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GEOTHERMAL ENERGY DEVELOPMENT IN THE PHILIPPINES WITH THE ENERGY DEVELOPMENT CORPORATION EMBARKING INTO POWER GENERATION

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ABSTRACT

Starting with a 3 MW development in 1977, the Philippines pursued an aggressive geothermal development program which placed the country as the second largest geothermal power producer in the world at 1954 MW. This was precipitated by the oil crisis that hit the country in the 1970's which paved the way for the creation of the Philippine National Oil Company – Energy Development Corporation (PNOC-EDC) on March 5, 1976 which was tasked to develop the indigenous resources of the country for power generation. From being a purely steam field developer and steam supplier, EDC has evolved into a fully integrated geothermal power company with its entry into power generation in 1996 through the Build-Operate-Transfer scheme. The BOT arrangement is for a period ten years (ten year cooperation period) after which the power plants are to be handed-over to EDC. This paper will discuss the brief history of the geothermal development in the Philippines, and the factors that made that growth possible through; 1) the Government's policy standpoint in geothermal energy development, 2) EDC's expertise in geothermal resource management and utilization, 3) EDC's entry into the power generation business, and, 4) EDC's transformation from a government owned and controlled corporation (GOCC) to a fully privatized corporation and its plan to move forward in optimizing the utilization of the country's geothermal resource.

1. BRIEF HISTORY OF THE GEOTHERMAL DEVELOPMENT IN THE PHILIPPINES

The catalyst to the geothermal development of the Philippines was the oil crisis that hit the country in the early 1970's, exposing the country's vulnerability to imported fossil fuel. Geothermal development efforts were initially started by the National Power Corporation which ushered in the development of the Tiwi and Makban geothermal fields in the Luzon island through the Philippine Geothermal Incorporated (now Chevron) which resulted in the establishment of aggregate 660 MW plants (1979-1984). Recognizing the massive task ahead, the PNOC-EDC was created which immediately embarked in the exploration and development of the other geothermal areas in the country. This resulted in the commissioning of the 112.5 MW Palinpinon I geothermal plant (1983), the 112.5 MW Tongonan geothermal plant (1983), the 150 MW Bacon-Manito geothermal plants (1994), and the Palinpinon II geothermal power plants (1992), all with the National Power Corporation as the power plant operator. With the advent of the BOT Law in 1992, the 588.4 MW Unified Leyte Plants (1996-1997), and the 106.0 MW Mindanao geothermal power plants (1997-1999) were installed. In February 2007, EDC commissioned its first merchant plant, the 49.4 MW Northern Negros geothermal power plant (2007). Chevron also optimized their geothermal resource (added

95.7 MW) increasing the country's geothermal power capacity to 1954.1 MW, making the Philippines the second largest geothermal power producer in the world. Looking forward, EDC as a private corporation is putting on stream growth projects with a capacity of up to 300 MW which is expected to be on line starting 2010.

1.1 Contribution of geothermal power to the country's energy mix

The 2007 data taken from the Department of Energy indicated that Geothermal Power contributes 12% of the country's total installed capacity and 17% in the energy mix which clearly demonstrates the high reliability and availability of the geothermal plants. After the completion of the growth projects, the share of geothermal energy in the national energy mix is expected to reach 20%. Although geothermal development cost is substantial, it has the advantage of being available most of the time as fuel supply (steam) is identified upfront, and is spared from the misfortune of the numerous risks involved in the procurement of fuel, like; availability of supply, transport, currency movement, etc. Since the Company began commercial operations, it has produced approximately 87,850 GWh, or 146 MMBFOE. This has generated a total foreign exchange savings for the Philippines of approximately $3.9 billion (based on an average crude oil prise of $27.00 between June 1983 and August 2006 and assuming 600 kWh = 1 BFOE).

