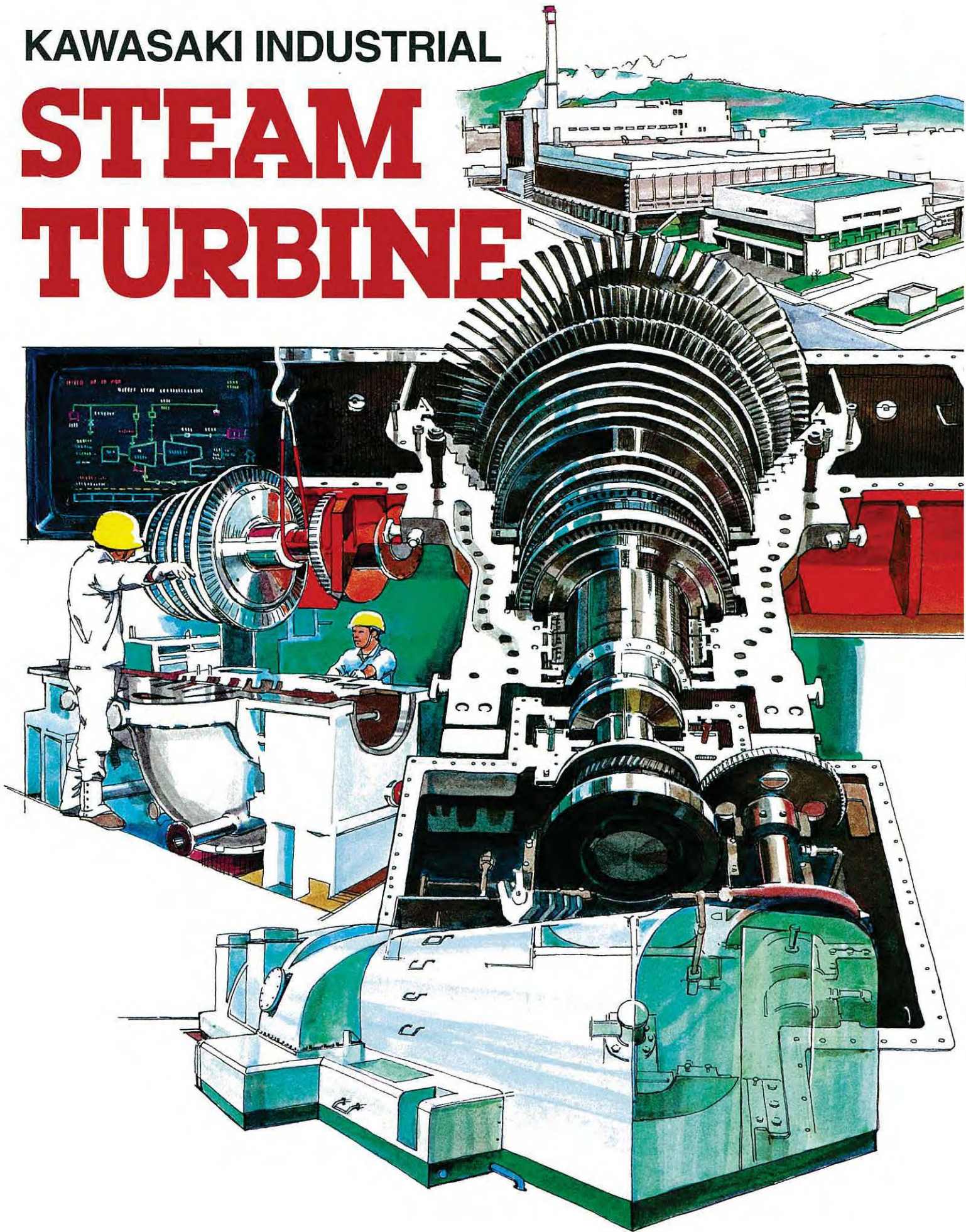


KAWASAKI INDUSTRIAL

STEAM TURBINE



A Brief History of KAWASAKI INDUSTRIAL TURBINES

Kawasaki first started to manufacture steam turbines under technical tie-ups with Curtis Co.(USA) and John Brown Co.(Great Britain) in 1907. Since those agreements were terminated in 1925, Kawasaki has continued manufacturing turbines of its own original design. To date, it has produced over 1,000 units.

Kawasaki's turbines are applied for marine use and various industrial applications. Despite competition from other Japanese manufacturers who began manufacturing licensed turbines using technology from abroad in the 1950's, Kawasaki's original techniques have succeeded in earning for the company a high reputation, especially in marine turbines.

Since 1956, Kawasaki has used its long and extensive turbine experience to expand to the field of industrial steam turbines. Today, more than 260 units amounting to 3,600MW have been delivered to various industrial fields, and Kawasaki industrial turbines enjoy the same high reputation as its marine turbines.

Kawasaki industrial turbines are completely standardized and series-designed, and are available in a variety of types and sizes.





FEATURES

Kawasaki industrial turbines are available for steam pressure up to 13.5MPaG; temperatures to 550°C ; speeds to 13,000RPM; capacities from 0.5MW to 100MW. The turbines operate directly or indirectly connected with speed reducing gear.

Flexible and wide range of applications

Kawasaki steam turbines meet various requirements for driving electric generators in thermal plants as well as for driving process compressors, pumps, fans, blowers and other machines in the industrial process.

Excellent performance

Kawasaki turbines deliver high performance thanks to the use of newly-developed aero-foil blades and Kawasaki's original design philosophy for the Semi-Curtis control stage, optimum value design, and other fluid dynamic improvements.

