Reliable Quality Power for
ENHANCED GEOTHERMAL SYSTEMS

PROJECTS AND CHALENGES
STRASBOURG 2006

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Time, the only true test of reliability

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1982-2006 : ORMAT'S WORLDWIDE GREEN ENERGY FROM 250 KW MODULE TO 125 MW POWER PLANTS

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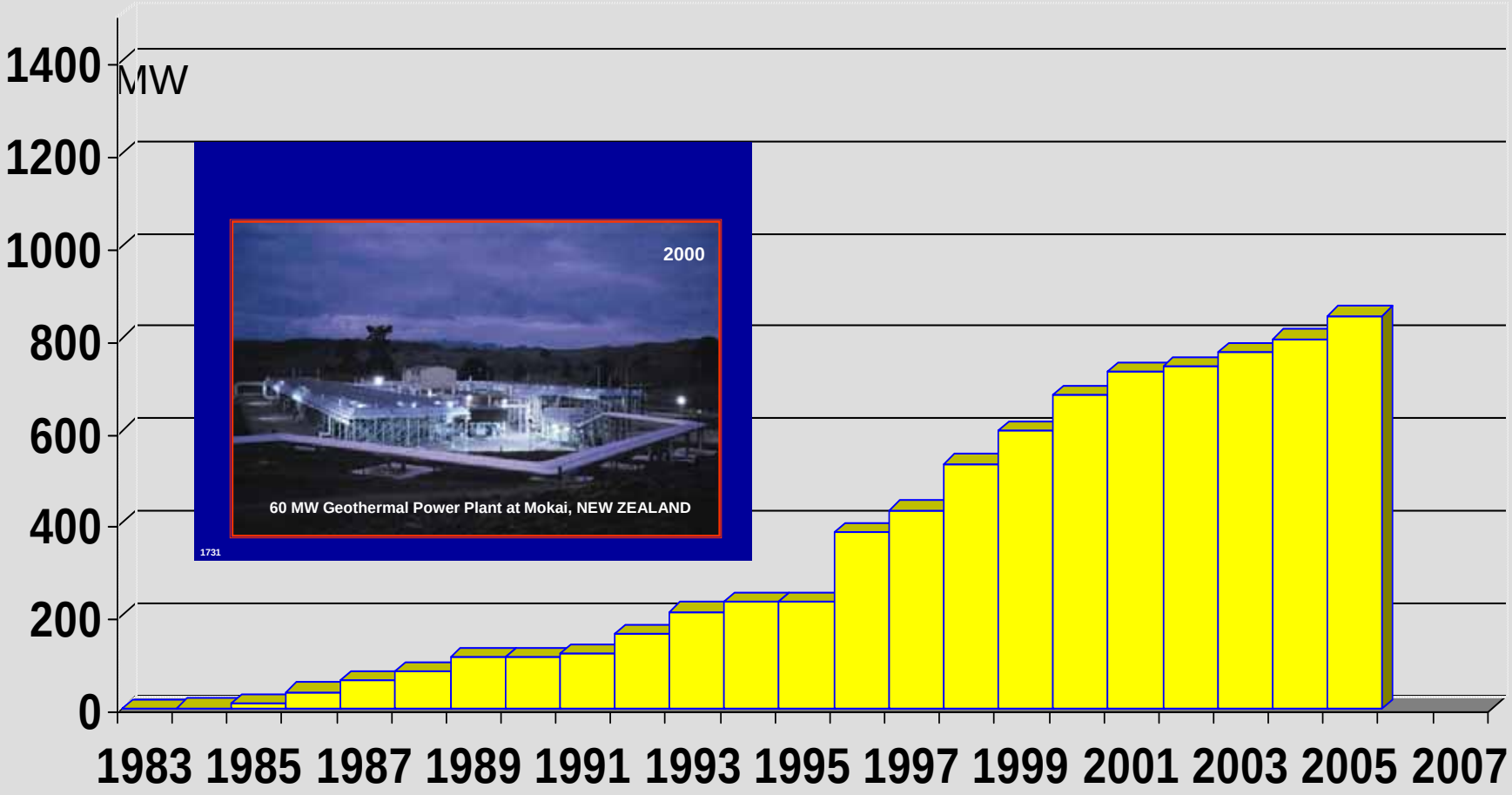
ORMAT's GREEN POWER PLANTS

