Equipment and Services for Thermal Power Industry
ATOMERGOMASH JSC (Company, Holding, AEM) is one of the leading power-engineering companies in Russia, and supplier of effective integrated solutions for nuclear and thermal power, gas and petrochemical industries, shipbuilding and special steel market.

- Scientific, research and development activities;
- Manufacturing of special steel castings and forgings;
- Manufacturing and supply of machinery equipment;
- Construction and erection works;
- More than 30 enterprises in Russia and abroad;
- About 20% of domestic power engineering market;
- Over 21,000 employees;
- Equipment manufactured at AEM is used in more than 20 countries all over the world.
MACHINERY FOR THERMAL POWER INDUSTRY

Atomenergomash JSC is one of the largest and leading suppliers of effective technological solutions for thermal power industry in Russia and abroad.

Atomenergomash Enterprises have long-term experience in design and supply of thermal power equipment. The Company comprises scientific research, engineering, manufacturing, service construction, and installation entities in the Russian Federation and abroad.

Design and engineering companies of Atomenergomash have high potential for integrated engineering design cycle — from research and development and process documentation to technological processes and further equipment manufacturing.

Customers of AEM have trust in technologies and professional experience of its affiliated companies either in equipment and components for new thermal power plants or in engineering and development of effective solutions for retrofits and modernization of the existing plants.

Milestones of Thermal Power Engineering Development

1942 — the first drum-type boiler with gravity circulation

1944 — the first direct-flow boiler with capacity of 220 t/h for sub-critical steam conditions

1947 — the first in the world experimental-industrial prototype 60-OP (Russian: 60-ОП) boiler with capacity of 12 t/h for ultra-supercritical steam parameters

1962 — first USC boiler as a part of 100 MW power unit (PK-37) was commissioned at Kashirskaya State District Power Plant (GRES)

70s — start of production of supercritical pulverized-coal-fired boilers with steam capacity of 1,650 t/h for 500 MW power units

80s — start of production of supercritical pulverized-coal-fired boilers with steam capacity of 2,650 t/h for 800 MW power units

60s — start of production of supercritical direct-flow boilers with steam capacity of 950 t/h for 300 MW power units

90s — start of localization of heat-recovery steam generators (HRSG) in Russia

In 1958, PK-33 (Russian: ПК-33) boiler won Grand Prix Brussels Exhibition.

Hydro Power Plant GES-1, Mosenergo.
GEOGRAPHY OF OPERATIONS

Projects of power units’ construction with AEM participation for the last 30 years

1. Russia
   - Beryozovskaya GRES-1
   - Reftinskaya GRES
   - Ryazanskaya GRES-24
   - Hydro Power Plant GES-1, Mosenergo
   - Central Heating and Power Plant CHPP-27, Mosenergo
   - Severo-Zapadnaya CHPP
   - Ivanovskie CCGTs
   - Kaliningradskaya CHPP-2
   - Kirishskaya GRES
   - CHPP-26, Mosenergo
   - Nizhnevartovskaya GRES
   - Novomoskovskaya GRES
   - Nazarovskaya GRES
   - Yuzhnouralskaya GRES-2

2. Belarus
   - Thermal power plant (TPP) of Naftan OJSC

3. Hungary
   - Geller TPP

4. Macedonia
   - Bitola TPP

5. Bulgaria
   - Maritsa-Vostok II TPP
   - Maritsa-Vostok III TPP

6. Ukraine
   - CHPP of Dnepropetrovsk Metallurgical Plant

7. India
   - Neyveli TPP

8. Kazakhstan
   - Ekibastuzskaya GRES-2

9. Uzbekistan
   - Novo-Angrenskaya GRES

10. China
    - Tszisyan TPP
    - Imin TPP
KEY SUPPLIES

**Power boilers**
- Belarus: 15
- Bulgaria: 20
- Bosnia and Herzegovina: 2
- Vietnam: 4
- Germany: 16
- Greece: 1
- India: 2
- Kazakhstan: 48
- Kyrgyzstan: 1
- China: 14
- Lithuania: 2
- Macedonia: 4
- Poland: 9
- Russia: 338
- Romania: 18
- Serbia: 1
- Turkmenistan: 2
- Uzbekistan: 7
- Ukraine: 29
- Croatia: 2

**Heat Recovery Steam Generators (HRSG)**
- Belarus: 2
- Hungary: 1
- Russia: 77
AEM companies manufactured about 800 boiler units of different capacity and parameters for more than 150 domestic and foreign electric power plants with total capacity of over 66 GW, including 16 GW for export. AEM boilers are used at electric power plants in 20 countries all over the world.

**EQUIPMENT**

- Power boilers for power-generating units with capacity of up to 50–800 MW;
- Heat recovery steam generators (HRSG) for combined cycle gas turbine (CCGT) with capacity of up to 20–800 MW;
- Hot water HRSG for units with capacity of up to 6–45 MW;
- Hot water boilers;
- Boiler auxiliary equipment;
- Steam and water heaters of spiral finned tubes;
- Standard sections of tubular air heaters;
- Equipment of regeneration system;
- Pumping equipment;
- Water-to-water heaters;
- Cooling towers;
- Heavy welded structures;
- Vessel equipment, including pressure vessels;
- Deaerators;
- Burners;
- Steam silencers;
- Water-steam heaters;
- Filters;
- Power valves;
- Parts and assembly units for pipelines;
- Metalwork;
- Distillation and desalination units;
- Automatic controls.

**SERVICES**

- Engineering;
- Integrated supply;
- Project management;
- Construction and erection works;
- Retrofitting and Modernization.
The Holding includes ZIOMAR Engineering Company established in 1991. Nowadays, it is one of the leading Russian design-engineering companies specialized in research and development works for Russian and foreign sites of thermal, nuclear and petrochemical industries.

The works are performed with involvement of the leading relevant research institutions and organizations of the Russian Federation: OJSC OKB Gidropress, OJSC Afrikantov OKBM, OJSC NPO TsNIITMASh, OJSC NPO CKTI, JSC VTI, OJSC Engineering Center ORGRES. In terms of the license agreement, AEM carries out cooperation together with the NEM Energy b.v. (Holland) company, which is one of the leading engineering companies in Europe supplying equipment for thermal power plants, i.e. HRSGs.

ZIOMAR Engineering Company has relevant licenses and permits of state and supervising entities of the Russian Federation required for performing its activities, including the license issued by the Federal Nuclear and Radiation Safety Authority of Russia that authorizes to carry out design-engineering works and designer’s supervision at all stages of the equipment and pipelines’ life cycle of nuclear power plants.

Nowadays, ZIOMAR Engineering Company OJSC employs about 400 highly qualified specialists. The specialists of the Company are certified according to the Rules and Norms of Nuclear Power Industry valid in the Russian Federation.

ZIOMAR Engineering Company OJSC includes:

- Power boilers department;
- HRSG department;
- Special design bureau for nuclear power, gas and petrochemical industries and special-purpose equipment;
- Calculation and engineering center;
- Experimental department.

