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GEOTHERMAL POWER DEVELOPMENT IN THE PHILIPPINES

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ABSTRACT

Large scale geothermal energy for electric power generation was put into operation with the inauguration of two 55-MW geothermal generating units at Tiwi, Albay in Southern Luzon in 1979. Another two 55-MW units were added to the Luzon Grid in the same year from Makiling-Banahaw field about 70 kilometers south of Manila. For that year alone, therefore, 220-MW of generating capacity was added to the power supply coming from geothermal energy. Last year a total of 220-MW power was added from the same areas. This brought to 446-MW of installed generating capacity from geothermal energy with 3-MW contributed by the Tongonan Geothermal pilot plant in Tongonan, Leyte, Central Philippines and another 3-MW from Palimpinon-Dauin field in Southern Negros in operation since 1977 and 1980, respectively.

To realize the benefits that stem from the utilization of indigenous geothermal resources and in the light of the country's ever increasing electric power demand and in the absence of large commercial oil discovery in the Philippines, geothermal energy resource development has been accelerated anew. The program includes development of six fields by 1985 by adding Manito and Daklan fields to the currently developed and producing geothermal areas.

INTRODUCTION

In the decade that was the seventies, perhaps no single event of international economic import could compare with the energy crisis of 1973. It affected developed and developing countries alike and clearly showed the fallacy of overdependence on foreign sources of energy. For the Philippines, it provided one of the more severe tests in recent times of the nation's economic and political resilience.

The crisis of 1973 poised great difficulties to the Philippine economy and with further increases in the price of imported oil coupled with uncertainties in the prospects of future supply, the nation was indeed faced in the ensuing years with the spectre of economic strangulation. Thanks, however, to wise planning backed by promulgation of necessary measures and their rapid implementation with an unwavering decisiveness, the country has weathered the energy crisis.

The strategy taken was simple and direct. President Ferdinand E. Marcos enunciated a power development program aimed at attaining self-reliance through availment of indigenous energy resources. He called for an intensive search for alternative sources of energy, the acceleration of oil and coal-exploration work and a dedicated effort to conserve energy. That this strategy has worked can not be denied.

HISTORICAL DEVELOPMENT

Geothermal studies in the Philippines were initiated in 1962 by the Commission on Volcanology, a research agency of the Philippine Government. With research funds made available by the National Science Development Board, the agency undertook geoscientific investigations of the Tiwi, Albay geothermal area. In house expertise, with occasional advice from visiting foreign scientists and with the Bureau of Mines helping out in the drilling of thermal gradient holes was largely relied on to carry out the research project.

Five years later, on April 12, 1967, for the first time in the country, an electric bulb was lighted by geothermal energy at Cale, a remote sleepy barrio in the municipality of Tiwi, Albay Province. The geothermal steam came from a 400-foot one and half inch drillhole and it turned a turbo-generator borrowed from the Mechanical Department of the Mapua Institute of Technology.

Later, with additional research funds, a 641-foot well with a four-inch production liner was bored in 1968 and it produced steam. This enabled the setting up of a 2.5 KW non-condensing geothermal pilot plant for demonstration purposes on what geothermal energy is all about. The well after twelve years is still discharging steam which is also now being used to evaporate sea water in connection with a pilot salt-making plant.

By 1970, the Philippine Government, recognizing the benefits that can be obtained from geothermal energy and realizing that the exploration work at Tiwi had reached the stage for commercial development, gave the National Power Corporation the task to develop and exploit the field. A service contract was entered into in 1971 by the Corporation with Union Oil of California through its subsidiary the Philippine Geothermal, Inc. for the latter to develop the steam field while NPC put up the necessary generating plant. Meanwhile, the Commission on Volcanology was instructed by the Executive Office to transfer its geothermal studies to prospects in Leyte and in the Makiling-Banahaw area of Luzon. Since then, geothermal exploration and drilling activities have been in full swing in these areas.

Thus, it may be said that the support given to a research agency by the government and its early recognition of the potential of geothermal energy as an alternative indigenous energy resource paid off handsomely when the energy crisis came.

