A Summary of the Technical Specifications
of the Geothermal Power Plants in the World:

Revision 1

by

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1. Introduction

This revised and updated version of Brown University Report No. CATMEC/8 [Ref. A.1] includes data for several additional geothermal power plants and corrections of errors of omission and commission. The situation in the area of geothermal power is a rapidly changing one, and any report that intends to present the current state of the art soon becomes obsolete. The information contained herein is as accurate and as up-to-date as possible. The reader, however, should be aware that the characteristics of geothermal fields do change with time and that such changes can reflect on the operating conditions of the power plants operating on those fields.

A series of detailed reports have been written which thoroughly describe the geothermal stations and development activities in the following countries: Costa Rica [Ref. B.5], El Salvador [Ref. B.5], Guatemala [Ref. B.5], Honduras [Ref. B.5], Indonesia [Ref. G.4], Japan [Ref. E.3], Mexico [Ref. F.3], New Zealand [Ref. G.4], Nicaragua [Ref. B.5], Panama [Ref. B.5], the Philippines [Ref. H.1], and the United States [Ref. K.5]. The material in the present report plus that from the above series will be edited to form a chapter in the Sourcebook on the Production of Electricity from Geothermal Energy which is being produced at Brown University for the Department of Energy.

2. Summary of worldwide geothermal power plant installed capacity

<u>Country/Plant Site</u>	<u>Year of Start-up</u>	<u>Capacity/MW</u>	<u>Totals</u>
<u>El Salvador</u>			
Ahuachapán, Unit 1	1975	30.0	} Installed...60 MW Planned....385 MW
Ahuachapán, Unit 2	1976	30.0	
Ahuachapán, Unit 3	1980	35.0	
Ahuachapán Start-up Unit	1975	1.1	
Berlín	future	100.0	
Chinameca	future	100.0	
Chipilapa	future	50.0	
San Vicente	future	100.0	
<u>Iceland</u>			
Námafjall	1969	3.0	} Installed...33 MW Planned.....30 MW
Krafla, Unit 1	1978	30.0	
Krafla, Unit 2	future	30.0	
<u>Italy</u>			
Larderello 2 (5 units)	—	69.0	} Installed...420.6 MW Planned.....400.0 MW
Larderello 3 (6 units)	1969	120.0	
Gabbro	1969	15.0	
Castelnuovo V.C. (4 units)	—	50.0	
Serrazzano (5 units)	—	47.0	
Lago 2 (3 units)	—	33.5	
Sasso Pisano (2 units)	—	15.7	
Monterotondo	—	12.5	
Sant'Ippolito-Vallonsordo	1972	0.9	
Lagoni Rossi 1	1962	3.5	
Lagoni Rossi 2	—	3.0	
Sasso 1	—	7.0	
Capriola	—	3.0	
Molinetto	—	3.5	
Travale	1973	15.0	
Bagnore 1	1959	3.5	
Bagnore 2	—	3.5	
Piancastagnaio	1969	15.0	
(unspecified sites)	future	400.0	
<u>Japan</u>			
Matsukawa	1966	20.0	} Installed...166 MW Planned.....100 MW
Otake	1967	10.0	
Onuma	1973	10.0	
Onikobe	1975	25.0	
Hatchobaru	1977	50.0	
Kakkonda (Takinoue)	1977	50.0	
Binary (pilot)	1978	1.0	
Kuzuneda	future	50.0	
Mori	future	50.0	

<u>Country/ Plant Site</u>	<u>Year of Start-up</u>	<u>Capacity/MW</u>	<u>Totals</u>
<u>Mexico</u>			
Cerro Prieto I, Unit 1	1973	37.5	} Installed... 75 MW Planned.....215 MW
Cerro Prieto I, Unit 2	1973	37.5	
Cerro Prieto I, Unit 3	1979	37.5	
Cerro Prieto I, Unit 4	1979	37.5	
Cerro Prieto I, Unit 5	1982	30.0	
Cerro Prieto II	future	110.0	
<u>New Zealand</u>			
Kawerau	1961	10.0	} Installed...202.6 MW Planned.....150.0 MW
Wairakei, Station A:			
Unit 1 (HP)	1958	6.5	
Unit 2 (HP)	1959	6.5	
Unit 3 (HP)	1962	11.2	
Unit 4 (HP)	1962	11.2	
Unit 1 (IP)	1959	11.2	
Unit 2 (IP)	1959	11.2	
Unit 1 (LP)	1959	11.2	
Unit 2 (LP)	1959	11.2	
Unit 3 (LP)	1960	11.2	
Unit 4 (LP)	1960	11.2	
Wairakei, Station B:			
Unit 1 (MP)	1962	30.0	
Unit 2 (MP)	1963	30.0	
Unit 3 (MP)	1963	30.0	
Broadlands:			
Unit 1	1983	50.0	
Unit 2	1984	50.0	
Unit 3	1984	50.0	
<u>Philippines</u>			
Leyte, Portable Power Unit	1977	3.0	} Installed... 4.2 MW Planned.....1320.0 MW
Los Baños, Wellhead Unit	1977	1.2	
Los Baños, Unit 1	1978	55.0	
Los Baños, Unit 2	1979	55.0	
Los Baños, Unit 3	1981	55.0	
Los Baños, Unit 4	1982	55.0	
Tiwi, Unit 1	1978	55.0	
Tiwi, Unit 2	1978	55.0	
Tiwi, Unit 3	1981	55.0	
Tiwi, Unit 4	1981	55.0	
Tongonan, Unit 1	1980	55.0	
Tongonan, Unit 2	1981	55.0	
Southern Negros, Unit 1	1981	55.0	
Southern Negros, Unit 2	1982	55.0	
Manat-Masara, Unit 1	1981	55.0	
Manat-Masara, Unit 2	1982	55.0	
(all sites)	future	555.0	

<u>Country/Plant Site</u>	<u>Year of Start-up</u>	<u>Capacity/MW</u>	<u>Totals</u>
<u>Turkey</u>			
Kızıldere, Wellhead Unit	1975	0.5	} Installed... 0.5 MW Planned.....14.0 MW
Kızıldere	future	14	
<u>Union of Soviet Socialist Republics</u>			
Paratun'ka (dismantled)	1967	0.7	} Installed... 5.0 MW Planned.....58.0 MW
Pauzhetka	1967	5.0	
Bol'she-Bannaya	future	8.0	
Nizhne-Koleshevskaya	future	50.0	
<u>United States</u>			
The Geysers, Unit 1	1960	11.0	} Installed.. 502 MW Planned....1170.55 MW
The Geysers, Unit 2	1963	13.0	
The Geysers, Unit 3	1967	27.0	
The Geysers, Unit 4	1968	27.0	
The Geysers, Unit 5	1971	53.0	
The Geysers, Unit 6	1971	53.0	
The Geysers, Unit 7	1972	53.0	
The Geysers, Unit 8	1972	53.0	
The Geysers, Unit 9	1973	53.0	
The Geysers, Unit 10	1973	53.0	
The Geysers, Unit 11	1976	106.0	
The Geysers, Unit 12	1978	106.0	
The Geysers, Unit 13	1979	135.0	
The Geysers, Unit 14	1979	110.0	
The Geysers, Unit 15	1978	55.0	
The Geysers, Unit 16	1981	110.0	
The Geysers, Unit 17	1981	110.0	
The Geysers, Unit 18	1982	110.0	
The Geysers, Unit 19	1982	110.0	
The Geysers, N.C.P.A.	1981	110.0	
East Mesa, Magmamax Dual Binary	1978	11.2	
East Mesa, Republic Geothermal	1979, 1980	48.0	
Hawaii Wellhead Generator	1980	5.0	
Raft River Binary	1980	3.35	
Valles Caldera, Baca No. 1	1982	50.0	
Heber, Binary Demonstration	1981	45.0	
Roosevelt H.S., UP&L/Rogers	1982	52.0	

World total installed capacity.	1468.9 MW
Capacity planned or under construction for 1982	2045.55 MW
Total (1982)	3514.45 MW
Future capacity in planning	1762.0 MW
TOTAL.	5276.45 MW

3. Summary of technical specifications for geothermal power plants

The tables which follow contain technical data for each of the geothermal power units installed in the world and for some of those under construction or in planning. The data cover the primary mechanical areas of the power station including the turbine, condenser, gas extraction system and heat rejection system. In the cases of plants which are in the planning stage or under construction, the plant design specifications are listed but must be viewed as preliminary.

For the convenience of the reader, the data are quoted in two sets of units, the International System (SI) and the U.S. Customary System. The table below shows typical units used for the quantities found in the technical specifications. To convert from U.S. Customary to SI units, multiply by the factor shown or use the formula given. All pressures are given in absolute units.

<u>Physical quantity</u>	<u>SI units</u>	<u>US units</u>	<u>Factor</u>
mass flow rate	Mg/h	10^6 lbm/h	453.6
pressure	kPa	lbf/in ²	6.895
pressure	kPa	in Hg	3.386
temperature	°C	°F	$^{\circ}\text{C} = \left(\frac{5}{9}\right) (^{\circ}\text{F} - 32)$
volume flow rate	m ³ /h	ft ³ /min	1.699

Overall plant performance and economic data are omitted from this report. The interested reader may consult the earlier version of this report [Ref. A.1.], or the appropriate report in the series on the geothermal power plants of the world [Refs. B.5, E.3, G.4, and K.5].

Country	El Salvador
Unit name	Ahuachapán, Units 1 and 2
Owner	Comision Ejecutiva Hidroelectrica del Rio Lempa (CEL)
Year of start-up	1975 (Unit 1), 1976 (Unit 2)
Plant type	Separated steam ("single flash")

Turbine characteristics/unit

Manufacturer	Mitsubishi Heavy Industries, Ltd.	
Type	Single-cylinder, double-flow, 5 × 2 impulse	
Rated capacity	30.0 MW	
Maximum capacity	35.0 MW	
Speed	3600 rev/min	
Steam inlet pressure	558.9 kPa	81.1 lbf/in ²
Steam inlet temperature	156.1 °C	313.0 °F
Noncondensable gas content	0.2 % by weight of inlet steam	
Exhaust pressure	8.33 kPa	2.46 in Hg
Turbine steam flow rate	230.0 Mg/h	0.507×10^6 lbm/h
Maximum allowable pressure	984.0 kPa	142.7 lbf/in ²
Last stage blade height	520.0 mm	20.5 in

Condenser characteristics/unit

Type	Spray jet, barometric	
Pressure	8.33 kPa	2.46 in Hg
Cooling water temperature	27.0 °C	80.6 °F
Outlet water temperature	40.3 °C	104.5 °F
Cooling water flow rate	8,650 m ³ /h	19.1×10^6 lbm/h

Gas extractor characteristics/unit

Type	Steam jet ejector	
Number of stages or sets	2	
Suction pressure	7.84 kPa	2.32 in Hg
Capacity	11,700 m ³ /h	6,886 ft ³ /min
Steam consumption	4.1 Mg/h	9.04 × 10 ³ lbm/h

Heat rejection system characteristics/unit

Type	Cross-flow, mechanical draft cooling tower	
Number of cells	5	
Water inlet temperature	40.3 °C	104.5 °F
Water outlet temperature	27.0 °C	80.6 °F
Design wet-bulb temperature	22.0 °C	71.6 °F
Water flow rate	9.02 Gg/h	19.9 × 10 ⁶ lbm/h
Water pump power	(NA) kW	
Draft fan type	Vertical, axial	
Air flow rate/fan	443.3 m ³ /s	0.939 × 10 ⁶ ft ³ /min
Fan motor power	80.0 kW	

Country	El Salvador
Unit name	Ahuachapán, Unit 3
Owner	Comision Ejecutiva Hidroelectrica del Rio Lempa (CEL)
Year of start-up	1980
Plant type	Separated steam/flash ("double flash")

Turbine characteristics

Manufacturer	Fuji Electric Company, Ltd.	
Type	Single-cylinder, double-flow, 7 x 2, pass-in	
Rated capacity	35.0	MW
Maximum capacity	40.0	MW
Speed	3600	rev/min
Main steam inlet pressure	548.1 kPa	79.5 lbf/in ²
Main steam inlet temperature	155.3 °C	311.6 °F
Secondary steam pressure	150.0 kPa	21.8 lbf/in ²
Secondary steam temperature	111.4 °C	232.6 °F
Noncondensable gas content	0.2 % by weight of main steam	
Exhaust pressure	8.33 kPa	2.46 in Hg
Main steam flow rate	171.0 Mg/h	0.377×10^6 lbm/h
Secondary steam flow rate	145.0 Mg/h	0.320×10^6 lbm/h
Maximum allowable pressure	(NA) kPa	(NA) lbf/in ²
Last stage blade height	565.0 mm	22.2 in

Condenser characteristics

Type	Spray jet, low-level barometric	
Pressure	8.33 kPa	2.46 in Hg
Cooling water temperature	27.0 °C	80.6 °F
Outlet water temperature	40.3 °C	104.5 °F
Cooling water flow rate	12,260 Mg/h	27.0×10^5 lbm/h

Gas extractor characteristics

Type	Steam jet ejector		
Number of stages or sets	2		
Suction pressure	(NA) kPa	(NA)	in Hg
Capacity	(NA) m ³ /h	(NA)	ft ³ /min
Steam consumption	(NA)		

Heat rejection system characteristics

Type	Cross-flow, mechanical-draft cooling tower		
Number of cells	5		
Water inlet temperature	40.3 °C	104.5 °F	
Water outlet temperature	27.0 °C	80.6 °F	
Design wet-bulb temperature	22.0 °C	71.6 °F	
Water flow rate	12.26 x 10 ⁶ g/h	27.0 x 10 ⁶ lbm/h	
Water pump power	(NA) kW		
Draft fan type	Vertical, axial		
Air flow rate/fan	(NA) m ³ /s	(NA)	ft ³ /min
Fan motor power	(NA) kW		

Country	El Salvador
Unit name	Ahuachapán Auxiliary Turbo-Generator
Owner	Comisión Ejecutiva Hidroelectrica del Rio Lempa (CEL)
Year of start-up	1975
Plant type	Separated steam ("single-flash")

Turbine characteristics

Manufacturer	Mitsubishi Heavy Industries, Ltd.	
Type	Single-cylinder, Curtis stage, geared, noncondensing	
Rated capacity	1.1 MW	
Maximum capacity	1.3 MW	
Speed, turbine/generator	7129/1800 rev/min	
Steam inlet pressure	552.9 kPa	80.2 lbf/in ²
Steam inlet temperature	156 °C	313 °F
Noncondensable gas content	0.2 % by weight of inlet steam	
Exhaust pressure	96.2 kPa	28.4 in Hg
Turbine steam flow rate	21.0 Mg/h	0.0463x 10 ⁶ lbm/h
Maximum allowable pressure	974.5 kPa	141.3 lbf/in ²
Last stage blade height	(NA) mm	(NA) in

Condenser characteristics

Type	(None)	
Pressure	- kPa	- in Hg
Cooling water temperature	- °C	- °F
Outlet water temperature	- °C	- °F
Cooling water flow rate	- Mg/h	- lbm/h

Country	Iceland
Unit name	Námafjall
Owner	Laxa Power Works
Year of start-up	1969
Plant type	Separated steam ("single flash")

Turbine characteristics

Manufacturer	British Thomson-Houston	
Type	Single Curtis stage, noncondensing	
Rated capacity	3.0 MW	
Maximum capacity	3.0 MW	
Speed	3000 rev/min	
Steam inlet pressure	983.8 kPa	142.7 lbf/in ²
Steam inlet temperature	179.2 °C	354.5 °F
Noncondensable gas content	0.6 % by weight of inlet steam	
Exhaust pressure	106.3 kPa	31.4 in Hg
Turbine steam flow rate	49.5 Mg/h	0.109 × 10 ⁶ lbm/h
Maximum allowable pressure	(NA) kPa	(NA) lbf/in ²
Last stage blade height	(NA) mm	(NA) in

Condenser characteristics

Type	(None)	
Pressure	- kPa	- in Hg
Cooling water temperature	- °C	- °F
Outlet water temperature	- °C	- °F
Cooling water flow rate	- Mg/h	- lbm/h