Specialists of ZIOMAR Engineering Company OJSC perform complete design and engineering works for thermal and nuclear power, gas and petrochemistry sites; rig and industrial testing of designed and manufactured equipment; perform thermal-hydraulic and strength calculations and carry out equipment adjustment; retrofit feasibility study of the operating generation units for evaluation of retrofitting and modernization solutions.
MANUFACTURING CAPACITIES

The unique manufacturing capabilities let AEM offer customers equipment in accordance with their strict requirements. Nowadays, thanks to industrial upgrading and modernization of the Holding’s assets, AEM is one of the leaders of the Russian power engineering industry.

**Zio-PODOLSK**

JSC Machine-Building Plant ZIO-Podolsk is one of the largest machine-building enterprises in Russia with more than 90 years history. Nowadays, the plant has almost all types of the main machine-building facilities allowing to manufacture modern equipment. Introduction of Rosatom production system (RPS) enables to detect and reduce all kinds of losses in manufacturing and business processes.

**Energomashspetsstal OJSC**

Energomashspetsstal OJSC is the largest in the Eastern Europe manufacturer of special steel heavy castings and forgings. Energomashspetsstal has a large pool of metal cutting equipment, including turning, boring, turning-and-boring lathes, deep boring lathes, planer-type milling machines, slotting machines, gear-milling machines, bandsaw machines and others. Production capacities of the electric-furnace shop provide for production of large size different steel grades forgings.

**Petrozavodskmash**

Petrozavodskmashin the Northwest Russia, supplying casing..., vessel, tank and other equipment. The plant has unique melting and weight-lifting capacities providing production of castings of almost all required standard sizes. The enterprise has also a unique pool of equipment: turning and boring mills, horizontal milling lathes, boring lathes, multi-spindle drilling, grinding and finishing CNC machines, balancing and other machines. Production areas are connected to all European ports via its own port terminal and Volga-Baltic Route.

**Gänz**

The company is specialized in production of pumping equipment for the enterprises of thermal, nuclear, oil and gas industries and in production of fuel-handling machines for nuclear power plants. GANZ EEM also manufactures hydropower equipment.

It produces pipeline valves for thermal, nuclear oil & gas and chemical industries.

- Manufacturing of boiler equipment for 2 x 500 MW steam units and of 4 HRSGs for 450 MW CCPs a year;
- Equipment capacity up to 6 GW per year for all thermal power industry programs of;
- Finned tube production comes to 7.5-8 thousand tons per year;
- Up to 60 thousand tons of castings, steels, non-ferrous alloys;
- ISO standards.
BIOTECHNOLOGY

ZIOMAR Engineering Company OJSC performs boiler equipment retrofit and modernization solutions.

Main Directions of Retrofit & Modernization Solutions Provided to Customer Equipment

Implementation of the listed above activities is impossible without applying new technologies.

The workshop is equipped with modern machine tools. Design subdivision is equipped with required computers and software.

Development of design documentation is performed with modern software for 2D and 3D drawing (Autodesk Inventor, SolidWorks). Calculations are performed by use of software for numerical simulation (ANSYS, FlowVision), allowing to obtain results which are maximum approximated to experimental data of operation.

List of Boiler Equipment Retrofits:

- Increase of the unit load adjusted range (threshold reduction of reliable operation);
- Shift to off-design types of fuel;
- Arrangement of sludge-free operation mode of slagging coal boilers combustion chamber by means of low-temperature and layer-by-layer fuel combustion;
- Enhancement of fuel ignition stability and operation range extension without fuel oil support flame by means of installation of telescopic dust separators and special dust concentrators, high-temperature air heating, using low-temperature vortex technology etc.;
- Enhancement of technical and economic efficiency by means of structure optimization and implementation of modern design and circuit solutions (usage of diaphragm and spirally finned heating surfaces, light piping insulation, etc.);
- Retrofitting aimed at environmental performance improvement; increase of boilers steam generating capacity by mean of installation of intensified heating surfaces in economizer, evaporation and superheating boiler areas.

Complex Activities for Power Engineering Facilities’ Economical Efficiency Enhancement

Analysis, preparation and approval of solution for nonconformity elimination

Project and customer development specifications

Modernization and retrofitting

Follow-up retrofit results (tests)

Operation Modes:

- Adjustment of operation modes;
- Testing;
- Efficiency evaluation.

Technical State (Lifetime, Project and Installation Quality):

- Studying domestic and foreign experience;
- Development of technical assignment for retrofitting;
- Development of design documentation;
- Modernization and retrofitting;
- Follow-up retrofit results and efficiency evaluation.
LOW-TEMPERATURE VORTEX TECHNOLOGY COMBUSTION

Low-temperature vortex technology is based on principles of solid fuel low-temperature combustion under conditions of particles multiple circulation in chamber furnace.

Key Advantages of Low-Temperature Vortex Technology

- 1.3–3.4 times increase in efficiency of dust system;
- Increase in lifetime of grinding elements;
- Explosion safety;
- Fuel treatment system easing;
- Decrease of electric power cost of grinding works;
- Improvement of ash collecting equipment operation.

1.3–3.4 times increase in efficiency of dust system;
Increase in lifetime of grinding elements;
Explosion safety;
Fuel treatment system easing;
Decrease of electric power cost of grinding works;
Improvement of ash collecting equipment operation.

Rapid heating of fuel air flow

- Stable ignition and burning;
- Refuse from gas or fuel oil support flame;
- Stable burning process regardless of load and fuel parameters.

Stable ignition and burning;
Refuse from gas or fuel oil support flame;
Stable burning process regardless of load and fuel parameters.

Heat exchange intensification (increase of screens thermal efficiency factor)

- Potential increase of boiler steam generating capacity by 15–20%.
- No slagging and contamination of furnace and convective heating surfaces;
- Decrease of nitrogen oxides emission NOx by 20–70%;
- Decrease of sulfur oxides emission SOx to 70%.

Potential increase of boiler steam generating capacity by 15–20%.
No slagging and contamination of furnace and convective heating surfaces;
Decrease of nitrogen oxides emission NOx by 20–70%;
Decrease of sulfur oxides emission SOx to 70%.

Adjustment of thermal field and decreasing maximum temperature in flame core to 1,000 … 1,350 °C

Modernization of Power Unit No. 7 at Nazarovskaya GRES

- It retrofit of K-500-240 turbine (COMTEC-Energoservice LLC);
- Upgrading automated process control system of power unit No. 7 (Honeywell CJSC);
- replacement of three phases of the unit transformer;
- retrofitting central dust plant (CDP) equipment;
- retrofitting boiler 7A, 7B (Russian: 7Б) including shift to low-temperature vortex technology of combustion as well as replacement of heating surfaces, brickwork and insulation (ZIO-Podolsk).

It retrofit of K-500-240 turbine (COMTEC-Energoservice LLC);
Upgrading automated process control system of power unit No. 7 (Honeywell CJSC);
replacement of three phases of the unit transformer;
retrofitting central dust plant (CDP) equipment;
retrofitting boiler 7A, 7B (Russian: 7Б) including shift to low-temperature vortex technology of combustion as well as replacement of heating surfaces, brickwork and insulation (ZIO-Podolsk).

