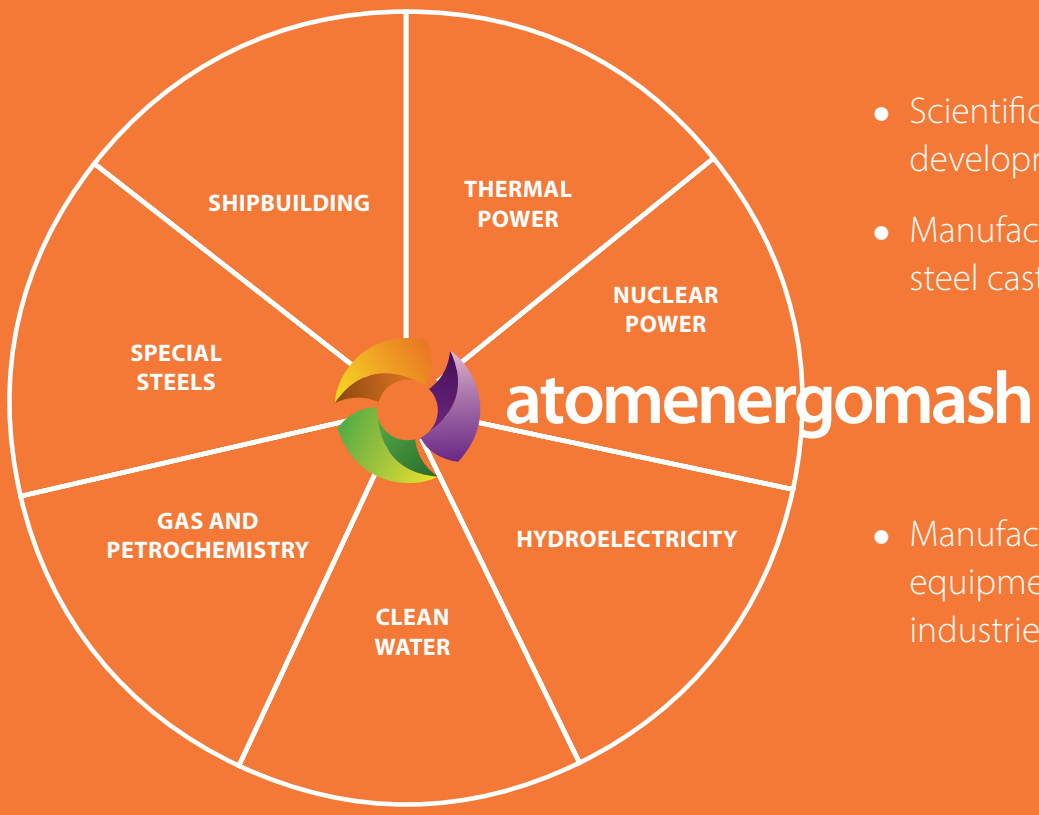
Equipment and Services for Thermal Power Industry

atomenergomash
COMPANY OF ROSATOM

ABOUT US

Atomenergomash JSC (AEM, Company, Group) is a machine building division of ROSATOM State Atomic Energy Corporation. One of the leading Russian power engineering companies, a supplier of efficient integrated solutions for nuclear and thermal power plants, natural gas and petrochemical industry, shipbuilding, hydroelectricity, demineralization, water treatment, water purification and special steel market.



- Scientific, research and development solutions
- Manufacturing of special steel castings and forgings
- Manufacturing of equipment for various industries

- More than 20 enterprises in Russia and abroad
- About 25% of domestic power engineering market
- Backlog of orders around 8$ bn.
- 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 technological processes and further equipment manufacturing.

