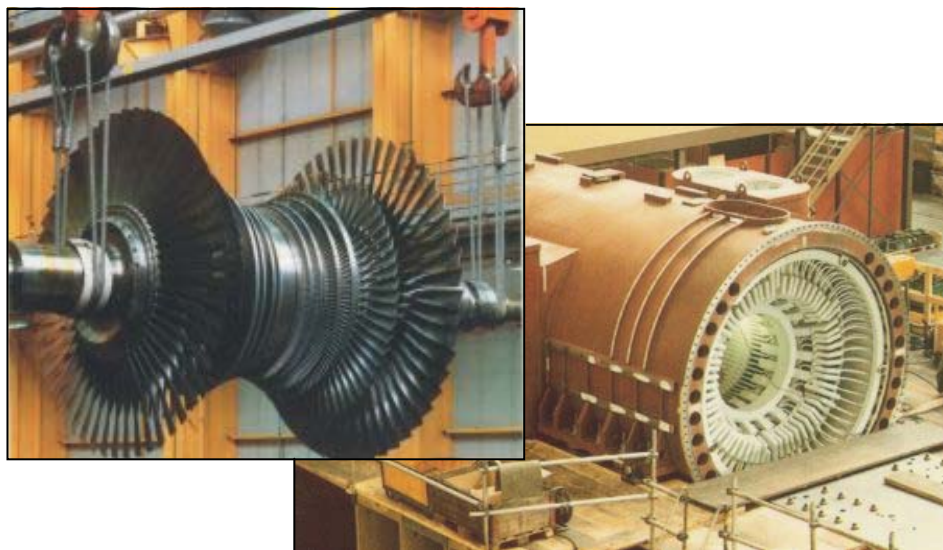


BLACK SEA GROUP



STEAM TURBINES, GENERATORS AND EXCITATION SYSTEMS





ABOUT BLACK SEA GROUP

BLACK SEA GROUP is formed from:

- 1. BLACK SEA TECHNOCHIM CO. S.R.L.**, having its head office in Bucharest, Romania, registered at the Register of Commerce under no. J40/18522/1994 with C.U.I. no. 6286263 and the fiscal attribute R;
Black Sea Technochim Co. is liable for Romania and European markets.
- 2. BLACK SEA ENERGY GENERATING EQUIPMENT TRADING (L.L.C.)** having its head office in Dubai, U.A.E., registered at the Department of Economic Development with license no. 515004 and Commercial Register no. 53617/1999;
Black Sea Energy Generating Equipment Trading L.L.C. is liable for the United Arab Emirates markets.
- 3. SUN ORBIT FOR GENERAL TRADING CO.**, having its head office in Baghdad-IRAQ, registered at Commercial Register no. 13116/2004;
Sun Orbit for General Trading Co. is liable for Iraqi markets.
- 4. BLACK SEA POWER GENERATING FZCO**, having its head office in Jebel Ali Free Zone - Dubai, U.A.E., License no.40146 Government of Dubai.
Black Sea Power Generating FZCO is liable for International, Middle East and Africa markets.

The main markets for our activities are in the Middle East and Africa countries.

Since its formation, as an international trade company, Black Sea Group has been dealing in the field of power generation, representing and collaborating with famous Romanian companies, for supplying of equipments and spare parts and performing overhaul for all types of steam power plants with power up to 330MW and boilers up to 1035t/h.

Due to an extensive experience, we offer to our clients high-quality products under international standards, short time delivery, competitive prices and a transparent collaboration.

Highly-qualified personnel work hard so that all the products, works and services to be completed according to our clients requirements and in time.

Quality Management

Black Sea Technochim Co. is certified by TÜV Technische Überwachung Hessen GmbH for the implementation and the application of the quality system according to DIN EN ISO 9001:2000.





From the beginning the **Black Sea Group** was focused intensively on quality, technical development and marketing.