Accumulated installed generating capacity



Global Presence
Meeting the Needs of Customers in 71 Countries

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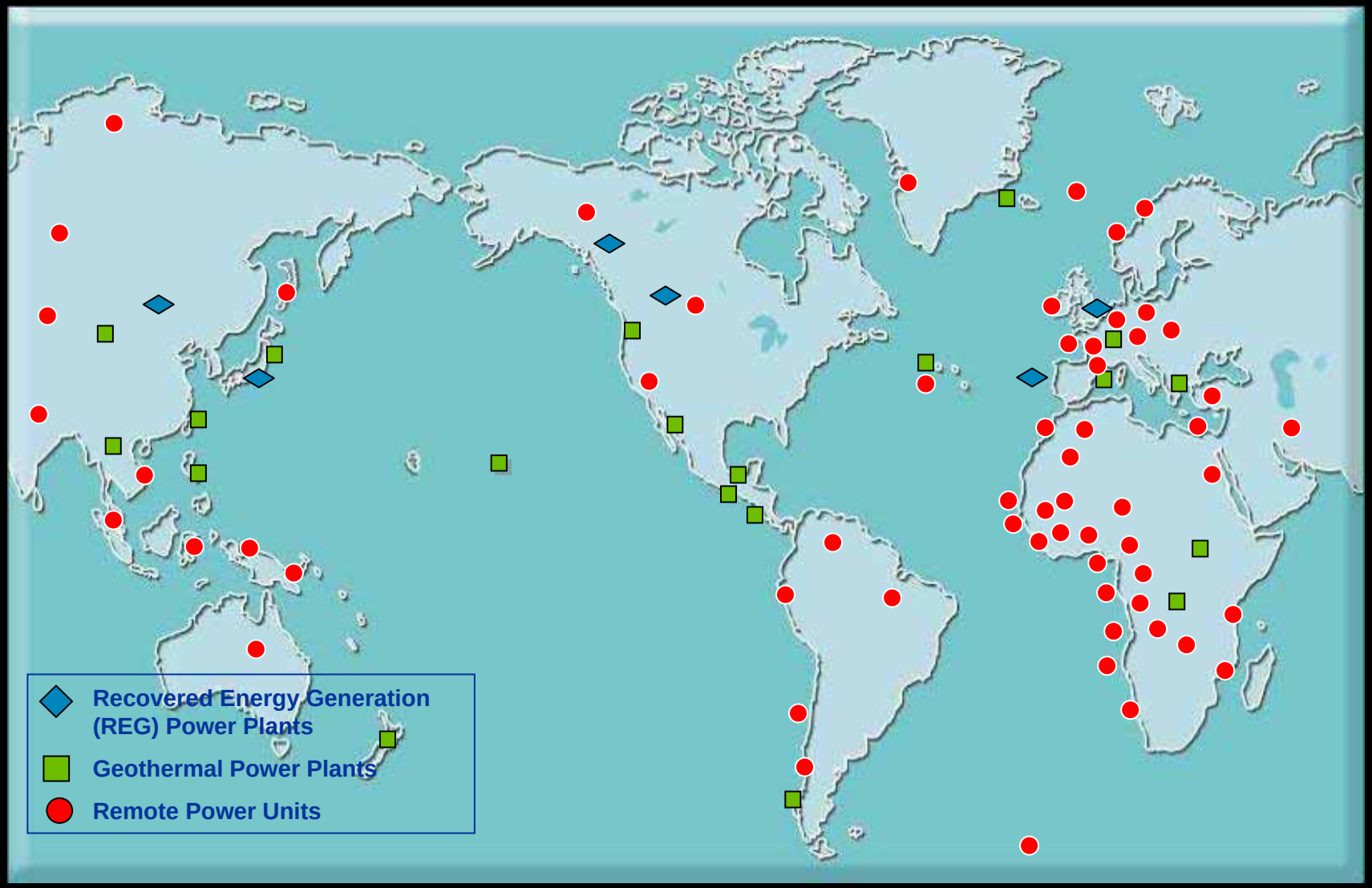

Symbols indicate type of equipment installed in each country

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Company Profile Main Areas of Activities

Geothermal Power Plants

Recovered Energy Generation
Gas Compressors on Pipelines

Recovered Energy Generation
Cement Plants

Recovered Energy Generation
from Industrial Processes

Remote Power Units

How Did We Get Here ?