High reliability

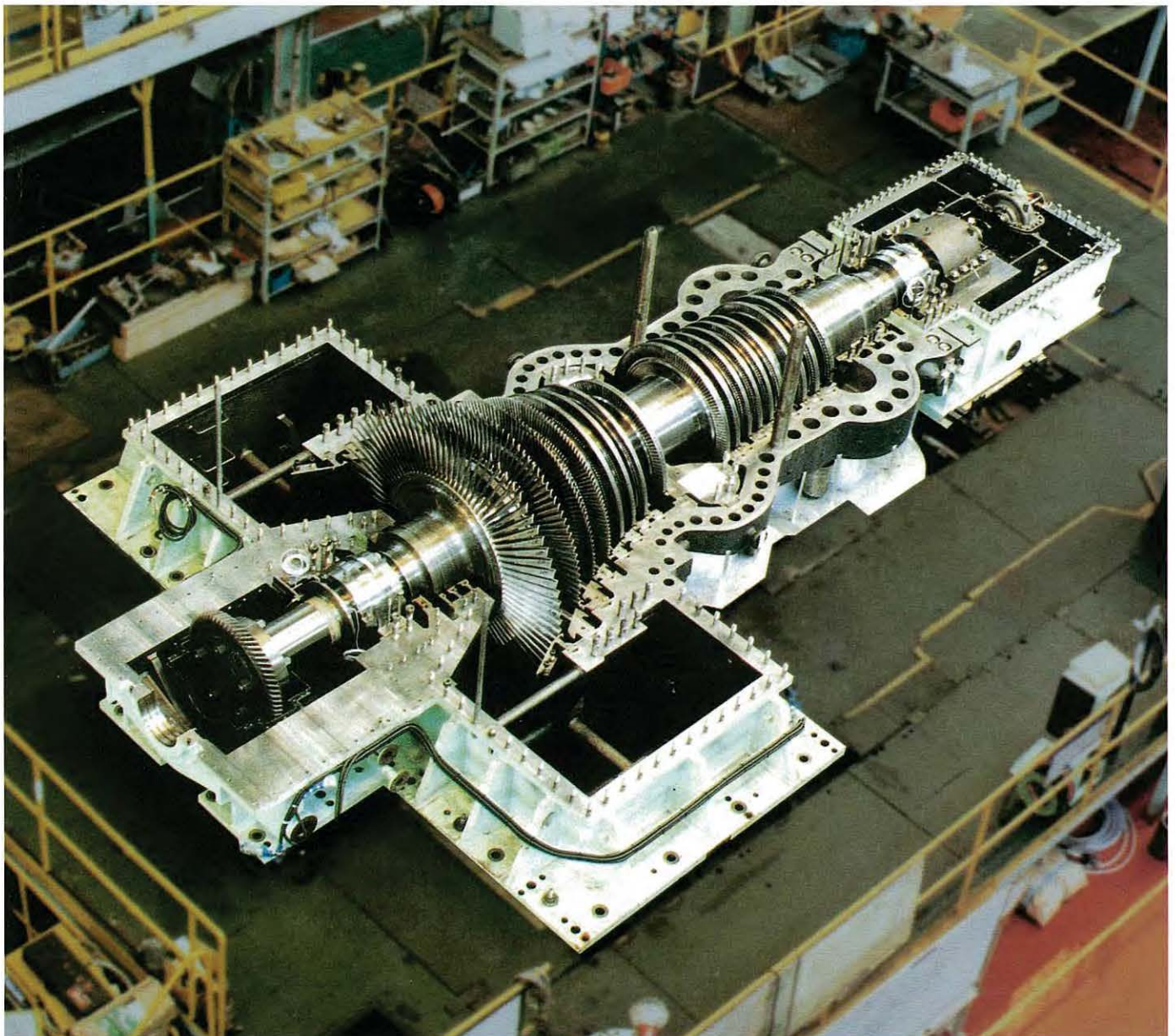
All essential parts such as casing, rotor, blades, nozzle and diaphragm, labyrinth packing, bearing, governing and safety devices are based on Kawasaki's long experience and have been successfully field proven.

Easy maintenance, inspection and construction

Horizontally-split casing provides easy maintenance and inspection work. Bearings can be individually removed without disturbing other parts of the machine. The packaged design saves space and turbine weight, as well as minimizes labor costs and installation time.

Competitive price

The standardized and series design makes Kawasaki turbines economical and cost competitive.



REDUCTION GEARED TURBINE

● Table1. RC, RCE Type (Condensing type for 4 pole generator, pump, or blower)

Type	Rated Output kW	Revolution rpm		Steam Inlet Press. MPaG	Exhaust Vacuum mmHg
		Turbine	Wheel		
RC-32	2,500~4,000	9,000~11,200	1,500/1,800	2~6	500~710
RCE-50/RC-50	4,000~6,300	9,000~11,200	1,500/1,800	3~8	500~710
RCE-80/RC-80	6,300~9,000	7,100~11,200	1,500/1,800	5~10	550~722
RCE-100/RC-100	9,000~11,200	7,100~9,000	1,500/1,800	5~10	550~722
RCE-125/RC-125	11,200~14,000	7,100~9,000	1,500/1,800	6~12	550~722
RCE-160/RC-160	14,000~18,000	5,600~7,100	1,500/1,800	6~12	550~722
RCE-200/RC-200	18,000~22,400	4,500~7,100	1,500/1,800	6~12	600~722
RCE-250/RC-250	22,400~28,000	4,500~7,100	1,500/1,800	8~13.5	600~722
RCE-315/RC-315	28,000~35,500	4,000~5,600	1,500/1,800	8~13.5	600~722
RCE-400/RC-400	35,500~	4,000~4,500	1,500/1,800	8~13.5	600~722

● Table2. RP, RPE Type (Back pressure type for 4 pole generator, pump, or blower)

Type	Rated Output kW	Revolution rpm		Steam Inlet Press. MPaG	Back Press. kPaG
		Turbine	Wheel		
RP-32	2,500~4,000	9,000~11,200	1,500/1,800	2~6	100~1,600
RP-50	4,000~6,300	9,000~11,200	1,500/1,800	3~8	100~1,600
RPE-80/RP-80	6,300~9,000	7,100~9,000	1,500/1,800	5~10	100~1,600
RPE-100/RP-100	9,000~11,200	7,100~9,000	1,500/1,800	5~10	200~1,600
RPE-125/RP-125	11,200~14,000	7,100~9,000	1,500/1,800	6~12	200~1,600
RPE-160/RP-160	14,000~18,000	5,600~7,100	1,500/1,800	6~12	200~1,600
RPE-200/RP-200	18,000~22,400	5,600~7,100	1,500/1,800	6~12	300~1,600
RPE-250/RP-250	22,400~28,000	5,600~7,100	1,500/1,800	8~13.5	300~1,600
RPE-315/RP-315	28,000~35,500	4,000~5,600	1,500/1,800	8~13.5	300~1,600

Note. 1. E type turbine is equipped with extraction pressure governing valve.

2. When mixing steam is applied, the type is named with "M" (as RCM-160).

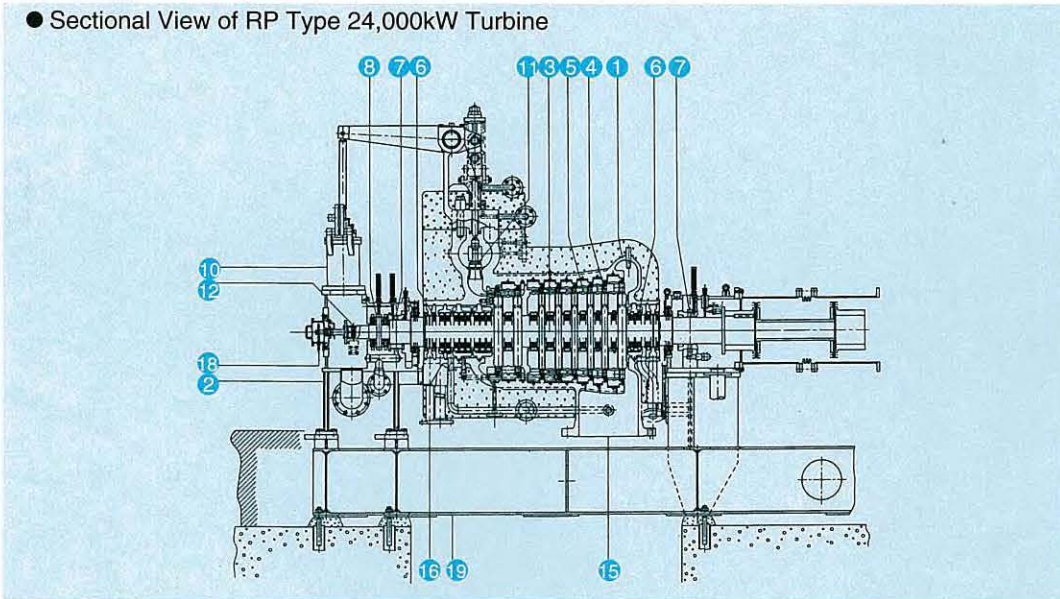
3. When exhaust direction is axial, the type is named with "X" (as RCX-160).