Customers of AEM have trust in technologies and professional experience of the Group both when it comes to supplying the equipment and components for new thermal power plants and in the area of engineering and developing effective solutions for upgrading 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

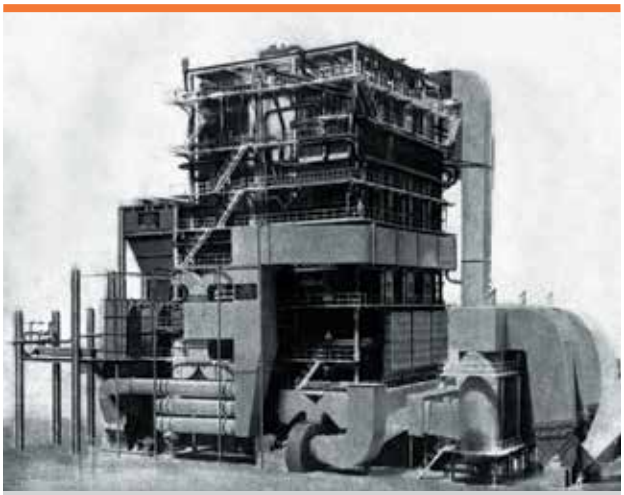
1962 — first USC boiler as a part of 100 MW power unit (PK-37) was commissioned at Kashirskaya State District Power Plant (GRES)

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
- Ivanovskiye 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

EQUIPMENT AND SERVICES FOR THERMAL POWER INDUSTRY

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;
- 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.

ENGINEERING

AEM includes enterprises with unique engineering competences and solid research and development base. The group of companies comprises leading design-engineering and research companies with long-term experience in design and development of machinery equipment.

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 involvment of the leading relevant research institutions and organizations of the Russian Federation: OJSC OKB Gidropress, OJSC Afrikantov OKBM, OJSC NPO CNIITMASH, 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.

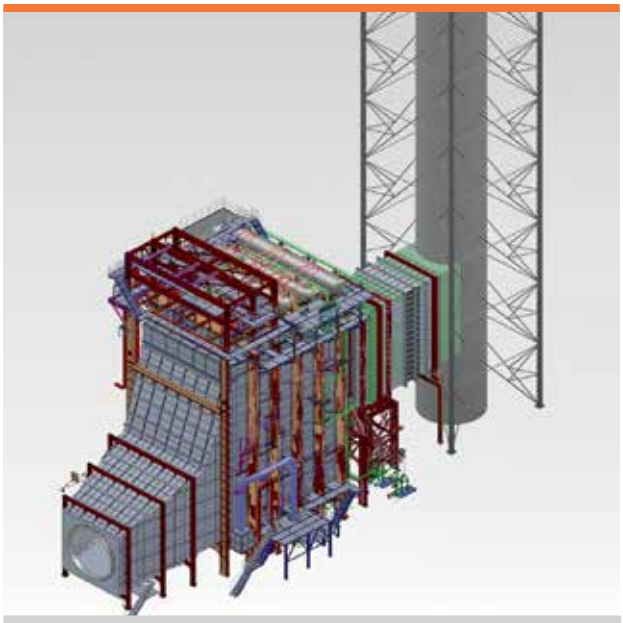
ZIOMAR Engineering Company has relevant licenses and permits of state and supervising entities of the Russian Federation required for performing its activities, including the license issued by the Federal Nuclear and Radiation Safety Authority of Russia that authorizes to carry out design-engineering 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 accordances 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.

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 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.

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 is the largest machine-building enterprise in the South of Russia with total area 1.7 ha. The process capabilities allow to manufacture any heat exchange, casing and vessel equipment for nuclear power plants, steelstructures and modular boiler equipment of high readiness.

The company owns a large pool of unique metal cutting, press, thermal and welding equipment. Another advantage of the company is its logistic capacity ofequipment transportation by road and railway as wellas by sea from its own port terminal.

Petrozavodskmash is one of the largest machine-building enterprises in 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.

