7.4 Application of Multi-purpose Utilization of Geothermal Energy to Indonesia

7.4.1 Multi-purpose Utilization of Geothermal Energy

The geothermal resource is versatile for not only power generation but also multipurpose utilization for agriculture and the fishing industry, etc. The geothermal energy are used by receiving the supply of heat from the geothermal power plant, or securing geothermal energy by geothermal well drilling in general. A plantation agriculture, horticulture, cultivation, air-conditioning, and dry processing, etc. in the low cost can be done using geothermal energy as by-product of geothermal power business. Only the power application seems to be noted in the geothermal development in Indonesia. It is hardly thought to grant favors of the geothermal development, such as the heat supply etc. to local people in the surrounding area of the geothermal field of power development. It is necessary to introduce the industry by the multipurpose utilization of geothermal energy using a waste heat from the geothermal power plant in the future for social development. Furthermore, geothermal energy of relatively low temperature from hot springs will be used as alternative energy source of fossil fuel. The multipurpose utilization will contribute to global environmental preservation as well as geothermal power generation.

This study was conducted to investigate the possibility of application of the multipurpose utilization of geothermal energy to geothermal fields in Indonesia. According to the geothermal law, not only geothermal power development but also direct (multipurpose) use of geothermal energy should be promoted and the business of the direct use of geothermal energy by local governments is encouraged. However, a specific method of multipurpose utilization is still opaque, and does not have an appropriate business model either. It is necessary to discuss the overall plan of geothermal development including the multipurpose utilization. Examples of the effort of various promotions of multipurpose utilizations of geothermal energy in Indonesia and other countries, and useful information for future introduction of the multipurpose utilization into the Indonesian geothermal fields are introduced in this section.

Utilizations at various fluid temperatures on the basis of the geothermal direct use in many countries of the world are shown in Fig.7.4.1-1. Various direct uses of geothermal energy are conducted in the geothermal countries. For example, the heat supplied from the power plant is used for a dry processing of farm products in the southern Negros in the Philippines and the floriculture cultivation is done using air-conditioned green houses with geothermal energy around the Olkaria geothermal power station in Kenya. However, detailed data and condition of these multipurpose utilization businesses cannot be available. Therefore, the direct use businesses in Japan are introduced in this section.

The cases of the direct use businesses in Oita prefecture, Japan, where geothermal

generation businesses are active, are introduced (ECFA 2003). Farm and fishery products and processed goods by the multipurpose utilization of geothermal energy are known as results One Village One Product Movement in Oita prefecture in Japan. One Village One Product Movement is cooperation activity between citizen and local government for social development in Oita.

Utilization of geothermal energy in Oita, Japan, such as Onsen and swimming pool in tourist industry is well known from of old. Recently, the geothermal heat is noted as a clean energy source and is being used for horticulture of the vegetable and floriculture, soft-shelled turtle's culture fishery, heating of facilities, and the forestry use, etc. in Oita as shown in Table 7.4.1-1. In particular, horticultures of floriculture in Amagase town and Kokonoe town are regarded as successful business. An eminent floriculture apartment of a housing complex was constructed, and the hot water from a few geothermal wells has been supplied for the greenhouse.

Roses are cultivated in the greenhouse, and are shipped to major cities in Japan everyday. This must be successful business with a high profitability. People in these towns are establishing the floriculture union. Construction and management of the greenhouse are being executed by the union. The local government takes charge of securing the geothermal energy using geothermal wells in Amagase town because there was a resources development risk. The geothermal wells were drilled by the local government of Amagase town and the hot water from the wells is supplied to the green house by the government. The local government is applying the fee from the union for to maintenance of the geothermal wells and pipelines.

In Kokonoe town, hot water is supplied from the geothermal wells in the geothermal power station to the green houses. The green house complex has been managed by the floriculture productive union and floriculture cultivation in the green houses is conducted by union members.

Local people are able to participate in the business of the multipurpose utilization of geothermal energy without risk, if hot water is supplied from the geothermal power plants in Indonesia. It is necessary to organize the union etc. when the supply of heat is received from the geothermal power plants. It is necessary to discuss best operation procedure that is appropriate for the region. Neither design nor operation of the facility for the multipurpose utilization of geothermal energy is technically arduous. However, scale are deposited in the hot water pipelines and the heat exchanger, when the hot water is supplied from the power plant. Since the scale hinders smooth operation of the facilities, the countermeasure is necessary. There are excellent technologies in Japan and these technologies can be applied to prevent the scale trouble.

Present projects and possibility of the multipurpose utilization of geothermal energy in

Indonesia were introduced below on the basis of information provided from BPPT (Taufan Surana 2007) (Figs. 7.4.1-2 to 7.4.1-6).

7.4.2 General Information in the Whole Country

As a country with vast potential of high enthalpy geothermal resources, Indonesia has been focusing the development of geothermal energy for electricity generation. On the other hand, Indonesia is also blessed with a huge low-to-medium geothermal resources as well as hot springs, natural geothermal wells, etc., which can be applied for multi-purpose utilization or as so called direct use applications. Besides the above geothermal resources, direct use applications also utilize energy from un-exploited brine and small capacity production wells.

In general, the geothermal resources in Indonesia are located in mountainous areas with agricultural lands (including plantations), forestry, bathing and spa resorts, etc. which need heat for their processes or activities. This is a perfect situation for the geothermal energy direct use to be developed. However, unfortunately the multi-purpose utilization of geothermal energy in Indonesia is very low. Table 7.4.2-1 shows the summary of direct use data from individual countries (Taufan Surana 2007).

Many local governments have been starting the identification of the direct use potential in their administrative territories. For example, West Java, a province with the largest geothermal resources, completed the study and reported it on the development plan of direct use in the West Java Province in 2003, and started the implementation in 2006 by adopting the existing mushroom growing direct use for the community development program.

Indonesian government is interested in the expansion of the multipurpose utilization of geothermal energy and BPPT (Agency for the Assessment and Application of Technology) advances the investigation of the multipurpose utilization of geothermal energy in this country. Many of information on the multipurpose utilization of geothermal energy in this country were provided by BPPT (Taufan Surana 2007). The university in this country etc. shows interest in the multipurpose utilization of geothermal energy as study object. At present, BPPT is only research institute, which is studying about the multipurpose utilization of geothermal energy systematically in Indonesia. It is thought that BPPT plays an important role to the expansion of the multipurpose utilization of geothermal energy in Indonesia.

(1) Bathing and Swimming

The most common and traditional usage is for balneology, bathing and heated swimming pools. Some of them, for example in Cipanas and Ciater of West Java Province, are being commercially exploited as hot spring and spa resorts. At present, there are no accurate data

on the total countrywide utilization and capacity because they are very difficult to collect and quantify. According to the estimation by Lund and Freeston (2001), the use for bathing and swimming in Indonesia is 2.3MWt in capacity with an annual energy use of 42.6TJ/yr.

Since about 10 years ago, Pertamina has been utilizing the geothermal steam to heat up freshwater for the domestic and office use in Kamojang Geothermal Field, and there is no measurement for the capacity as well as the annual energy use.

When the multipurpose utilization of geothermal energy is proposed for the tourism industry and the medical use, it is necessary to investigate the condition and needs in the region where the geothermal power plants are constructed.

(2) Agriculture

The utilization of geothermal energy for agriculture in Indonesia was initiated by a geothermal research group of BPPT (Agency for the Assessment and Application of Technology) in 1999. BPPT, with the cooperation of Pertamina, implemented a pilot plant of the geothermal energy direct use for mushroom growing in Kamojang Geothermal Field (West Jawa). BPPT also implemented a pilot plant of the utilization of natural geothermal well for coconut meat drying (copra) in Way Ratai Geothermal Field (Lampung). Starting from last year, BPPT and Magma Nusantara Limited (MNL) are studying the utilization of geothermal energy for silk thread process and tea drying in Wayang Windu Geothermal Field (West Java).

In Lahendong Geothermal Field (North Sulawesi), a non-governmental organization built a full-scale facility for palm wine processing by utilizing geothermal steam. In the same field, Pertamina built a pilot plant for coconut meat drying (copra) by utilizing geothermal steam.

Any project of the multipurpose utilization of geothermal energy in Indonesia is an investigation or a pilot phase excluding the palm wine processing business in the Lahendong geothermal power plant. It is thought that there are a lot of regions where the multipurpose utilization of geothermal energy can be used for agriculture and forestry, because the geothermal fields are often located in the mountain range. If distribution structure and the market of the products are surveyed and the proper procedure of introduction of the multipurpose utilization of geothermal energy can be discussed, the useful business using geothermal energy for social development can be proposed.

(3) Aquaculture

At present, there is only one place identified as an aquacultural facility that utilizes geothermal fluid in Indonesia. It is a traditional freshwater fishery in Lampung, mixing natural geothermal hot water (outflow) with freshwater from a river to grow large catfishes.

The farmer reported that the fishes grow better in the geothermal fluid and freshwater mixture.

(4) Space Heating

As a tropical country, the need of space heating in Indonesia is extremely limited. A small space heating facility is applied in Patuha Geothermal Field, but the information about the exact size and capacity is unavailable. The humidity adjustment by air-conditioning using geothermal energy is effective for the cultivation of the high additional value floriculture (orchid, rose etc.), but this application has not been done in Indonesia.

7.4.3 Specific Projects

(1) Kamojang

BPPT (Agency for the Assessment and Application of Technology) with the cooperation of Pertamina started a research on the geothermal energy direct use for mushroom growing in Kamojang Geothermal Field in 1999. The facility consists of a steam generator heat exchanger, an autoclave, a freshwater tank, an inoculation room, incubation rooms and production rooms. The schematic diagram of the facility is as shown in Fig. 7.4.3-1 below. Steam from a small capacity well with the temperature of 110-120ºC is directed to a steam generator to heat up freshwater. The heated fresh-steam is used to sterilize the mushroom growing media, or as so called “baglogs”, and also for space heating to keep the incubation room warm. The geothermal steam is to substitute the use of fossil fuel (kerosene), which is getting very expensive year by year(Fig. 7.4.3-2).

Starting from 2006, the local government of the West Java Province has been adopting this facility as a model for an ‘income generating’ community development program, and expanding the capacity of the facility to 25,000 baglogs per month. The provincial government provides production houses for the local community, and they are involved in the production process. They can buy the sterilized baglogs at a lower price, and are allowed to deliver the mushroom directly to the market.

(2) Lahendong

Lahendong Geothermal Field is surrounded with a palm wine plantation, which is managed by 3,500 farmers. A non-governmental organization called Yayasan Masarang with the cooperation of Pertamina implemented a geothermal energy direct use facility for palm wine production with the capacity of 2 – 5 tons/day. At present, the facility is running with capacity 1 ton/day. The schematic diagram of the facility is as shown in Fig. 7.4.3-3 below. Steam in the 2-phase fluid from the wells is separated in a separator, and then directed to a condensing turbin to generate 20 MW electricity. The excess steam of 4 tons/hour is utilized

for the palm wine production. Some of the products are exported to the Netherland (Fig. 7.4.3-4).

(3) Way Ratai

Way Ratai is an undeveloped geothermal field in Lampung Province, located in a coconut plantation area. There are many natural shallow wells in it with temperature range between 80 – 98ºC. BPPT (Agency for the Assessment and Application of Technology) implemented a pilot plant of the utilization of natural geothermal well for coconut meat drying (copra) in this field in 2003 – 2004, with the capacity of 200 kg coconut meat per batch. The facility consists of a downhole heat exchanger, a drying room, a pump, and a freshwater tank. The schematic diagram of the facility is as shown in Fig. 7.4.3-5. The downhole heat exchanger is put in a natural geothermal well with the temperature of 92 - 98ºC, and the freshwater is flowed into it. The freshwater is heated up and directed to the drying room to dry up the coconut meat by natural drag conduction heat exchange. The quality of the copra produced in this facility is much better compared to the conventional one because there is no smoke contamination in it.

7.4.4 Future Possibility

The development of geothermal direct use in Indonesia is stipulated in the Geothermal Law (Law No. 27 / 2003). Consequently, the Government of Indonesia cq. the Department of Energy and Mineral Resources cq. the Directorate General of Mineral, Coal and Geothermal (DGMCG) has been starting the identification of the direct use potential in Indonesia to prepare its regulation. At present, the multipurpose utilization of geothermal for the application of community development programs in Indonesia is mostly in the research stage, but in the near future the commercial base direct use business is predicted to grow rapidly, provided that the regulations on it is settled and come into effect.

(1) Kamojang

Learning from the experience of the existing direct use application for mushroom growing in Kamojang, the calculation result by BPPT showed that a commercial base business is economically feasible for a certain large scale. A detailed study for the market demand analysis is necessary before the implementation.

(2) Lahendong

The North Sulawesi, where Lahendong Geothermal Field is located, is a province with a large potential of coconut plantation and corn farming. Pertamina has a plan to utilize the geothermal steam in Lahendong for coconut meat and corn drying business commercially. A pilot plant for coconut meat drying (copra) has been built by Pertamina, and its operational

experiment gave a good result. The commercial implementation is expected to be commenced in the near future (Fig. 7.4.4-1).

Besides the above products, the local municipal government of Tomohon City plans to adopt the Kamojang's mushroom growing direct use in Lahendong Geothermal Field as a pilot plan for the community development program.

(3) Wayang Windu

Wayang Windu Geothermal Field, which is being developed by Magma Nusantara Limited (MNL), is located in a tea plantation area owned by the State Own Company called PTPN8, and surrounded by a national forest. The geothermal fluid produced in Wayang Windu is of two-phase, so that a separator is installed to separate the steam from the hot water. The steam is directed to a turbine to generate electricity with the capacity of 110 MWe, while the separated hot water (or so called brine) which still has a high energy content with the temperature of 175 – 180ºC, is reinjected into the earth through a brine pipeline and wells. This pipeline is about 4 kms long, laid down near the PTPN8's tea drying plant. BPPT with the cooperation of MNL and PTPN8 is studying the feasibility of utilizing the brine for tea withering and drying processes in commercial base business, to substitute the use of the Industrial Diesel Oil (IDO). PTPN8 spends more than 1 million liters of IDO or equivalent to more than Rp. 4 billions yearly. The application of the geothermal direct use is expected to reduce not only a huge fuel cost, but also the CO2 gas emission of more than 3,000 tons per year. Before the implementation, it is very important to assess the possibility of silica scaling occurrence due to lowering the brine temperature (Fig. 7.4.4-2).

(4) Ulubelu

Ulubelu geothermal field is located in Lampung Province. At present, exploration well drilling activities by Pertamina is in progress to develop 220 MW power generation in total. Ulubelu geothermal field is surrounded by a coffee plantation. The direct utilization for coffee processing is a very prospective in this field. BPPT is planning to make a study on it in 2008.

(5) Sarulla

Sarulla Geothermal Field is located in the North Sumatra Province. This field is owned by PLN and being developed by the joint venture cooperation of Medco Energy, Itochu and ORMAT. There are many agricultural and plantation products such as coffee, etc. in this field that can be processed by utilizing geothermal fluids.

(6) Sibayak

Sibayak Geothermal Field is also located in the North Sumatra Province, and being developed by Pertamina for 2 MW monoblock power generation. This field is surrounded by a coffee plantation. At present, a 10MW power plant is being constructed, and since fluids in this field is a water-dominated fluid, there is a great possibility to utilize the brine for coffee processing.

(7) Ulumbu and Mataloko

Ulumbu and Mataloko Geothermal Fields are located in the East Nusa Tenggara (NTT) Province, being developed by PLN. There are many agricultural products yielded from these areas, for example, maize, cassava, onion, etc. These products need heat for their processing treatment, and geothermal fluids (steam or brine) can be utilized to do it.

7.4.5 Advisable Promotion Methods

As described previously, the multi-purpose geothermal utilization in Indonesia is decelerated. In order to accelerate its development, it necessary to implement actions such as the following:

- ✓ Prepare and issue regulations on multi-purpose geothermal utilization or direct use, including the brine pricing policy.
- ✓ Identify the direct use potential in Indonesia and prepare an action plan to develop it.
- ✓ Study on defining and characterizing the direct use applications for geothermal energy, with emphasis on defining barriers to widespread application.
- ✓ Study and research to remove barriers, to enhance technology and economics, and to test and standardize equipment.
- ✓ Implement direct use facilities (pilot project or commercial project) in the most potential fields.
- ✓ Develop engineering standard for the direct use application facility.

The geothermal power development must be promoted positively in the whole country in the future as shown in the master plan of this report. If the multi-purpose geothermal utilization in the objected field is promoted in accordance with the geothermal power development plan, even the local people can be received the favor of the geothermal development. It is possible that the local people positively accept the geothermal power development and plant

construction in their field. Considering shortage of technical capability and lack of funding for projects of the multi-purpose geothermal utilization, technical and financial supports for the projects by developed countries are necessary. Most of all multi-purpose geothermal utilization projects are believed to contribute to social development for local people. If the pilot project of the multipurpose geothermal utilization, in which the local people take part, is executed and the reasonable profitability of the project can be demonstrated, these probably have the large positive effect for the dissemination and the expansion of the multipurpose utilization.

7.4.6 Summary

Considerations affecting the introduction of a project for multi-purpose geothermal utilization in Indonesia are as follows.

- ✓ Since multipurpose geothermal utilization contributes to a reduction in the consumption of fossil fuel and to global environmental protection, it is positively advanced in developed countries.

- ✓ Industry driven by multipurpose geothermal utilization can be introduced for the development of rural areas in Indonesia.

- ✓ It is suitable to plan for multipurpose geothermal utilization in combination with the geothermal power development, because geothermal energy securing accompanies the resource development risk.

- ✓ Studies of multipurpose geothermal utilization have been carried out in Indonesia, and multipurpose geothermal utilization projects are functioning in Kamojang and Lahendong.

- ✓ Legislation concerning geothermal applications and multipurpose geothermal utilization is insufficient at present. Legislation that better suits the current state of the country is necessary.

- ✓ The study of multipurpose geothermal utilization is mainly advanced by BPPT. It is expected that BPPT will play the key role in the promotion of multipurpose geothermal utilization in the future.

- ✓ It is necessary to solve technical problems and to study the economics of projects and distribution and markets to encourage the dissemination and expansion of multipurpose geothermal utilization, and to establish a business model.

It is advisable that technical assistance concerning multipurpose geothermal utilization be

obtained from developed countries that have the requisite experience and know-how in geothermal development. In addition, the business model should be established through a pilot project in cooperation with a developed country. Incorporating the project for multipurpose geothermal utilization into the geothermal power development plans would appear to be effective for promoting the expansion of multipurpose geothermal utilization.

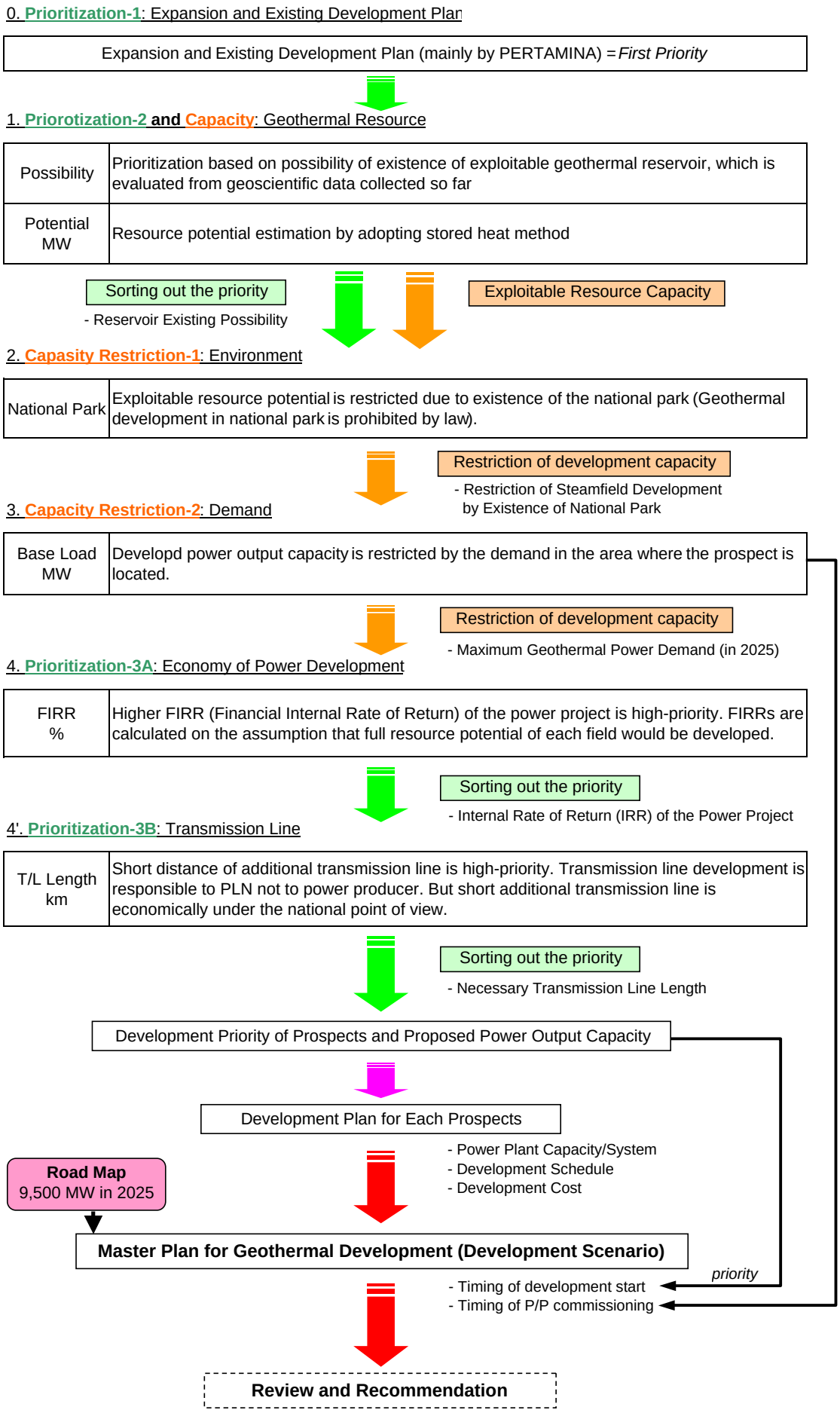


Fig. 7.1.1-1 Methodological Flow for Formation of Master Plan for Geothermal Development

Table 7.1.2-1 Existing Geothermal Development Plan in Indonesia (as of June 2007)

No.	Field (Working Area)	Installed Capacity (MW)	Estimated Resource Potential by PERTAMINA or MEMR (MW)		Development Plan (MW)											Note
			Reserves	Resources	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total	
PERTAMINA's Working Area																
1	**Sibayak-Sinabung**	2	170	220	8	-	-	-	-	-	-	-	-	-	8	new 10MW unit, 2MW retire PT Priamanaya
2	**Sibual-Buali (Sarula)**	-	880	250	-	-	-	-	-	300	-	-	-	-	300	PLN-Medco,Ormat,Itochu
3	**Sungai Penuh**	-	160	110	-	-	-	*	-	-	-	55	-	-	55	
4	**Hululais-Tambang Sawah**	-	500	150	-	-	-	*	-	-	-	110	-	-	110	
5	**Lumut Balai**	-	600	230	-	-	-	**	110	-	-	110	-	-	220	
6	**Waypanas (Ulubelu)**	-	400	160	-	-	-	**	110	-	-	110	-	-	220	
7	**Cibeureum-Parabakti (Salak)**	380	590	-	-	-	-	-	-	-	-	-	-	-	0	Unocal
8	Pangalengan		800	140												
	G. Patuha	-	-	-	-	-	-	-	-	60	-	-	-	60	120	GeoDipa
	Wayang Windu	110	-	-	-	110	-	-	-	-	-	-	-	-	110	Magma Nusantara, Star Energy
9	Kmojang-Darajat		660	-												
	Kamojang	140	-	-	-	60	-	-	60	-	-	-	-	-	120	
	Darajat	145	-	-	-	110	-	-	-	-	-	-	-	-	110	Amoseas
10	**Karaha, Cakrabuana**	-	400	120	-	-	-	-	-	-	-	-	-	-	30	*tentative plan*
11	**DTT. Dieng**	60	580	200	-	-	-	-	-	60	-	-	-	60	120	GeoDipa
12	**Iyang, Argopuro**	-	-	-	-	-	-	-	-	-	-	-	-	-	0	
13	**Tabanan (Bedugul)**	-	270	80	-	-	-	-	-	-	-	-	-	-	175	Bali Energy
14	**Lahendong (inc. Tompaso)**	20	300	230	20	20	-	20	40	-	-	-	-	-	100	
15	**Kotamobagu**	-	180	100	-	-	-	*	-	-	-	40	-	-	40	
Others																
1	**Ulumbu (Flores)**	-	200	-	-	-	6	-	-	-	-	-	-	-	6	near Ruteng
2	**Mataloko (Flores)**	-	65	10	2.5	-	-	-	-	-	-	-	-	-	2.5	near Bajawa
Total		857	6,755	2,000	31	300	6	20	320	420	0	425	0	120	**1,847**	

* : modular plants tailored to available steam at the wellheads

** : modular plants tailored, or one unit (55MW) will be proceeded earlier by PLN

Table 7.1.3-1 Exploitable Resource Potential of Promising Fields (Sumatra)

Region	No	Field Name (underline: Existing W/A)	Develop. Status*	Temperature(°C)			Estimated Resource Potential (MW)						Reservoir Existence Possibility **	Installed Capacity (MW)	Existing Develop. Plan (MW)	Possible Additional /New Capa. (MW)	Total Potential (MW)	Note
				Surface Max.	Geot./ Reserv.	Measured @well	source	Unidentified		Identified								
								Spec.	Hypo.	Possible	Probable	Proven						
SUMATRA																		
Aceh	1	IBOIH - JABOI	S2	100	-	-	JICA	-	-	10-20	-	-	3	0	0	20	20	
							MEMR	25	73	50	-	-						
Aceh	2	LHO PRIA LAOT	S1	101	170-220	-	MEMR	50	-	-	-	-	NE	0	0	-	-	
Aceh	3	SEULAWAH AGAM	S2	100	180-300	-	JICA	-	-	560-1,380	-	-	3	0	0	600	600	
							MEMR	-	-	282	-	-						
Aceh	4	G. GEUREUDONG	RE	69	-	-	MEMR	-	120	-	-	-	NE	0	0	-	-	
Aceh	5	G. KEMBAR	S1	89	>190	-	MEMR	-	92	-	-	-	NE	0	0	-	-	
N.Sumatra	6	G. SINABUNG	RE	65	-	-	MEMR	225	-	-	-	-	NE	0	0	-	-	
N.Sumatra	7	LAU DEBUK-DEBUK / SIBAYAK	OP	116	-	302	MEMR	-	34	35	-	30	1	2	8	150	160	
							PERTAMINA	-	220	130	-	40						
N.Sumatra	8	SARULA	F2	101	-	310	MEMR	-	100	200	-	80	1					
							PERTAMINA	-	(250)	(750)	-	(130)						
N.Sumatra	9	SIBUAL BUALI	F1	72	-	267	JICA	-	-	-	-	60-115		0	300	360	660	within one Working Area
							MEMR	-	-	556	-	-	1					
							PERTAMINA	-	(250)	(750)	-	(130)						
N.Sumatra	10	S. MERAPI - SAMPURAGA	S2	119	<290	-	JICA	-	-	500-1,120	-	-	2	0	0	500	500	
							MEMR	-	-	420	-	-						
N.Sumatra	11	PUSUK BUKIT - DANAU TOBA	S1	90	<290	-	MEMR	225	-	-	-	-	NE	0	0	-	-	
N.Sumatra	12	SIMBOLON - SAMOSIR	S1	91	>170	-	MEMR	225	-	-	-	-	NE	0	0	-	-	
N.Sumatra	71	SIPAHOLON-TARUTUNG	S1	65	>170	-	JICA	-	-	55-135	-	-	Low	0	0	50	50	
							MEMR	100	-	190	-	-						
W.Sumatra	13	MUARALABUH	S2	106	180-270	-	JICA	-	160-400	160-420	-	-	2	0	0	240	240	
							MEMR	-	-	194	-	-						
W.Sumatra	14	G. TALANG	S2	98	<290	-	JICA	-	-	15-40	-	-	3	0	0	30	30	
							MEMR	-	-	94	-	-						
Jambi	15	LEMPUR / KERINCI	F1	97	210-290	-	JICA	-	-	15-30	-	10-25		0	0	60	60	
							MEMR	-	-	150	15	40	1					
Jambi	16	SUNGAI TENANG	S1	96	-	-	MEMR		74	-	-	-	NE	0	0	-	-	
Jambi	17	SUNGAI PENUH	S2	102	200-250	-	JICA	-	-	420-900	-	-		0	55	300	355	
							MEMR	-	-	208	-	-	2					
							PERTAMINA	-	110	160	-	-						
Jambi	18	SUNGAI BETUNG	S1	30	-	-	MEMR	100	-	-	-	-	NE	0	0	-	-	
Jambi	19	AIR DIKIT	S1	98	-	-	MEMR	225	-	-	-	-	NE	0	0	-	-	
Jambi	20	G. KACA	S1	41	-	-	MEMR	25	-	-	-	-	NE	0	0	-	-	
Bengkulu	21	B. GEDUNG HULU LAIS	S2	95	180-290	-	JICA	-	-	640-1,580	-	-		0	110	800	910	within one Working Area
							MEMR	-	150	500	-	-	2					
							PERTAMINA	-	(150)	(500)	-	-						
Bengkulu	22	TAMBANG SAWAH	S2	99	>230	-	JICA	-	-	300-560	-	-						
							MEMR	-	73	100	-	-	2					
							PERTAMINA	-	(150)	(500)	-	-						
Bengkulu	23	BUKIT DAUN	S1	95	-	-	MEMR	225	-	-	-	-	NE	0	0	-	-	
S.Sumatra	24	MARGA BAYUR	S2	98	180-250	-	JICA	-	-	80-200	-	-		0	0	170	170	
							MEMR	-	145	194	-	-	3					
S.Sumatra	25	LUMUT BALAI	S2	98	-	-	JICA	-	-	600-1,140	-	-		0	220	400	620	
							MEMR	-	235	600	-	-	2					
							PERTAMINA	-	230	600	-	-						
S.Sumatra	26	RANTAU DADAP - SEGAMIT	S1	96	-	-	MEMR	225	-	-	-	-	NE	0	0	-	-	
Lampung	27	ULUBELU	F1	99	-	210	JICA	-	-	380-860	-	-		0	220	220	440	
							MEMR	-	156	380	-	20	1					
							PERTAMINA	-	160	400	-	-						
Lampung	28	SUOH ANTATAI	S2	99	230-300	-	JICA	-	-	680-1,280	-	-		0	0	600	600	
							MEMR	-	163	300	-	-	2					
Lampung	29	G. SEKINCAU	S2	98	260-300	-	JICA	-	-	280-540	-	-		0	0	300	300	
							MEMR	-	100	130	-	-	2					
Lampung	30	RAJABASA	S2	100	200-280	-	JICA	-	-	120-250	-	-		0	0	120	120	
							MEMR	-	40	40	-	-	3					
Lampung	31	WAI RATAI	S2	92	220-290	-	JICA	-	-	135-260	-	-		0	0	120	120	
							MEMR	-	194	-	-	-	3					
													Subtotal	**2**	**913**	5,040	**5,955**	

* Development Status: RE: Unexplored or regional reconnaissance only; S1: Local surface exploration done; S2: Detailed surface exploration done; F1: Pre-feasibility studies done; F2: Feasibility studies done (complete); OP: Power plant in operation

** Reservoir Existing Possibility: 1 : Confirmed by well(s); 2 : Infered mainly by geothermometer; 3 : Infered by some geoscientific data; Low : Low possibility or low temp.; NE : Not enough data for evaluation

Table 7.1.3-1 Exploitable Resource Potential of Promising Fields (Java-Bali)

Region	No	Field Name (underline: Existing W/A)	Develop. Status*	Temperature(°C)			Estimated Resource Potential (MW)						Reservoir Existence Possibility **	Installed Capacity (MW)	Existing Develop. Plan (MW)	Possible Additional /New Capa. (MW)	Total Potential (MW)	Note
				Surface Max.	Geot./ Reserv.	Measured @well	source	Unidentified		Identified								
								Spec.	Hypo.	Possible	Probable	Proven						
JAVA-BALI																		
W.Java	32	KAMOJANG	OP	96	-	252	PERTAMINA	-	-	-	(70)	(590)	1	140	120	60	320	
W.Java	33	G. SALAK	OP	-	-	312	PERTAMINA	-	-	110	-	480	1	380	0	120	500	
W.Java	34	DARAJAT	OP	103	235-240	247	PERTAMINA	-	-	-	(70)	(590)	1	145	110	75	330	
W.Java	35	CISOLOK - CISUKARAME	F1	99	>250	100	JICA	-	-	240-580	-	-	2	0	0	180	180	
							MEMR	-	50+0	50+83	-	-						
W.Java	36	G. PATUHA	F2	89	220	242	PERTAMINA	-	(140)	(250)	(130)	(420)	1	0	120	380	500	
W.Java	37	G. WAYANG - WINDU	OP	50	-	270	PERTAMINA	-	(140)	(250)	(130)	(420)	1	110	110	180	400	
W.Java	38	G. KARAHA	F2	95	203-300	350	PERTAMINA	-	(120)	(190)	(180)	(30)	1	0	30	370	400	
W.Java	39	G. TELAGABODAS	S2	92	217-258	350	PERTAMINA	-	(120)	(190)	(180)	(30)	1					
W.Java	40	TANGKUBANPERAHU	S2	96	>170	-	JICA	-	-	10-30	-	-	3	0	0	20	20	
							MEMR	-	100	90	-	-						
Banten	41	BATUKUWUNG	S2	52	-	-	MEMR	-	-	115	-	-	NE	0	0	-	-	
Banten	42	CITAMAN - G. KARANG	F1	94	>180	-	JICA	-	-	15-35	-	-	Low	0	0	20	20	
							MEMR	-	-	170	-	-						
Banten	43	G. ENDUT	RE	84	-	-	MEMR	225	-	-	-	-	NE	0	0	-	-	
C.Java	44	DIENG	OP	94	-	330	PERTAMINA	-	200	190	110	280	1	60	120	220	400	
C.Java	45	MANGUNAN	S2	46	-	-	MEMR	-	-	92	-	-	NE	0	0	-	-	
C.Java	46	TELOMOYO	S2	37	>190	-	JICA	-	-	60-125	-	-	Low	0	0	50	50	
							MEMR	-	92	-	-	-						
C.Java	47	UNGARAN	S2	86	180-320	-	JICA	-	-	140-355	-	-	2	0	0	180	180	
							MEMR	-	50	52	-	-						
C.Java	48	G. SLAMET	S2	51	-	-	MEMR	-	-	185	-	-	NE	0	0	-	-	
E.Java	49	G. ARJUNO - WELIRANG	S1	70	-	-	MEMR	-	38	92	-	-	NE	0	0	-	-	
E.Java	50	WILIS / NGEBEL	S2	93	190-250	137	JICA	-	-	120-280	-	-	2	0	0	120	120	
							MEMR	-	-	120	-	-						
E.Java	51	IJEN	S2	57	-	-	JICA	-	-	80-200	-	-	3	0	0	120	120	
							MEMR	-	92	185	-	-						
E.Java	72	IYANG ARGOPURO	S1	65	-	-	MEMR	-	110	185	-	-	NE	0	0	-	-	
							PERTAMINA	-	-	-	-	-						
Bali	52	BEDUGUL	F2	32	280-300	310	JICA	-	-	460-820	-	-	1	0	175	155	330	
							MEMR	-	-	226	-	-						
							PERTAMINA	-	80	240	-	30						
													Subtotal	**835**	**785**	2,250	**3,870**	

* Development Status:
RE: Unexplored or regional reconnaissace only
F1: Pre-feasibility studies done
S1: Local surface exploration done
F2: Feasibility studies done (complete)
S2: Detailed surface exploration done
OP: Power plant in operation

** Reservoir Existing Possibility:
1 : Confirmed by well(s)
2 : Infered mainly by geothermometer
3 : Infered by some geoscientific data
Low : Low possibility or low temp.
NE : Not enough data for evaluation

Table 7.1.3-1 Exploitable Resource Potential of Promising Fields (Nusa Tenggara, Sulawesi and Maluku)

Region	No	Field Name (underline: Existing W/A)	Develop. Status*	Temperature(°C)			Estimated Resource Potential (MW)						Reservoir Existence Possibility **	Installed Capacity (MW)	Existing Develop. Plan (MW)	Possible Additional /New Capa. (MW)	Total Potential (MW)	Note
				Surface Max.	Geot./ Reserv.	Measured @well	source	Unidentified		Identified								
								Spec.	Hypo.	Possible	Probable	Proven						
NUSA TENGGARA																		
W.Nusa Tenggara	53	HU'U DAHA	S2	86	-	-	JICA	-	-	115-290	-	-	3	0	0	110	110	
							MEMR	-	-	69	-	-						
E.Nusa Tenggara	54	WAI SANO	S2	92	>250	-	JICA	-	-	50-105	-	-	3	0	0	50	50	
							MEMR	-	90	33	-	-						
E.Nusa Tenggara	55	ULUMBU	F2	96	260-300	240	JICA	-	-	-	-	125-250	1	0	6	144	150	
							MEMR	-	-	187.5	-	12.5						
E.Nusa Tenggara	56	BENA - MATALOKO	F2	95	270-300	197	JICA	-	-	-	-	15-35	1	0	2.5	27.5	30	
							MEMR	-	10	63.5	-	1.5						
E.Nusa Tenggara	57	SOKORIA - MUTUBUSA	S1	97	180-320	-	JICA	-	-	90-235	-	-	2	0	0	90	90	
							MEMR	-	145	25	-	-						
E.Nusa Tenggara	58	OKA - LARANTUKA	S1	90	-	-	JICA	-	-	90-230	-	-	3	0	0	90	90	
							MEMR	-	-	40	-	-						
E.Nusa Tenggara	59	ILI LABALEKEN	RE				MEMR	-	-	36	-	-	NE	0	0	-	-	
E.Nusa Tenggara	60	ATADEI	F1	97	-	-	JICA	-	-	55-140	-	-	3	0	0	50	50	
							MEMR	-	-	40	-	-						
													Subtotal	**0**	**9**	562	**570**	
SULAWESI																		
N.Sulawesi	61	LAHENDONG	OP	99	-	356	PERTAMINA	-	(230)	(130)	(90)	(80)	1	20	100	260	380	including Tompaso capasity
N.Sulawesi	62	KOTAMOBAGU	S2	98	<320	-	JICA	-	-	155-390	-	-	2	0	40	180	220	around G. Ambang only
							MEMR	-	-	185	-	-						
							PERTAMINA	-	100	180	-	-						
N.Sulawesi	63	TOMPASO	S2	98	>250	-	JICA	-	-	260-600	-	-	2	included in Lahendong				same Working Area with Lahendong
							MEMR	-	-	130	-	-						
Golontaro	73	SUWAWA-GORONTALO	S2	94	>130	-	JICA	-	-	130-325	-	-	3	0	0	130	130	
							MEMR	50	-	110	-	-						
C.Sulawesi	64	BORA	RE	81			MEMR	-	-	8	-	-	NE	0	0	-	-	
C.Sulawesi	65	MERANA	S1	90	>130	-	JICA	-	-	240-600	-	-	3	0	0	200	200	
							MEMR	-	-	40	-	-						
S.Sulawes	66	BITUANG	RE	98			MEMR	-	-	17	-	-	NE	0	0	-	-	
SE.Sulawes	67	LAINEA	RE	85			MEMR	-	-	36	-	-	NE	0	0	-	-	
													Subtotal	**20**	**140**	770	**930**	
MALUKU																		
N.Maluku	68	TONGA WAYANA	S1	60			MEMR	-	110	-	-	-	NE	0	0	-	-	
Maluku	69	TULEHU	S2	92	>230	-	JICA	-	-	15-40	-	-	3	0	0	40	40	
							MEMR	-	-	100	-	-						
N.Maluku	70	JAILOLO	S2	97	>130	-	JICA	-	220-500	-	-	-	3	0	0	40	40	
							MEMR	-	-	42	-	-						
													Subtotal	**0**	**0**	80	**80**	
													Total	**857**	**1,847**	8,702	**11,405**	

* Development Status: RE: Unexplored or regional reconnaissance only; S1: Local surface exploration done; S2: Detailed surface exploration done; F1: Pre-feasibility studies done; F2: Feasibility studies done (complete); OP: Power plant in operation

** Reservoir Existing Possibility: 1 : Confirmed by well(s); 2 : Infered mainly by geothermometer; 3 : Infered by some geoscientific data; Low : Low possibility or low temp.; NE : Not enough data for evaluation

Subtotals for each reservoir possibilities

1	857	1,422	2,782	5,060
2	0	425	3,890	4,315
3	0	0	1,910	1,910
Low	0	0	120	120
NE	0	0	?	?
Total	**857**	**1,847**	**8,702**	**11,405**

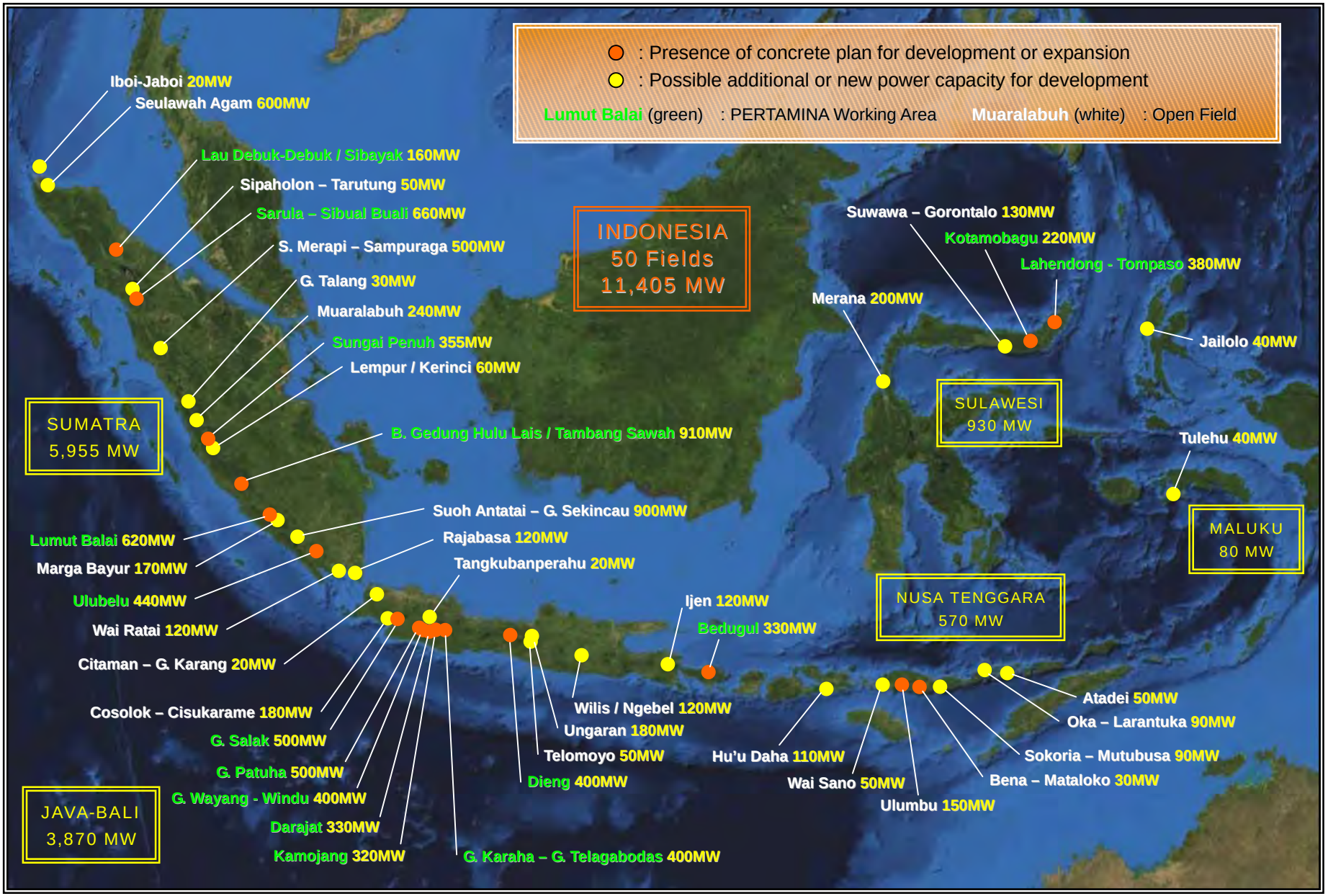


Fig. 7.1.3-1 Map Showing the Resource Potential in Promising Geothermal Fields

Table 7.1.3-2 Minimum Exploitable Resource Potential of Geothermal Fields where Geoscientific Data is not enough for Evaluation (within 73 fields)

Region	No	Field Name (underline: Existing W/A)	Surface Max Temperature (°C)	Estimated Resource Potencial by MEMR (MW)					Reservoir Existence Possibility	Minimum Exploitable Resource Potential (MW)
				Unidentified		Identified				
				Spec.	Hypo.	Possible	Probable	Proven		
SUMATRA										
Aceh	2	LHO PRIA LAOT	101	50	-	-	-	-	NE	5
Aceh	4	G. GEUREUDONG	69	-	120	-	-	-	NE	24
Aceh	5	G. KEMBAR	89	-	92	-	-	-	NE	18.4
N.Sumatra	6	G. SINABUNG	65	225	-	-	-	-	NE	22.5
N.Sumatra	11	PUSUK BUKIT - DANAU TOBA	90	225	-	-	-	-	NE	22.5
N.Sumatra	12	SIMBOLON - SAMOSIR	91	225	-	-	-	-	NE	22.5
Jambi	16	SUNGAI TENANG	96		74	-	-	-	NE	14.8
Jambi	18	SUNGAI BETUNG	30	100	-	-	-	-	NE	10
Jambi	19	AIR DIKIT	98	225	-	-	-	-	NE	22.5
Jambi	20	G. KACA	41	25	-	-	-	-	NE	2.5
Bengkulu	23	BUKIT DAUN	95	225	-	-	-	-	NE	22.5
S.Sumatra	26	RANTAU DADAP - SEGAMIT	96	225	-	-	-	-	NE	22.5
Number of fields	12								Subtotal	**210**
JAVA-BALI										
Banten	41	BATUKUWUNG	52	-	-	115	-	-	NE	115
Banten	43	G. ENDUT	84	225	-	-	-	-	NE	22.5
C.Java	45	MANGUNAN	46	-	-	92	-	-	NE	92
C.Java	48	G. SLAMET	51	-	-	185	-	-	NE	185
E.Java	49	G. ARJUNO - WELIRANG	70	-	38	92	-	-	NE	99.6
E.Java	72	IYANG ARGOPURO	65	-	110	185	-	-	NE	207
Number of fields	6								Subtotal	**721**
NUSA TENGGARA										
E.Nusa Tenggara	59	ILI LABALEKEN		-	-	36	-	-	NE	36
Number of fields	1								Subtotal	**36**
SULAWESI										
C.Sulawesi	64	BORA	81	-	-	8	-	-	NE	8
S.Sulawesi	66	BITUANG	98	-	-	17	-	-	NE	17
SE.Sulawesi	67	LAINEA	85	-	-	36	-	-	NE	36
Number of fields	3								Subtotal	**61**
MALUKU										
N.Maluku	68	TONGA WAYANA	60	-	110	-	-	-	NE	22
Number of fields	1								Subtotal	**22**
Total	23								Total	**1,050**