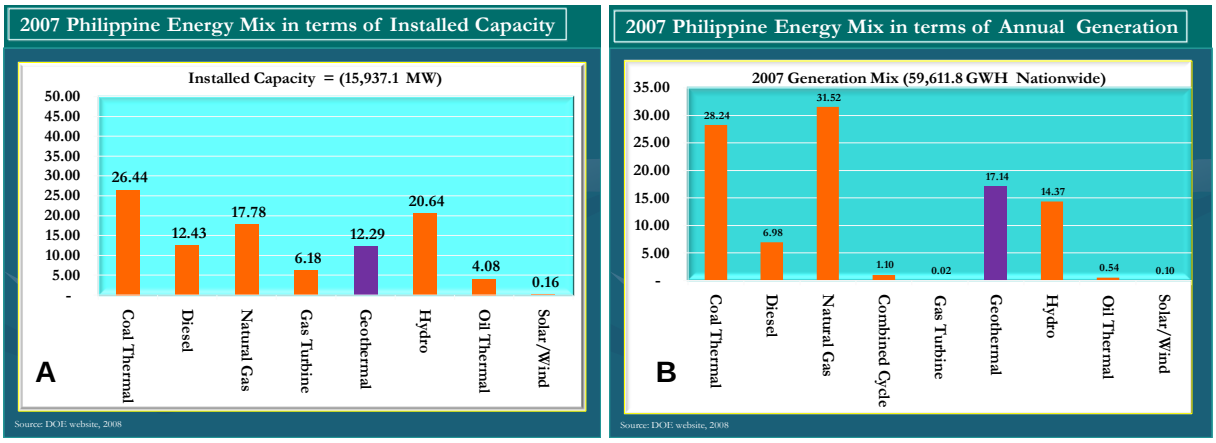

FIGURE 1: The 2007 Philippine energy mix in terms of a) installed capacity; and b) annual generation

1.2 The Philippine settings of the geothermal resources

The Philippines is situated in the western flank of the Circum-Pacific Ring of Fire where numerous active and dormant volcanoes can be found. Under these volcanic centres, lie vast geothermal resources. It is this same Ring of Fire which has made Japan, Indonesia, New Zealand, and the United States major players in the geothermal industry. Indonesia, however, is touted to be the major player in the future with its untapped potential of approximately 20,000 MW. According to the study conducted by the Department of Energy, the Philippines have a geothermal potential of 4500 MW. Out of these only 1954 MW is currently being produced, of which about 60% of the steam fields is operated by the Energy Development Corporation, and the remainder by Chevron (Table 1).

2. GOVERNMENT POLICIES TOWARDS GEOTHERMAL ENERGY DEVELOPMENT

Triggered by the oil crisis in the 1970's, the Philippine Government, in its desire to hasten the exploration, and utilization of the geothermal energy resources enacted laws that served as the foundation of its rapid development (Table 2). As mentioned earlier in this paper, Chevron (then Philippine Geothermal Incorporated) developed the first geothermal steam fields in the Philippines at

Tiwi and Makban. However, due to the huge expenditure required, the Government decided to do it on its own through the creation of PNOC-EDC.

TABLE 1: The existing operating geothermal fields in the Philippines
(with steam sales agreement with plant operator)

Field	Gross cap (MW)	Steam field operator	Power plant operator
Tiwi	330.0	Chevron	National Power Corporation
Mak-Ban	425.7	Chevron	National Power Corporation
Tongonan I	112.5	Energy Development Corp.	National Power Corporation
Unified Leyte	588.4	Energy Development Corp.	Energy Development Corp.
Palinpinon I	112.5	Energy Development Corp.	National Power Corporation
Palinpinon II	80.0	Energy Development Corp.	National Power Corporation
Bacman I	110.0	Energy Development Corp.	National Power Corporation
Bacman II	40.0	Energy Development Corp.	National Power Corporation
Mindanao I	52.0	Energy Development Corp.	Marubeni (EDC BOT)
Mindanao II	54.0	Energy Development Corp.	Marubeni (EDC BOT)
Northern Negros	49.4	Energy Development Corp.	Energy Development Corp.
TOTAL	**1954.1**		

