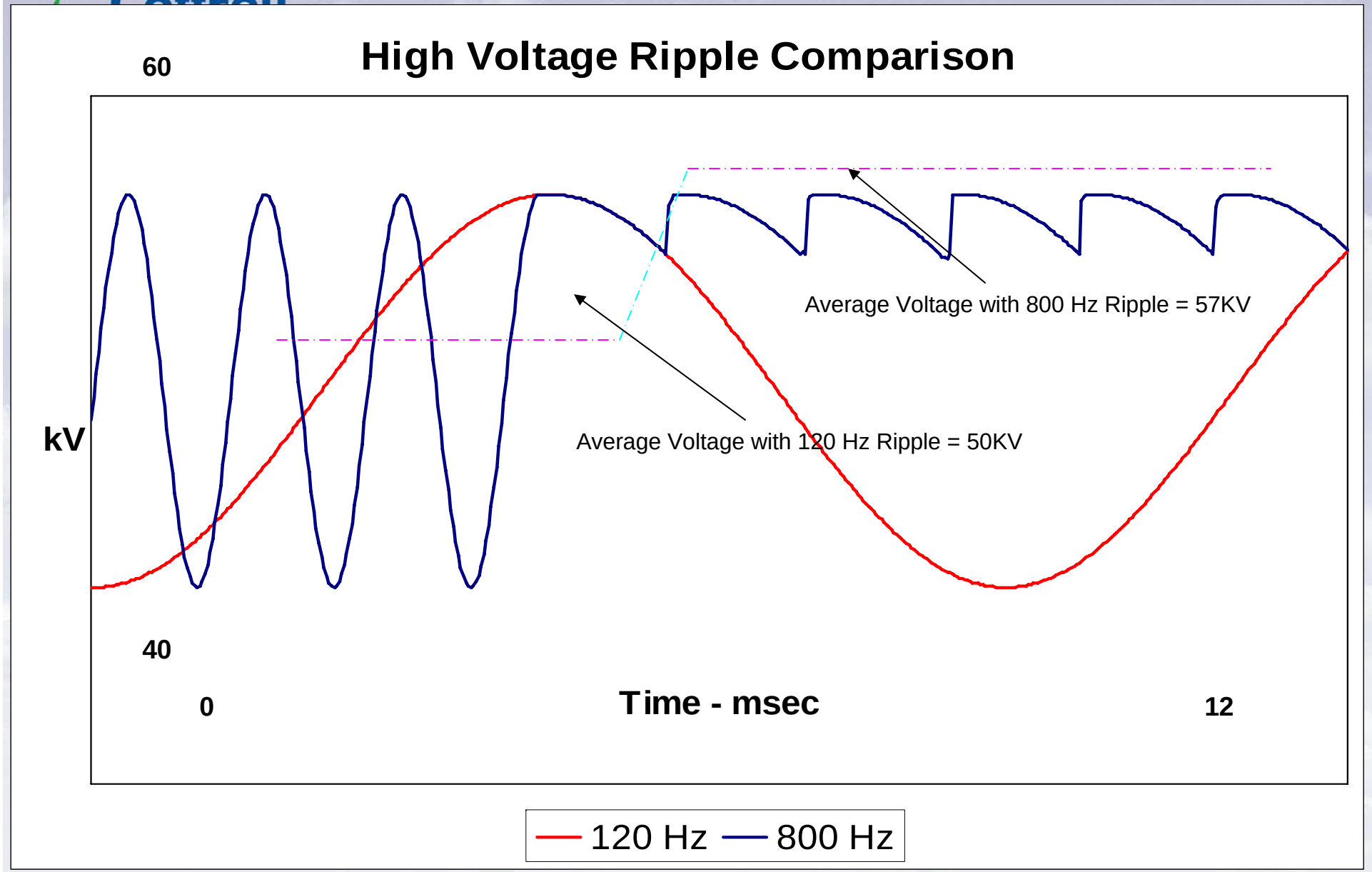


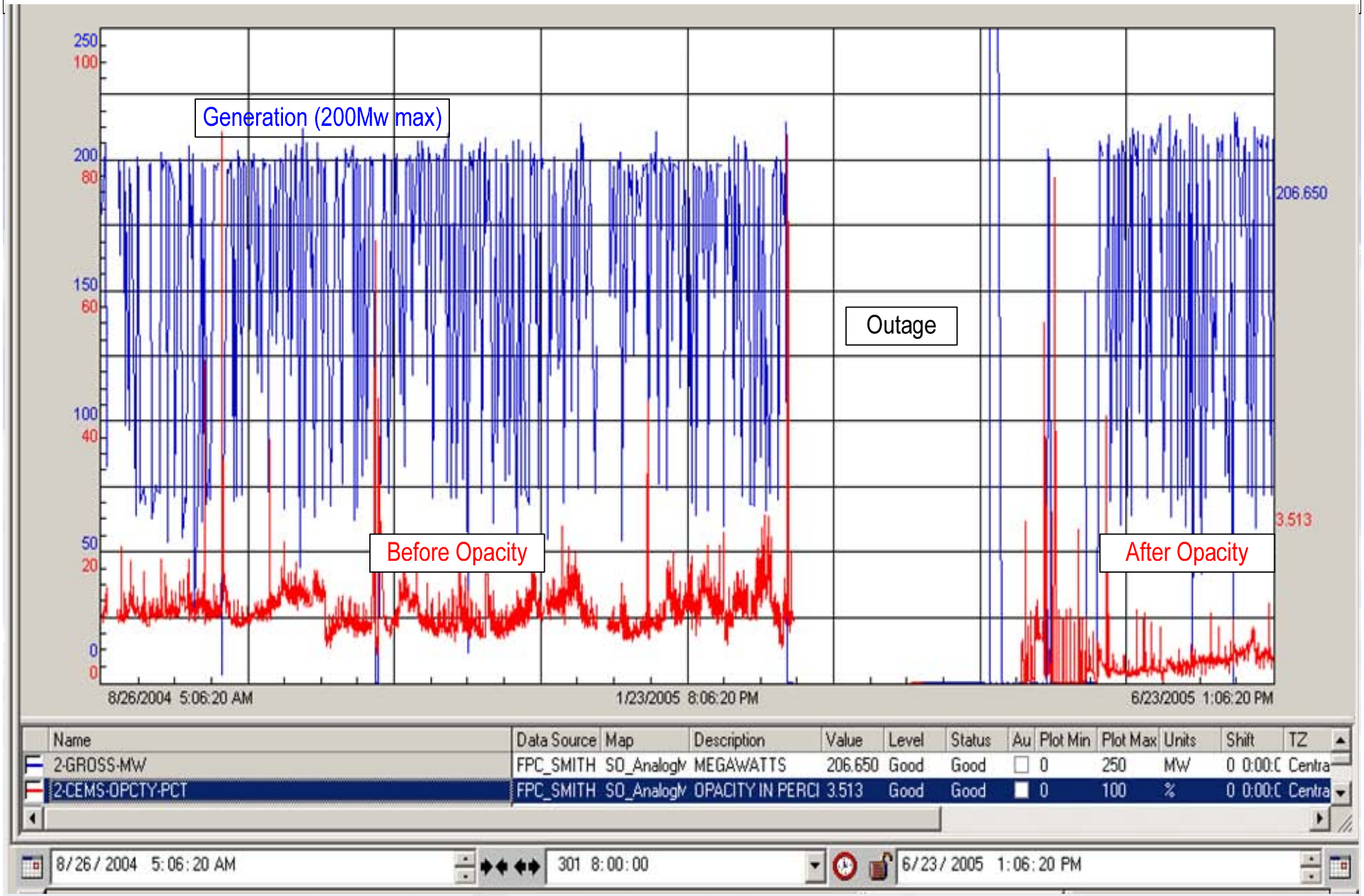
VOLTAGE WAVEFORMS

