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Article from:

Proceedings of the Fifth Annual Geothermal Conference and Workshop, June 23-25, 1981, San Diego, California. Palo Alto, California: Electric Power Research Institute, 1981.

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JAPAN'S GEOTHERMAL POWER DEVELOPMENT

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Abstract Japan is the only one country which has operated geothermal plants of the dry steam, single flash, double flash and binary type.

The total geothermal electric generating capacity is 168 MW as of June, 1981. However more than 10,000 MW is aimed to be put on line by the year 2000.

Japan has more than 200 geothermal areas including 65 volcanoes which promise abundant geothermal energy potential.

However, exploitation of geothermal energy for electric power has been slow in Japan because almost all of the outstanding geothermal prospects are located in national parks, which are protected for their natural beauty.

The construction and operation of geothermal power plants are subject to strict controls.

The full range of geothermal activities in Japan is directed by the government's Ministry of International Trade and Industry (MITI) through the Sunshine Project.

"Development of geothermal energy utilization" started in 1974 by Sunshine Project. This is divided into ① Exploitation Technology, ② Extracting Technology, ③ Material Development, ④ Hot Dry Rocks Power Generation, ⑤ Environment Protection & Multi-Purpose Utilization and ⑥ Hot Water Power Generation, and these are expected to be completed by the year 2000.

(1) Status of Power Plants on Line

Name of Plant	Rated Output kW	Date of Initial Operation
Japan Metals and Chemicals Co. Matsukawa	20,000	Oct., 1966
Kyushu Electric Power Co. Otake	10,000	Aug., 1967
Mitsubishi Metal Co. Onuma	10,000	Nov., 1973

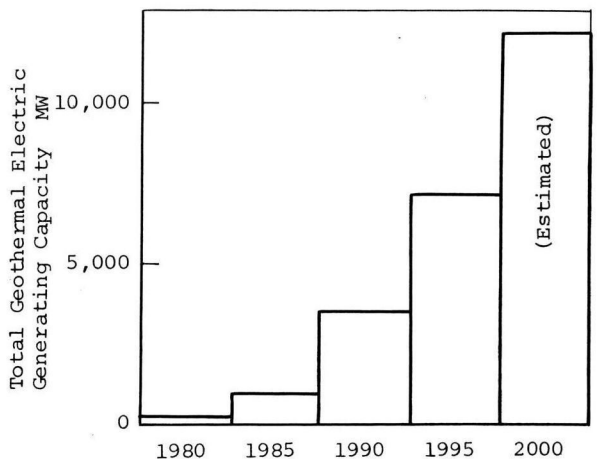
(*) Speaker

Electric Power Development Co. Onikobe	25,000	May, 1975
Kyushu Electric Power Co. Hatchobaru	50,000	Jun., 1977
Japan Metals and Chemicals Co. Tohoku Electric Power Co. Kakkonda	50,000	May, 1978
Hotel Suginoi Suginoi	3,000	Mar., 1981
Total	168,000	—

(2) Status of Power Plants Planned or under Construction

Name of Plant	Rated Output kW	Date of Initial Operation
Donan Geothermal Energy Co. Hokkaido Electric Power Co. Mori	50,000	Nov., 1981
Total	50,000	—

(3) Forecast of Geothermal Electric Generating Capacity to the Year 2000



(4) Technical Features of the Plants

DATA	PLANT UNIT	Matsukawa	Otake	Onuma	Onikobe	Hatchobaru	Kakkonda	Suginoi
		Plant						
Type	-	Dry Steam	Single Flash	Single Flash	Single Flash	Double Flash	Single Flash	Single Flash
Turbine								
Type	-	SCSF	SCSF	SCSF	SCSF	SCDF	SCDF	SCSF
No. of Stages	-	4	4	4	5	5 x 2	4 x 2	1
Rated Output	kW	20,000	10,000	10,000	25,000	50,000	50,000	3,000
Capability	kW	22,000	13,000	12,500	25,000	55,000	50,000	3,000
Speed	rpm	3,000	3,600	3,000	3,000	3,600	3,000	3,600
Main Steam								
Pressure	kg/cm ² g	3.5	1.5	1.5	3.5	5.5/0.43	4.5	3.0
Temperature	°C	147	127	127	147	161/109	147	143
Gas Content (wt)	%	0.2~0.6	0.8	0.1	0.5	0.45	0.62	0.5
Exhaust Press.	kg/cm ² abs.	0.138	0.11	0.11	0.116	0.10	0.138	0.30
Main Steam Flow	T/H	193	113	107	220	312/107	478	40
Last Stage Blade Height	mm (in)	584 (23)	420 (16.5)	500 (19.7)	630 (24.8)	635 (25)	584 (23)	75 (2.95)
Condenser								
Type (a)	-	DCB	DCB	DCB	DCB	DCL	DCL	DCB
Pressure	kg/cm ² abs.	0.13	0.10	0.10	0.102	0.10	0.138	0.30
Cooling Water Temp.	°C	25	26	23	26	26	25	32
Hot Water Temp.	°C	47.0	41.4	43.4	41.8	43.5	48.8	66.7
Cooling Water Flow	m ³ /H	4,320	3,900	2,850	7,062	12,300	10,218	600
Gas Extractor								
Type (b)	-	SJE	MDRVP	MDRVP	SJE	MDRB	SJE	MDVP
No. of Stages	-	2	1	1	2	4	2	1
Suction Press.	kg/cm ² abs.	0.129	0.092	0.092	0.095	0.095	0.138	0.29
Capacity	m ³ /H	18,000	4,620x2	1,050	6,750	20,600	3,840 kg/H	600
Steam Consumption	T/H	-	-	-	15	-	14.23	-
Power Consumption	kW	-	53 x 2	30	-	315	-	22
Cooling Tower								
Type (c)	-	ND	CXMD	CXMD	CTMD	CTMD	CXMD	Pond
No. of Cells	-	1	3	3	5	4	8	-
Design Wet Bulb Temp.	°C	17	17	14	17	17	17	-
Fan Motor Power	kW	-	66	86	-	213	110	-

- (a) DCB = direct contact barometric type
DCL = direct contact low level type
- (b) SJE = steam jet ejector
MDRVP= motor driven reciprocating vacuum pump
MDRB = motor driven radial blower
MDVP = motor driven rotary vacuum pump
- (c) ND = natural draft
CXMD = cross flow mechanical draft
CTMD = counterflow mechanical draft

(5) Constraints on Development

1. Geothermal Energy Exploitation Technology

- ① Investigation and verification of geothermal energy exploitation technology
- ② Investigation on exploitation technology of deep geothermal resources
- ③ Investigation on making national geothermal resources map

2. Geothermal Energy Extracting Technology

- ① Development of mud water usable under geothermal environment
- ② Development of cement usable under geothermal environment
- ③ Development of drilling technology for high temperature stratum
- ④ Development of measuring technology in geothermal well
- ⑤ Investigation of hot water reinjection mechanism

3. Development of Materials for Geothermal Energy Utilization

- ① Investigation on development of materials for geothermal energy utilization

4. Hot Dry Rocks Power Generating System

- ① Investigation on drilling and crushing of hot dry rocks
- ② Feasibility study on hot dry rock power generation system

5. Environment Protection Technology
Multi-Purpose Utilization Technology

- ① Development of geofluid treatment
 - ° Hydrogen sulfide scrubbing technology
 - ° Scale deposition prevention technology

6. Hot Water Power Generation System

- ① Development of two phase total flow rotating expander
- ② Development of hot water power generation plant

7. Development of hot water supply system from deep stratum

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