Power Supply for ESP application
Kraft Classic single-phase CC + TR unit

Output characteristics

- High voltage ripple ≈ 40 - 50 %
- Average voltage ≈ 75 - 80 % of peak voltage
- Ripple frequency = 120 Hz

- From 50 kV to 150 kV and from 100 mA to 4500 mA
- Two units CC + TR
Kraft Classic 3-phase CC + TR unit

- Up to 150 kV and 4500 mA
- Two units CC + TR
- Lower output ripple compared to single-phase TR

Output characteristics

- Low voltage ripple ≈ 1 - 2%
- Average voltage ≈ 98 - 99% of peak voltage
- Ripple frequency = 360 Hz
High Frequency SMPS unit "SmartKraft +"

- Primary switched HF technology
- Up to 90 kV-1600 mA ( 72kV -1800 mA)
- One unit – No separate Control Cubical
- Low weight = 25% to 50% of T/R

Output characteristics

- Very low voltage ripple < 1 %
- Average voltage ≈ peak voltage
- Ripple frequency = 24 kHz
- Highest Power Factor

![Graph of output characteristics](image)
MicroPulse 2

Is design by integration of 2 separate power supplies: DC + Pulse

Output characteristics

- Very high voltage peaks and high pulse current
- DC voltage with low ripple
- Pulse repetition frequency = 2-100Hz
- Increase voltage peaks by the shore pulse length

- Output DC Voltage : 60kV
- Output DC Current : 1000mA
- Output Peak Voltage: 140kV
### Summary waveform comparison

#### Single-phase TR unit
- 120 Hz current ripple
- Results in ≈ 35-45 % ripple voltage on an ESP load
- Voltage peaks limits the current into the ESP

#### 3-phase TR unit
- 360 Hz current ripple
- Results in ≈ 0.5-1.5 % ripple voltage on an ESP load
- 30–40% higher current into the ESP compared to single-phase TR

#### High frequency SMPS
- 24kHz current ripple
- Results in < 1 % ripple voltage on an ESP load
- 30–40 % higher current into the ESP compared to single-phase TR

![Waveform comparison graphs](image)
## Design Comparison

<table>
<thead>
<tr>
<th></th>
<th>SmartKraft DC</th>
<th>Competitor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Oil Cooled</td>
<td>• Air Cooled</td>
</tr>
<tr>
<td></td>
<td>• 12 IGBT’s</td>
<td>• 4-6 IGBTs</td>
</tr>
<tr>
<td></td>
<td>• Aluminium Tank</td>
<td>• Steel Tank</td>
</tr>
<tr>
<td></td>
<td>• Phase Shift Series Resonant Converter –</td>
<td>• Frequency Controlled Series Resonant</td>
</tr>
<tr>
<td></td>
<td>Amplitude Control</td>
<td>Converter</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SMPS waveforms for different topologies

**SmartKraft DC**  
Phase Shift Series Resonant Converter

**Competitor**  
Frequency Controlled Series Resonant Converter

Rated output 83kV 1000mA
SMPS waveforms for different topologies

**SmartKraft DC**
Current limited to 75% and 50%

**Competitor**
Current limited to 75% and 50%
Safety
Internal switch connects TR to ground

**Keystones**

- In order to ground the power supply and/or the ESP
- Internal in the tank for difficult environments
- Possible to use limit switch and key interlock
Connect TR to ground externally

Keystones

- For grounding the power supply and/or the ESP
- Limit switch and key interlock is possible
Automatic Grounding Switch AGS

Keystones

• For grounding the power supply and/or the ESP in less than one second
• Remote function
• Integrated Limit Switch
• IP54
• Wide working temperature range
Control
Next Generation of Advanced Controller of ESP Power supplies

