PRESENT AND FUTURE GEOTHERMAL DEVELOPMENT IN THE PHILIPPINES

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ABSTRACT

The geologic setting, pre-development history, and institutional and milestone events are presented leading to the countrywide current installed geothermal power capacity of 1445 MWe. Factors such as production capacities of developed fields, technological advancements, and the prevailing commercial climate are addressed in assessing the potential of future development and generation expansion programs.

INTRODUCTION

The Philippines currently has 1445 MWe of installed geothermal power capacity, and within the year, this will increase to a total of 1900 MWe as we commission additional plants which are now in the late stages of construction. These developments will bring to a close a series of major efforts which commenced in 1993 and have resulted in the installation of 1000 MWe of geothermal power in 5 years. It is thus timely to consider opportunities for future geothermal development in the Philippines, and the commercial climate that now prevails.

GEOLOGICAL SETTING AND GEOGRAPHIC LOCATION OF GEOTHERMAL RESOURCES

The Philippines is endowed with a considerable number of high quality geothermal resources. These are all island arc volcanic systems as typically found through the western pacific rim, and show close similarities with geothermal systems in Indonesia and Japan. All the fields drilled to date have been found to be liquid dominated in the natural state, with or without two phase conditions in the central parts. Maximum temperatures in these systems tend to be high, in the range of 300 to 340C. Fracture permeability is invariably dominant over primary permeability. The most exploitable of these systems are found in mature volcanic complexes which over geologic time have reacted out acidic volcanic gases injected early in their genesis, from degassing magmatic intrusives. A number of younger volcanic systems are still influenced by acid gases and are considered to be non-exploitable within the limits of today's technologies.

These fields are all associated with volcanism developed above trench and subduction zone systems formed at crustal plate boundaries. The trench systems define volcanic belts in which all of the geothermal potential of the Philippines is contained. From north to south these include the following:

1. The Manila trench lying to the west of Luzon has an associated on-shore volcanic belt ranging from the Cordilleras in northern Luzon, to Mt. Mariveles west of Manila. At the southern end of this belt is located the highly productive Makiling-Banahaw geothermal field. Elsewhere to the north there are a number of hot geothermal prospects in this belt, however, none has yet been developed due to poor permeability, and in some cases, e.g. Mt. Pinatubo, the presence of pervasive acidic and magmatic fluids.

2. The Philippine Trench running parallel to the eastern coasts of Luzon, Samar and Leyte defines several major onshore volcanic belts which host the biggest geothermal developments in the Philippines - the Tiwi and BacMan fields in southern Luzon and a number of fields in Leyte, of which the most significant are located in the Tongonan area.

3. The Negros trench to the west of Negros island defines a volcanic belt which ranges from the mature and dissected volcanic complex of Cuernos de Negros in Southern Negros, where we have developed the Palinpinon geothermal field, to Mt. Canlaon in Northern Negros where we are now undertaking development activities.

4. In Mindanao, there are several trench and subduction zone systems. The most significant of these is an extension of the Sangihe volcanic arc from Indonesia northwards into central Mindanao. Volcanic activity on

this arc has given rise to the Mt. Apo volcanic complex, where we are in the late stages of developing a 52 MWe power facility, and at other younger prospects to the north.

The widely distributed nature of the geothermal resources in the Philippines has long been an impediment to geothermal power development because, with the exception of Makban, the most productive fields are all located at considerable distance from the major load centres of Manila and Cebu, and are frequently isolated from these markets by sea passages. An integrated series of inter-island submarine EHV transmission projects are now approaching completion which will link the Visayan islands to Luzon via a hub in Leyte. This will have a great benefit in allowing for a much increased market for geothermal power in the Philippines.

HISTORY

With over 20 years experience in geothermal development and generation the geothermal industry in the Philippines is now in a mature state. We currently have 1445 MWe of geothermal power capacity installed and over the next 12 months this will increase to a total of 1900 MWe as we commission an additional 455 MWe of plant which is now in the early to late stages of construction. With this level of capacity we are now running just behind the US in terms of geothermal generation, and in terms of wet steam field capacity, we lead the world.