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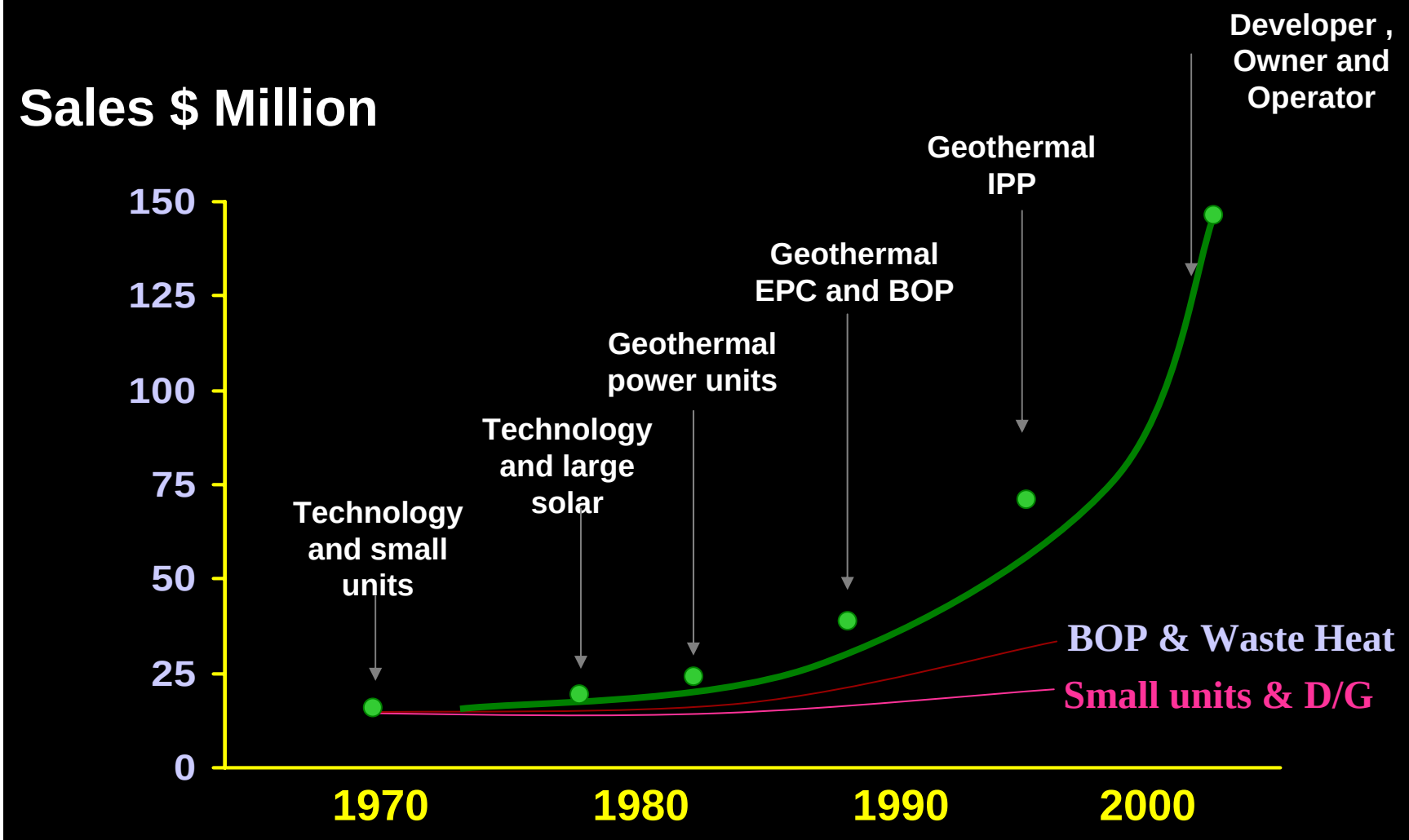
TOTAL INVESTMENT IN R&D: MORE THAN US$100M



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2006 : 150 MW IN CONSTRUCTION

- 4.6 MW Enagas Spain
- 2.9 MW Geox ,Germany
- 15MW Desert Peak II, USA
- 6 MW Goulds, USA
- 10 MW Galena, USA
- 10 MW Ormesa, USA
- 3 MW Heber USA
- 5 MW Steamboat, USA
- 10 MW Imperial Valey,USA
- 6.9 MW Denizli Turkey
- 6.9 MW Mokai 1A, NZ
- 5 MW Momotombo, Nicaragua
- 8 MW Hawaii, USA and
- 100 MW additional installations