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SmartESP™: Automatic Control of ESP Power supplies parameters based on ESP performance</td>
<td>Remote monitoring via variety of communication protocols as well as Internet</td>
</tr>
<tr>
<td>All in one Hardware to control Single, three Phase or HF ESP power supplies</td>
<td>Support most of industrial communication protocols</td>
</tr>
<tr>
<td>VI Curve function</td>
<td>Datalogger function</td>
</tr>
<tr>
<td>Simple oscilloscope function</td>
<td>Export data, setting parameters and oscilloscope waveform to the USB flash memory</td>
</tr>
<tr>
<td>Bootloader and upgrade firmware via USB</td>
<td>SoftPLC/DAQ function. No limit of customized IO number.</td>
</tr>
<tr>
<td>Intermittent Energization Mode &quot;IE&quot;</td>
<td>Individual program can be saved for different setting</td>
</tr>
<tr>
<td>Spark Control</td>
<td>Support more than 14 languages per request</td>
</tr>
<tr>
<td>Back Corona Control</td>
<td>CO and Voltage reduction</td>
</tr>
<tr>
<td>Rapper Control</td>
<td>Opacity Control</td>
</tr>
<tr>
<td>Control mode in both Voltage and Current</td>
<td>Auto-Restart function</td>
</tr>
</tbody>
</table>
MK2 / MK3 to MK4 retrofit Kit

Upgrade your existing Control Cabinet in no time

Short Delivery time and installation

Access to all MK4 features and values

NO need to change DCS/PLC program

Less cost and investment
Control Cubicles

Keystones

- ESP power supply control
- Control system communication
- ESP rapper & heating control
- Optional enclosure ratings
- Combine to one line, save space
NetKraft
keeps your ESP under smart control
From anywhere

- Cut investment cost
- Increase efficiency
- Prevent unplanned shutdown
- Better Performance
- Easy integrated to existing solution
NetKraft

Is your ESP management System

- Complete Control of ESP
- Support KP or customized Controller
- Web/LAN Server/Client Base
- Energy Management System
- Monitoring Features (data logger, trending/I curve, alarm handling, reporting and etc)
- Customized I/O configuration possibilities.
TR and Control Replacement Options
Single-Phase T/R Retrofit
AEP Oklaunion
Controller Retrofit
AEP Oklaunion
Case Studies
KraftPowercon ESP upgrade solution

PROJECT STEPS
1. Replace ESP electrodes
2. Replace rapper heads
3. To be sure there is no major failure in ESP shell and case.
4. Change both TR to SmartKraft™ on both fields

Plant information
Plant Name: Gleifar
Geographical: Spain
Size: 7 MW
Fuel: Biomass-Wood chips
Process Type: Initially in 1987 the precipitator was designed for a pulp mill, but today the process is the generation of electricity through a boiler burning forest biomass.

ESP information
Type: Hakt
No of Chamber: 1
No of Field: 2
Age: 1987

Before retrofit
Type: Single phase Transformer and control cabinet
Rating: 70kV 400mA
Age: 1967
MFG: TR: Kraftlektronik, Controller: ABB, EPIC
Emission level: Average more than 300 mg/m³

SmartKraft+
Type: SmartKraft HFS MPS
Rating: 80kV 800mA
Target Emission Level: Less than 150 mg/m³
Final Emission Level: Average less than 27 mg/m³
Project Time: from inspection till end of retrofit 5-6 weeks
Downtime: Less than a week
Project date: April 2017

RELIEF

300 mg/m³

27 mg/m³
**Project steps**

1. KP SMPS installed on first and second fields, the original Longking SMPS installed on 3rd and 4th fields, the original Longking single phase PSUs installed on fields 5th and 6th.
2. To be sure there is no major failure in ESP shell and case.

**Before retrofit**

- **Type**: SMPS + Single phase
- **Transformer and control cabinet**
- **Rating**: SMPS 72kV/1000mA, TR 60/1000
- **Age**: 2014
- **MFG**: China Longking
- **Emission level**: 39.4 mg/m³

**ESP information**

- **Plant name**: Huaneng Yimin Power Plant Boiler 2#
- **Company**: Huaneng Power Group
- **Website**: www.mhncwz.com
- **Geographical**: Yimin town, Neimenggu Province, China
- **Size**: 500MW
- **Process Type**: Coal Power Plant
- **Fuel**: Coal
- **Type**: Russian
- **3TA2-108-9-6-6
- **No of ESP per boilers**: 3
- **No of chambers**: 4
- **No of fields**: 6
- **Age**: 1998