4. When exhaust direction is upward, the type is named with "U" (as RCU-80).



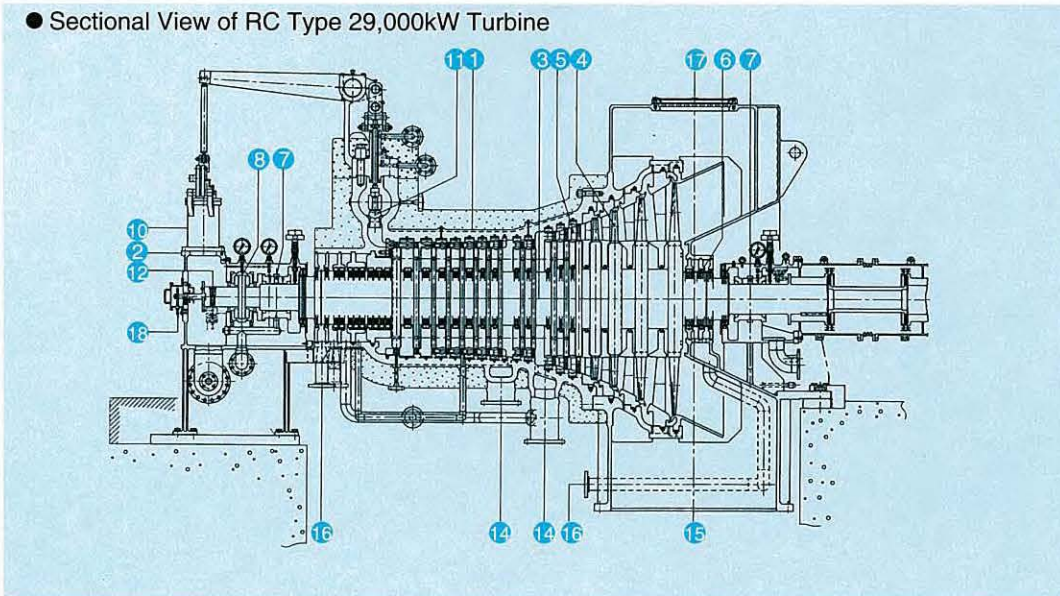
RCE-200 Type Turbine (18,000kW)

● Sectional View of RP Type 24,000kW Turbine



- 1 Turbine casing
- 2 Bearing pedestal
- 3 Rotor
- 4 Blade
- 5 Nozzle & diaphragm
- 6 Labyrinth packing
- 7 Journal bearing
- 8 Thrust bearing
- 9 Turning equipment
- 10 Servo motor
- 11 Governing valve
- 12 Over speed governor
- 13 Main oil pump
- 14 Extraction steam port
- 15 Exhaust steam port
- 16 Gland steam port
- 17 Relief diaphragm
- 18 Speed pick-up
- 19 Base plate

● Sectional View of RC Type 29,000kW Turbine



DIRECT COUPLED TURBINE

● Table3. SC, SCE Type (Condensing type for 2 pole generator)

Type	Rated Output kW	Revolution rpm	Steam Inlet Press. MPaG	Exhaust Vacuum mmHg	No. of Extraction
SCE-160/SC-160	14,000~18,000	3,000/3,600	6~12	680~722	3~4
SCE-200/SC-200	18,000~22,400	3,000/3,600	8~13.5	680~722	3~4
SCE-250/SC-250	22,400~28,000	3,000/3,600	8~13.5	680~722	4~5
SCE-315/SC-315	28,000~35,500	3,000/3,600	8~13.5	680~722	4~5
SCE-400/SC-400	35,500~45,000	3,000/3,600	8~13.5	690~722	4~5
SCE-500/SC-500	45,000~56,000	3,000/3,600	8~13.5	690~722	4~5
SCE-630/SC-630	56,000~71,000	3,000/3,600	8~13.5	690~722	4~5
SCE-800/SC-800	71,000~90,000	3,000/3,600	8~13.5	690~722	4~5
SCE-1000/SC-1000	90,000~112,000	3,000/3,600	8~13.5	690~722	4~5
SCE-1250/SC-1250	112,000~150,000	3,000/3,600	8~13.5	690~722	4~5

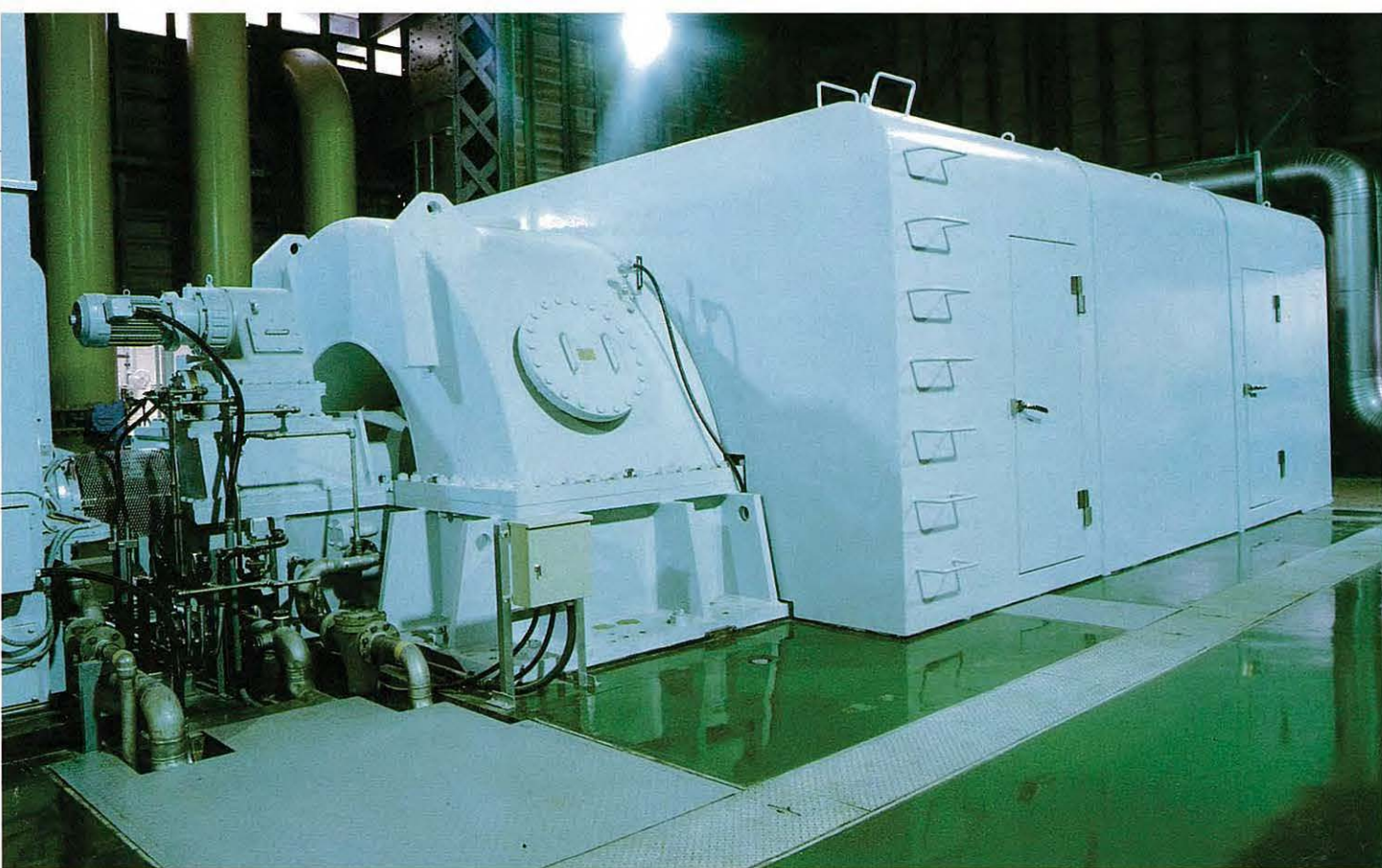
● Table4. DP, DPE Type (Back pressure type for 2 pole generator)