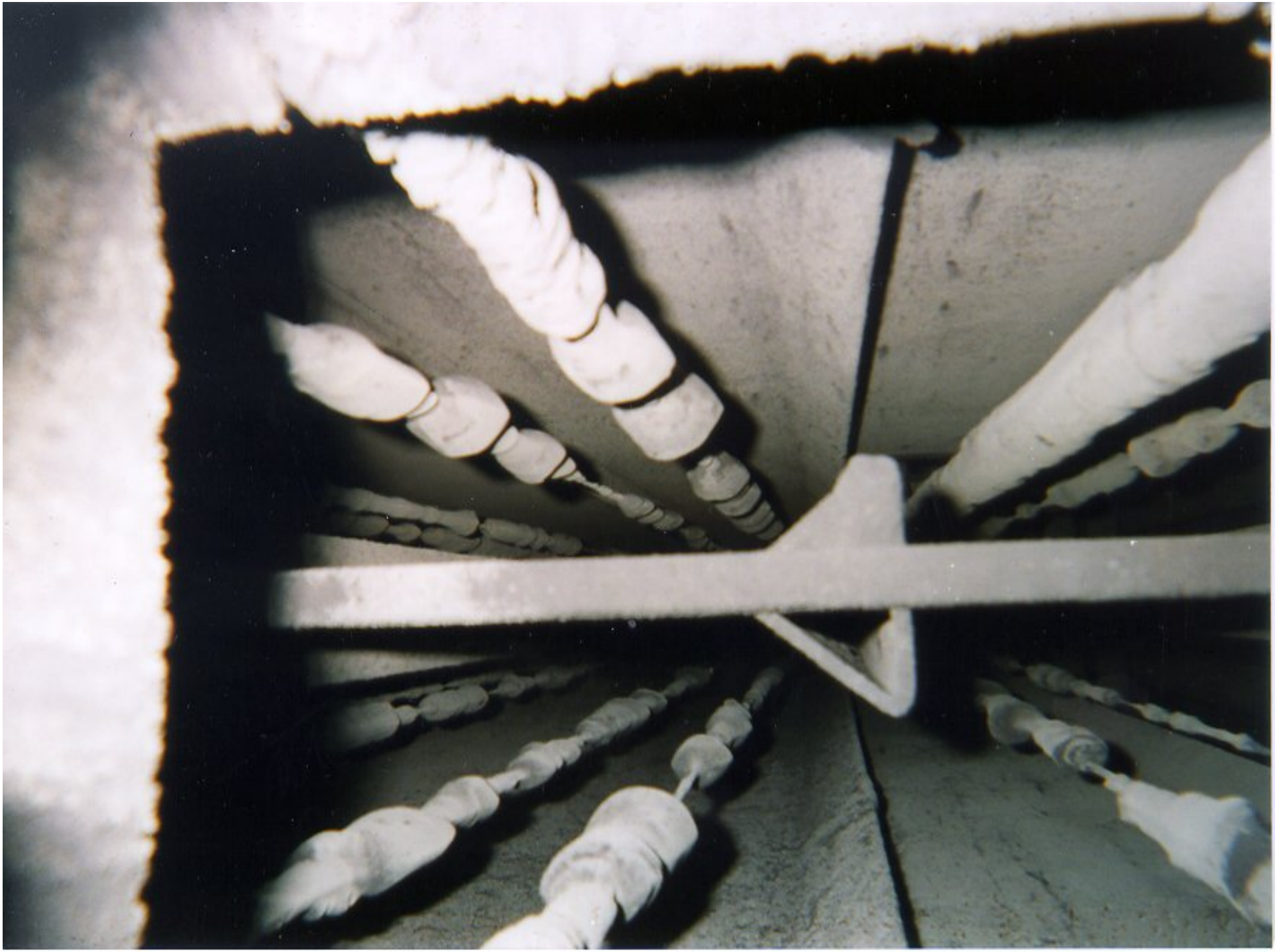
HIGH FREQUENCY vs. CONVENTIONAL T-Rs

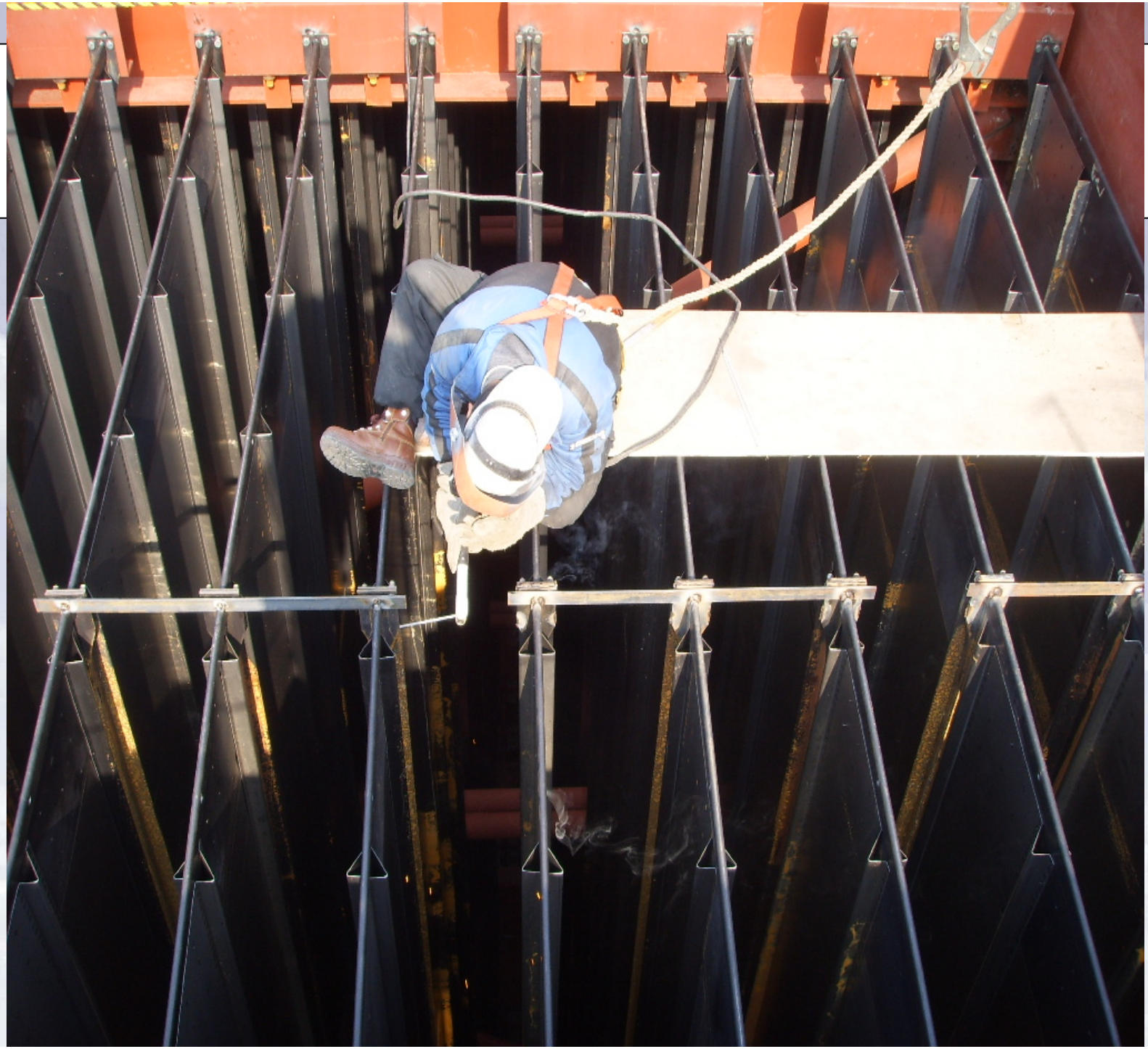


The ripple-free DC output from
compared with a conventional rectifier


High Voltage Ripple Comparison
60
kV
40
0
Time - msec
12
Average Voltage with 800 Hz Ripple = 57KV
Average Voltage with 120 Hz Ripple = 50KV
120 Hz
800 Hz