Source: PNOC-EDC and Chevron

TABLE 2: Laws, presidential decrees and issuances that support geothermal development
(PD - Presidential Decree, PP - Presidential Proclamation, RA - Republic Act, EO - Executive Order)

Date	Laws, etc.	Purpose
1973	PD 334	Created the Philippine National Oil Company (PNOC)
1975	PP 1112	Established the Geothermal Reservation in Tongonan, Leyte
1975	PP 1413	Established the Geothermal Reservation in Palinpinon, Negros Or.
1975	PP 2036-A	Established the Geothermal Reservation in Bacon-Manito, Sorsogon
1976	PD 927	Created the Energy Development Corporation under PNOC
1978	PD 1442	Enacted the Philippine Geothermal Service Contract Law
1987	EO 215	Allowed private sector to finance, build, and operate power plants
1992	PP 853	Established the Geothermal Reservation in Mt. Apo, Cotabato
1990	RA 6957	Enacted the Build Operate Transfer Law
2001	RA 9136	Enacted the Electric Power Industry Reform Act - Privatization of NPC

The Philippine Geothermal Service Contract law (PD 1442), simply known as the Geothermal Law, provided incentives to geothermal developers as follows:

a) Exemption from payment of tariff duties and compensating tax on the importation of machinery and equipment, spare parts and all materials required for geothermal operations;
b) Entry of alien technical and specialized personnel who may exercise their profession solely for the operations of the contractor;
c) Repatriation of capital investment and remittance of earnings derived from its service contract operations.

Prospective developers, including EDC are required to secure a Geothermal Service Contract (GSC) with the Department of Energy for a particular geothermal reservation.

EO 215 and RA 6957 removed the power generation monopoly of the National Power Corporation (NPC) by opening the power industry to the private sector. It paved the way for PNOC-EDC's entry into the power generation business through Build-Operate-Transfer (BOT) contracts with private

contractors, including foreign investors for the financing, construction, operation and maintenance of the geothermal power plants within a defined cooperation period (10 years). This was implemented for the Unified Leyte project (125 MW UMPP, 232.5MW Malitbog, 180MW Mahanagdong, and the 50.9MW optimization plants) which were turned-over to EDC in 2006 and 2007, and the 106 MW Mindanao plants which are due to be turned-over on June 17, 2009. On the one hand, RA 9136 which calls for the privatization of NPC through the sale of its assets will provide an opportunity for EDC to acquire the NPC geothermal plants which EDC is supplying steam through a steam sales agreement (SSA).

The current status of the Philippines as the second largest user of geothermal energy was the result of the deliberate effort of the Government to develop an indigenous resource that nature provided and its desire to loosen the grip of imported fuels in its energy needs. This success can be summarized through the following:

a) The creation of PNOC-EDC (a GOCC), to avail of soft loans afforded by lending institutions to the government or its agencies;
b) Allocation of reservation areas for geothermal development;
c) Provision of incentives to developers;
d) Opening up of geothermal development to the private sector local and foreign, and lately;
e) Deregulation of the electricity industry through the privatization of its power generating assets (owned and operated by NPC).