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

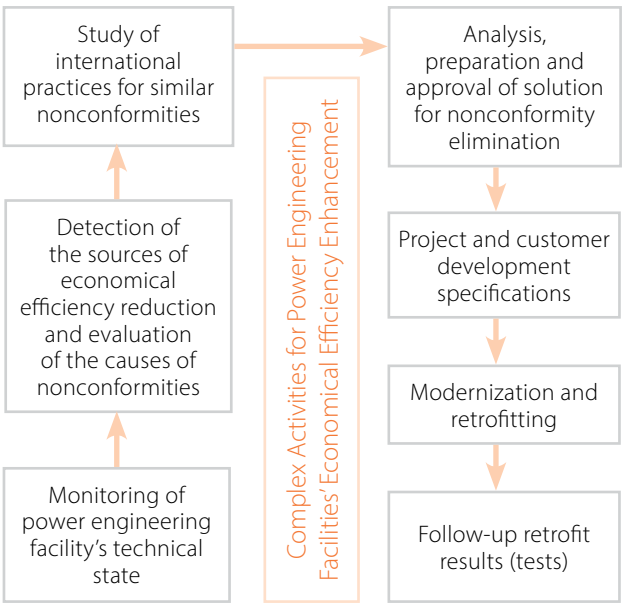
- Manufacturing of boiler equipment for 2 x 500 MW steam units and of 4 HRSGs for 450 MW CCPs a year;
- Equipment capacity up to 6 GW per year for all thermal power industry programs of;
- Finned tube production comes to 7.5-8 thousand tons per year;
- Up to 60 thousand tons of castings, steels, non-ferrous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

BOILER EQUIPMENT MODERNIZATION

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

Main Directions of Retrofit & Modernization Solutions Provided to Customer Equipment

Monitoring of power engineering facility's technical state



Detection of the sources of reliability degrading and evaluation of the causes of nonconformities

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.

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, Flow Vision), allowing to obtain results which are maximum approximated to experimental data of operation.

List of Boiler Equipment Retrofits:

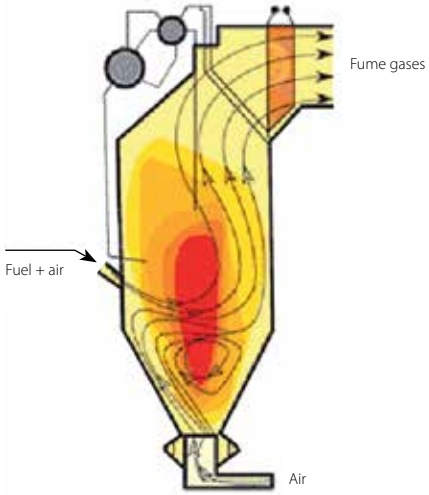
- Increase of the unit load adjusted range (threshold reduction of reliable operation);
- Shift to off-design types of fuel;
- Arrangement of sludge-free operation mode of slagging coal boilers combustion chamber by means of low-temperature and layer-by-layer fuel combustion;
- Enhancement of fuel ignition 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 modernt 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.

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

Combustion of coarse grinding fuel (turf, brown coal)	• 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 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.
Heat exchange intensification (increase of screens thermal efficiency factor)	• Potential increase of boiler steam generating capacity by 15–20%.
Adjustment of thermal field and decreasing maximum temperature in flame core to 1,000 … 1,350 °C	• 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%.



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).

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


LRQA

СЕРТИФИКАТ СООТВЕТСТВИЯ

ОАО «Машиностроительный завод «ЗиО-Подольск»
ОАО «Инжиниринговая компания «ЗИОМАР»
142103, Московская обл.,
г. Подольск, Железнодорожная д. 2,
Россия

BS EN ISO 9001:2008
EN ISO 9001:2008
ISO 9001:2008

Проектирование, разработка, изготовление и поставка котлов, включая паровые и водогрейные котлы, сосудов под давлением, трубопроводов и элементов трубопроводов, теплообменного оборудования и сопутствующих компонентов для тепловой и атомной энергетики, газовой и нефтехимической промышленности.