Type	Rated Output kW	Revolution rpm	Steam Inlet Press. MPaG	Back Press. kPaG
DPE-160/DP-160	14,000~18,000	3,000/3,600	8~13.5	300~1,600
DPE-200/DP-200	18,000~22,400	3,000/3,600	8~13.5	300~1,600
DPE-250/DP-250	22,400~28,000	3,000/3,600	8~13.5	300~1,600
DPE-315/DP-315	28,000~35,500	3,000/3,600	8~13.5	300~1,600
DPE-400/DP-400	35,500~45,000	3,000/3,600	8~13.5	300~1,600
DPE-500/DP-500	45,000~56,000	3,000/3,600	8~13.5	300~1,600

Note. 1. E type turbine is equipped with extraction pressure governing valve.

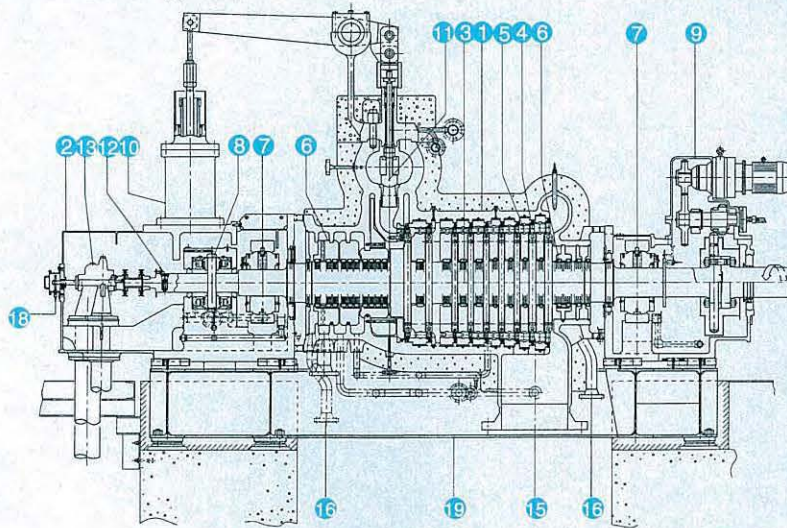
2. When mixing steam is applied, the type is named with "M" (as SCM-400).

3. When exhaust direction is axial, the type is named with "X" (as SCX-400).



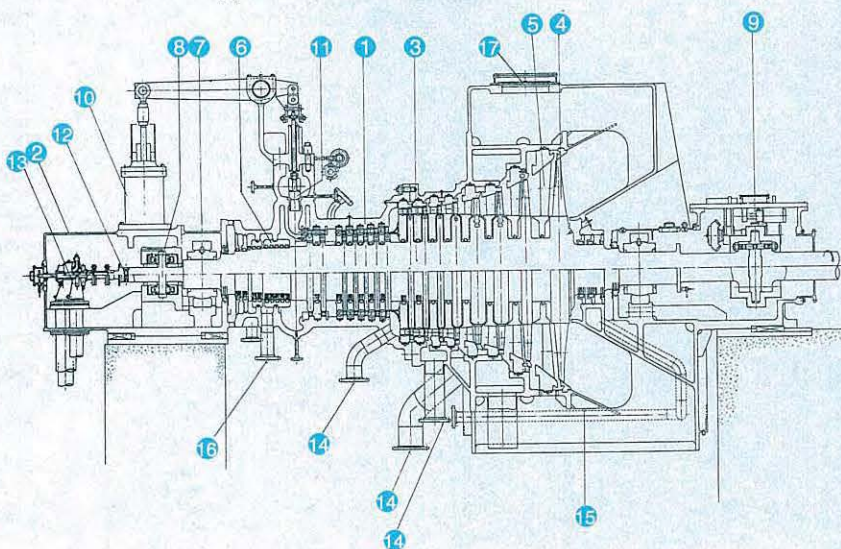
SCE-315 Type Turbine (30,000kW)

● Sectional View of DP Type 42,600kW Turbine



- 1 Turbine casing
- 2 Bearing pedestal
- 3 Rotor
- 4 Blade
- 5 Nozzle & diaphragm
- 6 Labyrinth packing
- 7 Journal bearing
- 8 Thrust bearing
- 9 Turning equipment
- 10 Servo motor
- 11 Governing valve
- 12 Over speed governor
- 13 Main oil pump
- 14 Extraction steam port
- 15 Exhaust steam port
- 16 Gland steam port
- 17 Relief diaphragm
- 18 Speed pick-up
- 19 Base plate

● Sectional View of SC Type 75,000kW Turbine



APPLICATION

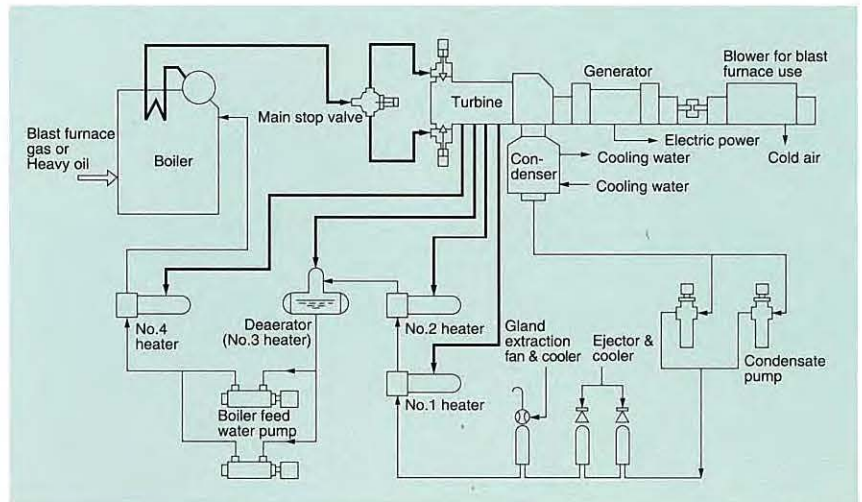
Iron & Steel Making Plant

●Turbine

Type : Single flow condensing turbine (SC-250)
 Steam condition : $9.61\text{MPaG} \times 535^{\circ}\text{C}$
 Exhaust pressure: 722mmHg
 Output : $35,000\text{kW}$