The **Black Sea Group**'s main competencies include:

- Tight contacts with old and possible future clients;
- Through market studies for finding new possible tenders to take part to;
- Looking for the best designers and manufacturers for each possible future job;
- **Black Sea Group** buys the tender documents;
- The best offer issued on the name of one BSG member is sent to the client;
- **Black Sea Group** participates to the negotiations and signs the contracts as Main Contractor;
- **Black Sea Group** is responsible for the necessary finances required for each offer/contract like: bid bonds and performance bonds, opens L/C or makes advance payments for the manufacturers;
- During the development of each contract, in order to assure the best conditions in accomplishing the job, **Black Sea Group** is responsible for the delivery of goods from manufacturers to the client in the shortest time, for the transportation and accommodation of the employed personnel during the rehabilitations and/or service period, insurances of the goods during the shipment and during the erection works;
- **Black Sea Group** as Main Contractor is responsible in front of the client during the warranty period of each job performed.





BLACK SEA GROUP - CONTACT

ROMANIA



Black Sea Technochim Co.

Contact person: Mrs. Aurelia Neacsu - Commercial Manager

Phone: +40-21-3373951

FAX: +40-21-3366112

E-mail: bsbucharest@blackseagroup.com

UNITED ARAB EMIRATES



Black Sea Energy Generating Power Equipment Trading L.L.C.

Contact person: Mr. Saud Thuny – Commercial Manager
Mr. Tawfeeq Majeed

Phone: +971-4-2727806

Mobile: +050-6587708

FAX: +971-4-2728553

E-mail: bsdubai@blackseagroup.com

Black Sea Power Generating FZCO

Contact person: Mr. Mohanad Ahmeh – Comercial Manager

Phone: +971-4-2727806

Mobile: +050-2589854

FAX: +971-4-2728553

E-mail: bspower@blackseagroup.com

IRAQ



Sun Orbit for General Trading Co.

E-mail: bsbaghdad@blackseagroup.com

YEMEN



Representative office

Contact person: Mr. Yassir Mosa

Phone/FAX: +967-1-410.433

E-mail: bssanaa@blackseagroup.com

LARGE-SCALE WORKS FOR POWER PLANTS

STEAM TURBINE

Design of:

1. Reverse engineering of all energetically equipment (rotor, blades, bearings, etc.) with improvement effects on life time extension;
2. Modernization of control valves assembly and gland steam.

Delivery of the equipments for steam turbines:

1. Turbine rotor and turbine rotor disks;
2. Rotor and stator blades;
3. Diaphragms and diaphragms carrier;
4. Steam and oil labyrinth seal rings ;
5. Stem, valves, bushing for control valves; main steam stop valves and by-pass valve assembly;
6. Bolts, studs and nuts for turbine casing;
7. Couplings ;
8. Gear wheels;
9. Radial and axial bearings.



Service for steam turbines

1. Erection and commissioning of the repaired equipment in the power plant, etc.
2. Deblading and reblading of rotors including the redesign of some stages with improvement effects for efficiency improvement and prolong of the life time;
3. Measurements, tests and geometric corrections for turbine rotor;
4. Dynamic rotors balancing and overspeed tests;
5. Reconditioning of gland steam and oil labyrinths, and the manufacturing of new labyrinths, modernization of sealing solutions;
6. Reconditioning of bearings;
7. Valves and seat valves reconditioning, including replacement with new parts (studs, mechanical sleeves, chests, joins, pistons, etc) sterilization of bearing surfaces;
8. Reconditioning or manufacturing of new parts for turbine governing parts;
9. Modernization of hydro electric valves;

10. Manufacturing of special assembling parts: studs and bolts, nuts, joints, segments, rings, cotters, etc;
11. Reconditioning of turbine auxiliary equipment (steam ejector, oil centrifuges, couplings, gears, turning gears, etc.);
12. Reconditioning and manufacturing of casings, foundation elements, covers);
13. Reconditioning and manufacturing of spare parts for pumps.
14. Non destructive test on site



- fast spectroscopic analyses;
- non-destructive tests;
- dimensional inspections;
- diaphragm/bucket area check;
- fast chemical analysis;
- metallographic examination;
- determination of surface roughness using modern equipment;
- elaboration of technical documentation and studies performed by specialists;

15. Balancing and vibration analysis
 - Vibration measurement and frequency analysis;
 - Machine diagnosis;
 - Rotor balancing on balancing machine or on site at nominal speed;
 - Natural frequency of turbine rotor blades and analysis;
16. Deep preliminary inspection to determine turbine status
 - Operating characteristics
 - Analysis of operation data for turbine and auxiliary
 - Visual inspection and non destructive test for:
 - turbine casing and rotor
 - turbine components
 - Identifying problems and critical components;
 - Technical solutions for solving problems and modernization;
17. Aligning rotating machines (turbine rotor, generator rotor, exciter rotor, pump motor).