3. EDC'S EXPERTISE IN GEOTHERMAL RESOURCE MANAGEMENT AND UTILIZATION

PNOC-EDC's expertise in geothermal resource management and utilization was not attained overnight. But it had the luxury of having employed visionaries who set out the road map of what PNOC-EDC is today. It started with good recruitment, training, and hiring of consultants from countries which pioneered in the development and utilization of geothermal energy, like; New Zealand, USA, and Iceland among others. The learning process was two-pronged; 1) on the job training with consultants at the geothermal sites, and 2) foreign training of some technical personnel sending them to learn geothermal technologies in countries with known expertise such as New Zealand, Iceland, Japan and the Unites States. This collaboration brought about the commissioning of two 112.5 MW plants in Tongonan, Leyte and in Palinpinon, Negros Oriental with PNOC-EDC as the steam field operator which sold steam to NPC through a Steam Sales Agreement (SSA). As soon as the SSA was put into effect, the biggest challenge to the company emerged, and that was, to sustain the supply of high-quality steam to the power plants for at least 25 years. Tongonan 1 and Palinpinon 1 served as the laboratory where the scientists and engineers had to put into practice what they had learned.

The 1990's proved to be another milestone for EDC. As it was in the 1970's, the country was beset with power shortage. It would seem that the growth of the company was tied up with the crisis. EDC developed the steam fields which supplied steam to the 150 MW BacMan plants, and the 80 MW Palinpinon 2 plants of NPC. With the enactment of the BOT Law at this time, EDC partnered with California Energy and developed the steam fields for the 588.4 MW Unified Leyte plants and with Marubeni for the supply of steam to the 106 MW Mindanao plants. The BOT agreements were covered with a ten-year cooperation period after which the plants will be handed over to EDC. These expansions also enlarged the geothermal laboratory at which EDC's scientists and engineers applied their expertise. After more than two decades of managing its geothermal production fields and having operated what could be considered the biggest geothermal laboratory in the world, the company has now developed a pool of about 700 geothermal experts in all disciplines of geothermal energy utilization; i.e. exploration, drilling, development, engineering design and construction of fluid collection and recycling systems, reservoir management, steam field operations, environmental

management, and very recently, power plant operations and maintenance. After the hand-over of the Unified Leyte plants in 2006 and 2007, EDC became a fully integrated geothermal company.

3.1 EDC's business contracts

The Company's steam field and power plant operations are based on a framework that covers four types of contracts, from which its financial position is practically hinged:

- Geothermal Service Contracts (GSC) with the Department of Energy (DOE) - give EDC the right to explore, develop and utilize geothermal resources in a certain contract area and in turn remits to the government taxes and royalties from the net proceeds;
- Steam Sales Agreements (SSA) with NPC - EDC delivers and sells steam to NPC power plants for conversion to electricity with a minimum take or pay provision;
- Power Purchase Agreements (PPA) with NPC - EDC sells to NPC electricity with a minimum energy off-take level provision;
- Energy Conversion Agreements (ECA) with BOT contractors - EDC delivers steam to the BOT power plant pays the contractor for the conversion of steam to electricity at a nominated capacity;
- Energy Sales Agreement with cooperatives and DU's - EDC sells electricity from its own merchant plant.