FULL STEAM AHEAD FOR GEOTHERMAL

With the flip-over in the economics of petroleum-based electrical power in 1973, a drastic change in the country's power development was imperative. Where before, planning was centered on oil-fired thermal plants providing base load requirements, especially in the provincial service areas, a shift was made so that the main thrust became the availment of hydro, coal and geothermal resources. Since assessment of the Philippines' geothermal power potential is of such magnitude that it can be relied more and more to meet a significant portion of the country's energy requirement, geothermal energy became a major component of the energy program and so the government gave the signal "full steam" for its development.

The Philippines entered into commercial utilization of geothermal energy in July 1977 with operation of a 3-MW geothermal pilot power plant in Tongonan, Leyte. This power plant supplies part of the power needs of Ormoc City. However, it was really only in 1979 that saw the harnessing of large-scale geothermal energy from Tiwi in Albay and Makiling-Banahaw (Mak-Ban) in Laguna. Two 55-megawatt plants were commissioned in each of these areas, adding 220 MW of generating capacity to the Luzon grid and displacing 2.73 million barrels of oil equivalent for 1979.

These were followed almost immediately last year (1980) by an additional two 55-megawatt plants each in Tiwi and Mak-Ban and two 1.5 MW pilot plants in Palimpinon area of Southern Negros thus bringing the total geothermal power generation of the country to an amazing 446 MW by the last quarter of 1980. This means a displacement of slightly over 5.5 million barrels-of-oil equivalent which at oil price levels of $32 per barrel crude would mean a dollar saving of $176 million for 1980.

More geothermal generating units are abuilding or planned in the next five years. Under construction is the first large power plant of three 37.5 MW units to tap the Leyte geothermal resource. This plant is targeted to be commissioned in the last quarter of 1982. A similar 3 x 37.5 MW power plant will soon begin construction in Palimpinon, Southern Negros. This plant planned to be completed in 1983 will supply power to the Negros Island grid and will be further beefed up by a like 112.5 MW geothermal plant in 1985. Additional units are also expected from Tongonan, Tiwi and Mak-Ban, while two new geothermal areas under current exploration, Manito in Albay and Daklan in Benguet, are expected to contribute 165 MW.

By 1985, therefore, the 5-year compressed energy program envisions a whopping 1,718.5 MW contribution from geothermal energy. This amount is to come from only six geothermal fields. Yet there are other geothermal prospects that are already under initial exploratory studies like Biliran, Anahawan, Burawen, Nabunturan, Kidapawan, Montelago, Mabini, Mount Pinatubo and Buguias.

DEVELOPMENT STRATEGIES

If the Philippines has been able to achieve this phenomenal growth in the utilization of her geothermal resources it was perhaps largely due to the unorthodox and bold approach taken in its development. The government opted to take an aggressive stand and put in a little more risk capital to the undertaking than what a conservative orthodox approach would have called for.

Exploration wells were drilled to be production wells so that if successful the time to bring the field into the exploitation stage would be shortened. As soon as two or three producing wells were drilled and pertinent data on steam characteristics obtained, National Power Corporation on advice of the field developer then proceeded to design, bid out, and order the generating units. As much as possible, time-consuming administrative procedures were streamlined and even short-circuited in the interest of rapid development.

The drilling programme was also planned as to complement this bold approach. After a deep well is drilled and it is a steam producer, then subsequent wells were drilled as a cluster around it rather than give priority to delineation wells. This way the decision to put up a power plant came sooner, though, of course, the potential of the field was still just better than a guess. It was a gamble, but perhaps the end justified the means.

GEOTHERMAL POWER PROGRAM

In order to maximize the benefits from the utilization of indigenous geothermal resources, the government's five year program for geothermal exploration and development aims at 1718.5 MW of generating capability by the year 1985 (Table No. 1). The program includes the development of six fields to the currently developed and producing fields at Tiwi, Makiling-Banahaw and Tongonan Valley.