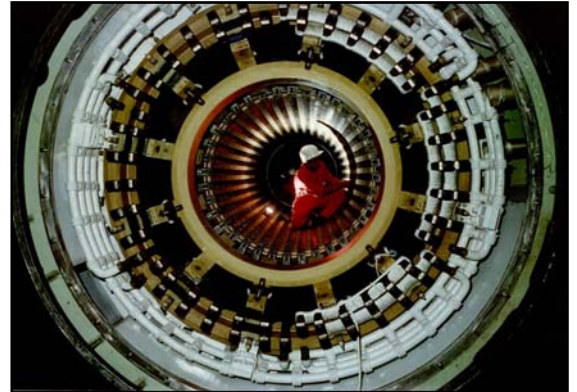
LARGE-SCALE WORKS FOR POWER PLANTS

TURBO GENERATORS

Black Sea Group provides services for all types of generators with power range up to 330 MW, air-cooled, hydrogen cooled or hydrogen and water-cooled.

Delivery of the equipments:

1. Generator complete sets;
2. Rotor winding;
3. Stator bars up to 18 kV;
4. Retaining rings;
5. Stator wedges sets;
6. Mechanical and electrical spare parts;
7. Coolers for cooling system;
8. Gas distribution system;
9. Hydrogen sealing system.



Service for generators:

1. Deep preliminary inspection to determine the generator status:
 - Operating characteristics
 - Analysis of operation data for generator, auxiliary plant and excitation;
 - Analysis of shaft voltages and shaft currents on generator and turbine shaft;
 - Analysis of rotor winding insulation.
 - Visual inspection
 - Inspection of complete generator and auxiliary plant;
 - Analysis of rotor winding insulation;
 - Inspection of protection, excitation and synchronizing equipment.
 - Water flow in stator winding
 - Analysis of water flow in the stator winding bars;
 - Measurements of stator water system conditions.
 - Stator bore test
 - Measurements of stator slot wedging condition;
 - Flux test on stator core, test of lamination insulation quality;
 - Check of shaft insulation quality.
 - Winding insulation tests
 - Leakage current measurements at low and high DC – voltages;
 - Dielectric loss angle measurements;
 - High potential tests;
 - Partial discharge measurements.
 - Non destructive test on site
 - fast spectroscopic analyses;
 - non-destructive tests;

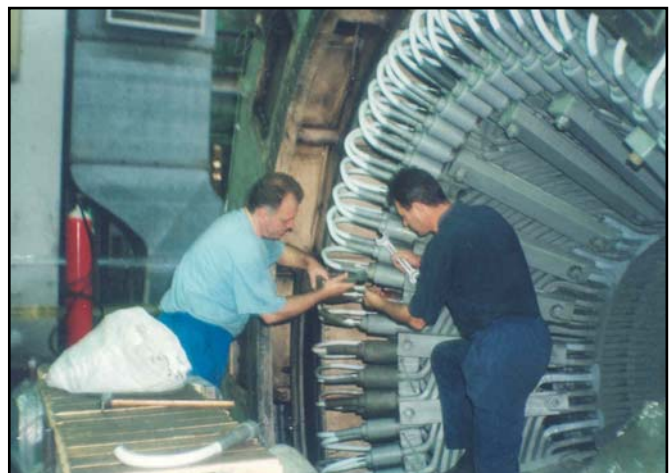


- dimensional inspections;
- fast chemical analysis;
- metallographic examination;
- determination of surface roughness using modern equipment;
- elaboration of technical documentation and studies performed by specialists.