Country	Iceland
Unit name	Krafla, Unit 1
Owner	North Iceland Power Corporation
Year of start-up	1977
Plant type	Separated steam/flash ("double flash")

Turbine characteristics

Manufacturer	Mitsubishi Heavy Industries, Ltd.	
Type	single-cylinder, double-flow, pass-in, impulse-reaction	
Rated capacity	30.0 MW	
Maximum capacity	35.0 MW	
Speed	3000 rev/min	
Main steam inlet pressure	758.3 kPa	110.0 lbf/in ²
Main steam inlet temperature	168.0 °C	334.4 °F
Secondary steam pressure	189.6 kPa	27.5 lbf/in ²
Secondary steam temperature	118.0 °C	244.4 °F
Noncondensable gas content	~ 1.0 % by weight of main steam	
Exhaust pressure	11.9 kPa	3.5 in Hg
Main steam flow rate	189.1 Mg/h	0.417×10^6 lbm/h
Secondary steam flow rate	64.3 Mg/h	0.142×10^6 lbm/h
Maximum allowable pressure	1,376.0 kPa	199.6 lbf/in ²
Last stage blade height	420.0 mm	16.5 in

Condenser characteristics

Type	Spray-jet, tray type	
Pressure	11.9 kPa	3.5 in Hg
Cooling water temperature	23.0 °C	73.4 °F
Outlet water temperature	46.2 °C	115.2 °F
Cooling water flow rate	5,640.0 Mg/h	12.4×10^6 lbm/h

Gas extractor characteristics

Type	Steam jet ejector	
Number of stages or sets	2	
Suction pressure	11.3 kPa	3.33 in Hg
Capacity	16,280 m ³ /h	9,582 ft ³ /min
Steam consumption	10.26 Mg/h	22.62 × 10 ³ lbm/h

Heat rejection system characteristics

Type	Cross-flow, mechanical-draft cooling tower	
Number of cells	4	
Water inlet temperature	46.2 °C	115.2 °F
Water outlet temperature	22.0 °C	71.6 °F
Design wet-bulb temperature	11.0 °C	51.8 °F
Water flow rate	6.153 Gg/h	13.6 × 10 ⁶ lbm/h
Water pump power	(NA) kW	
Draft fan type	Vertical, axial	
Air flow rate/fan	(NA) m ³ /s	(NA) ft ³ /min
Fan motor power	(NA) kW	

Country	Iceland
Unit name	Krafla, Unit 2
Owner	North Iceland Power Corporation
Year of start-up	Future
Plant type	Separated steam/flash ("double flash")

Turbine characteristics

Manufacturer	Mitsubishi Heavy Industries, Ltd.	
Type	single-cylinder, double-flow, pass-in, impulse-reaction	
Rated capacity	30.0 MW	
Maximum capacity	35.0 MW	
Speed	3000 rev/min	
Main steam inlet pressure	758.3 kPa	110.0 lbf/in ²
Main steam inlet temperature	168.0 °C	334.4 °F
Secondary steam pressure	189.6 kPa	27.5 lbf/in ²
Secondary steam temperature	118.0 °C	244.4 °F
Noncondensable gas content	~ 1.0 % by weight of main steam	
Exhaust pressure	11.9 kPa	3.5 in Hg
Main steam flow rate	189.1 Mg/h	0.417×10^6 lbm/h
Secondary steam flow rate	64.3 Mg/h	0.142×10^6 lbm/h
Maximum allowable pressure	1,376.0 kPa	199.6 lbf/in ²
Last stage blade height	420.0 mm	16.5 in

Condenser characteristics

Type	Spray-jet, tray type	
Pressure	11.9 kPa	3.5 in Hg
Cooling water temperature	23.0 °C	73.4 °F
Outlet water temperature	46.2 °C	115.2 °F
Cooling water flow rate	5,640.0 Mg/h	12.4×10^6 lbm/h

Gas extractor characteristics

Type	Steam jet ejector	
Number of stages or sets	2	
Suction pressure	11.3 kPa	3.33 in Hg
Capacity	16,280 m ³ /h	9,582 ft ³ /min
steam consumption	10.26 Mg/h	22.62 × 10 ³ lbm/h

Heat rejection system characteristics

Type	Cross-flow, mechanical-draft cooling tower	
Number of cells	4	
Water inlet temperature	46.2 °C	115.2 °F
Water outlet temperature	22.0 °C	71.6 °F
Design wet-bulb temperature	11.0 °C	51.8 °F
Water flow rate	6.153 Gg/h	13.6 × 10 ⁶ lbm/h
Water pump power	(NA) kW	
Draft fan type	Vertical, axial	
Air flow rate/fan	(NA) m ³ /s	(NA) ft ³ /min
Fan motor power	(NA) kW	

Country	Italy
Unit name	Larderello 2 (5 units)
Owner	Ente Nazionale per L'Energia Elettrica (ENEL)
Year of start-up	-
Plant type	Natural, direct, dry steam

Turbine characteristics

Manufacturer	Franco Tosi Company		
Type	Single-cylinder, double-flow		
Rated capacity	69.0	MW	(1)
Maximum capacity	69.0	MW	
Speed	3000	rev/min	
Steam inlet pressure	411.8	kPa	59.7 lbf/in ²
Steam inlet temperature	196.0	°C	384.8 °F
Noncondensable gas content	7.0	% by weight of inlet steam	
Exhaust pressure	10.2	kPa	3.0 in Hg
Turbine steam flow rate (2)	408.0	Mg/h	0.899 × 10 ⁶ lbm/h

Condenser characteristics

Type	Spray jet, barometric		
Pressure	10.2	kPa	3.0 in Hg
Cooling water temperature	31.0	°C	87.8 °F
Outlet water temperature	41.0	°C	105.8 °F
Cooling water flow rate	(NA)	Mg/h	(NA) lbm/h

(1) Four units at 14.5 MW; one unit at 11 MW.

(2) Total all units.

Gas extractor characteristics

Type	Turbocompressors	
Number of stages or sets	2	
Suction pressure	10.2 kPa	3.0 in Hg
Capacity	(NA) m ³ /h	(NA) ft ³ /min
Power consumption	(NA)	

Heat rejection system characteristics

Type	Natural draft cooling tower	
Number of towers	3	
Water inlet temperature	41.0 °C	105.8 °F
Water outlet temperature	31.0 °C	87.8 °F
Design wet-bulb temperature	19.4 °C	67.0 °F
Water flow rate	(NA) Gg/h	(NA) lbr/h
Water pump power	(NA) kW	

Country	Italy
Unit name	Larderello 3 (6 units)
Owner	Ente Nazionale per L'Energia Elettrica (ENEL)
Year of start-up	-
Plant type	Natural, direct, dry steam

Turbine characteristics

Manufacturer	Franco Tosi Company	
Type	Single-cylinder, double-flow	
Rated capacity	120.0	MW ⁽¹⁾
Maximum capacity	120.0	MW
Speed	3000 rev/min	
Steam inlet pressure	431.4 kPa	62.6 lbf/in ²
Steam inlet temperature	197.0 °C	386.6 °F
Noncondensable gas content	6.8 % by weight of inlet steam	
Exhaust pressure	11.8 kPa	3.5 in Hg
Turbine steam flow rate ⁽²⁾	673.0 Mg/h	1.48 × 10 ⁶ lbm/h

Condenser characteristics

Type	Spray jet, barometric	
Pressure	11.8 kPa	3.5 in Hg
Cooling water temperature	28.3 °C	82.9 °F
Outlet water temperature	41.3 °C	106.3 °F
Cooling water flow rate	(NA) Mg/h	(NA) lbm/h

(1) Three units at 26 MW; one unit at 24 MW; one unit at 9 MW

(2) Total all units.

Gas extractor characteristics

Type	Turbocompressors	
Number of stages or sets	2	
Suction pressure	6.9 kPa	2.0 in Hg
Capacity	$93 \times 10^3 \text{ m}^3/\text{h}$	$54.7 \times 10^3 \text{ ft}^3/\text{min}$
Power consumption ⁽³⁾	1.36 MW	

Heat rejection system characteristics

Type	Natural draft cooling tower	
Number of towers	4	
Water inlet temperature	41.3°C	106.3 °F
Water outlet temperature	28.3°C	82.9 °F
Design wet-bulb temperature	14.7°C	58.4 °F
Water flow rate	(NA) Gg/h	(NA) lbm/h
Water pump power	855 kW	

(3) Per each 26 MW unit.

Country	Italy
Unit name	Gabbro
Owner	Ente Nazionale per L'Energia Elettrica (ENEL)
Year of start-up	1969
Plant type	Natural, direct, dry steam

Turbine characteristics

Manufacturer	Ansaldo Company	
Type	Tandem-compound, single-flow (HP), double-flow (LP)	
Rated capacity	15.0 MW	
Maximum capacity	16.75 MW	
Speed	3000 rev/min	
Steam inlet pressure	715.7 kPa	103.8 lbf/in ²
Steam inlet temperature	223.0 °C	433.4 °F
Noncondensable gas content	6.7 % by weight of inlet steam	
Exhaust pressure	10.2 kPa	3.0 in Hg
Turbine steam flow rate	108.0 Mg/h	0.238×10^6 lbm/h

Condenser characteristics

Type	Spray jet, barometric	
Pressure	10.2 kPa	3.0 in Hg
Cooling water temperature	31.0 °C	87.8 °F
Outlet water temperature	41.0 °C	105.8 °F
Cooling water flow rate	(NA) Mg/h	(NA) lbm/h

Gas extractor characteristics

Type	Turbocompressor	
Number of stages or sets	2	
Suction pressure	10.2 kPa	3.0 in Hg
Capacity	$> 300 \times 10^3 \text{ m}^3/\text{h}$	$> 176.6 \times 10^3 \text{ ft}^3/\text{min}$
Power consumption	$\sim 1750 \text{ kW}$	

Heat rejection system characteristics

Type	Natural draft cooling tower	
Number of towers	1	
Water inlet temperature	41.0 °C	105.8 °F
Water outlet temperature	31.0 °C	87.8 °F
Design wet-bulb temperature	19.4 °C	67.0 °F
Water flow rate	8.0 Gg/h	$17.6 \times 10^6 \text{ lbm/h}$
Water pump power	(NA) kW	

Country	Italy
Unit name	Castelnuovo V.C.
Owner	Ente Nazionale per L'Energia Elettrica (ENEL)
Year of start-up	1964
Plant type	Natural, direct, dry steam

Turbine characteristics

Manufacturer	Franco Tosi Company		
Type	Single-cylinder, double-flow		
Rated capacity	26.0	MW	
Maximum capacity	30.0	MW	
Speed	3000	rev/min	
Steam inlet pressure	421.6	kPa	61.1 lbf/in ²
Steam inlet temperature	188.0	°C	370.4 °F
Noncondensable gas content	14.3	% by weight of inlet steam	
Exhaust pressure	8.8	kPa	2.6 in Hg
Turbine steam flow rate	170.0	Mg/h	0.375×10^6 lbm/h

Condenser characteristics

Type	Spray jet, barometric		
Pressure	8.8	kPa	2.6 in Hg
Cooling water temperature	23.0	°C	73.4 °F
Outlet water temperature	37.0	°C	98.6 °F
Cooling water flow rate	(NA)	Mg/h	(NA) lbm/h

Gas extractor characteristics

Type	Turbocompressor	
Number of stages or sets	2	
Suction pressure	6.9 kPa	2.0 in Hg
Capacity	$> 300 \times 10^3 \text{ m}^3/\text{h}$	$> 176.6 \times 10^3 \text{ ft}^3/\text{min}$
Power consumption	(NA)	

Heat rejection system characteristics

Type	Natural draft cooling tower	
Number of towers	(NA)	
Water inlet temperature	37.0 °C	98.6 °F
Water outlet temperature	23.0 °C	73.4 °F
Design wet-bulb temperature	17.4 °C	63.3 °F
Water flow rate	(NA) Gg/h	(NA) lbm/h
Water pump power	750 kW	

Country	Italy
Unit name	Castelnuovo V.C. (2 units)
Owner	Ente Nazionale per L'Energia Elettrica (ENEL)
Year of start-up	-
Plant type	Natural, direct, dry steam

Turbine characteristics/unit

Manufacturer	Franco Tosi Company		
Type	Single-cylinder, double-flow		
Rated capacity	11.0 MW		
Maximum capacity	11.0 MW		
Speed	3000 rev/min		
Steam inlet pressure	186.3 kPa	27.0 lbf/in ²	
Steam inlet temperature	174.0 °C	345.2 °F	
Noncondensable gas content	3.8 % by weight of inlet steam		
Exhaust pressure	8.8 kPa	2.6 in Hg	
Turbine steam flow rate	57.5 Mg/h	0.127 × 10 ⁶ lbm/h	

Condenser characteristics/unit

Type	Spray jet, barometric		
Pressure	8.8 kPa	2.6 in Hg	
Cooling water temperature	23.0 °C	73.4 °F	
Outlet water temperature	37.0 °C	98.6 °F	
Cooling water flow rate	(NA) Mg/h	(NA) lbm/h	

Gas extractor characteristics/unit

Type	Turbocompressor	
Number of stages or sets	(NA)	
Suction pressure	6.9 kPa	2.0 in Hg
Capacity	(NA) m ³ /h	(NA) ft ³ /min
Power consumption	(NA)	

Heat rejection system characteristics/unit

Type	Natural draft cooling tower	
Number of towers	(NA)	
Water inlet temperature	37.0 °C	98.6 °F
Water outlet temperature	23.0 °C	73.4 °F
Design wet-bulb temperature	17.4 °C	63.3 °F
Water flow rate	(NA) Gg/h	(NA) lbm/h
Water pump power	(NA) kW	

Country	Italy
Unit name	Castelnuovo V.C.
Owner	Ente Nazionale per L'Energia Elettrica (ENEL)
Year of start-up	-
Plant type	Natural, direct, dry steam

Turbine characteristics

Manufacturer	Franco Tosi Company		
Type	Single-cylinder, double-flow		
Rated capacity	2.0 MW		
Maximum capacity	2.0 MW		
Speed	3000 rev/min		
Steam inlet pressure	107.9 kPa	15.6 lbf/in ²	
Steam inlet temperature	150.0 °C	302.0 °F	
Noncondensable gas content	2.4 % by weight of inlet steam		
Exhaust pressure	8.8 kPa	2.6 in Hg	
Turbine steam flow rate	28.0 Mg/h	0.0617 × 10 ⁶ lbm/h	

Condenser characteristics

Type	Spray jet, barometric		
Pressure	8.8 kPa	2.6 in Hg	
Cooling water temperature	23.0 °C	73.4 °F	
Outlet water temperature	37.0 °C	98.6 °F	
Cooling water flow rate	(NA) Mg/h	(NA) lbm/h	

Gas extractor characteristics

Type	Turbocompressor	
Number of stages or sets	(NA)	
Suction pressure	6.9 kPa	2.0 in Hg
Capacity	(NA) m ³ /h	(NA) ft ³ /min
Power consumption	(NA)	

Heat rejection system characteristics

Type	Natural draft cooling tower	
Number of towers	(NA)	
Water inlet temperature	37.0 °C	98.6 °F
Water outlet temperature	23.0 °C	73.4 °F
Design wet-bulb temperature	17.4 °C	63.3 °F
Water flow rate	(NA) Gg/h	(NA) lbm/h
Water pump power	(NA) kW	

Country	Italy
Unit name	Serrazzano (5 units)
Owner	Ente Nazionale per L'Energia Elettrica (ENEL)
Year of start-up	-
Plant type	Natural, direct, dry steam

Turbine characteristics

Manufacturer	Franco Tosi Company		
Type	Single-cylinder, double-flow (single-flow, 3.5 MW)		
Rated capacity	47.0 MW ⁽¹⁾		
Maximum capacity	47.0 MW		
Speed	3000 rev/min		
Steam inlet pressure	480.4 kPa	69.7 lbf/in ²	
Steam inlet temperature	196.0 °C	384.8 °F	
Noncondensable gas content	3.8 % by weight of inlet steam		
Exhaust pressure	9.8 kPa	2.9 in Hg	
Turbine steam flow rate ⁽²⁾	287.0 Mg/h	0.633 × 10 ⁶ lbm/h	

Condenser characteristics

Type	Spray jet, barometric		
Pressure	9.8 kPa	2.9 in Hg	
Cooling water temperature	29.0 °C	84.2 °F	
Outlet water temperature	40.0 °C	104.0 °F	
Cooling water flow rate	(NA) Mg/h	(NA) lbm/h	

(1) One unit at 15 MW; two units at 12.5 MW; two units at 3.5 MW.