TABLE: 1

PHILIPPINE INSTALLED AND PLANNED
GENERATING CAPACITIES, MWe (1977-81)

GEOTHERMAL FIELD	1977	1978	1979	1980	1981	1982	1983	1984	1985	TOTAL
Tongonan	3					75	37.5	110	220	445.5
Tiwi			110	110		110		110	110	550
Mak-Ban			110	110			110			330
Manito									110	110
Daklan									55	55
Palimpinon				3			112.5		112.5	228
Total	3		220	223		185	260	220	607.5	
Cumulative Total	3		223	446		631	891	1111	1718.5	1718.5

POSSIBLE RESEARCH & DEVELOPMENT DIRECTION

The occurrence of numerous hotsprings throughout the Philippines indicates that the country is well endowed with geothermal resources and suggests that all possible methods of utilization of this energy be investigated. Scattered throughout the archipelago are a number of thermal spots that could have geothermal significance.

Research should be directed to accurate evaluation of other potential geothermal areas by correlation with magma generation, structural setting of geothermal fields and association of rock type and mineral alterations. This study should lead to a geothermal reservoir models.

The use of binary system in power generation to utilize low heat subsurface waters should be pursued rigorously. If proven economically viable, this method could find applicability in tapping low-temperature hotsprings in our small island communities.

The utilization of geothermal energy in any form is not without its share of problems. Some of these are environmental problems which should be defined and evaluated in order to insure an environmentally compatible development of geothermal resources. Basically, the possible impact on the environment due to geothermal utilization are, ground subsidence because of extraction of fluid from the subsurface, and chemical-thermal pollution because of disposal and discharge of effluent. The problem of scaling, most often by carbonates or silica, high-acidity of geothermal fluids and the attendant corrosion can be minimized by proper research and development program. These problems are, however, not inherent to all geothermal fields, but are specific only in certain areas in some cases specific only to some steam wells of a particular area.

Hardwares used in geothermal exploration and development are carry overs from the oil industry. Some are therefore found to be insufficient to cope with head pressure and chemical conditions peculiar to geothermal operations.

Geothermal energy is relatively a newcomer in the energy field though earth-heat can be said as old as the earth. Its state of the art has not reached the sophistication of oil and gas technologies.

THE FUTURE OF GEOTHERMAL ENERGY

With further increases in oil and gas prices almost a certainty as the depletion points of their known reserves are approached, the position of geothermal energy compared to fossil fuels improves because it is a renewable form of energy. In the coming decades more and more of the geothermal resources of the world will be developed and exploited, not only for power generation, but for direct applications of the energy as well.

It is indeed a comforting thought that the Philippines has managed within so short a time to be among the foremost users of this indigenous energy resource.

REFERENCES

Alcaraz, Arturo. Geothermal Exploration and Development in the Philippines. Paper read before the Circum-Pacific Energy and Mineral Resources Conference, Hawaii, 26-30 August 1974.

Datuin, Rogelio. 1977 Geothermal Resources of the Philippines, Status of Geothermal Projects Development, and the Geothermal Power Development Program. The National Security Review, Vol. IV, September 1977, pp. 3-16.

Datuin, Rogelio and Fernando L. Uy. In press. Quaternary Volcanism and Volcanic Rocks of the Philippines, Journal of the Geographical Society of the Philippines.