Vibration analysis

- Analysis of bearing and shaft vibration;
 - Analysis of vibration at generator stator, turbine casing and foundation.
2. Identifying problems and critical components;
 3. Technical solutions for solving problems and for modernization;
 4. Reconditioning of stator core ends;
 5. Reconditioning of core pressplates /pressfingers;
 6. Reconditioning of stator winding bars and / or end-winding support structure;
 7. Reconditioning of stator slot wedging;
 8. Reconditioning of stator phase leads (parallel rings);
 9. Reconditioning / replacement of terminal bushing;
 10. Tightness test, replacement of gaskets (stationary seals);
 11. Retightening of foundation bolts;
 12. Improvement of rotor removal and installation;
 13. Reconditioning / replacement of retaining rings plus end plates;
 14. Reconditioning of rotor end - winding including spacers;
 15. Reconditioning / replacement of rotor wedges;
 16. Implementation of cross slots / damper slots in the pole area;
 17. Reconditioning of bearing and shaft sealing area;
 18. Reconditioning of coupling flanges;
 19. Reconditioning / replacement of fan blades;
 20. Dynamic balancing and electrical tests for generator rotor;
 21. Replacement of bearing and seal housing insulation;
 22. Reconditioning of radial studs, leading bar;
 23. Reconditioning of baffles for bearings and seal housing;
 24. Reconditioning of grounding brush between LP turbine and generator casing;
 25. Reconditioning of sliprings, slidings surface run out groove shape;
 26. Reconditioning of slipring insulation;
 27. Reconditioning of brush gear or replacement with improved one;
 28. Removal of cooper oxides from hollow conductors in stator bar;
 29. Improvement of rotor - Material/Structural design;
 30. Retaining ring design;
 31. Improved H2 leakproofing;
 32. Redesigned winding Stator & Rotor for increasing power;
 33. Replacement of exciter - New exciter system;

34. New voltage regulator;
35. New stator core, new end winding support structure including new stator core suspension with stabilization of core end regions against loosening of lamination;
36. New stator winding and new wedging, double tapered wedges (with convex/concave system or with leaf springs system);
37. New rotor encompassing new forging, new field and damper winding, new retaining rings and new slipring plus brush gear;
38. Upgrading of the generator to higher power output according to higher turbine and boiler capabilities;
39. Upgrading of the generator for conversion from-base load to peak load service;
40. New digital generator protection system;
41. New seal oil system encompassing radial shaft sealing design and seal oil supply unit;
42. Rewinding of stator on site or in our workshop;
43. Rewinding of rotor with or without cooper recovery, with F class insulation, on site or in our workshop;
44. Dismantling, nondestructive tests and mounting the retaining rings on site;
45. Nondestructive tests for rotor shaft;
46. Flux test on stator core and local reconditioning of core laminations;
47. Measurement of stator slots wedging condition;
48. Restore or improvement of stator slot wedging;
49. Restore of stator and rotor **H₂** cooling system;
50. Restore or improvement of hydrogen seals;
51. Improvement of generator auxiliaries using modern components;
52. Inspection and restore or modernization of excitation equipment;
53. Replacement of mechanical and electrical spare parts;
54. Modernization and implementation of new sealing solutions.





Retrofit of Excitation System for Generator

The important changes of the control technology applied on power generation requires new performances of the control systems such as Digital Voltage Regulator of the Generators, able to comply the most restrictive performances, reliability and free of maintenance.

The actually digital technology has largely applied for Power Plant by approx. 10 years with entire satisfaction.

BLACK SEA GROUP is able to offer such of Digital Voltage Regulator implemented in existing Excitation System or a new modern Excitation System with Digital Voltage Regulator which complies with all approved international standards.

BLACK SEA GROUP after complete expertise and preliminary discussions with customer, can offer solutions for replacement of analog control by digital control system.

This Automatic Voltage Regulator-AVR controls the terminal voltage of a synchronous generator respectively the reactive power flow, when the generator is on line. This is done by direct control of the field current at a static excitation system with shunt supply or indirect control at a brushless exciter or AC exciter with stationary diodes.