Note: Minimum Exploitable Resource Potential = 1 x ("Identified" Potential) + 0.2 x ("Hypothetical" Potential) + 0.1 x ("Speculative" Potential)

Table 7.1.3-3 Minimum Exploitable Resource Potential of Geothermal Fields where Geoscientific Data is not enough for Evaluation (whole Indonesia besides 73 fields)

Area	Number of fields within the area	Estimated Resource Potential by MEMR (MW)					Minimum Exploitable Resource Potential (MW)
		(Unidentified)		(Identified)			
		Spec.	Hypo.	Possible	Probable	Proven	
Sumatra	48	3,525	518	692	0	0	1053.5
Java-Bali	51	1,980	524	752	0	0	1054.8
Nusa Tenggara	14	290	114	223	0	0	274.8
Sulawesi	43	900	12	327	0	0	419.4
Maluku	12	250	7	15	0	0	41.4
Kalimantan	3	45	0	0	0	0	4.5
Papua	2	50	0	0	0	0	5.0
Total	173	7,040	1,175	2,009	0	0	**2,853**
		8,215		2,009			
		10,224					

Note:
Minimum Exploitable Resource Potential
= 1 x ("Identified" Potential) + 0.2 x ("Hypothetical" Potential) + 0.1 x ("Speculative" Potential)

Table 7.1.4-1 Evaluation of Promising Fields (Restriction-1: National Park) (Sumatra)

Region	No	Field Name (underline: Existing W/A)	Reservoir Existence Possibility *	Installed Capacity (MW)	Existing Develop. Plan (MW)	Possible Additional /New Capa. (MW)	Total Potential (MW)	National Park in Possible Reservoir Area		Percentage of Protected Forest in Possible Reservoir Area	Limited by National Park (MW)		Note
								Percentage in the Area**	Note / Name of National Park		Possible Add./New Capacity	Total Potential	
SUMATRA													
Aceh	1	IBOIH - JABOI	3	0	0	20	20	none	-	25%	20	20	
Aceh	2	LHO PRIA LAOT	NE	0	0	-	-	none	-	25%	-	-	
Aceh	3	SEULAWAH AGAM	3	0	0	600	600	60%	southern and eastern part/ THR. G. Seulawah	5%	275	275	
Aceh	4	G. GEUREUDONG	NE	0	0	-	-	-	-	-	-	-	
Aceh	5	G. KEMBAR	NE	0	0	-	-	-	-	-	-	-	
N.Sumatra	6	G. SINABUNG	NE	0	0	-	-	-	-	-	-	-	
N.Sumatra	7	LAU DEBUK-DEBUK / SIBAYAK	1	2	8	150	160	100%	THR. Bukit Barisan	none	30	40	
N.Sumatra	8	SARULA	1	0	300	360	660	25%	western and southern part/ CA. Sibolga, CA. Sibual Bual, etc.	20%	330	630	
N.Sumatra	9	SIBUAL BUALI	1										
N.Sumatra	10	S. MERAPI - SAMPURAGA	2	0	0	500	500	80%	southwestern part/ SM. Batang Gadis	none	100	100	
N.Sumatra	11	PUSUK BUKIT - DANAU TOBA	NE	0	0	-	-	none	-	75%	-	-	
N.Sumatra	12	SIMBOLON - SAMOSIR	NE	0	0	-	-	none	-	10%	-	-	
N.Sumatra	71	SIPAHOLON-TARUTUNG	Low	0	0	50	50	none	-	3%	50	50	
W.Sumatra	13	MUARALABUH	2	0	0	240	240	<25%	southern end/ TN. Kerinci Seblat	<10%	240	240	
W.Sumatra	14	G. TALANG	3	0	0	30	30	none	-	55%	30	30	volcanic hazard
Jambi	15	LEMPUR / KERINCI	1	0	0	60	60	>80%	TN. Kerinci Seblat	none	20	20	
Jambi	16	SUNGAI TENANG	NE	0	0	-	-	-	-	-	-	-	
Jambi	17	SUNGAI PENUH	2	0	55	300	355	15%	western part/ TN. Kerinci Seblat	none	300	355	
Jambi	18	SUNGAI BETUNG	NE	0	0	-	-	-	-	-	-	-	
Jambi	19	AIR DIKIT	NE	0	0	-	-	-	-	-	-	-	
Jambi	20	G. KACA	NE	0	0	-	-	-	-	-	-	-	
Bengkulu	21	B. GEDUNG HULU LAIS	2	0	110	800	910	<30%	northeastern part near Tambang Sawah/ TN. Kerinci Seblat	35% south of Hulu Lais	800	910	
Bengkulu	22	TAMBANG SAWAH	2										
Bengkulu	23	BUKIT DAUN	NE	0	0	-	-	-	-	-	-	-	
S.Sumatra	24	MARGA BAYUR	3	0	0	170	170	none	-	95%	170	170	
S.Sumatra	25	LUMUT BALAI	2	0	220	400	620	none	-	90%	400	620	
S.Sumatra	26	RANTAU DADAP - SEGAMIT	NE	0	0	-	-	-	-	-	-	-	
Lampung	27	ULUBELU	1	0	220	220	440	none	-	50%	220	440	
Lampung	28	SUOH ANTATAI	2	0	0	600	600	50%	northeastern part/ TN. Bukit Barisan Selatan	15%	330	330	
Lampung	29	G. SEKINCAU	2	0	0	300	300	90%	TN. Bukit Barisan Selatan	none	60	60	
Lampung	30	RAJABASA	3	0	0	120	120	none	-	70%	120	120	
Lampung	31	WAI RATAI	3	0	0	120	120	15%	northern end/ THR. Wan Abdul Rachman	none	120	120	
			Subtotal	**2**	**913**	5,040	**5,955**			Subtotal	3,615	**4,530**	

* Reservoir Existing Possibility: 1 : Confirmed by well(s); 2 : Infered mainly by geothermometer; 3 : Infered by some geoscientific data; Low : Low possibility or low temp.; NE : Not enough data for evaluation

** Percentage of National Park in possible reservoir area : >75%; : 25 - 75%; : 0 - 25%

Table 7.1.4-1 Evaluation of Promising Fields (Restriction-1: National Park) (Java-Bali)

Region	No	Field Name (underline: Existing W/A)	Reservoir Existence Possibility **	Installed Capacity (MW)	Existing Develop. Plan (MW)	Possible Additional /New Capa. (MW)	Total Potential (MW)	National Park in Possible Reservoir Area		Percentage of Protected Forest in Possible Reservoir Area	Limited by National Park (MW)		Note
								Percentage in the Area**	Note / Name of National Park		Possible Add./New Capacity	Total Potential	
JAVA-BALI													
W.Java	32	KAMOJANG	1	140	120	60	320	75%	CA. Kawah Kamojang	none	60	320	
W.Java	33	G. SALAK	1	380	0	120	500	85%	TN. GUnung Halimun	none	120	500	
W.Java	34	DARAJAT	1	145	110	75	330	50%	CA. Kawah Kamojang CA. Gunung Papandayan	none	75	330	
W.Java	35	CISOLOK - CISUKARAME	2	0	0	180	180	20%	TN. Gunung Halimun TW. Cinapas Cisolok	none	180	180	gold mining area
W.Java	36	G. PATUHA	1	0	120	380	500	25%	CA. Gunung Tilu etc.	none	380	500	
W.Java	37	G. WAYANG - WINDU	1	110	110	180	400	2%	CA. Malabar	35%	180	400	
W.Java	38	G. KARAHA	1	0	30	370	400	<5%	southern part/ CA. Sepakung	<20%	370	400	
W.Java	39	G. TELAGABODAS	1										
W.Java	40	TANGKUBANPERAHU	3	0	0	20	20	<5%	CA. Tangkuban Perahu	none	20	20	
Banten	41	BATUKUWUNG	NE	0	0	-	-	-	-	-	-	-	
Banten	42	CITAMAN - G. KARANG	Low	0	0	20	20	none	(CA. G. Karang)	none	20	20	
Banten	43	G. ENDUT	NE	0	0	-	-	-	-	-	-	-	
C.Java	44	DIENG	1	60	120	220	400	30%	SM. Gunung Perahu TW. Telogo Warno Pangilon CA. Telogo Sumurup	none	220	400	
C.Java	45	MANGUNAN	NE	0	0	-	-	-	-	-	-	-	
C.Java	46	TELOMOYO	Low	0	0	50	50	5%	CA. Sepakung	none	50	50	
C.Java	47	UNGARAN	2	0	0	180	180	none	(CA. Ungaran)	none	180	180	
C.Java	48	G. SLAMET	NE	0	0	-	-	-	-	-	-	-	
E.Java	49	G. ARJUNO - WELIRANG	NE	0	0	-	-	-	-	-	-	-	
E.Java	50	WILIS / NGEBEL	2	0	0	120	120	5%	CA. G. Picis (SM. G. Wilis)	none	120	120	
E.Java	51	IJEN	3	0	0	120	120	65%	TB. Maelang CA. Kawah Ijen Ungup-ungup CA. Gunung Raung	35%	40	40	volcanic hazard
E.Java	72	IYANG ARGOPURO	NE	0	0	-	-	>50%	SM. Dataran Tinggi Iyang	<50%	-	-	
Bali	52	BEDUGUL	1	0	175	155	330	80%	CA. Batukahu	none	0	175	local people movement against geothermal development
			Subtotal	**835**	**785**	2,250	**3,870**			Subtotal	2,015	**3,635**	

* Reservoir Existing Possibility: 1 : Confirmed by well(s); 2 : Infered mainly by geothermometer; 3 : Infered by some geoscientific data; Low : Low possibility or low temp.; NE : Not enough data for evaluation

** Percentage of National Park in possible reservoir area : >75%; : 25 - 75%; : 0 - 25%

Table 7.1.4-1 Evaluation of Promising Fields (Restriction-1: National Park) (Nusa Tenggara, Sulawesi and Maluku)

Region	No	Field Name (underline: Existing W/A)	Reservoir Existence Possibility **	Installed Capacity (MW)	Existing Develop. Plan (MW)	Possible Additional /New Capa. (MW)	Total Potential (MW)	National Park in Possible Reservoir Area		Percentage of Protected Forest in Possible Reservoir Area	Limited by National Park (MW)		Note
								Percentage in the Area**	Note / Name of National Park		Possible Add./New Capacity	Total Potential	
NUSA TENGGARA													
W.Nusa Tenggara	53	HU'U DAHA	3	0	0	110	110	none	-	25%	110	110	
E.Nusa Tenggara	54	WAI SANO	3	0	0	50	50	30%	southern part/ TW. Danau Sanau	none	50	50	
E.Nusa Tenggara	55	ULUMBU	1	0	6	144	150	5%	eastern part/ TW. Ruteng	none	144	150	
E.Nusa Tenggara	56	BENA - MATALOKO	1	0	2.5	27.5	30	none	-	none	27.5	30	
E.Nusa Tenggara	57	SOKORIA - MUTUBUSA	2	0	0	90	90	55%	northwestern part/ TN. Danau Kelimutu	none	40	40	
E.Nusa Tenggara	58	OKA - LARANTUKA	3	0	0	90	90	none	-	35%	90	90	
E.Nusa Tenggara	59	ILI LABALEKEN	NE	0	0	-	-	-	-	-	-	-	
E.Nusa Tenggara	60	ATADEI	3	0	0	50	50	none	-	none	50	50	
			Subtotal	**0**	**9**	562	**570**			Subtotal	512	**520**	
SULAWESI													
N.Sulawesi	61	LAHENDONG	1	20	100	260	380	<5%	sonthwestern part in Tompaso/ CA. Gn. Soputan	none	260	380	
N.Sulawesi	62	KOTAMOBAGU	2	0	40	180	220	40%	northeastern part/ CA. Gn. Ambang Perluasan CA. Gn. Ambang	3%	120	160	
N.Sulawesi	63	TOMPASO	2	included in Lahendong				included in Lahendong					
Golontaro	73	SUWAWA-GORONTALO	3	0	0	130	130	none	-	20%	130	130	
C.Sulawesi	64	BORA	NE	0	0	-	-	-	-	-	-	-	
C.Sulawesi	65	MERANA	3	0	0	200	200	none	-	none	200	200	
S.Sulawes	66	BITUANG	NE	0	0	-	-	-	-	-	-	-	
SE.Sulawes	67	LAINEA	NE	0	0	-	-	-	-	-	-	-	
			Subtotal	**20**	**140**	770	**930**			Subtotal	710	**870**	
MALUKU													
N.Maluku	68	TONGA WAYANA	NE	0	0	-	-	-	-	-	-	-	
Maluku	69	TULEHU	3	0	0	40	40	none	-	70%	40	40	
N.Maluku	70	JAILOLO	3	0	0	40	40	none	-	-	40	40	
			Subtotal	**0**	**0**	80	**80**			Subtotal	80	**80**	
			Total	**857**	**1,847**	8,702	**11,405**			**Total**	6,932	**9,635**	

* Reservoir Existing Possibility: 1 : Confirmed by well(s); 2 : Infered mainly by geothermometer; 3 : Infered by some geoscientific data; Low : Low possibility or low temp.; NE : Not enough data for evaluation

** Percentage of National Park in possible reservoir area : >75% ; : 25 - 75% ; : 0 - 25%

Subtotals for each reservoir possibilities

1	857	1,422	2,782	5,060
2	0	425	3,890	4,315
3	0	0	1,910	1,910
Low	0	0	120	120
NE	0	0	?	?
Total	**857**	**1,847**	**8,702**	**11,405**

1	2,437	4,715
2	2,870	3,295
3	1,505	1,505
Low	120	120
NE	?	?
Total	**6,932**	**9,635**

Table 7.1.5-1 Evaluation of Promising Fields (Restriction-2: Power Demand) (Sumatra)

Region	No	Field Name (underline: Existing W/A)	Reservoir Existence Possibility *	Installed Capacity (MW)	Existing Develop. Plan (MW)	Limited by National Park (MW)		Power Grid	Minimum Demand in 2025 (MW)	Remarks on T/L	Limited by demand (MW)		Note
						Possible Add./New Capacity	Total Potential				Possible Add./New Capacity	Total Potential	
SUMATRA													
Aceh	1	IBOIH - JABOI	3	0	0	20	20	Weh	～10	Distribution Line	10	10	
Aceh	2	LHO PRIA LAOT	NE	0	0	-	-	Weh	～10	Distribution Line	-	-	
Aceh	3	SEULAWAH AGAM	3	0	0	275	275	Sumatra-Java	～27,000		275	275	
Aceh	4	G. GEUREUDONG	NE	0	0	-	-	Sumatra-Java	～27,000		-	-	
Aceh	5	G. KEMBAR	NE	0	0	-	-	Sumatra-Java	～27,000		-	-	
N.Sumatra	6	G. SINABUNG	NE	0	0	-	-	Sumatra-Java	～27,000		-	-	
N.Sumatra	7	LAU DEBUK-DEBUK / SIBAYAK	1	2	8	30	40	Sumatra-Java	～27,000		30	40	
N.Sumatra	8	SARULA	1	0	300	330	630	Sumatra-Java	～27,000	planned S/S (Sarula)	330	630	
N.Sumatra	9	SIBUAL BUALI	1										
N.Sumatra	10	S. MERAPI - SAMPURAGA	2	0	0	100	100	Sumatra-Java	～27,000		100	100	
N.Sumatra	11	PUSUK BUKIT - DANAU TOBA	NE	0	0	-	-	Sumatra-Java	～27,000		-	-	
N.Sumatra	12	SIMBOLON - SAMOSIR	NE	0	0	-	-	Sumatra-Java	～27,000		-	-	
N.Sumatra	71	SIPAHOLON-TARUTUNG	Low	0	0	50	50	Sumatra-Java	～27,000		50	50	
W.Sumatra	13	MUARALABUH	2	0	0	240	240	Sumatra-Java	～27,000	planned S/S	240	240	
W.Sumatra	14	G. TALANG	3	0	0	30	30	Sumatra-Java	～27,000		30	30	
Jambi	15	LEMPUR / KERINCI	1	0	0	20	20	Sumatra-Java	～27,000	planned S/S	20	20	
Jambi	16	SUNGAI TENANG	NE	0	0	-	-	Sumatra-Java	～27,000		-	-	
Jambi	17	SUNGAI PENUH	2	0	55	300	355	Sumatra-Java	～27,000	planned S/S	300	355	
Jambi	18	SUNGAI BETUNG	NE	0	0	-	-	Sumatra-Java	～27,000	planned S/S	-	-	
Jambi	19	AIR DIKIT	NE	0	0	-	-	Sumatra-Java	～27,000		-	-	
Jambi	20	G. KACA	NE	0	0	-	-	Sumatra-Java	～27,000	planned S/S	-	-	
Bengkulu	21	B. GEDUNG HULU LAIS	2	0	110	800	910	Sumatra-Java	～27,000		800	910	
Bengkulu	22	TAMBANG SAWAH	2										
Bengkulu	23	BUKIT DAUN	NE	0	0	-	-	Sumatra-Java	～27,000		-	-	
S.Sumatra	24	MARGA BAYUR	3	0	0	170	170	Sumatra-Java	～27,000		170	170	
S.Sumatra	25	LUMUT BALAI	2	0	220	400	620	Sumatra-Java	～27,000		400	620	
S.Sumatra	26	RANTAU DADAP - SEGAMIT	NE	0	0	-	-	Sumatra-Java	～27,000		-	-	
Lampung	27	ULUBELU	1	0	220	220	440	Sumatra-Java	～27,000	planned T/L	220	440	
Lampung	28	SUOH ANTATAI	2	0	0	330	330	Sumatra-Java	～27,000		330	330	
Lampung	29	G. SEKINCAU	2	0	0	60	60	Sumatra-Java	～27,000		60	60	
Lampung	30	RAJABASA	3	0	0	120	120	Sumatra-Java	～27,000		120	120	
Lampung	31	WAI RATAI	3	0	0	120	120	Sumatra-Java	～27,000	planned T/L	120	120	
			Subtotal	**2**	**913**	3,615	**4,530**			Subtotal	3,605	**4,520**	

* Reservoir Existing Possibility: 1 : Confirmed by well(s); 2 : Infered mainly by geothermometer; 3 : Infered by some geoscientific data; Low : Low possibility or low temp.; NE : Not enough data for evaluation

Table 7.1.5-1 Evaluation of Promising Fields (Restriction-2: Power Demand) (Java-Bali)

Region	No	Field Name (underline: Existing W/A)	Reservoir Existence Possibility *	Installed Capacity (MW)	Existing Develop. Plan (MW)	Limited by National Park (MW)		Power Grid	Minimum Demand in 2025 (MW)	Remarks on T/L	Limited by demand (MW)		Note
						Possible Add./New Capacity	Total Potential				Possible Add./New Capacity	Total Potential	
JAVA-BALI													
W.Java	32	KAMOJANG	1	140	120	60	320	Java-Bali	～27,000	Existing P/S	60	320	
W.Java	33	G. SALAK	1	380	0	120	500	Java-Bali	～27,000	Existing P/S	120	500	
W.Java	34	DARAJAT	1	145	110	75	330	Java-Bali	～27,000	Existing P/S	75	330	
W.Java	35	CISOLOK - CISUKARAME	2	0	0	180	180	Java-Bali	～27,000	planned T/L	180	180	
W.Java	36	G. PATUHA	1	0	120	380	500	Java-Bali	～27,000	planned T/L	380	500	
W.Java	37	G. WAYANG - WINDU	1	110	110	180	400	Java-Bali	～27,000	planned T/L	180	400	
W.Java	38	G. KARAHA	1	0	30	370	400	Java-Bali	～27,000		370	400	
W.Java	39	G. TELAGABODAS	1										
W.Java	40	TANGKUBANPERAHU	3	0	0	20	20	Java-Bali	～27,000		20	20	
Banten	41	BATUKUWUNG	NE	0	0	-	-	Java-Bali	～27,000		-	-	
Banten	42	CITAMAN - G. KARANG	Low	0	0	20	20	Java-Bali	～27,000	planned new 150kV R. BitungS/S	20	20	
Banten	43	G. ENDUT	NE	0	0	-	-	Java-Bali	～27,000	planned T/L	-	-	
C.Java	44	DIENG	1	60	120	220	400	Java-Bali	～27,000	Existing P/S	220	400	
C.Java	45	MANGUNAN	NE	0	0	-	-	Java-Bali	～27,000		-	-	
C.Java	46	TELOMOYO	Low	0	0	50	50	Java-Bali	～27,000		50	50	
C.Java	47	UNGARAN	2	0	0	180	180	Java-Bali	～27,000		180	180	
C.Java	48	G. SLAMET	NE	0	0	-	-	Java-Bali	～27,000		-	-	
E.Java	49	G. ARJUNO - WELIRANG	NE	0	0	-	-	Java-Bali	～27,000		-	-	
E.Java	50	WILIS / NGEBEL	2	0	0	120	120	Java-Bali	～27,000		120	120	
E.Java	51	IJEN	3	0	0	40	40	Java-Bali	～27,000		40	40	
E.Java	72	IYANG ARGOPURO	NE	0	0	-	-	Java-Bali	～27,000		-	-	
Bali	52	BEDUGUL	1	0	175	0	175	Java-Bali	～27,000		0	175	
			Subtotal	**835**	**785**	2,015	**3,635**			Subtotal	2,015	**3,635**	

* Reservoir Existing Possibility: 1 : Confirmed by well(s); 2 : Infered mainly by geothermometer; 3 : Infered by some geoscientific data; Low : Low possibility or low temp.; NE : Not enough data for evaluation

Table 7.1.5-1 Evaluation of Promising Fields (Restriction-2: Power Demand) (Nusa Tenggara, Sulawesi and Maluku)

Region	No	Field Name (underline: Existing W/A)	Reservoir Existence Possibility *	Installed Capacity (MW)	Existing Develop. Plan (MW)	Limited by National Park (MW) Possible Add./New Capacity	Limited by National Park (MW) Total Potential	Power Grid	Minimum Demand in 2025 (MW)	Remarks on T/L	Limited by demand (MW) Possible Add./New Capacity	Limited by demand (MW) Total Potential	Note
NUSA TENGGARA													
W.Nusa Tenggara	53	HU'U DAHA	3	0	0	110	110	Sumbawa	~30	Distribution Line	30	30	
E.Nusa Tenggara	54	WAI SANO	3	0	0	50	50	Flores	~40	Distribution Line	10	10	
E.Nusa Tenggara	55	ULUMBU	1	0	6	144	150	Flores	~40		30	36	
E.Nusa Tenggara	56	BENA - MATALOKO	1	0	2.5	27.5	30	Flores	~40		17.5	20	
E.Nusa Tenggara	57	SOKORIA - MUTUBUSA	2	0	0	40	40	Flores	~40		20	20	
E.Nusa Tenggara	58	OKA - LARANTUKA	3	0	0	90	90	Flores	~40	Distribution Line	20	20	
E.Nusa Tenggara	59	ILI LABALEKEN	NE	0	0	-	-	Flores	~40	Distribution Line	-	-	
E.Nusa Tenggara	60	ATADEI	3	0	0	50	50	Lomblen	<10	Distribution Line	10	10	
			Subtotal	**0**	**9**	512	**520**			Subtotal	138	**146**	
SULAWESI													
N.Sulawesi	61	LAHENDONG	1	20	100	260	380	Minahasa	~500		220	340	
N.Sulawesi	62	KOTAMOBAGU	2	0	40	120	160	Minahasa	~500		100	140	
N.Sulawesi	63	TOMPASO	2	included in Lahendong				Minahasa	~500		included in Lahendong		
Golontaro	73	SUWAWA-GORONTALO	3	0	0	130	130	Minahasa	~500		55	55	
C.Sulawesi	64	BORA	NE	0	0	-	-	C. Sulawesi	~800		-	-	
C.Sulawesi	65	MERANA	3	0	0	200	200	C. Sulawesi	~800		200	200	
S.Sulawes	66	BITUANG	NE	0	0	-	-	S. Sulawesi	~800		-	-	
SE.Sulawes	67	LAINEA	NE	0	0	-	-	SE. Sulawesi	~800		-	-	
			Subtotal	**20**	**140**	710	**870**			Subtotal	575	**735**	
MALUKU													
N.Maluku	68	TONGA WAYANA	NE	0	0	-	-	Halmahera	~20	Distribution Line	-	-	
Maluku	69	TULEHU	3	0	0	40	40	Ambon	~20	Distribution Line	20	20	
N.Maluku	70	JAILOLO	3	0	0	40	40	Halmahera	~20	Distribution Line	20	20	
			Subtotal	**0**	**0**	80	**80**			Subtotal	40	**40**	
			Total	**857**	**1,847**	6,932	**9,635**			Total	6,373	**9,076**	

* Reservoir Existing Possibility:

1 : Confirmed by well(s)

2 : Infered mainly by geothermometer

3 : Infered by some geoscientific data

Low : Low possibility or low temp.

NE : Not enough data for evaluation

Subtotals for each reservoir possibilities

1	857	1,422	2,437	4,715
2	0	425	2,870	3,295
3	0	0	1,505	1,505
Low	0	0	120	120
NE	0	0	?	?
Total	**857**	**1,847**	**6,932**	**9,635**

1	2,273	4,551
2	2,830	3,255
3	1,170	1,170
Low	100	100
NE	?	?
Total	**6,373**	**9,076**

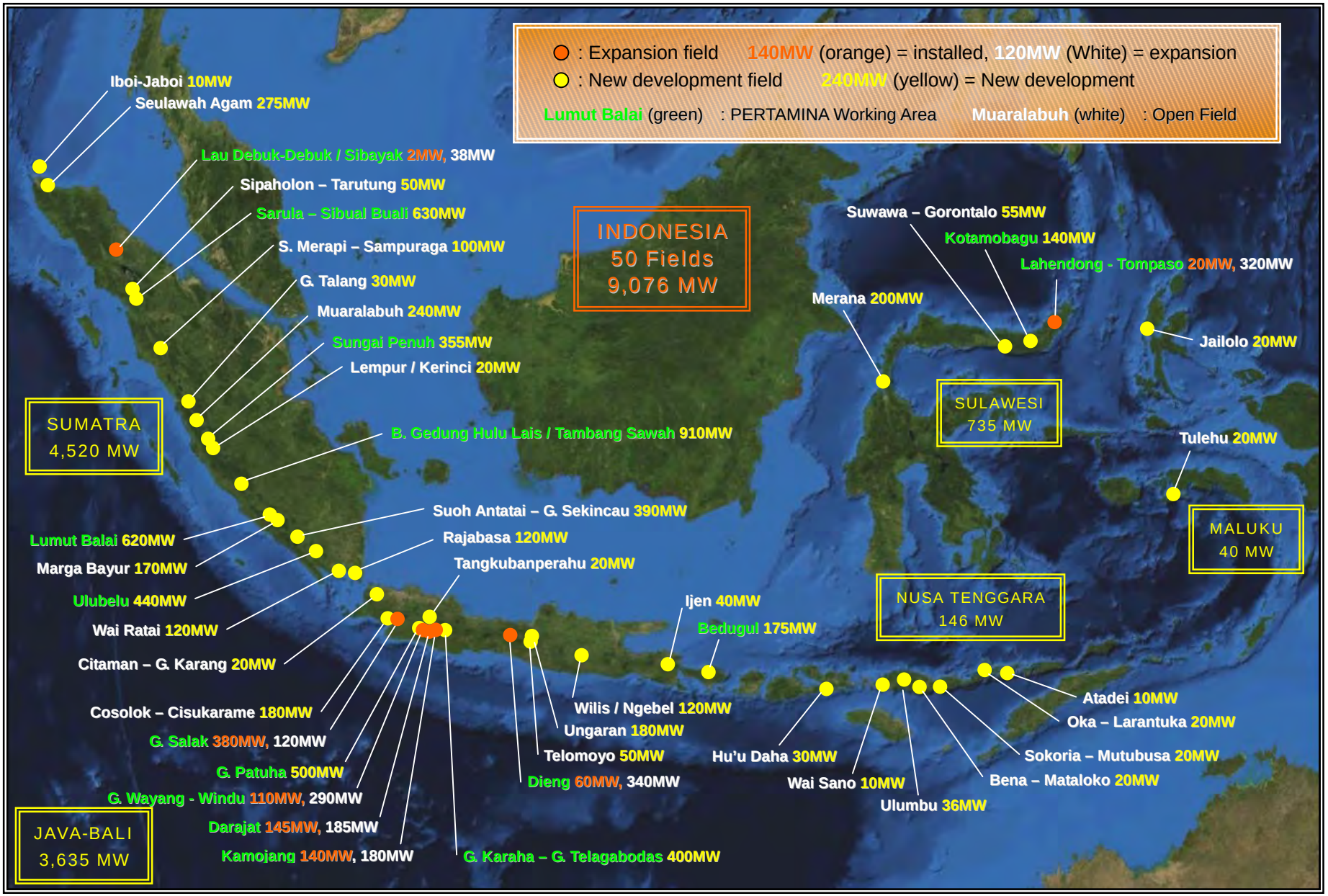


Fig. 7.1.5-1 Map Showing the Possible Development/Expansion Capacity in Promising Geothermal Fields

Table 7.1.6-1 Exploitable Resource Potential and Development Priority of the Promising Field

Region	No	Field Name (underline: Existing W/A)	Expansion and Existing Development Plan	Reservoir Existence Possibility *	Economy ***	T/L Length km	Resouce Potential (MW)	Limited by National Park (MW)	Limited by demand (MW)	Installed Capacity (MW)	Expansion and Existing Development Plan (MW)	Possible Add./New Capacity (MW)	Development Priority****	Small Scale Develop.
N.Sumatra	8 9	SARULA SIBUAL BUALI	○	1	E1	21	660	630	630	0	300	330	A	
Lampung	27	ULUBELU	○	1	E1	19	440	440	440	0	220	220	A	
W.Java	32	KAMOJANG	○	1	E1	10	320	320	320	140	120	60	A	
W.Java	33	G. SALAK	○	1	E1	1	500	500	500	380	0	120	A	
W.Java	34	DARAJAT	○	1	E1	3	330	330	330	145	110	75	A	
W.Java	36	G. PATUHA	○	1	E1	19	500	500	500	0	120	380	A	
W.Java	37	G. WAYANG - WINDU	○	1	E1	15	400	400	400	110	110	180	A	
W.Java	38 39	G. KARAHA G. TELAGABODAS	○	1	E1	9	400	400	400	0	30	370	A	
C.Java	44	DIENG	○	1	E1	4	400	400	400	60	120	220	A	
N.Sulawesi	61 63	LAHENDONG TOMPASO**	○	1	E1	11	380	380	340	20	100	220	A	
Bali	52	BEDUGUL	○	1	E2	6	330	175	175	0	175	0	A	
N.Sumatra	7	LAU DEBUK-DEBUK / SIBAYAK	○	1	E3	6	160	40	40	2	8	30	A	
E.Nusa Tenggara	55	ULUMBU	○	1	E3	14	150	150	36	0	6	30	A	○
E.Nusa Tenggara	56	BENA - MATALOKO	○	1	E4	8	30	30	20	0	2.5	18	A	○
Jambi	17	SUNGAI PENUH	○	2	E1	5	355	355	355	0	55	300	A	
S.Sumatra	25	LUMUT BALAI	○	2	E1	50	620	620	620	0	220	400	A	
Bengkulu	21 22	B. GEDUNG HULU LAIS TAMBANG SAWAH	○	2	E2	44	910	910	910	0	110	800	A	
N.Sulawesi	62	KOTAMOBAGU	○	2	E2	2	220	160	140	0	40	100	A	
Jambi	15	LEMPUR / KERINCI		1	E4	32	60	20	20	0	0	20	B	
W.Sumatra	13	MUARALABUH		2	E1	7	240	240	240	0	0	240	B	
Lampung	28	SUOH ANTATAI		2	E1	18	600	330	330	0	0	330	B	
W.Java	35	CISOLOK - CISUKARAME		2	E1	4	180	180	180	0	0	180	B	
C.Java	47	UNGARAN		2	E1	2	180	180	180	0	0	180	B	
Lampung	29	G. SEKINCAU		2	E2	19	300	60	60	0	0	60	B	
E.Java	50	WILIS / NGEBEL		2	E2	5	120	120	120	0	0	120	B	
N.Sumatra	10	S. MERAPI - SAMPURAGA		2	E3	23	500	100	100	0	0	100	B	
E.Nusa Tenggara	57	SOKORIA - MUTUBUSA		2	E4	20	90	40	20	0	0	20	B	○
Aceh	3	SEULAWAH AGAM		3	E1	4	600	275	275	0	0	275	C	
Lampung	30	RAJABASA		3	E2	8	120	120	120	0	0	120	C	
Lampung	31	WAI RATAI		3	E2	16	120	120	120	0	0	120	C	
S.Sumatra	24	MARGA BAYUR		3	E2	29	170	170	170	0	0	170	C	
C.Sulawesi	65	MERANA		3	E2	40	200	200	200	0	0	200	C	
Golontaro	73	SUWAWA-GORONTALO		3	E3	24	130	130	55	0	0	55	C	
Aceh	1	IBOIH - JABOI		3	E4	5	20	20	10	0	0	10	C	○
W.Sumatra	14	G. TALANG		3	E4	7	30	30	30	0	0	30	C	
W.Java	40	TANGKUBANPERAHU		3	E4	16	20	20	20	0	0	20	C	
E.Java	51	IJEN		3	E4	5	120	40	40	0	0	40	C	
W.Nusa Tenggara	53	HU'U DAHA		3	E4	15	110	110	30	0	0	30	C	○
E.Nusa Tenggara	54	WAI SANO		3	E4	17	50	50	10	0	0	10	C	○
E.Nusa Tenggara	58	OKA - LARANTUKA		3	E4	10	90	90	20	0	0	20	C	○
E.Nusa Tenggara	60	ATADEI		3	E4	12	50	50	10	0	0	10	C	○
Maluku	69	TULEHU		3	E4	12	40	40	20	0	0	20	C	○
N.Maluku	70	JAILOLO		3		14	40	40	20	0	0	20	C	○
C.Java	46	TELOMOYO		Low	E4	19	50	50	50	0	0	50	L	
N.Sumatra	71	SIPAHOLON-TARUTUNG		Low	E4	19	50	50	50	0	0	50	L	
Banten	42	CITAMAN - G. KARANG		Low	E4	8	20	20	20	0	0	20	L	
Aceh	2	LHO PRIA LAOT		NE		3						0	N	
Aceh	4	G. GEUREUDONG		NE		11						0	N	
Aceh	5	G. KEMBAR		NE		59						0	N	
N.Sumatra	6	G. SINABUNG		NE		38						0	N	
N.Sumatra	11	PUSUK BUKIT - DANAU TOBA		NE		18						0	N	
N.Sumatra	12	SIMBOLON - SAMOSIR		NE		3						0	N	
Jambi	16	SUNGAI TENANG		NE		83						0	N	
Jambi	18	SUNGAI BETUNG		NE		32						0	N	
Jambi	19	AIR DIKIT		NE		35						0	N	
Jambi	20	G. KACA		NE		29						0	N	
Bengkulu	23	BUKIT DAUN		NE		14						0	N	
S.Sumatra	26	RANTAU DADAP - SEGAMIT		NE		25						0	N	
Banten	41	BATUKUWUNG		NE		6						0	N	
Banten	43	G. ENDUT		NE		13						0	N	
C.Java	45	MANGUNAN		NE		19						0	N	
C.Java	48	G. SLAMET		NE		20						0	N	
E.Java	49	G. ARJUNO - WELIRANG		NE		3						0	N	
E.Nusa Tenggara	59	ILI LABALEKEN		NE		15						0	N	
C.Sulawesi	64	BORA		NE		16						0	N	
S.Sulawesi	66	BITUANG		NE		4						0	N	
SE.Sulawesi	67	LAINEA		NE		53						0	N	
N.Maluku	68	TONGA WAYANA		NE		37						0	N	
E.Java	72	IYANG ARGOPURO		NE		26						0	N	
		TOTAL					11,405	9,635	9,076	857	1,847	6,373		

* Reservoir Existing Possibility: 1 : Confirmed by well(s); 2 : Infered mainly by geothermometer; 3 : Infered by some geoscientific data; Low : Low possibility or low temp.; NE : Not enough data for evaluation

** No.63 TOMPASO: Reservoir possibility in TOMPASO is 2.

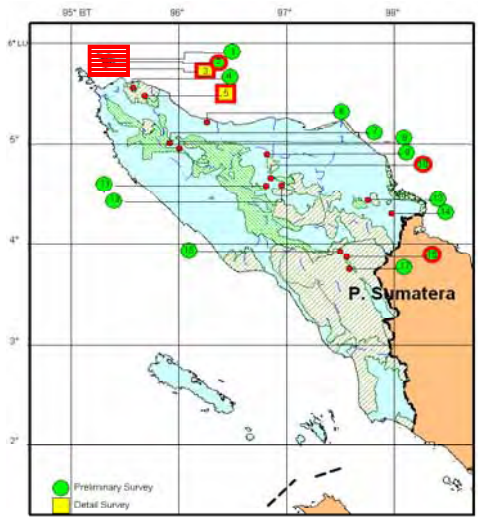
*** Economy: Classification of Project IRR — E1 | E2 | E3 | E4

****Development Priority
- A : Existing Power Plant or Existing Expansion/Development Plan
- B : High Possibility of Existing Geothermal Reservoir
- C : Medium Possibility of Existing Geothermal Reservoir
- L : Low Possibility of Existing Geothermal Reservoir
- N : Not Enough Data for Evaluation

Table 7.1.9-1 Development Plan Sheet for New Working Area (No.1 IBOIH-JABOI)

No.1 IBOIH-JABOI	Region	Sumatra	Province/ Location	Aceh, Southeast of Weh Island

Field Evaluation



Resource Characteristics	The field is situated at SE of Pulau Weh (Sabang) island and is composed of Quaternary andesitic volcanics. The geothermal prospect is devided by NNW-SSE trending fault and NE-SW trending fault. Possible reservoir area is defined based on low resistivity zone (Schlumberger <10 ohm-m (AB/2=500m)), geologic struture and analysis data of hot spring. The detected possible area is located between G. Semeureuguh and G. Kenaldi. Reservoir fluid originates essencially in meteoric water but possibly contains some seawater. Some of the fluid ascents vertically, yielding fumaroles and thermal springs with mixing of shallow groundwater. Reservoir connection with that in Lho Pria Laot is not clear. Reservoir temperature is estimated higher than 170^{0}C at least, and possibly up to 290^{0}C according to gas geothermometry. Resource potential estimated by stored heat method applying Monte Carlo analysis is 10-20 MW.
Natural/Social Environmental Condition	Possible geothermal reservoir area is not within any National Parks. But the area is surrounded by some Protected Forest existing at higher elevation (about 25% of the possible reservoir area).
Power Sector Situation	The whole system in the Sabang Island is D/L. At present, electrification ratio in this area reachs only 56.4%. The demand of electricity in Sabang Island with the peak load is about 20MW.

Power Output Potential	Resource Potential	20 MW	Restricted by National Park	10 MW	Restricted by Power Demand	10 MW
Rank of Development Priority	C		Potential (Expected) Developer		Private Company or Central/Local Government	

Proposed Geothermal Development Plan

Outline for Power Development	Scope for Power Development	CO_2 Emmission Reduction ('000 tone/year)
The possible development site in this field is located between G. Semeureuguh and G. Kenaldi. The demand of electricity in Sabang Island is small, so a small scale with multi-unit power plant development is recommendable. If sufficient steam is obtained by steamfield development, the power system available for variable load is disireble for power supply not only for base load but also peak load.	Power Plant Capacity: 10MW (5MWx2unit) Plant System: Condencing or Back-Pressure Explor.+Production Well: approx. 5 wells Reinjection Well: less than 3 wells Transmission Line: 20kV, less than 5km Connection: Distribution Line in Sabang Island	61
Possibile or Recommended Multi-purpose Geothermal Heat Use		
Direct heat use for agricultural or marine product industry is recommendable.		

Proposed Geothermal Development Schedule

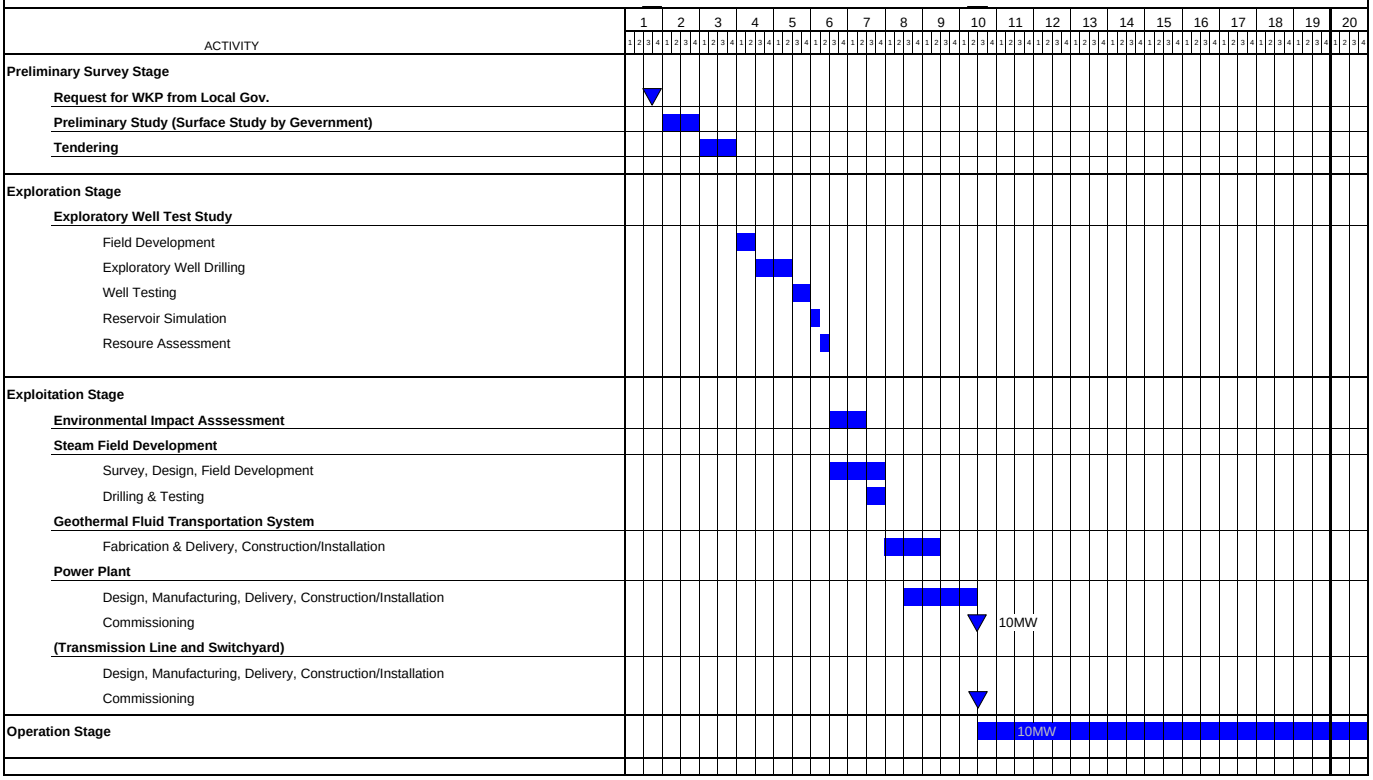
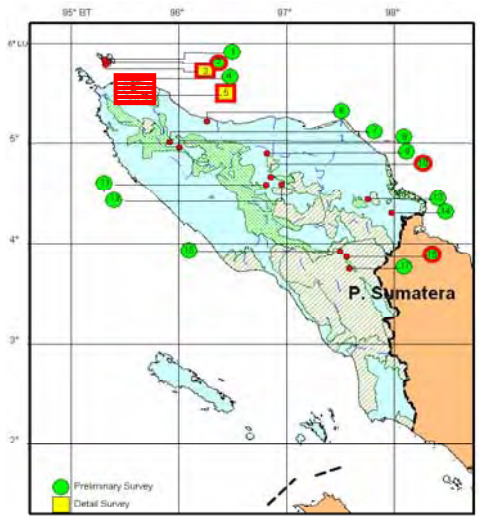


Table 7.1.9-1 Development Plan Sheet for New Working Area (No.3 SEULAWAH AGAM)

No.3 SEULAWAH AGAM	Region	Sumatra	Province/ Location	Aceh, Northwestern side of G. Seulawah Agam

Field Evaluation



Resource Characteristics	Major structural features are a large caldera (Lam Teuba) extending from G. Seulawa Agam to the NW and a smaller collapse structure within its caldera. Possible reservoir area is defined at the Northwestern flank of the G. Seulawah Agum based on low resistivity zone detected by the MT survery and on geologic strucutre. There are three areas where hydrothermal manifestations exist. Occurrence of numerous fumarolic activities in all the three areas suggest large extent of high temperature reservoir, but detailed fluid connection between these areas is not clear. Reservoir temperature is estimated higher than 180°C at least; but considering strong activities of surface manifestation, a highest temperature of around 250-300°C would be expected. Resource potential estimated by stored heat method applying Monte Carlo analysis is 560-1,380 MW.
Natural/Social Environmental Condition	Southern and eastern part of possible geothermal reservoir area is within THR. G. Seulawah National Park at around summit of G. Seulawah Agam (about 60% of the possible reservoir area).
Power Sector Situation	Estimated T/L length from the field to intersection T/L between Sigli S/S and Banda Aceh S/S is about 4 km. 2P connection with 150kV is recommendable.

Power Output Potential	Resource Potential	600 MW	Restricted by National Park	275 MW	Restricted by Power Demand	275 MW
Rank of Development Priority	C		Potential (Expected) Developer		Private Company	

Proposed Geothermal Development Plan

Outline for Power Development

The possible development site in this field is located near Ie Seu Uem on the northwestern flank of G. Seulawah Agam. The demand of electricity in northern part of Sumatra including Aceh province is large, so a large scale power plant development as far as resource available is recommendable.

Scope for Power Development

Power Plant Capacity: 275MW (55MWx5unit)
Plant System: Condencing
Explor.+Production Well: approx. 65 wells
Reinjection Well: less than 30 wells
Transmission Line: 150kV, approx. 4km
Connection: 2P connection between Sigli S/S and Banda Aceh S/S

CO_2 Emmission Reduction ('000 tone/year)

1,677

Possibile or Recommended Multi-purpose Geothermal Heat Use

Direct heat use for agricultural or marine product industry is recommendable.