Construction of Mokai II 45 MW (2004)

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MOKAI 100 MW GEOTHERMAL POWER PLANT

100 MW air cooled geothermal power plant, operating from steam and brine at 17 bara / 204 o C and 100% geothermal fluid reinjection

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Isolated high temperature resource (Ngawha)
North Island
New Zealand
Auckland
High temperature resources (TVZ)
Zone of low temerprature springs
Rotorua
Strongly mineralised warm springs
Taupo
Gisborne
Tasman
Sea
Wellington
Zone of springs associated with Alpine Fault
South Island
Christchurch
Pacific
Ocean
Queenstown
Dunedin
Invercargill
Stewart Island
0
100
200
Kilometres

Wairakei power station

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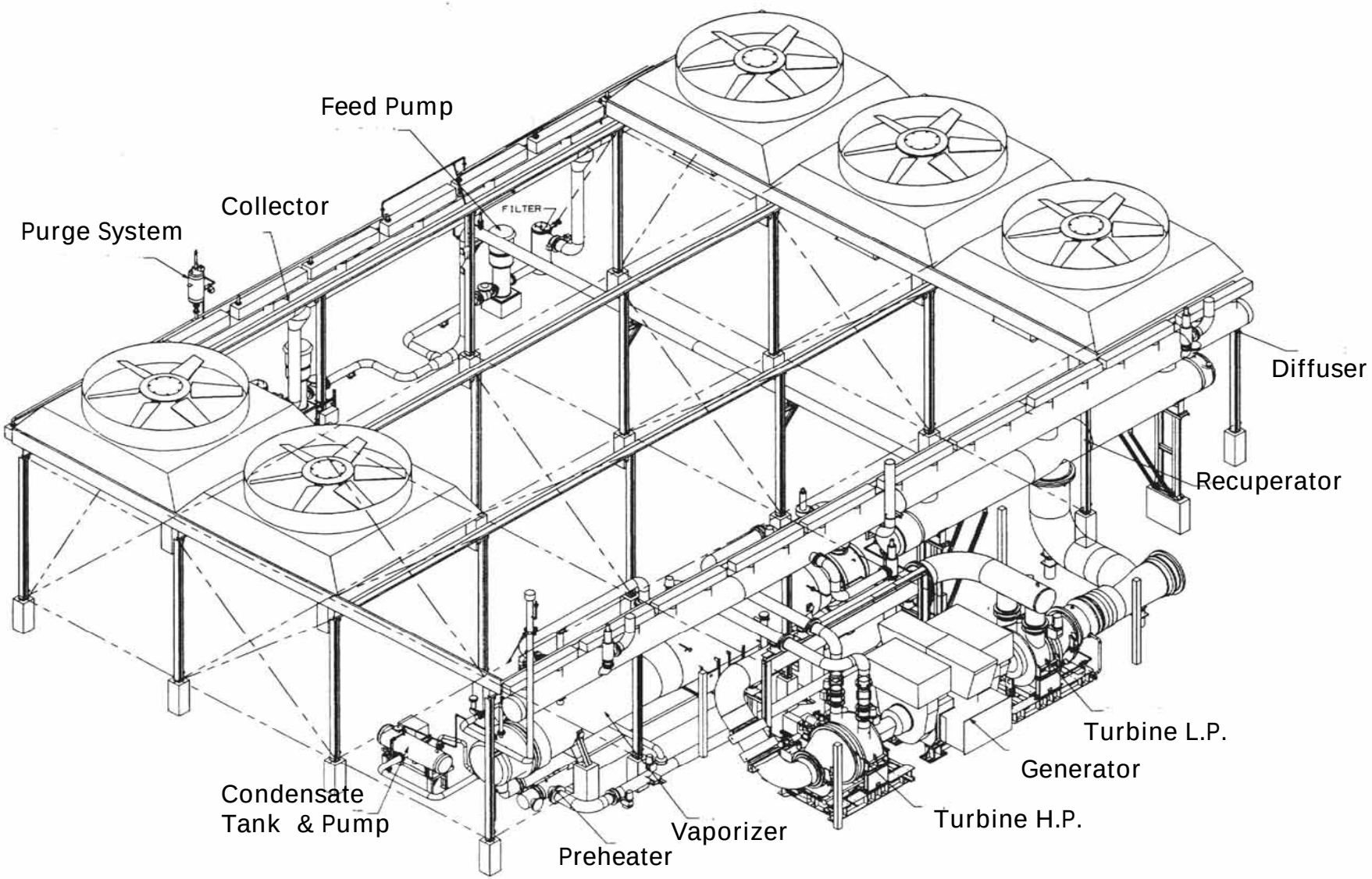
WAIRAKEI GEOTHERMALBINARY PROJECT