The AVR is based on proven reliable technology and can be applied to any type of exciter machine. The use of the advanced microprocessor technology and printed circuit boards which are equipped with solid state components. The system allows easy commissioning and a lot of flexibility for future system parameters changing.

The AVR contains the voltage regulator function together with limiters functions as standards able to precisely control the generator on entire P-Q diagram operation and other useful option control functions.

A well structured software application program controls and monitors all operations of the AVR.

Parameter setting and optimisation is possible using the software PC tools for Microsoft Windows.

In addition, a friendly software is able for commissioning and for optimisation:

- Configuration of inputs and outputs



- Setting of parameters
- Trending display (oscilloscope; measure values; etc)
- Parameter File download and upload

The monitoring software includes:

- Alarm logger display
- Data logger display

which stores a large amount alarms with time stamp of the system.

A local control panel connected with AVR via RS 485 interface displays system information.

The AVR offered can be connected through an optical link to a Laptop or Desktop PC with an installed application software and with a connection board inside the AVR hardware.

Standards functions

The AVR functions can be enabled or disabled with an engineering tool program:

- PID- Voltage Regulator (Automate Channel)
- Reactive and Active Current compensation
- PI- Field Current Regulator (Manual Channel)
- Follow-up control (Auto-Auto/Auto-Man)
- Power factor or Reactive power regulation
- Limiters:
 - overexcitation
 - underexcitation
 - maximum stator current(inductive or capacitive load)
 - overflux(V/Hz gradient)
 - stator voltage
- Soft-start

Optional functions.

Optional functions are able:

- Reactive power sharing between parallel generators via RS485 bus
- Power system stabilizer
- Rotor temperature
- V/Hz protection
- Voltage matching prior to synchronizing

Monitoring and protection functions

There are some standards functions:

- Maximum field current
- Loss of excitation
- Loss of Auxiliary supply
- Field flashing time
- Main supply undervoltage

The Monitoring and protection functions activate for indication and changing of the operation level to avoid unnecessary tripping or instantaneous excitation trip for protection purpose.

Communication with power plant SCADA system

The Communication with Higher Master System is available based PROFIBUS protocol via optical link.

Connection board which must be installed inside AVR hardware on additionally required.

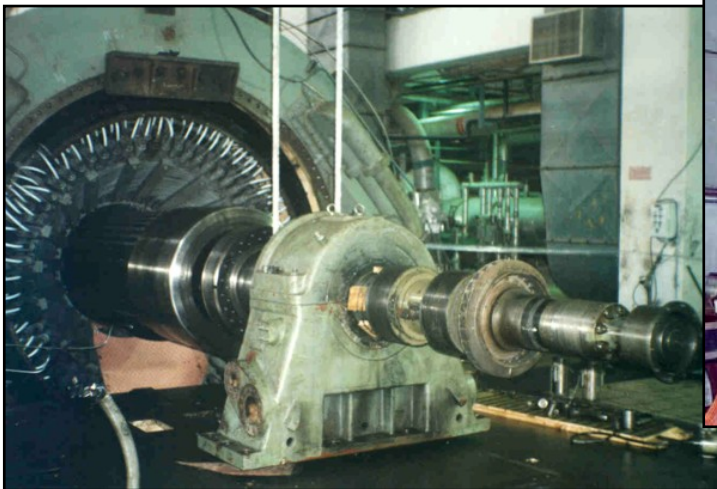
Technical Data

- AVR for AC supply input to Thyristor Converter, 9 - 500 V; 50/60 Hz
- AVR for DC supply input to IGBT chopper, 18 – 300 V DC
- High performance: Highest control accuracy: \pm (0.2% - 0.5%)
- Fastest response: 20 ms

BLACK SEA GROUP - PARTIAL REFERENCE LIST

Spare parts for steam turbine and generators recently delivered to our clients:

- Bearing bed ring
- Bearing oil guard
- Bushing
- Blades with accessories
- Blades manufacturing and reblading rotor turbine 2x75MW
- Blades manufacturing and reblading rotor turbine 2x40MW
- Blades manufacturing and reblading rotor turbine 30MW
- Cam shaft bushing
- Complete oil guard
- Complete set of spare parts for turbine
- Condenser water box
- Control valves components
- Coupling bolts and nuts
- Diaphragm
- Dowel pin
- Labyrinth seal cover
- Electrical motor
- External radial packing ring
- Expansion joint for gas ducts
- Flexible Washer
- Gas and air ducts
- Gaskets
- Gear wheel
- Gear coupling
- Holder bush
- HP and LP labyrinth rings
- Hydrogen sealing
- Insulation under retaining ring
- Main oil pump
- Pins
- Mechanical safety valve
- Nuts
- Nozzle ring
- Oil cooler
- Packing ring for diaphragm
- Pin
- Plate
- Pumps
- Radial bearing
- Retaining rings
- Ring type gasket
- Rolling Bearings
- Roller Pin
- Rotor Disk
- Safety plate
- Screws
- Shaft sleeve
- Shims for rotor slot
- Shroud
- Special gasket
- Spring shims
- Spring
- holder strip
- Stator shims
- Stator wedges set
- Steam seal packing for diaphragms
- Stem
- Stator wedges
- Studs
- Support plate
- Toothed Shaft
- Top rotor slot
- Turbine & Generator Coupling
- Turbine intermediate ring complete assembly
- Thrust bearing pads and rings
- Turning gear wheel and shaft
- Valves





PARTNER: ICPET SA ROMANIA as DESIGNER

Research and Designing Institute for Thermopower Equipment

Research works, studies and new projects for:

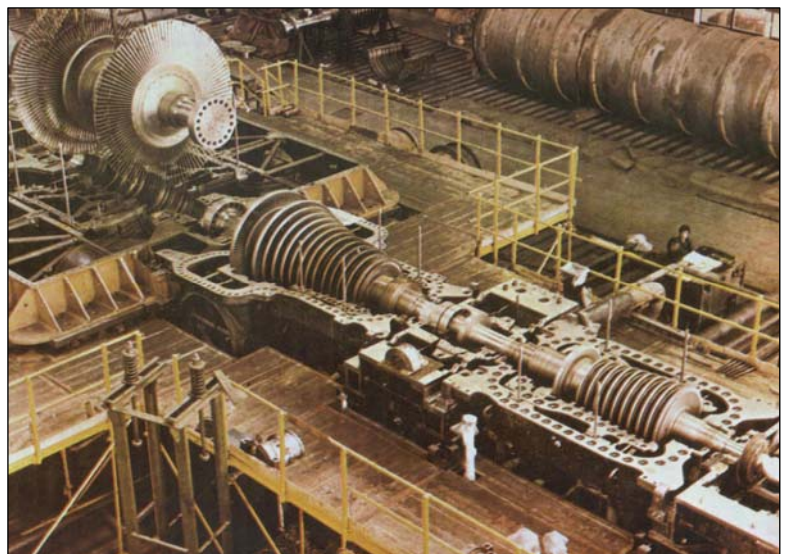
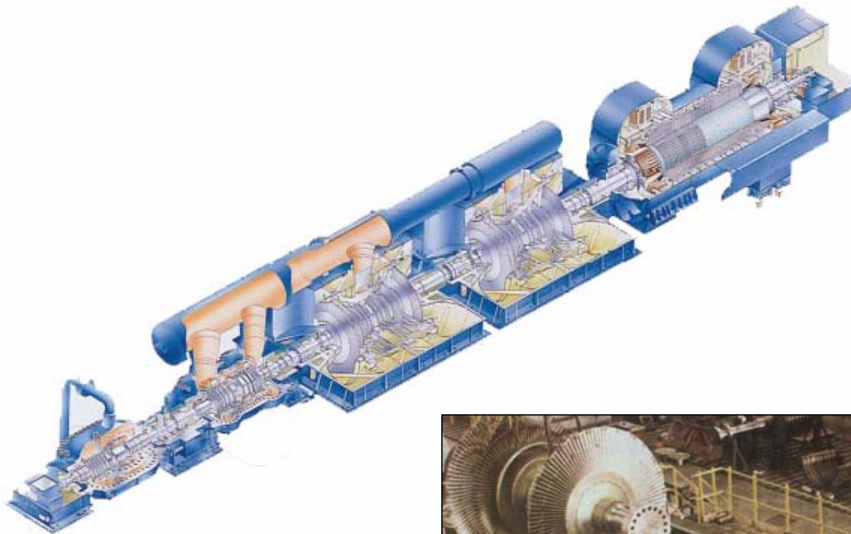
1. Steam turbines (also including control, protection and lubrication systems) of various constructional types (condensing, back-pressure, condensing and controllable extractions, back-pressure and controllable extractions) having unitary powers up to 330 MW meant for fossil fuel thermo power plants and up to 700 MW for nuclear power plants;
2. Air blowers with powers ranging up to 30 MW;
3. Turbocompressors and compressors for marsh gas, hydrogen, synthesis gas, H₂S with unitary powers up to 12 MW and speeds up to 12000 rpm;
4. Feed water turbopumps and electropumps with unitary powers up to 15 MW and variable speed;
5. Forced draft fans and induced draft fans with unitary powers up to 10 MW and speed up to 3000 rpm;
6. Turbo-generators, including the related equipment and circuits for hydrogen, CO₂, sealing oil and deionized water systems with unitary powers up to 330 MW at 3000 rpm and up to 700 MW, at 1500 rpm speed;
7. Special electric machines with powers ranging up to 12 MW manufactured in various protection classes, explosion proof included;
8. Excitation systems in several constructional variants: with auxiliary excitation generator, static excitation system with transformer directly connected to the generator terminals or to the auxiliary substation bus, with rotative rectifier, of BRUSHLESS type;
9. Electrohydraulic control systems for steam turbines;
10. Heat exchangers specific to the power plants or nuclear power plants: condensers, preheaters, deaerators, district heating heat exchangers, steam accumulators and converters, special installation and recoverers, humidity separators, expanders, special tanks, a.s.o, equipped with the fittings necessary for operation and automation purposes (level gauges, safety valves, venting, drains, a.s.o.)
11. Local measurement and control instrumentation and connection leads into the centralized control room;
12. Special fitting for the equipment and installations in the machine hall of power plants and nuclear power plants (control valves, main stop valves, the related hydraulic power actuators, hydraulically/ pneumatically driven non-return valves, equipped with their attendant power actuators, air-oil relays, tripping devices, pneumo-hydraulic accumulators, a.s.o.);
13. Ducts connecting the equipment making up the machine halls in the power plants and in the nuclear power plants.