Clearly this amount of development has taken a lot of effort and involves a lot of history. There are a number of milestones in this worth pointing out:-

1. Pre-Geothermal Development (prior to 1977)

The foundation for the commercial utilisation of geothermal energy was laid by the Philippine Commission on Volcanology between 1952 and the late nineteen sixties. This group studied and inventoried geothermal activity at a number of localities, particularly at the Makban, Tiwi, Tongonan and Southern Negros areas. In the latter part of this period ComVol's work aroused interest in both in the US and New Zealand. This led in 1971 to Union Oil of California entering into a geothermal service contract with the Philippine National Power Corporation (NPC) to explore and develop geothermal resources at Tiwi and Makban, for and on behalf of NPC. Unocal formed a local subsidiary, Philippine Geothermal Inc., PGI, to undertake this work. In 1972 the New Zealand Government entered into a bilateral energy co-operation program with the Philippine Government and this led to the commencement of exploratory geothermal drilling at Tongonan and Southern Negros in 1973 in conjunction with NPC.

2. First commercial power generation in the Philippines in 1977.

In 1976, the PNOC-Energy Development Corporation was created, as a subsidiary of the Philippine National Oil Company. This group was mandated by Government to undertake accelerated development of indigenous energy sources to reduce the countries dependence on imported fossil fuels, which had risen dramatically in cost during the energy crisis of the early seventies. PNOC-EDC assumed NPC's interests at Tongonan and Southern Negros and commenced deep exploration drilling at Tongonan in late December of 1976. This was successful and quickly led to PNOC-EDC supplying steam to a NPC owned 3 MWe power plant at Tongonan in July of 1977 - the first commercial geothermal power generation in the Philippines.

3. First Major Phase of Geothermal Development - 1978 to1983

A very rapid build up in geothermal generating capacity occurred between 1978 and 1983 as NPC and PGI sequentially commissioned 6 x 55 MWe units and associated steam field facilities at each of the Tiwi and Makban projects. PNOC-EDC and NPC followed in 1983 with the coommissioning of 3 x 37.5 MWe units at Tongonan and 3 x 37.5 plus 3 x 1.5 MWe at the Palinpinon field in Southern Negros.

By the end of 1983 there was then 896 MWe of geothermal capacity in the Philippines of which:

- NPC owned 100% of the generating capacity
- NPC and PGI owned and operated, respectively, 74% of the total steam field capacity
- and PNOC-EDC owned and operated the 26% balance of steam field capacity.

4. Hiatus -1983 to 1991

There was a decade long hiatus in geothermal development from 1983 to 1993 due to a combination of political, funding and institutional problems. In spite of this a major exploration drilling program was pursued

by PNOC-EDC at Luzon and elsewhere. These programs confirmed the development potential of the BacMan project in Luzon, and at prospects in Leyte and Mt. Apo.

5. Revived Institutional Interest in Geothermal Development 1991-1993

In the early nineties there was a strong revival in interest in geothermal development as a result of a number of events:

- an energy crisis on Luzon which led to severe electricity shortages and rationing in the capital city of Manila. This eventually led to the state owned National Power Corporation (NPC) relinquishing sole control on power generation;
- introduction in 1990 of Build-Operate-Transfer legislation (Republic Act 6957) allowing for private sector development of geothermal and other types of power plant and infrastructure facilities;
- the resurrection in late 1992 of a Government Energy Department which had been disbanded six years previous. This allowed for the Government to develop strong initiatives in the energy sector and implement a country wide Master Energy Plan (Department of Energy, 1993);

6. Second Major Phase of Geothermal Development - 1993 to 1997

As a result of the changed institutional and commercial climate there has been a very rapid upswing in geothermal power development in recent years which has led us to add 1000 MWe of geothermal capacity from 1993 to the end of 1997. 90% of this has come from developments undertaken by PNOC at Bacman, Mt. Apo and particularly at Leyte. NPC and PGI have provided the balance by completing in 1994 and 1995 an infield expansion at Makban of 80 MWe and a 16 MWe binary unit using heat from waste brine.