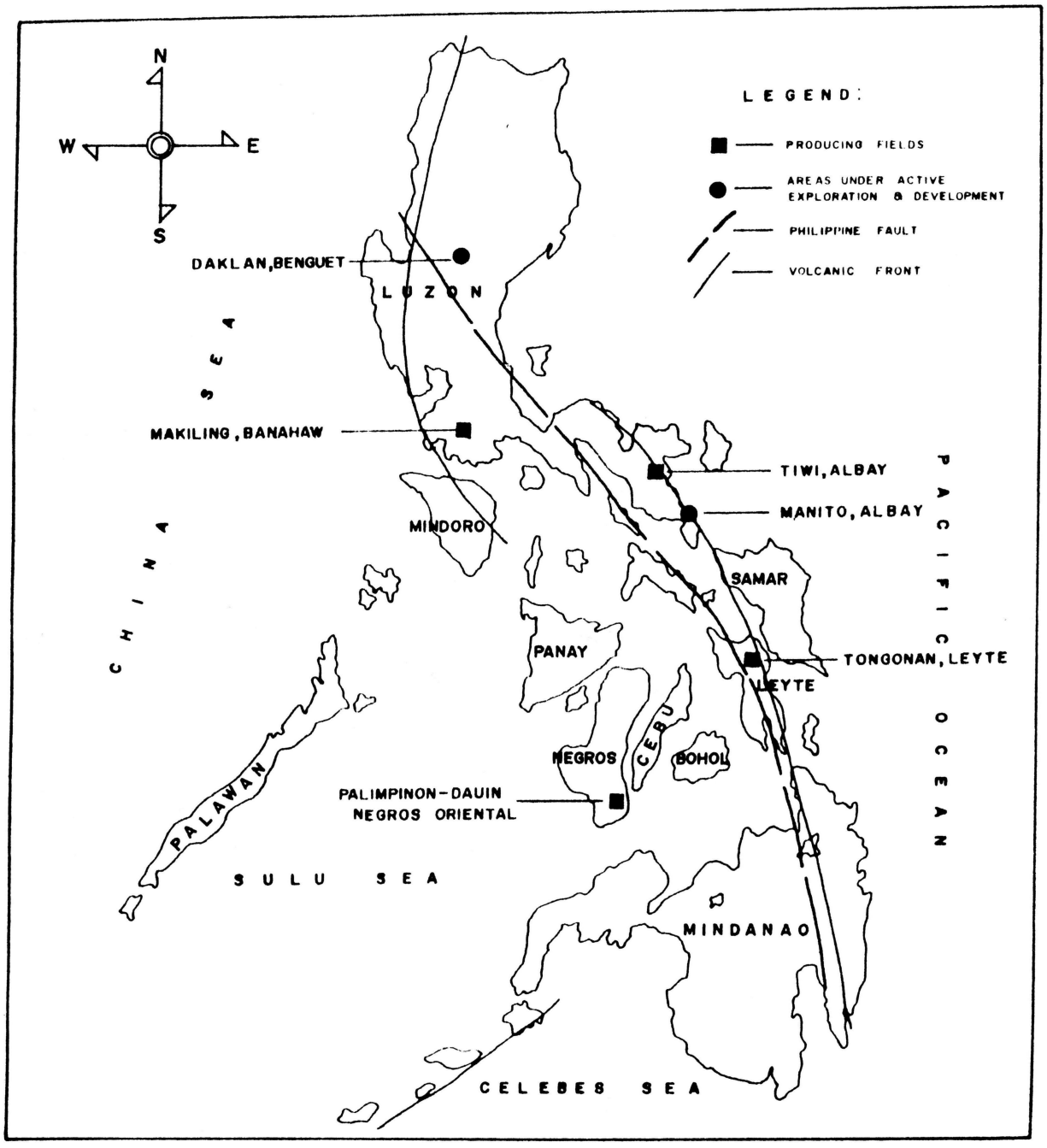
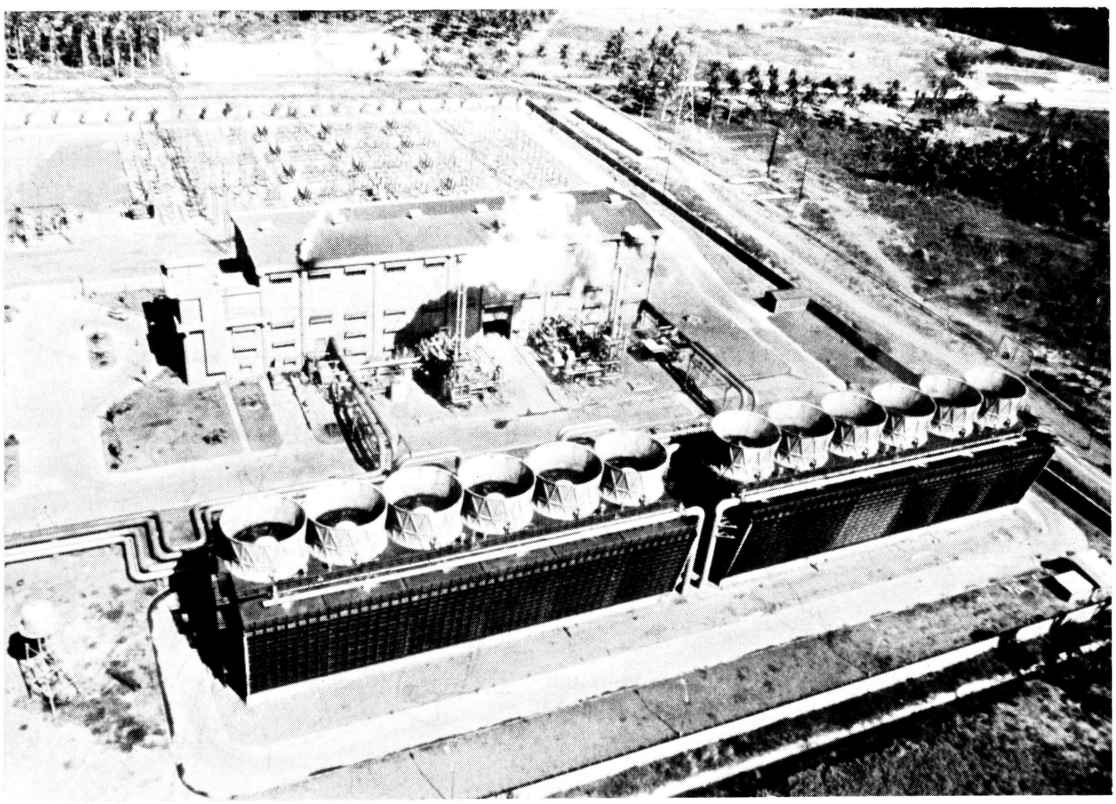