SUMMARY OF TECHNICAL DATA

Heating media	Brine from the 1st flash
– Temperature	127º C
– Flow	2800 T/ Hr
Cooling media	ambient air
– design temperature	11º C
Output	
– Net system output	16.6 MW
– Generated Gwhr in the 1’st year	139,6 Gwhr
– Availability 1’st year	96 %

1.5 – 25 MW AIR COOLED ORMAT ENERGY CONVERTER



16.5 MW Wairakei Geothermal Power P
New Zealand, 2

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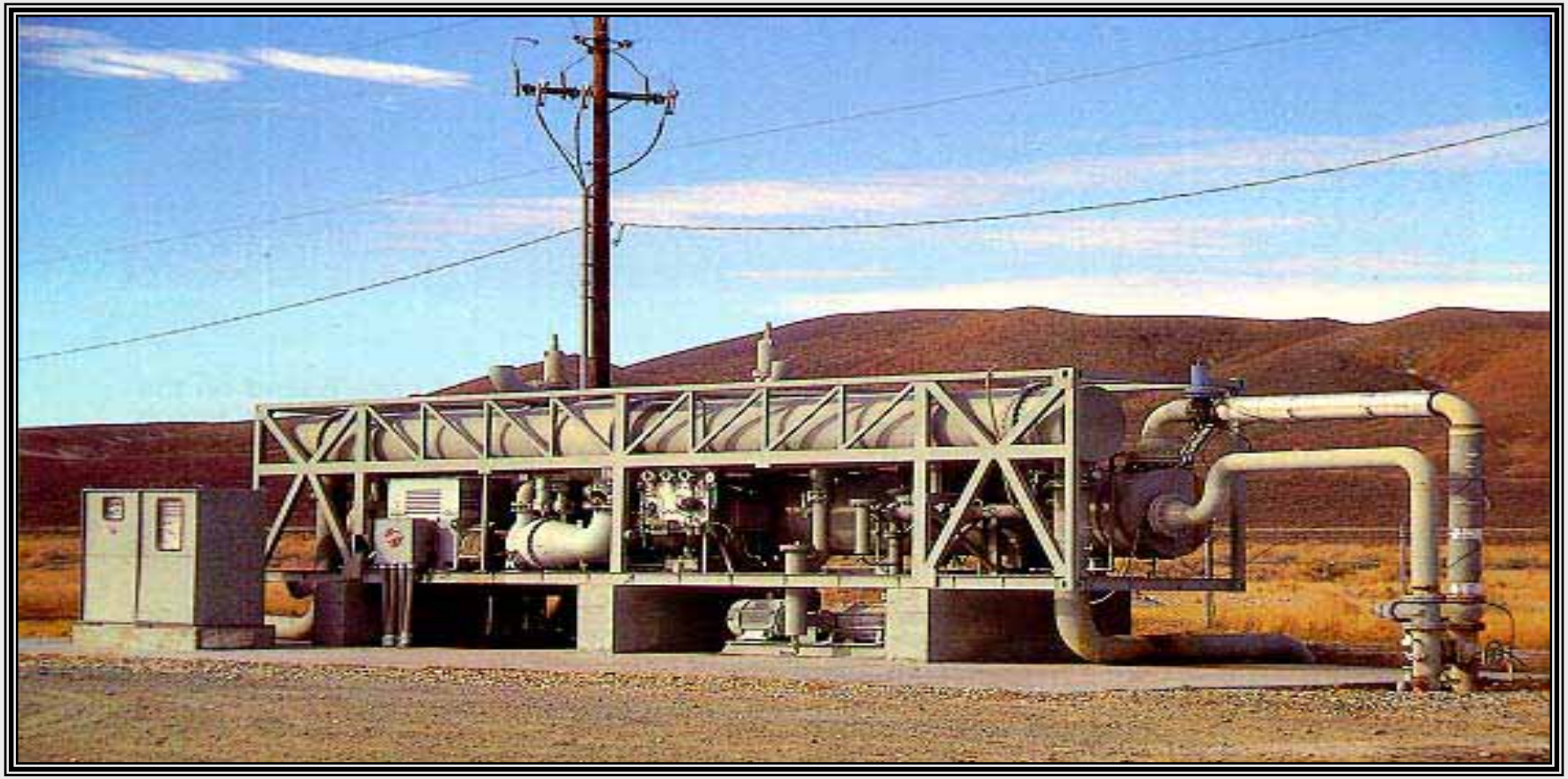
THE PHILOSOPHY (1982)