(2) Total all units.

Gas extractor characteristics

Type	Turbocompressor	
Number of stages or sets	2	
Suction pressure	6.9 kPa	2.0 in Hg
Capacity	(NA) m ³ /h	(NA) ft ³ /min
Power consumption(3)	1.28 MW	

Heat rejection system characteristics

Type	Natural draft cooling tower	
Number of towers	(NA)	
Water inlet temperature	40.0 °C	104.0 °F
Water outlet temperature	29.0 °C	84.2 °F
Design wet-bulb temperature	14.7 °C	58.4 °F
Water flow rate	(NA) Gg/h	(NA) lbm/h
Water pump power (3)	560 kW	

(3) Per each 15 MW and 12.5 MW unit.

Country	Italy
Unit name	Lago 2
Owner	Ente Nazionale per L'Energia Elettrica (ENEL)
Year of start-up	-
Plant type	Natural, direct, dry steam

Turbine characteristics

Manufacturer	Franco Tosi Company		
Type	Single-cylinder, single-flow		
Rated capacity	6.5	MW	
Maximum capacity	6.5	MW	
Speed	3000	rev/min	
Steam inlet pressure	205.9	kPa	29.9 lbf/in ²
Steam inlet temperature	143.0	°C	289.4 °F
Noncondensable gas content	1.8 % by weight of inlet steam		
Exhaust pressure	6.9	kPa	2.0 in Hg
Turbine steam flow rate	70.0	Mg/h	0.154 × 10 ⁶ lbm/h

Condenser characteristics

Type	Spray jet, barometric		
Pressure	6.9	kPa	2.0 in Hg
Cooling water temperature	26.0	°C	78.8 °F
Outlet water temperature	35.0	°C	95.0 °F
Cooling water flow rate	(NA)	Mg/h	(NA) lbm/h

Gas extractor characteristics

Type	Turbocompressor	
Number of stages or sets	(NA)	
Suction pressure	6.9 kPa	2.0 in Hg
Capacity	(NA) m ³ /h	(NA) ft ³ /min
Power consumption	(NA)	

Heat rejection system characteristics

Type	Natural draft cooling tower	
Number of towers	(NA)	
Water inlet temperature	35.0 °C	95.0 °F
Water outlet temperature	26.0 °C	78.8 °F
Design wet-bulb temperature	14.7 °C	58.4 °F
Water flow rate	(NA) Gg/h	(NA) lbm/h
Water pump power	(NA) kW	

Country	Italy
Unit name	Lago 2 (2 units)
Owner	Ente Nazionale per L'Energia Elettrica (ENEL)
Year of start-up	1963
Plant type	Natural, direct, dry steam

Turbine characteristics

Manufacturer	Franco Tosi Company		
Type	Single-cylinder, double flow		
Rated capacity	27.0	MW	(1)
Maximum capacity	27.0	MW	
Speed	3000 rev/min		
Steam inlet pressure	529.5	kPa	76.8 lbf/in ²
Steam inlet temperature	178.0	°C	352.4 °F
Noncondensable gas content	2.2 % by weight of inlet steam		
Exhaust pressure	6.9	kPa	2.0 in Hg
Turbine steam flow rate (2)	253.0	Mg/h	0.558 × 10 ⁶ lbm/h

Condenser characteristics

Type	Spray jet, barometric		
Pressure	6.9	kPa	2.0 in Hg
Cooling water temperature	26.0	°C	78.8 °F
Outlet water temperature	35.0	°C	95.0 °F
Cooling water flow rate	(NA)	Mg/h	(NA) lbm/h

(1) One unit at 14.5 MW; one unit at 12.5 MW.

(2) Total both units.

Gas extractor characteristics

Type	Turbocompressor	
Number of stages or sets	2	
Suction pressure	6.9 kPa	2.0 in Hg
Capacity	(NA) m ³ /h	(NA) ft ³ /min
Power consumption (3)	800 kW	

Heat rejection system characteristics

Type	Natural draft cooling tower	
Number of towers	(NA)	
Water inlet temperature	35.0 °C	95.0 °F
Water outlet temperature	26.0 °C	78.8 °F
Design wet-bulb temperature	14.7 °C	58.4 °F
Water flow rate	(NA) Gg/h	(NA) lbm/h
Water pump power (3)	365 kW	

(3) For 14.5 MW unit only.

Country	Italy
Unit name	Sasso Pisano (2 units)
Owner	Ente Nazionale per L'Energia Elettrica (ENEL)
Year of start-up	-
Plant type	Natural, direct, dry steam

Turbine characteristics

Manufacturer	Ansaldo Company	
Type	Single-cylinder, double-flow (single-flow, 3.2 MW)	
Rated capacity	15.7 MW ⁽¹⁾	
Maximum capacity	15.7 MW	
Speed	3000 rev/min	
Steam inlet pressure	490.2 kPa	71.1 lbf/in ²
Steam inlet temperature	185.0 °C	365.0 °F
Noncondensable gas content	3.0 % by weight of inlet steam	
Exhaust pressure	10.2 kPa	3.0 in Hg
Turbine steam flow rate ⁽²⁾	162.0 Mg/h	0.357 × 10 ⁶ lbm/h

Condenser characteristics

Type	Spray jet, barometric	
Pressure	10.2 kPa	3.0 in Hg
Cooling water temperature	(NA) °C	(NA) °F
Outlet water temperature	(NA) °C	(NA) °F
Cooling water flow rate	(NA) Mg/h	(NA) lbm/h

(1) One unit at 12.5 MW; one unit at 3.2 MW.

(2) Total both units.

Gas extractor characteristics

Type	Turbocompressor	
Number of stages or sets	(NA)	
Suction pressure	10.2 kPa	3.0 in Hg
Capacity	(NA) m ³ /h	(NA) ft ³ /min
Power consumption	(NA)	

Heat rejection system characteristics

Type	Natural draft cooling tower	
Number of towers	(NA)	
Water inlet temperature	(NA) °C	(NA) °F
Water outlet temperature	(NA) °C	(NA) °F
Design wet-bulb temperature	(NA) °C	(NA) °F
Water flow rate	(NA) Gg/h	(NA) lbm/h
Water pump power	(NA) kW	

Country	Italy
Unit name	Monterotondo
Owner	Ente Nazionale per L'Energia Elettrica (ENEL)
Year of start-up	-
Plant type	Natural, direct, dry steam

Turbine characteristics

Manufacturer	Franco Tosi Company		
Type	Single-cylinder, double-flow		
Rated capacity	12.5	MW	
Maximum capacity	12.5	MW	
Speed	3000	rev/min	
Steam inlet pressure	441.2	kPa	64.0 lbf/in ²
Steam inlet temperature	188.0	°C	370.4 °F
Noncondensable gas content	1.7	% by weight of inlet steam	
Exhaust pressure	(NA)	kPa	(NA) in Hg
Turbine steam flow rate	122.0	Mg/h	0.269 × 10 ⁶ lbm/h

Condenser characteristics

Type	Spray jet, barometric		
Pressure	(NA)	kPa	(NA) in Hg
Cooling water temperature	(NA)	°C	(NA) °F
Outlet water temperature	(NA)	°C	(NA) °F
Cooling water flow rate	(NA)	Mg/h	(NA) lbm/h

Gas extractor characteristics

Type	Turbocompressor	
Number of stages or sets	(NA)	
Suction pressure	(NA) kPa	(NA) in Hg
Capacity	(NA) m ³ /h	(NA) ft ³ /min
Power consumption	(NA)	

Heat rejection system characteristics

Type	Natural draft cooling tower	
Number of towers	(NA)	
Water inlet temperature	(NA) °C	(NA) °F
Water outlet temperature	(NA) °C	(NA) °F
Design wet-bulb temperature	(NA) °C	(NA) °F
Water flow rate	(NA) Gg/h	(NA) lbm/h
Water pump power	(NA) kW	

Country	Italy
Unit name	Sant'Ippolito - Vallonsordo
Owner	Ente Nazionale per L'Energia Elettrica (ENEL)
Year of start-up	1972
Plant type	Natural, direct, dry steam

Turbine characteristics

Manufacturer	Ansaldo Company		
Type	Single-cylinder, single-flow, noncondensing, impulse		
Rated capacity	0.9	MW	
Maximum capacity	0.9	MW	
Speed	3000	rev/min	
Steam inlet pressure	755.0	kPa	109.5 lbf/in ²
Steam inlet temperature	215.0	°C	419.0 °F
Noncondensable gas content	3.3	% by weight of inlet steam	
Exhaust pressure	101.3	kPa	29.92 in Hg
Turbine steam flow rate	24.0	Mg/h	0.0529×10^6 lbm/h

Condenser characteristics

Type	(None)		
Pressure	-	kPa	- in Hg
Cooling water temperature	-	°C	- °F
Outlet water temperature	-	°C	- °F
Cooling water flow rate	-	Mg/h	- lbm/h

Country	Italy
Unit name	Lagoni Rossi 1
Owner	Ente Nazionale per L'Energia Elettrica (ENEL)
Year of start-up	1961
Plant type	Natural, direct, dry steam

Turbine characteristics

Manufacturer	Ansaldo Company		
Type	Single-cylinder, single-flow, noncondensing, impulse-reaction		
Rated capacity	3.5 MW		
Maximum capacity	3.5 MW		
Speed	3000 rev/min		
Steam inlet pressure	519.6 kPa	75.4 lbf/in ²	
Steam inlet temperature	156.0 °C	312.8 °F	
Noncondensable gas content	3.2 % by weight of inlet steam		
Exhaust pressure	102.9 kPa	30.4 in Hg	
Turbine steam flow rate	40.0 Mg/h	0.0882 × 10 ⁶ lbm/h	

Condenser characteristics

Type	(None)		
Pressure	- kPa	-	in Hg
Cooling water temperature	- °C	-	°F
Outlet water temperature	- °C	-	°F
Cooling water flow rate	- Mg/h	-	lbm/h

Country	Italy
Unit name	Lagoni Rossi 2
Owner	Ente Nazionale per L'Energia Elettrica (ENEL)
Year of start-up	-
Plant type	Natural, direct, dry steam

Turbine characteristics

Manufacturer	Ansaldo Company	
Type	Single-cylinder, single-flow, noncondensing	
Rated capacity	3.0 MW	
Maximum capacity	3.0 MW	
Speed	3000 rev/min	
Steam inlet pressure	451.0 kPa	65.4 lbf/in ²
Steam inlet temperature	180.0 °C	356.0 °F
Noncondensable gas content	3.8 % by weight of inlet steam	
Exhaust pressure	102.9 kPa	30.4 in Hg
Turbine steam flow rate	55.0 Mg/h	0.121×10^6 lbm/h

Condenser characteristics

Type	(None)	
Pressure	- kPa	- in Hg
Cooling water temperature	- °C	- °F
Outlet water temperature	- °C	- °F
Cooling water flow rate	- Mg/h	- lbm/h

Country	Italy
Unit name	Sasso 1
Owner	Ente Nazionale per L'Energia Elettrica (ENEL)
Year of start-up	-
Plant type	Natural, direct, dry steam

Turbine characteristics

Manufacturer	Ansaldo Company	
Type	Single-cylinder, single-flow, noncondensing	
Rated capacity	7.0 MW	
Maximum capacity	7.0 MW	
Speed	3000 rev/min	
Steam inlet pressure	490.2 kPa	71.1 lbf/in ²
Steam inlet temperature	187.0 °C	368.6 °F
Noncondensable gas content	2.7 % by weight of inlet steam	
Exhaust pressure	102.9 kPa	30.4 in Hg
Turbine steam flow rate	53.0 Mg/h	0.117×10^6 lbm/h

Condenser characteristics

Type	(None)	
Pressure	- kPa	- in Hg
Cooling water temperature	- °C	- °F
Outlet water temperature	- °C	- °F
Cooling water flow rate	- Mg/h	- lbm/h

Country	Italy
Unit name	Capriola
Owner	Ente Nazionale per L'Energia Elettrica (ENEL)
Year of start-up	-
Plant type	Natural, direct, dry steam

Turbine characteristics

Manufacturer	Ansaldo Company		
Type	Single-cylinder, single-flow, noncondensing		
Rated capacity	3.0 MW		
Maximum capacity	3.0 MW		
Speed	3000 rev/min		
Steam inlet pressure	392.2 kPa	56.9 lbf/in ²	
Steam inlet temperature	193.0 °C	379.4 °F	
Noncondensable gas content	4.0 % by weight of inlet steam		
Exhaust pressure	102.9 kPa	30.4 in Hg	
Turbine steam flow rate	51.0 Mg/h	0.112 × 10 ⁶ lbm/h	

Condenser characteristics

Type	(None)		
Pressure	- kPa	-	in Hg
Cooling water temperature	- °C	-	°F
Outlet water temperature	- °C	-	°F
Cooling water flow rate	- Mg/h	-	lbm/h

Country	Italy
Unit name	Molinetto
Owner	Ente Nazionale per L'Energia Elettrica (ENEL)
Year of start-up	-
Plant type	Natural, direct, dry steam

Turbine characteristics

Manufacturer	Ansaldo Company	
Type	Single-cylinder, single-flow, noncondensing, impulse-reaction	
Rated capacity	3.5 MW	
Maximum capacity	3.5 MW	
Speed	3000 rev/min	
Steam inlet pressure	500.0 kPa	72.5 lbf/in ²
Steam inlet temperature	188.0 °C	320.4 °F
Noncondensable gas content	3.3 % by weight of inlet steam	
Exhaust pressure	102.9 kPa	30.4 in Hg
Turbine steam flow rate	18.0 Mg/h	0.0397×10^6 lbm/h

Condenser characteristics

Type	(None)	
Pressure	- kPa	- in Hg
Cooling water temperature	- °C	- °F
Outlet water temperature	- °C	- °F
Cooling water flow rate	- Mg/h	- lbm/h

Country	Italy
Unit name	Travale
Owner	Ente Nazionale per L'Energia Elettrica (ENEL)
Year of start-up	1973
Plant type	Natural, direct, dry steam

Turbine characteristics

Manufacturer	Ansaldo Company	
Type	Single-cylinder, single-flow, noncondensing, impulse-reaction	
Rated capacity	15.0	MW
Maximum capacity	15.0	MW
Speed	3000	rev/min
Steam inlet pressure	1,098.1	kPa 159.3 lbf/in ²
Steam inlet temperature	212.0	°C 413.6 °F
Noncondensable gas content	10.6 % by weight of inlet steam	
Exhaust pressure	105.9	kPa 31.3 in Hg
Turbine steam flow rate	190.0	Mg/h 0.419 × 10 ⁶ lbm/h

Condenser characteristics

Type	(None)	
Pressure	-	kPa in Hg
Cooling water temperature	-	°C °F
Outlet water temperature	-	°C °F
Cooling water flow rate	-	Mg/h lbm/h

Country	Italy
Unit name	Bagnore 1
Owner	Ente Nazionale per L'Energia Elettrica (ENEL)
Year of start-up	1959
Plant type	Natural, direct, dry steam

Turbine characteristics

Manufacturer	Ansaldo Company	
Type	Single-cylinder, single-flow, noncondensing, impulse-reaction	
Rated capacity	3.5 MW	
Maximum capacity	3.5 MW	
Speed	3000 rev/min	
Steam inlet pressure	294.1 kPa	42.7 lbf/in ²
Steam inlet temperature	135.0 °C	275.0 °F
Noncondensable gas content	8.5 % by weight of inlet steam	
Exhaust pressure	102.9 kPa	30.4 in Hg
Turbine steam flow rate	44.0 Mg/h	0.0970×10^6 lbm/h