BOT POWER PLANT CONTRACTS

Build-Operate-Transfer (BOT) legislation in the Philippines has been a crucial component in realising the recent geothermal development expansion program, as it has allowed for the entry of international power utilities to fund, construct and operate geothermal power plants. The Philippines has thus been able to rapidly increase much needed electrical generation without increasing national debt.

The commercial strategy adopted for the Leyte and Mt. Apo projects has been for PNOC-EDC, as a state owned company, to move from its traditional role as steam field developer and operator, to instead sell wholesale electricity to NPC. Conversion of steam to electricity has been subcontracted by PNOC-EDC to third parties through BOT contracts. This approach results in the Philippine Government (through PNOC) assuming control of resource development and exploitation and (through NPC) guaranteeing the purchase of power, thus relieving the BOT power plant partner of any significant resource and/or market risk.

Since mid-1993, PNOC-EDC has entered 5 BOT contracts for the construction and operation of 10 individual power plants with an aggregate total of 640 MWe. A sixth BOT contract is in the process of being awarded. Two of these BOT power plants have recently achieved commercial operation, within 35 months of the BOT partners signing Energy Conversion Agreements with PNOC-EDC, and within 43 months from the time bids for the BOT projects were first advertised.

PRESENT GEOTHERMAL PLANT CAPACITY

The 1900 MWe of countrywide geothermal capacity that will be in place by end of 1997 is located at 6 fields (Table 1). Broken down in terms of field capacity, these include:- Makban with 426 MWe (which represents 23% of the total country geothermal plant capacity), Tiwi with 330 MWe (17%), Bacman with 150 MWe (9%), Leyte with 691 MWe (37%), Palinpinon with 193 MWe (10%) and Mt. Apo with 92 MWe (5%.)

Of this total capacity 1223 MWe (64%) is owned and operated by NPC. The balance of 677 MWe (or 36%) is owned and operated by private sector companies holding BOT contracts with PNOC-EDC. The ownership of these capacities relative to the total country capacity is CalEnergy holding 536 MWe or 28%, Ormat with 49 MWe or 3% and Oxbow currently with 52 MWe or 3%. Ownership of these plants will revert to PNOC-EDC at the conclusion of the 10 year BOT co-operation periods.

An analysis of geothermal plant in the Philippines in terms of turbine manufacturer shows the three leading Japanese manufacturers have obtained the major share of the Philippines market, supplying 82% of the total

Table 1

Presently Installed and Committed Future Geothermal Generation Capacity in the Philippines (to 1998)