PUNA 30 MW COMBINED CYCLE GEOTHERMAL POWER PLANT

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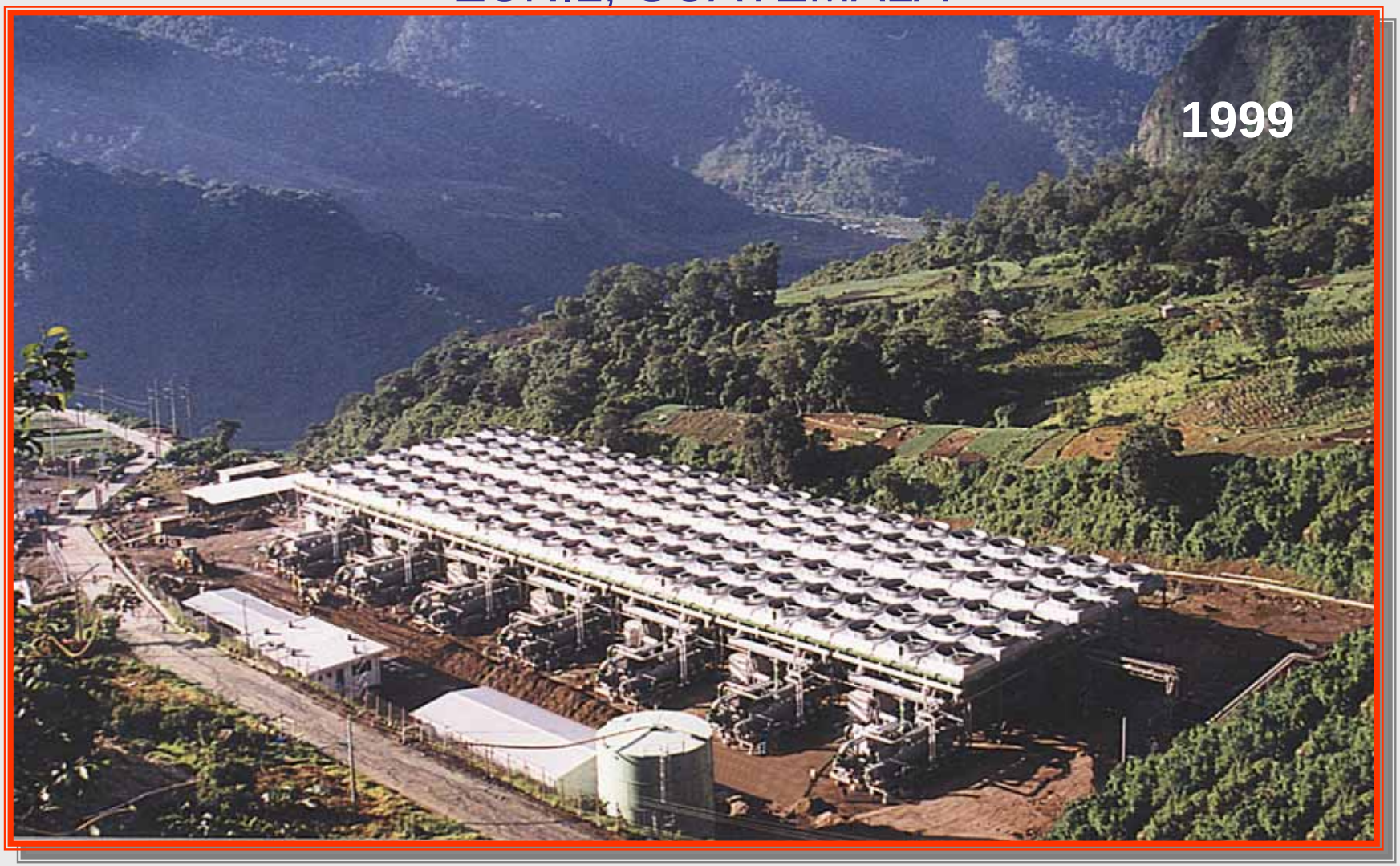
24 MW GEOTHERMAL POWER PLANT
ZUNIL, GUATEMALA



35 MW ROTOKAWA POWER PLANT

- 35 MW air cooled geothermal cycle power plant, operating with steam and brine at 27 bara / 225 ^{o} C
- 100% geothermal fluid reinjection
- Built as a turnkey EPC for Rotokawa Generation Ltd.