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


ZERTIFIKAT

JSC "ZIO-Podolsk"
Zheleznodorozhnaya street 2
RF - 142103 Podolsk

AD 2000-Merkblatt HP 0 und TRD 201 / EN 12952 / EN 12953 / EN 13445 in Verbindung mit EN ISO 3834-2

Druckgeräterichtlinie 97/23/EG

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 tor the agreement with customer.

Heat Recovery Steam Generators

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.

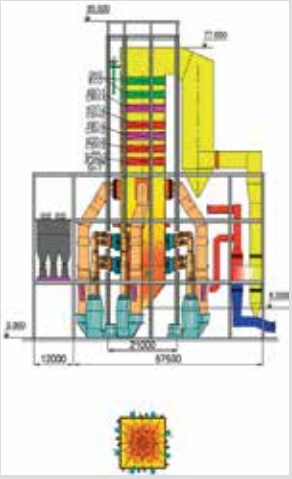
UTILITY BOILERS

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.

Development and engineering → ZIOMAR

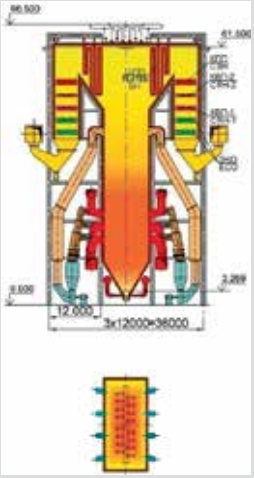
Manufacture → ZiO-PODOLSK

210 МВт



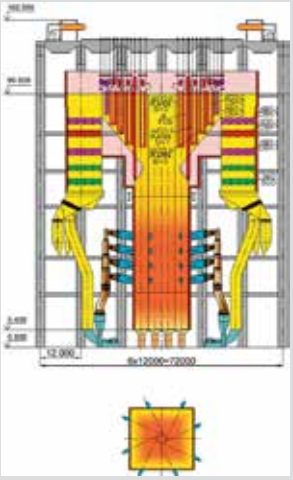
Ep-690-15.4-540 LT
(Russian: Еп-690-15,4-540 ЛТ) boiler
Neyveli TPP 2×210 MW (India)

300 МВт



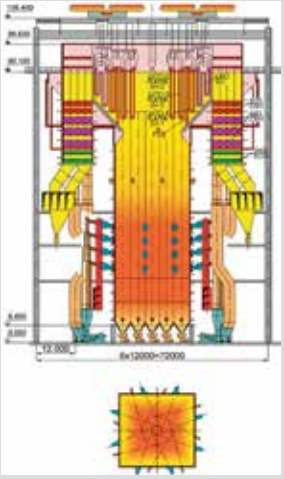
Pp-1000-25-545/545 (P-64)
(Russian: Пп-1000-25-545/545 (П-64)) boiler
Gacko and Ugljevik TPP (Yugoslavia), Novo-Angrenskaya TPP (Uzbekistan)

500 МВт



Pp-1650-25-545/545 (P-78)
(Russian: Пп-1650-25-545/545 (П-78)) boiler
Imin TPP2×500 MW (China)

800 МВт



Pp-2650-25-545/545 (P-67) (Russian: Пп-2650-25-545/545 (П-67)) boiler
Beryozovskaya GRES 3×800 MW (Russia)

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/cm^2.

High pressure direct-flow boilers:

- Steam capacity 540–670 t/h;
- Outlet steam temperature 540–570 °C;
- Outlet steam pressure 140 kgf/cm2.

Supercritical parameters direct-flow boilers:

- Steam capacity 950–2650 t/h;
- Outlet steam temperature 545–565 °C;
- Outlet steam pressure 255 kgf/cm^2.