Field	Location/ Sector	Unit #	Unit Capacity (MWe)	T/G Manu -facture	Installed Capacity (MWe)	For Installn (MWe)	Totals (MWe)	Com- mission Date	Power Plant Operator	Steam Field Operator
Mak-Ban	Bulalo	1 to 6	55	Mitsubishi	330			1979-1984	NPC	PGI
	Bulalo	7 to 9	5.2	Ormat	15.7			1994	NPC	PGI
	Bulalo	10 to 13	20	Mitsubishi	80			1996	NPC	PGI
							426			
Tiwi	Tiwi	1 to 6	55	Toshiba	330			1979-1982	NPC	PGI
							330			
Bacon Manito	Palayan	1 & 2	55	Ansaldo	110			1993/94	NPC	PNOC-EDC
	Cawayan	3	20	Fuji/Toshiba	20			1994	NPC	PNOC-EDC
	Botong	4	20	Fuji/Toshiba		20		1998	NPC	PNOC-EDC
	Binary	5	12	Ormat		12		1998	NPC	PNOC-EDC
							162			
Leyte	Tongonan I	1 to 3	37.5	Mitsubishi	112.5			1983	NPC	PNOC-EDC
	Upper Mahiao	4 to 7	118	Ormat	125			1996	Cal Engy/BOT	PNOC-EDC
	Malitbog	8	77	Fuji	77			1996	Cal Engy/BOT	PNOC-EDC
	S. Sambaloran	9,10	77	Fuji		154		1997	Cal Engy/BOT	PNOC-EDC
	Mahanagdong	13-15	60	Toshiba		180		1997	Cal Engy/ BOT	PNOC-EDC
	Tongonan 1	16T	17	GE		17		1998	Ormat/ BOT	PNOC-EDC
	Malitbog	17B	14	GE		14		1998	Ormat/ BOT	PNOC-EDC
	Mahanagdong	18-20T	6	GE		18		1998	Ormat/ BOT	PNOC-EDC
							698			
Sthn. Negros	Palinpinon I	1 to 3	37.5	Fuji	112.5			1983	NPC	PNOC-EDC
	Palinpinon II	4 & 5	20	Fuji	40			1994	NPC	PNOC-EDC
	Palinpinon II	6 & 7	20	Fuji	40			1995	NPC	PNOC-EDC
							193			
Mindanao	Matingao	1	52	Mitsubishi		52		1997	Oxbow/BOT	PNOC-EDC
	Sandawa	2	40	?		40		1998	Under Award	PNOC-EDC
							92			
T = topping cycle plant B = bottomimg cycle plant					**1393**	**507**	**1900**			

Notes on Operators:

NPC	National Power Corporation	Cal Engy	California Energy
PGI	Philippine Geothermal Inc.	Magma	Magma Power Company
PNOC-EDC	PNOC - Energy Development Corporation	Oxbow	Oxbow Geotheremal Corporation

installed capacity. Individually, each of these three companies have achieved very similar levels of sales with Mitsubishi supplying 30%, Toshiba 27% and Fuji 25% of total capacity.

There are three other turbine suppliers represented in the Philippines:-

- Ansaldo GIE with 2x 55 MWe condensing steam turbines at the Bacman field
- Ormat has supplied a number of turbines manufactured by both themselves and GE with an aggregate total of 2.5% and 7%, respectively, of the total country capacity

In terms of steam field production capacity in the Philippines, PNOC-EDC will by the end of 1997 owns and operates 60% of the total country capacity with the balance of 40% owned by NPC and operated by PGI.

LEYTE GEOTHERMAL POWER PROJECT

The Leyte geothermal power project is the largest geothermal development undertaken in the Philippines. It involves the commissioning of 600MWe of power plant in the Mahiao, Malitbog and Mahanagdong sectors at Tongonan, split over three staged phases of development:

1. 200 MWe of electricity for commissioning in mid 1996, for export to Cebu via an EHV AC submarine cable from Leyte. This generation is being obtained from two power plants:-

Upper Mahiao 125 MWe Plant
A BOT contract was awarded to Ormat in August of 1993 to construct and operate a 125MWe power plant for 10 years. Ormat subsequently contracted the operation of this plant to CalEnergy. The plant is comprised of 4 Ormat GCCU turbines of 29.9 MWe capacity each, and one brine OEC binary unit with a capacity of 5.5 MWe. Each GCCU consists of one GE non condensing steam turbine which exhausts to three OEC binary cycle turbines. Construction commenced in August of 1994 and the plant, the largest that Ormat has yet built, was commissioned in July of 1996.

