High Voltage Electrode Boiler

From POWER to HEAT for Steam or Hot water
Our electrode boiler has been designed and developed by our in-house engineers and manufactured in our workshop in Norway since 1990. Our boiler history goes all the way back to 1920. Thanks to our long experience, we were chosen to deliver the first steam boilers for Grid Regulation in the World.

Steam and hot water
The electrode boiler is delivered both in steam or hot water versions. Renewable energy can be used in steam grids and district heating networks. The electrode boiler is also a valuable backup boiler.

See our Electrode Boiler introduction video: www.parat.no/youtube

From renewable POWER to HEAT with PARAT electrode boiler

PARAT; boilers since 1920
Our electrode boiler has been designed and developed by our in-house engineers and manufactured in our workshop in Norway since 1990. Our boiler history goes all the way back to 1920. Thanks to our long experience, we were chosen to deliver the first steam boilers for Grid Regulation in the World.
Grid Regulation

The growing production of renewable power from sun and wind gives more and more often excess power in the grid. This power must be used, to stabilize the frequency of the current at 50 Hz. This is called grid frequency regulation.

Electrical grid regulation
Increasing power generation from wind and solar systems have created a demand for fast frequency regulation of the electrical power grids. The PARAT Electrode boiler can be used for primary regulation with less than 30 seconds response time from minimum to full load. Converting electrical power to heat makes it possible to accumulate renewable energy in periods of overproduction.

Backup boiler
Since electrical power will be available as a fuel in the future, the PARAT Electrode boiler will also be a valuable backup boiler in case of breakdown in the fired boilers or in the fuel distribution system.

Low power price
Even in countries where renewable energy is not yet significant in the power grid, the electrode boiler could be used in periods with low power prices e.g. in the night.

Typical SRL regulation curves at Infraserv Höchst, Frankfurt.
Steam Solutions

A steam grid is the perfect place to use excess power from renewable energy. When the electrode boiler runs, the traditional boilers can decrease their load and fossil fuel be saved.

Steam is produced in the water between the electrodes. The internal circulation system brings water to the electrodes in a ratio 10:1 for the evaporation. The output is controlled by a throttle valve that regulates the level in the upper chamber.

Steam accumulates in the upper part of the pressure vessel and is released through the main steam valve. If the steam pressure increases over the setpoint, the power is automatically regulated down.

An important parameter related to optimal function of the boiler is the water conductivity. The conductivity is continuously monitored to ensure that the boiler gives the correct output. When the conductivity exceeds the selected setpoint automatic blowdown is initiated.

**Super heating**

Electrical steam superheaters can be delivered separately with low voltage supply.

**Principle diagram of Electrode Boiler Steam generation system.**
By installing a thermal storage tank the capacity to receive large amounts of energy when the call for grid regulation is there. Thereafter the energy can be released from the tank when the client needs the heat. Hot water is generated by circulating the boiler water through the upper chamber where the electrodes are suspended. The boiler vessel is pressurized with nitrogen or a similar inert gas system, and due to the relatively low water volume the boiler also acts as an expansion vessel.

If temperature delivered to the client exceeds the setpoint, power of the boiler is automatically decreased. The output is controlled by a throttle valve that regulates the level in the upper boiler chamber.

An important parameter related to optimal function of the boiler is the water conductivity. The conductivity is continuously monitored to ensure that the boiler gives the correct output. When the conductivity exceeds the selected setpoint, automatic blowdown is initiated.

Our delivery includes piping, control valve and heat exchanger for heat supply to the district heating circuit.

A district heating network will always have the possibility to receive excess power from renewable energy. When the electrode boiler runs, the traditional boilers can decrease their load and save fossil fuel.
Weight data is given for 16 barg design pressure.

**Technical Specifications**

**Design codes**
We deliver the boiler CE marked according to PED/97/23/EC with boiler code EN12953. ASME stamp can be delivered as an option. The Electrode boiler is also available in EX version for installation in zone 2 hazardous areas. The Medium Voltage connection cell is designed according to EN 61936-1 for power installations.

**Boiler principles**
The boiler consists of an outer and an inner container. Inside the inner container, which is electrically insulated from the outer shell, the electrodes are suspended. The boiler is designed for 6 – 23 kV. Heat is generated by ohmic resistance in the water between the electrodes. The boiler acts as a pure ohmic resistance in the main circuit. The water and the inner container forms an insulated zero point in the star connection between the electrodes. PARAT has used this successful concept of electrodes since 1993. Thanks to the electrode geometry the current flux is so low that the electrodes are not worn out.

**Control system**
We have used our experience to develop a modern and robust boiler control system on the Siemens S7 Fail-safe PLC platform which is easy to use. The boiler is also available with PARAT remote monitoring system. This enables web-based remote monitoring of the boiler plant from anywhere in the world. This also includes online troubleshooting and upgrades of the control software from the PARAT service centre in Norway. Instrumentation can be 1oo2 or 2oo3.

**Steam boiler**

<table>
<thead>
<tr>
<th>Capacity (MW)</th>
<th>0-5</th>
<th>0-15</th>
<th>0-30</th>
<th>0-60</th>
</tr>
</thead>
<tbody>
<tr>
<td>D (mm)</td>
<td>2100</td>
<td>2350</td>
<td>2700</td>
<td>3500</td>
</tr>
<tr>
<td>H (mm)*</td>
<td>4800</td>
<td>5580</td>
<td>5800</td>
<td>6350</td>
</tr>
<tr>
<td>Transport weight (kg)</td>
<td>6500</td>
<td>8000</td>
<td>11000</td>
<td>16000</td>
</tr>
<tr>
<td>Operating weight (kg)</td>
<td>9000</td>
<td>12000</td>
<td>16200</td>
<td>25000</td>
</tr>
<tr>
<td>Test weight (kg)</td>
<td>14500</td>
<td>22000</td>
<td>30000</td>
<td>46000</td>
</tr>
</tbody>
</table>

*If circulation pumps is placed at same level as boiler, an additional height must be added for pump NPSH.

**Hot water boiler**

<table>
<thead>
<tr>
<th>Capacity (MW)</th>
<th>0-5</th>
<th>0-15</th>
<th>0-30</th>
<th>0-60</th>
</tr>
</thead>
<tbody>
<tr>
<td>D (mm)</td>
<td>2100</td>
<td>2350</td>
<td>2700</td>
<td>3500</td>
</tr>
<tr>
<td>H (mm)</td>
<td>4800</td>
<td>5580</td>
<td>5800</td>
<td>6350</td>
</tr>
<tr>
<td>Transport weight (kg)</td>
<td>4500</td>
<td>5000</td>
<td>7000</td>
<td>11000</td>
</tr>
<tr>
<td>Operating weight (kg)</td>
<td>7000</td>
<td>9000</td>
<td>12200</td>
<td>20000</td>
</tr>
<tr>
<td>Test weight (kg)</td>
<td>12500</td>
<td>19000</td>
<td>26000</td>
<td>41000</td>
</tr>
</tbody>
</table>

Weight data is given for 6 barg design pressure.

- From cold to full load in less than 5 minutes
- 30 seconds from minimum to full load
- Minimum load 0%
- No earth current
- Compact design - up to 60 MW in one unit
- No low voltage transformer required
- No Electrode wear
- Minimum maintenance required
PARAT Halvorsen AS
P.O. Box 173
NO-4402 Flekkefjord
Norway
Tel +47 99 48 55 00
Fax +47 38 32 44 71
office@parat.no
www.parat.no