Proposed Geothermal Development Schedule

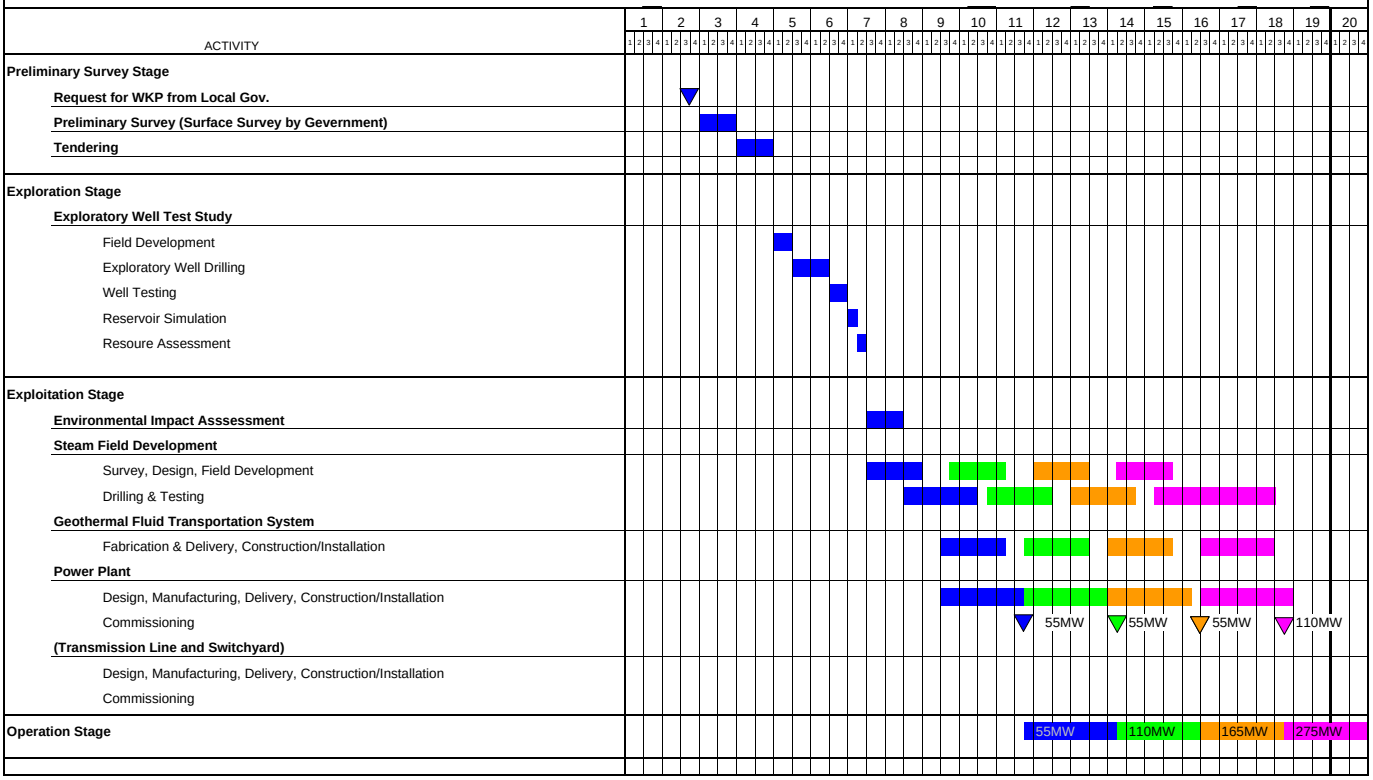
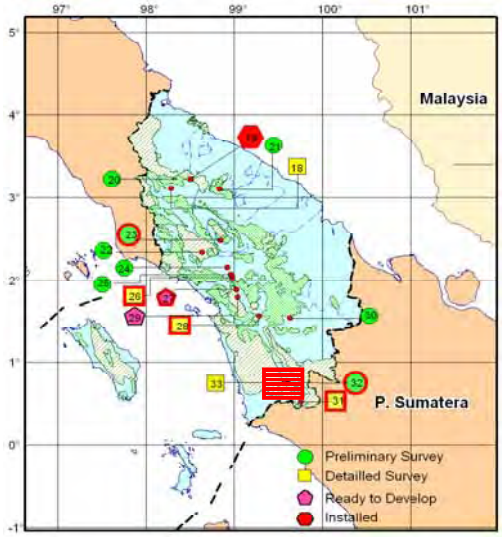


Table 7.1.9-1 Development Plan Sheet for New Working Area (No.10 S. MERAPI - SAMPURAGA)

No.10 S. MERAPI - SAMPURAGA	Region	Sumatra	Province/ Location	North Sumatra, Eeastern and northern side of Sorik Merapi

Field Evaluation



Resource Characteristics	The prospect of Sorik Merapi is around 60 km east of the coastal town of Natal. Extensive areas of thermal manifestations are present on the eastern and northern flanks of Sorik Merapi. Possible reservoir area is defined at the northeastern flank of the S. Merapi, based on low resistibity zone (schlumberger <5 ohm-m (T=0.3)), the surface manifestation, geologic struture, and shallow well data (SMR-1,2,3). The detected area is limited by the NW-SE trending faults. Reservoir fluid originates essencially in meteoric water but some volcanic fluid may contibute into shallow acid aquifer near the volcanic center. Main flow patern of reservoir fluid is from Sorik Merapi to NNW direction. The highest reservoir temperature is estimated around 290^{o}C from gas geothermometry mentioned in a literature. Resource potential estimated by stored heat method applying Monte Carlo analysis is 500-1,120 MW.
Natural/Social Environmental Condition	Southwestern part of possible geothermal reservoir area is within SM. Batang Gadis National Park (about 80% of the possible reservoir area). No Protected Forest exist in the field.
Power Sector Situation	Estimated T/L length from the field to intersection T/L between Payakumbuh S/S and Padang Sidempuan S/S is about 23 km. 2P connection with 150kV is recommendable. Electrification ratio in this area reachs only 67.5%.

Power Output Potential	Resource Potential	500 MW	Restricted by National Park	100 MW	Restricted by Power Demand	100 MW
Rank of Development Priority	B		Potential (Expected) Developer		Private Company	

Proposed Geothermal Development Plan

Outline for Power Development

The possible development site in this field is located in northeastern flank of Sorik Merapi. The demand of electricity in northern part of Sumatra is large, so a large scale power plant development as far as resource available is recommendable. For development in this field, the area of National Park should be taken into consideration.

Possibile or Recommended Multi-purpose Geothermal Heat Use

Direct heat use for agricultural industry is recommendable.

Scope for Power Development

Power Plant Capacity: 100MW (55MW+45MW)
Plant System: Condencing
Explor.+Production Well: approx. 25 wells
Reinjection Well: less than 12 wells
Transmission Line: 150kV, approx. 23km
Connection: 2P connection between
Payakumbuh S/S and Padang Sidempuan S/S

CO_2 Emmission Reduction ('000 tone/year)

610

Proposed Geothermal Development Schedule

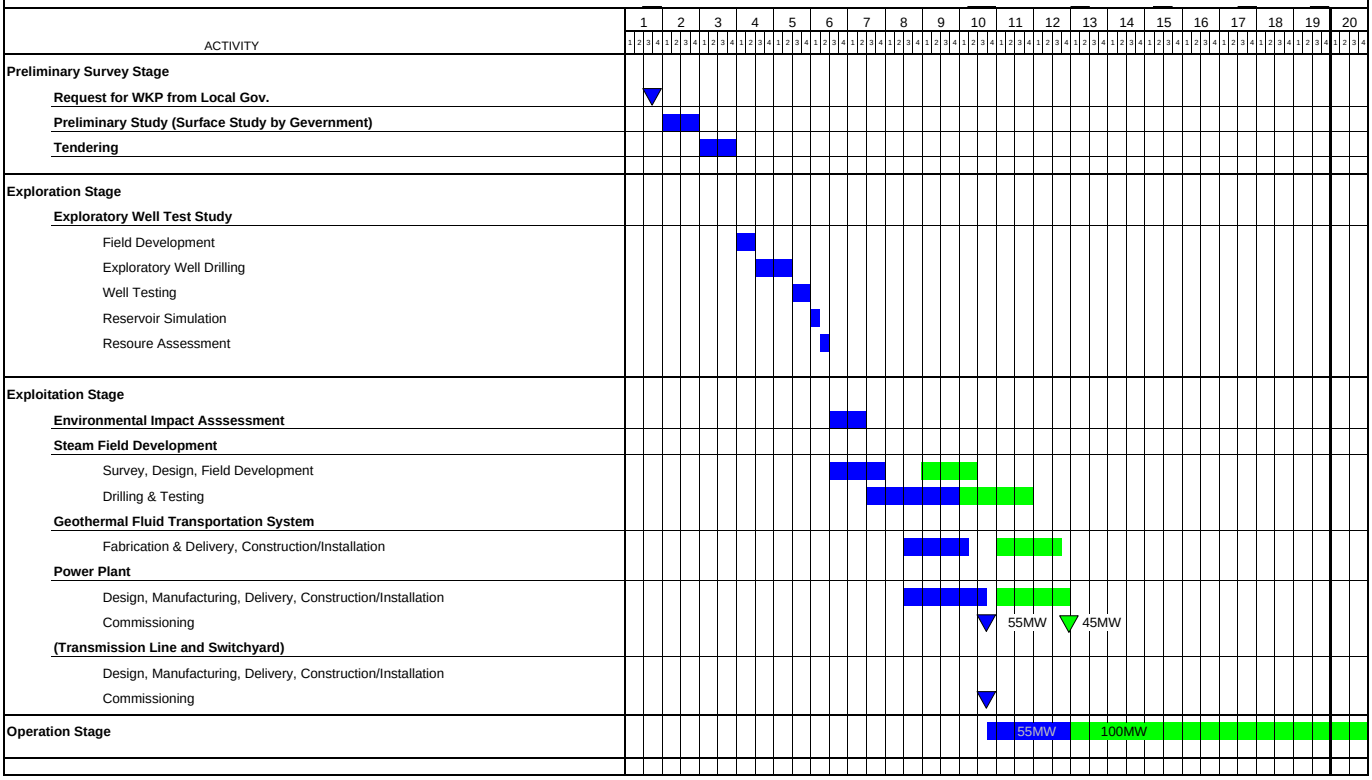
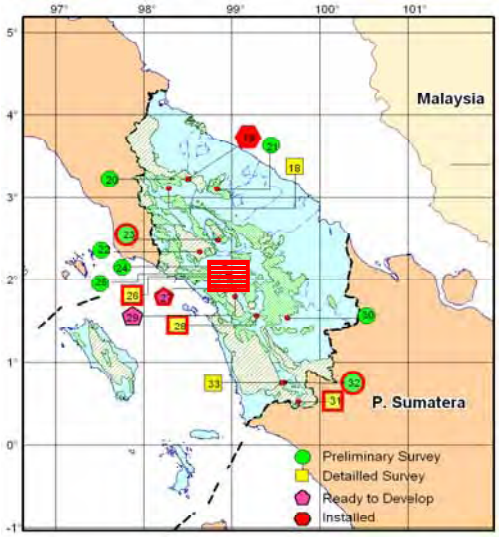


Table 7.1.9-1 Development Plan Sheet for New Working Area (No.71 SIPAHOLON-TARUTUNG)

No.71 SIPAHOLON-TARUTUNG	Region	Sumatra	Province/ Location	North Sumatra, Around Hutabarat Pantai village of Tarutung district

Field Evaluation



Resource Characteristics	This geothermal field is strongly controlled by faulting, especially along the Sumatra Fault System. NW-SE trending faults are dominant in parallel to the regional fault zone. Travertine occurs in the vicinity of hot springs in and around the Tarutung graven. The source of calcite is probably Alas Formation limestones beneath the Toba tuff. Possible reservoir area is defined in the Sipaholon-Tarutung graben based on the low resistivity zone (Schlumberger <30 ohm-m), surface manifestation and geologic struture. All the hot and warm springs are significantly diluted. Detailed fluid flow pattern is not clear. Reservoir temperature is estimated 170^{0}C at least. Resource potential estimated by stored heat method applying Monte Carlo analysis is 55-135 MW.
Natural/Social Environmental Condition	Possible geothermal reservoir area is not within any National Parks.
Power Sector Situation	Estimated T/L length from the field to planned Sarulla S/S is about 19km. Direct connection with 275kV to the planned Sarulla S/S is recommendable. Electrification ratio in this area reachs only 67.5%.

Power Output Potential	Resource Potential	50 MW	Restricted by National Park	50 MW	Restricted by Power Demand	50 MW
Rank of Development Priority	L		Potential (Expected) Developer		Private Company	

Proposed Geothermal Development Plan

Outline for Power Development

The possible development site in this field is located near Sipaholon hot spring area. The reservoir fluid is likely to have only low enthalpy, so that there is possibility that only binary plant system can be applied for power development and that the development priority is relatively low. The demand of electricity in northern part of Sumatra is large, so a large scale power plant development as far as resource available is recommendable.

Possibile or Recommended Multi-purpose Geothermal Heat Use

Direct heat use for agricultural industry is recommendable.

Scope for Power Development

Power Plant Capacity: 50MW (20MW+30MW)
Plant System: Condencing or Binary
Explor.+Production Well: approx. 20 wells
Reinjection Well: less than 7 wells
Transmission Line: 275kV, approx. 19km
Connection: Direct connection to planned Sarulla S/S

CO_2 Emmission Reduction ('000 tone/year)

305

Proposed Geothermal Development Schedule

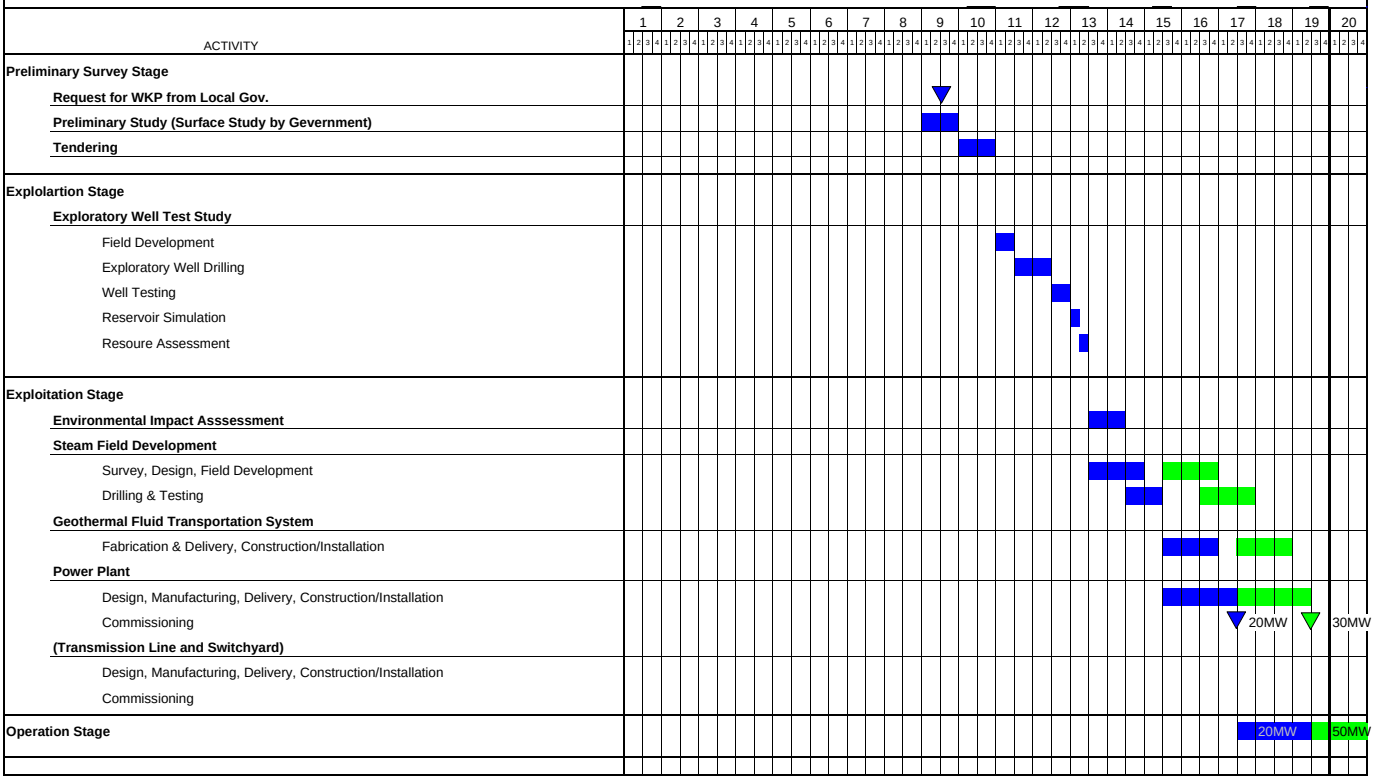
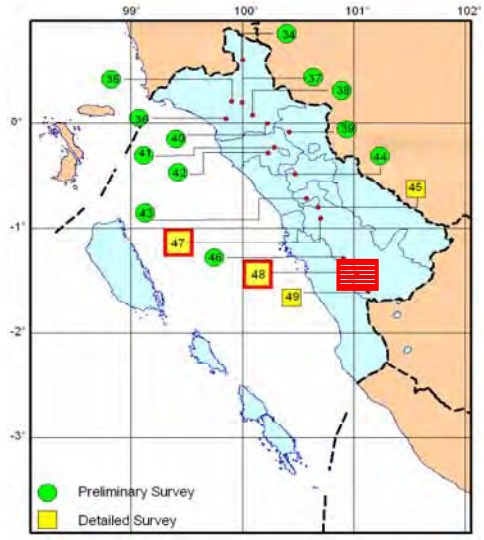


Table 7.1.9-1 Development Plan Sheet for New Working Area (No.13 MUARALABUH)

No.13 MUARALABUH	Region	Sumatra	Province/ Location	West Sumatra, Around Muaralabuh Town

Field Evaluation



Resource Characteristics	The Muaralabuh thermal features are situated along the Great Sumatran Fault Zone, which extends northwestwards down the prominent valley containing the Batang Sikin. There are four main clusters (Balun, Ambayan, Pekonina and Belirang Mati, toward the SE) of thermal features spaced a total of 10 km apart. The most possible reservoir area is estimated based on the surface manifestation, geologic struture (NNW-SSE trending faults such as Sesar Dung Mancung, Sesar Patah Sembilan) and low resistivity zone (<10 ohm-m) detected by the MT survery. Occurrece of typical deep reservoir fluid (neutral chloride type)is highly promising. Main flow patern of reservoir fluid is from SE to NW, but possibility of existence of another system (or up-flow) at NW end of this field is still remained. Reservoir temperature is estimated higher than 180°C at least, and possibly up to 270°C. Resource potential estimated by stored heat method applying Monte Carlo analysis is 160-420 MW.
Natural/Social Environmental Condition	Southern end of possible geothermal reservoir area is within TN. Kerinci Seblat National Park (less than 25% of the possible reservoir area). Some Protected Forest exists at the northeast (less than 10% of the possible reservoir area).
Power Sector Situation	Estimated T/L length from the field to Simangkok S/S is about 7 km. Direct connection with 150kV is recommendable. Electrification ratio in this area reachs only 61.1%.

Power Output Potential	Resource Potential	240 MW	Restricted by National Park	240 MW	Restricted by Power Demand	240 MW
Rank of Development Priority	B		Potential (Expected) Developer		Private Company	

Proposed Geothermal Development Plan

Outline for Power Development

The most possible development site in this field is located near Sapan Sentral, but the southeastern and northwestern parts are also promising. So, setting of Working Areas more than two would be possible. The demand of electricity in mid-western part of Sumatra including West Sumatra province is large, so a large scale power plant development as far as resource available is recommendable.

Possibile or Recommended Multi-purpose Geothermal Heat Use

Direct heat use for agricultural industry is recommendable.

Scope for Power Development

Power Plant Capacity:
240MW (55MWx3unit+75MW)
Plant System: Condencing
Explor.+Production Well: approx. 55 wells
Reinjection Well: less than 25 wells
Transmission Line: 150kV, approx. 7km
Connection: Direct connection to Simangkok S/S

CO_2 Emmission Reduction ('000 tone/year)

1,464

Proposed Geothermal Development Schedule

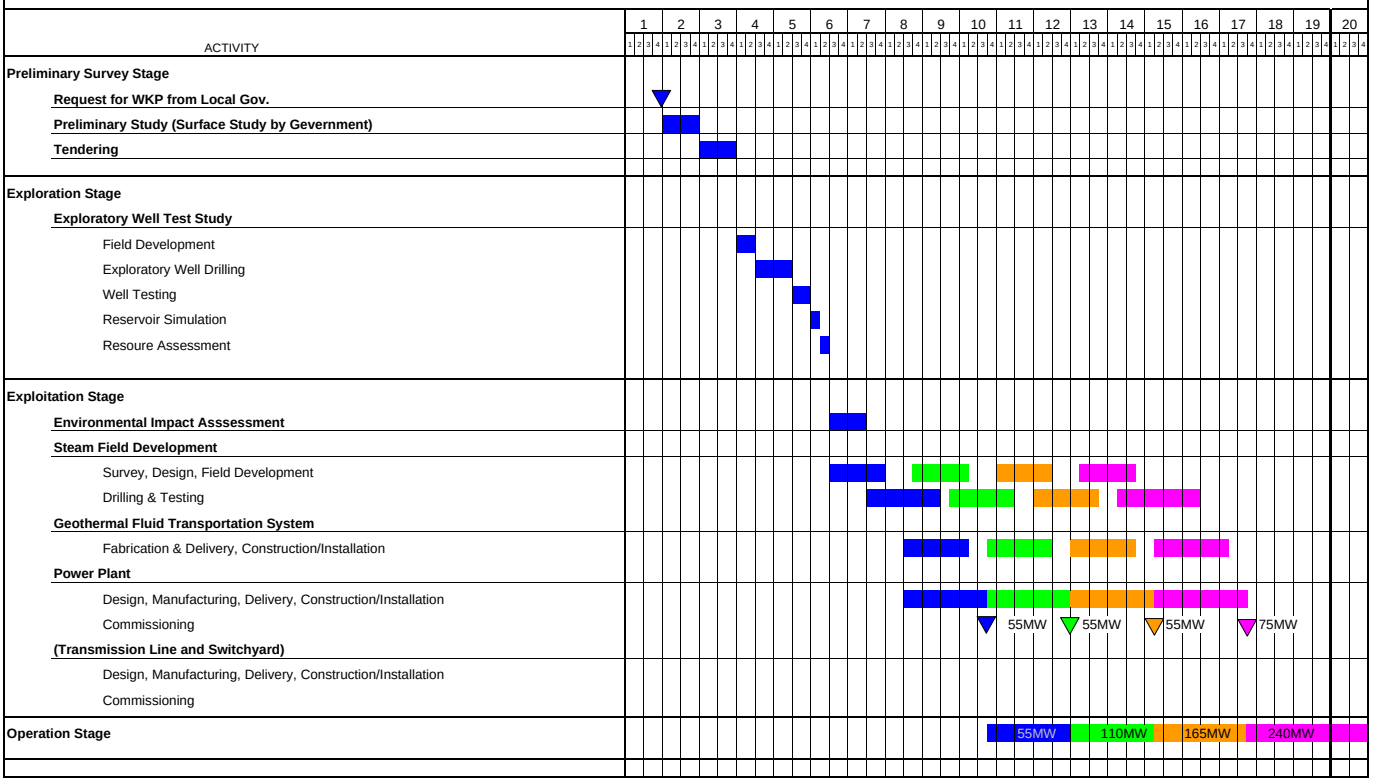
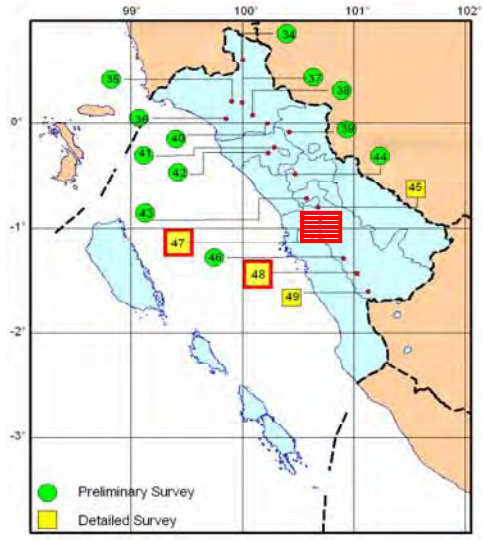


Table 7.1.9-1 Development Plan Sheet for New Working Area (No.14 G. TALANG)

No.14 G. TALANG	Region	Sumatra	Province/ Location	West Sumatra, Northeastern flank of G. Talang

Field Evaluation



Resource Characteristics	G.Talang lies approximately 20 km SE of Solok. There is a very active fault stretching NW from Danau Dibaru near the summit of G.Talang to Danau Singkarak 40 km distant. Most of the active features are associated with this fault. Possible area is defined at Batu Berjanjang located in the northeastern flank of the G. Talang, based on the low resistivity zone (schlumberger <50 ohm-m), surface manifestation and geologic struture. The major geologic strucutre in this field is NNW-SSE trending faults. Manifestations near summit of G. Talang is likely to be belong to a volcanic system. A shallow outflow to NNW yield diluted neutral bicarbonate waters. The highest reservoir temperature is estimated up to around 290°C. Resource potential estimated by stored heat method applying Monte Carlo analysis is 15-40 MW.
Natural/Social Environmental Condition	Possible geothermal reservoir area is not within any National Parks. But Protected Forest exists at the western part (about 55% of the possible reservoir area).
Power Sector Situation	Estimated T/L length from the field to Indarung S/S is about 7 km. Direct connection with 150kV is recommendable. Electrification ratio in this area reachs only 61.1%.

Power Output Potential	Resource Potential	30 MW	Restricted by National Park	30 MW	Restricted by Power Demand	30 MW
Rank of Development Priority	C		Potential (Expected) Developer		Private Company	

Proposed Geothermal Development Plan

Outline for Power Development

The most possible development site in this field is located in northeastern flank of G. Talang. The demand of electricity in mid-western part of Sumatra including West Sumatra province is large, so a large scale power plant development as far as resource available is recommendable.
For development in this field, volcanic hazard should be taken into consideration.

Possibile or Recommended Multi-purpose Geothermal Heat Use

Direct heat use for agricultural industry is recommendable.

Scope for Power Development

Power Plant Capacity: 30MWx1unit
Plant System: Condencing
Explor.+Production Well: approx. 10 wells
Reinjection Well: less than 5 wells
Transmission Line: 150kV, approx. 7km
Connection: Direct connection to Indarung S/S

CO_2 Emmission Reduction ('000 tone/year)
183

Proposed Geothermal Development Schedule

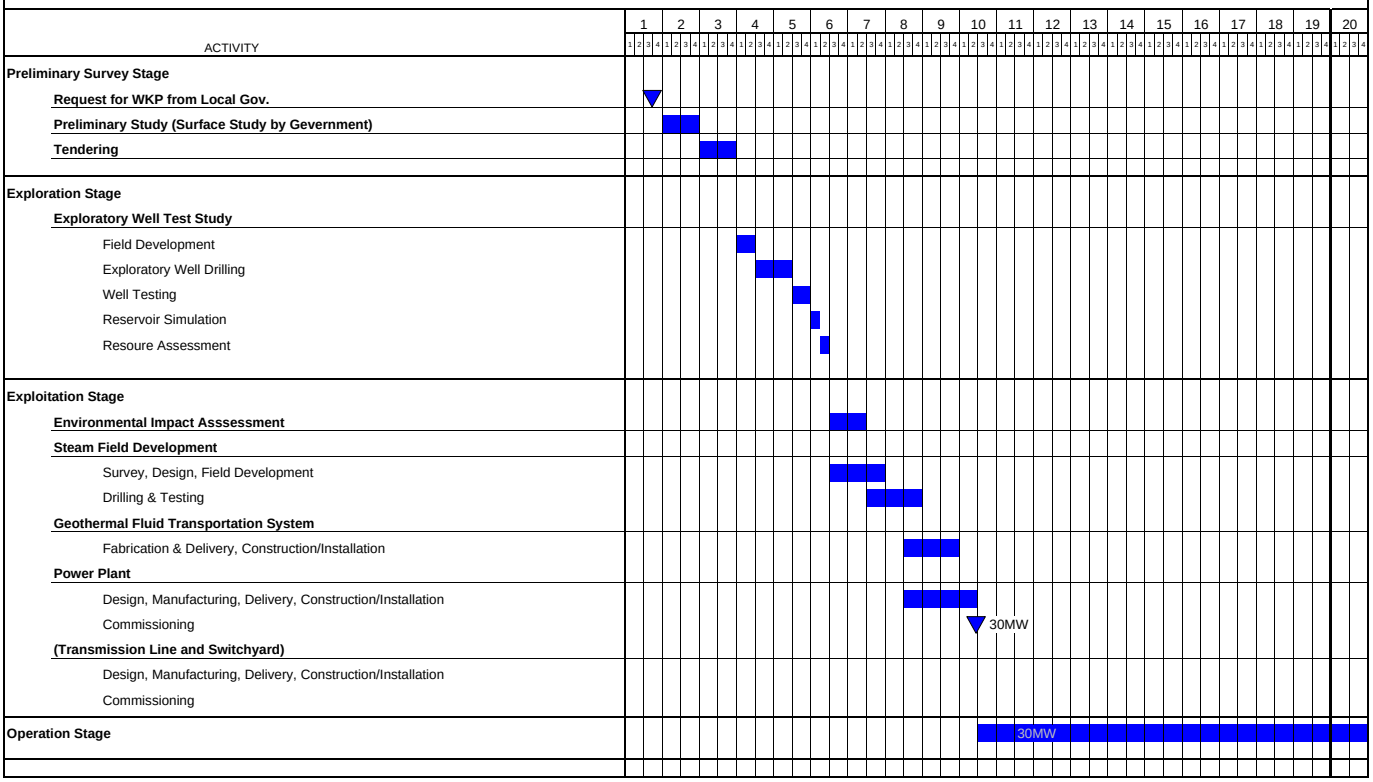
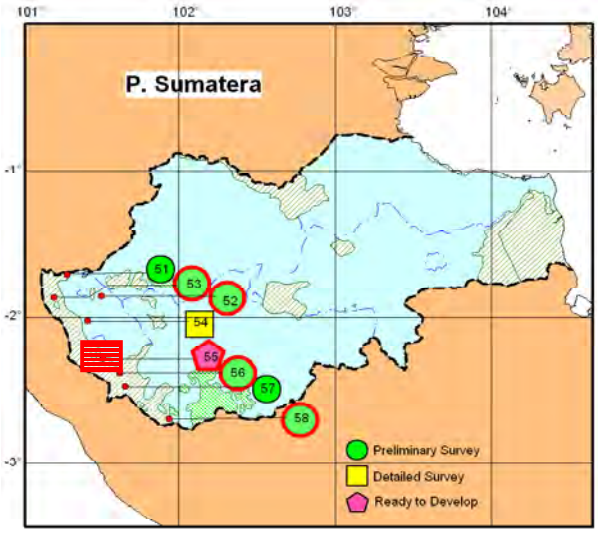


Table 7.1.9-1 Development Plan Sheet for New Working Area (No.15 LEMPUR / KERINCI)

No.15 LEMPUR / KERINCI	Region	Sumatra	Province/ Location	Jambi, Northeastern flank of G. Kunyit

Field Evaluation



Resource Characteristics	G. Kunyit, which is composed of andesitic volcanics and poured large volumes of lava into the depression caused by down-faulting along the Great Sumatra Fault zone. Most of the thermal features (fumaroles and steaming ground) are clustered along or around the Duabelas Fault. This fault trends NNE-SSW and is parelleled by the Sikai Fault. Proven reservoir area is identified by two deep exploratory wells (LP-1 and LP-2) by JICA study (1989). Reservoir fluid originates essencially in meteoric water. Neutral-pH chloride water does not occur at the surface but is confirmed by well drillings and flow tests. Reservoir temperature is estimated around 210-250^{o}C from silica geothermometry of well discharge water, while the highest temperature at deeper level is expected to be around 290^{o}C from gas geothermometries. Resource potential estimated by stored heat method applying Monte Carlo analysis is 25-55 MW.
Natural/Social Environmental Condition	Southern and western part of the possible geothermal reservoir area is within TN. Kerinci Seblat National Park (more than 80% of the possible reservoir area).
Power Sector Situation	Estimated T/L length from the field to Sungai Penuh S/S is about 32 km. Direct connection with 150kV is recommendable. Electrification ratio in this area reachs only 39.8%.

Power Output Potential	Resource Potential	60 MW	Restricted by National Park	20 MW	Restricted by Power Demand	20 MW
Rank of Development Priority	B		Potential (Expected) Developer		Private Company	

Proposed Geothermal Development Plan

Outline for Power Development

The most possible development site in this field is located in northeastern flank of G. Kunyit, where two deep well have been already drilled. For development in this field, the Preliminary Survey and Exploration stages could be skipped because of existence of sufficient surveys and drillings by the JICA's project in 1980's. The demand of electricity in middle part of Sumatra including Jambi province is large, so a large scale power plant development as far as resource available is recommendable.
For development in this field, the area of National Park should be taken into consideration.

Possibile or Recommended Multi-purpose Geothermal Heat Use

Direct heat use for agricultural industry is recommendable.

Scope for Power Development

Power Plant Capacity: 20MWx1unit
Plant System: Condencing
Explor.+Production Well: approx. 8 wells
Reinjection Well: less than 4 wells
Transmission Line: 150kV, approx. 32km
Connection: Direct connection to Sungai Penuh S/S

CO_2 Emmission Reduction ('000 tone/year)

122

Proposed Geothermal Development Schedule

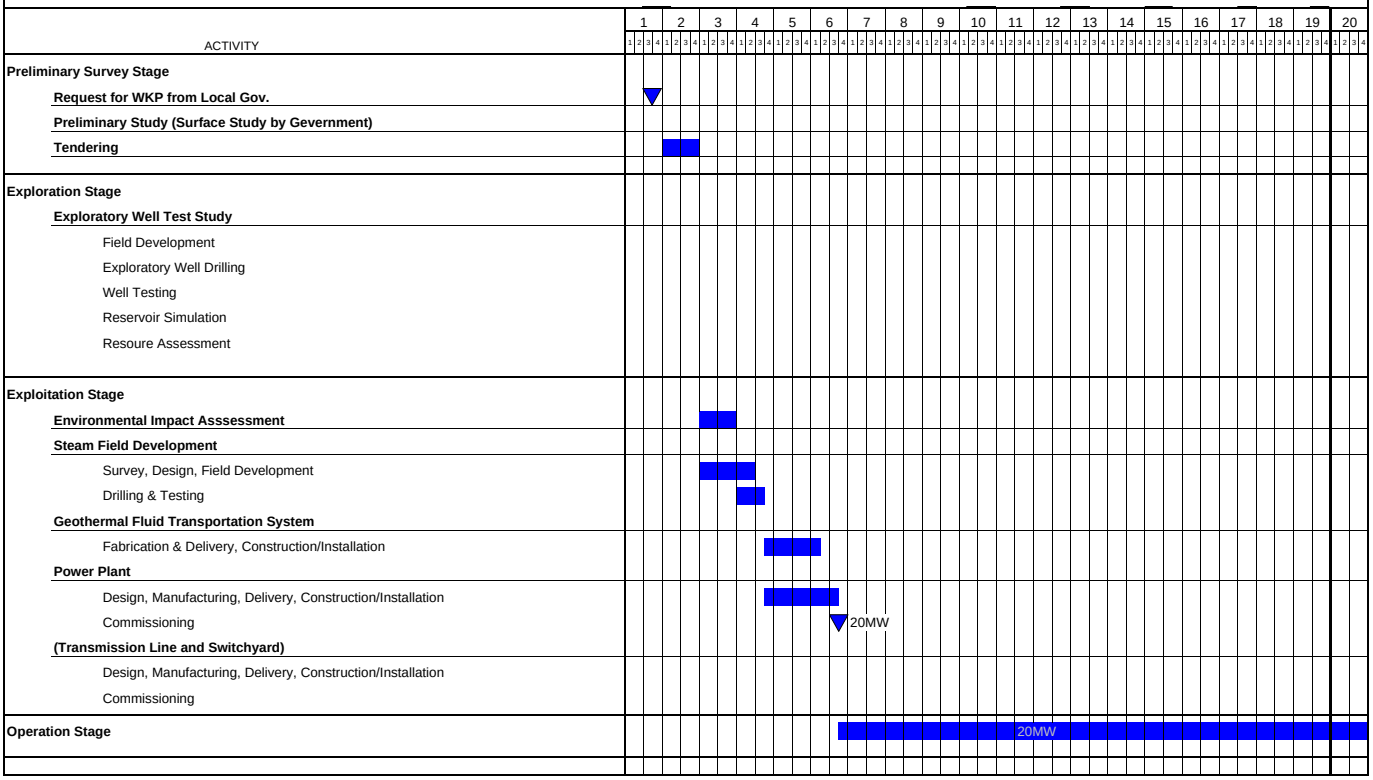
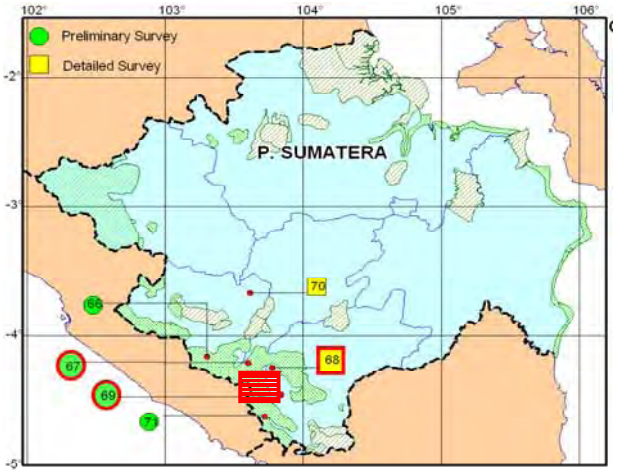


Table 7.1.9-1 Development Plan Sheet for New Working Area (No.24 MARGA BAYUR)

No.24 MARGA BAYUR	Region	Sumatra	Province/ Location	South Sumatra, Nothern flank of G. Besar

Field Evaluation



Resource Characteristics	Gunung Besar is an 1899m-high volcano with a minor sulfur deposit in its crater. A major solfatara field, Marga Bayur, is located along its north and NW flanks along the Semangko fault system. Possible reservoir area is defined based on low resistiviy zone (Schlumberger <10 ohm-m (AB/2=1000m)), surface manifestation, and geologic struture. The detected area is limited by NW-SE trending faults at southwest. The Schlumberger data indictes that a possibility of the existence of more widen area. Only fumaroles and steam-heated springs occurs, but these are likely to be derived from deep hot reservoir. Reservoir temperature is estimated higher than 180°C at least; but considering strong activities of surface manifestation, a highest temperature of around 250°C or higher would be expected. Resource potential estimated by stored heat method applying Monte Carlo analysis is 80-200 MW.
Natural/Social Environmental Condition	Possible geothermal reservoir area is not within any National Parks. But most of the area is within Protected Forest (about 95% of the possible reservoir area).
Power Sector Situation	Estimated T/L length from the field to planned Rantau dadap-Segamit S/S is about 29 km. Direct connection with 150kV is recommendable. Electrification ratio in this area reachs only 39.8%.

Power Output Potential	Resource Potential	170 MW	Restricted by National Park	170 MW	Restricted by Power Demand	170 MW
Rank of Development Priority	C		Potential (Expected) Developer		Private Company	

Proposed Geothermal Development Plan

Outline for Power Development

The most possible development site in this field is located near surface manifestations at Marga Bayur. The demand of electricity in southern part of Sumatra is large, so a large scale power plant development as far as resource available is recommendable.
For development in this field, the area of Protected Forest should be taken into consideration.

Possibile or Recommended Multi-purpose Geothermal Heat Use

Direct heat use for agricultural industry is recommendable.

Scope for Power Development

Power Plant Capacity:
170MW (55MWx2unit+60MW)
Plant System: Condencing
Explor.+Production Well: approx. 60 wells
Reinjection Well: less than 20 wells
Transmission Line: 150kV, approx. 29km
Connection: Direct connection to
planned Rantau dadap-Segamit S/S

CO_2 Emmission Reduction ('000 tone/year)

1,037

Proposed Geothermal Development Schedule

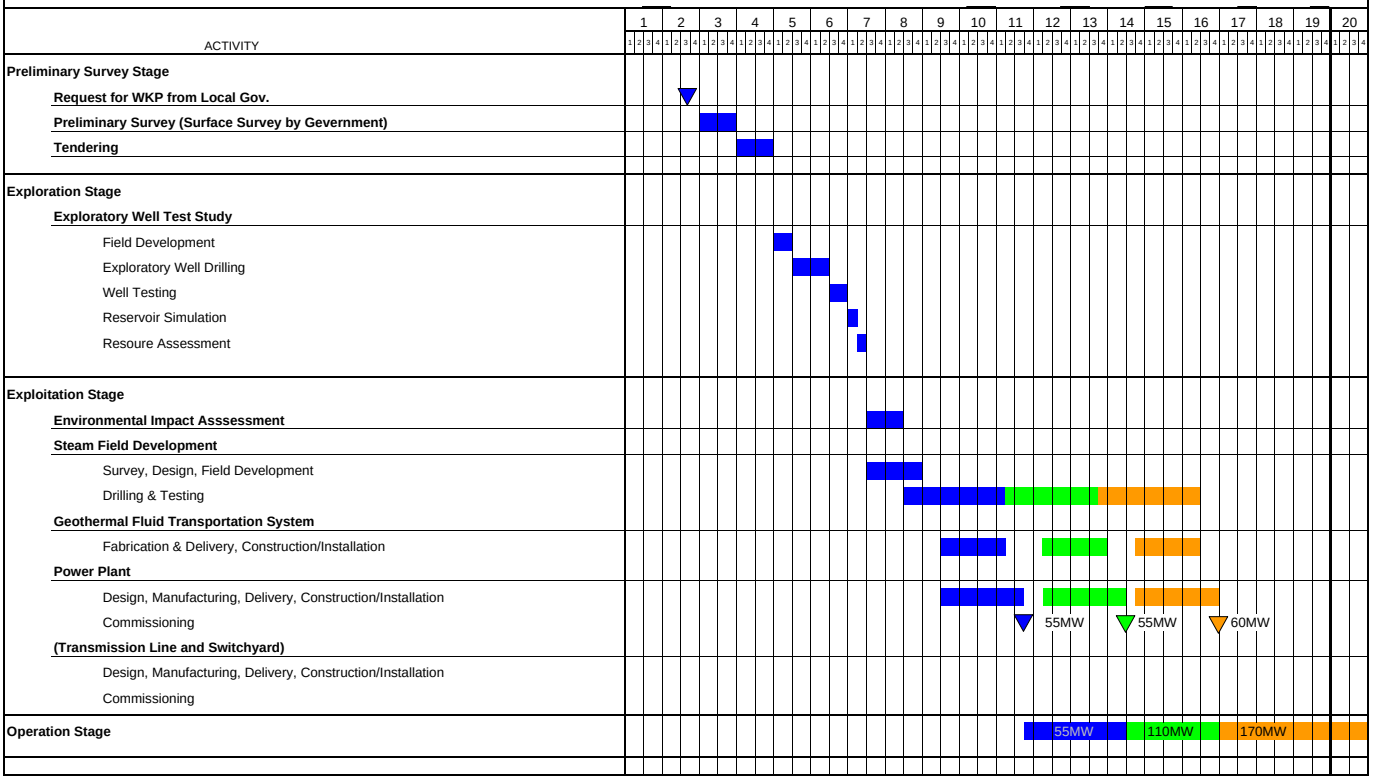
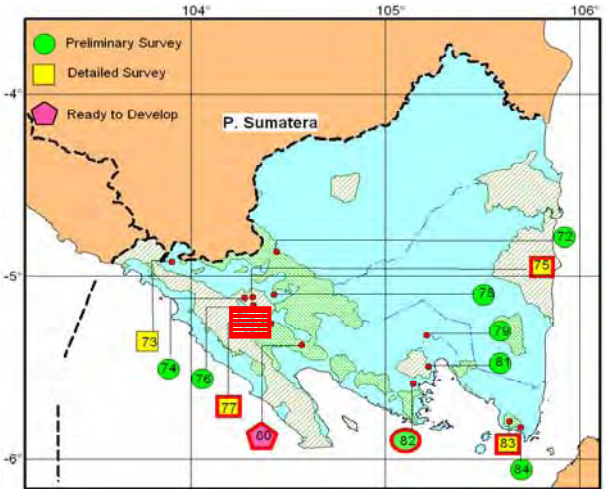


Table 7.1.9-1 Development Plan Sheet for New Working Area (No.28 SUOH ANTATAI)

No.28 SUOH ANTATAI	Region	Sumatra	Province/ Location	Lampung, At Suoh Valley on southern foot of G. Sekincau

Field Evaluation



Resource Characteristics	Suoh-Antatai is situated at the southern end of the Sumatera Fault Zone, 45 km NW of the port of Kota Agung. Thermal features cover an area of about 70 km^2 and are found within and immediately surrounding the Suoh Depression with fumaroles, springs and mud pools. Possible reservoir area is defined by PERTAMINA as area III. This area is defined based on surface manifestation, geologic struture, geochemistry and schlumberger. The area is limited by the N-S trending faults at the east and the west and NNW-SSE trending fault at the north. A large number of surface manifestations occur mainly within a NW-SE trending valley, suggesting large extent of high temperature reservoir. Reservoir temperature is estimated higher than 230°C; considering strong activities of surface manifestation, a highest temperature of around 270-300°C would be expected. Resource potential estimated by stored heat method applying Monte Carlo analysis is 680-1,280 MW.
Natural/Social Environmental Condition	Northeastern part of possible geothermal reservoir area is within TN. Bukit Barisan Selatan National Park (about 50% of the possible reservoir area). Protected Forest exists at the southeast end of the field (about 15% of the possible reservoir area).
Power Sector Situation	Estimated T/L length from the field to planned G. Sekincau S/S is about 18 km. Direct connection with 150kV to the G. Sekincau S/S is recommendable. Electrification ratio in this area reachs only 37.1%.

Power Output Potential	Resource Potential	600 MW	Restricted by National Park	330 MW	Restricted by Power Demand	330 MW
Rank of Development Priority	B		Potential (Expected) Developer		Private Company	

Proposed Geothermal Development Plan

Outline for Power Development

The most possible development site in this field is located around or south of Lake Danau Asam within the Suoh Depression. The demand of electricity in southern part of Sumatra is large, so a large scale power plant development as far as resource available is recommendable.
For development in this field, the area of National Park should be taken into consideration.

Possibile or Recommended Multi-purpose Geothermal Heat Use

Direct heat use for agricultural industry is recommendable.