Malitbog Power Plant - 1 x 77 MWe unit in a staged development
A 10 year BOT contract was awarded in September of 1993 to Visayas Geothermal Power Corporation, a Philippine subsidiary of Magma Power, to construct and operate the first unit in a 3x77 MWe power plant located in the Malitbog sector. CalEnergy subsequently bought out Magma Power and thus acquired VGPC. The Malitbog turbines are conventional single pressure Fuji units with direct contact condensers Plant construction commenced in September 1994 and commercial operation of this unit was attained in July 1996

2. 400 MWe of electricity for export in late 1997 via a DC EHV cable from Leyte to Luzon. This generation is being obtained from 6 power plants:-

Malitbog Power Plant - 2 x 77 MWe, in one station
This block of power is from Fuji units # 2 and 3 in the Malitbog power plant. Good progress is being made with construction and installation of these plants and it is expected that VGPC will readily meet their mid 1997 deadline for commercial operation

Mahanagdong A and B Power Plants - 3 x 60MWe, at two stations
A 10 year BOT contract was awarded in July of 1994 to CalEnergy to construct and operate a 3 x 60 MWe generation facility split over two sites. The plant consists of Toshiba turbines with surface condensers. Construction progress is well advanced and it is also expected that CalEnergy will have little difficulty in meeting their deadline for commercial operation by mid July 1997.

Optimisation Plants - 51 MWe, at 3 stations
A further 51 MWe of geothermal power is being obtained from topping and bottoming plants resulting from field optimisation studies. These consist of :

- a single 17.3 MWe non condensing HP turbine upstream of the existing Tongonan 1 power plant.
- 3 x 6.4 MWe non condensing steam turbines upstream of each of the Mahanagdong A and B power plants.
- a 14.6 MWe low pressure condensing steam turbine downstream of the Malitbog power plant.

All of these optimisation plants were bid out as a single BOT package which was awarded to Ormat offering GE turbines. Early construction work has now begun and these plants will be progressively commissioned between September 1997 and January 1998.

FUTURE GEOTHERMAL DEVELOPMENT PROSPECTS

Future geothermal development in the Philippines will ultimately be constrained by the availability of geothermal resources with sufficient quality and quantity of extractable fluids to allow for economic development. Such fluids can be obtained from a variety of sources, including:-

- new fields yet to be developed
- expansion of generation at developed fields with in-fill and step out production wells
- increased generation through improved plant efficiencies and technology advances
- lower grade resources (<230C) which have not yet attracted serious attention in the Philippines due to the abundance of high grade resources

When looking at the potential for future geothermal developments it is evident from the geothermal map of the Philippines (Figure 1) that there are a large number of geothermal areas, distributed widely throughout the country. Over the past 20 years, more than 40 of these prospects have been explored, 19 drilled and 7 have been developed. From these exploration and other data on regional heat flow we assess the country has a overall exploitable reserve of at least 3000 MWe and possibly up to 4000 MWe. It is thus significant that only some 50 to 60% of this reserve has yet been developed.

Based on geological and geochemical data and measured data from exploration wells where available, we rank future geothermal development opportunities as follows:-

1. The most prospective geothermal areas yet to be developed appear to be at Mt. Labo and Northern Negros. PNOC is currently drilling delineation wells at these two sites and we anticipate future developments of up to 100 MWe at each.

2. A number of prospects have been drilled and found to be hot (> 260 C), and with neutral chloride fluids, but with poor permeability characteristics. These include Daklan, Natib, Mahagnao, and Amacan. All of these prospects require further drilling to confirm their potential. We expect these will yield developments of 20 MWe or better at each site.

3. Geothermal areas which have yet to be drilled include prospects at Cabalian and Lobi in Leyte, and in the northern cordillera of Luzon where Philippine Geothermal Inc. (PGI) currently has a non-exclusive exploration permit and is undertaking field studies. PNOC-EDC is to commence exploration drilling at Cabalian in early 1997 and is bidding out a joint venture interest in this project. The successful development of Cabalian would provide considerable impetus to electrically interconnecting the islands of Leyte and Mindanao. This would provide the final link in a country wide EHV grid, which has been developed only because of the quality and widespread occurrence of geothermal resources in the Philippines.