Condenser characteristics

Type	(None)	
Pressure	- kPa	- in Hg
Cooling water temperature	- °C	- °F
Outlet water temperature	- °C	- °F
Cooling water flow rate	- Mg/h	- lbm/h

Country	Italy
Unit name	Bagnore 2
Owner	Ente Nazionale per L'Energia Elettrica (ENEL)
Year of start-up	-
Plant type	Natural, direct, dry steam

Turbine characteristics

Manufacturer	Ansaldo Company		
Type	Single-cylinder, single-flow, noncondensing, impulse-reaction		
Rated capacity	3.5 MW		
Maximum capacity	3.5 MW		
Speed	3000 rev/min		
Steam inlet pressure	323.6 kPa	46.9 lbf/in ²	
Steam inlet temperature	141.0 °C	285.8 °F	
Noncondensable gas content	7.2 % by weight of inlet steam		
Exhaust pressure	102.9 kPa	30.4 in Hg	
Turbine steam flow rate	50.0 Mg/h	0.110 × 10 ⁶ lbm/h	

Condenser characteristics

Type	(None)		
Pressure	- kPa	-	in Hg
Cooling water temperature	- °C	-	°F
Outlet water temperature	- °C	-	°F
Cooling water flow rate	- Mg/h	-	lbm/h

Country	Italy
Unit name	Piancastagnaio
Owner	Ente Nazionale per L'Energia Elettrica (ENEL)
Year of start-up	1969
Plant type	Natural, direct, dry steam

Turbine characteristics

Manufacturer	Ansaldo Company		
Type	Single-cylinder, single-flow, noncondensing, impulse-reaction		
Rated capacity	15.0	MW	
Maximum capacity	15.0	MW	
Speed	3000 rev/min		
Steam inlet pressure	804.0	kPa	116.6 lbf/in ²
Steam inlet temperature	183.0	°C	361.4 °F
Noncondensable gas content	21.1 % by weight of inlet steam		
Exhaust pressure	105.9	kPa	31.3 in Hg
Turbine steam flow rate	219.0	Mg/h	0.483×10^6 lbm/h

Condenser characteristics

Type	(None)		
Pressure	-	kPa	- in Hg
Cooling water temperature	-	°C	- °F
Outlet water temperature	-	°C	- °F
Cooling water flow rate	-	Mg/h	- lbm/h

Country	Japan
Unit name	Matsukawa
Owner	Japan Metals and Chemicals Co., Ltd.
Year of start-up	1966
Plant type	Natural direct, dry steam

Turbine characteristics

Manufacturer	Tokyo Shibaura Electric Co., Ltd. (Toshiba)	
Type	Single-cylinder, single-flow, 4-stage impulse	
Rated capacity	20.0 MW	
Maximum capacity	22.0 MW	
Speed	3000 rev/min	
Steam inlet pressure	441.2 kPa	64.0 lbf/in ²
Steam inlet temperature	147.5 °C	297.5 °F
Noncondensable gas content	< 1.0 % by weight of inlet steam	
Exhaust pressure	13.5 kPa	4.0 in Hg
Turbine steam flow rate	207.0 Mg/h	0.456×10^6 lbm/h
Maximum allowable pressure	(NA) kPa	(NA) lbf/in ²
Last stage blade height	584.2 mm	23.0 in

Condenser characteristics

Type	Spray jet, barometric	
Pressure	12.7 kPa	3.74 in Hg
Cooling water temperature	25.0 °C	77.0 °F
Outlet water temperature	47.0 °C	116.6 °F
Cooling water flow rate	4,320.0 Mg/h	9.52×10^6 lbm/h

Gas extractor characteristics

Type	Steam jet ejector	
Number of stages or sets	2	
Suction pressure	12.7 kPa	3.74 in Hg
Capacity	$\sim 18,000 \text{ m}^3/\text{h}$	$\sim 10,600 \text{ ft}^3/\text{min}$
Steam consumption	(NA)	

Heat rejection system characteristics

Type	Natural draft cooling tower	
Number of towers	1	
Water inlet temperature	47.0 °C	116.6 °F
Water outlet temperature	25.0 °C	77.0 °F
Design wet-bulb temperature	(NA) °C	(NA) °F
Water flow rate	5.00 Gg/h	$11.0 \times 10^6 \text{ lbm/h}$
Water pump power	(NA) kW	

Country	Japan
Unit name	Otake
Owner	Kyushu Electric Company
Year of start-up	1967
Plant type	Separated steam ("single flash")

Turbine characteristics

Manufacturer	Mitsubishi Heavy Industries, Ltd.	
Type	Single-cylinder, single-flow, 4-stage impulse	
Rated capacity	10.0 MW	
Maximum capacity	13.0 MW	
Speed	3600 rev/min	
Steam inlet pressure	245.1 kPa	35.6 lbf/in ²
Steam inlet temperature	127.0 °C	261.0 °F
Noncondensable gas content	0.8 % by weight of inlet steam	
Exhaust pressure	10.8 kPa	3.2 in Hg
Turbine steam flow rate	113.0 Mg/h	0.249×10^6 lbm/h
Maximum allowable pressure	572.0 kPa	83.0 lbf/in ²
Last stage blade height	420.0 mm	16.5 in

Condenser characteristics

Type	Spray jet, barometric, tray-type	
Pressure	9.8 kPa	2.9 in Hg
Cooling water temperature	26.0 °C	78.8 °F
Outlet water temperature	41.4 °C	106.5 °F
Cooling water flow rate	3,900.0 Mg/h	8.6×10^6 lbm/h

Gas extractor characteristics

Type	Motor-driven, reciprocating vacuum pump	
Number of stages or sets	2 stages	
Suction pressure	9.02 kPa	2.66 in Hg
Capacity	1,050.0 m ³ /h	618.0 ft ³ /min
Power consumption	30 kW (starting)	

Heat rejection system characteristics

Type	Cross-flow, mechanical-draft cooling tower	
Number of cells	3	
Water inlet temperature	43.4 °C	110.1 °F
Water outlet temperature	23.0 °C	73.4 °F
Design wet-bulb temperature	14.0 °C	57.2 °F
Water flow rate	3.1 Gg/h	6.38 × 10 ⁶ lbm/h
Water pump power	(NA) kW	
Draft fan type	Vertical, axial	
Air flow rate/fan	285.0 m ³ /s	60.4 × 10 ⁶ ft ³ /min
Fan motor power	86.0 kW	

Country	Japan
Unit name	Onikobe
Owner	Electric Power Development Corporation
Year of start-up	1975
Plant type	Natural, direct, dry steam

Turbine characteristics

Manufacturer	Kawasaki Heavy Industries, Ltd.	
Type	Single-cylinder, single-flow, 5-stage, impulse reaction	
Rated capacity	25.0 MW	
Maximum capacity	25.0 MW	
Speed	3000 rev/min	
Steam inlet pressure	441.2 kPa	64.0 lbf/in ²
Steam inlet temperature	147.2 °C	297.0 °F
Noncondensable gas content	0.5 % by weight of inlet steam	
Exhaust pressure	10.7 kPa	3.1 in Hg
Turbine steam flow rate	228.0 Mg/h	0.503×10^6 lbm/h
Maximum allowable pressure	(NA) kPa	(NA) lbf/in ²
Last stage blade height	~ 626.5 mm	~ 24.7 in

Condenser characteristics

Type	Spray jet, barometric	
Pressure	10.0 kPa	3.0 in Hg
Cooling water temperature	26.0 °C	78.8 °F
Outlet water temperature	42.1 °C	107.8 °F
Cooling water flow rate	7,062.0 Mg/h	15.6×10^6 lbm/h

Gas extractor characteristics

Type	Steam jet ejector ⁽¹⁾		
Number of stages or sets	2		
Suction pressure	10.0 kPa	3.0 in Hg	
Capacity	(NA) m ³ /h	(NA) ft ³ /min	
Steam consumption	15.0 Mg/h	0.033 × 10 ⁶ lbm/h	

Heat rejection system characteristics

Type	Counter-flow, mechanical-draft cooling tower		
Number of cells	5		
Water inlet temperature	42.1 °C	107.8 °F	
Water outlet temperature	26.0 °C	78.8 °F	
Design wet-bulb temperature	17.0 °C	62.6 °F	
Water flow rate	6.75 Gg/h	14.88 × 10 ⁶ lbm/h	
Water pump power	400 kW		
Draft fan type	Vertical, axial		
Air flow rate/fan	(NA) m ³ /s	(NA) 10 ⁶ ft ³ /min	
Fan motor power	(NA) kW		

(1) Improved design (Oct. 1975) replaced second-stage ejector with motor-driven vacuum pump.

Country	Japan
Unit name	Hatchobaru
Owner	Kyushu Electric Company
Year of start-up	1977
Plant type	Separated steam/flash ("double flash")

Turbine characteristics

Manufacturer	Mitsubishi Heavy Industries, Ltd.	
Type	Single-cylinder, double-flow, pass-in, 5 × 2	
Rated capacity	50.0 MW	
Maximum capacity	55.0 MW	
Speed	3600 rev/min	
Main steam inlet pressure	637.3 kPa	92.4 lbf/in ²
Main steam inlet temperature	164.2 °C	327.6 °F
Secondary steam pressure	147.1 kPa	21.3 lbf/in ²
Secondary steam temperature	102.0 °C	215.6 °F
Noncondensable gas content	0.3 % by weight of main steam	
Exhaust pressure	9.8 kPa	2.9 in Hg
Main steam flow rate	384.0 Mg/h	0.847×10^6 lbm/h
Secondary steam flow rate	116.0 Mg/h	0.256×10^6 lbm/h
Maximum allowable pressure	1,070.0 kPa	155.5 lbf/in ²
Last stage blade height	635.0 mm	25.0 in

Condenser characteristics

Type	Spray jet, integral with turbine support	
Pressure	9.8 kPa	2.9 in Hg
Cooling water temperature	26.0 °C	78.8 °F
Outlet water temperature	43.5 °C	110.3 °F
Cooling water flow rate	12,300 Mg/h	27.1×10^6 lbm/h

Gas extractor characteristics

Type	Steam jet ejector and two radial blowers, in series	
Number of stages or sets	1 set	
Suction pressure	9.3 kPa	2.75 in Hg
Capacity	16,300 m ³ /h	9,594 ft ³ /min
Steam consumption	5.2 Mg/h	1.15 × 10 ⁴ lbm/h

Heat rejection system characteristics

Type	Counter-flow, mechanical-draft cooling tower	
Number of cells	4	
Water inlet temperature	43.5 °C	110.3 °F
Water outlet temperature	26.0 °C	78.8 °F
Design wet-bulb temperature	17.0 °C	62.6 °F
Water flow rate	12.72 Gg/h	28.0 × 10 ⁶ lbm/h
Water pump power	(NA) kW	
Draft fan type	Vertical, axial	
Air flow rate/fan	710.0 m ³ /s	1.50 × 10 ⁶ ft ³ /min
Fan motor power	213.0 kW	

Country	Japan
Unit name	Kakkonda (Takinoue)
Owner	Tohoku Electric Power Company, Inc.
Year of start-up	1977
Plant type	Natural, dry steam

Turbine characteristics

Manufacturer	Tokyo Shibaura Electric Co., Ltd. (Toshiba)	
Type	Single-cylinder, double-flow, 4 × 2	
Rated capacity	50.0 MW	
Maximum capacity	50.0 MW	
Speed	3000 rev/min	
Steam inlet pressure	441.2 kPa	64.0 lbf/in ²
Steam inlet temperature	147.5 °C	297.5 °F
Noncondensable gas content	(NA) % by weight of inlet steam	
Exhaust pressure	13.5 kPa	4.0 in Hg
Turbine steam flow rate	398.0 Mg/h	0.877 × 10 ⁶ lbm/h
Maximum allowable pressure	(NA) kPa	(NA) lbf/in ²
Last stage blade height	584.2 mm	23.0 in

Condenser characteristics

Type	Spray jet, barometric	
Pressure	13.5 kPa	4.0 in Hg
Cooling water temperature	(NA) °C	(NA) °F
Outlet water temperature	(NA) °C	(NA) °F
Cooling water flow rate	(NA) Mg/h	(NA) lbm/h

Gas extractor characteristics

Type	Steam jet ejector	
Number of stages or sets	(NA)	
Suction pressure	13.5 kPa	4.0 in Hg
Capacity	(NA) m ³ /h	(NA) ft ³ /min
Steam consumption	(NA)	

Heat rejection system characteristics

Type	(NA)	
Number of cells	(NA)	
Water inlet temperature	(NA) °C	(NA) °F
Water outlet temperature	(NA) °C	(NA) °F
Design wet-bulb temperature	(NA) °C	(NA) °F
Water flow rate	(NA) Gg/h	(NA) lbm/h
Water pump power	(NA) kW	
Draft fan type	(NA)	
Air flow rate/fan	(NA) m ³ /s	(NA) ft ³ /min
Fan motor power	(NA) kW	

Country	Japan
Unit name	Binary Pilot Plant
Owner	Japanese Government
Year of start-up	1977
Plant type	Binary cycle

Turbine characteristics

Manufacturer	Mitsubishi Heavy Industries, Ltd.	
Type	Single-cylinder, geared, 1-stage radial	
Rated capacity	1.0 MW	
Maximum capacity	1.0 MW	
Speed, turbine/generator	17000/1800 rev/min	
Secondary working fluid	iso-butane ($i\text{-C}_4\text{H}_{10}$)	
S.w.f. inlet pressure	2,843.0 kPa	412.4 lbf/in ²
S.w.f. inlet temperature	120.0 °C	248.0 °F
S.w.f. exhaust pressure	490.0 kPa	71.1 lbf/in ²
S.w.f. exhaust temperature	52.0 °C	125.6 °F
S.w.f. mass flow rate	70.0 Mg/h	0.154×10^6 lbm/h

Geothermal fluid characteristics

Inlet pressure	269.6 kPa	39.1 lbf/in ²
Inlet temperature	130.0 °C	266.0 °F
Outlet pressure	(NA) kPa	(NA) lbf/in ²
Outlet temperature	50.0 °C	122.0 °F
Mass flow rate	52.8 Mg/h (1)	0.1164×10^6 lbm/h

(1) Vapor flow rate = 4.7 Mg/h (1.036×10^4 lbm/h);

Liquid flow rate = 48.1 Mg/h (1.06×10^5 lbm/h).

Condenser characteristics

Type	Forced-draft, air-cooled with spray surface condenser	
Pressure (isobutane)	490.0 kPa	71.1 in Hg
Cooling water temperature (2)	26.0 °C	78.8 °F
Outlet water temperature (2)	(NA) °C	(NA) °F
Cooling water flow rate (2)	11.5 Mg/h	0.0254×10^6 lbm/h

Gas extractor characteristics

Type	Water-seal rotary pump	
Number of stages or sets	1	
Suction pressure	12.26 kPa	3.62 in Hg
Capacity	600.0 m ³ /h	353.1 ft ³ /min
Power consumption	37.0 kW	

Heat rejection system characteristics

Type	Counter-flow, mechanical-draft cooling tower	
Number of cells	1	
Water inlet temperature	50.0 °C	122.0 °F
Water outlet temperature	26.0 °C	78.8 °F
Design wet-bulb temperature	15.0 °C	59.0 °F
Water flow rate	0.0550 Mg/h	0.121×10^6 lbm/h
Water pump power	(NA) kW	
Draft fan type	Vertical, axial	
Air flow rate/fan	13.3 m ³ /s	0.0282×10^6 ft ³ /min
Fan motor power	30.0 kW	

(2) water spray used only during hot season.