Scope for Power Development

Power Plant Capacity:
330MW (55MWx6unit or 110MWx3unit)
Plant System: Condencing
Explor.+Production Well: approx. 55 wells
Reinjection Well: less than 40 wells
Transmission Line: 150kV, approx. 18km
Connection: Direct connection to planned G. Sekincau S/S

CO_2 Emmission Reduction ('000 tone/year)

2,012

Proposed Geothermal Development Schedule

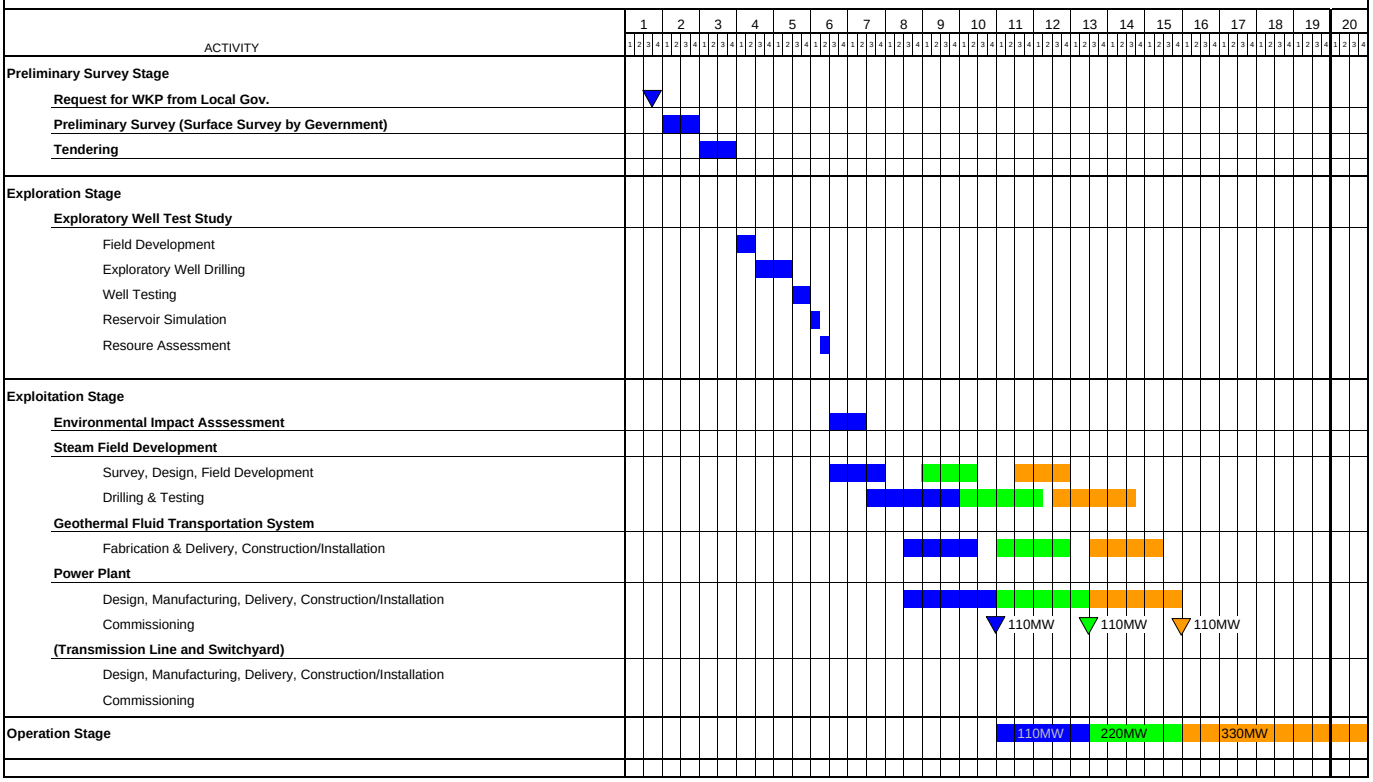
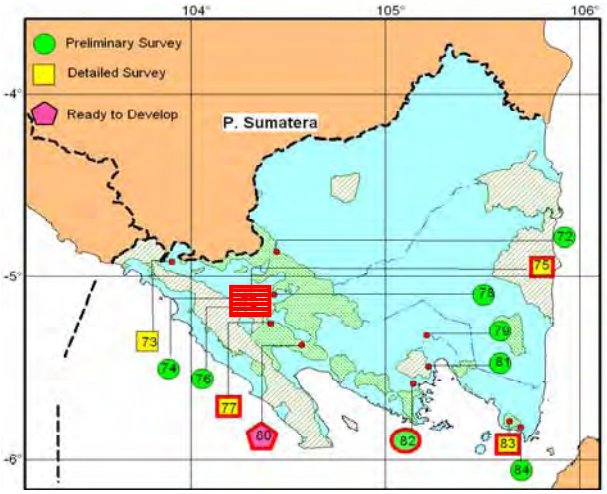


Table 7.1.9-1 Development Plan Sheet for New Working Area (No.29 G. SEKINCAU)

No.29 G. SEKINCAU	Region	Sumatra	Province/ Location	Lampung, East to south flank of G. Sekincau

Field Evaluation



Resource Characteristics	The prospect of G. Sekincau has approximately 15 km north of the Souh Antatai prospect. G. Sekincau is a quarternary andesite volcano (1718m in elevation). Many thermal manesfestations, especially the fumarolic features and solfataras lie close to the caldera rim. Also, fumaroles and springs occur on the flanks of G. Sekincau. Possible reservoir area defined by PERTAMINA as area I. This area is defined based on surface manifestation, geologic struture, geochemistry and schlumberger. The area is limited by the NE-SW trending faults and NW-SE trending faults at the south. Only fumaroles and steam-heated springs occurs, but these are likely to be derived from deep hot reservoir. This field is next to Suoh-Antatai at the north and there is a possibility of reservoir connection between both fields, but details are not clear yet. Reservoir temperature is estimated to be around 260°C, and a highest temperature near 300°C would be expected. Resource potential estimated by stored heat method applying Monte Carlo analysis is 280-540 MW.
Natural/Social Environmental Condition	Most of possible geothermal reservoir area is within TN. Bukit Barisan Selatan National Park (about 90% of the possible reservoir area).
Power Sector Situation	Estimated T/L length from the field to planned Besai S/S is about 19 km. Direct connection with 150kV is recommendable. Electrification ratio in this area reachs only 37.1%.

Power Output Potential	Resource Potential	300 MW	Restricted by National Park	60 MW	Restricted by Power Demand	60 MW
Rank of Development Priority	B		Potential (Expected) Developer		Private Company	

Proposed Geothermal Development Plan

Outline for Power Development	Scope for Power Development	CO_2 Emmission Reduction ('000 tone/year)
For development in this field, the area of National Park should be taken into consideration. The demand of electricity in southern part of Sumatra is large, so a large scale power plant development as far as resource available is recommendable.	Power Plant Capacity: 60MW (30MWx2unit) Plant System: Condencing Explor.+Production Well: approx. 12 wells Reinjection Well: less than 9 wells Transmission Line: 150kV, approx. 19km Connection: Direct connection to Besai S/S	366
Possibile or Recommended Multi-purpose Geothermal Heat Use		
Direct heat use for agricultural industry is recommendable.		

Proposed Geothermal Development Schedule

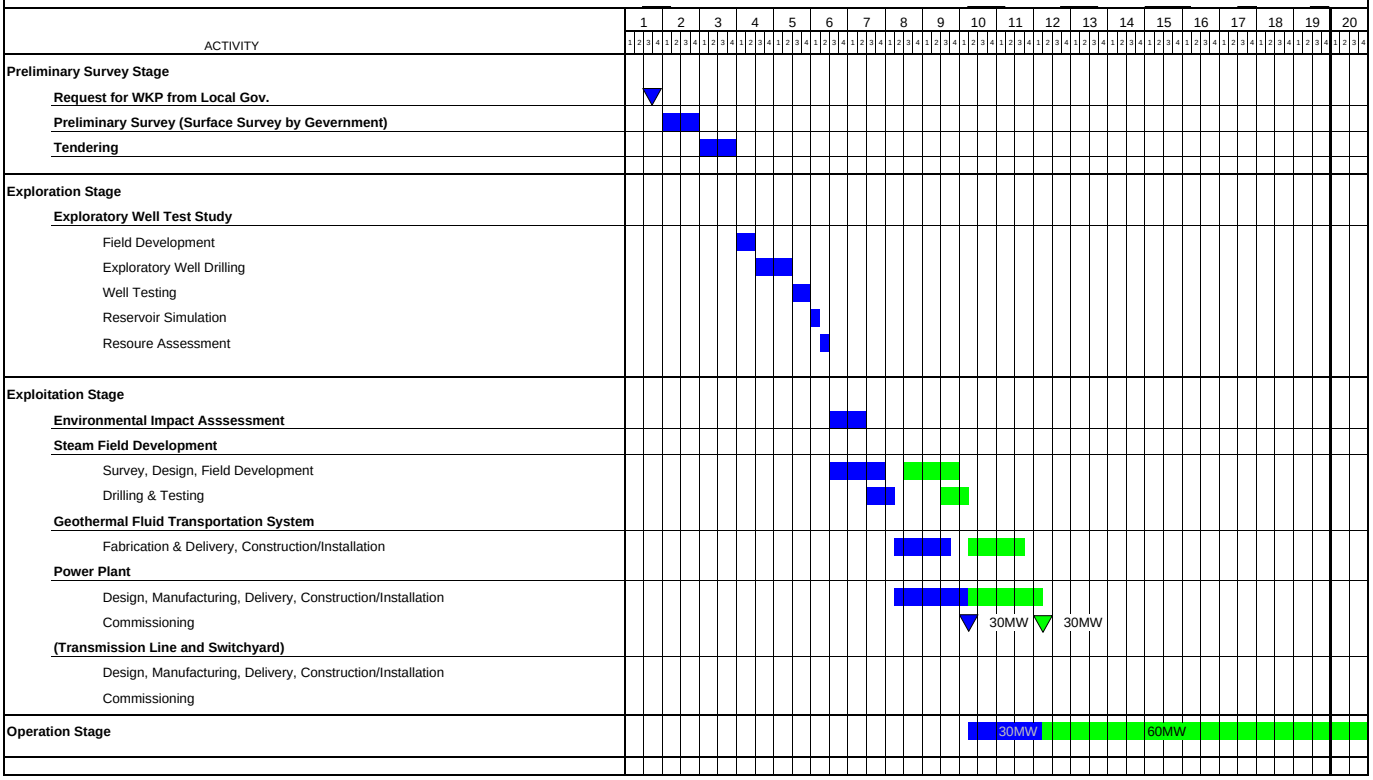
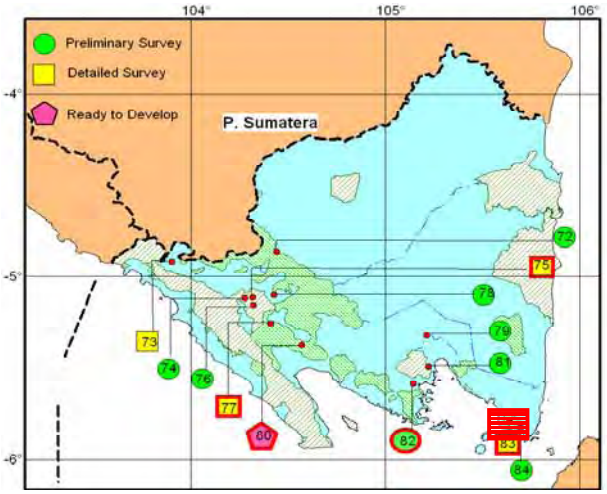


Table 7.1.9-1 Development Plan Sheet for New Working Area (No.30 RAJABASA)

No.30 RAJABASA	Region	Sumatra	Province/ Location	Lampung, South flank of G. Rajabasa

Field Evaluation



Resource Characteristics	Rajabasa field spreads over a quaternary andesitic volcanic system including the G. Rajabasa and G. Balerang volcanoes. The main surface manifestations, fumarolic activities appear at 500m elevation on south side on G. Rajabasa. Possible reservoir area is defined at the southern flank of G. Rajabasa, based on the low resistivity zone (MT resistivity <20 ohm-m), bouguer anomaly, hot spring, hydorothermal alteration zone, and geologic struture. The major geologic structure in this field is NE-SW trending faults and NW-SE trending faults. Hot springs of G. Botak and Kugung align on these fault strucutures. Reservoir fluid originates in meteoric water and seawater. Some of the boiled fluid yields surface fumaroles. Reservoir temperature is estimated from 200°C to 250°C, and possibly up to 280°C according to gas geothermometry. Resource potential estimated by stored heat method applying Monte Carlo analysis is 120-250 MW.
Natural/Social Environmental Condition	Possible geothermal reservoir area is not within any National Parks. But Protected Forest exists at northern part around the summit of G. Rajabasa (about 70% of the possible reservoir area).
Power Sector Situation	Estimated T/L length from the field to planned Kalianda S/S is about 8 km. Direct connection with 150kV is recommendable. Electrification ratio in this area reachs only 37.1%.

Power Output Potential	Resource Potential	120 MW	Restricted by National Park	120 MW	Restricted by Power Demand	120 MW
Rank of Development Priority	C		Potential (Expected) Developer		Private Company	

Proposed Geothermal Development Plan

Outline for Power Development

The most possible development site in this field is located in south flank of G. Rajabasa. The demand of electricity in southern part of Sumatra is large, so a large scale power plant development as far as resource available is recommendable.

Scope for Power Development

Power Plant Capacity: 120MW (40MWx3unit)
Plant System: Condencing
Explor.+Production Well: approx. 30 wells
Reinjection Well: less than 15 wells
Transmission Line: 150kV, approx. 8km
Connection: Direct connection to Kalianda S/S

CO_2 Emmission Reduction ('000 tone/year)

732

Possibile or Recommended Multi-purpose Geothermal Heat Use

Direct heat use for agricultural or marine product industry is recommendable.

Proposed Geothermal Development Schedule

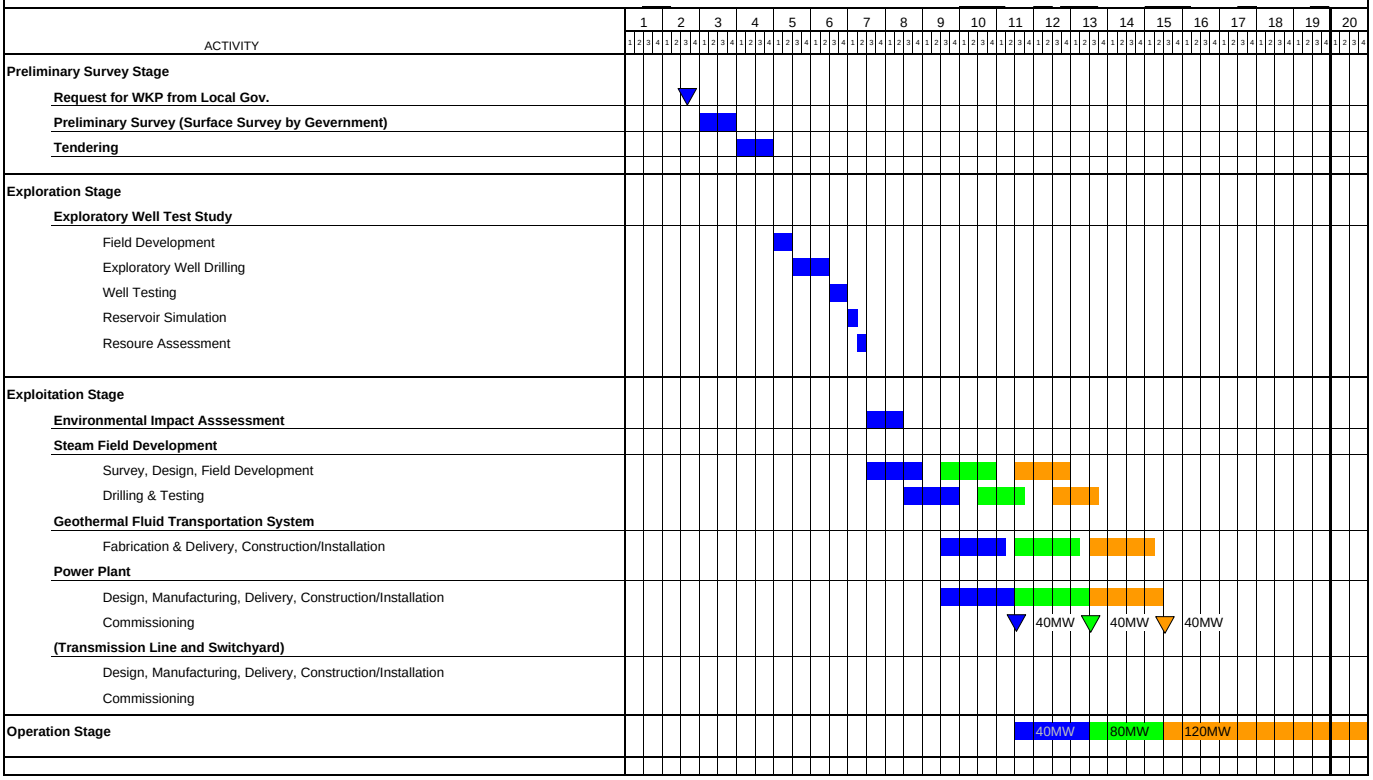
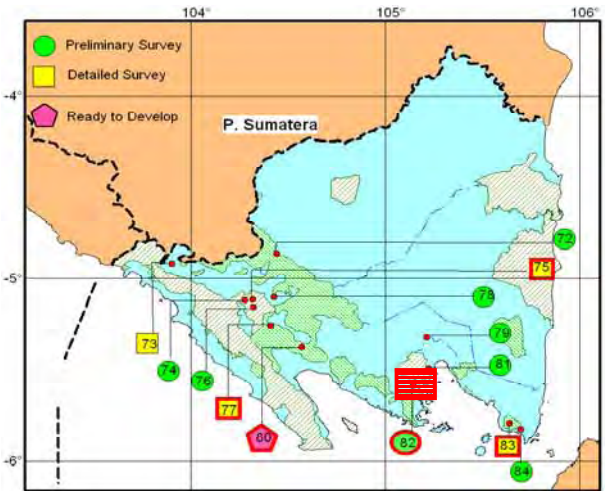


Table 7.1.9-1 Development Plan Sheet for New Working Area (No.31 WAI RATAI)

No.31 WAI RATAI	Region	Sumatra	Province/ Location	Lampung, Southeastern foot of G. Ratai

Field Evaluation



Resource Characteristics	Wai Ratai field is about 20 km southwest of the port of Teluk Betung with the area of 30 km^2 covering by many hot springs. The springs are mainly at low altitudes at the head of Teluk Ratai and north of the Wai Ratai river valley. Most of the springs occur in Tertiary predominatly andesitic volcanics. Possible reservoir area is defined based on low resistivity zone (Schlumberger <15 ohm-m), surface manifestation and geologic struture. The major geologic strucuture in this field is NW-SE trending. Reservoir fluid originates in meteoric water and possibly some seawater. Some of the boiled fluid yields surface mudpools. Reservoir temperature is estimated around 220^{0}C or higher, and possibly up to 290^{0}C according to gas geothermometry. Resource potential estimated by stored heat method applying Monte Carlo analysis is 135-260 MW.
Natural/Social Environmental Condition	Northern end of possible geothermal reservoir area is within THR. Wan Abdul Rachman National Park (about 15% of the possible reservoir area).
Power Sector Situation	Estimated T/L length from the field to intersection T/L between Teluk Betung S/S and Gedung Tataan S/S (planned) is about 16 km. P Connection between the two S/S with 150kV is recommendable.

Power Output Potential	Resource Potential	120 MW	Restricted by National Park	120 MW	Restricted by Power Demand	120 MW
Rank of Development Priority	C		Potential (Expected) Developer		Private Company	

Proposed Geothermal Development Plan

Outline for Power Development

The most possible development site in this field is located in southeastern foot of G. Ratai. The demand of electricity in southern part of Sumatra is large, so a large scale power plant development as far as resource available is recommendable.

Scope for Power Development

Power Plant Capacity: 120MW (40MWx3unit)
Plant System: Condencing
Explor.+Production Well: approx. 30 wells
Reinjection Well: less than 15 wells
Transmission Line: 150kV, approx. 16km
Connection: P connection between
Teluk Betung S/S and
Gedung Tataan S/S (planned)

CO_2 Emmission Reduction ('000 tone/year)

732

Possibile or Recommended Multi-purpose Geothermal Heat Use

Direct heat use for agricultural or marine product industry is recommendable.
A pilot drying plant using hot spring water for producing Copra has been constructed by BPPT.

Proposed Geothermal Development Schedule

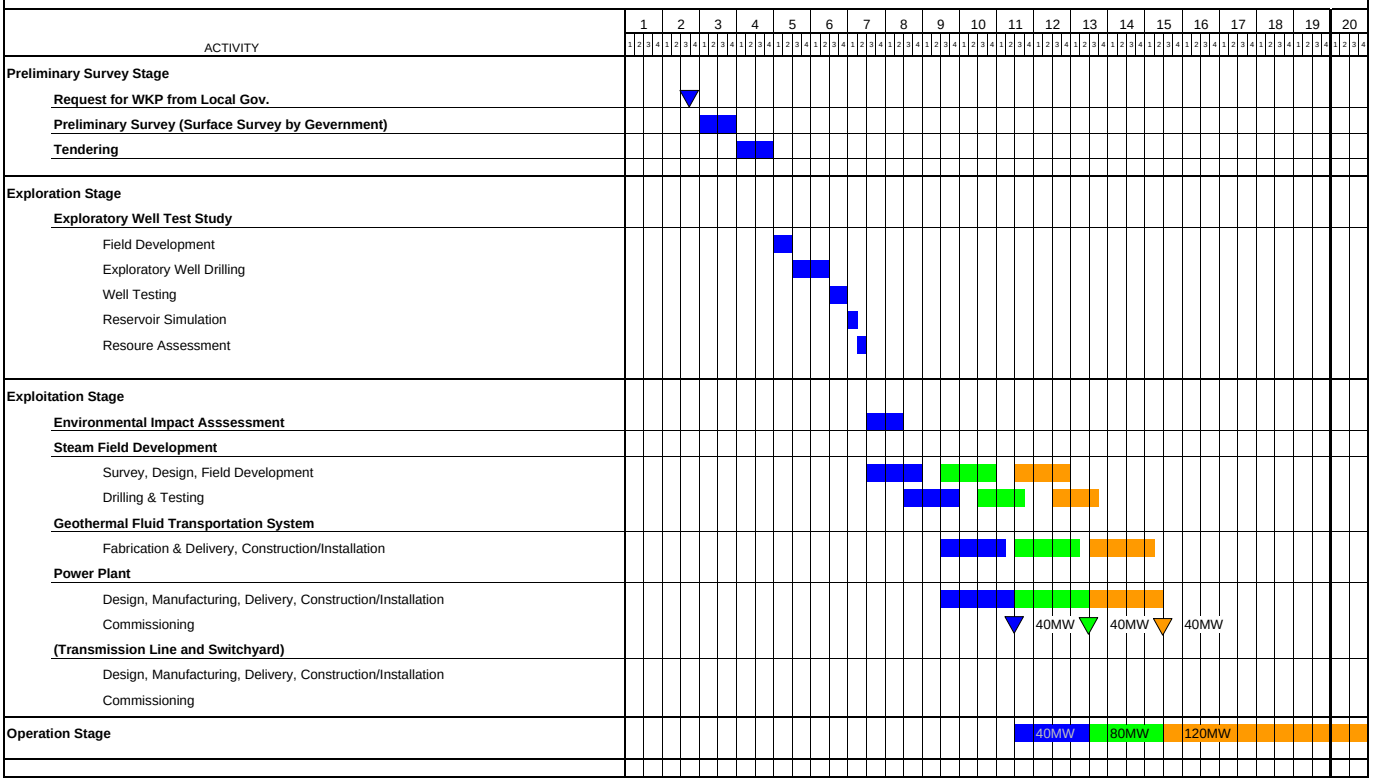
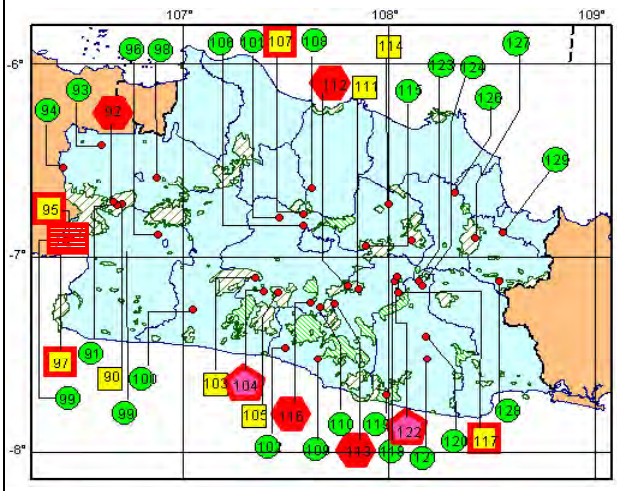


Table 7.1.9-1 Development Plan Sheet for New Working Area (No.35 CISOLOK - CISUKARAME)

No.35 CISOLOK - CISUKARAME	Region	Java-Bali	Province/ Location	West Java, Around Cisolok Town, Sukabumi

Field Evaluation



Resource Characteristics	In three areas (Cisolok, Cisukarame and Sangiang) the thermal features and altered ground are structurally controlled. NNE-SSW to NE-SW faults predominate in the area and are frequently cut by younger, small, less continuous faults trending NW-SE or N-S. The Cisukarame features are situated about 7 km northeast of the Cisolok springs. The Cisukarame springs emerge close to NE-SW faults and alignment of the alteration zones in this direction is apparent. In the Ciskarame area, 22.5 km^2 possible reservoir area is defined based on low resistivity zone (MT resistivity: apparent resistivity T=0.1s, skin depth=300m). In both Cisolok and Cisukarame areas, neutral chloride springs occur. They are possibly derived from outflows from deep high temperature reservoir(s) existing at the north. Reservoir temperature is estimated higher than around 180°C, and possibly up to 250°C or higher. Spring water geothermometries indicate higher potential in Cisukarame compared to Cisolok. Resource potential estimated by stored heat method applying Monte Carlo analysis is 240-580 MW.
Natural/Social Environmental Condition	Northern end of possible geothermal reservoir area is within THR. Wan Abdul Rachman National Park (about 15% of the possible reservoir area).
Power Sector Situation	Estimated T/L length from the field to intersection T/L between Pelabuhan Ratu S/S and Saketi S/S is about 4 km. 1P Connection between the two S/S with 150kV is recommendable. The existing T/L is 70 kV, but PLN has plan to grade up the grid to 150 kV.

Power Output Potential	Resource Potential	180 MW	Restricted by National Park	180 MW	Restricted by Power Demand	180 MW
Rank of Development Priority	B		Potential (Expected) Developer		Private Company	

Proposed Geothermal Development Plan

Outline for Power Development

The most possible development site in this field is located in northern part of Cisukarame. The demand of electricity in western part of Java is very large, so a large scale power plant development as far as resource available is recommendable.

Scope for Power Development

Power Plant Capacity:
180MW (55MWx2unit+70MW)
Plant System: Condencing
Explor.+Production Well: approx. 45 wells
Reinjection Well: less than 20 wells
Transmission Line: 150kV, approx. 4km
Connection: 1P connection between
Pelabuhan Ratu S/S and Saketi S/S

CO_2 Emmission Reduction ('000 tone/year)

1,098

Possibile or Recommended Multi-purpose Geothermal Heat Use

Direct heat use for agricultural or marine product industry is recommendable.

Proposed Geothermal Development Schedule

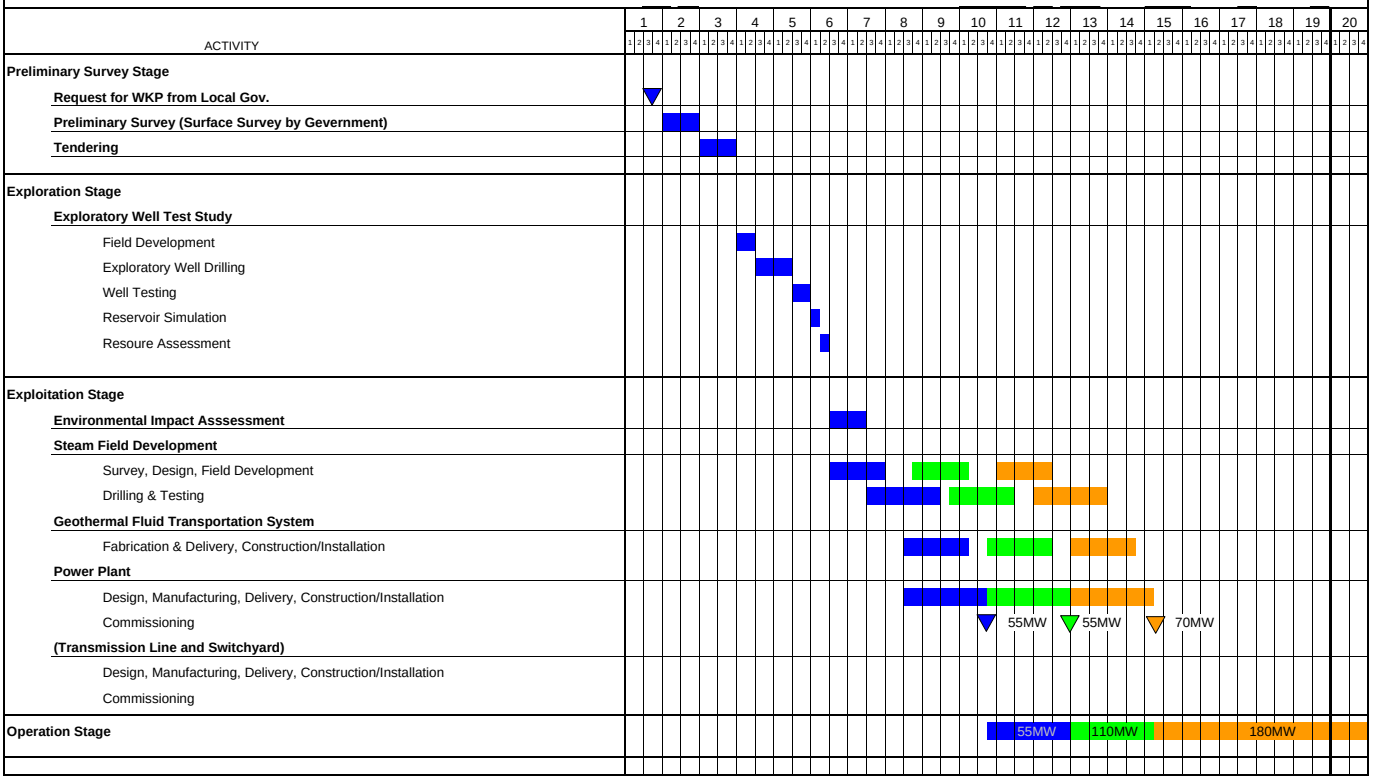
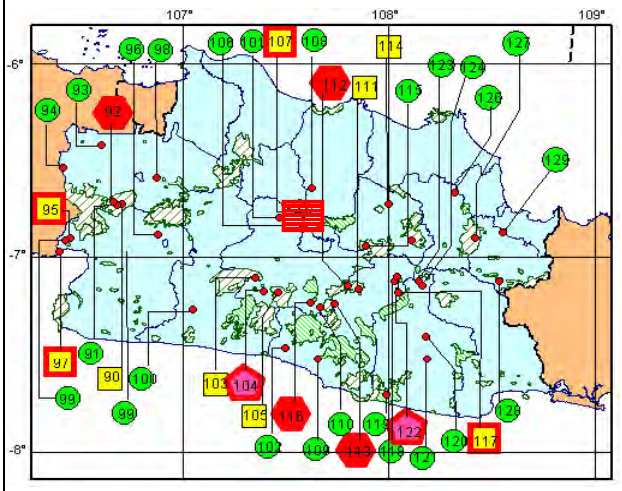


Table 7.1.9-1 Development Plan Sheet for New Working Area (No.40 TANGKUBANPERAHU)

No.40 TANGKUBANPERAHU	Region	Java-Bali	Province/ Location	West Java, Around Tangkubanperahu Volcano

Field Evaluation



Resource Characteristics	G.Tangkubanperahu is the popular volcanic tourist attraction 18km north of Bandung. The Quaternary volcanic sequence of G.Sunda-Tangkubanperahu rests unconformably on Tertiary sediments. Several major NE-SW trending faults cut the area, and it is along one of these that the Ciater springs are found. The Maribaya springs SE of Tangkubanperahu occur at the intersection of one of the NE-SW faults with the Lembang Fault. Possible reservoir area is defined at the southwesern flank of the Mt. Tangkubanperahu based on low resisivity zone (Schlumberger <150 ohm-m). Low resistivity zone trends NW-SE. All the spring waters can be attributed to outflows from the volcanic complex. The deep fluids are probably gaseous and corrosive. Reservoir temperature is estimated higher than 170^{0}C at least. Resource potential estimated by stored heat method applying Monte Carlo analysis is 10-30 MW.
Natural/Social Environmental Condition	Northern end of possible geothermal reservoir area of southwestern flank of Mt. Tangkubanperahu is within CA. Tangkuban Perahu National Park (less than 5% of the possible reservoir area).
Power Sector Situation	Estimated T/L length from the field to intersection T/L between Bandung Utara S/S and Ujung Berung S/S is about 16 km. 2P Connection between the two S/S with 150kV is recommendable.

Power Output Potential	Resource Potential	20 MW	Restricted by National Park	20 MW	Restricted by Power Demand	20 MW
Rank of Development Priority	C		Potential (Expected) Developer		Private Company	

Proposed Geothermal Development Plan

Outline for Power Development

The most possible development site in this field is located in southwester flank of Mt. Tangkubanperau. The demand of electricity in western part of Java is very large, so a large scale power plant development as far as resource available is recommendable.

Possibile or Recommended Multi-purpose Geothermal Heat Use

Direct heat use for agricultural industry is recommendable.

Scope for Power Development

Power Plant Capacity: 20MWx1unit
Plant System: Condencing
Explor.+Production Well: approx. 10 wells
Reinjection Well: less than 3 wells
Transmission Line: 150kV, approx. 16km
Connection: 2P connection between
Bandung Utara S/S and Ujung Berung S/S

CO_2 Emmission Reduction ('000 tone/year)

122

Proposed Geothermal Development Schedule

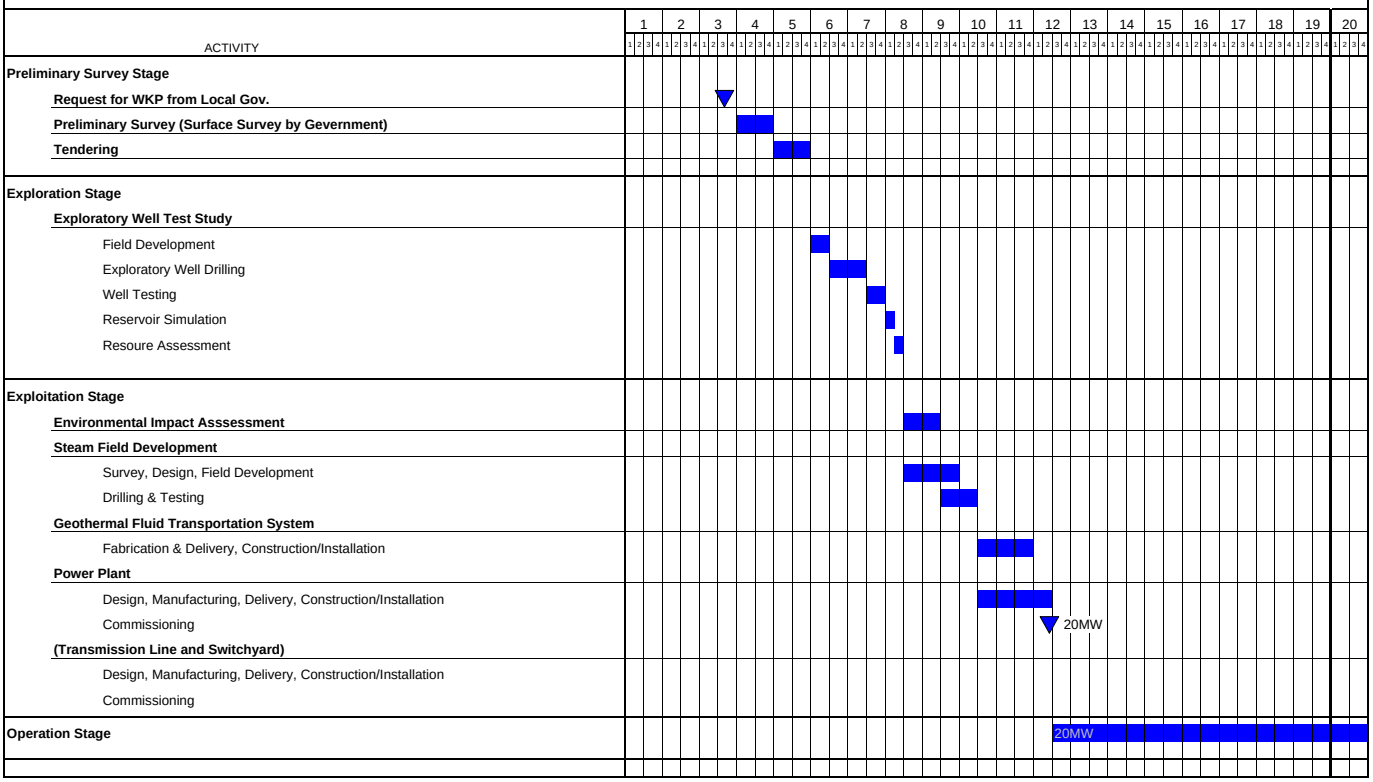
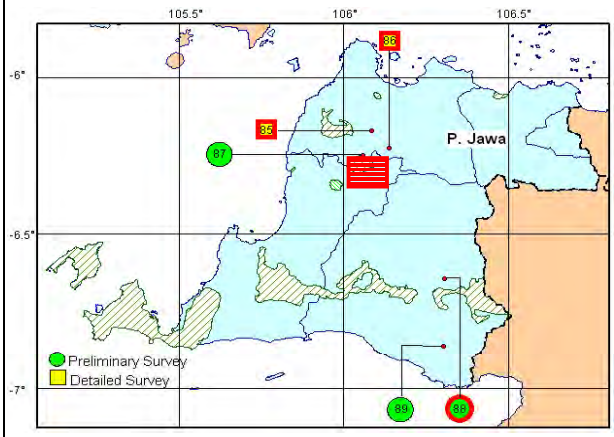


Table 7.1.9-1 Development Plan Sheet for New Working Area (No.42 CITAMAN - G. KARANG)

No.42 CITAMAN - G. KARANG	Region	Java-Bali	Province/ Location	Banten, Around G. Karang

Field Evaluation



Resource Characteristics	This field is associated with the Quaternary G. Karang volcano. A solfatara field is on the southern flank of G. Karang. Several hot, warm or cold springs are present and are aligned along this NW-SE reginal faults. Deep exploratory well BTN-1 was drilled by PERTAMINA in 1986 at the southeastern flank of the G. Karang, but the well didn't encounter the geothermal reservoir and logging tepmarature was low. Warm and hot bicarbonate springs occur at the SSE foot of G. Karang summit. These springs may be derived from outflows from reservoir(s) existing at the mountain side. Reservoir temperature is estimated higher than 180^{0}C at least according to a literature. Resource potential estimated by stored heat method applying Monte Carlo analysis is 15-35 MW.
Natural/Social Environmental Condition	Possible geothermal reservoir area is not within any National Parks. CA. Gunung Karang National Park exists around the summit of G. Karang.
Power Sector Situation	Estimated T/L length from the field to intersection T/L between Rangkasbitung S/S and Menes S/S is about 8 km. P Connection between the two S/S with 70kV is recommendable.

Power Output Potential	Resource Potential	20 MW	Restricted by National Park	20 MW	Restricted by Power Demand	20 MW
Rank of Development Priority	L		Potential (Expected) Developer		Private Company	

Proposed Geothermal Development Plan

Outline for Power Development

The possible development site in this field is located in southeastern flank of G. Karang. The reservoir fluid is likely to have only low enthalpy, so that there is possibility that only binary plant system can be applied for power development and that the development priority is relatively low. The demand of electricity in western part of Java is very large, so a large scale power plant development as far as resource available is recommendable.

Possibile or Recommended Multi-purpose Geothermal Heat Use

Direct heat use for agricultural industry is recommendable.

Scope for Power Development

Power Plant Capacity: 20MWx1unit
Plant System: Condencing or Binary
Explor.+Production Well: approx. 10 wells
Reinjection Well: less than 3 wells
Transmission Line: 70kV, approx. 8km
Connection: P connection between Rangkasbitung S/S and Menes S/S

CO_2 Emmission Reduction ('000 tone/year)

122

Proposed Geothermal Development Schedule

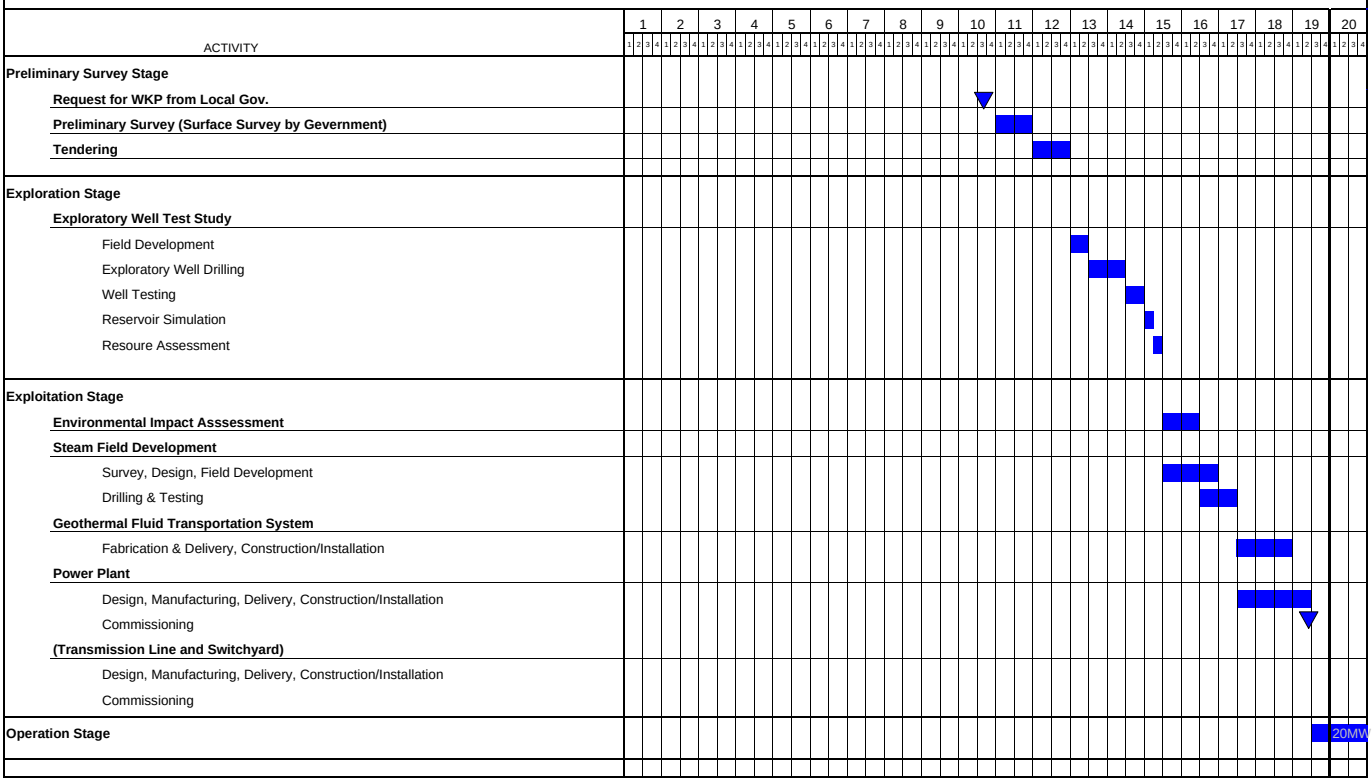
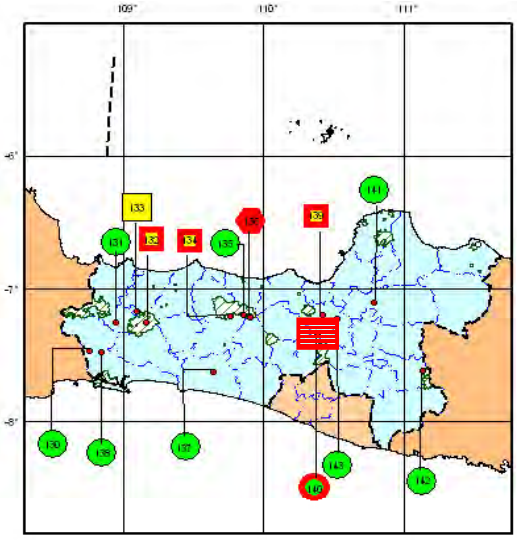


Table 7.1.9-1 Development Plan Sheet for New Working Area (No.46 TELOMOYO)

No.46 TELOMOYO	Region	Java-Bali	Province/ Location	Central Java, Northeast flank of G. Telomoyo

Field Evaluation



Resource Characteristics	This area is controlled by caldera structure and NNE trending faults. Two hot springs occurs in this area: the one on the southern edge of Rawa Pening, and the other is Candi Umbul at 12 km west of G. Telomoyo. Possible reservoir area is defined in the caldera strucuture based on low resistivity zone (Schlumberger <20 ohm-m (AB/2=1000m)), surface manifestation and geologic struture. A shallow slimhole TSH-01 was drilled in low resistivity zone by PERTAMINA (1993), but its borehole temparature was low. The warm springs at shore of Rawa Pening may be derived from outflow from reservoir existing at the mountain side with dilution. The highest reservoir temperature is estimated 190^{0}C or higher. Resource potential estimated by stored heat method applying Monte Carlo analysis is 60-125 MW.
Natural/Social Environmental Condition	A small area around possible geothermal reservoir area at southwestern part is within CA. Sepakung National Park (about 5% of the possible reservoir area).
Power Sector Situation	Estimated T/L length from the field to intersection T/L between Sanggrahan S/S and Bawen S/S is about 19 km. 2P Connection between the two S/S with 150kV is recommendable.

Power Output Potential	Resource Potential	50 MW	Restricted by National Park	50 MW	Restricted by Power Demand	50 MW
Rank of Development Priority	L		Potential (Expected) Developer		Private Company	

Proposed Geothermal Development Plan

Outline for Power Development

The possible development site in this field is located in northeastern flank of G. Telomoyo. The reservoir fluid is likely to have only low enthalpy, so that there is possibility that only binary plant system can be applied for power development and that the development priority is relatively low. The demand of electricity in western part of Java is very large, so a large scale power plant development as far as resource available is recommendable.

Possibile or Recommended Multi-purpose Geothermal Heat Use

Direct heat use for agricultural industry is recommendable.