HOT WATER BOILERS

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 system and ventilation. Boilers design allow to instal 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

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

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

Type of boiler (factory marking):	Water heating HRSG 5.5/110 (P-104)	Water heating HRSG 13.0/150 (P-105)	Water heating HRSG 35.0/150 (P-106)	Water heating HRSG 17.0/150 (P-109)	Water heating HRSG (B) 35.0/150 (P-122)	Water heating HRSG 12.2/150 (P-126)	Water heating HRSG 19/130 (P-128)	Water heating HRSG 60/150 (P-129)
Type of gas turbine (turbine power capacity):	GTE-6/6.3 M1УХЛ1 (6 MW)	GTA-6RM (6 MW)	LM2500+DLE (30 MW)	GTE-10/95BM (8 MW)	LM2500+DLE (30 MW)	GTES Ural-6000 (6 MW)	GTG-12VE (12 MW)	SGT-800 (43 MW)
Water heating HRSG inlet gas temperature, °C	303	416	505.2	420	505.2	437	283	523.5
Flow of recovered exhaust gases, kg/s	37.71	48	80,8	57.8	80.8	34.72	93.2	143.47
Temperature of exhaust gases, °C	138	133	95	110	109	111	103	99
Water heating HRSG inlet water temperature, °C	70	70	61	73	65	80	70	70
Water heating HRSG outlet water temperature, °C	110	150	129,3	155	150	150	130	150
Draft-pressure drop of water heating HRSG, max, Pa	1800	2000	1300	2500	2300	1500	2500	2500

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 water 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

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

Key References:

- 2× 450 MW CCGT*, Severo-Zapadnaya CHPP**, St. Petersburg, power units No. 1 and No. 2 — 4 HRSGs;
- 2× 450 MW CCGT, CHPP -27, Moscow, power units No. 3 and No. 4 — 4 HRSGs;
- 190 MW CCGT, Dzerzhinskaya CHPP, Dzerzhinsk;
- 2× 39 MW CCGT, Sochinskaya TPP, Sochi — 2 HRSGs;
- 2× 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 eqiupped with post injections. HRSGs can be eqiupped 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

Type of HRSG	Type of gas turbine, power, MW,	Steam parameters at HRSG outlet		
		D, t/h	P, bar	T, °C
P-88	GTE-110110 MW	155/35	72/7.0	501/231
P-96	GTE-160160 MW	232/45	77.5/5.0	510/226
P-131	PG-6581 GE 45 MW	58/12	74/7.0	525/209
P-132	SGT5-4000F 280 MW	258.4/309.3/35.1	149.9/31.4/4.4	540/534.6/263.2
P-133	GT-26 Alstom 288 MW	315/357/30.9	139/30/4.7	567/566/284
P-140	SGT5-4000F 280 MW	259/311/42	119/29/4.3	543/542/234
P-142	PG9171E 125 MW	186/39	74.9/7.25	515/229
P-143	PG9351FA 260 MW	277/302/44.1	110/22/3.9	566/565/300
P-146	SGT5-4000F 280 MW	288.6/317.1/42	138/32.5/5.2	566/568/244

Key References:

- 325 MW CCGT, Ivanovskiye CCGTs, Ivanovo;
- 450 MW CCGT, Kaliningradskaya CHPP-2, Kaliningrad;
- 60 MW CCGT, Noyabrskaya 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.

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.

Low pressure heaters manufactured by ZiO-Podolsk are successfully operated at CHPP-27 of Mosenergo as a part of PT-80 (Russian: ПТ-80) turbine group.

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

DISTRICT WATER HEATERS

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.

Key characteristics of district water heaters (Russian: ПСВ)	NWH-530-0.29-2.25	NWH-530-1.37-2.25
Heat-exchanging area, design, m^2	530/644	
Operation pressure in piping system (g), kgf/cm^2 (MPa)	23 (2.25)	
Operation pressure in casing (g), kgf/cm^2 (MPa)	3,0 (0.29)	14,0 (1.37)
Network water temperature, °C:		
Inlet	120	70
Outlet	150	110
Maximum temperature of heating steam, °C	400	
Nominal mass flow rate of network water, t/h	1130	
Hydraulic resistance of piping system at nominal flow rate of network water, kgf/cm^2 (MPa)	0.54 (0.053)	0.65 (0.064)
Nominal heat flow, MW (kcal/h)	66.0 (56.7)	53.4 (45.9)
Complete heating of network water, °C	12.7	8.7
Heating steam flow rate, t/h	110	94
Dry weight of the unit, t	18.3	19.9
Unit weight completely filled with water, t	30.3	31.9

PUMPING EQUIPMENT

AEM companies manufacture a wide range of pumps of different design, calculation parameters and materials.