Actual 33 MW increase enhanced power unit installed capacity up to 433 MW instead of the planned earlier 415 MW. Emissions of nitrogen and sulfur oxides decreased almost twice.
QUALITY MANAGEMENT SYSTEM

Enterprises of the Holding are specialized in manufacturing of equipment for thermal and nuclear power, gas and petrochemical industries. The basis for quality assurance of equipment manufacturing for thermal power industry is quality management system, relevant to modern worldwide practice, norms of international standards ISO 9000 series. Quality management system of AEM enterprises covers the whole management system of AEM and its subsidiaries, aimed at the quality assurance of provided services and applied processes.

For this purpose independent certification authorities (international and domestic) carried out certification of quality management and manufacturing system at the enterprises of the Holding. In particular, currently it is carried out prolongation of certificate of conformity to code of American Society of Mechanical Engineers (ASME): ASME Section 8 Division 1, Division 2, Stamp U and Stamp S.

All equipment manufactured by the Holding enterprises is subject to the strictest quality inspection, including detailed expert review of the documentation and tests performance at high quality level. The quality inspection starts from the moment of the contract signing. According to its requirements the manufacturer develops and agrees with the customer quality plans including all main stages of equipment production, starting from the approval of design documentation with customer, control of production availability, certification of technologies, equipment and personnel, incoming inspection of purchased materials and components to production workflow and customer acceptance.

Before enter into manufacturing all purchased materials and components pass through 100% incoming inspection. Visual and dimensional inspection of the arrived materials, semi-finished products, welding materials is performed as well as supporting documentation.

Laboratories of the Holding enterprises during equipment manufacturing perform the following types of inspection: chemical analysis, metallographic examination, corrosion tests, mechanical tests of metal and welded joints, radiographic, ultrasonic, magnetic particle testing, dye penetrant testing, metal and welded joints leakage testing.

Quality Management System and Production Certificates Availability

Quality management system corresponds to the requirements of ISO 9001:2008, which are valid till November 2015.

Production of the equipment operated under pressure as per European norms according to Directive AD 2000-Merkblatt HP0/TRD201 with CE 0036 marking, which is valid till April 2016.
Boiler Equipment

AEM has vast experience in design and manufacturing of boiler equipment for thermal power industry. The main products are steam boilers for power units with capacity from 50 to 800 MW and heat recovery steam generators (HRSG) for modern Combined Cycle Gas turbines (CCGTs) with capacity from 20 to 800 MW.

Types of Manufactured Equipment

**Utility Boilers**

Intended for generation of process steam or operation within power sources at power generation plants. Design of burner device of utility and hot water boilers for generation plants implies combustion of different kinds of fuel pursuant to the agreement with customer.

**Heat Recovery Steam Generators**

We offer complete recovery units, including HRSGs with inlet and outlet gas ducts and fume stacks, auxiliary equipment, including blowdown expanders, deaerators within low pressure drum, station pipelines, water-water heat exchangers, feed and circulation pumps, non-metallic condensers, after-burning units etc.

**Hot Water Boilers**

Designed and manufactured state-of-the-art gas fuel oil hot water boilers with heat capacity of 70–120 Gcal/h. The boilers are manufactured in gas leak-proof design of all-welded panels with tower-type arrangement of heating surface and supplied completed with auxiliary equipment, including valves of gas-air ducts, blowdown fans, noise suppressors, and fume stacks.

**Hot Water HRSGs**

Hot water HRSGs for gas turbines with capacity from 6 to 45 MW. In hot water HRSGs of such series there is a capacity to regulate the output heat rate with saving nominal electric load of gas turbine plant. Regulation of the heat rate is achieved due to tight gas valves of own design.

AEM provides services of boiler equipment erection supervision, including pre-installation inspection, designer’s supervision and assistance with installation, adjustment, tests, trial starting, starting and commissioning in guarantee maintenance, personnel training and post-warranty service.

**Intergrated Supply:**

- Soot-blowing equipment;
- Fuel supplying, coal milling and dust preparation equipment;
- Exhaust fans and air turboblowers;
- Colorific installations with piping and valves;
- Ash cleaning devices, including electrostatic precipitators;
- Metalwork of boiler island and fume stack;
- Dust-gas-air ducts complete with valves and compensators;
- Station pipelines;
- Single turn electric actuators and their joints;
- Other power equipment of boiler island.
UTILITY BOILERS

AEM solutions include wide range of steam boilers, designed and delivered for operation on brown coal and lignite of power units with capacity of up to 800 MW.

Scope of Boiler Supply
- Forced-draft equipment;
- Dust preparation equipment;
- Steam-water duct valves;
- Gas-air ducts valves;
- Burner devices with ignition safety devices and flame control sensors;
- Fuel oil nozzles;
- Equipment for cleaning heating surfaces from outer deposits;
- Service platforms (bridging and ladders);
- Boiler fittings;
- Piping within boiler skid;
- Gas piping with valves within boiler skid;
- Steam and fuel oil piping with valves within boiler skid;
- Embedded items for instruments and sensors;
- Calorifiers for preliminary air heating before air heater;
- Condensing units for obtaining own condensate;
- Steam-steam heat exchangers and injection steam coolers;
- Setting and insulation materials, decorative casing;
- Sampling cooler;
- Supports and suspensions for boiler piping;
- Expansion joints for gas-air ducts;
- Non-metallic gas ducts expansion joints;
- Rain screens;
- Boiler outlet silencers.

Boiler Technical Parameters

High pressure boilers with natural circulation:
- Steam capacity 120–670 t/h;
- Outlet steam temperature 510–540 °C;
- Outlet steam pressure 100–160 kgf/cm².

High pressure direct-flow boilers:
- Steam capacity 540–670 t/h;

Supercritical parameters direct-flow boilers:
- Steam capacity 950–2650 t/h;
- Outlet steam temperature 545–565 °C;
- Outlet steam pressure 255 kgf/cm².
ZIO-Podolsk and ZIOMAR developed modern gas-fuel oil and gas boilers with heat rate of 70, 100 and 120 Gcal/h for the needs of industrial power sector and public utilities. The boilers are designed for heating of district water and can be used in heat supply systems and ventilation. Boilers design allow to install them in the cells of worn out and outdated equipment.

All types of water heating boilers are equipped with low emission burner devices. There is staged fuel combustion (as per the height) providing partial supply of the air required for burning through nozzles of the upper blow down.

### Optional Equipment (supplied by agreement with customer):
- Blow down fan;
- Tight valves as per the diagram of gas-air ducts;
- Electric actuators for the tight valves/single-turn electric actuators and their joints;
- Compensators of gas-air ducts;
- Flow-metering devices for gas-air ducts;
- Lower level of ACS (automated control system).