Country	Mexico
Unit name	Cerro Prieto, Units 1 and 2
Owner	Comisión Federal de Electricidad
Year of start-up	1973
Plant type	Separated steam ("single flash")

Turbine characteristics/unit

Manufacturer	Tokyo Shibaura Electric Company, Ltd. (Toshiba)	
Type	Single-cylinder, double-flow, 6 × 2 impulse-reaction	
Rated capacity	37.5	MW
Maximum capacity	40.0	MW
Speed	3600	rev/min
Steam inlet pressure	618.1 kPa	89.6 lbf/in ²
Steam inlet temperature	160.0 °C	320.0 °F
Noncondensable gas content	~1.0% by weight of inlet steam	
Exhaust pressure	11.9 kPa	3.5 in Hg
Turbine steam flow rate	285.45 Mg/h	0.629 × 10 ⁶ lbm/h
Maximum allowable pressure	(NA) kPa	(NA) lbf/in ²
Last stage blade height	508.0 mm	20.0 in

Condenser characteristics/unit

Type	Spray jet, barometric	
Pressure	11.2 kPa	3.3 in Hg
Cooling water temperature	32.0 °C	89.6 °F
Outlet water temperature	45.3 °C	113.5 °F
Cooling water flow rate	10,710 Mg/h	23.6 × 10 ⁶ lbm/h

Gas extractor characteristics/unit

Type	Steam jet ejector		
Number of stages or sets	2 stages		
Suction pressure	10.7 kPa	3.1 in Hg	
Capacity	~ 32,000 m ³ /h	~ 19,000 ft ³ /min	
Steam consumption	24.2 Mg/h	0.053 × 10 ⁶ lbm/h	

Heat rejection system characteristics/unit

Type	Cross-flow, mechanical-draft cooling tower		
Number of cells	6		
Water inlet temperature	45.9 °C	114.6 °F	
Water outlet temperature	32.0 °C	89.6 °F	
Design wet-bulb temperature	(NA) °C	(NA) °F	
Water flow rate	11.4 Gg/h	25.5 x 10 ⁶ lbm/h	
Water pump power	835 kW		
Draft fan type	Vertical, axial		
Air flow rate/fan	(NA) m ³ /s	(NA) ft ³ /min	
Fan motor power	(NA) kW		

Country	New Zealand
Unit name	Kawerau
Owner	Tasman Pulp and Paper Company
Year of start-up	1961
Plant type	Separated steam ("single flash")/process heating

Turbine characteristics

Manufacturer	(NA)	
Type	single-cylinder, single-flow, noncondensing	
Rated capacity	10.0	MW
Maximum capacity	10.0	MW
Speed	3000	rev/min
Steam inlet pressure	790.9 kPa	114.7 lbf/in ²
Steam inlet temperature	169.9°C	337.9 °F
Noncondensable gas content	< 2.5% by weight of inlet steam	
Exhaust pressure	~ 101.6 kPa	~ 30 in Hg
Turbine steam flow rate	144.7 Mg/h	0.319 × 10 ⁶ lbm/h
Maximum allowable pressure	(NA) kPa	(NA) lbf/in ²
Last stage blade height	(NA) mm	(NA) in

Condenser characteristics

Type	(None) ⁽¹⁾	
Pressure	- kPa	- in Hg
Cooling water temperature	- °C	- °F
Outlet water temperature	- °C	- °F
Cooling water flow rate	- Mg/h	- lbm/h

(1) Up to 45 Mg/h (100 klbm/h) of exhaust steam is condensed in a black liquor pre-evaporator.

Country	New Zealand
Unit name	Wairakei: Station A, HP Units (2 units)
Owner	New Zealand Electricity Department
Year of start-up	1958, 1959
Plant type	Separated steam/multiple flash

Turbine characteristics/unit

Manufacturer	British Thomson-Houston	
Type	Single-cylinder, single-flow, noncondensing	
Rated capacity	6.5 MW	
Maximum capacity	6.5 MW	
Speed	3000 rev/min	
Steam inlet pressure (1)	910 kPa	132 lbf/in ²
Steam inlet temperature	175.8 °C	348.5 °F
Noncondensable gas content	0.5 % by weight of inlet steam	
Exhaust pressure	~ 441 kPa	~ 64 lbf/in ²
Turbine steam flow rate	(NA) ⁽²⁾ Mg/h	(NA) lbm/h
Maximum allowable pressure	(NA) kPa	(NA) lbf/in ²
Last stage blade height	(NA) mm	(NA) in

Condenser characteristics

Type	(None)	
Pressure	- kPa	- in Hg
Cooling water temperature	- °C	- °F
Outlet water temperature	- °C	- °F
Cooling water flow rate	- Mg/h	- lbm/h

(1) Original pressure was 1338 kPa (194 lbf/in²), but has been reduced owing to deterioration of reservoir pressure. Note that Bolton [1977] reported 1009 kPa (146 lbf/in²) in his Fig. 12, but gave the values shown above in the text.

(2) Original flow rate was 144.7 Mg/h (0.319 × 10⁶ lbm/h), per unit.

Country	New Zealand
Unit name	Wairakei: Station A, HP Units (2 units)
Owner	New Zealand Electricity Department
Year of start-up	1962
Plant type	Separated steam/multiple flash

Turbine characteristics/unit

Manufacturer	British Thomson-Houston		
Type	Single-cylinder, single-flow, noncondensing		
Rated capacity	11.2 MW		
Maximum capacity	11.2 MW		
Speed	3000 rev/min		
Steam inlet pressure (1)	910 kPa	132 lbf/in ²	
Steam inlet temperature	175.8 °C	348.5 °F	
Noncondensable gas content	0.5 % by weight of inlet steam		
Exhaust pressure	~ 441 kPa	~ 64 lbf/in ²	
Turbine steam flow rate	(NA) ⁽²⁾ Mg/h	(NA)	lbm/h
Maximum allowable pressure	(NA) kPa	(NA)	lbf/in ²
Last stage blade height	(NA) mm	(NA)	in

Condenser characteristics

Type	(None)		
Pressure	- kPa	-	in Hg
Cooling water temperature	- °C	-	°F
Outlet water temperature	- °C	-	°F
Cooling water flow rate	- Mg/h	-	lbm/h

(1) Original pressure was 1338 kPa (194 lbf/in²), but has been reduced owing to deterioration of steam reservoir pressure.

(2) Original flow rate was 258.0 Mg/h (0.569 × 10⁶ lbm/h), per unit.

Country	New Zealand
Unit name	Wairakei: Station A, IP Units (2 units)
Owner	New Zealand Electricity Department
Year of start-up	1959
Plant type	Separated steam/multiple flash

Turbine characteristics/unit

Manufacturer	British Thomson-Houston	
Type	Single-cylinder, single-flow, noncondensing	
Rated capacity	11.2 MW	
Maximum capacity	11.2 MW	
Speed	3000 rev/min	
Steam inlet pressure	441 kPa	64.0 lbf/in ²
Steam inlet temperature	147 °C	297 °F
Noncondensable gas content	~ 0.4 % by weight of inlet steam	
Exhaust pressure	106.7 kPa	15.5 lbf/in ²
Turbine steam flow rate	~ 209 Mg/h	~ 0.46 × 10 ⁶ lbm/h
Maximum allowable pressure	(NA) kPa	(NA) lbf/in ²
Last stage blade height	(NA) mm	(NA) in

Condenser characteristics

Type	(None)	
Pressure	- kPa	- in' Hg
Cooling water temperature	- °C	- °F
Outlet water temperature	- °C	- °F
Cooling water flow rate	- Mg/h	- lbm/h

Country	New Zealand
Unit name	Wairakei: Station A, LP Units (4 units)
Owner	New Zealand Electricity Department
Year of start-up	1959, 1960
Plant type	Separated steam/multiple flash

Turbine characteristics/unit

Manufacturer	British Thomson-Houston	
Type	Single-cylinder, single-flow, condensing	
Rated capacity	11.2 MW	
Maximum capacity	11.2 MW	
Speed	3000 rev/min	
Steam inlet pressure	~ 103.4 kPa	~ 15.0 lbf/in ²
Steam inlet temperature	~ 100.6°C	~ 213 °F
Noncondensable gas content	~ 0.4 % by weight of inlet steam	
Exhaust pressure	5.1 kPa	1.5 in Hg
Turbine steam flow rate	~ 130 Mg/h	~ 0.287 × 10 ⁶ lbm/h
Maximum allowable pressure	(NA) kPa	(NA) lbf/in ²
Last stage blade height	(NA) mm	(NA) in

Condenser characteristics/unit

Type	Spray jet, barometric	
Pressure	5.1 kPa	1.5 in Hg
Cooling water temperature	15.0 °C	59.0 °F
Outlet water temperature (1)	29.5 °C	85.1 °F
Cooling water flow rate (1)	~ 5,039 Mg/h	~ 11.1 × 10 ⁶ lbm/h

(1) Average values.

Gas extractor characteristics

Type	Steam jet ejector	
Number of stages or sets	3	
Suction pressure	5.1 kPa	1.5 in Hg
Capacity	(NA) m ³ /h	(NA) ft ³ /min
Steam consumption	(NA)	

Heat rejection system characteristics/unit

Type	Waikato River	
Number of cells	-	
Water inlet temperature	15.0 °C	59.0 °F
Water outlet temperature	29.5 °C	85.1 °F
Design wet-bulb temperature	- °C	- °F
Water flow rate	~ 6.04 Gg/h	~ 11.1 × 10 ⁶ lbm/h
Water pump power	100 kW	
Draft fan type	(None)	
Air flow rate/fan	- m ³ /s	- ft ³ /min
Fan motor power	- kW	

Country	New Zealand
Unit name	Wairakei: Station B, MP Units (3 units)
Owner	New Zealand Electricity Department
Year of start-up	1962, 1963
Plant type	Separated steam/multiple flash

Turbine characteristics/unit

Manufacturer	Associated Electrical Industries	
Type	Single-cylinder, single-flow, pass-in, condensing	
Rated capacity	30.0 MW	
Maximum capacity	30.0 MW	
Speed	1500 rev/min	
Main steam inlet pressure	441 kPa	64 lbf/in ²
Main steam inlet temperature	147 °C	297 °F
Secondary steam pressure	~ 103.4 kPa	~ 15 lbf/in ²
Secondary steam temperature	~ 100.6 °C	~ 213 °F
Noncondensable gas content	~ 0.4% by weight of main steam	
Exhaust pressure	5.1 kPa	1.5 in Hg
Main steam flow rate	~ 181.3 Mg/h	~ 0.4 × 10 ⁶ lbm/h
Secondary steam flow rate	~ 45.3 Mg/h	~ 0.1 × 10 ⁶ lbm/h
Maximum allowable pressure	(NA) kPa	(NA) lbf/in ²
Last stage blade height	(NA) mm	(NA) in

Condenser characteristics/unit

Type	Spray jet, barometric	
Pressure	5.1 kPa	1.5 in Hg
Cooling water temperature	15.0 °C	59.0 °F
Outlet water temperature	29.5 °C	85.1 °F
Cooling water flow rate	~ 7,460 Mg/h	~ 16.4 × 10 ⁵ lbm/h

Gas extractor characteristics

Type	Steam jet ejector	
Number of stages or sets	3	
Suction pressure	5.1 KPa	1.5 in Hg
Capacity	(NA) m ³ /h	(NA) ft ³ /min
Steam consumption	(NA)	

Heat rejection system characteristics/unit

Type	Waikato River	
Number of cells	-	
Water inlet temperature	15.0 °C	59.0 °F
Water outlet temperature	29.5 °C	85.1 °F
Design wet-bulb temperature	- °C	- °F
Water flow rate	~ 7.46 Gg/h	~ 16.4 × 10 ⁶ lbm/h
Water pump power	~ 2 kW	
Draft fan type	(None)	
Air flow rate/fan	- m ³ /s	- ft ³ /min
Fan motor power	- kW	

Country	New Zealand
Unit name	Broadlands Units 1, 2 and 3
Owner	New Zealand Electricity Department
Year of start-up	1983 (Unit 1), 1984 (Units 2 and 3)
Plant type	Separated steam/flash ("double flash")

Turbine characteristics

Manufacturer	(NA)	
Type	Dual-admission, condensing	
Rated capacity/unit	50.0	MW
Maximum capacity/unit	55.0	MW
Speed	3000	rev/min
Main steam inlet pressure	650.0 kPa	94.3 lbf/in ²
Main steam inlet temperature	162.0 °C	323.6 °F
Secondary steam pressure	200.0 kPa	29.0 lbf/in ²
Secondary steam temperature	120.0 °C	248.0 °F
Noncondensable gas content	~ 2.4 % by weight of main steam	
Exhaust pressure	(NA) kPa	(NA) in Hg
Main steam flow rate/unit	413.7 Mg/h	0.913×10^6 lbm/h
Secondary steam flow rate/unit	93.3 Mg/h	0.206×10^6 lbm/h
Maximum allowable pressure	(NA) kPa	(NA) lbf/in ²
Last stage blade height	(NA) mm	(NA) in

Condenser characteristics

Type	(NA)	
Pressure	(NA) kPa	(NA) in Hg
Cooling water temperature	30.0 °C	86.0 °F
Outlet water temperature	43.0 °C	109.4 °F
Cooling water flow rate	59,200 Mg/h	130.5×10^6 lbm/h

Gas extractor characteristics

Type	Steam jet ejector or radial blower		
Number of stages or sets	(NA)		
Suction pressure	(NA) kPa	(NA)	in Hg
Capacity	~ 22,000 m ³ /h	~ 13,000	ft ³ /min
Power consumption	(NA) ⁽¹⁾		

Heat rejection system characteristics

Type	Mechanical, induced draft cooling tower		
Number of cells	14 (total 3 units)		
Water inlet temperature	43.0 °C	109.4 °F	
Water outlet temperature	30.0 °C	86.0 °F	
Design wet-bulb temperature	(NA) °C	(NA) °F	
Water flow rate	60.6 Gg/h	133.7 × 10 ⁶	lbm/h
Water pump power	(NA) ⁽¹⁾ kW		
Draft fan type	Vertical, axial		
Air flow rate/fan	(NA) m ³ /s	(NA)	ft ³ /min
Fan motor power	(NA) ⁽¹⁾ kW		

(1) Total auxiliary power requirements are estimated to be 5 MW/unit.