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OLKARIA GEOTHERMAL III

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17 MW MIRAVALLES GEOTHERMAL

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GEOTHERMAL DRILLING

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GEOTHERMAL WATER PUMPING

ORMAT's EXECUTED PROJECTS

HEATING MEDIA

• Hot water	• Temperature: 80….225º C
• Steam	• Pressure : 1……27 bar (a)
• Hot oils	• Temperature: 80….280º C

COOLING MEDIA

• Ambient air	• -30……. +40º C
• Water	• 5…….35º C

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125 MW UPPER MAHIAO - THE PHILIPPINES

Distributed Renewable Grid Connected Base Load Power

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ORMAT ENERGY CONVERTER
250kW AIR COOLED CHP PLANT

MANUFACTURING

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Organic Vapor Turbine Assembly

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MANUFACTURING

Heat Exchangers Workshop

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HATSHOBARU Kyushu Electric, Japan

2 MW ORMAT ENERGY CONVERTER

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HATCHOBARU (Kyushu Electric, Japan), 2003

2 MW AIR COOLED ORMAT ENERGY CONVERTER

AVAILABILITY OF INDIVIDUAL

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Ormat Energy Converters

Power Plant	Commissioning Year	Number of OEC's	Availability
Steamboat	1986	9	96.7 %
Ormesa II	1987	20	99.1 %
TOI	1989	2	98.5 %
Puna	1993	10	96.7 %
Heber	1993	12	98.1 %
Rotokawa I	1997	3	98.6 %
Ngawha	1998	2	98. 8 %
HZ -Lengfurt	1999	1	98.7 %
Mokai I	2000	6	98.2 %
Rogner	2000	1	99.1 %
Mokai II	2005	3	97.6 %
Wairakei	2005	2	97.5 %

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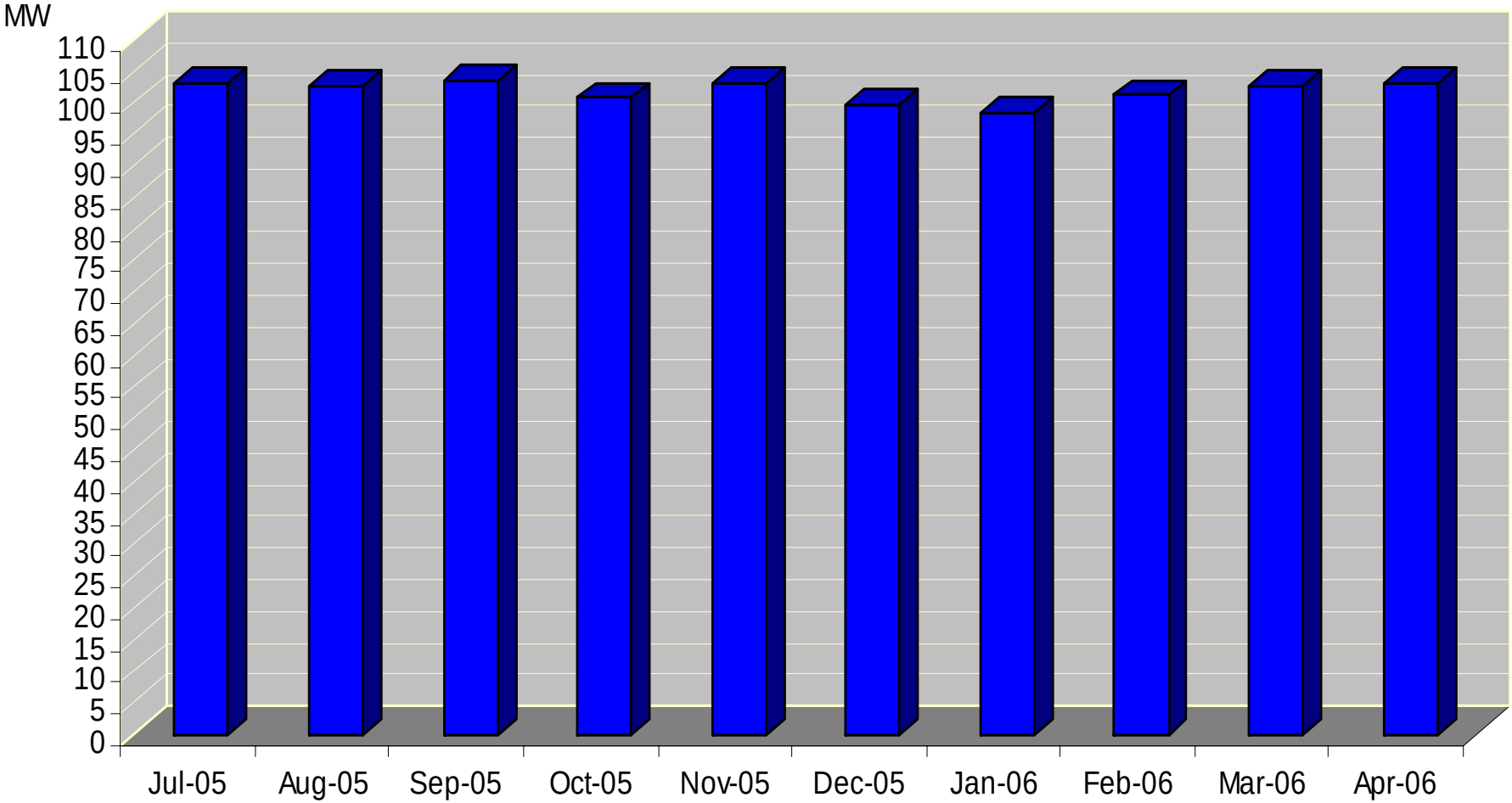
Mokai 100 MW PERFORMANCE