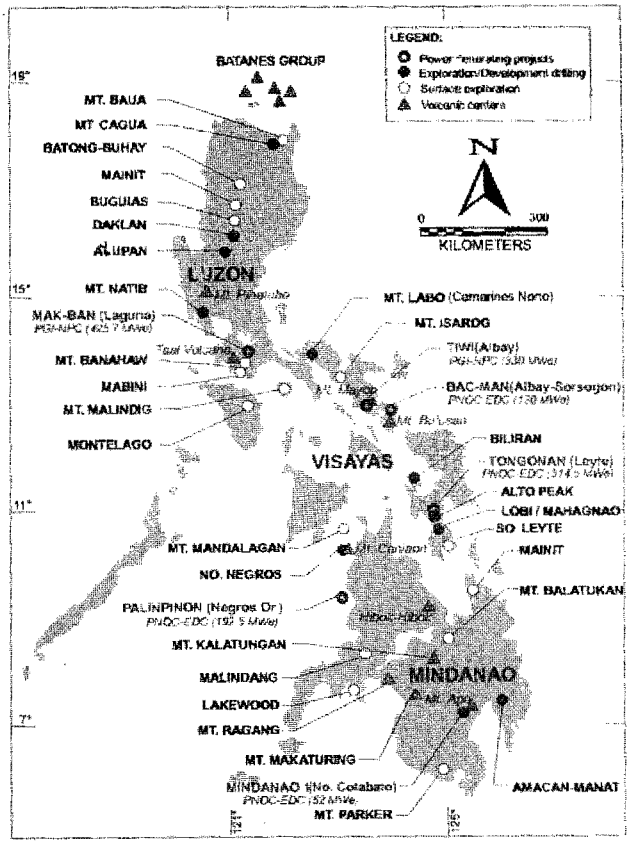

Figure 1 Philippine Geothermal Areas.

4. We exclude a number of young volcanic systems from the national reserve estimate. Some of these such as Mt. Pinatubo and Mt. Cagua are clearly unsuitable for geothermal development as adjudged from the results of well drilling which demonstrate the pervasive influence of condensed magmatic volatiles in the hyrothermal fluids at depth. At other younger volcanic systems, there remains a firm basis to undertake exploratory drilling to determine actual subsurface conditions. Prospects in this category include Mt.'s Bulusan, Balatukan, Parker, and Mandalagan.

5. There are several lower grade prospects (150 to 230C) which may be suited to binary cycle power generation in the range of 10 to 20 MWe. These include the Mabini, Manito Lowlands, Montelago, and Maiinit (Surigao) prospects.

Overall, we estimate that the forward potential for geothermal power at as yet undeveloped fields from a firm minimum of 500 MWe to an upper possible range of 1500 MWe.

EXPANSION OF GENERATION AT EXISTING FIELDS

Initial power developments at new fields tend to be conservatively sized because of uncertainties surrounding future reservoir performance. There is then frequently the opportunity to further expand power generation, after the initial response of a reservoir to production has been assessed, both by in-fill drilling within existing production fields, and by moving production drilling further outwards from the initially defined production boundaries. A good example of this is the recent commissioning by NPC and PGI of 80 MWe of additional in-field plant at the Makban field as a result of very good reservoir performance over 15 years at a withdrawal rate of 330 MWe. Similarly PNOC-EDC is examining the potential to further expand generation at developed fields by a further 40 MWe at BacMan, a further 60 MWe at Mahanagdong and a further 40 MWe at the Southern Negros geothermal field.

INCREASED EFFICIENCIES AT EXISTING FIELDS

At the Leyte Geothermal Power Project we have closely optimised turbine inlet conditions to the thermodynamic characteristics of the reservoir and to predicted changes in reservoir performance with exploitation time. This has resulted in our installing a combination of topping and bottoming plant upstream and down stream of medium pressure turbines, allowing us to increase power generation by some 10%, without increasing mass extraction and thus rundown rate in the reservoir.