Country	Philippines
Unit name	Leyte Portable Power Unit
Owner	Philippine National Oil Co., Energy Dev. Corp.
Year of start-up	1977
Plant type	Separated steam ("single flash")

Turbine characteristics

Manufacturer	Mitsubishi Heavy Industries, Ltd.		
Type	Single Curtis stage, geared, noncondensing		
Rated capacity	3.0 MW		
Maximum capacity	3.0 MW		
Speed, turbine/generator	7554/1800 rev/min		
Steam inlet pressure	787.7 kPa	114.2 lbf/in ²	
Steam inlet temperature	170.0 °C	338.0 °F	
Noncondensable gas content	5.0 % by weight of inlet steam		
Exhaust pressure	127.5 kPa	37.6 in Hg	
Turbine steam flow rate	53.0 kg/h	0.117 × 10 ⁶ lbm/h	
Maximum allowable pressure	1,572.1 kPa	228.0 lbf/in ²	
Last stage blade height	(NA) mm	(NA) in	

Condenser characteristics

Type	(None)		
Pressure	- kPa	-	in Hg
Cooling water temperature	- °C	-	°F
Outlet water temperature	- °C	-	°F
Cooling water flow rate	- kg/h	-	lbm/h

Country	Philippines
Unit name	Los Baños, Wellhead Unit
Owner	National Power Corporation
Year of start-up	1977
Plant type	Separated steam ("single flash")

Turbine characteristics

Manufacturer	Mitsubishi Heavy Industries, Ltd.	
Type	Single Curtis stage, geared, noncondensing	
Rated capacity	1.2	MW
Maximum capacity	1.3	MW
Speed, turbine/generator	7129/1800 rev/min	
Steam inlet pressure	658.3 kPa	95.5 lbf/in ²
Steam inlet temperature	162.3 °C	324.1 °F
Noncondensable gas content	5.0 % by weight of inlet steam	
Exhaust pressure	102.9 kPa	30.4 in Hg
Turbine steam flow rate	22.3 Mg/h	0.0492×10^6 lbm/h
Maximum allowable pressure	1,572.1 kPa	228.0 lbf/in ²
Last stage blade height	(NA) mm	(NA) in

Condenser characteristics

Type	(None)	
Pressure	- kPa	- in Hg
Cooling water temperature	- °C	- °F
Outlet water temperature	- °C	- °F
Cooling water flow rate	- Mg/h	- lbm/h

Country	Philippines
Unit name	Los Baños, Units 1-4
Owner	National Power Corporation
Year of start-up	1978(?) (Unit 1), 1979 (Unit 2), 1981 (Unit 3), 1982 (Unit 4)
Plant type	Separated steam/flash ("double flash")

Turbine characteristics/unit

Manufacturer	Mitsubishi Heavy Industries, Ltd.	
Type	Single-cylinder, double-flow, pass-in, 5 × 2 stages	
Rated capacity	55.0	MW
Maximum capacity	68.75	MW
Speed	3600	rev/min
Main steam inlet pressure	653.4 kPa	94.8 lbf/in ²
Main steam inlet temperature	162.3 °C	324.1 °F
Secondary steam pressure	171.0 kPa	24.8 lbf/in ²
Secondary steam temperature	115.6 °C	240.1 °F
Noncondensable gas content	5.0% by weight of main steam	
Exhaust pressure	13.5 kPa	4.0 in Hg
Main steam flow rate	352.0 Mg/h	0.776×10^6 lbm/h
Secondary steam flow rate	125.0 Mg/h	0.276×10^6 lbm/h
Maximum allowable pressure	1,072.0 kPa	155.5 lbf/in ²
Last stage blade height	635.0 mm	25.0 in

Condenser characteristics/unit

Type	Spray jet, barometric	
Pressure	13.5 kPa	4.0 in Hg
Cooling water temperature	30.6 °C	87.1 °F
Outlet water temperature	48.9 °C	120.0 °F
Cooling water flow rate	13,200 Mg/h	29.1×10^5 lbm/h

Gas extractor characteristics /unit

Type	Blower and steam jet ejector	
Number of stages or sets	2	
Suction pressure	12.7 kPa	3.76 in Hg
Capacity	138,240 m ³ /h	4.88 × 10 ⁶ ft ³ /min
Power consumption; steam	1.55 MW (blower); 79.1 Mg/h (0.174 × 10 ⁶ lbm/h)	

Heat rejection system characteristics /unit

Type	Cross-flow, mechanical-draft cooling tower	
Number of cells	6	
Water inlet temperature	48.9 °C	120.0 °F
Water outlet temperature	30.6 °C	87.1 °F
Design wet-bulb temperature	26.7 °C	80.1 °F
Water flow rate	15.2 Gg/h	33.5 × 10 ⁶ lbm/h
Water pump power	(NA) kW	
Draft fan type	Vertical, axial	
Air flow rate/fan	(NA) m ³ /s	(NA) ft ³ /min
Fan motor power	(NA) kW	

Country	Philippines
Unit name	Tiwi, Units 1-4
Owner	National Power Corporation
Year of start-up	1978(?) (Units 1 and 2), 1981 (Units 3 and 4)
Plant type	Separated steam/flash ("double flash")

Turbine characteristics/unit

Manufacturer	Tokyo Shibaura Electric Company, Ltd. (Toshiba)		
Type	Single-cylinder, double-flow, pass-in, 6 × 2 stages		
Rated capacity	55.0 MW		
Maximum capacity	55.0 MW		
Speed	3600 rev/min		
Main steam inlet pressure	699.4 kPa	101.4 lbf/in ²	
Main steam inlet temperature	165.0 °C	329.0 °F	
Secondary steam pressure	184.7 kPa	26.8 lbf/in ²	
Secondary steam temperature	118.0 °C	244.4 °F	
Noncondensable gas content	5.0% by weight of main steam		
Exhaust pressure	13.5 kPa	4.0 in Hg	
Main steam flow rate	(NA) Mg/h	(NA)	lbm/h
Secondary steam flow rate	(NA) Mg/h	(NA)	lbm/h
Maximum allowable pressure	(NA) kPa	(NA)	lbf/in ²
Last stage blade height	584.2 mm	23.0 in	

Condenser characteristics/unit

Type	Spray jet, barometric		
Pressure	13.5 kPa	4.0	in Hg
Cooling water temperature	30.6 °C	87.1	°F
Outlet water temperature	48.9 °C	120.0	°F
Cooling water flow rate	12,600 Mg/h	27.8 × 10 ⁶ lbm/h	

Gas extractor characteristics/unit

Type	Blower and steam jet ejector	
Number of stages or sets	2	
Suction pressure	~ 12.7kPa	~ 3.76 in Hg
Capacity	(NA) m ³ /h	(NA) ft ³ /min
Power consumption	(NA)	

Heat rejection system characteristics/unit

Type	Cross-flow, mechanical-draft cooling tower	
Number of cells	6	
Water inlet temperature	48.9 °C	120.0 °F
Water outlet temperature	30.6 °C	87.1 °F
Design wet-bulb temperature	26.7 °C	80.1 °F
Water flow rate	~ 15.2 Gg/h	~ 33.5 × 10 ⁶ lbm/h
Water pump power	(NA) kW	
Draft fan type	Vertical, axial	
Air flow rate/fan	(NA) m ³ /s	(NA) ft ³ /min
Fan motor power	(NA) kW	

Country	Turkey
Unit name	Wellhead Unit KD 13
Owner	Mineral Research and Exploration Institute
Year of start-up	1975
Plant type	Separated steam ("single-flash")

Turbine characteristics

Manufacturer	O. Mertoglu and MTA Workshop, Ankara	
Type	Noncondensing	
Rated capacity	0.5 MW	
Maximum capacity	0.5 MW	
Speed	4500 rev/min	
Steam inlet pressure	475 kPa	69 lbf/in ²
Steam inlet temperature	150 °C	302 °F
Noncondensable gas content	17 % by weight of inlet steam	
Exhaust pressure	120 kPa	35.4 in Hg
Turbine steam flow rate ⁽¹⁾	8 Mg/h	17.6 × 10 ³ lbm/h
Maximum allowable pressure	800 kPa	116 lbf/in ²
Last stage blade height	75 mm	3 in

Condenser characteristics

Type	(None)	
Pressure	- kPa	- in Hg
Cooling water temperature	- °C	- °F
Outlet water temperature	- °C	- °F
Cooling water flow rate	- Mg/h	- lbm/h

(1) Based on assumed quality of 20%; total flow is 40 Mg/h (88 × 10³ lbm/h).

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Country	Union of Soviet Socialist Republics
Unit name	Paratun'ka (1)
Owner	Thermal Physics Institute, USSR Academy of Sciences
Year of start-up	1967
Plant type	Binary cycle

Turbine characteristics

Manufacturer	Kaluga Turbine Plant	
Type	Radial outflow	
Rated capacity	0.68	MW
Maximum capacity	0.75	MW
Speed, turbine/generator	(NA)	rev/min
Secondary working fluid	dichlorodifluoromethane (CCl_2F_2 , Ref. 12)	
S.w.f. inlet pressure	1,400 kPa	202.7 lbf/in ²
S.w.f. inlet temperature	65.5 °C	149.0 °F
S.w.f. exhaust pressure	506.0 kPa	73.5 lbf/in ²
S.w.f. exhaust temperature	(NA) °C	(NA) °F
S.w.f. mass flow rate	(NA) Mg/h	(NA) lbm/h

Geothermal fluid characteristics

Inlet pressure	293.9 kPa	42.6 lbf/in ²
Inlet temperature	81.5 °C	178.7 °F
Outlet pressure	(NA) kPa	(NA) lbf/in ²
Outlet temperature	(NA) °C	(NA) °F
Mass flow rate	280.0 Mg/h	0.617×10^6 lbm/h

(1) This plant is no longer operational and has been dismantled.

Condenser characteristics

Type	Surface, shell and tube	
Pressure	506.0 kPa	73.5 lbf/in ²
Cooling water temperature	15.0 °C	59.0 °F
Outlet water temperature	(NA) °C	(NA) °F
Cooling water flow rate	1,500 Mg/h	3.3 × 10 ⁶ lbm/h

Gas extractor characteristics

Type	(None)	
Number of stages or sets	-	
Suction pressure	- kPa	- in Hg
Capacity	- m ³ /h	- ft ³ /min
Power consumption	-	

Heat rejection svstem characteristics

Type	Paratun'ka River	
Number of cells	-	
Water inlet temperature	15.0 °C	59.0 °F
Water outlet temperature	(NA) °C	(NA) °F
Design wet-bulb temperature	(NA) °C	(NA) °F
Water flow rate	(NA) Gg/h	(NA) lbm/h
Water pump power	(NA) kW	
Draft fan type	(None)	
Air flow rate/fan	- m ³ /s	- ft ³ /min
Fan motor power	- kW	

Country	Union of Soviet Socialist Republics
Unit name	Pauzhetka
Owner	Kamchatka Electricity Production and Distribution Adm.
Year of start-up	1967
Plant type	Separated steam ("single flash")

Turbine characteristics

Manufacturer	(NA)	
Type	Tandem-compound, single-flow	
Rated capacity	5.0 MW	
Maximum capacity	5.0 MW	
Speed	(NA) rev/min	
Steam inlet pressure	196.1 kPa	28.4 lbf/in ²
Steam inlet temperature	127.0 °C	260.6 °F
Noncondensable gas content	(NA) % by weight of inlet steam	
Exhaust pressure	2.94 - 7.84 kPa	0.87 - 2.32 in Hg
Turbine steam flow rate	27.0 Mg/h	0.0595×10^6 lbm/h
Maximum allowable pressure	(NA) kPa	(NA) lbf/in ²
Last stage blade height	(NA) mm	(NA) in

Condenser characteristics

Type	Spray jet, barometric	
Pressure	2.94 - 7.84 kPa	0.87 - 2.32 in Hg
Cooling water temperature	(NA) °C	(NA) °F
Outlet water temperature	(NA) °C	(NA) °F
Cooling water flow rate	(NA) Mg/h	(NA) lbm/h

Gas extractor characteristics

Type	Water jet ejector	
Number of stages or sets	1	
Suction pressure	(NA) KPa	(NA) in Hg
Capacity	(NA) m ³ /h	(NA) ft ³ /min
Power consumption	170 kW, water impeller power	

Heat rejection system characteristics

Type	Pauzhetka River	
Number of cells	-	
Water inlet temperature	(NA) °C	(NA) °F
Water outlet temperature	(NA) °C	(NA) °F
Design wet-bulb temperature	(NA) °C	(NA) °F
Water flow rate	(NA) Gg/h	(NA) lbm/h
Water pump power	(NA) kW	
Draft fan type	(None)	
Air flow rate/fan	- m ³ /s	- ft ³ /min
Fan motor power	- kW	

Country	Union of Soviet Socialist Republics
Unit name	Bol'she-Bannaya
Owner	-
Year of start-up	Future
Plant type	Separated steam/flash ("double flash")

Turbine characteristics

Manufacturer	(NA)	
Type	Straight condensing (2); Multi-pass-in, condensing (4)	
Rated capacity	8.0 MW ⁽¹⁾	
Maximum capacity	8.0 MW	
Speed	3000 rev/min	
Main steam inlet pressure	121.6 kPa	17.6 lbf/in ²
Main steam inlet temperature	105.0 °C	221.0 °F
Secondary steam pressure	101.3 kPa	14.7 lbf/in ²
Secondary steam temperature	100.0 °C	212.0 °F
Noncondensable gas content	(NA) % by weight of main steam	
Exhaust pressure	(NA) kPa	(NA) in Hg
Main steam flow rate	12.0 Mg/h	0.0265×10^6 lbm/h
Secondary steam flow rate	(NA) Mg/h	(NA) lbm/h
Maximum allowable pressure	(NA) kPa	(NA) lbf/in ²
Last stage blade height	(NA) mm	(NA) in

Condenser characteristics

Type	Surface, shell and tube	
Pressure	(NA) kPa	(NA) in Hg
Cooling water temperature	(NA) °C	(NA) °F
Outlet water temperature	(NA) °C	(NA) °F
Cooling water flow rate	(NA) Mg/h	(NA) lbm/h

(1) Two turbines at 2.5 MW; four turbines at 0.75 MW.

Gas extractor characteristics

Type	(NA)		
Number of stages or sets	(NA)		
Suction pressure	(NA)	KPa	(NA) in Hg
Capacity	(NA)	m ³ /h	(NA) ft ³ /min
Power consumption	(NA)		

Heat rejection system characteristics

Type	River water		
Number of cells	-		
Water inlet temperature	(NA)	°C	(NA) °F
Water outlet temperature	(NA)	°C	(NA) °F
Design wet-bulb temperature	(NA)	°C	(NA) °F
Water flow rate	(NA)	Gg/h	(NA) lbm/n
Water pump power	(NA) kW		
Draft fan type	(None)		
Air flow rate/fan	-	m ³ /s	- ft ³ /min
Fan motor power	- kW		

Country	United States
Unit name	The Geysers, Unit 1
Owner	Pacific Gas and Electric Company
Year of start-up	1960
Plant type	Natural, direct dry steam

Turbine characteristics

Manufacturer	General Electric Company	
Type	Single-cylinder, single-flow, 6-stage, impulse-reaction	
Rated capacity	11.0	MW
Maximum capacity	11.0	MW
Speed	1800	rev/min
Steam inlet pressure	647.4 kPa	93.9 lbf/in ²
Steam inlet temperature	175.6 °C	348.0 °F
Noncondensable gas content	< 0.3 % by weight of inlet steam	
Exhaust pressure	13.5 kPa	4.0 in Hg
Turbine steam flow rate	108.9 Mg/h	0.240×10^6 lbm/h
Maximum allowable pressure	(NA) kPa	(NA) lbf/in ²
Last stage blade height	(NA) mm	(NA) in

Condenser characteristics

Type	Spray jet, barometric	
Pressure	13.5 kPa	4.0 in Hg
Cooling water temperature	27.0 °C	80.6 °F
Outlet water temperature	49.3 °C	120.8 °F
Cooling water flow rate	2,490.0 Mg/h	5.5×10^6 lbm/h

Gas extractor characteristics

Type	Steam jet ejector	
Number of stages or sets	2	
Suction pressure	13.5 kPa	4.0 in Hg
Capacity	~ 593 m ³ /h	~ 349 ft ³ /min
Steam consumption	~ 4.9 Mg/h	~ 0.01 × 10 ⁶ lbm/h

Heat rejection system characteristics

Type	Counter-flow, mechanical-draft cooling tower	
Number of cells	3	
Water inlet temperature	48.8 °C	119.8 °F
Water outlet temperature	27.0 °C	80.6 °F
Design wet-bulb temperature	19.2 °C	66.5 °F
Water flow rate	2.79 g/h	6.15 × 10 ⁵ lbm/h
Water pump power	(NA) kW	
Draft fan type	Vertical, axial	
Air flow rate/fan	(NA) m ³ /s	(NA) ft ³ /min
Fan motor power	(NA) kW	

Country	United States
Unit name	The Geysers, Unit 2
Owner	Pacific Gas and Electric Company
Year of start-up	1963
Plant type	Natural, direct dry steam

Turbine characteristics

Manufacturer	Elliott Company	
Type	Single-cylinder, single-flow, impulse-reaction	
Rated capacity	13.0	MW
Maximum capacity	13.0	MW
Speed	3600	rev/min
Steam inlet pressure	549.5 kPa	79.7 lbf/in ²
Steam inlet temperature	175.6 °C	348.0 °F
Noncondensable gas content	< 0.3 % by weight of inlet steam	
Exhaust pressure	13.5 kPa	4.0 in Hg
Turbine steam flow rate	115.9 Mg/h	0.255 × 10 ⁶ lbm/h
Maximum allowable pressure	(NA) kPa	(NA) lbf/in ²
Last stage blade height	(NA) mm	(NA) in

Condenser characteristics

Type	Spray jet, barometric	
Pressure	13.5 kPa	4.0 in Hg
Cooling water temperature	27.0 °C	80.6 °F
Outlet water temperature	49.0 °C	120.0 °F
Cooling water flow rate	(NA) Mg/h	(NA) lbm/h