Generation (200Mw max)
Outage
Before Opacity
After Opacity
206.650
3.513
250
100
200
80
150
60
100
40
50
20
0
0
8/26/2004 5:06:20 AM
1/23/2005 8:06:20 PM
6/23/2005 1:06:20 PM
Name
Data Source
Map
Description
Value
Level
Status
Au
Plot Min
Plot Max
Units
Shift
TZ
2-GROSS-MW
FPC_SMITH
SO_Analog
MEGAWATTS
206.650
Good
Good
0
250
MW
0 0:00:0
Centra
2-CEMS-OPCTY-PCT
FPC_SMITH
SO_Analog
OPACITY IN PERCI
3.513
Good
Good
0
100
%
0 0:00:0
Centra
8/26/2004 5:06:20 AM
301 8:00:00
6/23/2005 1:06:20 PM

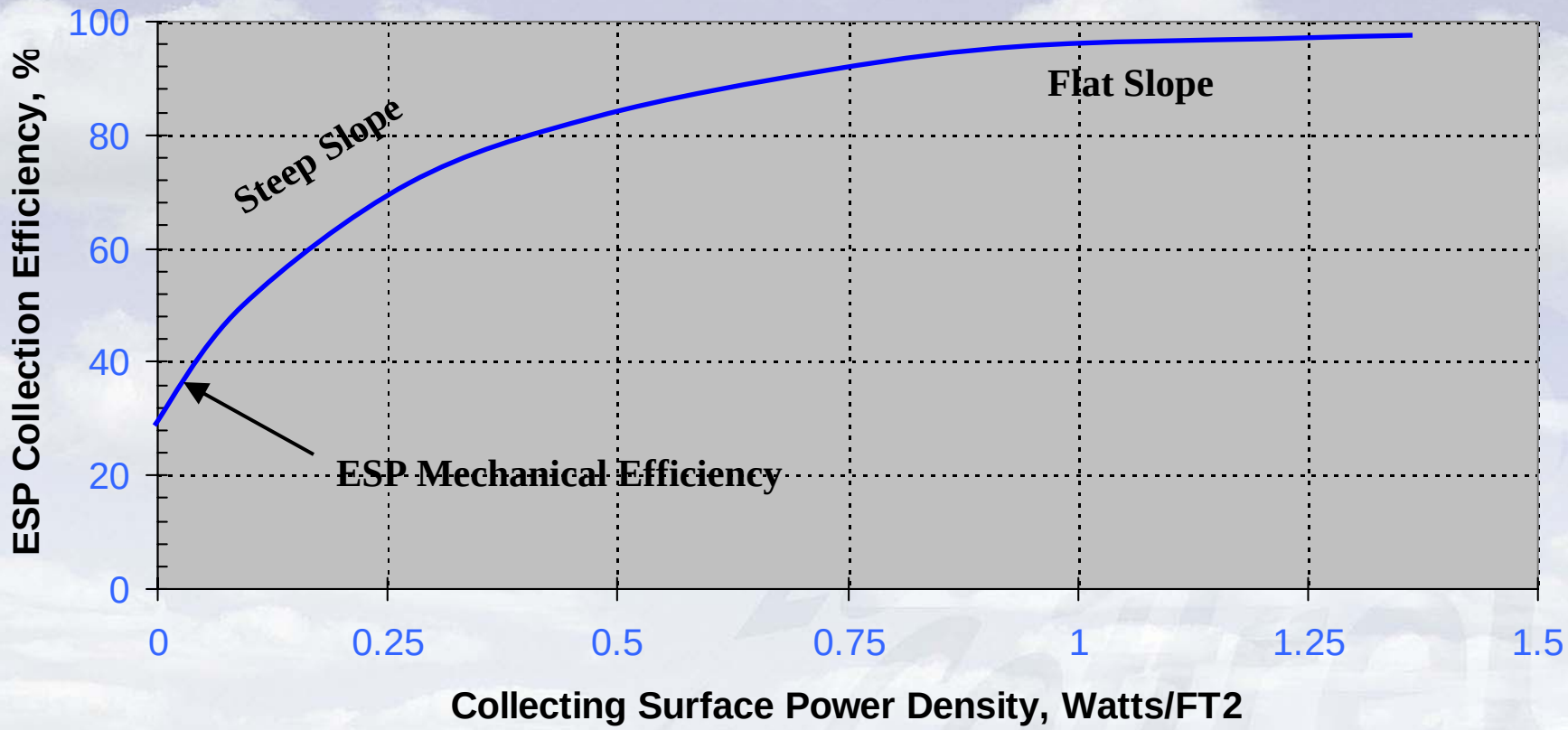




Reliability and Performance Enhancing Improvements in ESPs During Rebuilds

- Electrodes cleaned by rapping and thermal effects.
- Electrodes realigned and broken electrodes taken out.
- Insulators cleaned and broken insulators replaced.
- Replace weighted wires with rigid mast type designs.
- Collecting plates that “ring” better with rapping.
- Add rappers to reduce electrode build-up & re-entrainment.
- Adding T-Rs reduces % of surface affected by each spark.
- Gas flow modifications and hopper baffling
- High frequency T-Rs maximize power/minimize sparking.

Typical ESP Power vs. Performance
(For use in Title V Power Monitoring Strategy)



Lodge Cottrell

COAL-FIRED500MW ESP

DEUTSCH – ANDERSON EQUATION

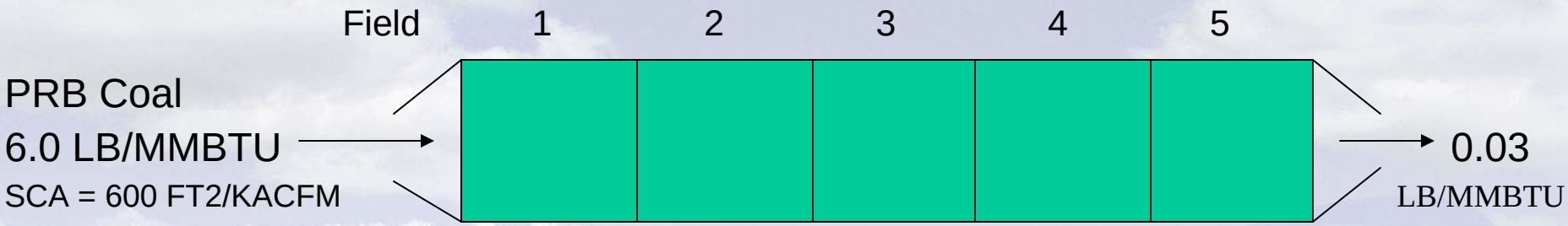
Standard Deutsch Equation (1922)

$$\text{Efficiency} = 1 - e^{-(A/V*w)} = 1 - e^{-(SCA/16.67*w)}$$

Modified Deutsch Equation (1964)