●Generator

Type : Revolving field air cooled type
 Output : $41,200\text{kVA}$
 Voltage : 11kV
 Frequency : 60Hz
 No. of pole : 2



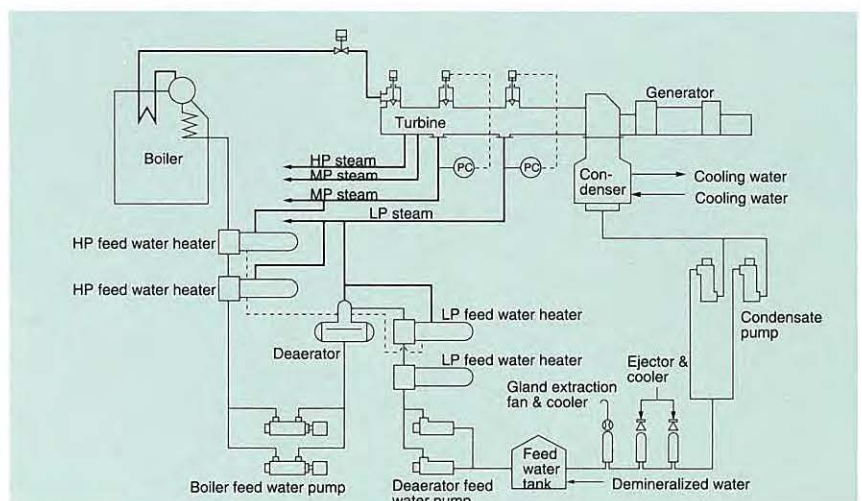
Chemical Plant

●Turbine

Type : Extraction pressure control single flow condensing turbine (SCE-315)
 Steam condition : $11.77\text{MPaG} \times 538^{\circ}\text{C}$
 Extraction pressure: $1.569\text{MPaG}/539\text{kPaG}$
 Exhaust pressure: 690mmHg
 Output : $35,000\text{kW}$

●Generator

Type : Revolving field air cooled type
 Output : $41,177\text{kVA}$
 Voltage : 11kV
 Frequency : 60Hz
 No. of pole : 2



Pulp & Paper Plant

● Turbine

Type : Extraction pressure control single flow condensing turbine (SCE-315)

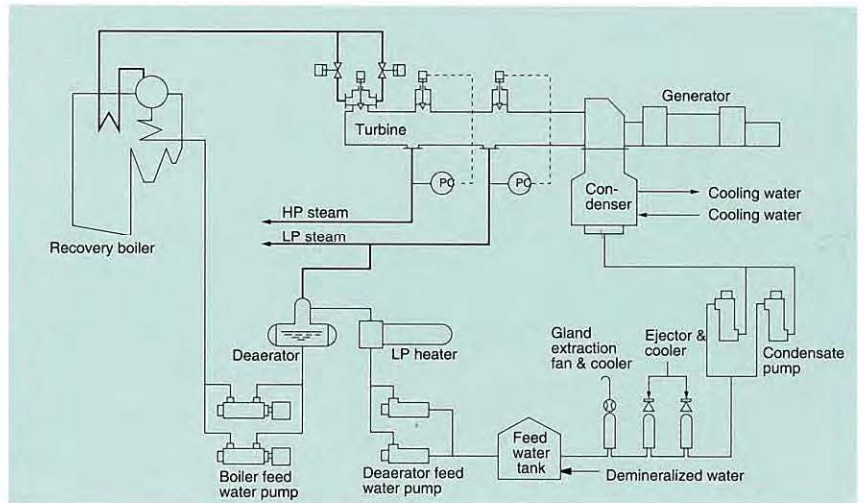
Steam condition : 10.3MPaG × 512°C
 Extraction pressure: 1.079MPaG/294kPaG
 Exhaust pressure: 680mmHg
 Output : 45,900kW



● Generator

Type : Revolving field air cooled type

Output : 54,000kVA
 Voltage : 11kV
 Frequency : 60Hz
 No. of pole : 2

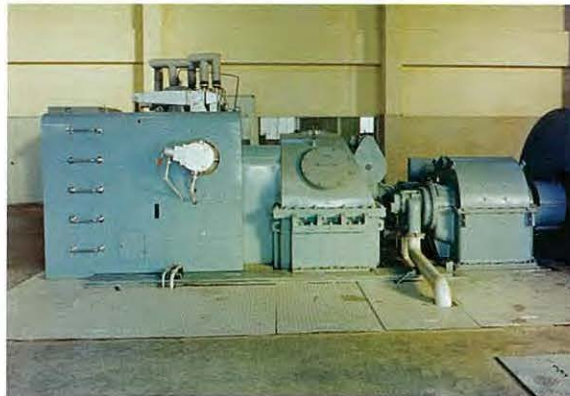


Copper Flash Smelting Plant

● Turbine

Type : Single flow condensing turbine with reduction gear (RC-160)

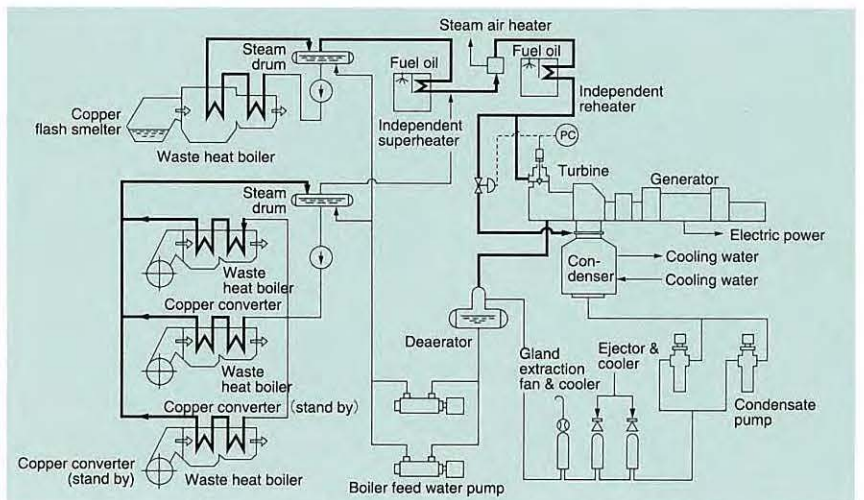
Steam condition : 3.43MPaG × 435°C
 Exhaust pressure: 680mmHg
 Output : 13,000kW



● Generator

Type : Revolving field brushless air cooled type

Output : 15,295kVA
 Voltage : 6.5kV
 Frequency : 50Hz
 No. of pole : 4



Cement Plant

●Turbine

Type : Mixed flow
condensing turbine
with reduction gear
(RCM-160)