Gas extractor characteristics

Type	Steam jet ejector	
Number of stages or sets	2	
Suction pressure	13.5 kPa	4.0 in Hg
Capacity	(NA) m ³ /h	(NA) ft ³ /min
Steam consumption	(NA)	

Heat rejection system characteristics

Type	Counter-flow, mechanical-draft cooling tower	
Number of cells	3	
Water inlet temperature	48.0 °C	118.4 °F
Water outlet temperature	27.0 °C	80.6 °F
Design wet-bulb temperature	18.3 °C	65.0 °F
Water flow rate	(NA) Gg/h	(NA) lbm/h
Water pump power	(NA) kW	
Draft fan type	Vertical, axial	
Air flow rate/fan	(NA) m ³ /s	(NA) ft ³ /min
Fan motor power	(NA) kW	

Country	United States
Unit name	The Geysers, Unit 3
Owner	Pacific Gas and Electric Company
Year of start-up	1967
Plant type	Natural, direct dry steam

Turbine characteristics

Manufacturer	Elliott Company	
Type	Single-cylinder, single-flow, 7-stage, impulse-reaction	
Rated capacity	27.0	MW
Maximum capacity	27.5	MW
Speed	3600	rev/min
Steam inlet pressure	544.0 kPa	78.9 lbf/in ²
Steam inlet temperature	172.1 °C	341.8 °F
Noncondensable gas content	< 0.5 % by weight of inlet steam	
Exhaust pressure	13.5 kPa	4.0 in Hg
Turbine steam flow rate	231.2 Mg/h	0.510×10^6 lbm/h
Maximum allowable pressure	(NA) kPa	(NA) lbf/in ²
Last stage blade height	(NA) mm	(NA) in

Condenser characteristics

Type	Spray jet, barometric	
Pressure	13.5 kPa	4.0 in Hg
Cooling water temperature	27.0 °C	80.6 °F
Outlet water temperature	48.8 °C	119.8 °F
Cooling water flow rate	2,910.0 Mg/h	6.41×10^6 lbm/h

Gas extractor characteristics

Type	Steam jet ejector	
Number of stages or sets	2	
Suction pressure	13.5 kPa	4.0 in Hg
Capacity	$\sim 1750 \text{ m}^3/\text{h}$	$\sim 1000 \text{ ft}^3/\text{min}$
Steam consumption	$\sim 10.4 \text{ Mg/h}$	$\sim 0.023 \times 10^6 \text{ lbm/h}$

Heat rejection system characteristics

Type	Counter-flow, mechanical-draft cooling tower	
Number of cells	6	
Water inlet temperature	48.3 °C	119.0 °F
Water outlet temperature	27.0 °C	80.6 °F
Design wet-bulb temperature	18.9 °C	66.0 °F
Water flow rate	6.58 Gg/h	$14.5 \times 10^6 \text{ lbm/h}$
Water pump power	(NA) kW	
Draft fan type	Vertical, axial	
Air flow rate/fan	(NA) m^3/s	(NA) ft^3/min
Fan motor power	335 kW, rating	

Country	United States
Unit name	The Geysers, Unit 4
Owner	Pacific Gas and Electric Company
Year of start-up	1968
Plant type	Natural, direct dry steam

Turbine characteristics

Manufacturer	Elliott Company		
Type	Single-cylinder, single-flow, 7-stage, impulse-reaction		
Rated capacity	27.0 MW		
Maximum capacity	27.5 MW		
Speed	3600 rev/min		
Steam inlet pressure	544.0 kPa	78.9 lbf/in ²	
Steam inlet temperature	172.1 °C	341.8 °F	
Noncondensable gas content	< 0.5 % by weight of inlet steam		
Exhaust pressure	13.5 kPa	4.0 in Hg	
Turbine steam flow rate	234.0 Mg/h	0.516 × 10 ⁶ lbm/h	
Maximum allowable pressure	(NA) kPa	(NA) lbf/in ²	
Last stage blade height	(NA) mm	(NA) in	

Condenser characteristics

Type	Spray jet, barometric		
Pressure	13.5 kPa	4.0 in Hg	
Cooling water temperature	27.0 °C	80.6 °F	
Outlet water temperature	48.8 °C	119.8 °F	
Cooling water flow rate	2,910.0 Mg/h	6.41×10^6 lbm/h	

Gas extractor characteristics

Type	Steam jet ejector	
Number of stages or sets	2	
Suction pressure	13.5 kPa	4.0 in Hg
Capacity	$\sim 1750 \text{ m}^3/\text{h}$	$\sim 1000 \text{ ft}^3/\text{min}$
Steam consumption	$\sim 10.4 \text{ Mg/h}$	$\sim 0.023 \times 10^6 \text{ lbm/h}$

Heat rejection system characteristics

Type	Counter-flow, mechanical-draft cooling tower	
Number of cells	6	
Water inlet temperature	48.3 °C	119.0 °F
Water outlet temperature	27.0 °C	80.6 °F
Design wet-bulb temperature	18.9 °C	66.0 °F
Water flow rate	6.58 Gg/h	$14.5 \times 10^6 \text{ lbm/h}$
Water pump power	(NA) kW	
Draft fan type	Vertical, axial	
Air flow rate/fan	(NA) m^3/s	(NA) ft^3/min
Fan motor power	335 kW, rating	

Country	United States
Unit name	The Geysers, Units 5 and 6
Owner	Pacific Gas and Electric Company
Year of start-up	1971
Plant type	Natural, direct dry steam

Turbine characteristics /unit

Manufacturer	Tokyo Shibaura Electric Company, Ltd. (Toshiba)	
Type	Single-cylinder, double-flow, 6 × 2 impulse	
Rated capacity	53.0	MW
Maximum capacity	55.0	MW
Speed	3600	rev/min
Steam inlet pressure	784.0 kPa	113.7 lbf/in ²
Steam inlet temperature	179.4 °C	355.0 °F
Noncondensable gas content	< 1.0 % by weight of inlet steam	
Exhaust pressure	13.5 kPa	4.0 in Hg
Turbine steam flow rate	411.7 Mg/h	0.9075 × 10 ⁶ lbm/h
Maximum allowable pressure	(NA) kPa	(NA) lbf/in ²
Last stage blade height	584.2 mm	23.0 in

Condenser characteristics/unit

Type	Low-level jet, tray type	
Pressure	13.5 kPa	4.0 in Hg
Cooling water temperature	26.7 °C	80.0 °F
Outlet water temperature	48.0 °C	118.4 °F
Cooling water flow rate	9,650.0 Mg/h	21.3 × 10 ⁶ lbm/h

Gas extractor characteristics/unit

Type	Steam jet ejector	
Number of stages or sets	2	
Suction pressure	13.5 kPa	4.0 in Hg
Capacity	~ 3,100 m ³ /h	~ 1,830 ft ³ /min
Steam consumption	26.49 Mg/h	0.0584 × 10 ⁶ lbm/h

Heat rejection system characteristics/unit

Type	Cross-flow, mechanical-draft cooling tower	
Number of cells	5	
Water inlet temperature	48.0 °C	118.4 °F
Water outlet temperature	26.7 °C	80.0 °F
Design wet-bulb temperature	18.3 °C	65.0 °F
Water flow rate	10.84 Gg/h	23.9 × 10 ⁶ lbm/a
Water pump power	930 kW	
Draft fan type	Vertical, axial	
Air flow rate/fan	(NA) m ³ /s	(NA) ft ³ /min
Fan motor power	605 kW	

Country	United States
Unit name	The Geysers, Units 7 and 8
Owner	Pacific Gas and Electric Company
Year of start-up	1972
Plant type	Natural, direct dry steam

Turbine characteristics/unit

Manufacturer	Tokyo Shibaura Electric Company, Ltd. (Toshiba)	
Type	Single-cylinder, double-flow, 6 × 2 impulse	
Rated capacity	53.0	MW
Maximum capacity	55.0	MW
Speed	3600	rev/min
Steam inlet pressure	779.1 kPa	113.0 lbf/in ²
Steam inlet temperature	179.4 °C	355.0 °F
Noncondensable gas content	< 1.0 % by weight of inlet steam	
Exhaust pressure	13.5 kPa	4.0 in Hg
Turbine steam flow rate	411.7 Mg/h	0.9075 × 10 ⁶ lbm/h
Maximum allowable pressure	(NA) kPa	(NA) lbf/in ²
Last stage blade height	584.2 mm	23.0 in

Condenser characteristics/unit

Type	Low-level jet, tray type	
Pressure	13.5 kPa	4.0 in Hg
Cooling water temperature	26.7 °C	80.0 °F
Outlet water temperature	48.0 °C	118.4 °F
Cooling water flow rate	9,650.0 Mg/h	21.3 × 10 ⁶ lbm/h

Gas extractor characteristics/unit

Type	Steam jet ejector	
Number of stages or sets	2	
Suction pressure	13.5 kPa	4.0 in Hg
Capacity	~ 3,100 m ³ /h	~ 1,830 ft ³ /min
Steam consumption	26.49 Mg/h	0.0584 × 10 ⁶ lbm/h

Heat rejection system characteristics/unit

Type	Cross-flow, mechanical-draft cooling tower	
Number of cells	5	
Water inlet temperature	48.0 °C	118.4 °F
Water outlet temperature	26.7 °C	80.0 °F
Design wet-bulb temperature	18.3 °C	65.0 °F
Water flow rate	10.84 Gg/h	23.9 × 10 ⁶ lbm/d
Water pump power	930 kW	
Draft fan type	Vertical, axial	
Air flow rate/fan	(NA) m ³ /s	(NA) ft ³ /min
Fan motor power	605 kW	

Country	United States
Unit name	The Geysers, Units 9 and 10
Owner	Pacific Gas and Electric Company
Year of start-up	1973
Plant type	Natural, direct dry steam

Turbine characteristics /unit

Manufacturer	Tokyo Shibaura Electric Company, Ltd. (Toshiba)	
Type	Single-cylinder, double-flow, 6 × 2 impulse	
Rated capacity	53.0 MW	
Maximum capacity	55.0 MW	
Speed	3600 rev/min	
Steam inlet pressure	779.1 kPa	113.0 lbf/in ²
Steam inlet temperature	179.4 °C	355.0 °F
Noncondensable gas content	< 1.0 % by weight of inlet steam	
Exhaust pressure	13.5 kPa	4.0 in Hg
Turbine steam flow rate	411.7 Mg/h	0.9075 × 10 ⁶ lbm/h
Maximum allowable pressure	(NA) kPa	(NA) lbf/in ²
Last stage blade height	584.2 mm	23.0 in

Condenser characteristics/unit

Type	Low-level jet, tray type	
Pressure	13.5 kPa	4.0 in Hg
Cooling water temperature	26.7 °C	80.0 °F
Outlet water temperature	48.0 °C	118.4 °F
Cooling water flow rate	9,650.0 Mg/h	21.3 × 10 ⁶ lbm/h

Gas extractor characteristics/unit

Type	Steam jet ejector	
Number of stages or sets	2	
Suction pressure	13.5 kPa	4.0 in Hg
Capacity	$\sim 3,100 \text{ m}^3/\text{h}$	$\sim 1,830 \text{ ft}^3/\text{min}$
Steam consumption	26.49 Mg/h	$0.0584 \times 10^6 \text{ lbm/h}$

Heat rejection system characteristics/unit

Type	Cross-flow, mechanical-draft cooling tower	
Number of cells	5	
Water inlet temperature	48.0 °C	118.4 °F
Water outlet temperature	26.7 °C	80.0 °F
Design wet-bulb temperature	18.3 °C	65.0 °F
Water flow rate	10.84 Gg/h	$23.9 \times 10^6 \text{ lbm/h}$
Water pump power	930 kW	
Draft fan type	Vertical, axial	
Air flow rate/fan	(NA) m^3/s	(NA) ft^3/min
Fan motor power	605 kW	

Country	United States
Unit name	The Geysers, Unit 11
Owner	Pacific Gas and Electric Company
Year of start-up	1976
Plant type	Natural, direct dry steam

Turbine characteristics

Manufacturer	Tokyo Shibaura Electric Company, Ltd. (Toshiba)	
Type	Tandem-compound, four-flow, 6 × 4, impulse	
Rated capacity	106.0	MW
Maximum capacity	110.0	MW
Speed	3600	rev/min
Steam inlet pressure	781.2 kPa	113.3 lbf/in ²
Steam inlet temperature	179.4 °C	355.0 °F
Noncondensable gas content	< 1.0 % by weight of inlet steam	
Exhaust pressure	13.5 kPa	4.0 in Hg
Turbine steam flow rate	820.1 Mg/h	1.808 × 10 ⁶ lbm/h
Maximum allowable pressure	(NA) kPa	(NA) lbf/in ²
Last stage blade height	584.2 mm	23.0 in

Condenser characteristics

Type	Low-level jet, tray type	
Pressure	13.5 kPa	4.0 in Hg
Cooling water temperature	26.7 °C	80.0 °F
Outlet water temperature	48.0 °C	118.4 °F
Cooling water flow rate	~ 28,500 Mg/h	~ 62.8 × 10 ⁶ lbm/h

Gas extractor characteristics

Type	Steam jet ejector	
Number of stages or sets	2	
Suction pressure	13.5 kPa	4.0 in Hg
Capacity	$\sim 6,200 \text{ m}^3/\text{h}$	$\sim 3,660 \text{ ft}^3/\text{min}$
Steam consumption	$\sim 53 \text{ Mg/h}$	$\sim 0.12 \times 10^6 \text{ lbm/h}$

Heat rejection system characteristics

Type	Cross-flow, mechanical-draft cooling tower	
Number of cells	10	
Water inlet temperature	48.0 °C	118.4 °F
Water outlet temperature	26.7 °C	80.0 °F
Design wet-bulb temperature	18.3 °C	65.0 °F
Water flow rate	32.0 Gg/h	$70.6 \times 10^6 \text{ lbm/h}$
Water pump power	1860 kW	
Draft fan type	Vertical, axial	
Air flow rate/fan	(NA) m^3/s	(NA) ft^3/min
Fan motor power	1210 kW	

Country	United States
Unit name	The Geysers, Unit 12
Owner	Pacific Gas and Electric Company
Year of start-up	1978
Plant type	Natural, direct dry steam

Turbine characteristics

Manufacturer	Tokyo Shibaura Electric Company, Ltd. (Toshiba)	
Type	Tandem-compound, four-flow, 6 × 4, impulse	
Rated capacity	106.0	MW
Maximum capacity	110.0	MW
Speed	3600	rev/min
Steam inlet pressure	781.2 kPa	113.3 lbf/in ²
Steam inlet temperature	179.4 °C	355.0 °F
Noncondensable gas content	< 1.0 % by weight of inlet steam	
Exhaust pressure	13.5 kPa	4.0 in Hg
Turbine steam flow rate	820.1 Mg/h	1.808 × 10 ⁶ lbm/h
Maximum allowable pressure	(NA) kPa	(NA) lbf/in ²
Last stage blade height	584.2 mm	23.0 in

Condenser characteristics

Type	Low-level jet, tray type	
Pressure	13.5 kPa	4.0 in Hg
Cooling water temperature	26.7 °C	80.0 °F
Outlet water temperature	48.0 °C	118.4 °F
Cooling water flow rate	~ 28,500 Mg/h	~ 62.8 × 10 ⁶ lbm/h

Gas extractor characteristics

Type	Steam jet ejector	
Number of stages or sets	2	
Suction pressure	13.5 kPa	4.0 in Hg
Capacity	~ 6,200 m ³ /h	~ 3,660 ft ³ /min
Steam consumption	~ 53 Mg/h	~ 0.12 × 10 ⁶ lbm/h

Heat rejection system characteristics

Type	Cross-flow, mechanical-draft cooling tower	
Number of cells	10	
Water inlet temperature	48.0 °C	118.4 °F
Water outlet temperature	26.7 °C	80.0 °F
Design wet-bulb temperature	18.3 °C	65.0 °F
Water flow rate	32.0 Gg/h	70.6 × 10 ⁶ lbm/h
Water pump power	1860 kW	
Draft fan type	Vertical, axial	
Air flow rate/fan	(NA) m ³ /s	(NA) ft ³ /min
Fan motor power	1210 kW	