###Technical Parameters

<table>
<thead>
<tr>
<th>No.</th>
<th>Technical parameters of</th>
<th>KV-G-81.4-150N</th>
<th>KV-GM-140150N</th>
<th>KVGM-116.3-150N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Heat rate (gas/fuel oil), Gcal/h</td>
<td>70</td>
<td>120</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>Fuel</td>
<td>Gas/Fuel oil</td>
<td>Gas/Fuel oil</td>
<td>Gas/Fuel oil</td>
</tr>
<tr>
<td>3</td>
<td>Boiler outlet water temperature, °C</td>
<td>150</td>
<td>150/160</td>
<td>150</td>
</tr>
<tr>
<td>4</td>
<td>Boiler outlet water pressure, kgf/cm²</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>5</td>
<td>Design boiler efficiency (gross), %</td>
<td>95.0</td>
<td>95.5/90.8</td>
<td>93.9/91.1</td>
</tr>
<tr>
<td>6</td>
<td>Nitrogen oxides emissions after the boiler (if α = 1.4), mg/m³</td>
<td>≤125</td>
<td>≤125/300</td>
<td>≤125/300</td>
</tr>
</tbody>
</table>

### Hot Water HRSGs for Operation with Gas Turbine from 6 to 45 MW

Hot Water HRSGs are designed to produce hot water by using exhaust gases heat supplied from the gas turbine. Technical parameters of hot water HRSGs and types of gas turbines, which they are installed behind, are given in the table below. Water heating HRSG allows operation with changes in flow and temperature of combustion products after gas turbine due to changes in temperature of ambient air and changes in gas turbine load.

### Technical Parameters

<table>
<thead>
<tr>
<th>Type of boiler (factory marking):</th>
<th>Water heating HRSG 5.5/110 (P-104)</th>
<th>Water heating HRSG 13.0/150 (P-105)</th>
<th>Water heating HRSG 35.0/150 (P-106)</th>
<th>Water heating HRSG 17.0/150 (P-109)</th>
<th>Water heating HRSG 35.0/150 (P-112)</th>
<th>Water heating HRSG 12.2/150 (P-126)</th>
<th>Water heating HRSG 19/130 (P-128)</th>
<th>Water heating HRSG 60/150 (P-129)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of gas turbine (turbine power capacity):</td>
<td>GTE-6/6.3 M1X131 (6 MW)</td>
<td>GTA-6RM (6 MW)</td>
<td>LM2500+DLE (8 MW)</td>
<td>GTE-10/95BM (8 MW)</td>
<td>LM2500+DLE (8 MW)</td>
<td>GTE-12V/6000 (8 MW)</td>
<td>GTE-12VE (12 MW)</td>
<td>SGT-800 (43 MW)</td>
</tr>
<tr>
<td>Water heating HRSG inlet gas temperature, °C</td>
<td>303</td>
<td>416</td>
<td>505.2</td>
<td>420</td>
<td>505.2</td>
<td>437</td>
<td>283</td>
<td>523.5</td>
</tr>
<tr>
<td>Flow of recovered exhaust gases, kg/s</td>
<td>37.71</td>
<td>48</td>
<td>80.8</td>
<td>57.8</td>
<td>80.8</td>
<td>34.72</td>
<td>93.2</td>
<td>143.47</td>
</tr>
<tr>
<td>Temperature of exhaust gases, °C</td>
<td>138</td>
<td>133</td>
<td>95</td>
<td>110</td>
<td>109</td>
<td>111</td>
<td>103</td>
<td>99</td>
</tr>
<tr>
<td>Water heating HRSG inlet water temperature, °C</td>
<td>70</td>
<td>70</td>
<td>61</td>
<td>73</td>
<td>65</td>
<td>80</td>
<td>70</td>
<td>70</td>
</tr>
<tr>
<td>Water heating HRSG outlet water temperature, °C</td>
<td>110</td>
<td>150</td>
<td>129.3</td>
<td>155</td>
<td>150</td>
<td>150</td>
<td>130</td>
<td>150</td>
</tr>
<tr>
<td>Draft-pressure drop of water heating HRSG, max, Pa</td>
<td>1800</td>
<td>2000</td>
<td>1300</td>
<td>2500</td>
<td>2300</td>
<td>1500</td>
<td>2500</td>
<td>2500</td>
</tr>
</tbody>
</table>
HEAT RECOVERY STEAM GENERATORS

Single- and Double-Circuit Vertical Type Boiler with Controlled Circulation in Evaporation Circuits

Designed for superheated steam generation of one and two pressures due to recovery of exhaust products heat after gas turbine. HRSGs are manufactured in a wide range of standard sizes and can be operated with an independent deaerator or a deaerator head integrated into a low pressure drum or a deaerator column. Gas heater condensate circuit (recirculation line) can comprise water-water heat exchanger for heating piping network or be provided with separated circuit of gas heater for network water. Higher parameters for steam generation capacity and steam temperature of HRSG can be reached by operating in a combined cycle (heat recovery of exhaust gases and additional burning of natural gas in an afterburning device using the air excess which exists in exhaust gases as an oxidant). HRSGs can be equipped with a bypass system (with separate bypass fume stack or joint fume stack) for gas turbine operation when the boiler is shutdown.

Advantages of Vertical HRSGs:

- The capability to install HRSG above the gas turbine frame with vertical exhaust from the gas turbine;
- Lower number of pipelines as well as drains and air vents and valves in these lines;
- Modular design of heating surfaces for easy shipment.

Technical Parameters

<table>
<thead>
<tr>
<th>Type of HRSG</th>
<th>Type of the gas turbine, capacity, MW,</th>
<th>Steam parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>D, t/h</td>
<td>P, bar</td>
<td>T, °C</td>
</tr>
<tr>
<td>P-90</td>
<td>V-94.2 Siemens 160 MW</td>
<td>242/56 82/7.0 515/200</td>
</tr>
<tr>
<td>P-91</td>
<td>V-94.2 Siemens 160 MBr</td>
<td>310 15 275</td>
</tr>
<tr>
<td>P-103</td>
<td>GT-10C Alstom</td>
<td>39/8 55/6 487/212</td>
</tr>
<tr>
<td>P-107</td>
<td>GTE-160160 MW</td>
<td>224/51 77/5.8 509/206</td>
</tr>
<tr>
<td>P-108</td>
<td>SGT-800 Siemens 45 MW</td>
<td>58/12 74/7.0 525/209</td>
</tr>
<tr>
<td>P-116</td>
<td>GTE-160160 MW</td>
<td>224/51 77/5.8 509/206</td>
</tr>
<tr>
<td>P-120</td>
<td>GTE 20C/40P 20 MW</td>
<td>40 40 440</td>
</tr>
<tr>
<td>P-134</td>
<td>GTE-160160 MW</td>
<td>224/57 71.5/5.3 509/207</td>
</tr>
<tr>
<td>P-137</td>
<td>GTE-160160 MW</td>
<td>224/49 98/8.7 508/222</td>
</tr>
<tr>
<td>P-144</td>
<td>GTE-160160 MW</td>
<td>232/47 78/7.9 503/217</td>
</tr>
</tbody>
</table>

Key References:

- 2x 450 MW CCGT, Severo-Zapadnaya CHPP, St. Petersburg, power units No. 1 and No. 2 — 4 HRSGs;
- 2x 450 MW CCGT, CHPP -27, Moscow, power units No. 3 and No. 4 — 4 HRSGs;
- 190 MW CCGT, Dzerzhinskaya CHPP, Dzerzhinsk;
- 2x 39 MW CCGT, Sochinskaya TPP, Sochi — 2 HRSGs;
- 2x 130 MW CCGT, district thermal station Strogino, Moscow — 4 HRSGs;
- 450 MW CCGT, CHPP-21, Moscow — 2 HRSGs;
- 52 MW CCGT, Yeletskaya CHPP, Yelets — 2 HRSGs;
- CCGT-230T, Chelyabinskaya CHPP-3, Chelyabinsk;
- 210 MW CCGT, Novgorodskaya CHPP, Novgorod;
- 450 MW CCGT, Khuadyan-Teninskaya CHPP, Yaroslavl — 2 HRSGs.