Additionally by awarding power plants to private sector BOT companies on the basis of competitive bids for converting steam to electricity at least cost, we have obtained turbo generators with steam consumption's in the vicinity of 1.75 kg/sec / MWe. Turbine technology is continuing to advance rapidly and machines are now coming into the market with 30 inch back row turbine blades which yield specific steam consumption's approaching 1.5 kg/sec / MWe. In contrast, geothermal power plants installed in the late seventies and early eighties typically have steam consumption's of 2.2 to 2.5 k/sec/MWe.

The other key area where we are keen to increase utilisation efficiencies of geothermal fluid is in greater recovery of the heat in waste brine. Conventionally geothermal developments necessarily reject up to 45% of the total heat in produced geofluids because of silica saturation constraints which dictate the reject temperature to be frequently as high as 180 to 190C.. Over the past several years we have maintained a collaborative research association with a major water treatment company and we have now trialled a number of chemical inhibitors for delaying or preventing silica scaling from hot, saturated brine solutions. Results from this work have been very encouraging and we believe we are now in a position to utilise waste heat in brine down to close to 100C. This will have a significant and beneficial impact on the efficiency and thus the economics of geothermal power generation.

We thus see considerable potential for increasing geothermal power generation in the Philippines from not just new field developments but also from infield development at existing production fields, the retrofitting of more efficient plant and from utilising progressively more of the total heat available in geofluids with chemical controls on silica scaling.

COMMERCIAL CLIMATE

The large scale of the geothermal developments achieved over the past 3 years has been driven by recent changes in the commercial climate in the Philippines. These include deregulation of power generation from government to the private sector and the passing of a BOT law which has allowed for a high level of participation by private energy companies in power generation in the Philippines. The commercial climate is continuing to change, with rapidly increasing emphasis on private sector involvement. Currently, there are major thrusts in this direction which will affect future geothermal development in the Philippines.

The first of these is the privatisation of the PNOC Energy Development Corporation
We are now in the advanced stages of planning for the privatisation of PNOC-EDC which is a state owned group of energy companies with well developed interests in oil and gas, coal and geothermal energy. The geothermal assets of this group include production steam fields totalling 1140 MWe capacity, subcontracted BOT power plants with an aggregate capacity of 670 MWe which will revert to ownership by PNOC-EDC in 10 years, and a large, highly trained technical workforce.

The two main options we have under consideration for the privatisation are the public listing of shares and direct sale to strategic private investors, and/or various combinations thereof. Government has mandated that 60% of the shares of PNOC-EDC will be sold and under Philippine law ownership by foreign entities will be limited to 40% of the total shares of the company. We have appointed a financial consultant in late- 1996 to assist us with the development of a privatisation strategy and master plan and we are programming to have privatisation completed within the next 6 months, i.e. by mid 1997.

The second major commercial thrust that will affect future geothermal developments is privatisation of the National Power Corporation:-
The National Power Corporation has commenced planning for the sale of part of Government's interests in power generation and transmission throughout the Philippines. Policy covering this is enunciated in the

Omnibus Electric Power Industry Act of 1996 which is currently awaiting approval by the House of Congress. The draft Act proposes that the following benefits will be realised from the privatisation of NPC:-

- will ensure the reliability, security and affordability of future power supply
- will promote competition and accountability amongst industry participants
- will enhance the inflow of private capital to broaden the ownership base in the power generation, transmission and distribution subsectors

NPC is a large corporation, with assets of some USD25 billion in hydro and thermal power plants, and nearly nation-wide transmission facilities. It seems likely that all NPC owned geothermal power plants and production steam fields will be privatised and this will clearly be of considerable interest to major power companies and geothermal developers. The assets of NPC include 1223 MWe of geothermal generating capacity at the Tiwi, Makban, Bacman, Tongonan, and Palinpinon geothermal fields, and 756 MWe of the steam field production facilities fields at Tiwi and Makban. These latter two fields have been developed and managed by Philippine Geothermal Inc., a subsidiary of Union Oil of California, for and on behalf of NPC. The twenty five year contract between NPC and PGI expired at the end of September 1996 and has been extended for another 6 months.