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.

Deaerator

Gas condenser

Steam separation unit for Verkhne-Mutnovskaya Geothermal Power Plant

Types of Vessel Equipment:

- Vessels operated under pressure up to 70 MPa, to 1,000 m^3;
- Horizontal and vertical vessels for liquid media;
- Vertical vessels for air and gases;
- Evaporators.

Technical Parameters

Volume, m^3	to 300
Diameter, mm	to 3800
Nominal pressure, MPa	to 70
Temperature, °C	from –70 to +950
Material:	carbon and stainless steel, iron-nickel alloys

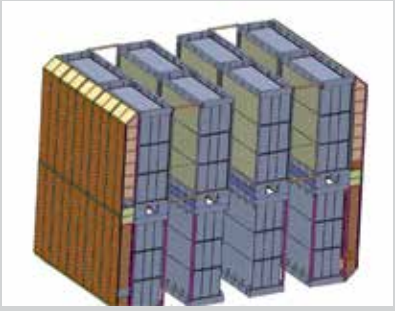
References:

- 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.

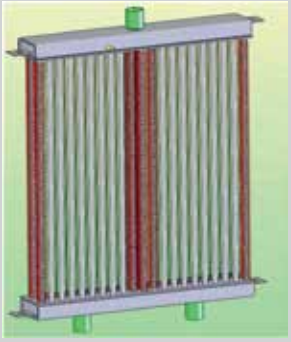


Calorifiers

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/m^{2}s;
- Inlet steam pressure — up to 16 kg/cm^2.

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/nm^3.

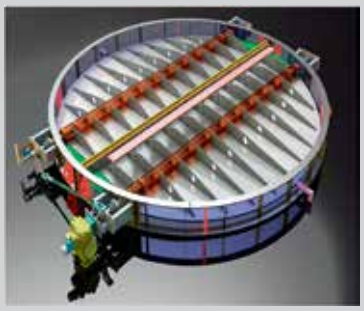
The valves are manufactured with round and rectangular cross-sections. Valves of a round cross-section have one shutoff or control element made as a gate valve. Valves of a rectangular cross-section have one, two, three or more gate valves with parallel rotation with pair-wise counter gate valves rotation 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.

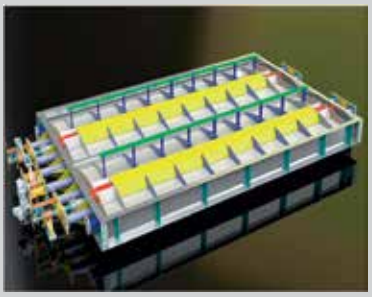
Isolating valves serves to shutdown separate areas of DGAD during repair work performance.

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.

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





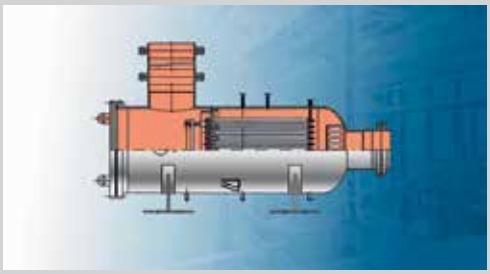
FILTERS

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.



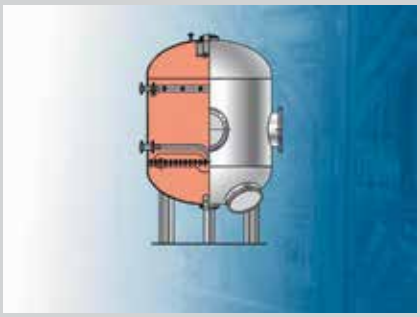
Ion-Exchange Filters

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.