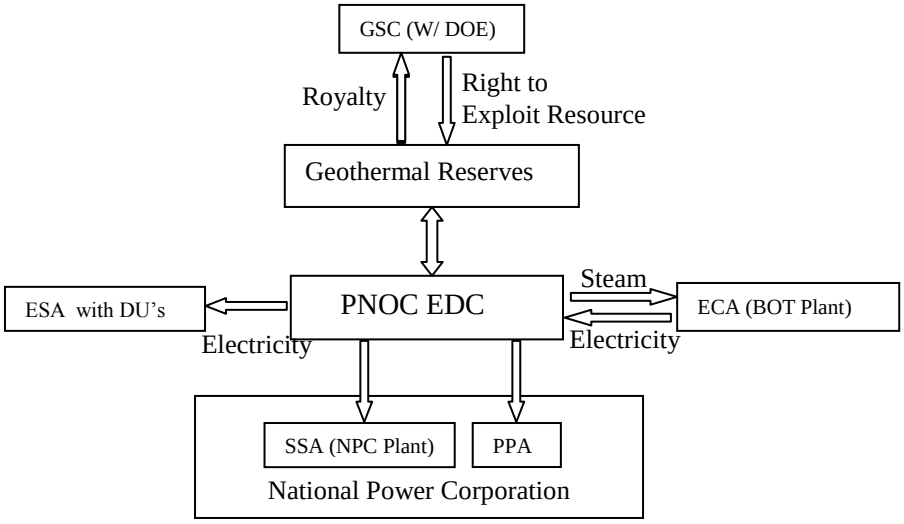

FIGURE 2: Contractual arrangements entered into by PNOC-EDC

4. EDC'S ENTRY INTO THE POWER GENERATION BUSINESS

The entry of EDC into the power generation business was made possible by RA 6957 (see Table 2) or the BOT Law of 1990. Earlier, only NPC was allowed to generate electricity, but this was relaxed in 1987 with the issuance of EO 215 where the private sector was allowed to finance, construct and operate power plants. This paved the way for the sprouting of the Independent Power Producers (IPP's) where they sell the electricity to NPC thru a PPA. EDC on the other hand, being a GOCC at that time entered into BOT contracts with California Energy (CalEn) and Ormat, for the financing, construction, and operation of the Unified Leyte plants for an aggregate capacity of 588.4 MW and with Marubeni for the 106 MW Mindanao plants. Both contracts have a term of 10 years "Cooperation period", after which the plants will be handed over to EDC. The electricity generated is sold to NPC through a PPA for a period of 25 years. The handovers done in 2006 and 2007 for the Unified Leyte plants, however, raised some doubts, as to whether EDC as a GOCC is legally allowed

to own and operate power plants, under Section 47g of RA 9136. EDC had two options though, to sell the power plants or convert itself into a private entity.

4.1 Brief description of the Unified Leyte plants

The Unified Leyte plants have an aggregate capacity of 588.4 MW composed of; 180 MW Mahanagdong A and B plants (Figure2 2 and 3), the 232.5 MW Malitbog power plant (Figure 4), the 125 MW Upper Mahiao binary plant (Figure 5), and 50.9 MW optimization plants (6 topping cycle plants, 1 bottoming plant and 1 binary plant).

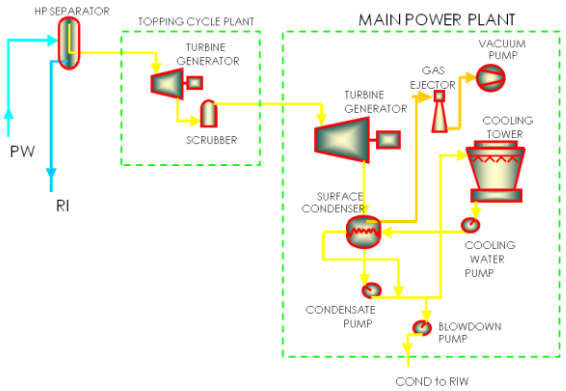

FIGURE 2: 60 MW Maha B plant process diagram; The Maha B plant utilizes exhaust steam from a high pressure non-condensing topping plant

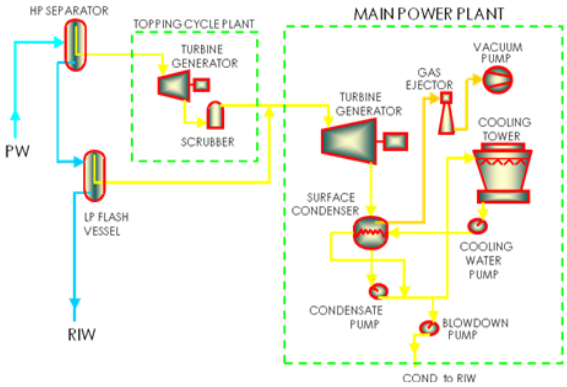

FIGURE 3: 120 MW Maha A plant process diagram; the Maha A plant utilizes exhaust steam from 2 units of non-condensing topping plants as well as steam from a second flash system