Scope for Power Development

Power Plant Capacity:
50MW (50MWx1unit or 25MWx2unit)
Plant System: Condencing
Explor.+Production Well: approx. 20 wells
Reinjection Well: less than 6 wells
Transmission Line: 150kV, approx. 19km
Connection: 2P connection between
Sanggrahan S/S and Bawen S/S

CO_2 Emmission Reduction ('000 tone/year)

305

Proposed Geothermal Development Schedule

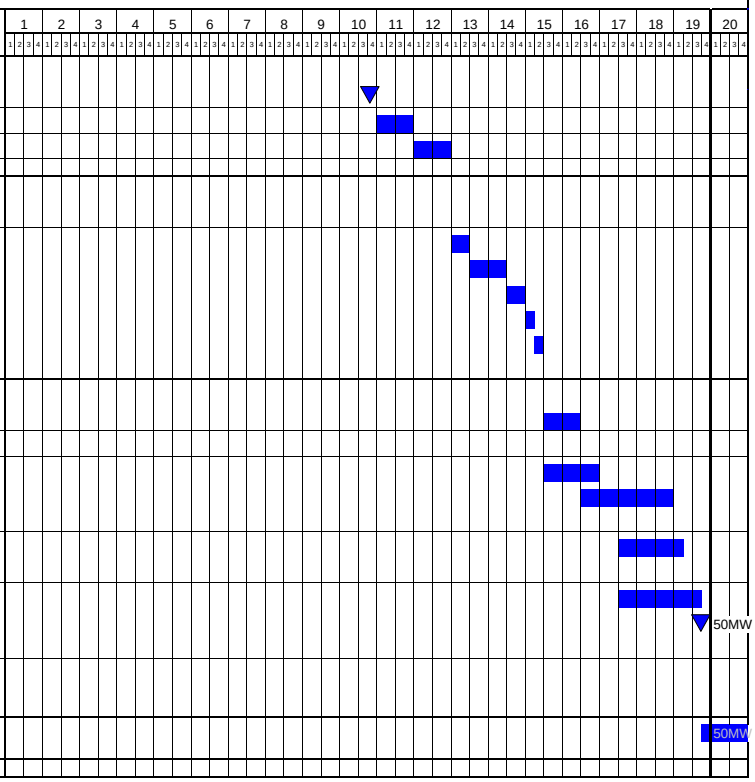
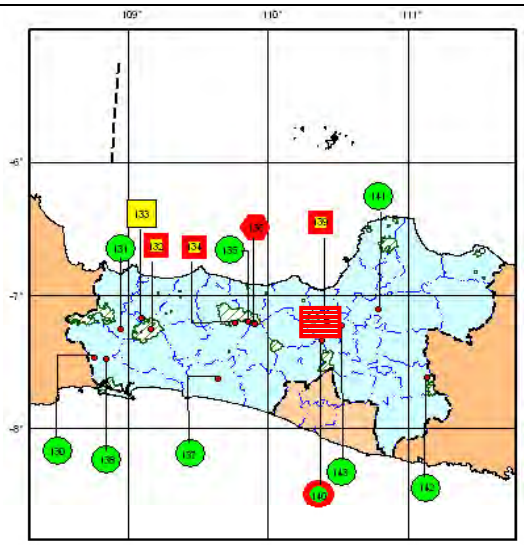


Table 7.1.9-1 Development Plan Sheet for New Working Area (No.47 UNGARAN)

No.47 UNGARAN	Region	Java-Bali	Province/ Location	Central Java, Southern flank of G. Ungaran

Field Evaluation



Resource Characteristics	G. Ungaran is located to the NNW direction from G. Merapi active volocano. The hydrothermal area at Gedongsongo is associated with the youngest volcanic activities on G. Ungaran since just to the north is the crater from which the youngest andesite lavas flowed. Possible reservoir area is defined at the southern to southeastern flank of G. Ungaran, based on low resistivity zone (MT resistivity <10 ohm-m), surface manifestation and geologic struture. Fumaroles at Gedong Songo on the southern slope of G. Ungaran are the only high temperature manifestations in this field. The warm springs may be basically derived from outflows. Reservoir temperature is estimated higher than 180^{0}C at least, and possibly up to 320^{0}C from gas and Na/K geothermometries. Resource potential estimated by stored heat method applying Monte Carlo analysis is 140-355 MW.
Natural/Social Environmental Condition	Possible geothermal reservoir area is not within any National Parks. CA. Ungaran National Park exists around the summit of G. Ungaran.
Power Sector Situation	Estimated T/L length from the field to intersection T/L between Ungaran S/S and Bawen S/S is about 2 km. 1P Connection between the two S/S with 150kV is recommendable.

Power Output Potential	Resource Potential	180 MW	Restricted by National Park	180 MW	Restricted by Power Demand	180 MW
Rank of Development Priority	B		Potential (Expected) Developer		Private Company	

Proposed Geothermal Development Plan

Outline for Power Development

The most possible development site in this field is located in southern flank of G. Ungaran. The demand of electricity in western part of Java is very large, so a large scale power plant development as far as resource available is recommendable.

Scope for Power Development

Power Plant Capacity:
180MW (55MWx2unit+70MW)
Plant System: Condencing
Explor.+Production Well: approx. 45 wells
Reinjection Well: less than 20 wells
Transmission Line: 150kV, approx. 2km
Connection: 1P connection between Ungaran S/S and Bawen S/S

CO_2 Emmission Reduction ('000 tone/year)

1,098

Possibile or Recommended Multi-purpose Geothermal Heat Use

Direct heat use for agricultural industry is recommendable.

Proposed Geothermal Development Schedule

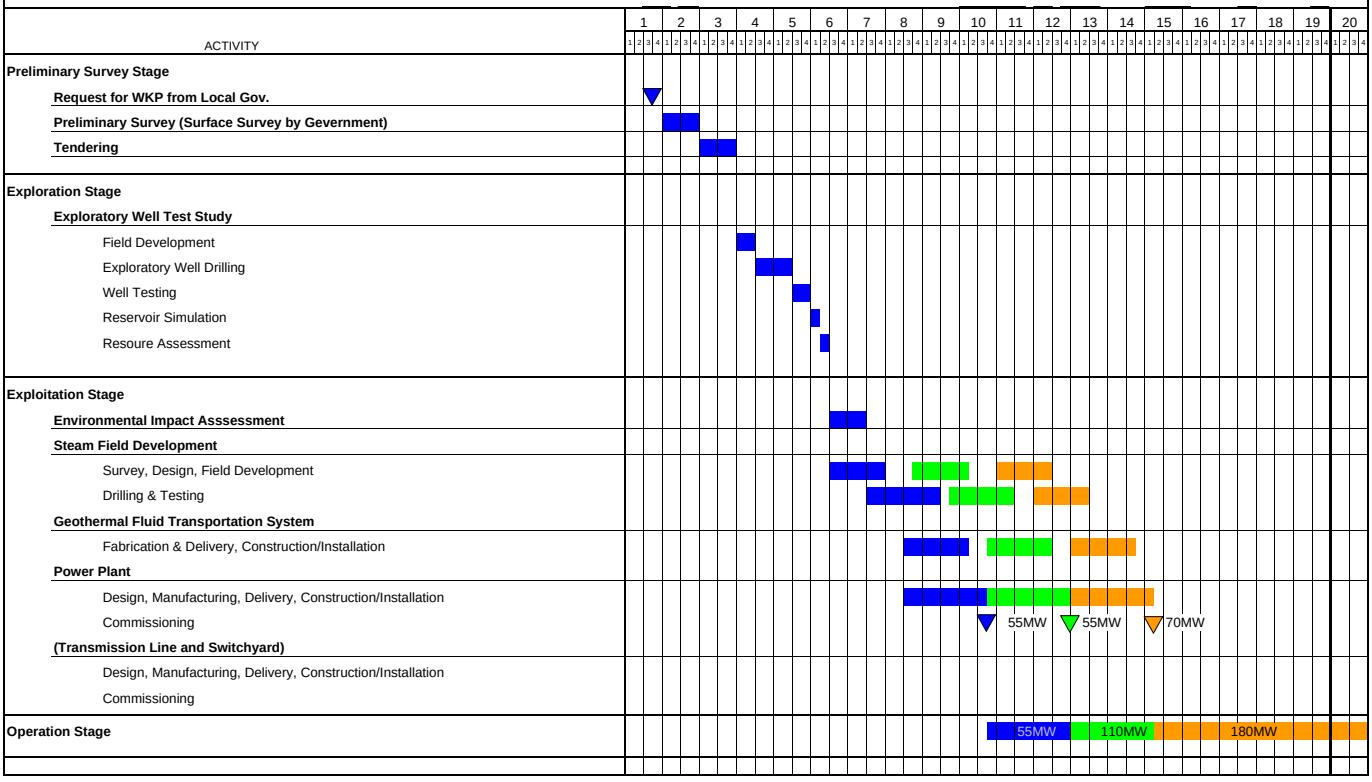
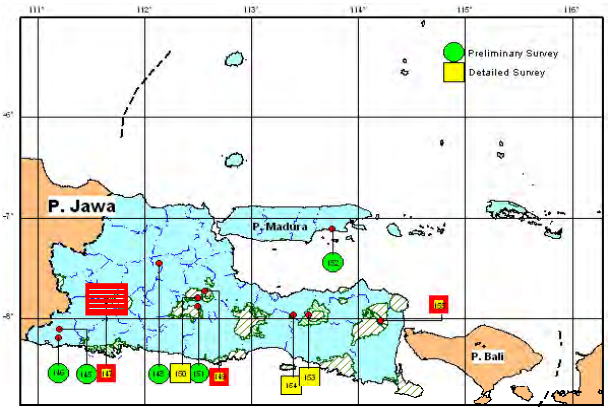


Table 7.1.9-1 Development Plan Sheet for New Working Area (No.50 WILIS / NGEBEL)

No.50 WILIS / NGEBEL	Region	Java-Bali	Province/ Location	Central Java, Western flank of G. Wilis

Field Evaluation



Resource Characteristics	Thermal features in this field occur at about 1.5 km south of the lake Telaga Ngebel. The dominant geological structures are some arcuate caldera structres and normal faults. As small scaled fractures, NW-SE to NNW-SSE trending faults are observed at Telaga Ngebel, accompanied with weakly altered zone and open fracture. Possible reservoir area is defined arond Telaga Ngebel based on low resistivity zone (MT resistivity <5 ohm-m (T=3s)), surface manifestation and geologic struture. A shallow slimhole WSH-02 (504m) was drilled in low resistivity zone by PERTAMINA, maximum measured borehole temparature was 146.16°C. Hot spring water in Pandusan at the south of Telaga Ngebel and WSH-02 well water is neutral chloride type. Reservoir temperature is estimated around 190-250°C or higher. Resource potential estimated by stored heat method applying Monte Carlo analysis is 120-280 MW.
Natural/Social Environmental Condition	Minor National Parks (CA. G. Picis, SM. G. Wilis, etc.) exist around possible geothermal reservoir area (about 5% of the possible reservoir area).
Power Sector Situation	Estimated T/L length from the field to intersection T/L between Kedungbaru S/S and Manisrejo S/S is about 5 km. 1P Connection between the two S/S with 150kV is recommendable.

Power Output Potential	Resource Potential	120 MW	Restricted by National Park	120 MW	Restricted by Power Demand	120 MW
Rank of Development Priority	B		Potential (Expected) Developer		Private Company	

Proposed Geothermal Development Plan

Outline for Power Development

The most possible development site in this field is located in the south of Telaga Ngebel. The demand of electricity in eastern part of Java is very large, so a large scale power plant development as far as resource available is recommendable.

Possibile or Recommended Multi-purpose Geothermal Heat Use

Direct heat use for agricultural industry is recommendable.

Scope for Power Development

Power Plant Capacity:
120MW (55MW+65MW)
Plant System: Condencing
Explor.+Production Well: approx. 30 wells
Reinjection Well: less than 15 wells
Transmission Line: 150kV, approx. 5km
Connection: 1P connection between
Kedungbaru S/S and Manisrejo S/S

CO_2 Emmission Reduction ('000 tone/year)

732

Proposed Geothermal Development Schedule

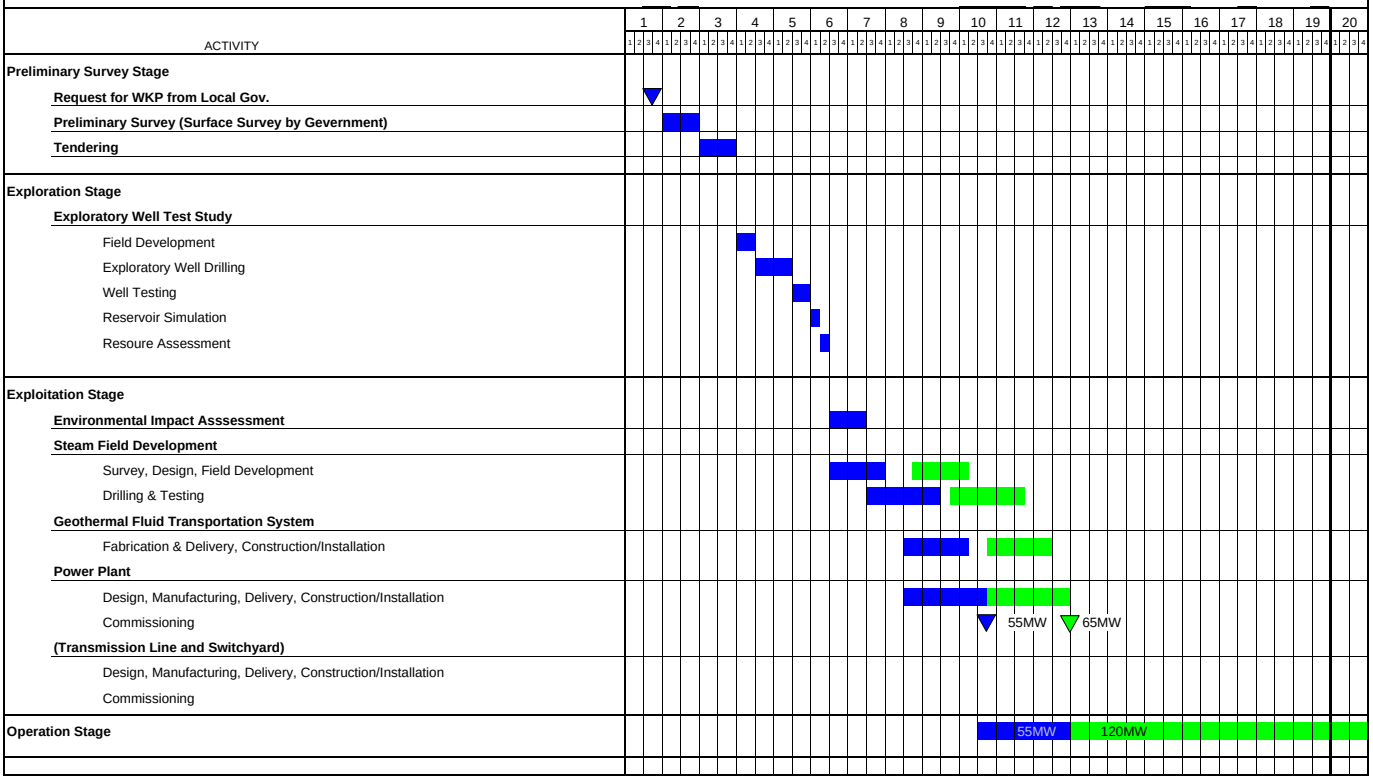
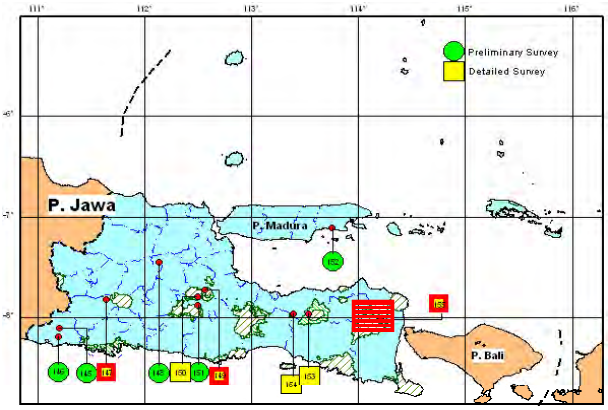


Table 7.1.9-1 Development Plan Sheet for New Working Area (No.51 IJEN)

No.51 IJEN	Region	Java-Bali	Province/ Location	East Java, North to west of Kawah Ijen

Field Evaluation



Resource Characteristics	Ijen is a very large strato-volcano with a 16 km diameter caldera (Kendeng Caldera) at the summit of the old basalt-andesite sequence. Thermal features are only situated within this caldera. Two distinct areas of thermal activity are present, at Kawah Ijen, where there is a large warm lake, fumaroles and solfatara, and 10km northwestward at Blawan where there are hot and warm springs. Possible reservoir area is defined based on low resistivity zone (MT resistivity <7 ohm-m). The low resistivity zone distribute trending N-S and it distribute along circled volcanic crater. The fumarole in Kawah Ijen having a temperature over 200°C. Warm springs in and around Blawan are peripheral system or strongly diluted outflow of Kawah Ijen volcanic fluid system. The deep hot fluids possibly existin near Kawah Ijen are probably gaseous and corrosive. Resource potential estimated by stored heat method applying Monte Carlo analysis is 80-200 MW.
Natural/Social Environmental Condition	Southern and western part of possible geothermal reservoir area is within TB. Maelang, CA. Kawah Ijen Ungup-ungup and CA. Gunung Raung National Parks (about 65% of the possible reservoir area). The rest (about 35%) of the area is within Protected Forest.
Power Sector Situation	Estimated T/L length from the field to intersection T/L between SitubondoS/S and Banyuwangi S/S is about 5 km. 1P Connection between the two S/S with 150kV is recommendable.

Power Output Potential	Resource Potential	120 MW	Restricted by National Park	40 MW	Restricted by Power Demand	40 MW
Rank of Development Priority	C		Potential (Expected) Developer		Private Company	

Proposed Geothermal Development Plan

Outline for Power Development

The most possible development site in this field is located in northwestern flank of Kawah Ijen. The demand of electricity in eastern part of Java is very large, so a large scale power plant development as far as resource available is recommendable.
For development in this field, the area of National Park should be taken into consideration.

Possibile or Recommended Multi-purpose Geothermal Heat Use

Direct heat use for agricultural industry is recommendable.

Scope for Power Development

Power Plant Capacity: 40MW (20MWx2unit)
Plant System: Condencing
Explor.+Production Well: approx. 15 wells
Reinjection Well: less than 5 wells
Transmission Line: 150kV, approx. 5km
Connection: 1P connection between SitubondoS/S and Banyuwangi S/S

CO_2 Emmission Reduction ('000 tone/year)

244

Proposed Geothermal Development Schedule

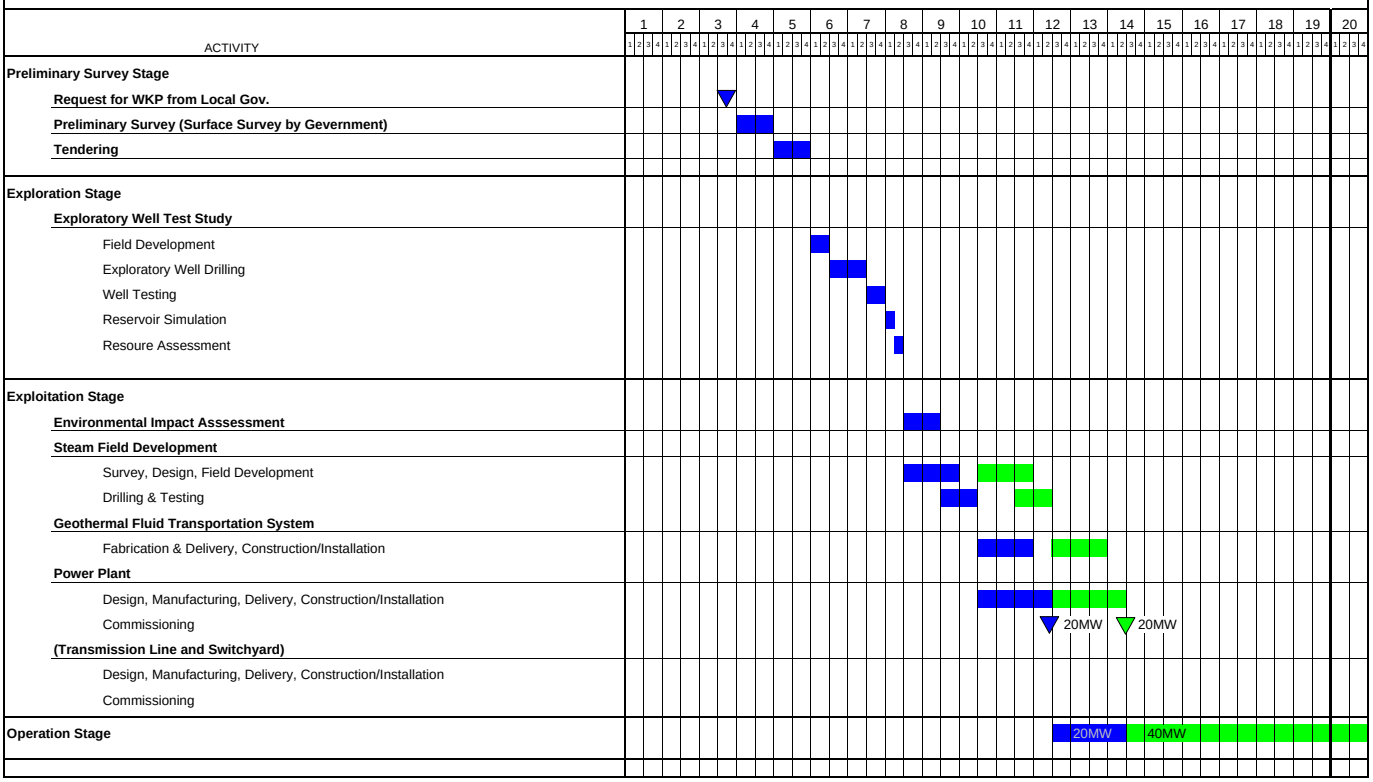
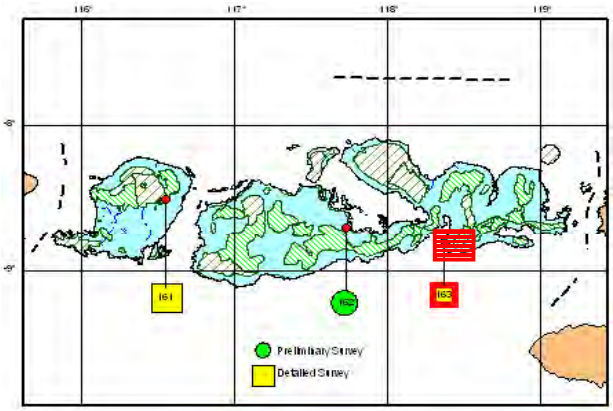


Table 7.1.9-1 Development Plan Sheet for New Working Area (No.53 HU'U DAHA)

No.53 HU'U DAHA	Region	Nussa Tenggara	Province/ Location	West Nusa Tenggara, Southeast of Sumbawa Island

Field Evaluation



Resource Characteristics	The prospect covers the whole promontory - an area in excess of 150 km^2. There are 4 hot spring areas scattered around a circle of radius 10 km, centred on the highest point in prospect (around 1000 m.a.s.l.). The only hot spring area of note is at Limea, on the southern edge of the promontory. Here acidic water with a maximum recorded temperature of 86^{o}C seeps through dacitic tuff breccia on the beach. The prospect appears to have its heat source beneath the Doro Pure cone with small outflows to the west and south. Resource potential estimated by stored heat method applying Monte Carlo analysis is 115-290 MW.
Natural/Social Environmental Condition	Possible geothermal reservoir area is not within any National Parks. But the eastern part of the area is within Protected Forest (about 25% of the possible reservoir area).
Power Sector Situation	The whole system in the Sumbawa is D/L. At present, electrification ratio in this area reachs only 28.1%. Estimated D/L length from the field to the nearest existing line is about 15 km.

Power Output Potential	Resource Potential	110 MW	Restricted by National Park	110 MW	Restricted by Power Demand	30 MW
Rank of Development Priority	C		Potential (Expected) Developer		Private Company or Central/Local Government	

Proposed Geothermal Development Plan

Outline for Power Development

The possible development site in this field is located around Doro Pure. The demand of electricity in Sumbawa Island is not large, so a small scale with multi-unit power plant development is recommendable. If sufficient steam is obtained by steamfield development, the power system available for variable load is disireble for power supply not only for base load but also peak load.

Scope for Power Development

Power Plant Capacity: 30MW (10MWx3unit)
Plant System: Condencing or Back-pressure
Explor.+Production Well: approx. 15 wells
Reinjection Well: less than 4 wells
Transmission Line: 20kV, approx. 15km
Connection: Distribution Line in Sumbawa Island

CO_2 Emmission Reduction ('000 tone/year)

183

Possibile or Recommended Multi-purpose Geothermal Heat Use

Direct heat use for agricultural or marine product industry is recommendable.

Proposed Geothermal Development Schedule

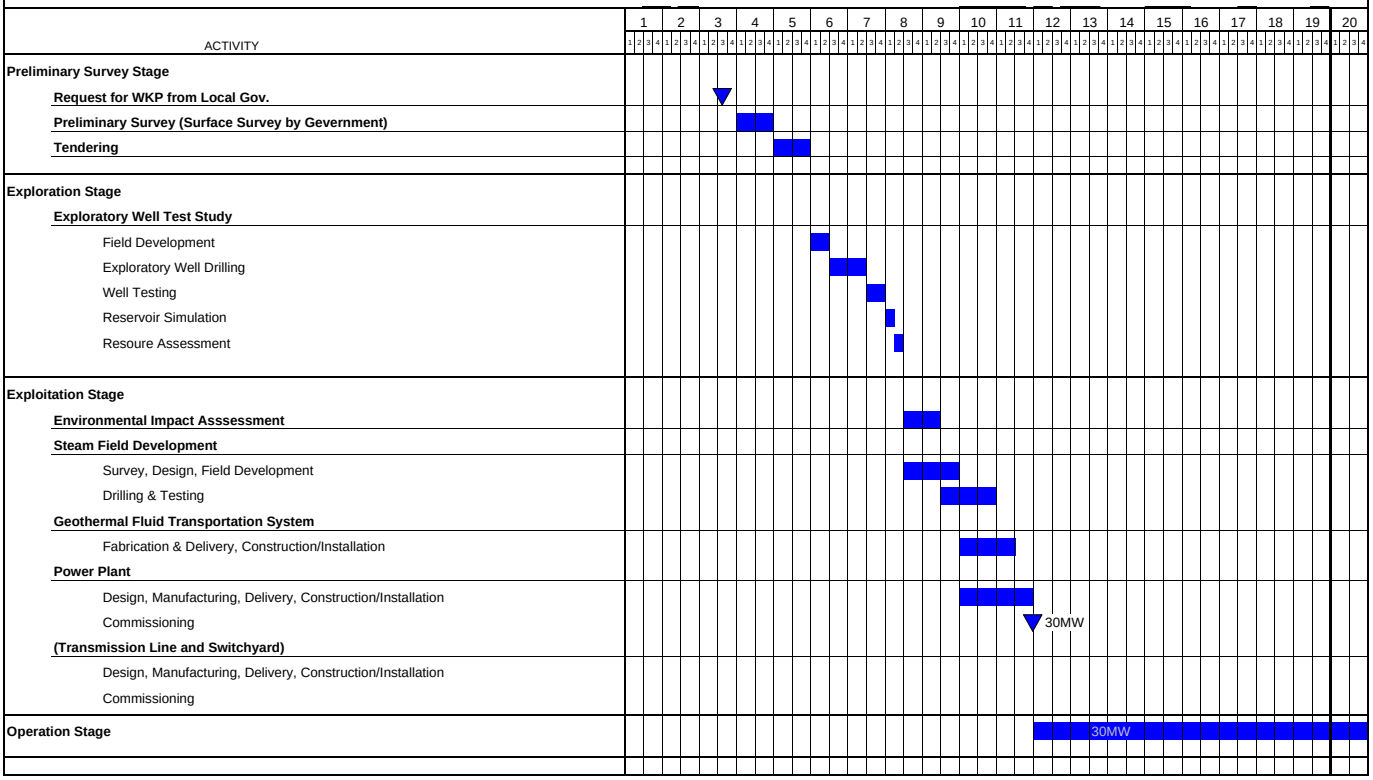
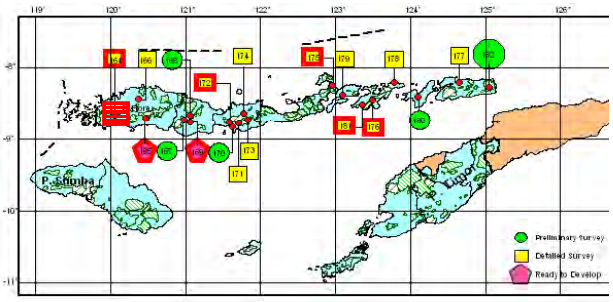


Table 7.1.9-1 Development Plan Sheet for New Working Area (No.54 WAI SANO)

No.54 WAI SANO	Region	Nussa Tenggara	Province/ Location	East Nusa Tenggara, Western part of Flores Island

Field Evaluation



Resource Characteristics	Wai Sano is a 2.5 km diameter crater lake in the center of G. Wai Sano. G. Wai Sano is an upper Quaternary andesitic volcano resting on the older Quaternary andesites of Pegunungan Geliran. The thermal area is situated on the SE corner of the lake where three springs are noted with temperatures up to 92°C. Silica sinter is reported. Possible reservoir area is defined based on low resistivity zone (Schlumberger <10 ohm-m (AB/2=1000m)). The low resistivity zone coincide with the volcanic crater (D. Sanongoang). Reservoir fluid contain significant magmatic water, possibly arising from previous volcanic activity near G. Wai Sano. Main fluid flow pattern is from Wai Sano to north and northeast. Spring water geothermometries suggest a reservoir temperature around 200-250°C or higher. Resource potential estimated by stored heat method applying Monte Carlo analysis is 50-105 MW.
Natural/Social Environmental Condition	Southern part of possible geothermal reservoir area is within TW. Danau Sanau National Park (about 30% of the possible reservoir area).
Power Sector Situation	Estimated D/L length from the field to the nearest existing line is about 18 km. At present, electrification ratio in this area reachs only 22.5%.

Power Output Potential	Resource Potential	50 MW	Restricted by National Park	50 MW	Restricted by Power Demand	10 MW
Rank of Development Priority	C		Potential (Expected) Developer		Private Company or Central/Local Government	

Proposed Geothermal Development Plan

Outline for Power Development

The possible development site in this field is located northeastern flank of G. Wai Sano. The demand of electricity in western part of Flores Island is small, so a small scale with multi-unit power plant development is recommendable. If sufficient steam is obtained by steamfield development, the power system available for variable load is disireble for power supply not only for base load but also peak load.

Possibile or Recommended Multi-purpose Geothermal Heat Use

Direct heat use for agricultural or marine product industry is recommendable.

Scope for Power Development

Power Plant Capacity: 10MW (5MWx2unit)
Plant System: Condencing or Back-pressure
Explor.+Production Well: approx. 5 wells
Reinjection Well: less than 3 wells
Transmission Line: 20kV, approx. 18km
Connection: Distribution Line in western Flores

CO_2 Emmission Reduction ('000 tone/year)

61

Proposed Geothermal Development Schedule

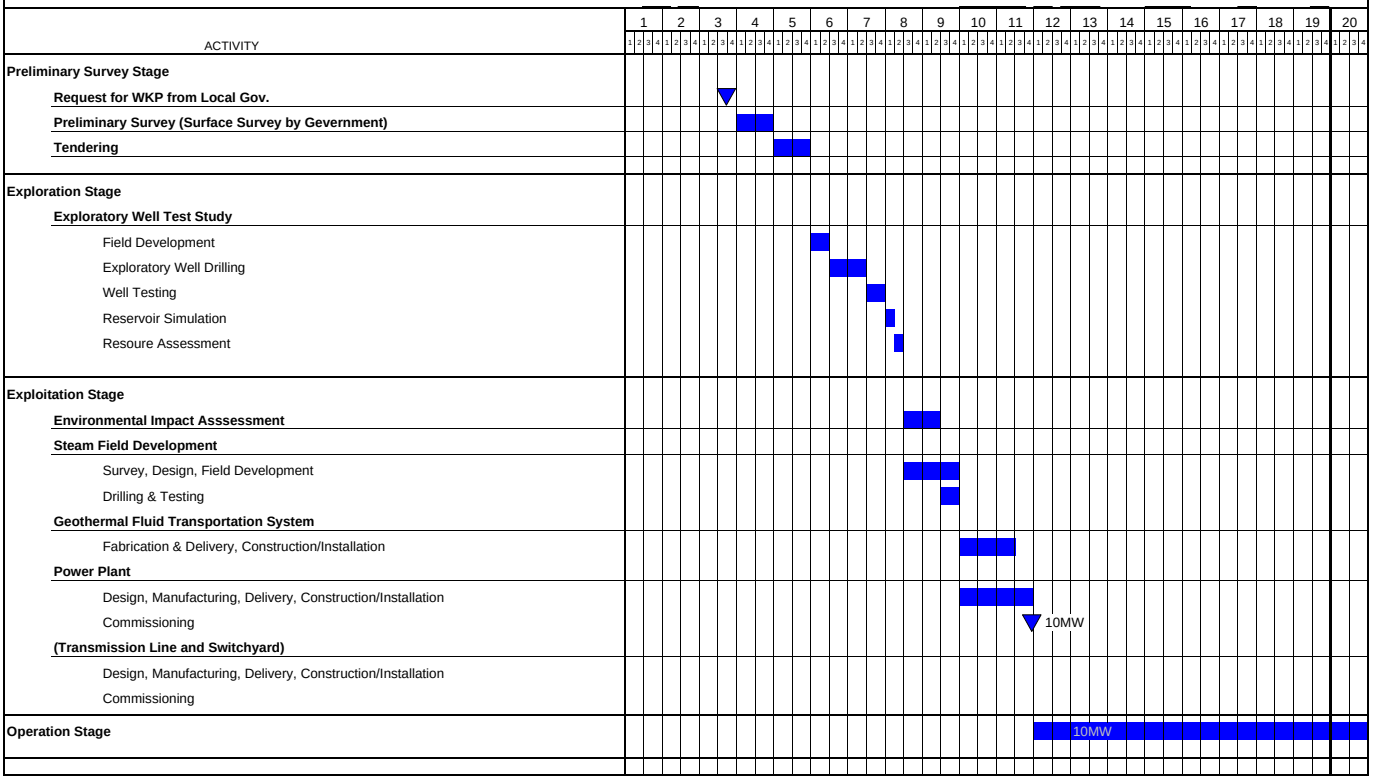
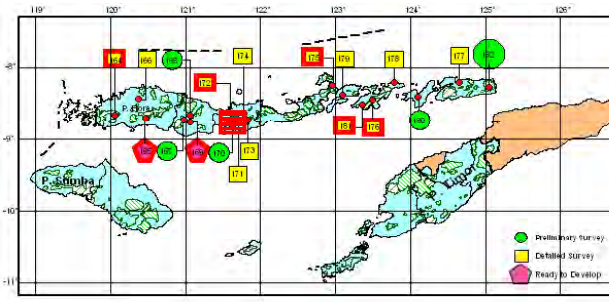


Table 7.1.9-1 Development Plan Sheet for New Working Area (No.57 SOKORIA - MUTUBUSA)

No.57 SOKORIA - MUTUBUSA	Region	Nussa Tenggara	Province/ Location	East Nusa Tenggara, Central part of Flores Island

Field Evaluation



Resource Characteristics	Sokoria-Mutubusa geothermal prospect is located 30km north of Ende. Surface thermal manifestations in Mutubusa, north of Sokoria village, contain fumaroles, mud pools, hot springs and alterd ground. Several warm to hot springs occur around and south of Sokoria village. Possible reservoir area is definedin by caldera structure, based on low resistivity zone (Schlumberger <5 ohm-m, MT/TDEM), surface manifestation and geologic struture trending NNW-SSE. Hot springs in Sokoria may be derived from various kind of fluids including shallow condensate, deep reservoir water and outflow containing magmatic fluid. Occurrence of fumaroles in Mutubasa suggests existence of another upflow center of hot fluid there besides the Keli Mutu system. Reservoir temperature is estimated higher than 180°C at least, and possibly up to 320°C from gas and Na/K geothermometries. Resource potential estimated by stored heat method applying Monte Carlo analysis is 90-235 MW.
Natural/Social Environmental Condition	Northwestern part of possible geothermal reservoir area is within TN. Danau Kelimutu National Park (about 55% of the possible reservoir area).
Power Sector Situation	Estimated D/L length from the field to the nearest existing line is about 22 km. At present, electrification ratio in this area reachs only 22.5%.

Power Output Potential	Resource Potential	90 MW	Restricted by National Park	40 MW	Restricted by Power Demand	20 MW
Rank of Development Priority	B		Potential (Expected) Developer		Private Company or Central/Local Government	

Proposed Geothermal Development Plan

Outline for Power Development

The possible development site in this field is located around Sokoria village. The demand of electricity in central part of Flores Island is small, so a small scale with multi-unit power plant development is recommendable. If sufficient steam is obtained by steamfield development, the power system available for variable load is disireble for power supply not only for base load but also peak load.
For development in this field, the area of National Park should be taken into consideration.

Possibile or Recommended Multi-purpose Geothermal Heat Use

Direct heat use for agricultural industry is recommendable.

Scope for Power Development

Power Plant Capacity: 20MW (5MWx4unit)
Plant System: Condencing or Back-pressure
Explor.+Production Well: approx. 8 wells
Reinjection Well: less than 4 wells
Transmission Line: 20kV, approx. 22km
Connection: Distribution Line in around Ende or planned 70kV T/L

CO_2 Emmission Reduction ('000 tone/year)

122

Proposed Geothermal Development Schedule

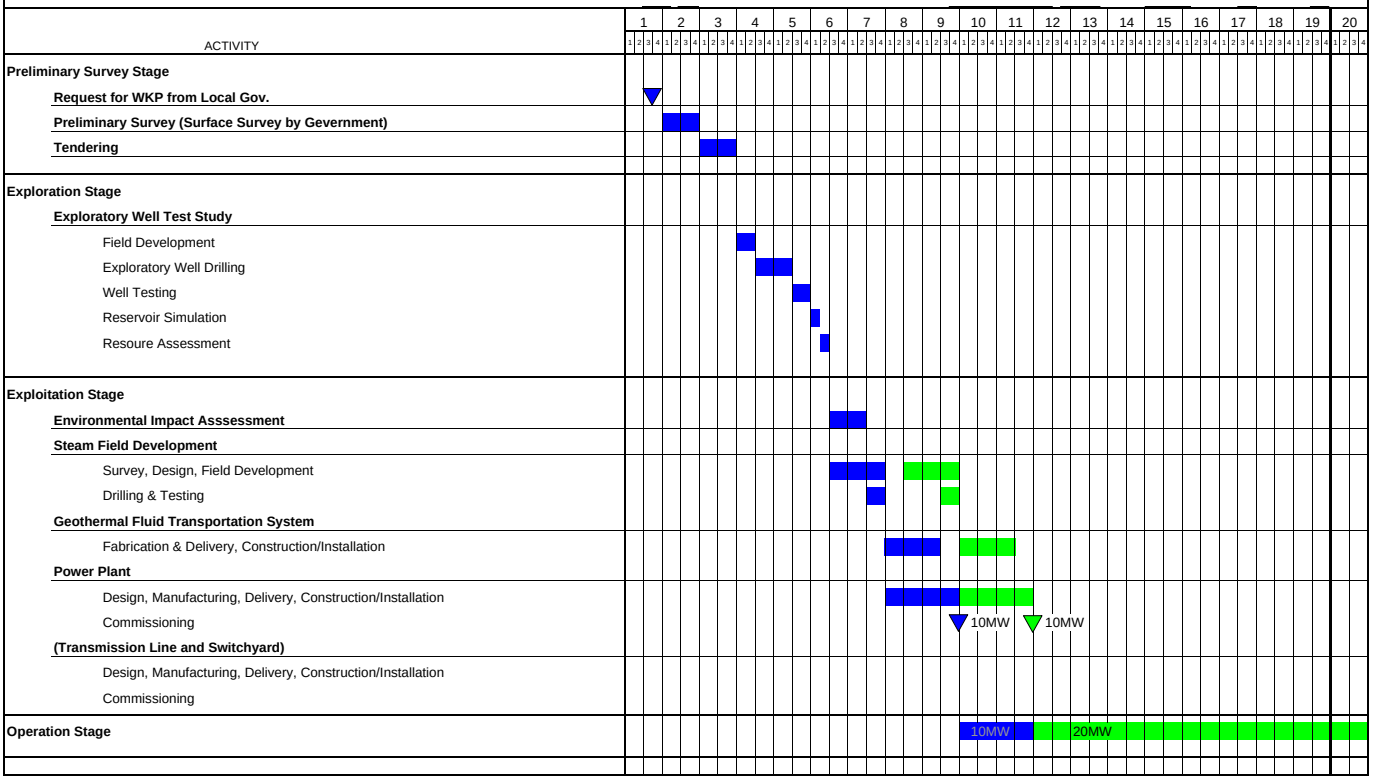
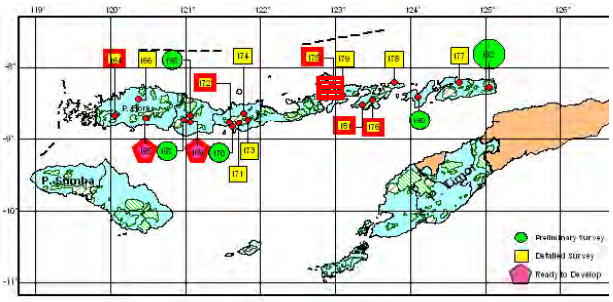


Table 7.1.9-1 Development Plan Sheet for New Working Area (No.58 OKA - LARANTUKA)

No.58 OKA - LARANTUKA	Region	Nussa Tenggara	Province/ Location	East Nusa Tenggara, East end of Flores Island

Field Evaluation



Resource Characteristics	Geothermal system in this field occurs at western foot of Mt. Ile Mandiri. Surface thermal manifestations include fumaroles, hot spring with silica sinter. Possible reservoir area is defined based on low resistivity zone (Schlumberger). Reservoir temperature is estimated possibly up to 250^{0}C from Na/K geothermometry. Resource potential estimated by stored heat method applying Monte Carlo analysis is 90-230 MW.
Natural/Social Environmental Condition	Possible geothermal reservoir area is not within any National Parks. But the central part of the area is within Protected Forest (about 35% of the possible reservoir area).
Power Sector Situation	Estimated D/L length from the field to the nearest existing line is about 11 km. At present, electrification ratio in this area reachs only 22.5%.

Power Output Potential	Resource Potential	90 MW	Restricted by National Park	90 MW	Restricted by Power Demand	20 MW
Rank of Development Priority	C		Potential (Expected) Developer		Private Company or Central/Local Government	

Proposed Geothermal Development Plan

Outline for Power Development

The possible development site in this field is located in southwestern foot of Mt. Ile Mandiri. The demand of electricity in eastern part of Flores Island is small, so a small scale with multi-unit power plant development is recommendable. If sufficient steam is obtained by steamfield development, the power system available for variable load is disireble for power supply not only for base load but also peak load.

Possibile or Recommended Multi-purpose Geothermal Heat Use

Direct heat use for agricultural or marine product industry is recommendable.

Scope for Power Development

Power Plant Capacity: 20MW (5MWx4unit)
Plant System: Condencing or Back-pressure
Explor.+Production Well: approx. 10 wells
Reinjection Well: less than 3 wells
Transmission Line: 20kV, approx. 11km
Connection: Distribution Line

CO_2 Emmission Reduction ('000 tone/year)

122

Proposed Geothermal Development Schedule

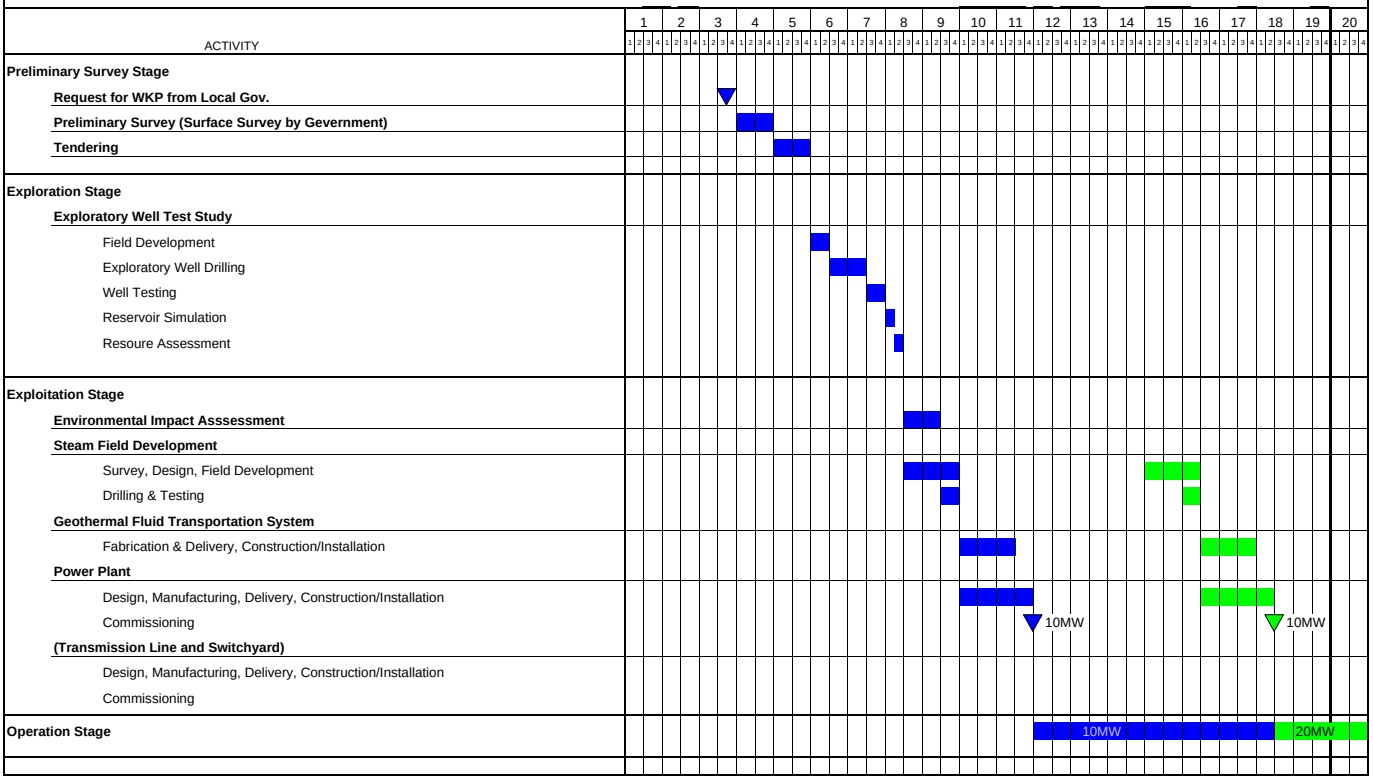
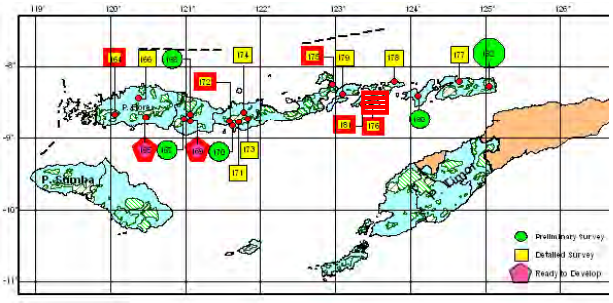


Table 7.1.9-1 Development Plan Sheet for New Working Area (No.60 ATADEI)

No.60 ATADEI	Region	Nussa Tenggara	Province/ Location	East Nusa Tenggara, South of Lembata Island

Field Evaluation



Resource Characteristics	The Atadei field is located in northwest of Werung volcano. Surface thermal manifestations include steaming ground, hot spring and altered ground. Major structures contain N-E of volcanic lineament, NE-SW trending normal faults, Watu Kuba caldera and Atalojo dome. Bougeur anomaly shows high anomaly around Watu Wawer caldera. It is presumably indicates a caldera structure. Possible reservoir area is defined based on low resistivity zone (Schlumberger and MT), surface manifestatios and local structures. Reservoir temperature is estimated higher than 175°C at least from gas geothermometry. Resource potential estimated by stored heat method applying Monte Carlo analysis is 55-140 MW.
Natural/Social Environmental Condition	Possible geothermal reservoir area is not within any National Parks nor Protected Forests.
Power Sector Situation	Estimated D/L length from the field to the nearest existing line is about 13 km. At present, electrification ratio in this area reachs only 22.5%.

