TABLE OF CONTENTS:

- About us: KED
- Major features of Power Plant Simulator & Designer
- Typical applications (extract of multiple references)
- Additional modules

Power Plant Simulator & Designer
✓ ABOUT KED

➤ History:

- KED was established in 1975. Its main activities were piping calculations for nuclear power stations, the automotive and chemical industries, together with the development of computer programs.

- KED is the market leader in Germany with the programs Power Plant Simulator & Designer since 1995 and SHEET CAD and has the absolute best specialists in the field of fluid and structural dynamics and FE calculations.

- Pipeline calculation program Easypipe

➤ Management

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- 10 engineers and experts employed with different qualifications
Widely used by more than 150 Boiler-manufacturers & Operators:

- RWE Energie AG, Essen, Germany
- Nooter Eriksen, St.Louis, USA
- Florida Power & Light, West Palm Beach, Florida, USA
- Siemens AG, Erlangen, Germany
- Babcock & Wilcox USA and Denmark
- Alstom Power AG, Baden, Switzerland
- Babcock Kraftwerkstechnik GmbH, Oberhausen, Germany
- Siemens Westinghouse, Orlando, USA
- NEM, Leiden, Netherlands
- CMI Erie, USA
- Austrian Energy and Environment, Austria
- STF, Italy
- Keppel-Seghers Belgium NV, Willebroek, Belgium
- Balcke-Dürr, Vienna, Austria
- Thermax, Pune, India
- Bertsch-Energy, Bludenz, Austria
- Deltak, USA
- Standardkessel-Baumgarte, Duisburg, Germany
- CMI, Willebroek, Belgium
- TÜV Süddeutschland : Filderstadt, Dresden, Munich, Mannheim
- EDF, France
- Vyncke Energietechniek, Harelbeke, Belgium
- Wuxi Huaguang Boiler Co, Wuxi, China
- ....... and many other users of HRSG, Biomass, Coal, Oil-Gas, CFB, AFB boilerplants
- Major features of Power Plant Simulator & Designer
Main Features of Power Plant Simulator & Designer

- Nearly all kind of boilers, incl. HRSG, biomass steam & hot water boiler, Fluidized Bed Boiler
- Fully modular design structure and interconnections
- Selection between approx. 60 different elements (heat exchanger surface, spray cooler, control elements etc.)
- Almost any combinations of the heaters, coolers, combustion chambers are possible
- Complete water-steam circuit, incl. turbine, condenser, feed water preheater (high pressure and low pressure), feed pump, dearator etc.
- Combustion and post-combustion calculation (staged combustion), supplementary combustion (duct-burners)
- Complete thermal calculation, pressure drop, natural-, sub- and supercritical forced circulation calculation with all kinds of recirculation's
- Precise vaporization calculation in economizer
- Efficiency calculation (direct & indirect method, acc. EN-12952-15/ DIN 1942 and ASME PTC)
- Easy switch to nearly all units (SI, US, Imperial, mixed)
- Heat exchanger can be divided into zones to take different temperatures and mass flows into consideration
- Performance range from 100 kW to 1500MW
- Hot water and Thermal Oil boiler (shell tube, water tube and waste heat boiler)
Typical Features (flue gas scheme)

- Element with drag & drop in scheme
- Selection Element group
- Start simulation calculation
- Undo & redo button
- Selection of scheme
Typical Features (water-steam scheme)

- Element with drag & drop in scheme
- Selection of scheme
- Zooming
- Selection Element group
- Save File

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Main Features of Power Plant Simulator & Designer (2)

- Design mode calculation
- Easy multi-part load calculation (Multicalc),
- Tube bundle vibration calculation
- Natural circulation calculation, forced circulation
- Once through steam generators
- High pressure gas possible (real gas properties for e.g. reformer etc…)
- User-definable detailed input and output calculation data with Excel Files
- Extraction of specific data with Drag & Drop,
- User-definable graphical illustrations with diagrams
- Integration of own specific additional parallel calculations with script’s
- Creation of own data-bank (e.g. fuel analysis…)
- Undo-and Redo button, Help topics (F1 button), Language selection
- Error alerts and warnings
- Working in the networks
- Executable with MS Windows 95/98/NT/ME/XP/2000/Vista/Windows 7/8/10
Typical Example of detailed output data of WHB