Country	United States
Unit name	The Geysers, Unit 13
Owner	Pacific Gas and Electric Company
Year of start-up	1979
Plant type	Natural, direct dry steam

Turbine characteristics

Manufacturer	General Electric Company	
Type	Tandem-compound, four-flow, 5 × 4, impulse-reaction	
Rated capacity	135.0 MW	
Maximum capacity	~ 140.0 MW	
Speed	3600 rev/min	
Steam inlet pressure	786 kPa	114 lbf/in ²
Steam inlet temperature	170 °C	338 °F
Noncondensable gas content	~ 1.0 % by weight of inlet steam	
Exhaust pressure	18.6 kPa	5.5 in Hg
Turbine steam flow rate	~ 1,200 Mg/h	~ 2.64 × 10 ⁶ lbm/h
Maximum allowable pressure	(NA) kPa	(NA) lbf/in ²
Last stage blade height	426.7 mm	16.8 in

Condenser characteristics

Type	Surface, shell and tube	
Pressure	10.2 kPa	3.0 in Hg
Cooling water temperature	26.7 °C	80.0 °F
Outlet water temperature	48.0 °C	118.4 °F
Cooling water flow rate	(NA) Mg/h	(NA) lbm/h

Gas extractor characteristics

Type	Steam jet ejector	
Number of stages or sets	2	
Suction pressure	18.6 kPa	5.5 in Hg
Capacity	(NA) m ³ /h	(NA) ft ³ /min
Steam consumption	(NA)	

Heat rejection system characteristics

Type	Cross-flow, mechanical-draft cooling tower	
Number of cells	(NA)	
Water inlet temperature	48.0 °C	118.4 °F
Water outlet temperature	26.7 °C	80.0 °F
Design wet-bulb temperature	13.3 °C	65.0 °F
Water flow rate	~ 41.6 Gg/h	~ 91.7 × 10 ⁶ lbm/h
Water pump power	(NA) kW	
Draft fan type	Vertical, axial	
Air flow rate/fan	(NA) m ³ /s	(NA) ft ³ /min
Fan motor power	(NA) kW	

Country	United States
Unit name	The Geysers, Unit 14
Owner	Pacific Gas and Electric Company
Year of start-up	1979
Plant type	Natural, direct dry steam

Turbine characteristics

Manufacturer	Tokyo Shibaura Electric Company, Ltd. (Toshiba)	
Type	Tandem-compound, four-flow, 6 × 4, impulse	
Rated capacity	113.5	MW
Maximum capacity	117.5	MW
Speed	3600	rev/min
Steam inlet pressure	784 kPa	113.7 lbf/in ²
Steam inlet temperature	179 °C	355 °F
Noncondensable gas content	~ 1.0 % by weight of inlet steam	
Exhaust pressure	10.2 kPa	3.0 in Hg
Turbine steam flow rate	880 Mg/h	1.94 × 10 ⁶ lbm/h
Maximum allowable pressure	(NA) kPa	(NA) lbf/in ²
Last stage blade height	584.2 mm	23.0 in

Condenser characteristics

Type	Surface, shell and tube	
Pressure	10.2 kPa	3.0 in Hg
Cooling water temperature	26.7 °C	80.0 °F
Outlet water temperature	48.0 °C	118.4 °F
Cooling water flow rate	32,000 Mg/h	70.6 × 10 ⁶ lbm/h

Gas extractor characteristics

Type	Steam jet ejector	
Number of stages or sets	2	
Suction pressure	10.2 kPa	3.0 in Hg
Capacity	(NA) m ³ /h	(NA) ft ³ /min
Steam consumption	27 Mg/h	0.06 × 10 ⁶ lbm/h

Heat rejection system characteristics

Type	Cross-flow, mechanical-draft cooling tower	
Number of cells	10	
Water inlet temperature	48.0 °C	118.4 °F
Water outlet temperature	26.7 °C	80.0 °F
Design wet-bulb temperature	18.3 °C	65.0 °F
Water flow rate	32 Gg/h	70.6 × 10 ⁶ lbm/h
Water pump power	~ 1860 kW	
Draft fan type	Vertical, axial	
Air flow rate/fan	(NA) m ³ /s	(NA) ft ³ /min
Fan motor power	~ 1210 kW	

Country	United States
Unit name	The Geysers, Unit 15
Owner	Pacific Gas and Electric Company
Year of start-up	1978
Plant type	Natural, direct dry steam

Turbine characteristics

Manufacturer	General Electric Company	
Type	Single-cylinder, double-flow, 5 × 2, impulse-reaction	
Rated capacity	55.0	MW
Maximum capacity	60.0	MW
Speed	3600	rev/min
Steam inlet pressure	784.0 kPa	113.7 lbf/in ²
Steam inlet temperature	170.0 °C	338.0 °F
Noncondensable gas content	~ 1.0 % by weight of inlet steam	
Exhaust pressure	18.6 kPa	5.5 in Hg
Turbine steam flow rate	~ 500 Mg/h	~ 1.1 × 10 ⁶ lbm/h
Maximum allowable pressure	(NA) kPa	(NA) lbf/in ²
Last stage blade height	426.7 mm	16.8 in

Condenser characteristics

Type	Surface, shell and tube	
Pressure	10.2 kPa	3.0 in Hg
Cooling water temperature	26.7 °C	80.0 °F
Outlet water temperature	49.1 °C	120.4 °F
Cooling water flow rate	~ 15,900 Mg/h	~ 35.0 × 10 ⁶ lbm/h

Gas extractor characteristics

Type	Steam jet ejector	
Number of stages or sets	2	
Suction pressure	18.6 kPa	5.5 in Hg
Capacity	(NA) m ³ /h	(NA) ft ³ /min
Steam consumption	~ 23 Mg/h	~ 0.05 × 10 ⁶ lbm/h

Heat rejection system characteristics

Type	Cross-flow, mechanical-draft cooling tower	
Number of cells	5	
Water inlet temperature	49.1 °C	120.4 °F
Water outlet temperature	26.7 °C	80.0 °F
Design wet-bulb temperature	18.3 °C	65.0 °F
Water flow rate	~ 15.9 Gg/h	~ 35 × 10 ⁶ lbm/h
Water pump power	~ 900 kW	
Draft fan type	Vertical, axial	
Air flow rate/fan	(NA) m ³ /s	(NA) ft ³ /min
Fan motor power	~ 625 kW	

Country	United States
Unit name	The Geysers, Unit 16 and 17
Owner	Pacific Gas and Electric Company
Year of start-up	1981
Plant type	Natural, direct dry steam

Turbine characteristics/unit

Manufacturer	Tokyo Shibaura Electric Company, Ltd. (Toshiba)	
Type	Tandem-compound, four-flow, 6 × 4, impulse	
Rated capacity	110.0	MW
Maximum capacity	115.0	MW
Speed	3600	rev/min
Steam inlet pressure	784.0 kPa	113.7 lbf/in ²
Steam inlet temperature	169.0 °C	336.2 °F
Noncondensable gas content	~ 1.0 % by weight of inlet steam	
Exhaust pressure	10.2 kPa	3.0 in Hg
Turbine steam flow rate	~ 880 Mg/h	~ 1.94 × 10 ⁶ lbm/h
Maximum allowable pressure	(NA) kPa	(NA) lbf/in ²
Last stage blade height	584.2 mm	23.0 in

Condenser characteristics/unit

Type	Surface, shell and tube	
Pressure	10.2 kPa	3.0 in Hg
Cooling water temperature	26.7 °C	80.0 °F
Outlet water temperature	48.9 °C	120.0 °F
Cooling water flow rate	~ 32,000 Mg/h	~ 70 × 10 ⁶ lbm/h

Gas extractor characteristics/unit

Type	Steam jet ejector	
Number of stages or sets	2	
Suction pressure	10.2 kPa	3.0 in Hg
Capacity	(NA) m ³ /h	(NA) ft ³ /min
Steam consumption	~ 27 Mg/h	~ 0.06 × 10 ⁶ lbm/h

Heat rejection system characteristics/unit

Type	Cross-flow, mechanical-draft cooling tower	
Number of cells	10	
Water inlet temperature	48.9 °C	120.0 °F
Water outlet temperature	26.7 °C	80.0 °F
Design wet-bulb temperature	18.3 °C	65.0 °F
Water flow rate	~ 32 Gg/h	~ 70 × 10 ⁶ lbm/n
Water pump power	~ 1860 kW	
Draft fan type	Vertical, axial	
Air flow rate/fan	(NA) m ³ /s	(NA) ft ³ /min
Fan motor power	~ 1210 kW	

Country	United States
Unit name	Magmamax ⁽¹⁾ , East Mesa
Owner	Magma Electric Company
Year of start-up	1978
Plant type	Dual-Binary cycle

Turbine characteristics

Manufacturer	York Division of Borg-Warner Corporation	
Type	Double-flow, tandem-design, 3 × 2, radian-inflow	
Rated capacity	9.0 MW ⁽²⁾	
Maximum capacity	10.5 MW	
Speed, turbine/generator	7000/3600 rev/min	
Secondary working fluid	isobutane (i-C ₄ H ₁₀)	
S.w.f. inlet pressure	3.45 MPa	500 lbf/in ²
S.w.f. inlet temperature	174 °C	345 °F
S.w.f. exhaust pressure	0.41 MPa	60 lbf/in ²
S.w.f. exhaust temperature	110 °C	230 °F
S.w.f. mass flow rate	468 Mg/h	1.031 × 10 ⁶ lbm/h

Geothermal fluid characteristics

Inlet pressure (after pumps)	1.86 MPa	270 lbf/in ²
Inlet temperature	182 °C	360 °F
Outlet pressure (after hx's)	0.81 MPa	117 lbf/in ²
Outlet temperature	82 °C	180 °F
Mass flow rate	655 Mg/h	1.444 × 10 ⁶ lbm/h

(1) Magmamax Process, U.S. Pat. No. 3757516.

(2) A parallel turbine, built by Mafi-Trench, with propane as the working fluid is rated at 2.2 MW, with a maximum capacity of 3.0 MW. Propane turbine inlet conditions are 96.1°C (205°F), 3.27 MPa (474 lbf/in²); exhaust conditions are 38.9°C (102°F), 0.98 MPa (142 lbf/in²); flow rate 124.5 Mg/h (0.274 × 10⁶ lbm/h).

Condenser characteristics

Type	Surface-type, shell-and-tube	
Pressure	0.41 MPa	59 lbf/in ²
Cooling water temperature	16.7 °C	62 °F
Outlet water temperature	26.4 °C	79.5 °F
Cooling water flow rate	(NA) Mg/h	(NA) lbm/h

Gas extractor characteristics

Type	(None)	
Number of stages or sets	-	
Suction pressure	- kPa	- in Hg
Capacity	- m ³ /h	- ft ³ /min
Power consumption	-	

Heat rejection system characteristics

Type	Phased cooling, storage ponds with sprays	
Number of cells	2 ponds	
Water inlet temperature	26.4 °C	79.5 °F
Water outlet temperature	16.7 °C	62 °F
Design wet-bulb temperature	14.4 °C	58 °F
Water flow rate	(NA) Gg/h	(NA) lbm/h
Water pump power	(NA) kW	
Draft fan type	(None)	
Air flow rate/fan	- m ³ /s	- ft ³ /min
Fan motor power	- kW	

Country	United States
Unit name	Raft River Double-Boiling Unit
Owner	Raft River Electrical Cooperative (INEL)
Year of start-up	1980
Plant type	Double-Boiling Isobutane Binary Cycle

Turbine characteristics

Manufacturer	(NA)	
Type	(NA)	
Rated capacity	3.35 MW	
Maximum capacity	5.0 MW	
Speed, turbine/generator	(NA) rev/min	
Secondary working fluid	isobutane (i-C ₄ H ₁₀)	
S.w.f. inlet pressure	2630 kPa	382 lbf/in ²
S.w.f. inlet temperature	116 °C	240 °F
S.w.f. exhaust pressure	(NA) kPa	(NA) lbf/in ²
S.w.f. exhaust temperature	54,51 ⁽¹⁾ °C	130,123 °F
S.w.f. mass flow rate	424 Mg/h	0.934 × 10 ⁶ lbm/h

Geothermal fluid characteristics

Inlet pressure	(NA) kPa	(NA) lbf/in ²
Inlet temperature	143 °C	290 °F
Outlet pressure	(NA) kPa	(NA) lbf/in ²
Outlet temperature	62 °C	144 °F
Mass flow rate	472 Mg/h	1.04 × 10 ⁶ lbm/h

(1) Values are for exhaust from high-pressure and low-pressure turbines.

Condenser characteristics

Type	Surface, shell-and-tube	
Pressure	534.9 kPa	77.6 lbf/in ²
Cooling water temperature	24 °C	75 °F
Outlet water temperature	35 °C	95 °F
Cooling water flow rate	3048 Mg/h	6.72 × 10 ⁶ lbm/h

Gas extractor characteristics

Type	(None)	
Number of stages or sets	-	
Suction pressure	- kPa	- in Hg
Capacity	- m ³ /h	- ft ³ /min
Power consumption	-	

Heat rejection system characteristics

Type	Mechanical-draft cooling tower	
Number of cells	(NA)	
Water inlet temperature	35 °C	95 °F
Water outlet temperature	~ 24 °C	~ 75 °F
Design wet-bulb temperature	(NA) °C	(NA) °F
Water flow rate	3.05 Gg/h	6.72 10 ⁶ lbm/h
Water pump power	1650 kW ⁽²⁾	
Draft fan type	Vertical, axial	
Air flow rate/fan	(NA) m ³ /s	(NA) ft ³ /min
Fan motor power	- kW ⁽²⁾	

(2) Total auxiliary power requirements.

Country	United States
Unit name	Heber Binary Demonstration
Owner	San Diego Gas and Electric Company
Year of start-up	1980
Plant type	Binary cycle

Turbine characteristics

Manufacturer	(To be determined)		
Type	(To be determined)		
Rated capacity	45.0	MW	
Maximum capacity	65.0	MW	
Speed, turbine/generator	(NA)	rev/min	
Secondary working fluid	mixture: iso-butane/iso-pentane		
S.w.f. inlet pressure	3,500.0	kPa	500.0 lbf/in ²
S.w.f. inlet temperature	146.0	°C	295.0 °F
S.w.f. exhaust pressure	498.5	kPa	72.3 lbf/in ²
S.w.f. exhaust temperature	74.2	°C	165.6 °F
S.w.f. mass flow rate	3,486.8	Mg/h	7.687×10^6 lbm/h

Geothermal fluid characteristics

Inlet pressure	1,050.0	kPa	153.0 lbf/in ²
Inlet temperature	183.0	°C	360.0 °F
Outlet pressure	917.0	kPa	133.0 lbf/in ²
Outlet temperature	67.2	°C	153.0 °F
Mass flow rate	3,049.1	Mg/h	6.722×10^6 lbm/h

Condenser characteristics

Type	Surface, shell and tube, single-pass, counterflow		
Pressure	498.5	kPa	72.3 lbf/in ²
Cooling water temperature	32.2	°C	90.0 °F
Outlet water temperature	42.3	°C	108.2 °F
Cooling water flow rate	30,746	Mg/h	67.783 × 10 ⁶ lbm/h

Gas extractor characteristics

Type	(None)		
Number of stages or sets	—		
Suction pressure	—	kPa	— in Hg
Capacity	—	m ³ /h	— ft ³ /min
Power consumption	—		

Heat rejection system characteristics

Type	Cross-flow, mechanical-draft cooling tower		
Number of cells	10		
Water inlet temperature	42.3	°C	108.2 °F
Water outlet temperature	32.2	°C	90.0 °F
Design wet-bulb temperature	26.7	°C	80.0 °F
Water flow rate	30.7	Gg/h	67.783 × 10 ⁶ lbm/h
Water pump power	5,000 kW (1)		
Draft fan type	Vertical, axial		
Air flow rate/fan	(NA)	m ³ /s	(NA) ft ³ /min
Fan motor power	— kW (1)		

(1) Total for water pumps and fan motors.

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