Power Output Potential	Resource Potential	50 MW	Restricted by National Park	50 MW	Restricted by Power Demand	10 MW
Rank of Development Priority	C		Potential (Expected) Developer		Private Company or Central/Local Government	

Proposed Geothermal Development Plan

Outline for Power Development

The possible development site in this field is located in northwest of Werung volcano. The demand of electricity in Lembata Island is small, so a small scale with multi-unit power plant development is recommendable. If sufficient steam is obtained by steamfield development, the power system available for variable load is disireble for power supply not only for base load but also peak load.

Possibile or Recommended Multi-purpose Geothermal Heat Use

Direct heat use for agricultural or marine product industry is recommendable.

Scope for Power Development

Power Plant Capacity:
10MW (5MWx2unit or samller units)
Plant System: Condencing or Back-pressure
Explor.+Production Well: approx. 6 wells
Reinjection Well: less than 2 wells
Transmission Line: 20kV, approx. 13km
Connection: Distribution Line

CO_2 Emmission Reduction ('000 tone/year)

61

Proposed Geothermal Development Schedule

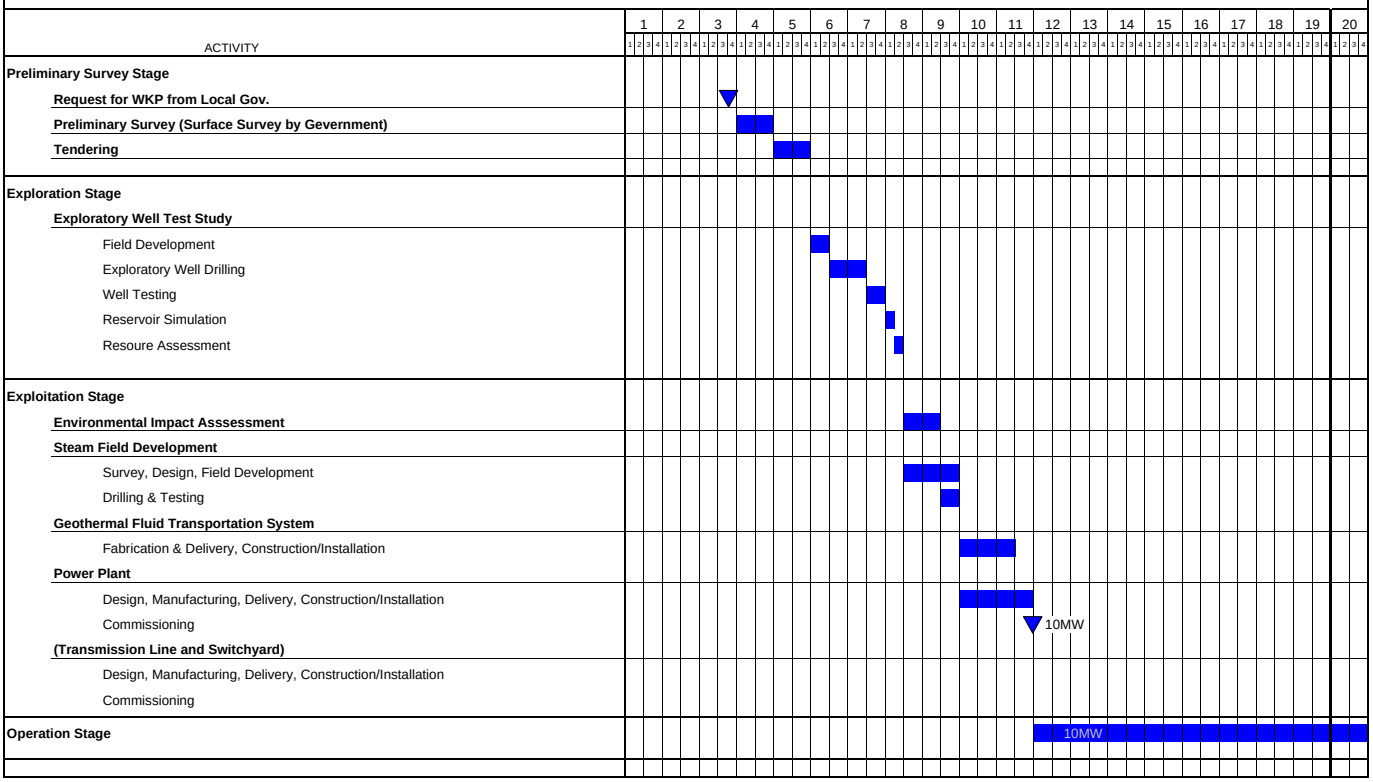
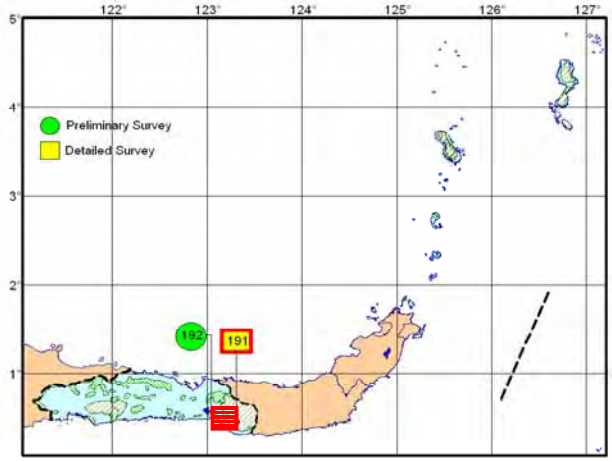


Table 7.1.9-1 Development Plan Sheet for New Working Area (No.73 SUWAWA-GORONTALO)

No.73 SUWAWA-GORONTALO	Region	Sulawesi	Province/ Location	Gorontalo, East of Gorontalo City

Field Evaluation



Resource Characteristics	This field is situated aroung 10 km ENE of the captial city of Gorontalo Province and is depressed with 3-5 km width between WNW trending fault to the south and NW trending fault. Several NNW oriented faults are oblique to the graben. Warm springs are located along the faults forming the depression structure. Possible reservoir area is defined at the graben limited NW-SE trending fautlts at the north and E-W trending faults at the south based on the Schlumberger <50 ohm-m (AB/2=1000m), surface manifestation and geologic struture. Reservoir temperature is estimated 130oC at least, but higher temperature would be expected. Resource potential estimated by stored heat method applying Monte Carlo analysis is 130-325 MW.
Natural/Social Environmental Condition	Possible geothermal reservoir area is not within any National Parks. But the eastern and southwestern part of the area is within Protected Forest (about 20% of the possible reservoir area).
Power Sector Situation	Estimated T/L length from the field to Gorontalo S/S is about 24 km. Direct connection with 70kV is recommendable. Electrification ratio in this area reachs only 47.1%.

Power Output Potential	Resource Potential	130 MW	Restricted by National Park	130 MW	Restricted by Power Demand	55 MW
Rank of Development Priority	C		Potential (Expected) Developer		Private Company	

Proposed Geothermal Development Plan

Outline for Power Development

The most possible development site in this field is located in the east of Gorontalo city. The demand of electricity in Minahasa system including Gorontalo province is large, but in Minahasa system development of Lahendong (including Tompaso) and Kotamobagu may have higher priority considering the resource potential and risk.

Possibile or Recommended Multi-purpose Geothermal Heat Use

Direct heat use for agricultural or marine product industry is recommendable.

Scope for Power Development

Power Plant Capacity:
55MW (10MW+20MW+25MW)
Plant System: Condencing
Explor.+Production Well: approx. 20 wells
Reinjection Well: less than 6 wells
Transmission Line: 70kV, approx. 24km
Connection: Direct connection to Gorontalo S/S

CO_2 Emmission Reduction ('000 tone/year)

335

Proposed Geothermal Development Schedule

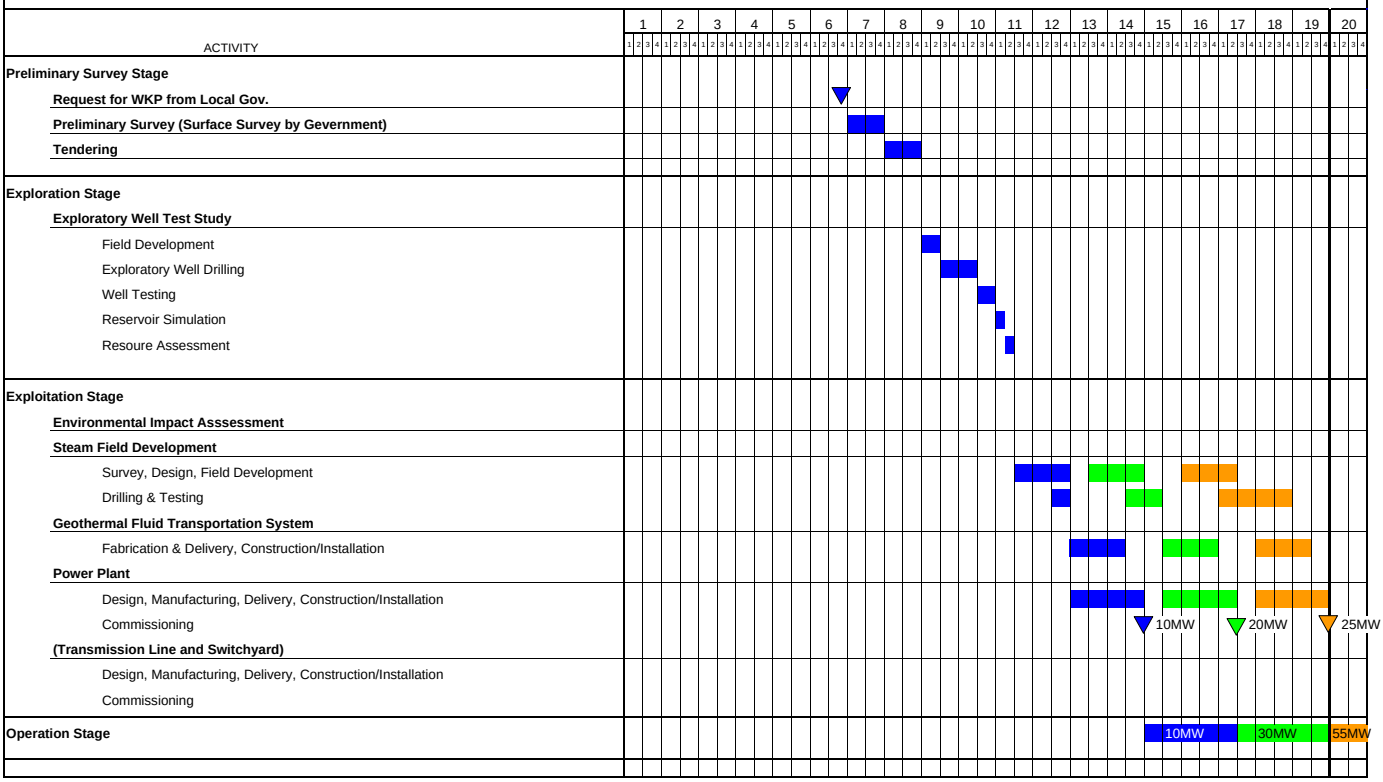
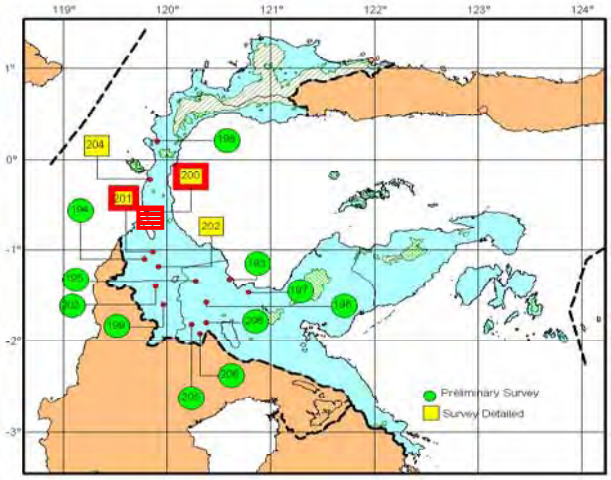


Table 7.1.9-1 Development Plan Sheet for New Working Area (No.65 MERANA)

No.65 MERANA	Region	Sulawesi	Province/ Location	Central Sulawesi, Southeastern foot of G. Ratai

Field Evaluation



Resource Characteristics	The Merana field is located in coast area near Merana village. Surface thermal manifestations are several warm to hot springs. Major structures are NE-SW trending faults. Reservoir temperature is estimated 220°C or higher from Na/K geothermometry. Resource potential estimated by stored heat method applying Monte Carlo analysis is 240-600 MW.
Natural/Social Environmental Condition	Possible geothermal reservoir area is not within any National Parks nor Protected Forests.
Power Sector Situation	Estimated T/L length from the field to Palu S/S is about 40 km. Direct connection with 70kV is recommendable. Electrification ratio in this area reachs only 47.1%.

Power Output Potential	Resource Potential	200 MW	Restricted by National Park	200 MW	Restricted by Power Demand	200 MW
Rank of Development Priority	C		Potential (Expected) Developer		Private Company	

Proposed Geothermal Development Plan

Outline for Power Development

The most possible development site in this field is located near the hot spring areas around Merana village. The demand of electricity in central part of Sulawesi is large, so a large scale power plant development as far as resource available is recommendable.

Possibile or Recommended Multi-purpose Geothermal Heat Use

Direct heat use for agricultural or marine product industry is recommendable.

Scope for Power Development

Power Plant Capacity:
200MW (40MWx2unit+60MWx2unit)
Plant System: Condencing
Explor.+Production Well: approx. 70 wells
Reinjection Well: less than 20 wells
Transmission Line: 70kV, approx. 40km
Connection: Direct connection to Palu S/S

CO_2 Emmission Reduction ('000 tone/year)

1,220

Proposed Geothermal Development Schedule

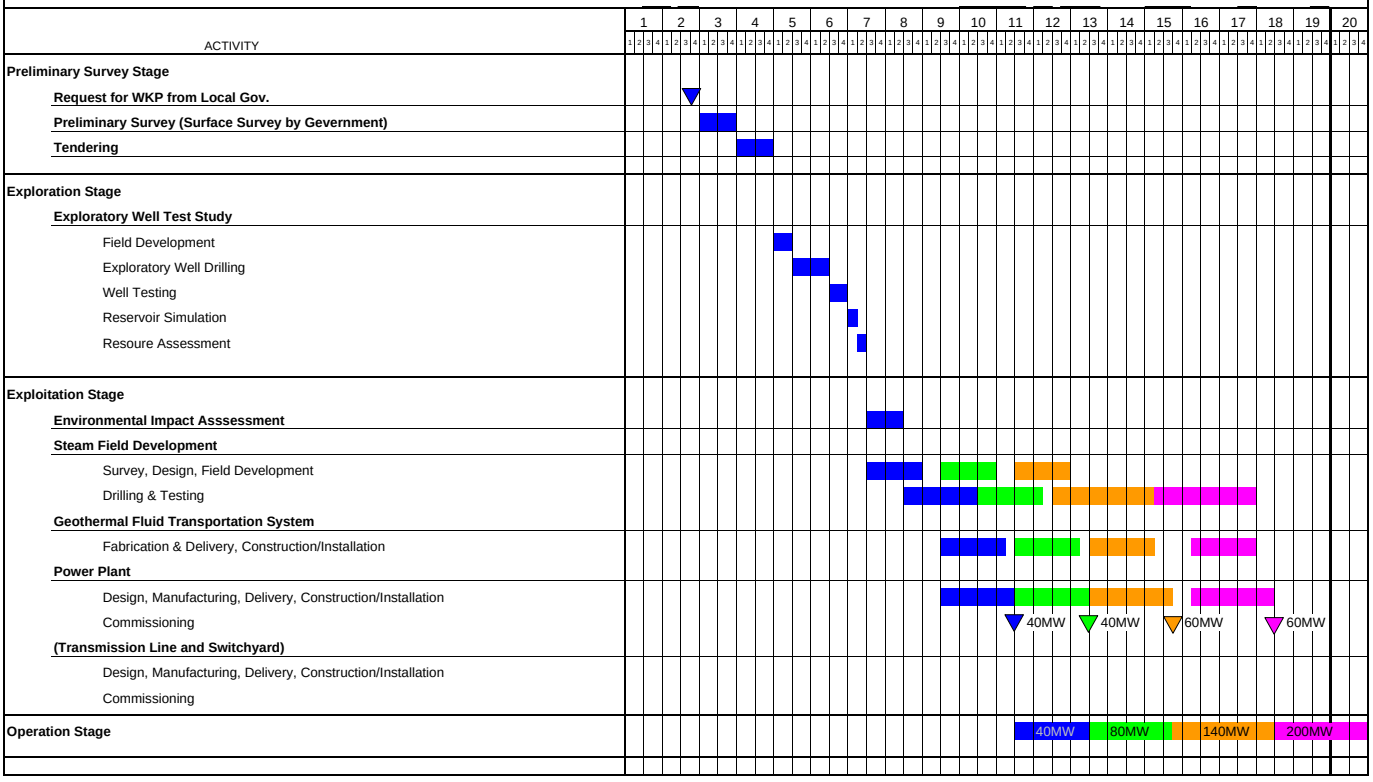
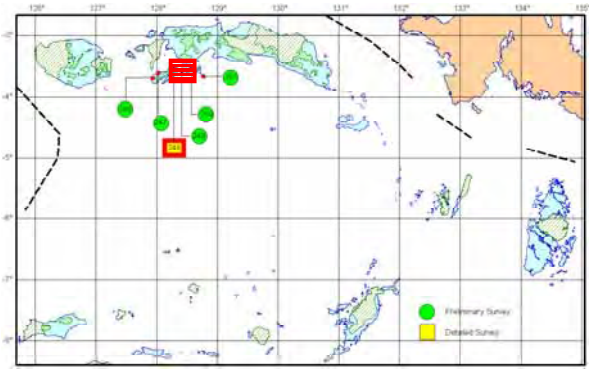


Table 7.1.9-1 Development Plan Sheet for New Working Area (No.69 TULEHU)

No.69 TULEHU	Region	Maluku	Province/ Location	Maluku, Eastern end of Ambon Island

Field Evaluation



Resource Characteristics	The Tulehu field is located in the west of Tulehu village. Surface thermal manifestations are several warm to hot springs. Major structures are NE-SW trending faults. Possible reservoir area is defined based on the low resistivity zone, surface manifestation, geologic struture and geochemistry. Reservoir fluid originates in meteoric water and seawater. Reservoir temperature is estimated around 230^{0}C or higher. Resource potential estimated by stored heat method applying Monte Carlo analysis is 15-40 MW.
Natural/Social Environmental Condition	Possible geothermal reservoir area is not within any National Parks. But the western part of the area is within Protected Forest (about 70% of the possible reservoir area).
Power Sector Situation	Estimated D/L length from the field to the nearest existing line is about 13 km. At present, electrification ratio in this area reachs only 50.6%.

Power Output Potential	Resource Potential	40 MW	Restricted by National Park	40 MW	Restricted by Power Demand	20 MW
Rank of Development Priority	C		Potential (Expected) Developer		Private Company or Central/Local Government	

Proposed Geothermal Development Plan

Outline for Power Development

The possible development site in this field is located in the west of Tulehu village. The demand of electricity in Ambon Island is small, so a small scale with multi-unit power plant development is recommendable. If sufficient steam is obtained by steamfield development, the power system available for variable load is disireble for power supply not only for base load but also peak load.

Possibile or Recommended Multi-purpose Geothermal Heat Use

Direct heat use for agricultural or marine product industry is recommendable.

Scope for Power Development

Power Plant Capacity: 20MW (5MWx4unit)
Plant System: Condencing or Back-pressure
Explor.+Production Well: approx. 10 wells
Reinjection Well: less than 3 wells
Transmission Line: 20kV, approx. 13km
Connection: Distribution Line

CO_2 Emmission Reduction ('000 tone/year)

122

Proposed Geothermal Development Schedule

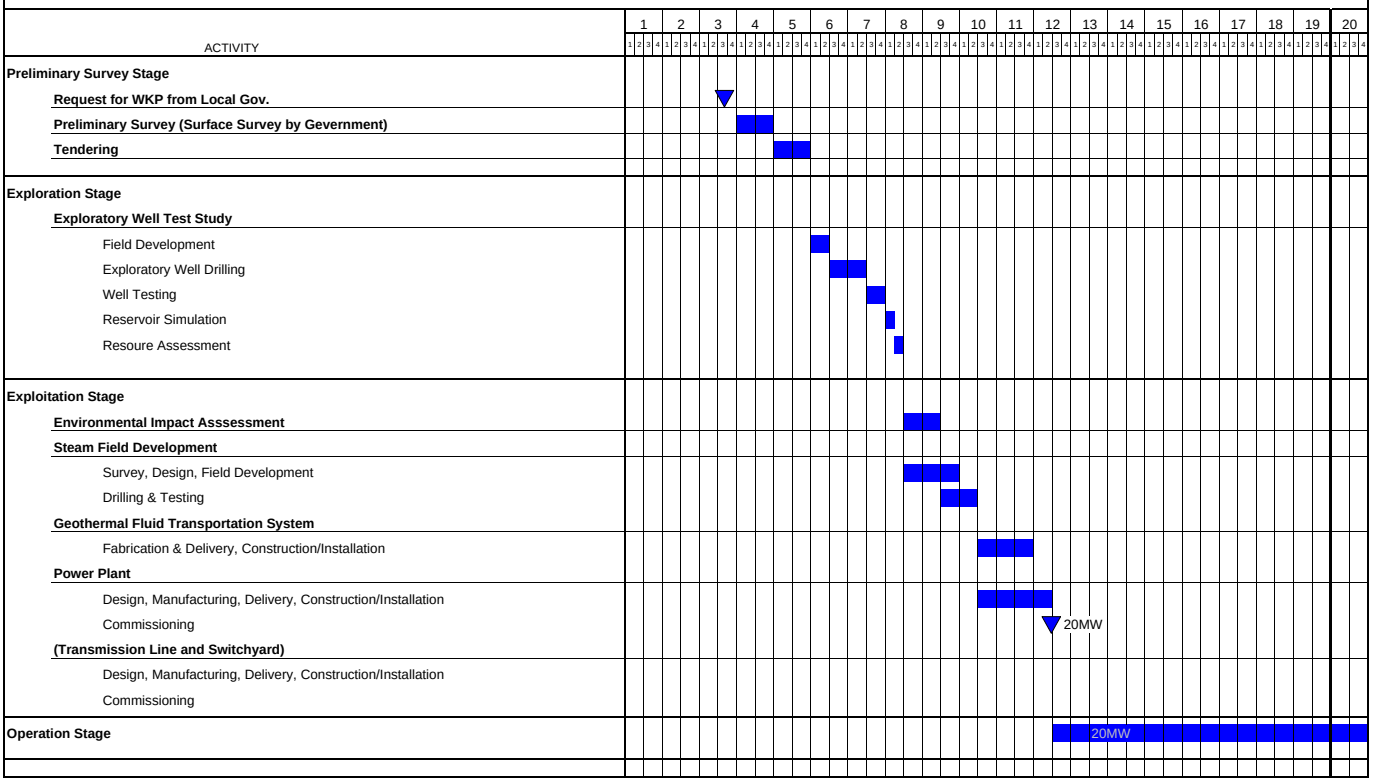
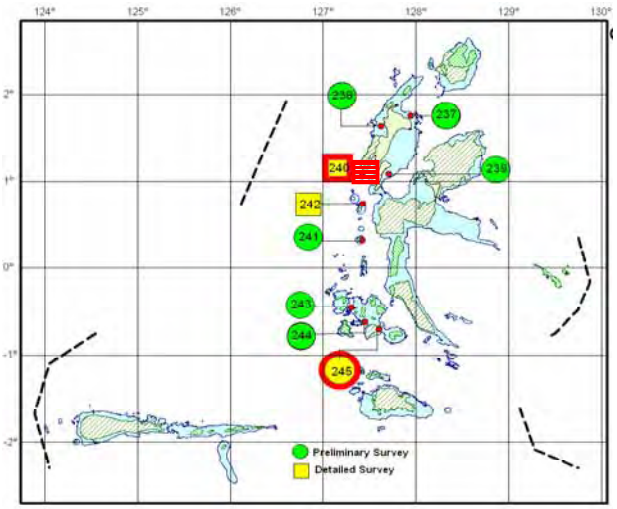


Table 7.1.9-1 Development Plan Sheet for New Working Area (No.70 JAILOLO)

No.70 JAILOLO	Region	Maluku	Province/ Location	North Maluku, Central part of Halmahera Island

Field Evaluation



Resource Characteristics	Thermal features of this field occur mainly around the flanks of G. Jailolo which forms a small peninsula on the west coast of Central Halmahera Island. Early Quaternary eruptive centres are situated at G.Toada and to the SW of G.Jailolo in the Teluk Bobo-Kailupa area. Major manifestations in this field are steaming ground and warm to hot springs. It is considered that the eastern part of the field around Kawah Idamdehe is the most promising for obtaining a geothermal resource. Reservoir temperature is estimated higher than 190°C from cation geothermometry. Resource potential estimated by stored heat method applying Monte Carlo analysis is 220-500 MW as Hypothetical resource.
Natural/Social Environmental Condition	Possible geothermal reservoir area is not within any National Parks nor Protected Forests.
Power Sector Situation	Estimated D/L length from the field to the nearest existing line is about 16 km. At present, electrification ratio in this area reachs only 50.6%.

Power Output Potential	Resource Potential	40 MW	Restricted by National Park	40 MW	Restricted by Power Demand	20 MW
Rank of Development Priority	C		Potential (Expected) Developer		Private Company or Central/Local Government	

Proposed Geothermal Development Plan

Outline for Power Development

The possible development site in this field is located around Kawah Idamdehe. The demand of electricity in Halmahera Island is small, so a small scale with multi-unit power plant development is recommendable. If sufficient steam is obtained by steamfield development, the power system available for variable load is disireble for power supply not only for base load but also peak load.

Possibile or Recommended Multi-purpose Geothermal Heat Use

Direct heat use for agricultural or marine product industry is recommendable.

Scope for Power Development

Power Plant Capacity: 20MW (5MWx4unit)
Plant System: Condencing or Back-pressure
Explor.+Production Well: approx. 10 wells
Reinjection Well: less than 3 wells
Transmission Line: 20kV, approx. 16km
Connection: Distribution Line

CO_2 Emmission Reduction ('000 tone/year)

122

Proposed Geothermal Development Schedule

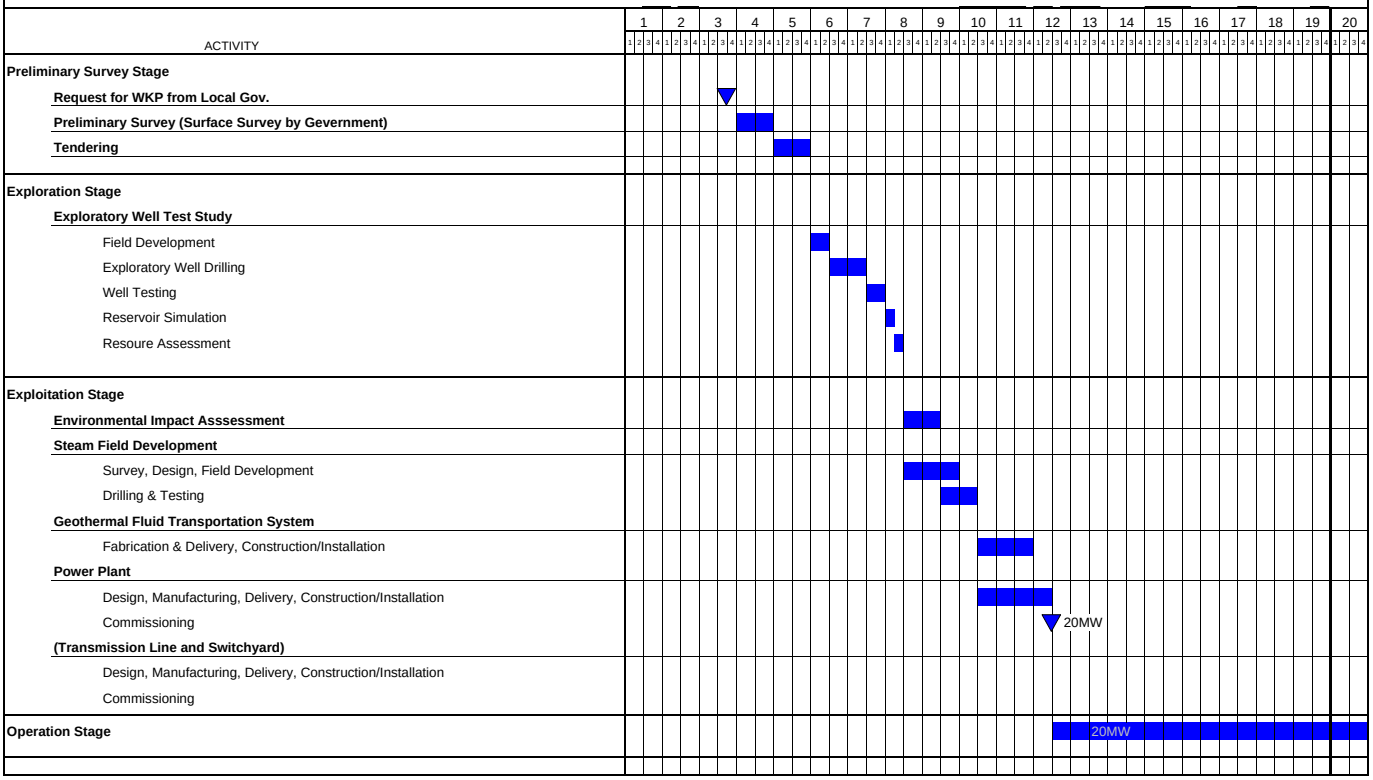
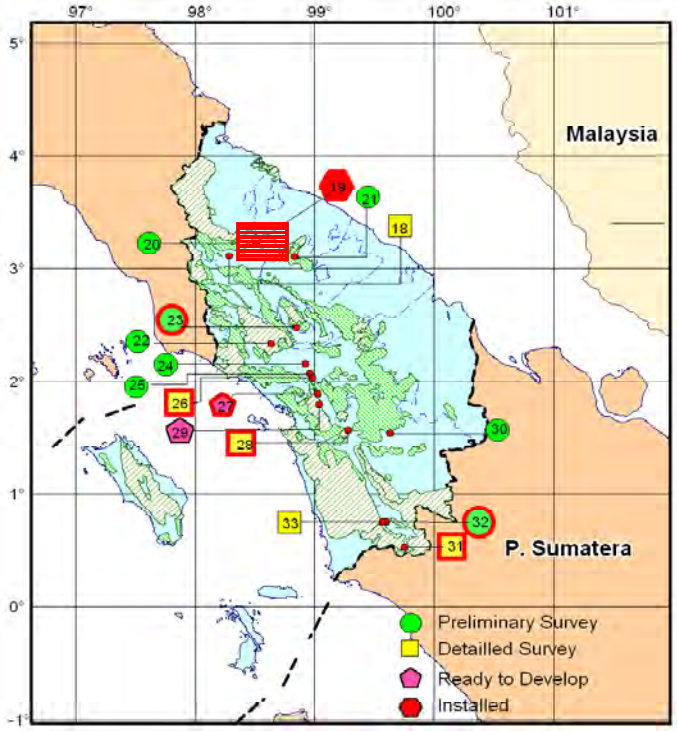


Table 7.1.9-2 Development Plan Sheet for Existing Project Field (No.7 LAU DEBUK-DEBUK / SIBAYAK)

No.7 LAU DEBUK-DEBUK / SIBAYAK	Region	Sumatra	Province/ Location	North Sumatra, Around Mt. Pratektekan

Field Information and Evaluation



Power Output Potential	Resource Potential	160 MW	Restricted by National Park	40 MW	Restricted by Power Demand	40 MW
Installed and planning Capacity	Installed Capacity	2 MW	Existing Plan	8 MW (10 MW replace)	Possible Additional Plan	30 MW
Rank of Development Priority	A		Developer		PERTAMINA - PT Priamanaya	

Planned and Proposed Geothermal Development Schedule

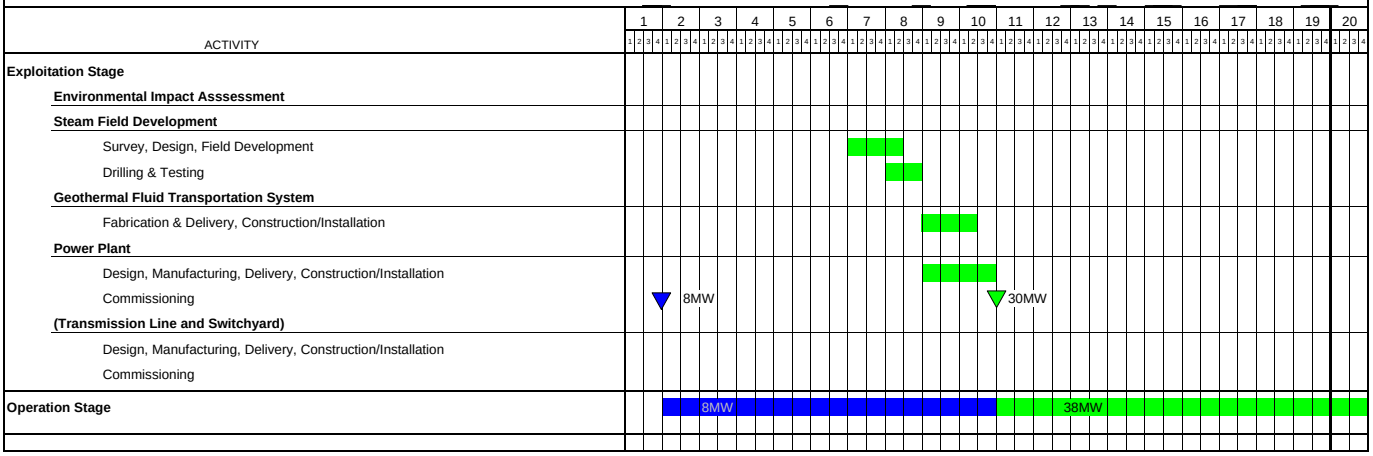
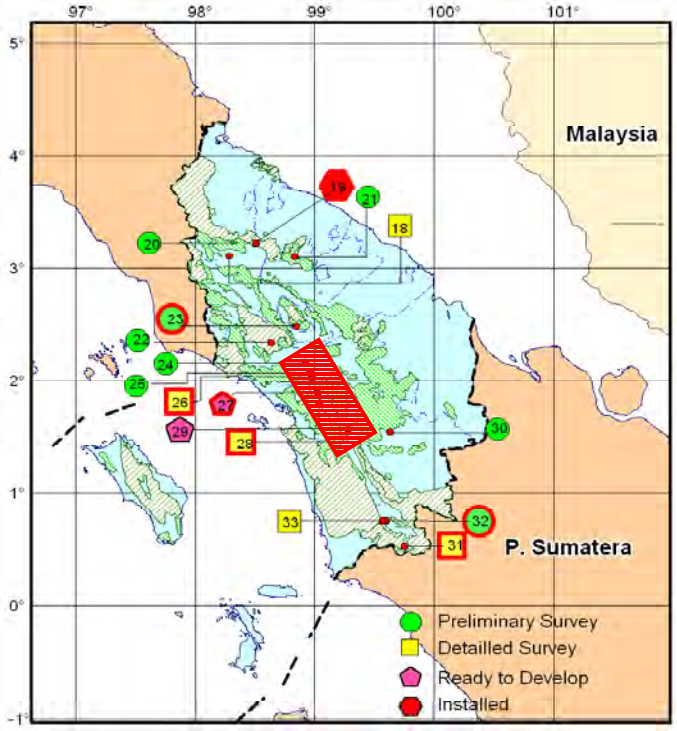


Table 7.1.9-2 Development Plan Sheet for Existing Project Field (No.8 SARULA, No.9 SIBUAL BUALI)

No.8 SARULA, No.9 SIBUAL BUALI	Region	Sumatra	Province/ Location	North Sumatra

Field Information and Evaluation



Power Output Potential	Resource Potential	660 MW	Restricted by National Park	630 MW	Restricted by Power Demand	630 MW
Installed and planning Capacity	Installed Capacity	0 MW	Existing Plan	300 MW	Possible Additional Plan	330 MW
Rank of Development Priority	A		Developer		(PLN) Medco-Ormat-Itochu - PERTAMINA	

Planned and Proposed Geothermal Development Schedule

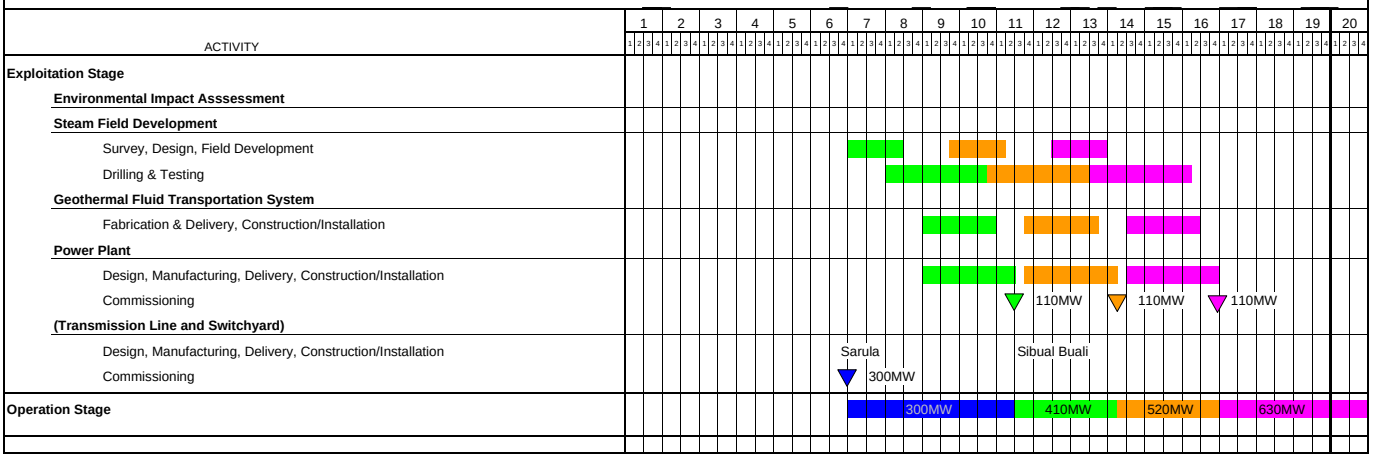
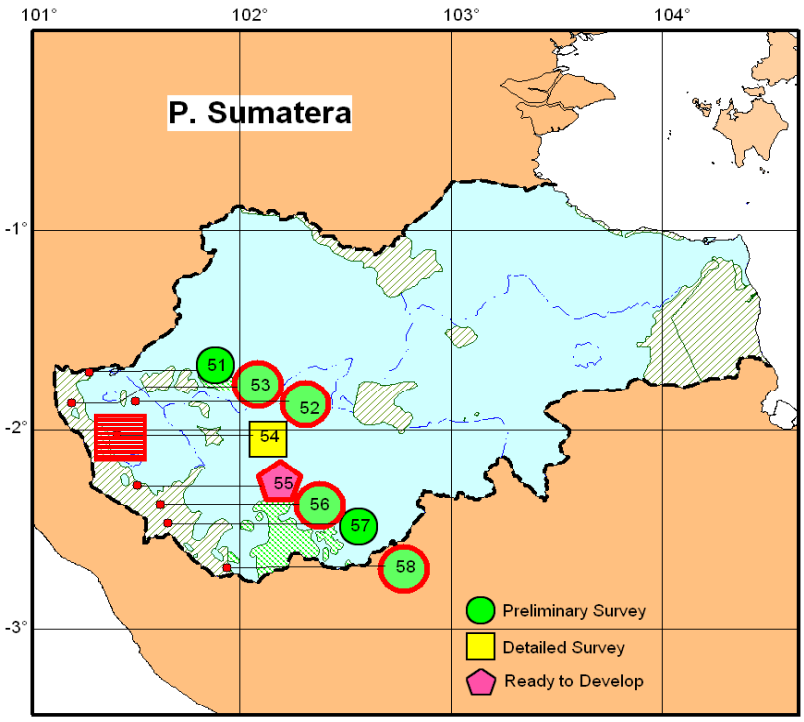


Table 7.1.9-2 Development Plan Sheet for Existing Project Field (No.17 SUNGAI PENUH)

No.17 SUNGAI PENUH	Region	Sumatra	Province/ Location	Jambi, Around Sumurup village

Field Information and Evaluation



Power Output Potential	Resource Potential	355 MW	Restricted by National Park	355 MW	Restricted by Power Demand	355 MW
Installed and planning Capacity	Installed Capacity	0 MW	Existing Plan	55 MW	Possible Additional Plan	300 MW
Rank of Development Priority	A		Developer		PERTAMINA	

Planned and Proposed Geothermal Development Schedule

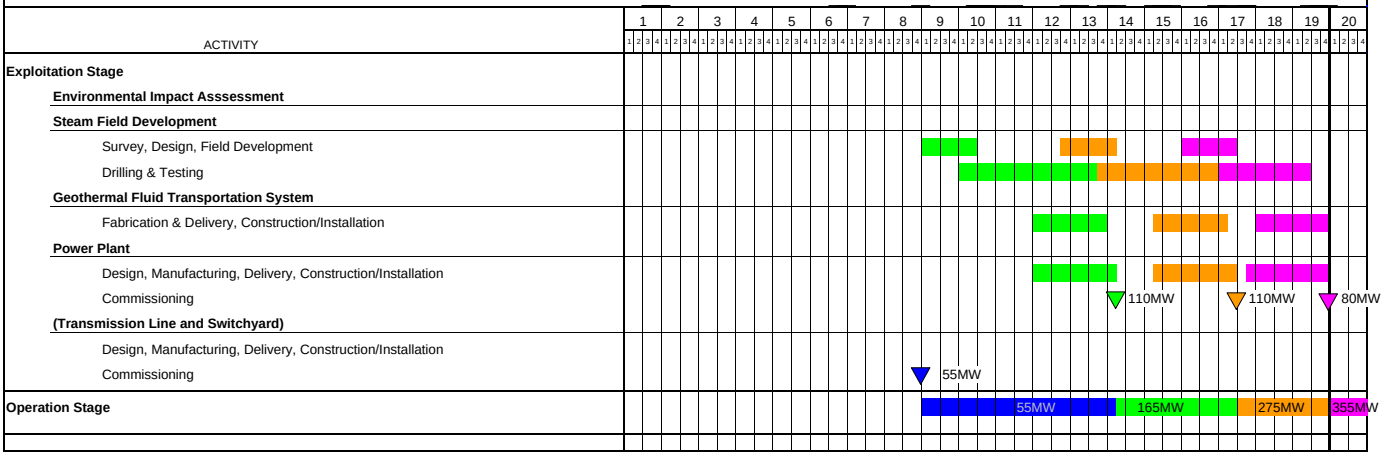
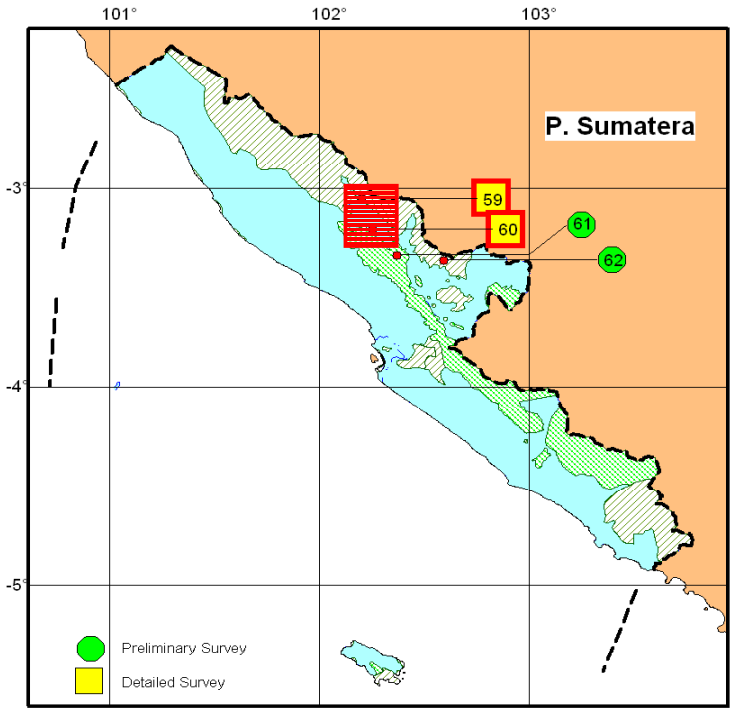


Table 7.1.9-2 Development Plan Sheet for Existing Project Field (No.21 B. GEDUNG HULU LAIS, No.22 TAMBANG SAWAH)

No.21 B. GEDUNG HULU LAIS, No.22 TAMBANG SAWAH	Region	Sumatra	Province/ Location	Bengkulu, Northern flank and foot of G. Hululais

Field Information and Evaluation



Power Output Potential	Resource Potential	910 MW	Restricted by National Park	910 MW	Restricted by Power Demand	910 MW
Installed and planning Capacity	Installed Capacity	0 MW	Existing Plan	110 MW (in Hululais)	Possible Additional Plan	800 MW
Rank of Development Priority	A		Developer		PERTAMINA	