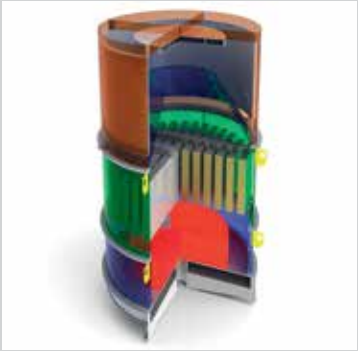
Depending on design, the burners are subdivided into vortex and direct flow (dust-coal, dust-gas). AEM offers burners that ensure combustion of different kinds of fuel, both separately and in mixture (gas, fuel oil, coal). The capacity of burners is from 5 to 80 MW.

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 mediais water steam with temperature not exceeding Toper. = 570 °C, pressure not exceeding Poper. = 25 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.



SHUTOFF AND CONTROL VALVES

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.





Gate valves	Shutoff and control valves	Drain and blow down valves

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

	High pressure gate valves	Low pressure gate valves	Shutoff and control valves and bellows valves	High pressure shutoff valves
Nominal diameter	50–350	40–500	15–200	10–150
Nominal pressure	160–500	10(6)–100	10–40	63–630
Minimum operation temperature, °C	–50	–105	(–196) –50	–196
Maximum operation temperature, °C	600	540	400	650
Application	Gas, water etc.	Gas, steam, water, oil, oil products, corrosive and non-corrosive media etc.	Gas, steam, water, oil, oil products, corrosive and non-corrosive media etc.	Gas, steam, water, oil, oil products, corrosive and non-corrosive media etc.

References:

- E-ON, Germany;
- Skoda, Czech Republic;
- AREVA, France;
- Slovenske Elektrarne, Slovenia;
- Mažeikiu Nafta, Latvia;
- Siemens AG, Germany;
- ČEZ a.s., Czech Republic;
- ALSTOM, France;
- ENEL, Italy;
- Thyssen Krupp, Germany.

				
Check valves		Check gate valves	Ball valves	Filters

Characteristics of the Valves Produced for Power Engineering, Chemical, Petrochemical and Gas Industries (continued)

	Drain and blow down valves	Check valves	Check gate valves	Ball valves	Filters
Nominal diameter	10–50	10–200	50–400	10–150	10–150
Nominal pressure	63–500	10–630	10–630		10–160
Minimum operation temperature, °C	(–196) –10	–196	–105	–196	–196
Maximum operation temperature, °C	580	600	540	200	550
Application	Steam, waste water	Gas, steam, water, oil, oil products, corrosive and non-corrosive media etc.	Gas, steam, water, oil, oil products, corrosive and non-corrosive media etc.	Gas, steam, water, oil, oil products, corrosive and non-corrosive media etc.	Gas, steam, water, oil, oil products, corrosive and non-corrosive media etc.

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.

atomenergomash
COMPANY OF ROSATOM

Specialization as per Water Treatment Technologies

VNIIAM

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.

SVERDNIIKHIMMASH | atomenergomash

Thermal Technologies:

- Evaporators;
- Evaporator vessels;
- Distilling desalination units.

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 50m^3/h for Zuyevskaya Experimental Combined Heat and Power Plant.

Products and Technologies:

- Purification of associated formation waters (æ ≤ 1.0 μS/cm);
- Production of desalinated water for power plants in oil and gas industry (æ ≤ 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 m^3/h, æ ≤ 1.0 μS
2. Sibur-Khimprom CJSC. Water treatment for desalination,
3. Tatneft OJSC. Petrochemical enterprises of Taneko OJSC. Water treatment for fine desalination of water, capacity 1,000 m^3/h

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.

Construction and installation works. Troitskaya GRES

Construction and installation works. Reftinskaya GRES

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