* CCGT - Combined Cycle Gas Turbine Power Plant
** CHPP - Combined Heat and Power Plant
Horizontal Type with Natural Circulation in Evaporation Circuits, Single-, Double- and Triple-Circuit Ones

Designed to generate superheated steam of one and two pressures by means of recovery of exhaust products heat behind the gas turbine. HRSGs are produced in wide range of standard sizes and can be operated with an independent deaerator or a deaerator head integrated into a low pressure drum or deaerator column. Gas heater condensate circuit can comprise a water-water heat exchanger for heating piping network water or provided with a separated circuit of a gas heater for the network water. To reach higher parameters for steam capacity and steam temperature HRSGs can be equipped with post injections. HRSGs can be equipped with a bypass system (with a separate bypass fume stack or a joint fume stack) for the gas turbine operation when the boiler is shutdown. Heating surfaces of HRSG can be supplied for installation as separate sections or modules, including sections of heating surfaces with pipelines, suspensions, beams and flooring with heat insulation.

In 2009, it was signed the license agreement with one of the leading HRSG suppliers in Europe NEM Energy b.v. company (Netherlands). Several HRSGs were produced on the NEM Energy b.v. engineering base for Russian thermal power plants: Novomoskovskaya GRES, Yuzhnouralskaya GRES-2, Nizhnevartovskaya GRES, Verkhnetagilskaya GRES.

Advantages of HRSGs based on NEM Energy b.v. Engineering:
- Minimum dimensions of HRSG;
- Guaranteed parameters proved by tests;
- Ease of assembling of heating surfaces using special assembling devices.

Technical Parameters

<table>
<thead>
<tr>
<th>Type of HRSG</th>
<th>Type of gas turbine, power, MW,</th>
<th>Steam parameters at HRSG outlet</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>D, t/h</td>
</tr>
<tr>
<td>P-88</td>
<td>GTE-11010 MW</td>
<td>155/35</td>
</tr>
<tr>
<td>P-96</td>
<td>GTE-160160 MW</td>
<td>232/45</td>
</tr>
<tr>
<td>P-131</td>
<td>PG-6581 GE 45 MW</td>
<td>58/12</td>
</tr>
<tr>
<td>P-132</td>
<td>SGTS-4000F 280 MW</td>
<td>258.4/309.3/35.1</td>
</tr>
<tr>
<td>P-133</td>
<td>GT-26 Alstom 288 MW</td>
<td>315/357/30.9</td>
</tr>
<tr>
<td>P-140</td>
<td>SGTS-4000F 280 MW</td>
<td>259/311/42</td>
</tr>
<tr>
<td>P-141</td>
<td>PG9171E 125 MW</td>
<td>186/39</td>
</tr>
<tr>
<td>P-142</td>
<td>PG9351FA 260 MW</td>
<td>277/302/44.1</td>
</tr>
<tr>
<td>P-143</td>
<td>SGTS-4000F 280 MW</td>
<td>288.6/317.1/42</td>
</tr>
</tbody>
</table>

Key References:
- 325 MW CCGT, Ivanovskiy CCGTs, Ivanovo;
- 450 MW CCGT, Kaliningradskaya CHPP-2, Kaliningrad;
- 60 MW CCGT, Noyabrskskaya CCGT, Noyabrsk;
- 800 MW CCGT, Kirishskaya GRES, Kirishi;
- 420 MW CCGT, CHPP-26, Moscow;
- 420 MW CCGT, Yuzhnouralskaya GRES-2 power unit 1 and 2, Yuzhnouralsk;
- 190 MW CCGT, Novomoskovskaya GRES, Novomoskovsk;
- 400 MW CCGT, Nizhnevartovskaya GRES, Nizhnevartovsk;
- 420 MW CCGT, Verkhnetagilskaya GRES, Verkhny Tagil.

* CCGT - Combined Cycle Gas Turbine Power Plant
  ** CHPP - Combined Heat and Power Plant
LOW PRESSURE HEATERS (LPH)

Enterprises of the Holding manufacture LPHs for turbine groups of power units. Standard range of new upgraded units for thermal power plants allows to eliminate the constructive weaknesses used nowadays at TPPs.

LPHs are intended to heat main condensate by the taken-off steam in the system for low pressure regeneration of steam turbine group.

<table>
<thead>
<tr>
<th>Key characteristics of LPH</th>
<th>LPH-2</th>
<th>LPH-3</th>
<th>LPH-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal flow rate of main condensate, t/h</td>
<td>464</td>
<td>565</td>
<td>565</td>
</tr>
<tr>
<td>Main condensate pressure, kgf/cm² (MPa)</td>
<td>14 (1.373)</td>
<td>13.0 (1.275)</td>
<td>12.0 (1.177)</td>
</tr>
<tr>
<td>Design pressure of main condensate, kgf/cm² (MPa)</td>
<td>20.0 (1.96)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inlet temperature of main condensate, °C</td>
<td>57</td>
<td>99</td>
<td>128</td>
</tr>
<tr>
<td>Outlet temperature of main condensate, °C</td>
<td>95</td>
<td>127</td>
<td>157.6</td>
</tr>
<tr>
<td>Design temperature of main condensate, °C</td>
<td>100</td>
<td>130</td>
<td>160</td>
</tr>
<tr>
<td>Flow rate of heating steam, t/h</td>
<td>31.3</td>
<td>25.5</td>
<td>28.4</td>
</tr>
<tr>
<td>Pressure of heating steam (g), kgf/cm² (MPa)</td>
<td>0.98 (0.096)</td>
<td>2.8 (0.275)</td>
<td>6.22 (0.605)</td>
</tr>
<tr>
<td>Design temperature of heating steam, °C</td>
<td>170</td>
<td>260</td>
<td>380</td>
</tr>
<tr>
<td>Outlet temperature of heating steam, °C</td>
<td>166</td>
<td>253</td>
<td>364</td>
</tr>
<tr>
<td>Underheating of main condensate at nominal flow rate of main condensate (max), °C</td>
<td>3</td>
<td>2.9</td>
<td>1.8</td>
</tr>
<tr>
<td>Hydraulic resistance of piping system, kgf/cm² (MPa)</td>
<td>0.51 (0.05)</td>
<td>0.92 (0.09)</td>
<td>0.91 (0.089)</td>
</tr>
<tr>
<td>Full area of heat exchange, design, m²</td>
<td>362</td>
<td>366</td>
<td>362</td>
</tr>
<tr>
<td>Heater weight, kg:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>at installation</td>
<td>10,906</td>
<td>11,633</td>
<td>11,135</td>
</tr>
<tr>
<td>at hydraulic test</td>
<td>18,386</td>
<td>19,863</td>
<td>18,615</td>
</tr>
</tbody>
</table>

Low pressure heaters manufactured by ZiO-Podol’sk are successfully operated at CHPP-27 of Mosenergo as a part of PT-80 (Russian: ПТ-80) turbine group.
The latest R&D of AEM allowed to retrofit district water heaters installed earlier in terms of heat-exchanging media flow improvement, providing directional condensate draining from heating surface, enhanced efficiency of non-condensing gases outlet, retrofit of distribution chamber, standardization of main assemblies and parts.