Planned and Proposed Geothermal Development Schedule

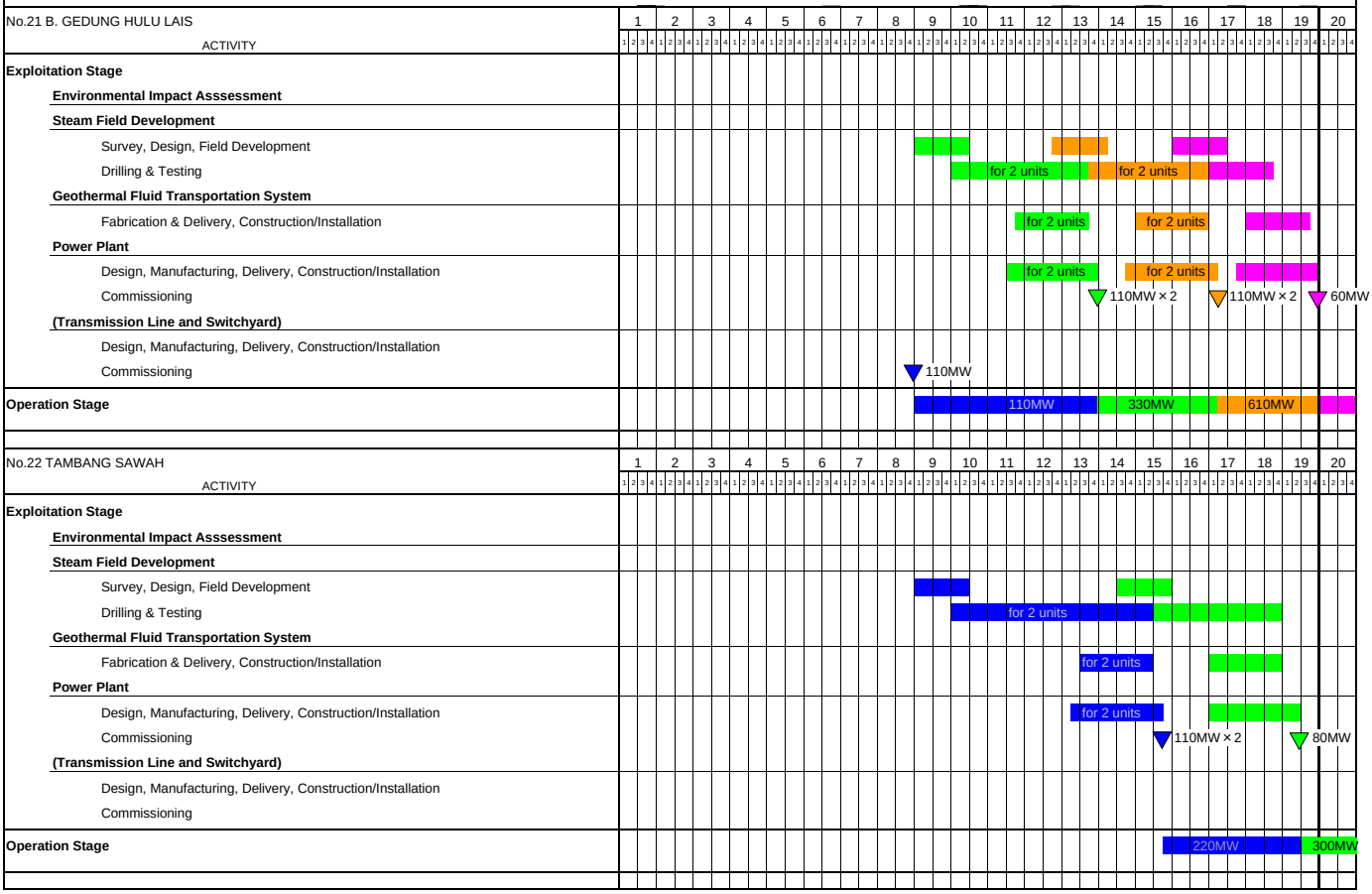
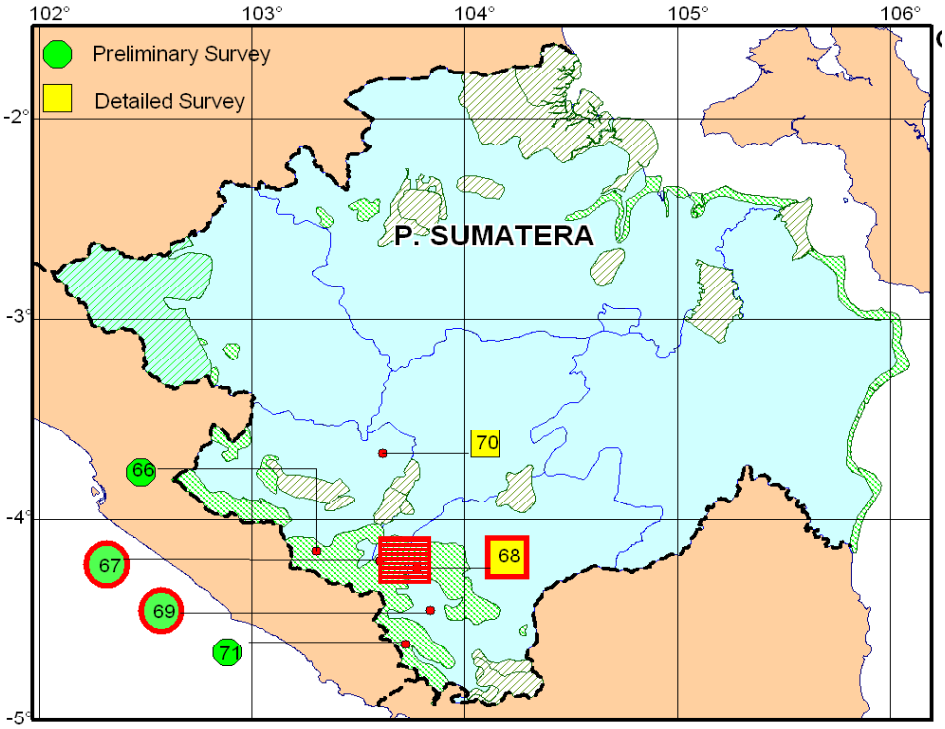


Table 7.1.9-2 Development Plan Sheet for Existing Project Field (No.25 LUMUT BALAI)

No.25 LUMUT BALAI	Region	Sumatra	Province/ Location	South Sumatra, Around G. Lumut and G. Balai

Field Information and Evaluation



Power Output Potential	Resource Potential	620 MW	Restricted by National Park	620 MW	Restricted by Power Demand	620 MW
Installed and planning Capacity	Installed Capacity	0 MW	Existing Plan	220 MW	Possible Additional Plan	400 MW
Rank of Development Priority	A		Developer		PERTAMINA	

Planned and Proposed Geothermal Development Schedule

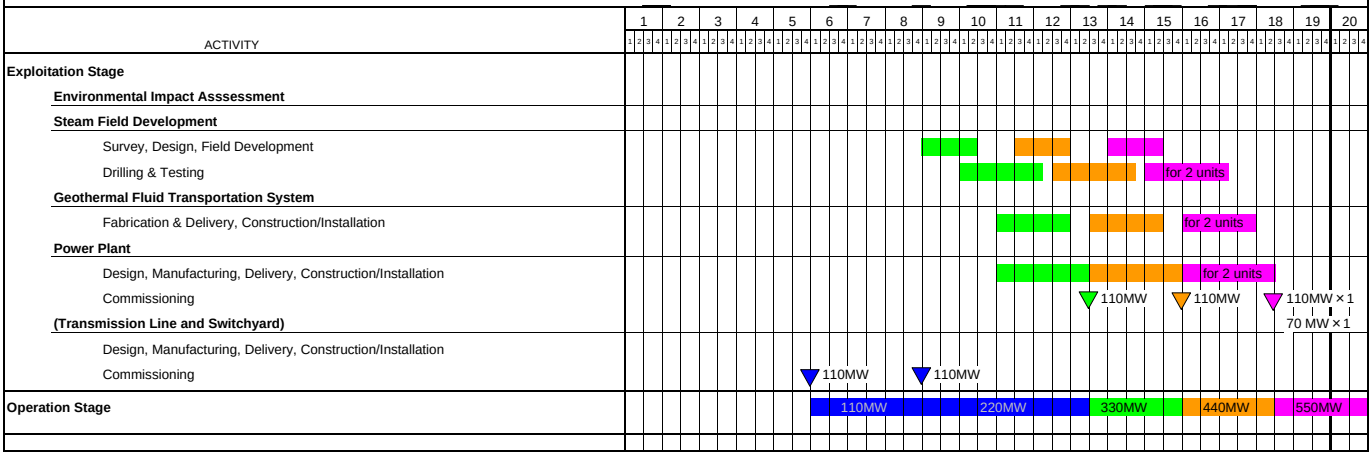
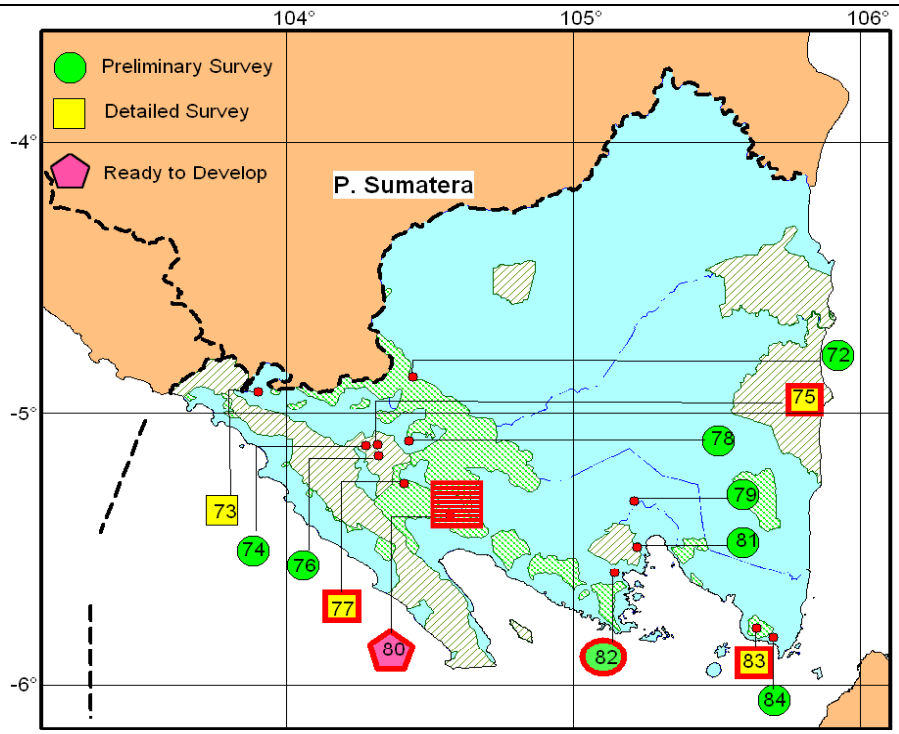


Table 7.1.9-2 Development Plan Sheet for Existing Project Field (No.27 ULUBELU)

No.27 ULUBELU	Region	Sumatra	Province/ Location	Lampung, Around Mt. Duduk and Mt. Kukusan

Field Information and Evaluation



Power Output Potential	Resource Potential	440 MW	Restricted by National Park	440 MW	Restricted by Power Demand	440 MW
Installed and planning Capacity	Installed Capacity	0 MW	Existing Plan	220 MW	Possible Additional Plan	220 MW
Rank of Development Priority	A		Developer		PERTAMINA	

Planned and Proposed Geothermal Development Schedule

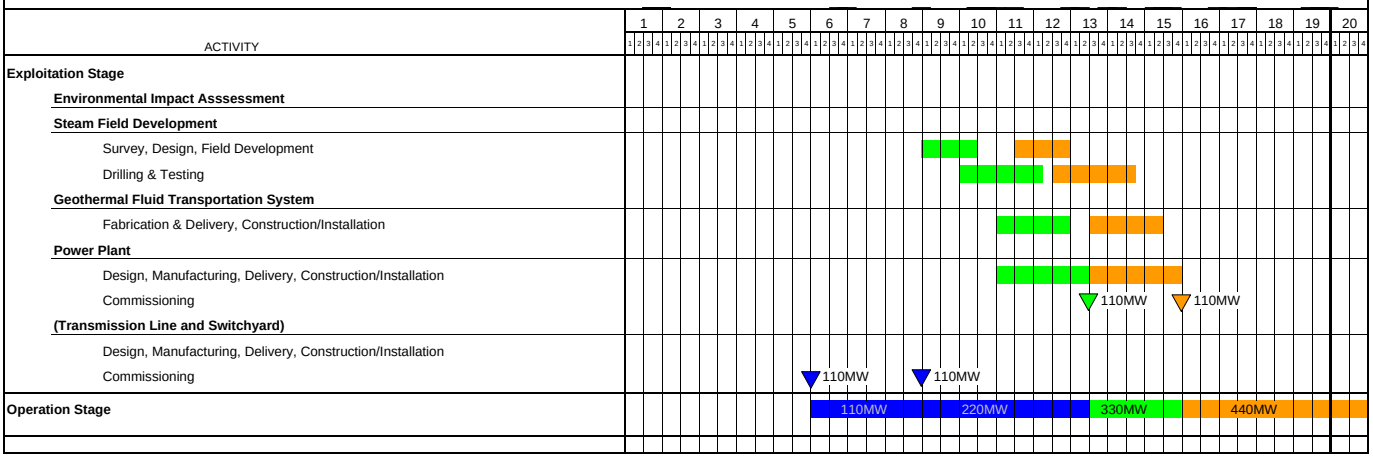
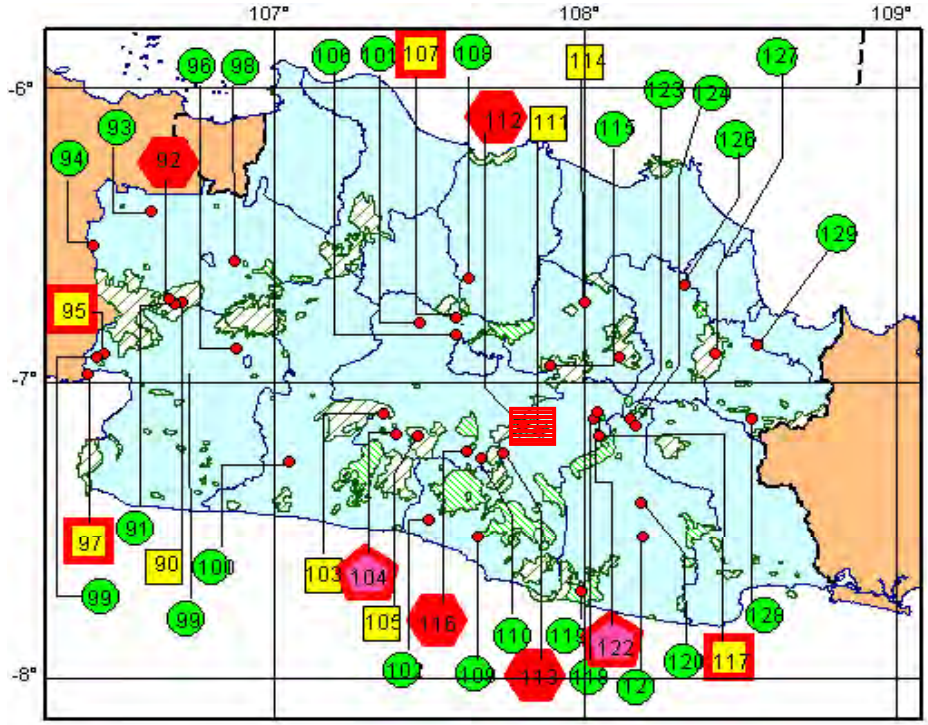


Table 7.1.9-2 Development Plan Sheet for Existing Project Field (No.32 KAMOJANG)

No.32 KAMOJANG	Region	Java-Bali	Province/ Location	West Java, Around Kawah Kamojang

Field Information and Evaluation



Power Output Potential	Resource Potential	320 MW	Restricted by National Park	320 MW	Restricted by Power Demand	320 MW
Installed and planning Capacity	Installed Capacity	140 MW	Existing Plan	120 MW	Possible Additional Plan	60 MW
Rank of Development Priority	A		Developer		PERTAMINA	

Planned and Proposed Geothermal Development Schedule

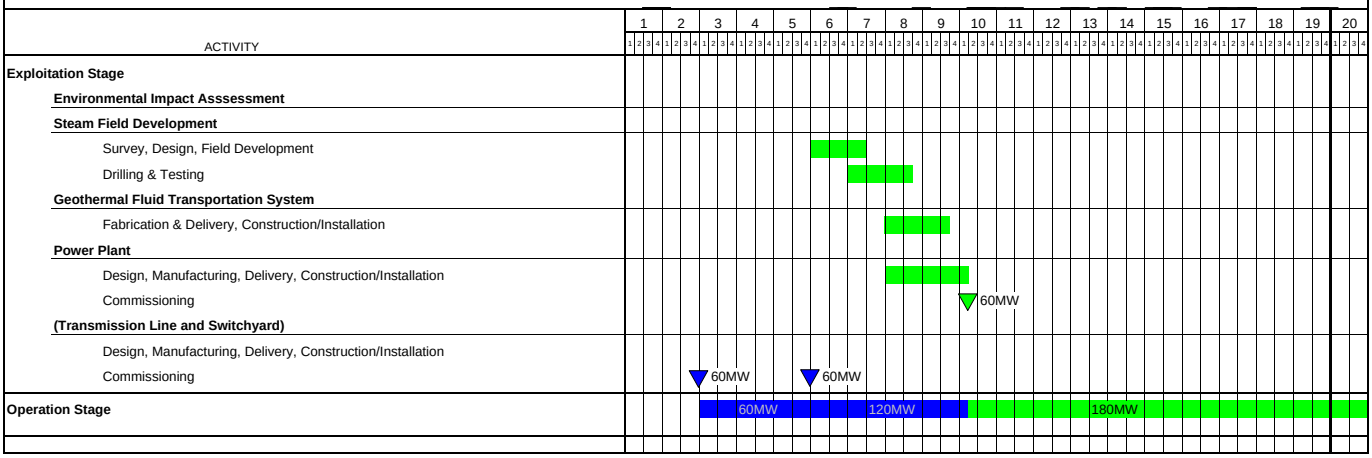
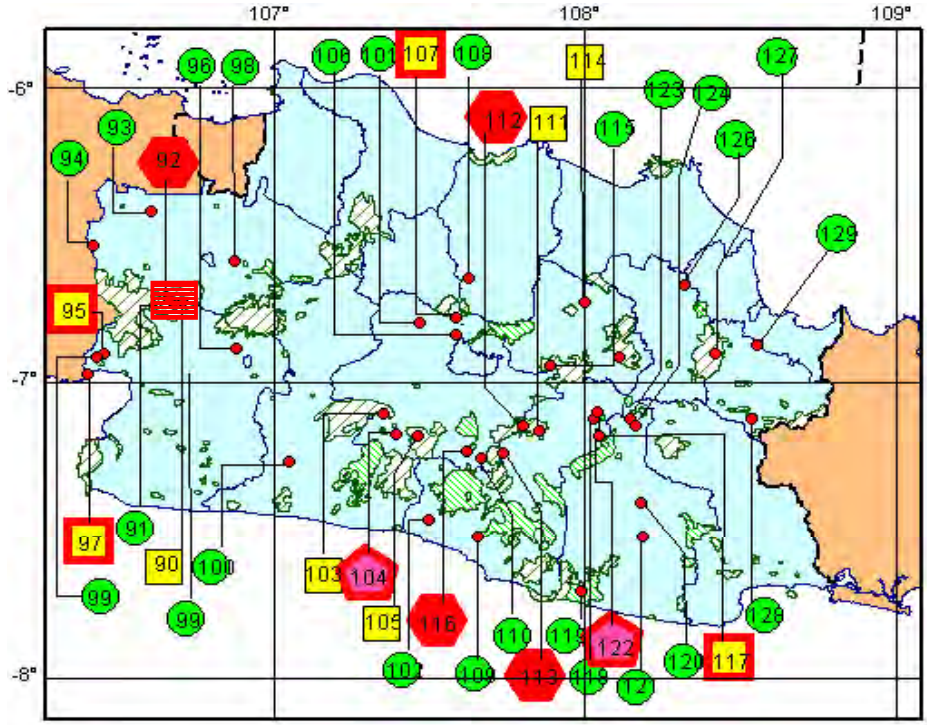


Table 7.1.9-2 Development Plan Sheet for Existing Project Field (No.33 G. SALAK)

No.33 G. SALAK	Region	Java-Bali	Province/ Location	West Java, Around Awibengkok

Field Information and Evaluation



Power Output Potential	Resource Potential	500 MW	Restricted by National Park	500 MW	Restricted by Power Demand	500 MW
Installed and planning Capacity	Installed Capacity	380 MW	Existing Plan	0 MW	Possible Additional Plan	120 MW
Rank of Development Priority	A		Developer		Unocal - PERTAMINA	

Planned and Proposed Geothermal Development Schedule

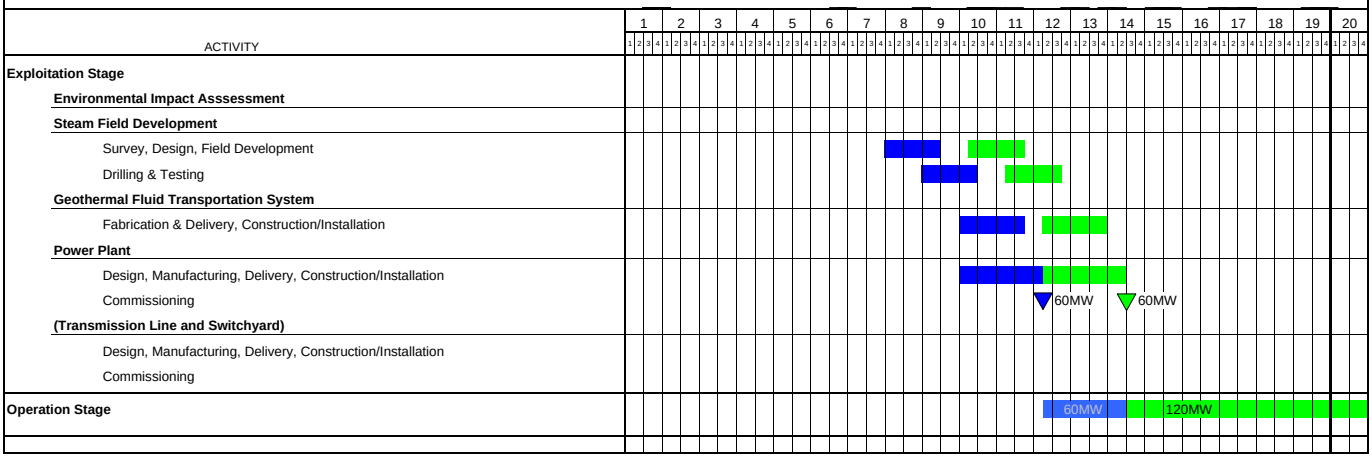
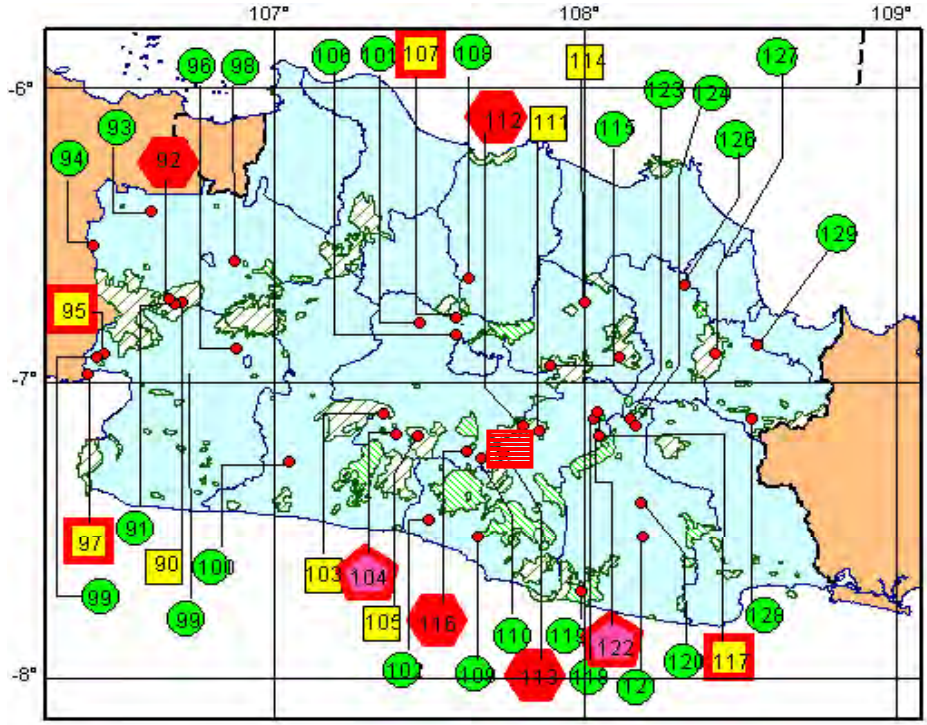


Table 7.1.9-2 Development Plan Sheet for Existing Project Field (No.34 DARAJAT)

No.34 DARAJAT	Region	Java-Bali	Province/ Location	West Java, Around G. Gagak

Field Information and Evaluation



Power Output Potential	Resource Potential	330 MW	Restricted by National Park	330 MW	Restricted by Power Demand	330 MW
Installed and planning Capacity	Installed Capacity	145 MW	Existing Plan	110 MW	Possible Additional Plan	75 MW
Rank of Development Priority	A		Developer		Amoseas - PERTAMINA	

Planned and Proposed Geothermal Development Schedule

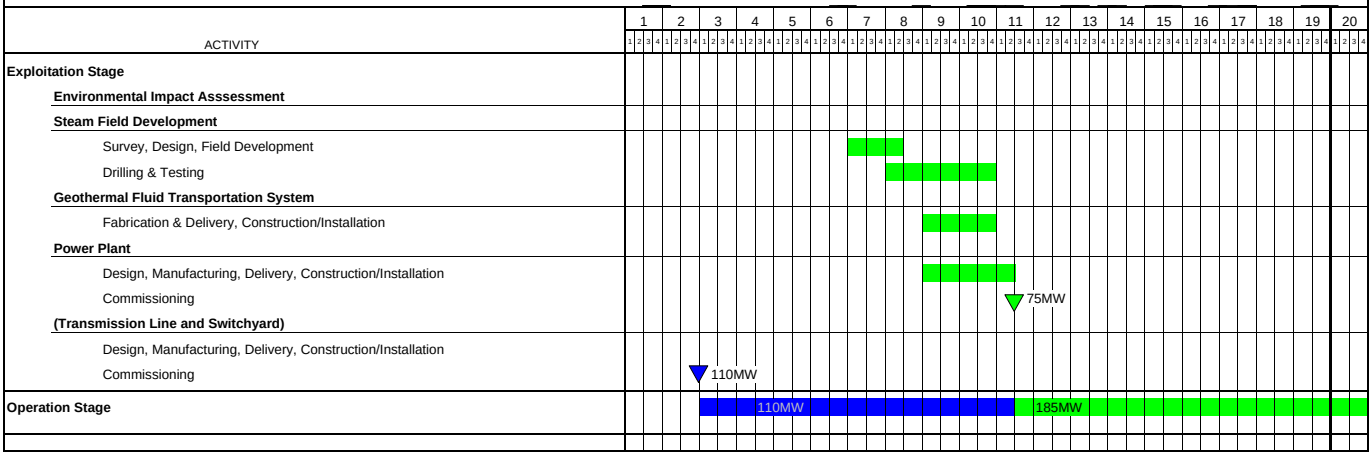
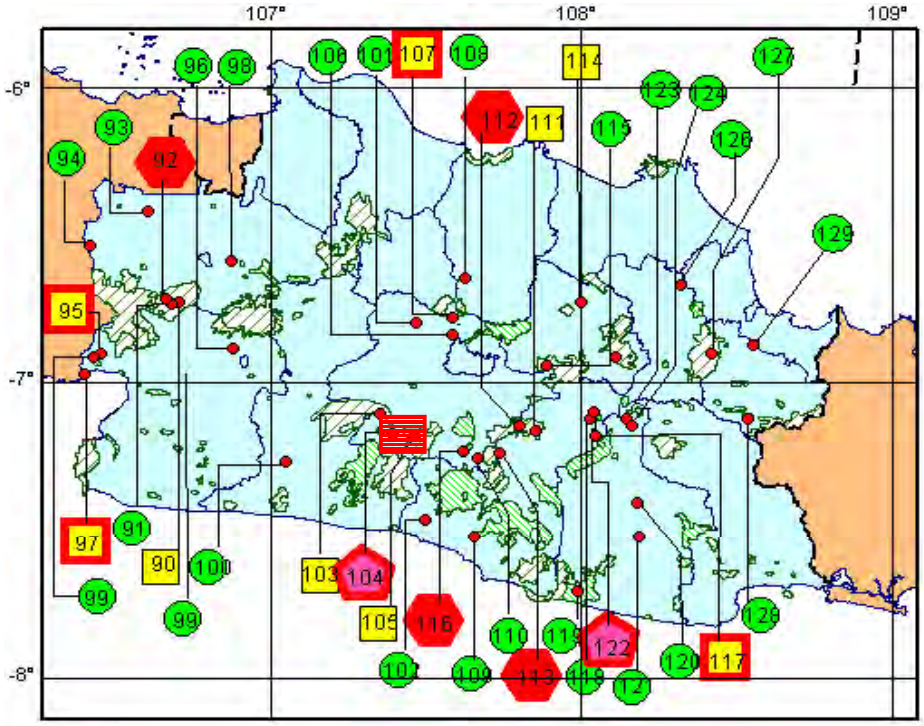


Table 7.1.9-2 Development Plan Sheet for Existing Project Field (No.36 G. PATUHA)

No.36 G. PATUHA	Region	Java-Bali	Province/ Location	West Java, Around G. Patuha

Field Information and Evaluation



Power Output Potential	Resource Potential	500 MW	Restricted by National Park	500 MW	Restricted by Power Demand	500 MW
Installed and planning Capacity	Installed Capacity	0 MW	Existing Plan	120 MW	Possible Additional Plan	380 MW
Rank of Development Priority	A		Developer		Geo Dipa Energy	

Planned and Proposed Geothermal Development Schedule

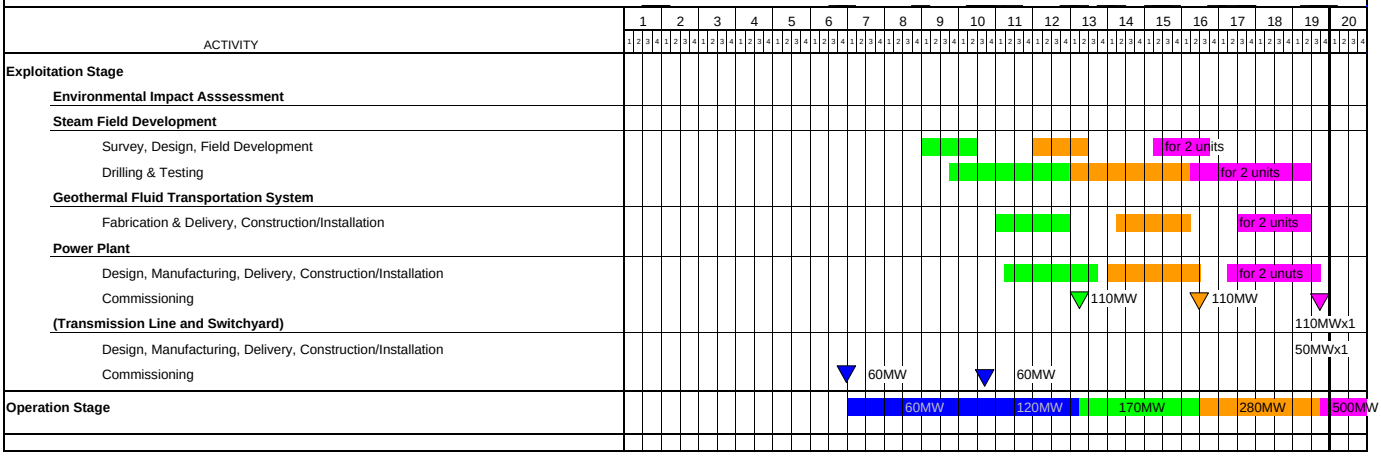
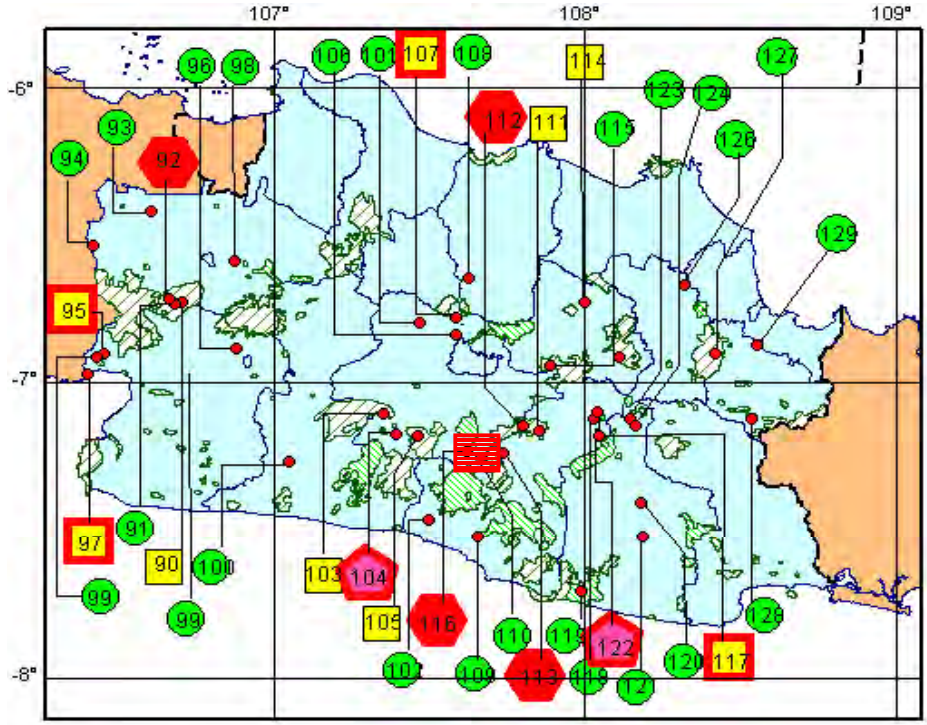


Table 7.1.9-2 Development Plan Sheet for Existing Project Field (No.37 G. WAYANG - WINDU)

No.37 G. WAYANG - WINDU	Region	Java-Bali	Province/ Location	West Java

Field Information and Evaluation



Power Output Potential	Resource Potential	400 MW	Restricted by National Park	400 MW	Restricted by Power Demand	400 MW
Installed and planning Capacity	Installed Capacity	110 MW	Existing Plan	110 MW	Possible Additional Plan	180 MW
Rank of Development Priority	A		Developer		Magma Nusantara-Star Energy PERTAMINA	

Planned and Proposed Geothermal Development Schedule

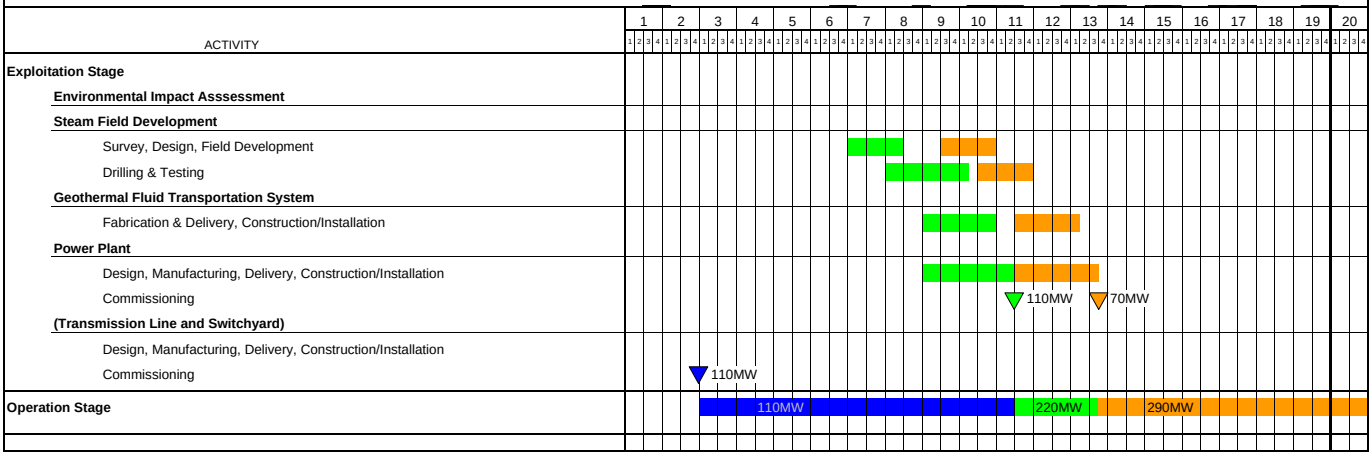
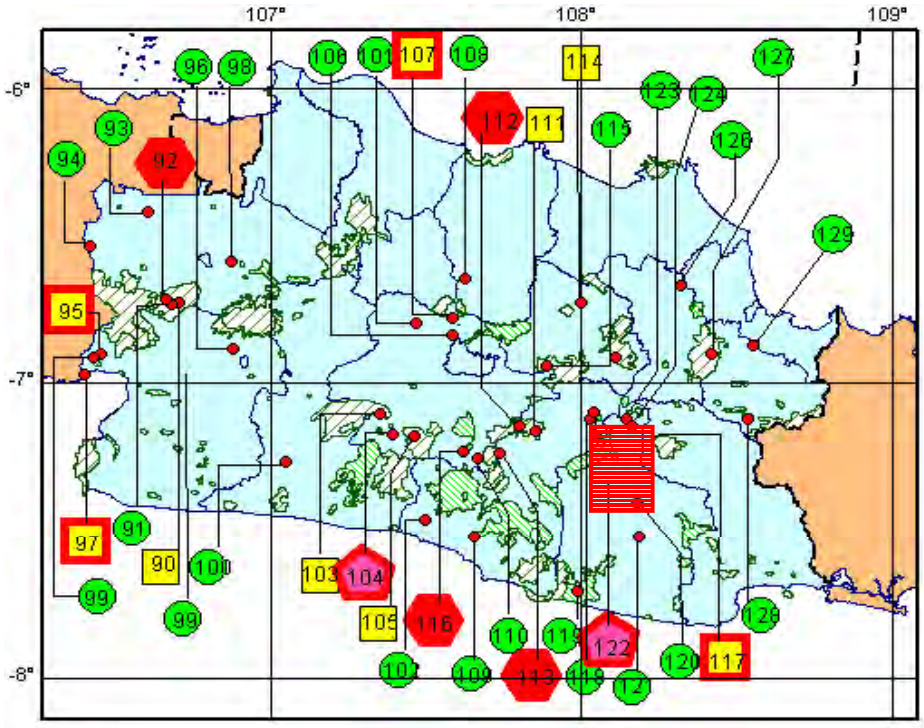


Table 7.1.9-2 Development Plan Sheet for Existing Project Field (No.38 G. KARAHA, No.39 G. TELAGABODAS)

No.38 G. KARAHA, No.39 G. TELAGABODAS	Region	Java-Bali	Province/ Location	West Java, Around G. Karaha and G. Telagabodas

Field Information and Evaluation



Power Output Potential	Resource Potential	400 MW	Restricted by National Park	400 MW	Restricted by Power Demand	400 MW
Installed and planning Capacity	Installed Capacity	0 MW	Existing Plan	30 MW	Possible Additional Plan	370 MW
Rank of Development Priority	A		Developer		PERTAMINA	

Planned and Proposed Geothermal Development Schedule

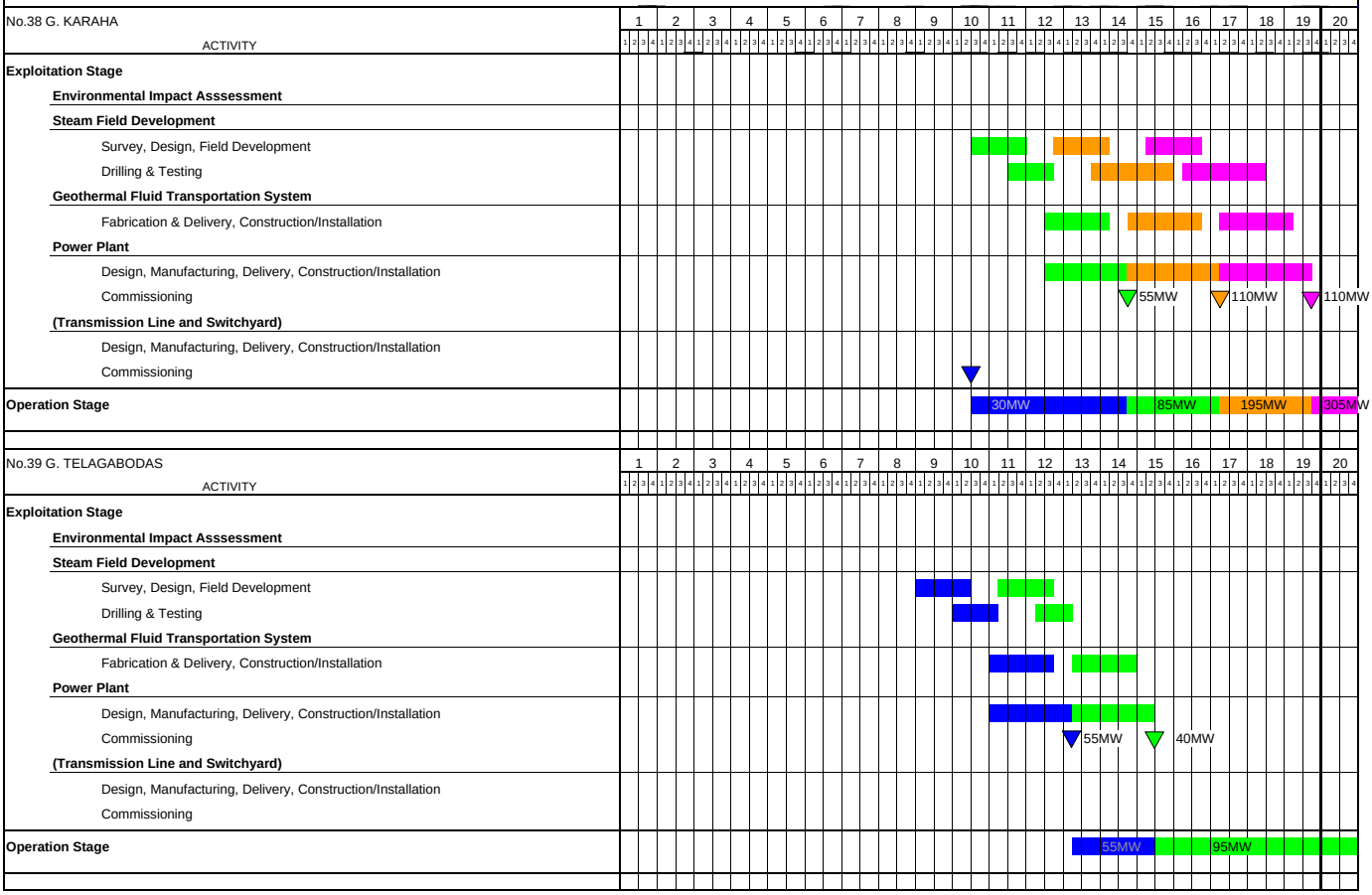
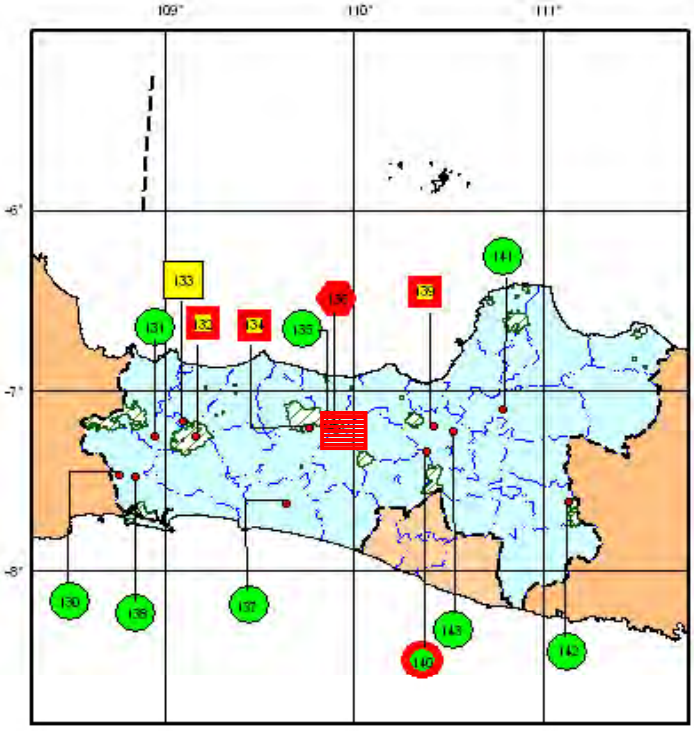


Table 7.1.9-2 Development Plan Sheet for Existing Project Field (No.44 DIENG)

No.44 DIENG	Region	Java-Bali	Province/ Location	Central Java, Around G. Pangoman

Field Information and Evaluation



Power Output Potential	Resource Potential	400 MW	Restricted by National Park	400 MW	Restricted by Power Demand	400 MW
Installed and planning Capacity	Installed Capacity	60 MW	Existing Plan	120 MW	Possible Additional Plan	220 MW
Rank of Development Priority	A		Developer		Geo Dipa Energy	