The third major commercial thrust which we believe will have a significant impact on future geothermal development in the Philippines is revised legislation embodied in the Geothermal Resources Act of 1994
Geothermal development in the Philippines has been undertaken since 1978 under a regulatory framework formulated in Presidential Decree 1442. This provided for the first time incentives for private sector investment in geothermal projects. In practice, however, the incentives have proven to be unattractive to the private sector and PNOC-EDC as the state owned geothermal service contractor has been the only group, other than NPC, to be active in the Philippine geothermal development sector.

The Geothermal Resource Act of 1994 amends PD 1442 and provides for increased fiscal incentives to further encourage private sector participation. These incentives will significantly improve cash flow and return on investment for a geothermal service contractor. The main features of the Act for a geothermal services contractor include :-

- an 8 year holiday on production royalties
- tax incentives under the Omnibus Investment Code of the Philippines
- Filipino Participation Incentive Allowance (FPIA) equivalent to 5% of gross revenues
- development uplift allowance equivalent to 60% of development costs
- cross recovery allowance (CRA)

The FPIA and CRA will effectively accelerate cost recovery, at the same time reduce the income tax base and royalty base. The CRA will also allow for the recovery of exploration costs in unsuccessful areas, thus significantly reducing exploration risk on the contractor.
The six year income tax holiday has the effect of front loading the cash inflows to the service contractor and thus reducing the project payback period. The 8 year royalty holiday starting in the seventh year of steam production significantly improves the geothermal service contractors cash flow during the period when the royalty base abruptly increases. Overall this package of fiscal incentives proposed in the Act improves the IRR to the geothermal service contractor by about an additional 4.5%.

The Act is currently before the House of Congress awaiting approval. It is of great importance that it is approved and passed into law in order to stimulate direct investment by the private sector in the exploration and development of new geothermal steam fields.

CONCLUSIONS

The geothermal industry in the Philippines has proven to be very exciting over the past 5 years and it now has a strong international character as a result of the private sector groups now involved. The beneficial effects of private sector participation have been profound.

There will be an increasingly greater involvement by the private sector in the future because of firm plans by Government to disinvest 60% of its ownership in the two major government geothermal groups in the Philippines, NPC and PNOC. In retrospect, what appears to lie in the future for Philippine geothermal development are summed up in the following themes:-

Firstly, there is still a substantial geothermal resource base available for development in the Philippines. Although the Philippines has developed over the past 20 years some 2000 MWe of geothermal power, which represents the largest installed wet steam field capacity in the world, we have reached only some 50-60% of our ultimate potential. We expect additional geothermal generation in the future to come from a mix of new field developments, expansion of existing production steam fields, increased utilisation efficiencies and application of technology advances.

Secondly, in spite of having a 20 year old geothermal; industry there as yet has been no private sector development of any geothermal field in the Philippines. We therefore see it is vital that Government pass into law Geothermal Resource Act of 1994.

Thirdly, the introduction in 1993 of BOT legalisation has had an enormous impact on the Philippine Geothermal Industry through allowing the private sector to participate in power plant ownership and operation. This has directly triggered the commercialisation of about 586 MWe in Leyte and the 92 MW Mt. Apo geothermal power projects.

Fourthly, the Philippines geothermal industry is rapidly moving toward domination by the private sector with both PNOC-EDC and NPC privatising, and with a number of large foreign energy companies now well established in the local market place and keen to obtain further participation in the industry.

Finally, we see the future is bright for geothermal energy in the Philippines due to the commercial and institutional environment now promoting the concepts of reliable and affordable power supply through open competition, accountability, and operational and economic efficiencies. Over the past few years we in Philippine Government have become increasingly exposed to the international, privately owned energy groups. We are now looking forward with much interest to further developing both geothermal resources and our relationships with these groups, both inside and outside the Philippines.