District heaters are installed in heat supply system and designed for district water heating at thermal power plants by steam from turbines’ taking-offs.

<table>
<thead>
<tr>
<th>Key characteristics of district water heaters (Russian: ПСВ)</th>
<th>NWH-530-0.29-2.25</th>
<th>NWH-530-1.37-2.25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat-exchanging area, design, m²</td>
<td>530/644</td>
<td></td>
</tr>
<tr>
<td>Operation pressure in piping system (g), kgf/cm² (MPa)</td>
<td>23 (2.25)</td>
<td></td>
</tr>
<tr>
<td>Operation pressure in casing (g), kgf/cm² (MPa)</td>
<td>3.0 (0.29)</td>
<td>14.0 (1.37)</td>
</tr>
<tr>
<td>Network water temperature, °C:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inlet</td>
<td>120</td>
<td>70</td>
</tr>
<tr>
<td>Outlet</td>
<td>150</td>
<td>110</td>
</tr>
<tr>
<td>Maximum temperature of heating steam, °C</td>
<td>400</td>
<td></td>
</tr>
<tr>
<td>Nominal mass flow rate of network water, t/h</td>
<td>1130</td>
<td></td>
</tr>
<tr>
<td>Hydraulic resistance of piping system at nominal flow rate of network water, kgf/cm² (MPa)</td>
<td>0.54 (0.053)</td>
<td>0.65 (0.064)</td>
</tr>
<tr>
<td>Nominal heat flow, MW (kcal/h)</td>
<td>66.0 (56.7)</td>
<td>53.4 (45.9)</td>
</tr>
<tr>
<td>Complete heating of network water, °C</td>
<td>12.7</td>
<td>8.7</td>
</tr>
<tr>
<td>Heating steam flow rate, t/h</td>
<td>110</td>
<td>94</td>
</tr>
<tr>
<td>Dry weight of the unit, t</td>
<td>18.3</td>
<td>19.9</td>
</tr>
<tr>
<td>Unit weight completely filled with water, t</td>
<td>30.3</td>
<td>31.9</td>
</tr>
</tbody>
</table>
AEM companies manufacture a wide range of pumps of different design, calculation parameters and materials.

**PUMPING EQUIPMENT**

Multi-stage centrifugal horizontal sectional and double casing pumps

Horizontal centrifugal with double inlet impeller with a horizontal and a vertical split

Horizontal and vertical centrifugal single-stage with a scroll case pumps

Axial and angular-flow single-stage semi-submersible with regulation system of hydraulic characteristics pumps

Single and multiple stage centrifugal vertical semi-submersible
VESSEL EQUIPMENT

Applied in processing units at thermal power plants, gas, oil, oil-refining, petrochemical and other industries, including inflammable and hazardous media. Large size items are transported dismantled and mounted at the site.

Types of Vessel Equipment:
- Vessels operated under pressure up to 70 MPa, to 1,000 m³;
- Horizontal and vertical vessels for liquid media;
- Vertical vessels for air and gases;
- Evaporators.

Technical Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume, m³</td>
<td>to 300</td>
</tr>
<tr>
<td>Diameter, mm</td>
<td>to 3800</td>
</tr>
<tr>
<td>Nominal pressure, MPa</td>
<td>to 70</td>
</tr>
<tr>
<td>Temperature, °C</td>
<td>from –70 to +950</td>
</tr>
<tr>
<td>Material</td>
<td>carbon and stainless steel, iron-nickel alloys</td>
</tr>
</tbody>
</table>

References:
- Vessels for catalysts producing at Ishimbaysky Oil Refinery Plant (JGC Corporation, Japan);
- Vessels for hydrocyanic acid and acrolein producing (ERA, Mexico);
- Sewage water treatment plant for Nevinnomyssk (TEC, Japan);
- Steam collectors, separators, receivers, filters and other equipment for vacuum residue plant (LUKOIL-Permnefteorgsintez LLC);
- Degasifier, acid settler tanks, separators, economizers, tanks for alkylation for Omsk Oil Refinery (TECHNIP, France);
- Vessels for sulfuric acid producing plant (LUKOIL-Permnefteorgsintez LLC);
- Separators for arrangement of Verkhne-Salymskoye Oil and Gas Deposit (Salym Petroleum Development, subsidiary company of SHELL).
AIR HEATERS AND CALORIFIERS

Air Heaters

ZiO-Podolsk produces all types of tubular air heaters used in steam and water heating boilers. The air heater is installed in a convective gas duct of the boiler with the aim to heat the air driven to furnace to increase the efficiency of fuels combustion and to coal milling devices using exhaust gases heat. Air heaters are manufactured with different cubes design and arrangement depending on combusting fuel and boiler steam generating capacity.

Calorifiers

Sections of steam SP type calorifiers made of steel tubes with welded spiral-bend finning are designed for heating of blowdown air in solid, liquid and gaseous fuel fired boilers as well as for ventilation systems and air heating of power plants, public buildings and industrial enterprises.

Depending on the heat rate and draft loss sections of steam calorifiers of SP type are divided into three-row and four-row as well as they have different height of heating finned tubes.

Heat-release element is made of steel tube with welded spiral fins.

Main Technical Characteristics of Steam Calorifiers:

- Inlet air temperature — minus 15 °C;
- Inlet heating steam temperature — up to 250 °C;
- Air mass flow rate in incoming flow — 9.4 kg/m²s;
- Inlet steam pressure — up to 16 kg/cm².
VALVES OF GAS, AIR AND PULVERIZED-COAL DUCTWORK

Valves are designed for pulverized and air-gas ductworks of boiler units of TPP gas ducts with maximum ambient temperature 425°C or up to 550°C, pressure up to 20 kPa and coal concentration up to 100 g/nm³.

The valves are manufactured with round and rectangular cross-sections. Valves of a round cross-section have one shutoff or control element made as a gate valve. Valves of a rectangular cross-section have one, two, three or more gate valves with parallel rotation with pair-wise counter gate valves rotation providing a wide range of flow rate parameters and eliminating non-symmetric flow deflection. Besides that, there are valves with reciprocating movement of the gate valve.

Isolating valves serve to shutdown separate areas of DGAD during repair work performance.

Special-purpos valves and valves of other type sizes and parameters are manufactured at operating temperature up to 700 °C.