<table>
<thead>
<tr>
<th>Properties</th>
<th>Value</th>
<th>Dimension</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>efficiency heat loss</td>
<td>84.17</td>
<td>%</td>
<td>Efficiency according to the heat loss method based LHV</td>
</tr>
<tr>
<td>efficiency input output</td>
<td>84.23</td>
<td>%</td>
<td>Efficiency according to input output method based LHV</td>
</tr>
<tr>
<td>Q_input</td>
<td>10747</td>
<td>KW</td>
<td>Heat output water/steam</td>
</tr>
<tr>
<td>Q_output</td>
<td>12780</td>
<td>KW</td>
<td>Heat input fuel/flue gas</td>
</tr>
<tr>
<td>Effนม</td>
<td>15289</td>
<td>KW</td>
<td>Nominal power</td>
</tr>
<tr>
<td>Overall heat power</td>
<td>0.00</td>
<td>%</td>
<td>Overall heat power</td>
</tr>
<tr>
<td>loss unburned carbon</td>
<td>0.00</td>
<td>%</td>
<td>Loss unburned carbon</td>
</tr>
<tr>
<td>q: enthalpy</td>
<td>1382</td>
<td>KW</td>
<td>Enthalpy of the enthalpy</td>
</tr>
<tr>
<td>q: enthalpy gas</td>
<td>2620</td>
<td>KW</td>
<td>Total heat losses</td>
</tr>
<tr>
<td>q: stacklosses</td>
<td>1821</td>
<td>KW</td>
<td>Heat loss through stack</td>
</tr>
<tr>
<td>q: Q2</td>
<td>0</td>
<td>KW</td>
<td>Heat power losses uncomplete burning (CO, CH, etc.)</td>
</tr>
<tr>
<td>q: Q3</td>
<td>0</td>
<td>KW</td>
<td>Heat power losses unburned fuel</td>
</tr>
<tr>
<td>q: Q4</td>
<td>182</td>
<td>KW</td>
<td>Heat loss (radiation+convection) by walls</td>
</tr>
<tr>
<td>q: Q5</td>
<td>8</td>
<td>KW</td>
<td>Heat loss with a set</td>
</tr>
<tr>
<td>q: Q7</td>
<td>0</td>
<td>KW</td>
<td>Heat of ash and other losses</td>
</tr>
<tr>
<td>Power loss unburned</td>
<td>0</td>
<td>KW</td>
<td>Heat loss unburned fuel inserted in the furnace</td>
</tr>
<tr>
<td>Pts1:BL Tol</td>
<td>84.12</td>
<td>%</td>
<td>Coefficient of black efficiency</td>
</tr>
<tr>
<td>Pts1:BL Neto</td>
<td>84.12</td>
<td>%</td>
<td>Coefficient of black efficiency netto</td>
</tr>
<tr>
<td>Qoutside</td>
<td>-10734</td>
<td>KW</td>
<td>Heat of outside air in steam</td>
</tr>
<tr>
<td>NenlNeed</td>
<td>0.00</td>
<td>KW</td>
<td>Electrical thermal needs power</td>
</tr>
<tr>
<td>actH1</td>
<td>0.00</td>
<td>KW</td>
<td>Total electrical turbine power</td>
</tr>
<tr>
<td>swCorrAshcMech</td>
<td>0.00</td>
<td>-</td>
<td>Switch circulation of ashes 0, 1, 2, 3, 4 - in furnace 5 - output</td>
</tr>
<tr>
<td>wetAir</td>
<td>1.2872</td>
<td>kg/m³ X 3</td>
<td>Wet air density under normal conditions</td>
</tr>
<tr>
<td>QunburnedDueTo Coke</td>
<td>0</td>
<td>KW</td>
<td>Heat power of unburned fuel (unburned coke)</td>
</tr>
<tr>
<td>Hou, unburned</td>
<td>0</td>
<td>KW</td>
<td>Humidity of water</td>
</tr>
<tr>
<td>usefulHeatDiff</td>
<td>3</td>
<td>KW</td>
<td>Useful Heat Difference of heat balance</td>
</tr>
<tr>
<td>Heat Diff</td>
<td>1</td>
<td>KW</td>
<td>Heat Difference of heat balance</td>
</tr>
<tr>
<td>eff_2</td>
<td>97.98</td>
<td>%</td>
<td>Efficiency gross acc. to input output method</td>
</tr>
<tr>
<td>eff_3</td>
<td>97.05</td>
<td>%</td>
<td>Efficiency gross acc. to heat loss method</td>
</tr>
<tr>
<td>LG_G_rOut</td>
<td>4867</td>
<td>KW</td>
<td>Power Loss of the flue gas gross to the reference temperature</td>
</tr>
<tr>
<td>G_Z</td>
<td>15010</td>
<td>KW</td>
<td>Power gross input</td>
</tr>
</tbody>
</table>

**General output data**

**Specific output data Superheater 2**
Typical Example of output diagrams for a WTE-Boiler
Typical Example of Input/output reports with excel file
Typical Options: Language, Schema, Dimension set-up, Document properties, Calculation options.
Typical Example of scripts
Typical Example of MCR (Multi-Calculation-Reports)
Typical applications (extract of multiple references)
Typical Boiler Applications: Compact WT oil/gas fired Boiler
Typical Boiler Applications: Small Biomass Boiler
Typical Boiler Applications: Combined Thermal Oil Energy Plant
Typical Boiler Applications: Secondary fuel fired Boiler (ESB)
Typical Boiler Applications: Bio-Waste fired Boiler with separate fired Superheater (a)
Typical Boiler Applications: Bio-Waste fired Boiler with separate fired Superheater (b)
Typical Boiler Applications: WHB behind industrial furnaces (a)
Typical Boiler Applications: WHB behind industrial furnaces (b)
Typical Boiler Applications: CFB-Boiler (a)
Typical Boiler Applications: CFB-Boiler (b)
Typical Boiler Applications: Flue gas condensation

CASE 5: With FG-Condensing + Quenching + Stack plume avoidance
Additional Special Modules

⇒ Water Circulation Calculation Module
  ▪ Natural circulation
  ▪ Benson subcritical & supercritical

⇒ Dynamic Calculation Module
  ▪ Cold, warm start-up
  ▪ Load changes
  ▪ Tube metal temperatures during start-up
  ▪ Drum metal temperature during start-up

⇒ Tube bundle vibration calculation
Typical Example Biomass fired Boiler (nat. circulation scheme)
Typical Example HRSG (with 3 pressure levels)
Typical Example HRSG (with 3 pressure levels)

Dynamic calculation of metal temperatures during start-up