Steam condition : 1.91MPaG × 348°C

Mixed pressure : 294kPaG

Exhaust pressure: 710mmHg

Output : 15,700kW



●Generator

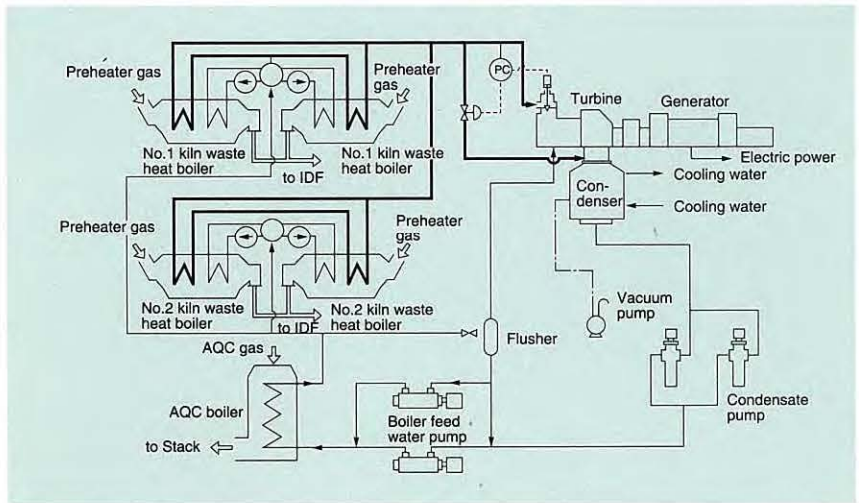
Type : Revolving field
brushless air cooled
type

Output : 17,650kVA

Voltage : 6.6kV

Frequency : 50Hz

No. of pole : 4



Garbage Incineration Plant

●Turbine

Type : Single flow
condensing turbine
(SC-250)

Steam condition : 2.35MPaG × 295°C

Exhaust pressure: 466mmHg

Output : 27,000kW



●Generator

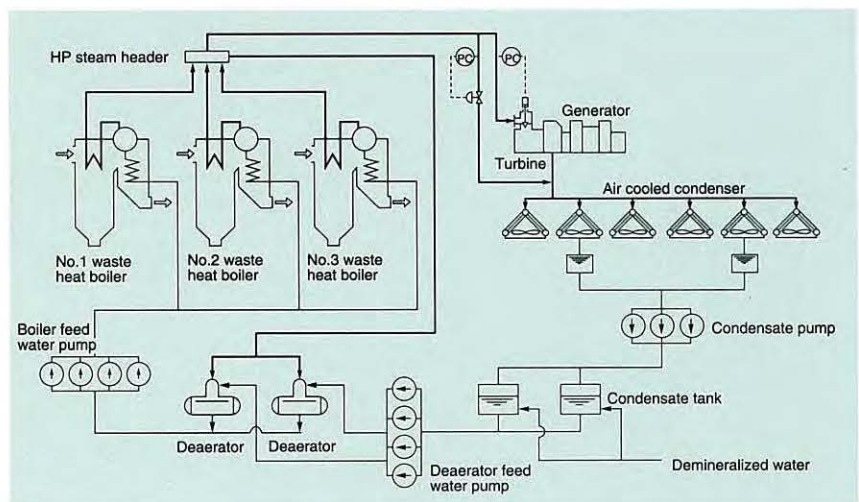
Type : Revolving field
air cooled type

Output : 30,000kVA

Voltage : 11kV

Frequency : 60Hz

No. of pole : 2



Sugar Industry

●Turbine

Type : Back pressure turbine with reduction gear (RPL-125)

Steam condition : 2.35MPaG × 360°C

Exhaust pressure: 147kPaG

Output : 12,000kW

●Generator

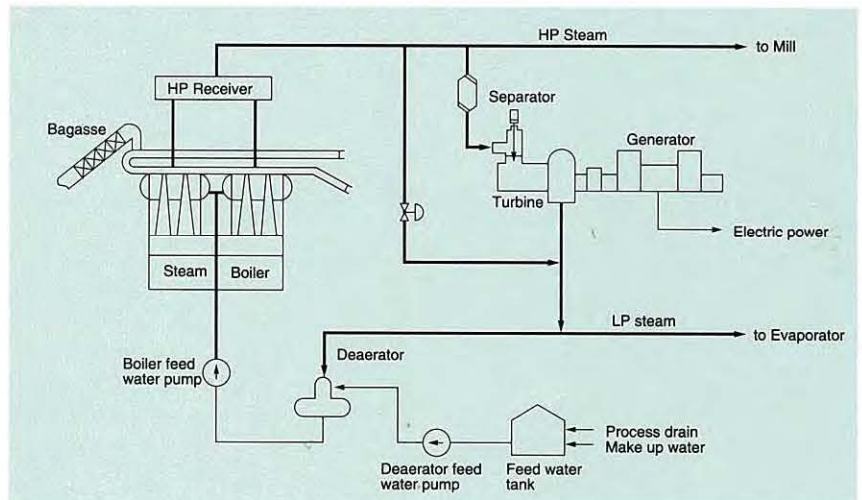
Type : Revolving field brushless air cooled type

Output : 15,000kVA

Voltage : 11kV

Frequency : 50Hz

No. of pole : 4



Food Industry

●Turbine

Type : Extraction back pressure turbine with reduction gear (RP-80)

Steam condition : 5.79MPaG × 475°C

Extraction pressure: 1.57MPaG

Exhaust pressure: 245kPaG

Output : 6,000kW

●Generator

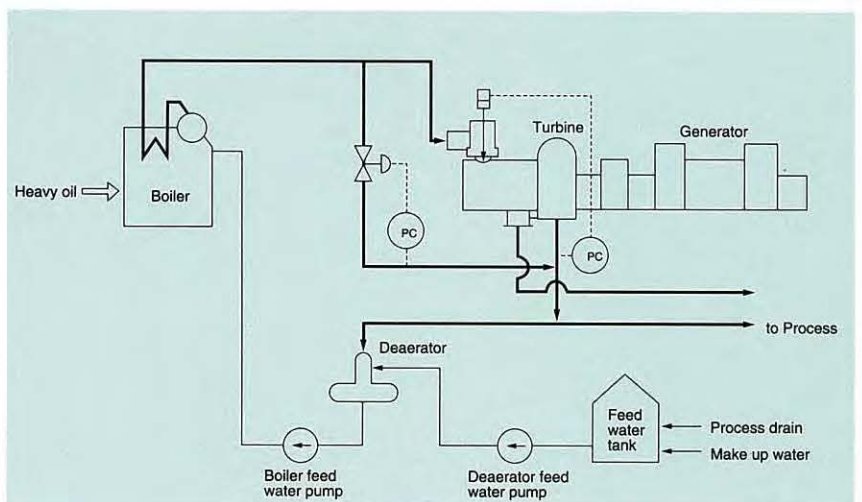
Type : Revolving field brushless air cooled type