$$\text{Efficiency} = 1 - e^{-(A/V*wk)^{y}} = 1 - e^{-(SCA/16.67*wk)^{y}}$$

ESP Performance Calculations as predicted by the Modified Deutsch Equation with 0.6 Exponent



Field Inlet loading	6.0	0.80	0.28	0.12	0.058 LB/MMBTU
Field outlet loading	0.80	0.28	0.12	0.058	0.03 LB/MMBTU
Field collection efficiency	86.7	64.7	56.7	52.0	48.3 %

CONCLUSIONS FROM MODIFIED DEUTSCH PREDICTIONS

- **Collection efficiency drops from inlet to outlet fields, due to particle size effects.**
- **Collection efficiency in the outlet field approaches 50%. This is approximately the same collection efficiency as the most optimistic claims for high frequency T-Rs.**
- **This outlet field comprises 20% of the total ESP treatment time.**

APPLICATIONS SUMMARY

- If high frequency T-Rs truly reduced particulate emissions by about one-half, this would correspond to a required ESP size decrease of about 20%.

- If however, the reported one-half decreases in particulate came partly from ESP cleaning/repairs and partly from adding high frequency T-Rs, then required ESP size decrease would be more in the range of only 5-10%.

- If the ESP has properly designed electrode geometry and is getting high power levels with a conventional 60 Hz T-R, then the ESP size requirement may not be greatly impacted by adding high frequency T-Rs. Then the required ESP size decrease with high frequency T-Rs would be in the range of 0-10%.