**PROJECT STEPS**

- **39.4 mg/Nm³** Level
- **Below 20 Nm³** Target
- **Below 20 Nm³** Result

**UPGRADE**

- **Type**: SmartKraft HF-SMPS
- **Rating**: 80kV 1600mA
- **Target Emission Level**: Less than 20 mg/m³
- **Final Emission Level**: Average less than 20mg/m³
- **Boiler shutdown date**: About 4 weeks
- **Project date**: Dec-2017

Contact KraftPowercon to learn how you can benefit from ESP upgrade solution.

www.kraftpowercon.com/esp

info@kraftpowercon.com
KraftPowercon ESP upgrade solution

Project reference

KraftPowercon ESP upgrade solution

PROJECT STEPS
1. Normal maintenance of ESP
2. Change both TR to SmartKraft™ only in first field

<table>
<thead>
<tr>
<th>Level</th>
<th>Target</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 mg/m³</td>
<td>40 mg/m³</td>
<td>25 mg/m³</td>
</tr>
</tbody>
</table>

Plant information
- Geographical: Poland
- Size: 70MW

ESP information
- No of Chamber: 2
- No of Field: 3
- Age: over 25 years old

Before retrofit
- Type: Single phase Transformer and control cabinet
- Rating: 100kV 1100mA
- Age: 1987
- Emission level: Average 50 mg/m³

Contact KraftPowercon to learn how you can benefit from ESP upgrade solution.
www.kraftpowercon.com/esp
info@kraftpowercon.com
Project reference

PET COKE

Plant information

Plant name: Raishree Cement works
Company: Ultratech cement Limited
Geographical: India
Size: 235 TPH (Klin load)
Process Type: Clinker Cooler ESP
Fuel: Pet coke

ESP information

Type: Clinker Cooler ESP
No of Chamber: 1
No of Field: 3
Age: 1999 Approx.

Before retrofit

Type: Single phase Transformer and control cabinet
Rating: 110 KV / 700 mA
MFG: TR-Ador, Controller: BHA make, Sa-300
Emission level: 50 to 70 mg/Nm³

PROJECT STEPS

1. Change the existing single phase TR to three phase TR.
2. Some mechanical damages were found and got it corrected under our supervision.

<table>
<thead>
<tr>
<th>Level</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>65 mg/Nm³</td>
<td>Level</td>
</tr>
<tr>
<td>30 mg/Nm³</td>
<td>Target</td>
</tr>
<tr>
<td>24 mg/Nm³</td>
<td>Result</td>
</tr>
</tbody>
</table>

KraftClassic 3PH

Type: Three Phase TR set
Rating: 95 KVP / 900 mA
Target Emission Level: Below 30 mg/Nm³
Final Emission Level: 25 mg/Nm³
Project time: For supply of three phase TR set it takes 8 weeks and 6 days for erection and commissioning
Downtime: Less than 6 days
Project date: Jan-2017

Contact KraftPowercon to learn how you can benefit from ESP upgrade solution.

www.kraftpowercon.com/esp
jain@kraftpowercon.com
KraftPowercon ESP upgrade solution

PROJECT STEPS
1. Change the existing single phase TR to three phase TR

<table>
<thead>
<tr>
<th>Level</th>
<th>44 mg/Nm³</th>
<th>Below 25 mg/Nm³</th>
<th>Target 17.4 mg/Nm³</th>
<th>Result</th>
</tr>
</thead>
</table>

Before retrofit

- Type: Single phase transformer and control cabinet
- Rating: 90 KV / 600 mA
- MFG: Hrec
- Emission level: 44 mg/Nm³

Kraft Classic

- Type: Three Phase TR set
- Rating: 80 KVP / 600 mA
- Target Emission Level: Below 25 mg/Nm³
- Final Emission Level: 17.4 mg/Nm³
- Project time: For supply of three phase TR it takes 6 to 8 weeks and 3 days for erection and commissioning
- Downtime: less than a 3 days
- Project date: May 2017

Contact KraftPowercon to learn how you can benefit from ESP upgrade solution.
www.kraftpowercon.com/esp
info@kraftpowercon.com
Thank you for your attention