Output : 7,500kVA

Voltage : 6.6kV

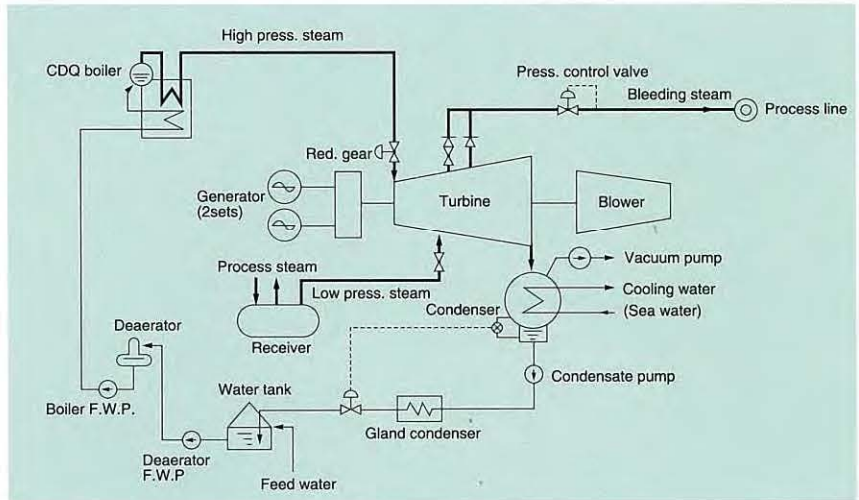
Frequency : 60Hz

No. of pole : 4



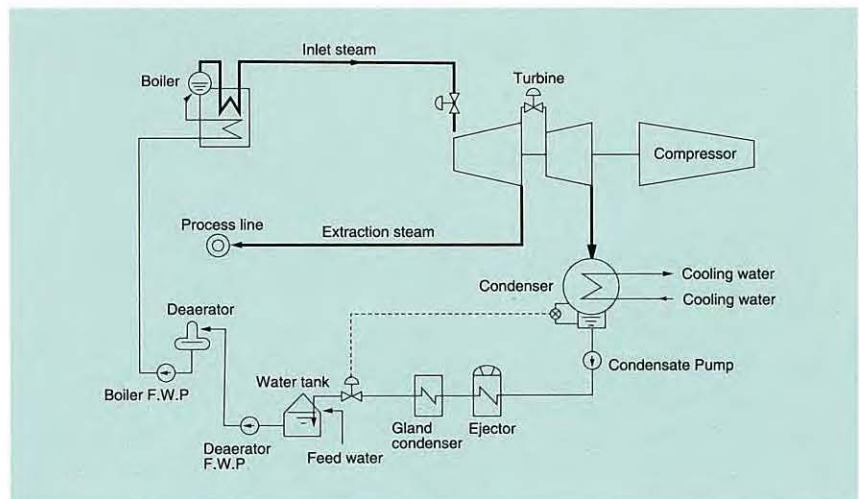
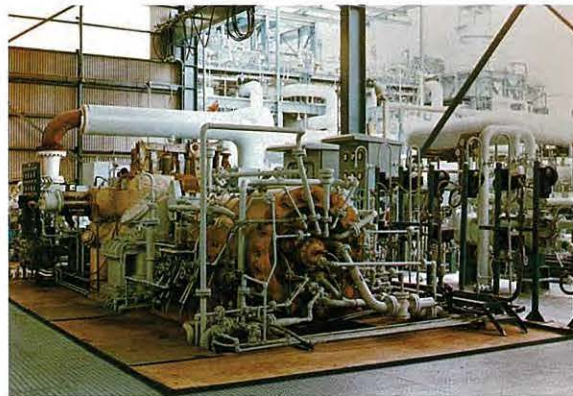
Multi-Purpose Use Turbine

- Type : Single flow mixed pressure condensing type (SCM-250)
- Rated output : 28,500kW
- Revolution : 3,610rpm (Turbine/Blower)
3,000rpm (Generator)
- High pressure steam : 3.92MPaG × 420°C
- Low pressure steam : 4.471MPaG × 220°C
- Bleeding pressure : 981kPaG
- Vacuum pressure : 722mmHg



Mechanical Drive Turbine for Compressor

- Type : High speed extraction condensing type (HCE-50)
- Rated output : 5,600kW
- Revolution : 9,800rpm
- Inlet steam : 3.92MPaG × 360°C
- Bleeding pressure : 1.049MPaG
- Vacuum pressure : 646mmHg



Medium-sized Combined Cycle Power Plant

●Turbine

Type : Axial Exhaust, Single flow condensing turbine with reduction gear (RCMX-250)

Steam condition : 4.37MPaG×417°C

Exhaust pressure: 713.5mmHg

Output : 24,470kW



●Generator

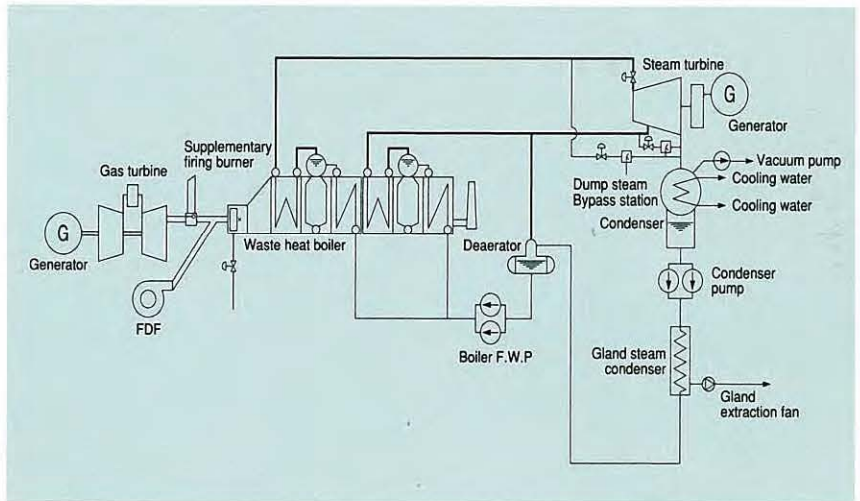
Type : Revolving field brushless air cooled type

Output : 27,189kVA

Voltage : 6.6kV

Frequency : 50Hz

No. of pole : 4



Small-sized Geothermal Power Plant

●Turbine

Type : Single flow condensing turbine with reduction gear (RC-20)

Steam condition : 196.1kPaG×132.9°C

Exhaust pressure : 605mmHg

Output : 2,000kW



●Generator

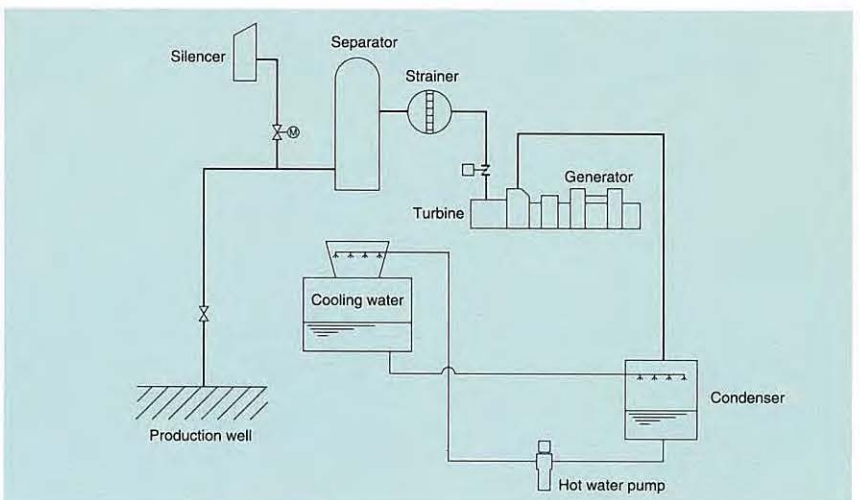
Type : Revolving field brushless air cooled type