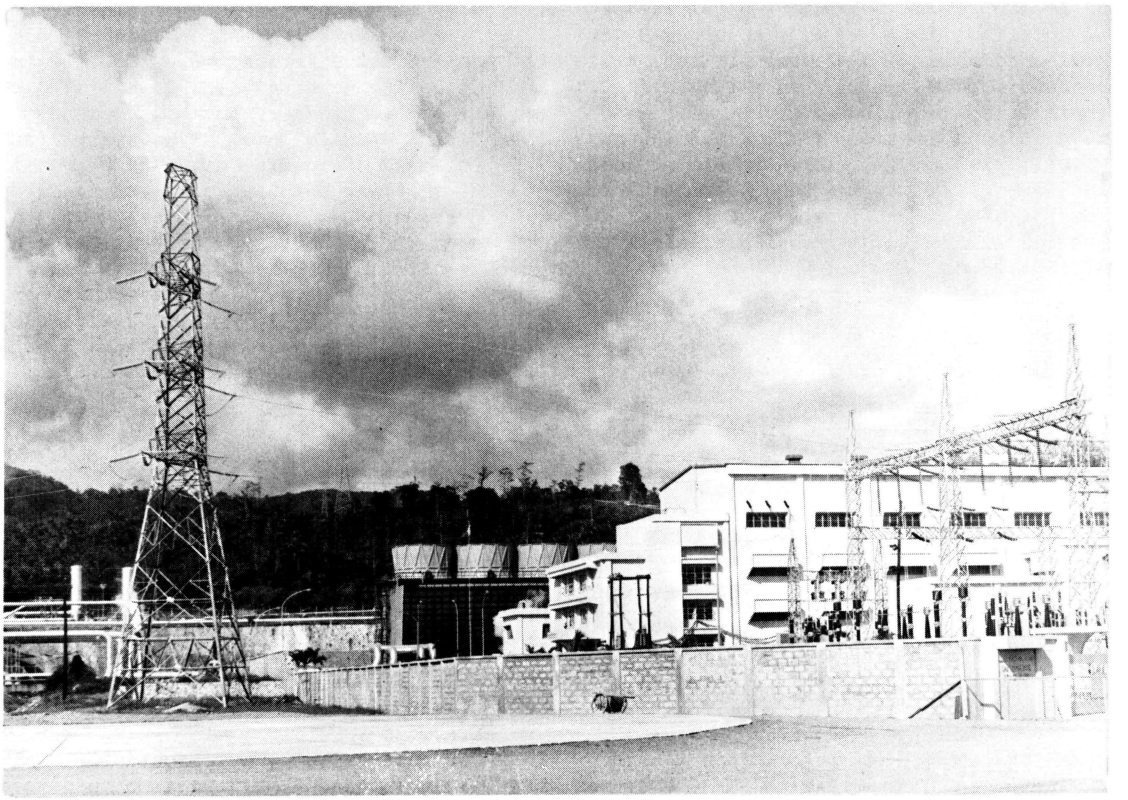