Specified service life before overhaul is 35,000 hours provided compliance with rules of operation. Mean time to failure is not less than 4,000 hours. Average lifetime is 30 years except for gate valves operating in dust gas flows.

<table>
<thead>
<tr>
<th>Description</th>
<th>Sizes, mm</th>
<th>Body passage area, m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shutoff and control round valves</td>
<td>from 100 to 2,000 (diameter)</td>
<td>0.01 to 3.1</td>
</tr>
<tr>
<td>Shutoff and control rectangular valves</td>
<td>from 300×500 to 5,500×2,500</td>
<td>0.01 to 13.75</td>
</tr>
<tr>
<td>Rectangular special control valves</td>
<td>From 800×400 to 1,600×3,000</td>
<td>0.32 to 3.8</td>
</tr>
<tr>
<td>Control and isolating valves</td>
<td>from 1,000×1,000 to 2,206×2,206</td>
<td>1 to 4.9</td>
</tr>
<tr>
<td>Isolating valve of CCGT</td>
<td>from 1,800×1,800 to 11,680×6,000, from 4,600 to 6,850 (diameter)</td>
<td>3.24 to 70</td>
</tr>
</tbody>
</table>
FILTERS

Trap Filters

Trap filters are produced with diameter from 0.2 to 0.8 m. Depending on the required parameters mesh elements and filtering cartridges are used as filtering elements.

Wire filtering cartridges ensure reliable interception of particles with a size of over 0.1 mm. The cartridges are made of stainless steel.

Depending on assignment, casings of entrainment filters are produced of stainless or carbon steel, both with vertical and horizontal designs.

Ion-Exchange Filters

The range of mixed-bed ion-exchange filters, regenerators varies in terms of diameter from 1 to 3.4 m. Depending on the processing media and regeneration solution, casings are made both of stainless steel and carbon steel with corrosion-proof coating.

Two types of filtering elements are used:

- Stainless steel caps with slots from 0.4 to 0.1 mm proved their efficiency and reliability during operation at different sites;
- Plastic caps are applied in corrosive media, where stainless steel caps cannot be used.

Upper and middle collection-distributive devices are made of stainless steel and polymeric materials.

Design feature of some devices results to be a use of a lower collection-distributive device, “false bottom” for carbon anticorrosive coated steel filters.
BURNERS

AEM has a great experience in production of high quality and reliable burner equipment for steam and water heating boilers.

Depending on design, the burners are subdivided into vortex and direct flow (dust-coal, dust-gas). AEM offers burners that ensure combustion of different kinds of fuel, both separately and in mixture (gas, fuel oil, coal). The capacity of burners is from 5 to 80 MW.

On shipment to customer, if required, the burner can be additionally completed with with ignitor, flare sensor and other required equipment.

STEAM SILENCERS

Silencers are designed to lower the sound power of the steam flow vented into the atmosphere. The processing media is water steam with temperature not exceeding $T_{oper.} = 570 \, ^\circ\text{C}$, pressure not exceeding $P_{oper.} = 25 \, \text{MPa}$. The medium flow rate is from 20 to 350 t/h.

Design of the noise silencer provides reduction of the noise level to norms specified by SN2.2.4/2.1.8.562-96 or customer requirements. Design of the noise silencer is developed individually on the base of a technical assignment or data specified by the customer in data sheet.
Pipeline valves by Czech company Arako are used in thermal and nuclear power, oil and gas industries. The valves are manufactured with respect to the standards ČSN, DIN, EN, ANSI. The product range includes carbon, alloyed and stainless steel valves. Product range of the company includes gate valves, shutoff, control and check valves, bellows valves, quick-action valves, drain and blow down valves, gate valves, check valves, ball valves and filters.

**Characteristics of Valves Produced for Power Engineering, Chemical, Petrochemical and Gas Industries**

<table>
<thead>
<tr>
<th></th>
<th>High pressure gate valves</th>
<th>Low pressure gate valves</th>
<th>Shutoff and control valves and bellows valves</th>
<th>High pressure shutoff valves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal diameter</td>
<td>50–350</td>
<td>40–500</td>
<td>15–200</td>
<td>10–150</td>
</tr>
<tr>
<td>Nominal pressure</td>
<td>160–500</td>
<td>10(6)–100</td>
<td>10–40</td>
<td>63–630</td>
</tr>
<tr>
<td>Minimum operation temperature, °C</td>
<td>–50</td>
<td>–105</td>
<td>(–196) –50</td>
<td>–196</td>
</tr>
<tr>
<td>Maximum operation temperature, °C</td>
<td>600</td>
<td>540</td>
<td>400</td>
<td>650</td>
</tr>
<tr>
<td>Application</td>
<td>Gas, water etc.</td>
<td>Gas, steam, water, oil, oil products, corrosive and non-corrosive media etc.</td>
<td>Gas, steam, water, oil, oil products, corrosive and non-corrosive media etc.</td>
<td>Gas, steam, water, oil, oil products, corrosive and non-corrosive media etc.</td>
</tr>
</tbody>
</table>
Characteristics of the Valves Produced for Power Engineering, Chemical, Petrochemical and Gas Industries (continued)

<p>| References: | Siemens AG, Germany; | ČEZ a.s., Czech Republic; | ALSTOM, France; | ENEL, Italy; | Thyssen Krupp, Germany. |</p>
<table>
<thead>
<tr>
<th>Check valves</th>
<th>Check gate valves</th>
<th>Ball valves</th>
<th>Filters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain and blow down valves</td>
<td>Check valves</td>
<td>Check gate valves</td>
<td>Ball valves</td>
</tr>
<tr>
<td>Nominal diameter</td>
<td>10–50</td>
<td>10–200</td>
<td>50–400</td>
</tr>
<tr>
<td>Nominal pressure</td>
<td>63–500</td>
<td>10–630</td>
<td>10–630</td>
</tr>
<tr>
<td>Minimum operation temperature, °C</td>
<td>(−196) –10</td>
<td>−196</td>
<td>−105</td>
</tr>
<tr>
<td>Maximum operation temperature, °C</td>
<td>580</td>
<td>600</td>
<td>540</td>
</tr>
<tr>
<td>Application</td>
<td>Steam, waste water</td>
<td>Gas, steam, water, oil, oil products, corrosive and non-corrosive media etc.</td>
<td>Gas, steam, water, oil, oil products, corrosive and non-corrosive media etc.</td>
</tr>
</tbody>
</table>
WATER TREATMENT AND WATER PURIFICATION

AEM offers a wide range of unique modern technologies of water treatment, purification and methods of desalination for the companies of thermal power, gas and petrochemical and other industries.

Ion-Exchanging Technologies:
- Counter flow and parallel flow ionization of water in filters.

Diaphragm Technologies:
- Reverse osmosis;
- Nanofiltration;
- Ultrafiltration;
- Electric deionization.

Reference Deliveries:
- Tatneft OJSC. In 2010, turn-key delivery of automated water treatment plant for fine desalination of surface water and purification of fuel oil contaminated condensates of petrochemical facilities of Taneko JSC;
- Taif OJSC. Implementation in 2014–2018, development and stage by-stage delivery of purification system for oil containing condensates to Nizhnekamskneftekhim OJSC.