Output : 2,222kVA

Voltage : 6.6kV

Frequency : 60Hz

No. of pole : 4

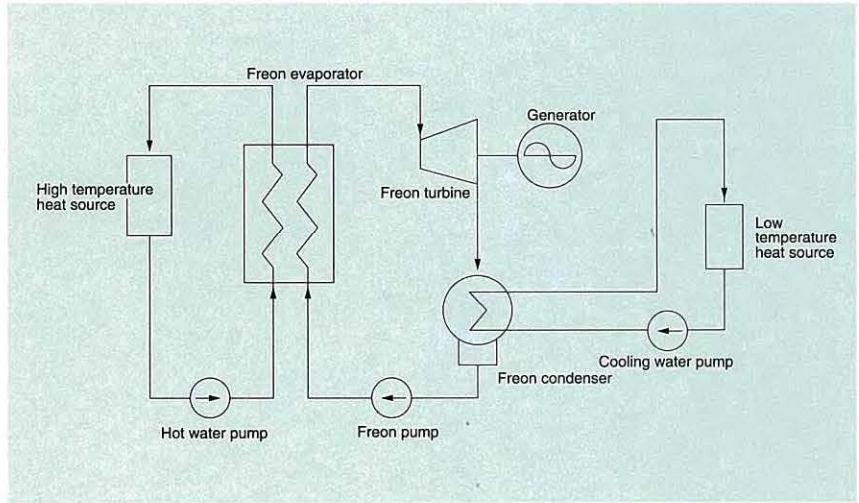




ANOTHER ARTICLES DEVELOPPED BY TURBINE TECHNOLOGY

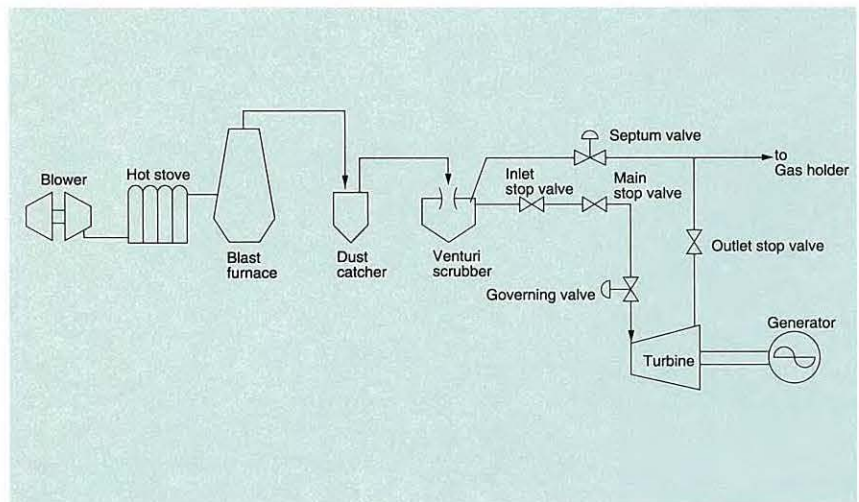
Freon Power Plant

The freon power plant can be applied to a wide variety of fields such as exhaust gas from diesel engines, as well as to steel mills or the chemical industry where a large volume of low-temperature heat source is available.

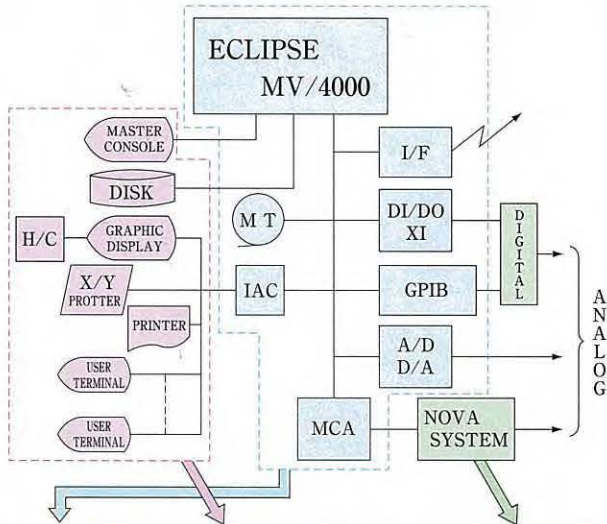


Blast Furnace Gas Energy Recovery Turbine

Kawasaki developed the expansion gas turbine generator unit which recovers the top pressure of a blast furnace.



RESEARCH & DEVELOPMENT



Vibration data analyzing system



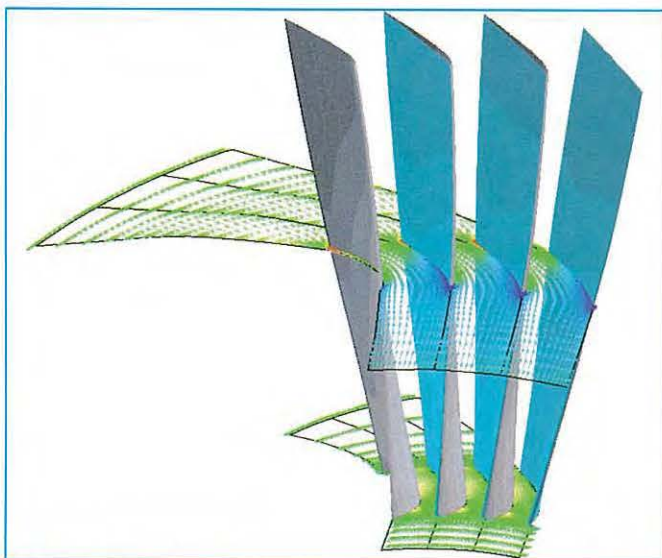
Fatigue crack propagation test of turbine blade material at elevated temperatures



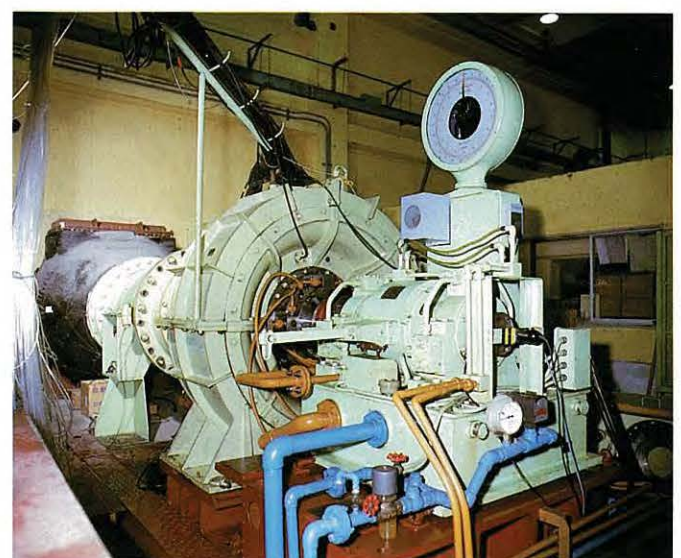
High speed cascade test facilities



High temperature corrosion fatigue testing machine



3-D numerical analysis of flow pattern between the blades



Turbine test facilities