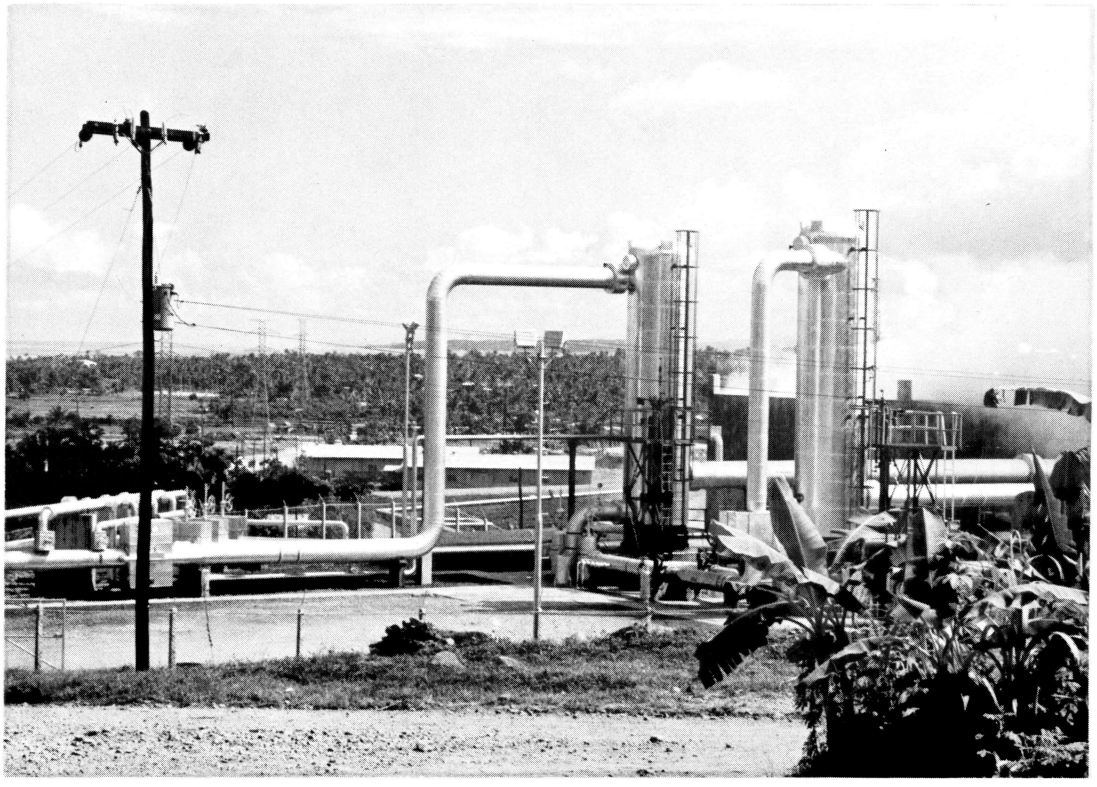
FIG.-1 PHILIPPINE GEOTHERMAL AREAS UNDER EXPLORATION AND DEVELOPMENT



Aerial View of Mak-Ban Geothermal Power Plant #1
(Units 1 & 2)



Tiwi Geothermal Power Plant #2 (Units 3 & 4) showing Cooling Tower and Transmission Tower



Sample of Steam/Water Separators used in Tiwi Geothermal Field