In 1989, National Research and Design Institute for Atomic Power Engineering (OJSC VNIIAM) developed the first in the USSR industrial reverse osmosis plant ROP-50 (Russian: УОО-50) with capacity of 50m³/h for Zuevskaya Experimental Combined Heat and Power Plant.

Products and Technologies:
- Purification of associated formation waters (ά ≤ 1.0 µS/cm);
- Production of desalinated water for power plants in oil and gas industry (ά ≤ 0.2 µS/cm);
- Water desalination systems, including potable water supply (SanPIN);
- Trapping radioactive elements.

1. Lukoil-Komi CJSC. Formation waters purification with capacity 700 m³/h, ά ≤ 1.0 µS
2. Sibur-Khimprom CJSC. Water treatment for desalination, capacity 700 m³/m, ά ≤ 0.2 µS
3. Nizhnekamskneftekhim OJSC. Purification system for oil containing condensates, capacity 800 m³/h, TOC ≤ 200 µg /dm³
4. Tatneft OJSC. Petrochemical enterprises of Taneko OJSC. Water treatment for fine desalination of water, capacity 1,000 m³/h
COOLING TOWERS

Cooling towers are designed for cooling of process water in the systems of recycling water supply for power consuming equipment (heat exchangers of compressor units, process equipment of power engineering, metallurgical, light and food industries, radio-electronic equipment etc.). Cooling towers are manufactured by Czech company Chladici věže Praha a.s.

Types of Cooling Towers

<table>
<thead>
<tr>
<th>Type of cooling tower</th>
<th>Hydraulic capacity, m³/h</th>
<th>Heat rate MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooling tower, IT</td>
<td>2,500–180,000</td>
<td>40–2,200</td>
</tr>
<tr>
<td>Fan cooling tower, VCHV 6–10 type (parameters given for one section, number of section varies)</td>
<td>200–7,500</td>
<td>2–130</td>
</tr>
<tr>
<td>Fan cooling tower, CHV 1000-1 – CHV 3000-3</td>
<td>130–1,120</td>
<td>0.76–33</td>
</tr>
<tr>
<td>Fan micro cooling tower, SAV 100–700</td>
<td>20–190</td>
<td>0.1–1.1</td>
</tr>
</tbody>
</table>

More than 60 years experience and company traditions in designing and building cooling towers on a turnkey basis;

Own production of process equipment for the cooling tower, including own framework for the cooling tower shell;

Process equipment for the cooling tower under extreme conditions of up to –50 °C.

Reference Deliveries:

- Design documentation development and turnkey construction of evaporative cooling tower for Pocherady TPP, the Czech Republic, with height of 129 m;
- Design documentation development and process equipment delivery for cooling towers at Chelyabinskaya GRES, the Russian Federation;
- Turnkey construction of a fan cooling tower for Hencovce Electric Power Plant, the Czech Republic;
- Turnkey construction of a fan cooling tower, pumping station and circulation water piping for Plzeňská teplárenská, the Czech Republic;
- Fan cooling tower delivery for Mordovcement OJSC, the Russian Federation;
- Micro-cooling tower delivery with cooling circuit for Škoda a.s., the Czech Republic;
- Micro-cooling tower delivery for ČKD Praha a.s., the Czech Republic.

International Certificates:

- ISO 9001:2001;
- Management system certificate OHSAS 18001:1999;
- Certificate of Reinforced Concrete Structures Redjustment Union;
- Certificate CONEXIO;
- CCGT-450, Khudyyan-Teninskaya CHPP, Yaroslavl — two boilers.
CONSTRUCTION AND ERECTION WORKS

AEM performs construction & erection and repair works at enterprises of power and oil and gas industries. Over the period of its activity the company proved itself as a reliable partner, stable in performing its liabilities to customers.

**Main Types of the Performed Works:**
- General contractor functions;
- Construction, reconstruction and overhaul of process pipelines;
- Arrangement of clusters of wells after drilling, reconstruction of clusters of wells;
- Construction, reconstruction and overhaul of automated process control system;
- Installation of production equipment;
- Installation of utility systems and communications;
- Instrumentation for the sites of treatment and oil and gas extraction;
- Process equipment installation.

Construction and erection companies of AEM are equipped with all necessary production means, advanced equipment and technologies, including:
- Lifting and transport means;
- Metal cutting, grinding and sheet bending machines;
- Press and welding equipment;
- Tooling and accessories.

**Key Projects:**
- Reftinskaya GRES;
- Troitskaya GRES;
- Sredneuralskaya GRES;
- Ikryanskoye gold deposit;
- Urnenskoye deposit;
- Ust-Tegusskoye deposit;
- Processing enterprises.
1. Moscow, Russia
   Central Research Institute for Engineering Technology OJSC
   Tel.: +7-495-675-83-02
   Web-site: www.cniitmash.ru
   E-mail: cniitmash@cniitmash.ru

   State Specialized Planning Institute OJSC
   Tel.: +7-495-988-80-50
   Web-site: www.oaogspi.ru
   E-mail: info@oaogspi.ru

2. Podolsk, Russia
   Experimental Design Bureau
   OKB Gidropress JSC
   Tel.: +7-495-502-79-10
   Web-site: www.gidropress.podolsk.ru
   E-mail: grpress@grpress.podolsk.ru

3. ZIO-Podolsk OJSC
   Tel.: +7-495-747-10-25
   Web-site: www.oaozio.ru
   E-mail: kd@eatom.ru

4. Nizhniy Novgorod, Russia
   Joint Stock Company “Afrikantov Experimental Design Bureau for Mechanical Engineering”
   Tel.: +7-831-241-87-72
   Web-site: www.okbm.nnov.ru
   E-mail: okbm@okbm.nnov.ru

5. Nizhnyaya Tura, Russia
   Venta OJSC
   Tel.: +7-343-422-30-20
   Web-site: www.venta-nt.ru
   E-mail: venta@venta-nt.ru

6. St. Petersburg, Russia
   Central Mechanical Engineering Design Bureau OJSC
   Tel.: +7-812-676-63-63
   Web-site: www.ckbm.ru
   E-mail: postbox@ckbm.ru

7. Yekaterinburg, Russia
   SverdNIKhimmash OJSC
   Tel.: +7-343-263-90-91
   Web-site: www.sverd.ru
   E-mail: nииhм@ural.ru

8. Petrozavodsk, Russia
   AEM-technologies OJSC subsidiary
   Tel.: +7-814-271-69-20
   Web-site: www.pzm.su
   E-mail: info@pzm.su

9. Prague, the Czech Republic
   Chladici veze Praha a.s.
   Tel.: +420-222-350-700
   Web-site: www.chv-praha.cz
   E-mail: info@chv-praha.cz

10. Opava, the Czech Republic
    ARAKO spol. s.r.o.
    Tel.: +420-553-694-111
    Web-site: www.arako.cz
    E-mail: arako@arako.cz

11. Budapest, Hungary
    Ganz EEM LLC
    Tel.: +36-1-872-58-00
    Web-site: www.ganz-eem.com
    E-mail: info@ganz-eem.com