Retrofit and service activities which consist in:

1. Feasibility studies concerning the retrofitting of several thermo-power plants and occasionally their shift to combined generation power plants (simultaneous combined generating of heat and electrical energy or to make process steam for various industrial utilities);
2. The diagram of general thermal balance sheets or by subsystems, detailed thermo-electric diagram included;

PARTNER: ICPET SA ROMANIA as DESIGNER

3. Performing extended complex subjects based on the solution studies or on the feasibility studies;
4. Development of coordinating subassembly drawings and erection documents at the purchaser's site for the machine halls attendant to the power plants;
5. Elaboration of instructions books for the equipment of the machine halls of thermo-power plants and of operating instructions, maintenance and repair instructions, as well;
6. Technical assistance at erection, commissioning and the guarantee and performance tests;
7. Development of projects according to mapping, required for the fabrication of spare parts, wearing parts or commissioning spare parts, subassemblies and components for turbo-compressors, turbo-blowers, turbo-pumps, forced draft fans and induced draft fans, special electrical machines, turbine-generators, a.s.o. respectively;
8. Projects to replace the mechano-hydraulic control system by electro-hydraulic control systems (EHC) or by a combined mechano-hydraulic and electro-hydraulic system;
9. Projects to replace the existing rotating excitation systems with d.c exciter by static excitation system or by brushless type excitation system;
10. Other service activities.