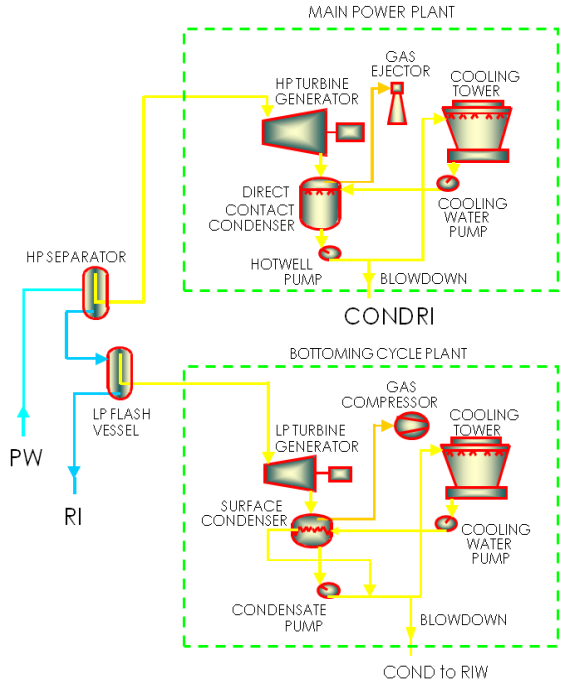

FIGURE 4: 232.5 MW Malitbog plant process diagram; the Malitbog main plant utilizes steam from a high pressure system from which the separated brine is flashed at a lower pressure to produce low pressure steam for the bottoming plant

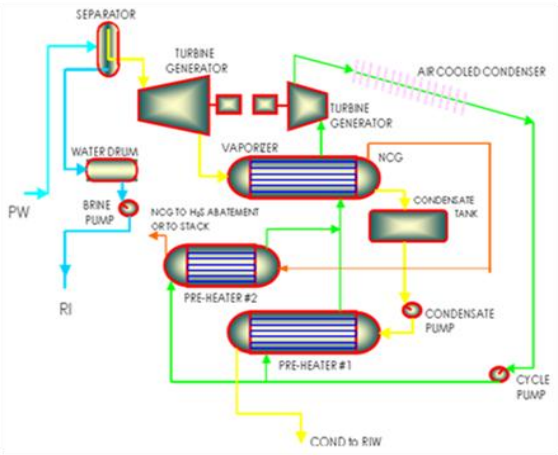

FIGURE 5: 125 MW UMPP binary plant process diagram; the upper Mahiao plant utilizes steam from a high pressure system for its back-pressure STG units which exhaust is used to vaporize

4.2 Brief description of the Mindanao and Northern Negros plants

The Mindanao plants have a total capacity of 106 MW while the Northern Negros plants have a capacity of 49.3 MW. The process diagrams for the power plants are given in Figure 6.

4.3 Brief description of the NPC geothermal plants for acquisition

As a private company, EDC can also add into its portfolio the NPC geothermal plants through acquisition. The NPC plants (see Table 1) for acquisition are conventional single-flash plants. These are: the 112.5 MW Pal 1 plant, the 80 MW Pal 2 plant, the 110 MW BacMan 1 plant, the 40 MW BacMan 2 plant, the 330 MW Tiwi plant, and the 425.7 MW MakBan plant.

4.4 Construction of new geothermal power plants

As a private company, EDC can also embark into building new power plants. It intends to capitalize on the tightening power demand-supply situation by exploring and developing new geothermal fields. Seven projects have been identified and are expected to provide an additional 280-310 MW capacity. The following table summarizes the company's future geothermal projects:

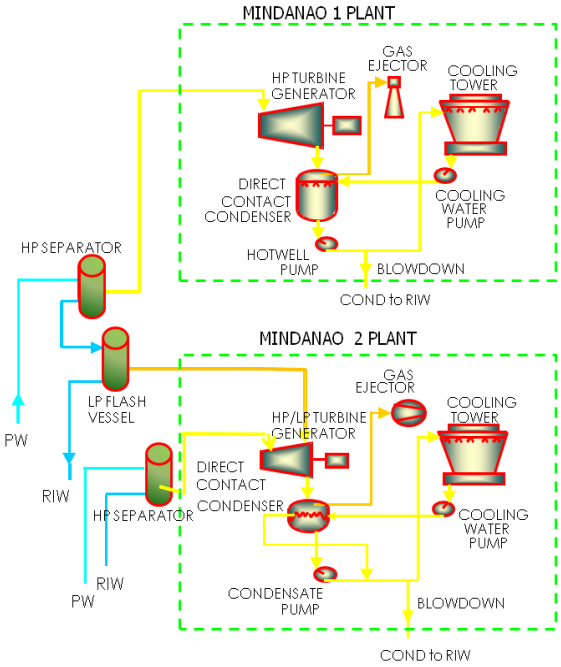

FIGURE 6: The process diagram of the 106 MW Mindanao plants (and the 49.3 MW NNGP plant). The main features of the Mindanao plants are that the M1 plant utilizes steam from a high-pressure system with its brine re-flashed at a lower pressure and fed to the low-pressure side of the M2 plant. The high-pressure steam line of both plants are interconnected for steam sharing purposes, at times when either plant has more steam than the other, or vice-versa. The NNGP plant is similar to M2 in that its turbine allows entry of low-pressure steam from re-flashed brine in its later stages

TABLE 3: EDC expansion projects

Project	Location	Capacity (MW)	Commissioning date
Nasulo	Negros Oriental	20	Jul 2010
Tanawon	Sorsogon	50	Nov 2010
Mindanao 3	North Cotabato	50	Dec 2011
Dauin	Negros Oriental	40	Jan 2014
Kayabon	Sorsogon	40	Jan 2014
Rangas	Sorsogon	40	Feb 2014
Cabalian	Southern Leyte	40	Jun 2016

Source: PNOC-EDC, 2008

5. PRIVATIZATION OF PNOC-EDC

Various sectors raised concerns on why PNOC-EDC should be privatized being an income generating GOCC. The following are the specific objectives of the company's privatization:

a) To generate funds for the government;
b) To generate capital to help further develop new geothermal resources
c) To remove from the national government the burden of additional debt financing of the loans of PNOC-EDC;
d) To allow its expansion into the power generation sector because under RA 9136, EDC as a GOCC should not compete with the private sector in the electricity generation business, consequently NPC plants are also being privatized in compliance with RA 9136;
e) To avoid operational inefficiencies brought about by government restrictions and limitations especially on the procurement of goods and services and employee benefits; and
f) To enhance the competitiveness of the company in the electricity business with the activation of the open access scheme and the Wholesale Electricity Spot Market (WESM).

The company started its privatization process on Dec. 13, 2006 when 40% of its common shares were sold through the IPO, a follow-on offering on July 13, 2007 of 20%, and finally the complete sale on Nov. 21, 2007 of its remaining shares to Red Vulcan Holdings. The privatization firmly made EDC a primary player in the power generation business.

6. CONCLUSIONS

Many factors contributed to the rapid growth of geothermal energy as the prime indigenous energy source in the Philippines; including a) the abundance of geothermal resource in the country, b) the strong government support, and c) the deliberate focus in acquiring and maintaining technical expertise. PNOC EDC as a major geothermal player in the country has already acquired expertise in all aspects of geothermal energy utilization making it a fully integrated geothermal company from exploration, to development, and power generation. With its recent privatization, the company is poised to continue with the pursuit of geothermal growth projects and acquire geothermal assets offered to the private investors to enhance its competitiveness. With the advent of reforms in the country's power industry, the global call for renewable sources of energy and the increasing fossil fuel prices, the growth of geothermal energy in the Philippines continues to have a bright outlook.

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