Data : Courtesy of Tuaropaki Power Company

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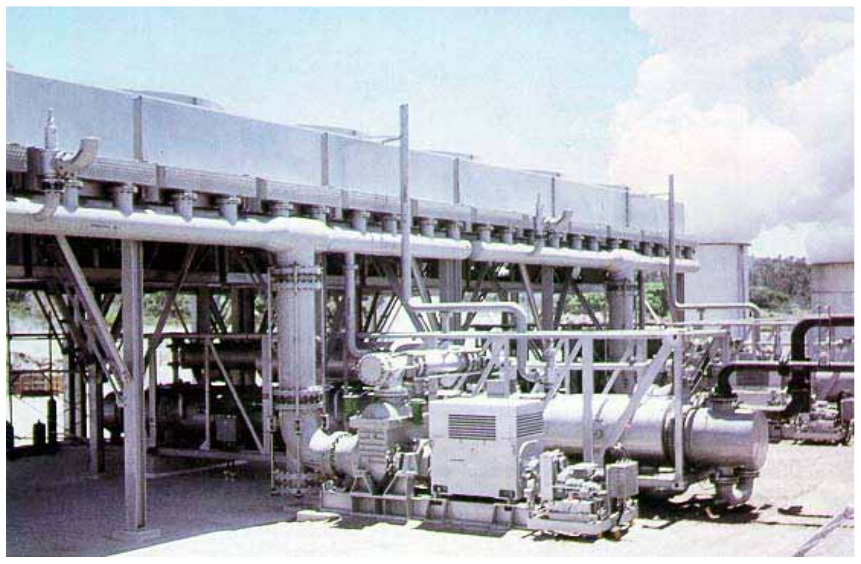
DECENTRALIZED PRIVATE POWER GENERATION



ORMAT'S POWER PLANT ADVANTAGES

- It is a tool capable to easily accommodate changes in reservoir enthalpy and operating conditions such as temperature and pressure
- Modular development, additional units may be added later and single units can be moved to other sites.
- Air cooling enabling 100 % reinjection of the geothermal fluid
- Track record for sustaining the pressure and temperature in the reservoir and avoiding subsidence
- Simple to operate and maintain
- Very high availability and low cost maintenance projects
- Know how capability and knowledge incorporating 40 years of experience in manufacturing ORC based power generations systems.

End

Hilel Legmann,
Marketing Manager
Ormat Industries Ltd