PARTNER: **ICPET SA ROMANIA** as **DESIGNER**

REFERENCE LIST

Steam turbines with condensation for generators and back pressure steam turbines with controlled extractions for electric generators

Turbine type	Power	Country	Year
F1C-330	330	Romania	1976-1987
F1C 330	330	China	1996-1997
D1L 210	210	Romania	1992
F1L 150	150	Romania	1989-1995
CC 50/60	50	Philippines (cebu)	1982
DSL 50	50	Romania	1967-1995
CL 50	50	Romania	1979-1989
DKU 50	50	Romania	1982-1986
DKUL 50	50	Romania	1984-1987
SL 25	25	Romania	1980
AC6	12	Romania	1972-1995
ASL 12	12	Romania	1973-1993
CSL 12	12	Romania	1966-1973
CTR 12	12	Romania	1970-1982
CKA 12	12	Romania	1983
CKTR 12	12	Romania	1976-1984
AS 7.2	7.2	Romania	1983-1987
AS 6	6	Romania	1962-1969
AS 6-1	6	Turkey (Samsun)	1969
AKSR 6	6	Romania	1961-1984
AKTR 6	6	Romania	1982-1984
AC4	4	Egypt	1974-1975
AKTP 4	4	Romania	1961-1969
AKTR 4	4	Romania	1961-1987
AC3	3	Romania	1957
AP 3-1	3	Romania	1952-1962
AP 3-1	3	China	1959-1961
AS 3	3	India	1960
AS 3	3	Romania	1965-1980
AT 3	3	Romania	1972-1975
AKP 3	3	Romania	1961-1964
AKSP 3	3	Romania	1968-1988
TKP 1/6000	1	Romania	1962-1974

Steam Turbines for different drivings

Turbine type	Power	Using	Country	Year
ACS 4.5 - 7000rpm	4.5	Air blower	China, Romania	1958-1983
ACS 12 - 3400rpm	12	Air blower	Romania	1980-1982
ACS 30 -max 3400rpm	30	Air blower	Romania	1976-1984

Turbine type	Power	Using	Country	Year
ACC 1.9 - 10234rpm	1.9	Synthesis gas compressor	Romania	1976-1984
ACC 2.6 - 11370rpm	2.6	Pit gas compressor	Romania	1976-1984
ACC 6.4 - 8600rpm	6.4	Air compressor	Romania	1976-1984
ACC 7.8 - 9000rpm	7.8	Ammonia compressor	Romania	1976-1984
ACC 8.9 - 5050rpm	8.9	Nitrous gas compressor	Romania	1976-1983
AKRC 1.6 - 12415rpm	1.6	Hydrogen compressor	Romania	1983
CKA 12 - 10234rpm	12	Synthesis gas compressor	Romania	1983

No extractions pure condensing turbines for generator driving

Turbine type	Power MW	Speed [rpm]	Inlet steam press.		Condenser steam press. (ata)	Inlet max steam flow (t/h)
			Press. ata	Temp °C		
AC 3	3	3000	35	435	0.05	16
AC 4	4	3000	35	435	0.05	21
AC 6 TH	6	3000	35	435	0.05	30
AC 12	12	3000	35	435	0.055	72
SC 1/7000	1	7000	15	280	0.07	7.5
CC 50/60	50	3600	90	535	0.085	208
F1C 330	330	3000	186	535	0.038	980
F1C 330	330	3000	186	535	0.055	1022

Excitation systems

Type	Destination	Excitation alternative	Rated D.C. [A]	Rated voltage [V]	Ceiling voltage [V]
SEGS 1-12	Turbogenerators 1-12MW	a) Static excitation system b) Compound power source-excitation system	100-500	80-125	Max 240 Max 350
MIEX 1-12 TFP	Turbogenerators 1-12MW	Brushless excitation system	100-500	80-125	Max 350
SEGS 50-330	Turbogenerators 50-330MW	a) Static excitation system b) Static excitation system with AC exciter supply	500-3000	124-480	Max 800
MIEX 60 TFP	Turbogenerators 25-100MW	Brushless excitation system	1000-1800	230-280	Max 440
SEGD 1-10	Standby Diesel generator 1-10MW	Compound power source-excitation system	Max 500	Max 100	Max 200
SEMS 1-10	Synchronous motors 1-10MW	a) Static excitation system b) Compound power system c) Brushless excitation system	100-500	80-120	240 240 180
SEGR 60-330	Generator standby excitation 60-330MW	Static excitation system	3000	400	800