Planned and Proposed Geothermal Development Schedule

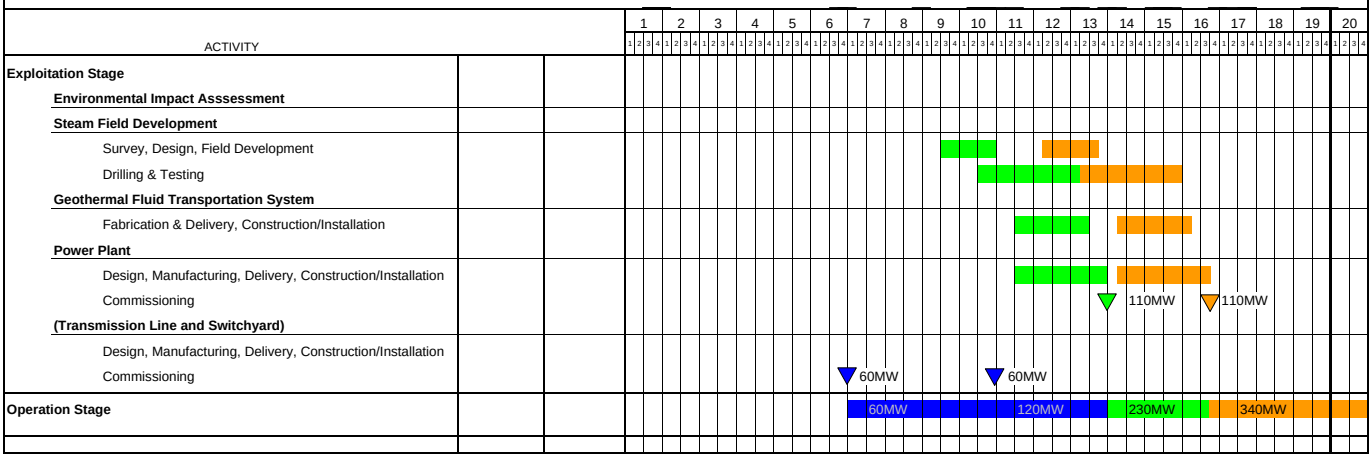
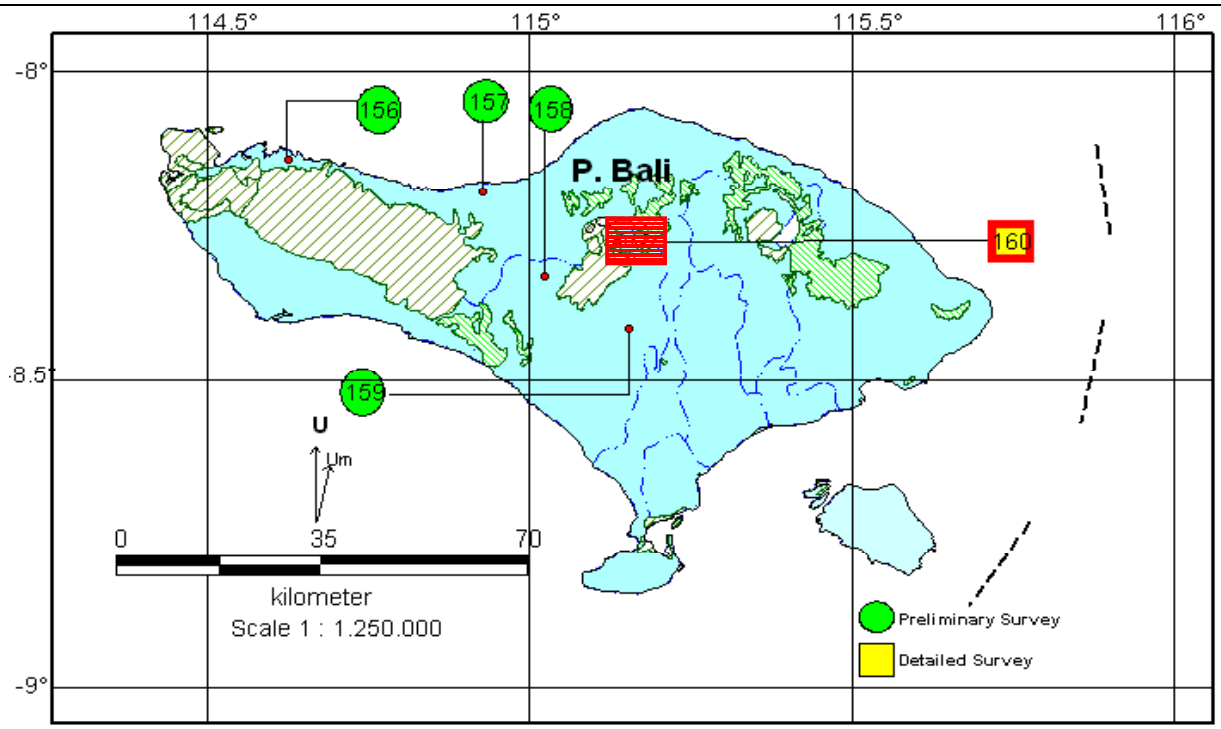


Table 7.1.9-2 Development Plan Sheet for Existing Project Field (No.52 BEDUGUL)

No.52 BEDUGUL	Region	Java-Bali	Province/ Location	Bali, Around G. Patak and G. Pohen

Field Information and Evaluation



Power Output Potential	Resource Potential	330 MW	Restricted by National Park	175 MW	Restricted by Power Demand	175 MW
Installed and planning Capacity	Installed Capacity	0 MW	Existing Plan	175 MW	Possible Additional Plan	0 MW
Rank of Development Priority	A		Developer		Bali Energy - PERTAMINA	

Planned and Proposed Geothermal Development Schedule

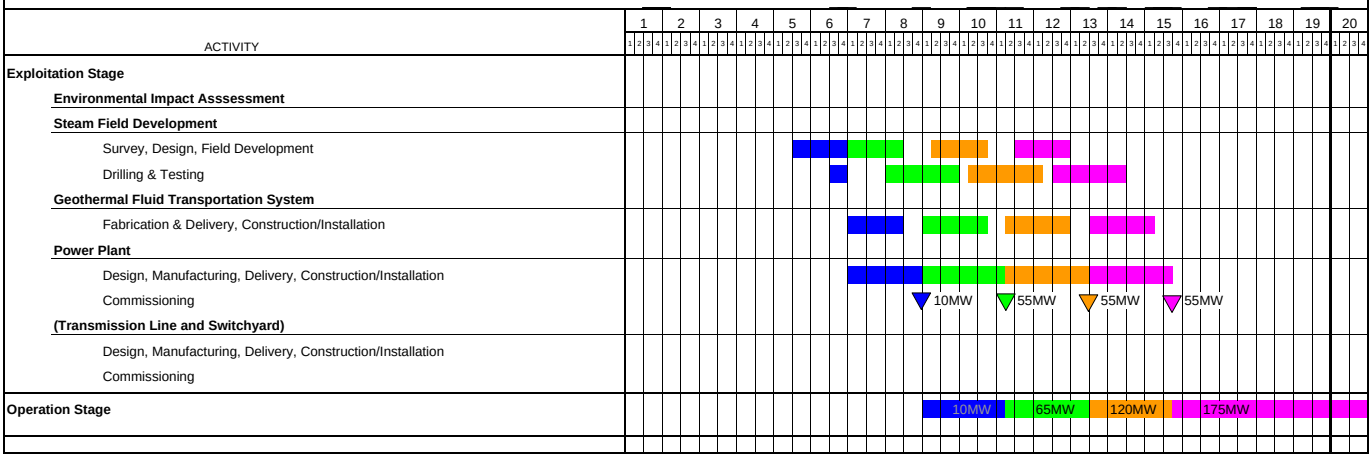
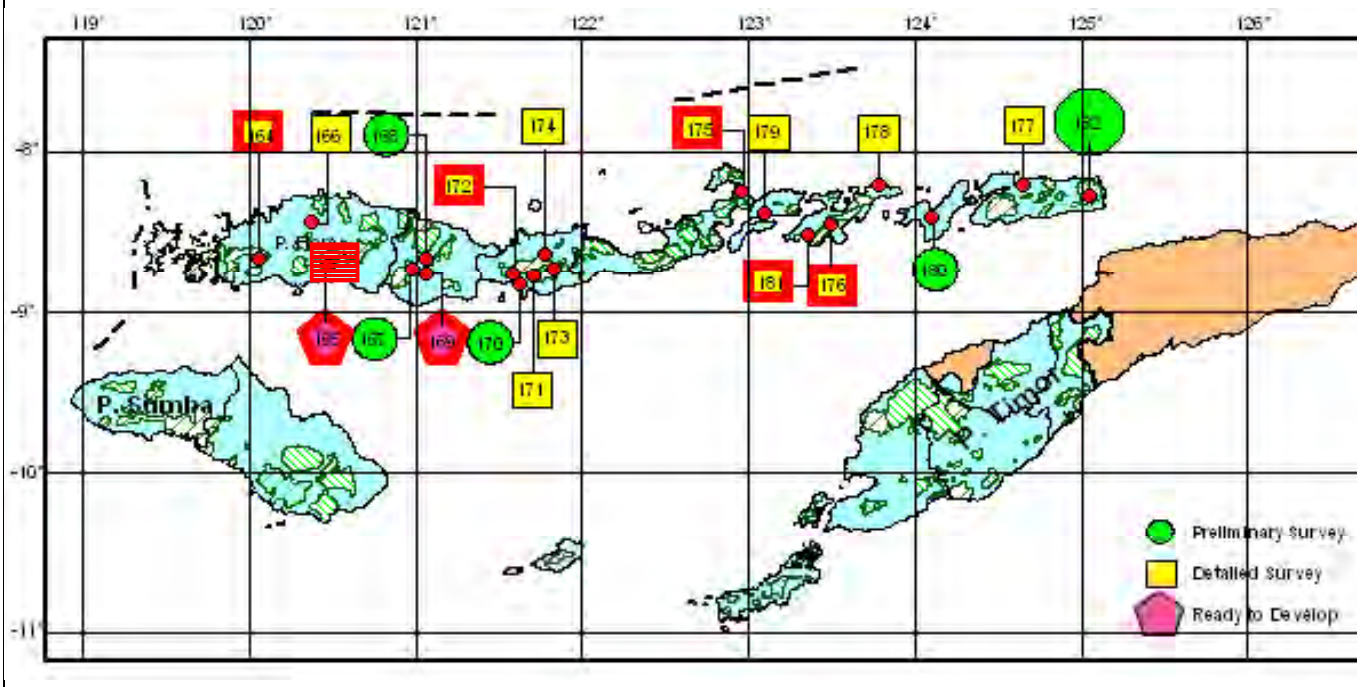


Table 7.1.9-2 Development Plan Sheet for Existing Project Field (No.55 ULUMBU)

No.55 ULUMBU	Region	Nusa Tenggara	Province/ Location	East Nusa Tenggara, South of Ruteng town

Field Information and Evaluation



Power Output Potential	Resource Potential	150 MW	Restricted by National Park	150 MW	Restricted by Power Demand	36 MW
Installed and planning Capacity	Installed Capacity	0 MW	Existing Plan	6 MW	Possible Additional Plan	30 MW
Rank of Development Priority	A		Developer		PLN	

Planned and Proposed Geothermal Development Schedule

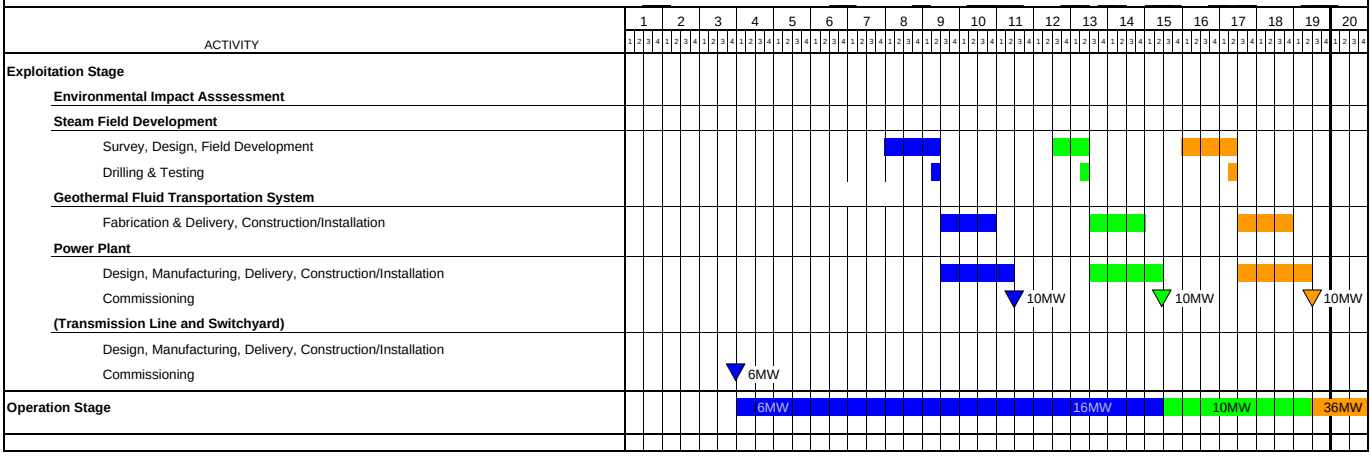
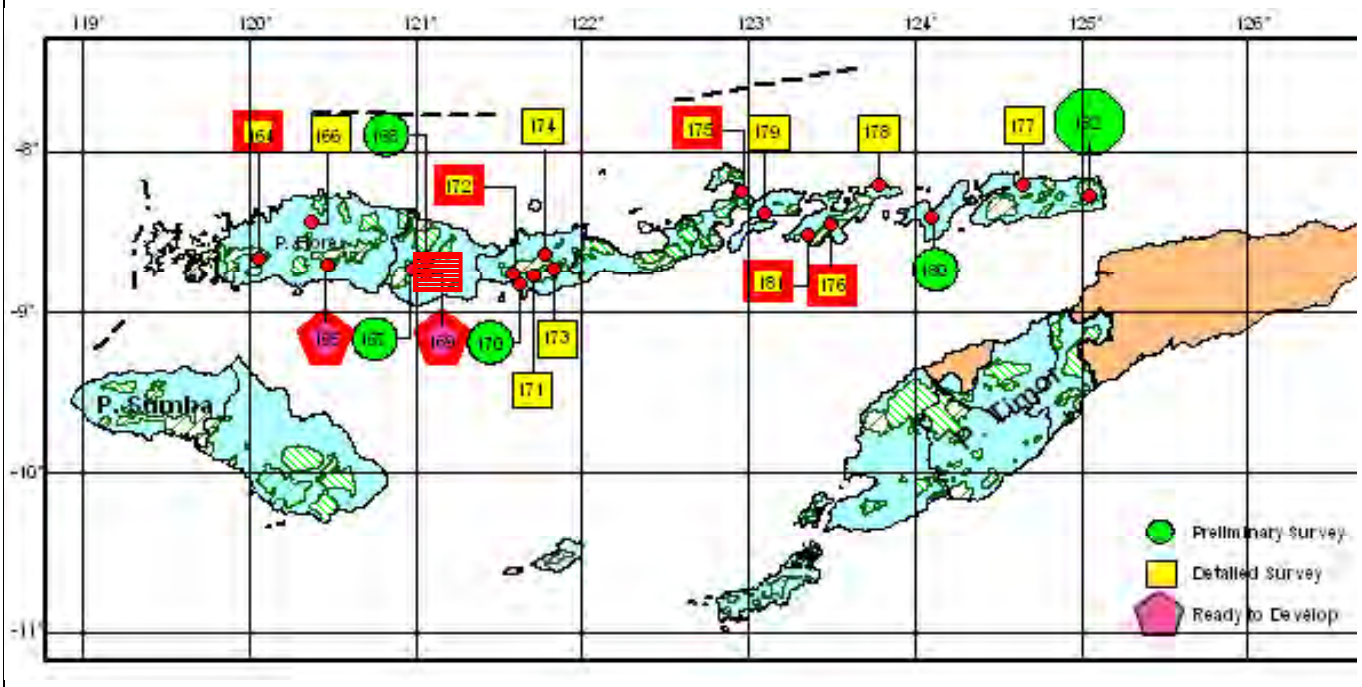


Table 7.1.9-2 Development Plan Sheet for Existing Project Field (No.56 BENA - MATALOKO)

No.56 BENA - MATALOKO	Region	Nusa Tenggara	Province/ Location	East Nusa Tenggara, East of Bajawa town

Field Information and Evaluation



Power Output Potential	Resource Potential	30 MW	Restricted by National Park	30 MW	Restricted by Power Demand	20 MW
Installed and planning Capacity	Installed Capacity	0 MW	Existing Plan	2.5 MW	Possible Additional Plan	17.5 MW
Rank of Development Priority	A		Developer		PLN	

Planned and Proposed Geothermal Development Schedule

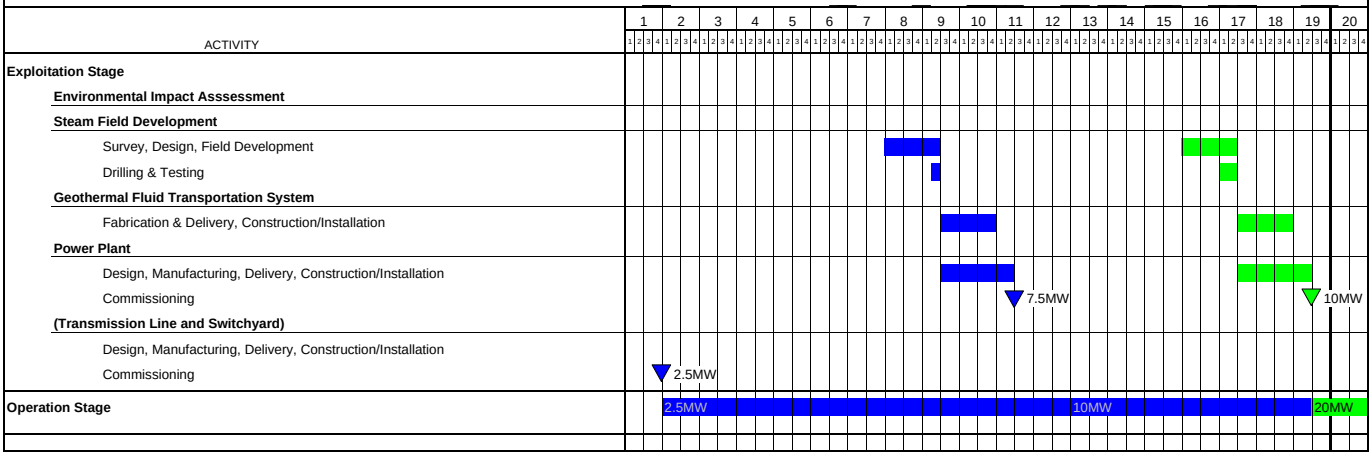
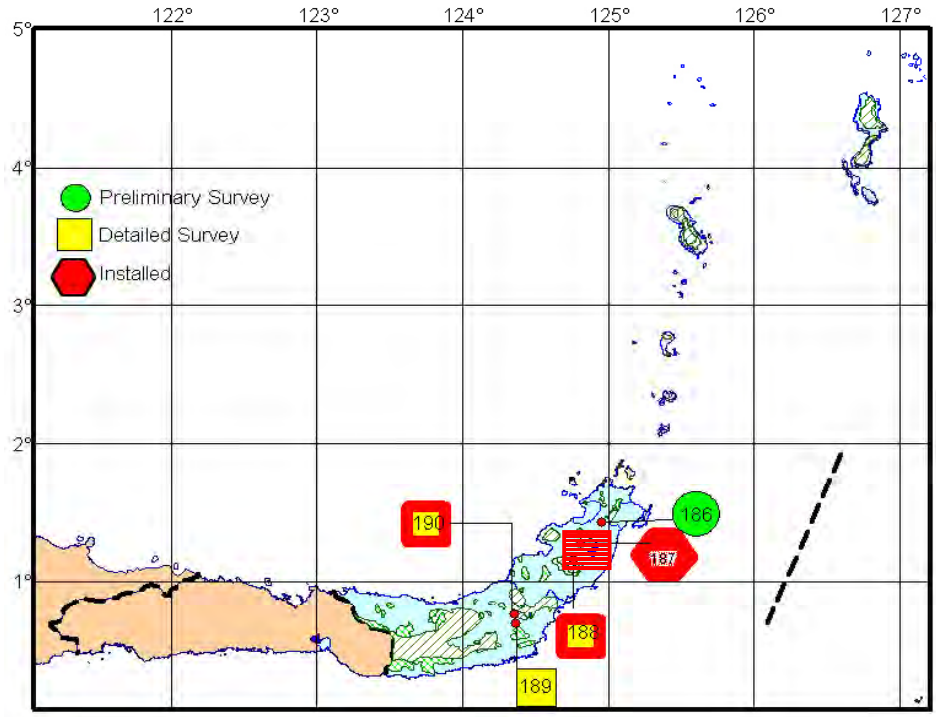


Table 7.1.9-2 Development Plan Sheet for Existing Project Field (No.61 LAHENDONG, No.63 TOMPASO)

No.61 LAHENDONG, No.63 TOMPASO	Region	Sulawesi	Province/ Location	North Sulawesi, Around Tomohon and Tompaso tomns

Field Information and Evaluation



Power Output Potential	Resource Potential	380 MW	Restricted by National Park	380 MW	Restricted by Power Demand	340 MW
Installed and planning Capacity	Installed Capacity	20 MW	Existing Plan	100 MW	Possible Additional Plan	220 MW
Rank of Development Priority	A		Developer		PERTAMINA	

Planned and Proposed Geothermal Development Schedule

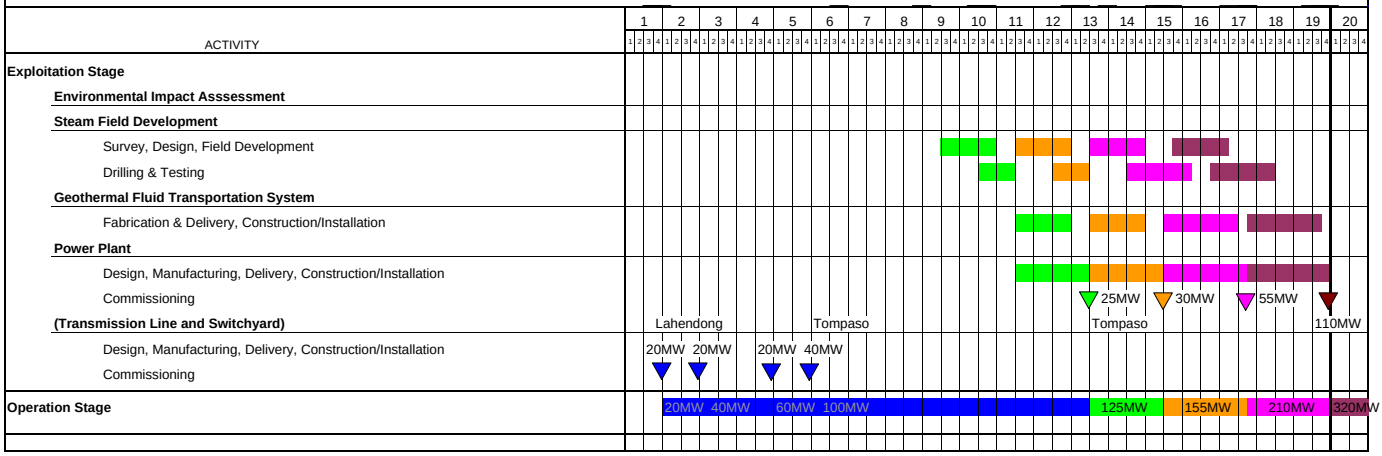
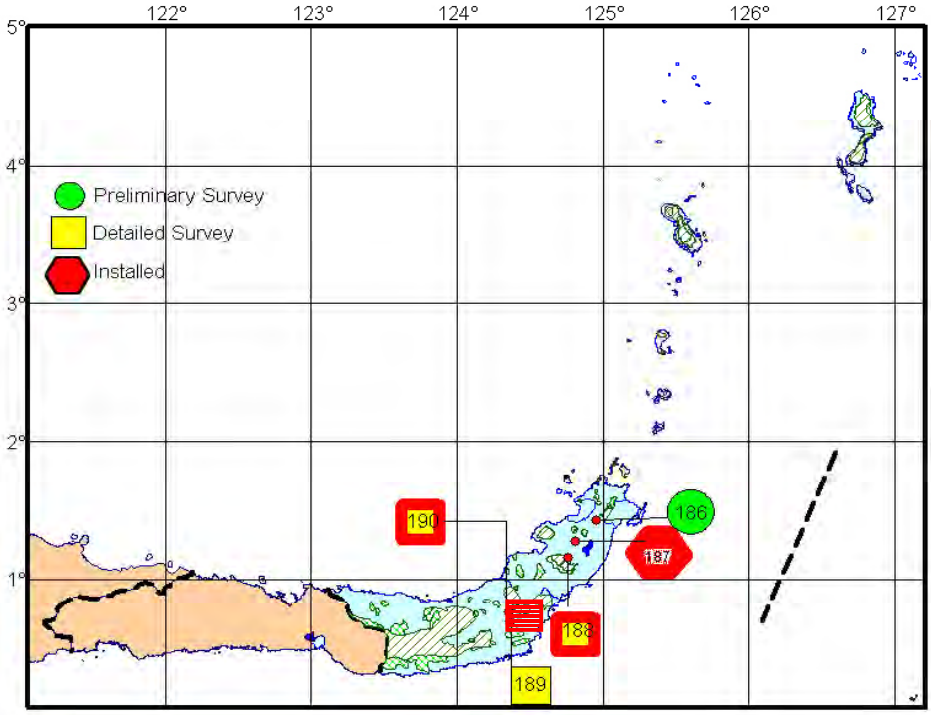


Table 7.1.9-2 Development Plan Sheet for Existing Project Field (No.62 KOTAMOBAGU)

No.62 KOTAMOBAGU	Region	Sulawesi	Province/ Location	North Sulawesi, South of G. Ambang

Field Information and Evaluation



Power Output Potential	Resource Potential	220 MW	Restricted by National Park	160 MW	Restricted by Power Demand	140 MW
Installed and planning Capacity	Installed Capacity	0 MW	Existing Plan	40 MW	Possible Additional Plan	100 MW
Rank of Development Priority	A		Developer		PERTAMINA	

Planned and Proposed Geothermal Development Schedule

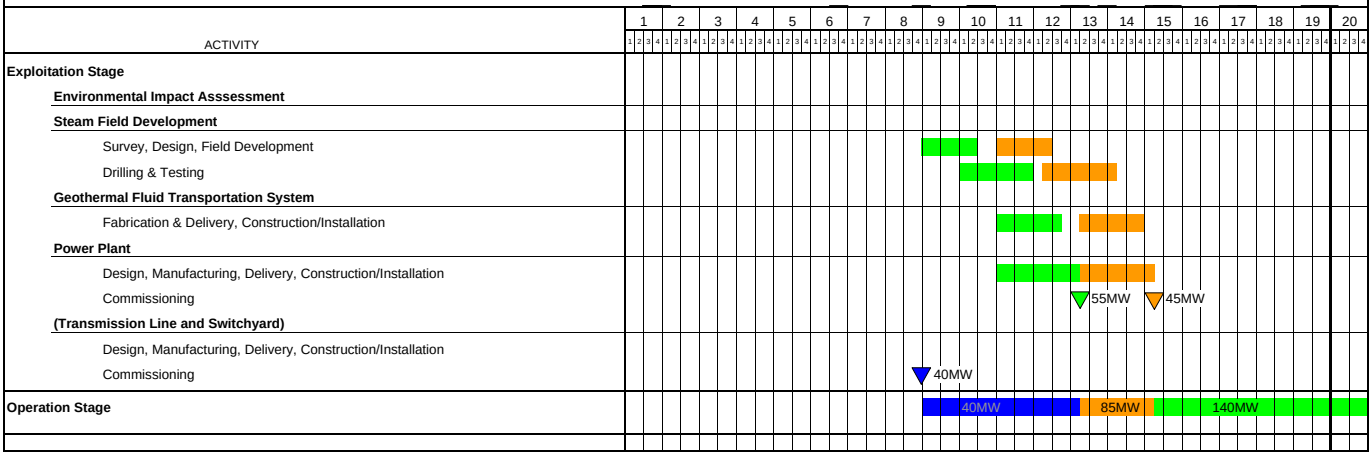
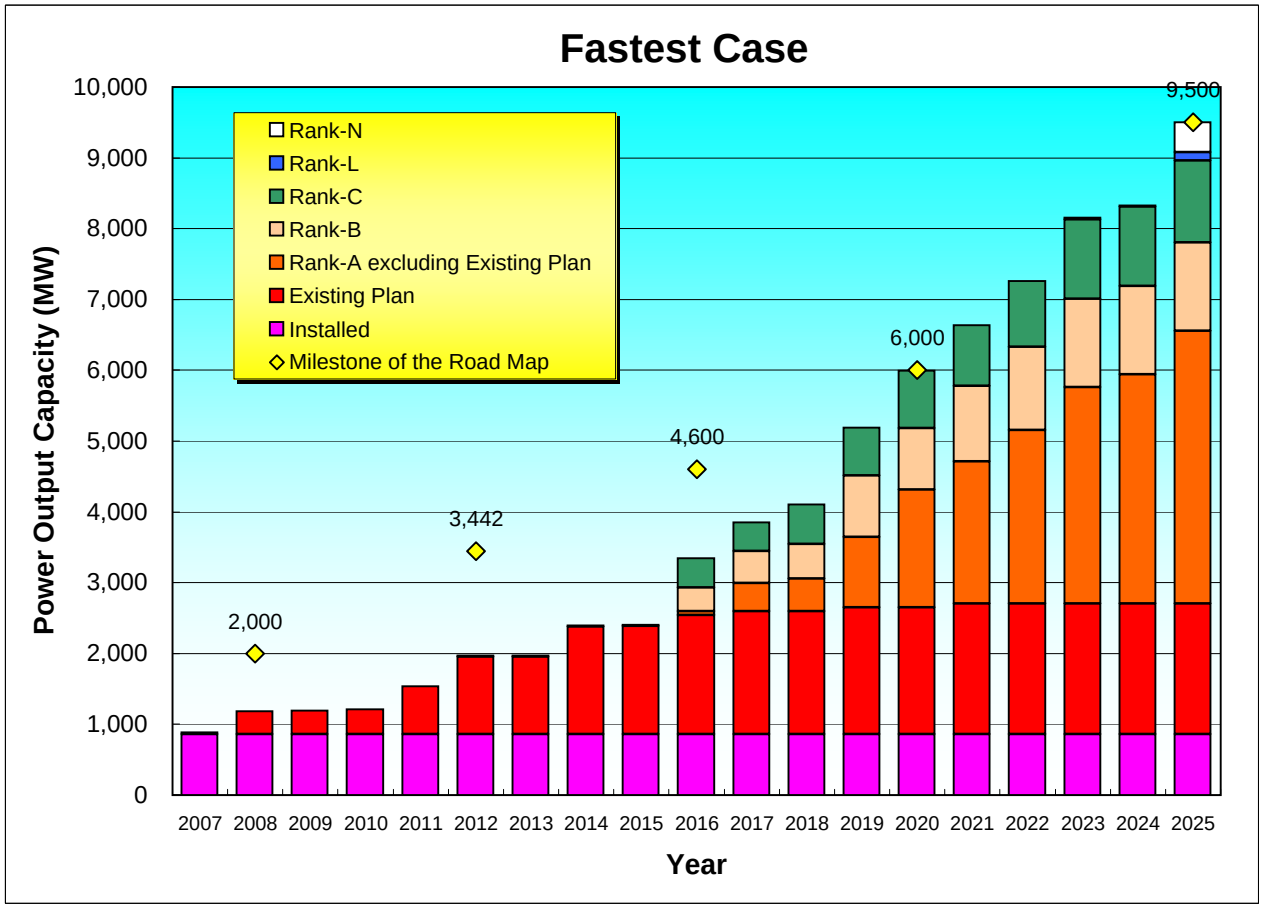


Table 7.1.9-3 Basic Duration for Implementation in Geothermal Power Development Schedule

ACTIVITY	Specification	Duration
Preliminary Survey Stage		
Request for WKP from Local Gov.	-	
Preliminary Study	Surface Study	12months
Geological Study	geology, Hydroaltaration	
Geochemical Study	water, gas chemical analysis	
Geophysical Study	MT,TDEM	
Integrated Analysis	Geothermal Structure Model	
Tendering	-	12months
Exploration Stage		
Exploratory Well Test Study		
Field Development	access roads, civil works, 3pads	2months/pad
Exploratory Well Drilling	3 wells (standard size, 2500m)	4months/well
Well Testing	logging, production test	6months
Reservoir Simulation	3D numerical model simulation	3months/field
Resource Assessment		3months/field
Exploitation Stage		
Environmental Impact Assessment	ANDAL, RKL, RPL	12months/field
Steam Field Development		
Survey, Design		6months/field
Field Development	access roads, civil works	6months advanced drilling
Drilling & Testing (basically, start in 1 month later of the beginning of Survey, Design Field Development)	1000m well (standard size) 1500m well (standard size) 2000m well (standard size) 2500m well (standard size) logging, production test	1.5months/well 1.5months/well 2months/well 2.5months/well 3months/well
Geothermal Fluid Transportation System		
Fabrication & Delivery, Construction/Installation (basically, start in 1 month later of the beginning of Drilling)	10MW 20MW 30MW 40MW 45MW 55MW 60MW 70MW 75MW 80MW 110MW	18months/unit 18months/unit 18months/unit 20months/unit 20months/unit 20months/unit 20months/unit 20months/unit 22months/unit 22months/unit 24months/unit
Power Plant		
Design, Manufacturing, Delivery, Construction/Installation (basically, start in 1 month later of the beginning of Drilling)	10MW 20MW 30MW 40MW 45MW 55MW 60MW 70MW 75MW 80MW 110MW	24months/unit 24months/unit 24months/unit 24months/unit 24months/unit 26months/unit 26months/unit 26months/unit 28months/unit 28months/unit 30months/unit
(Transmission Line and Switchyard)		
Design, Manufacturing, Delivery, Construction/Installation		



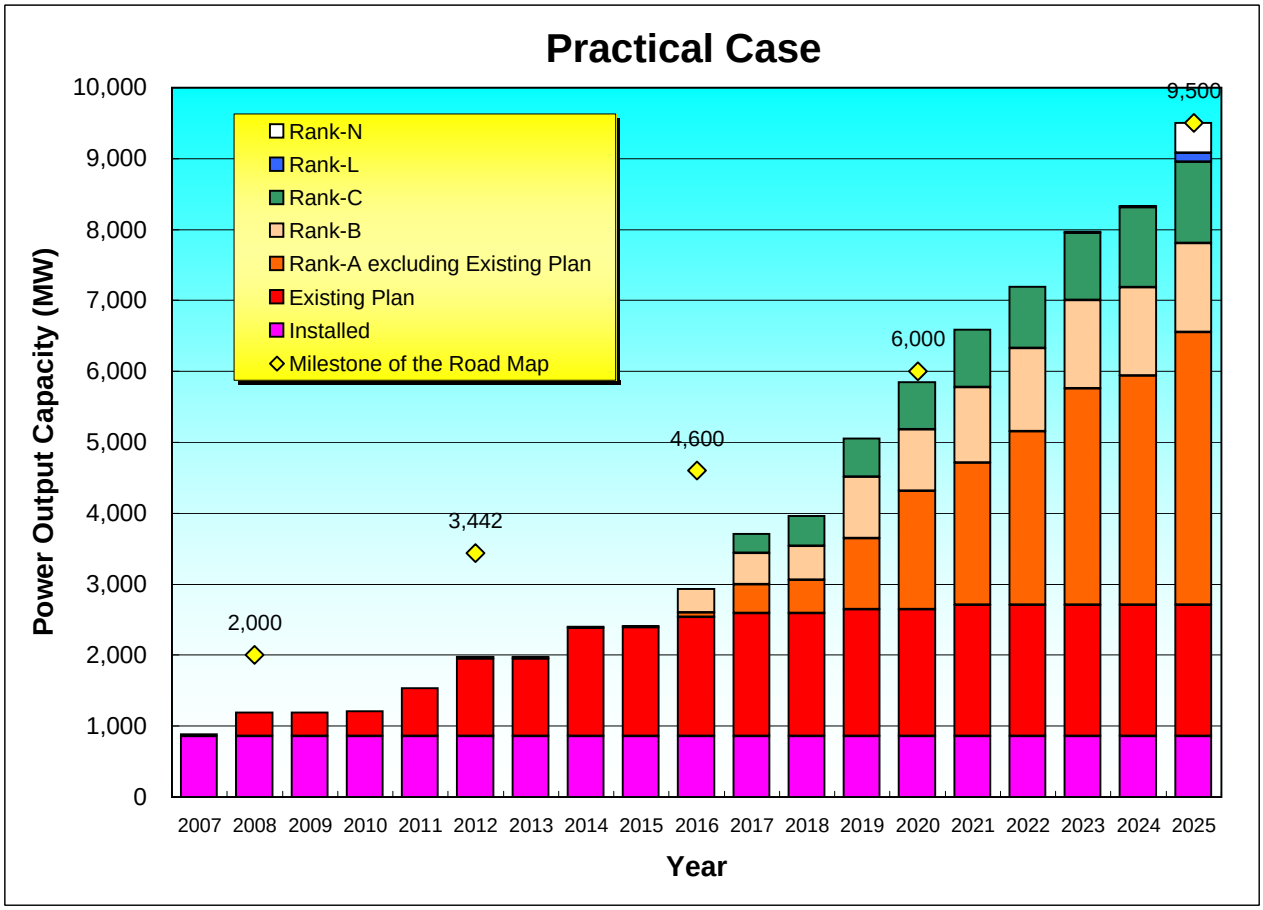


Fig. 7.1.10-1 Histogram for Geothermal Development Master Plan

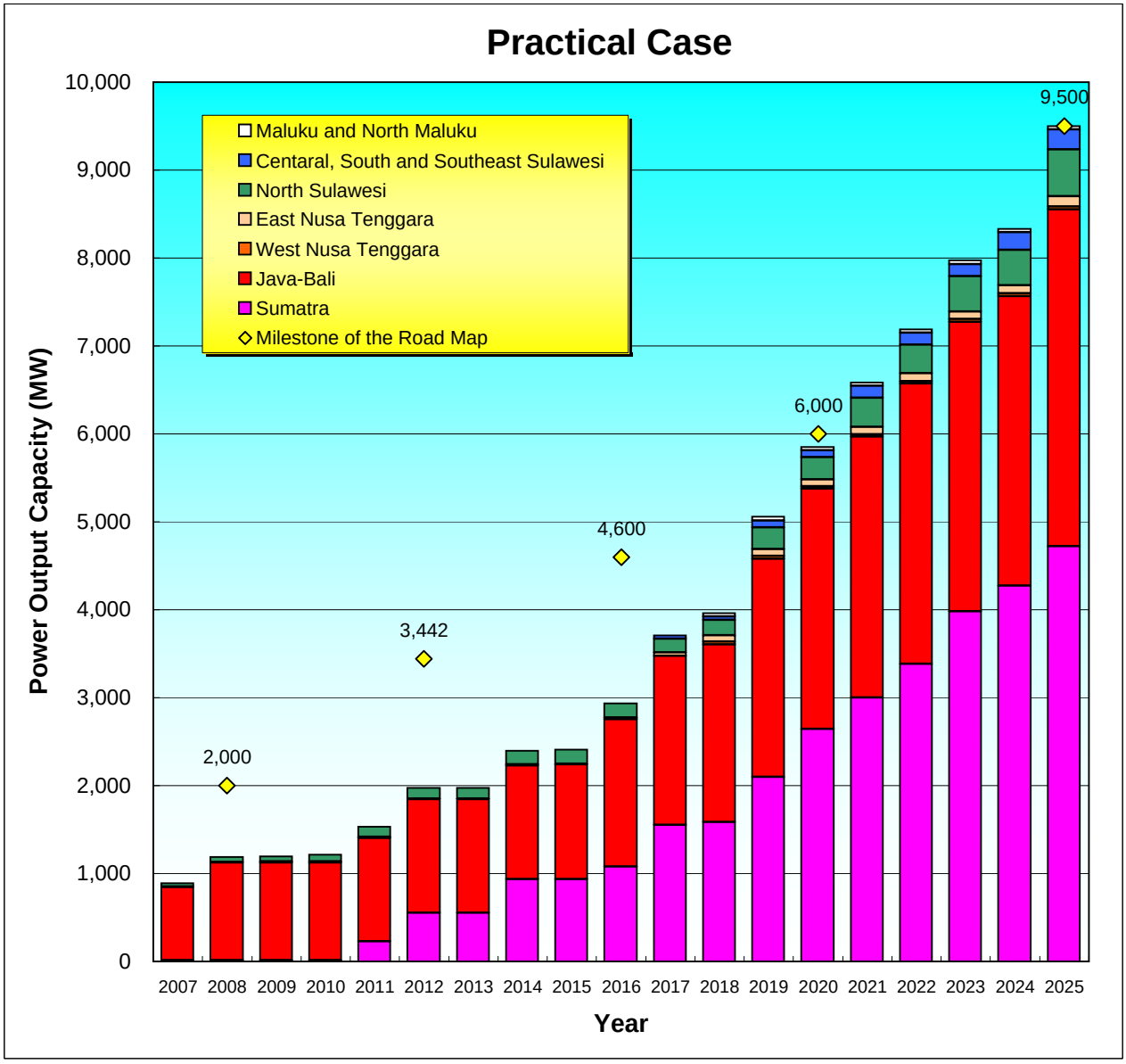
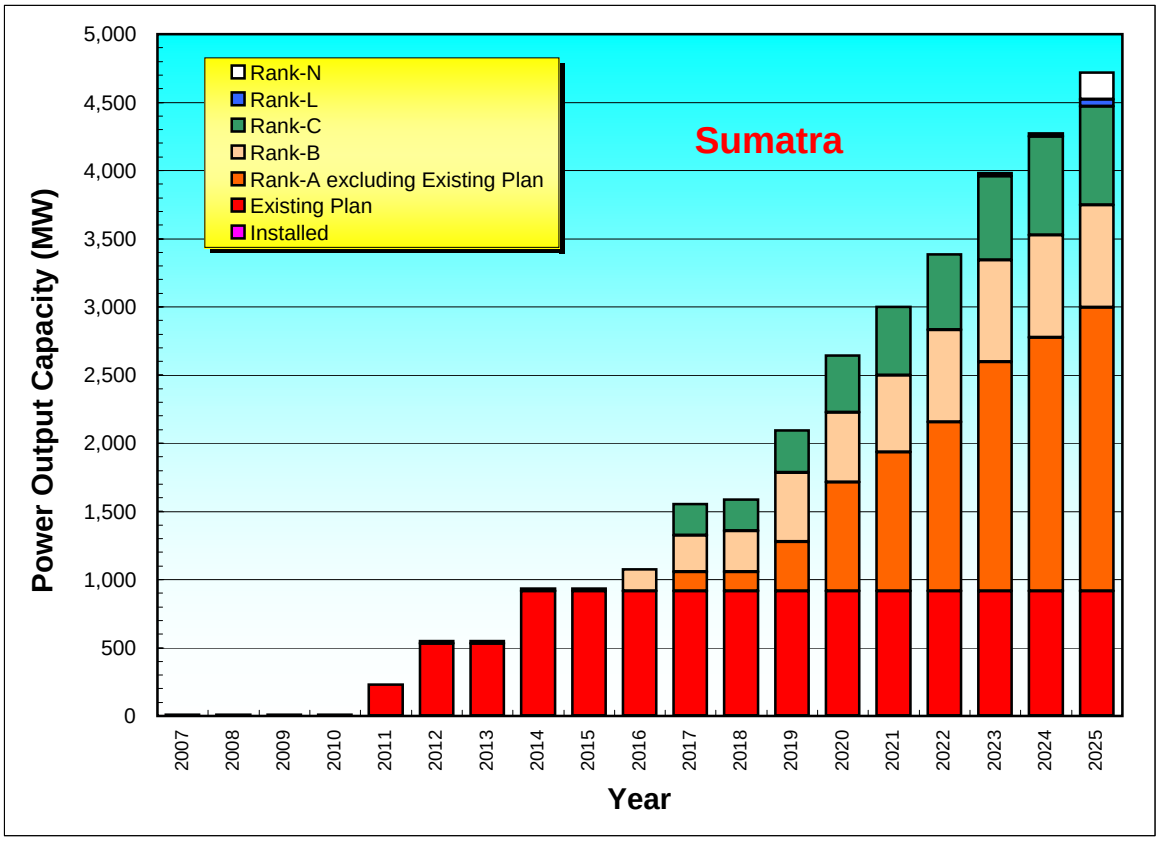


Fig. 7.1.10-2 Histogram for Development Capacity in Each Region



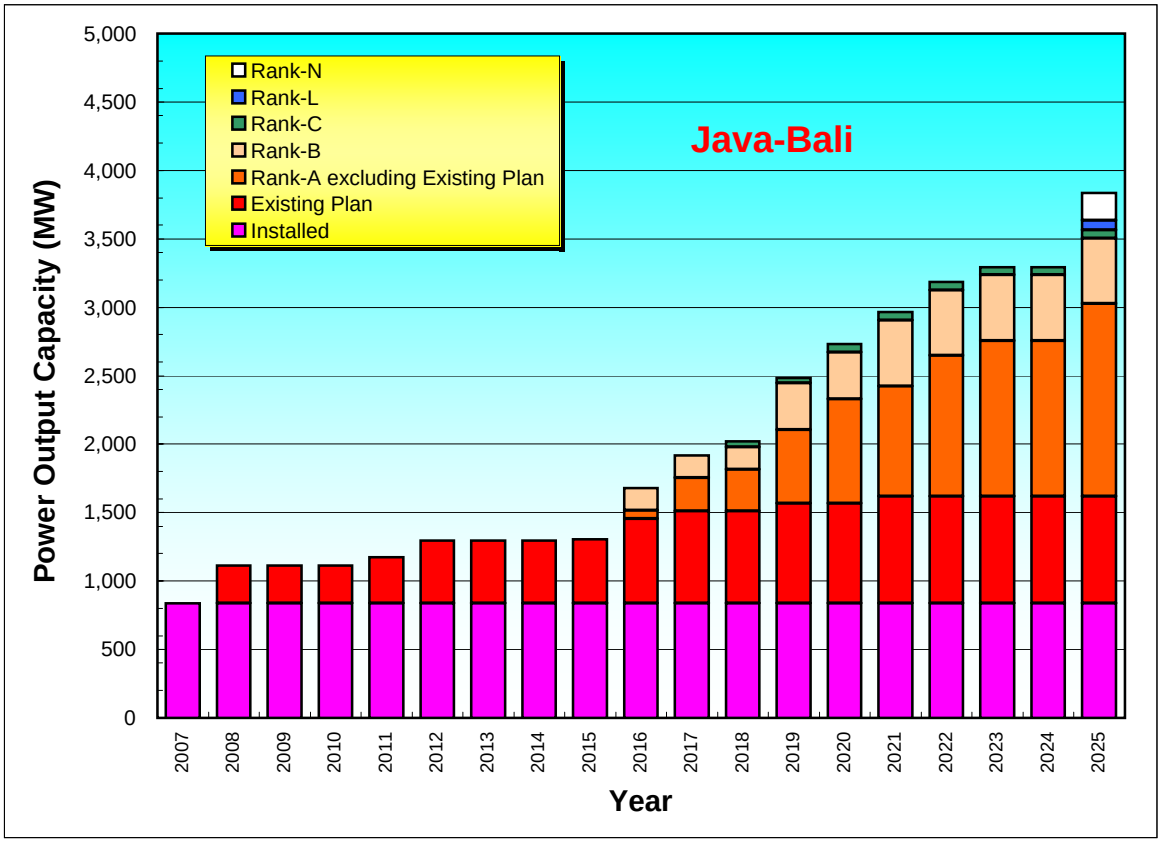


Fig. 7.1.10-3 Histogram for Development Capacity in Each Region
(Practical Case: Sumatra and Java-Bali)

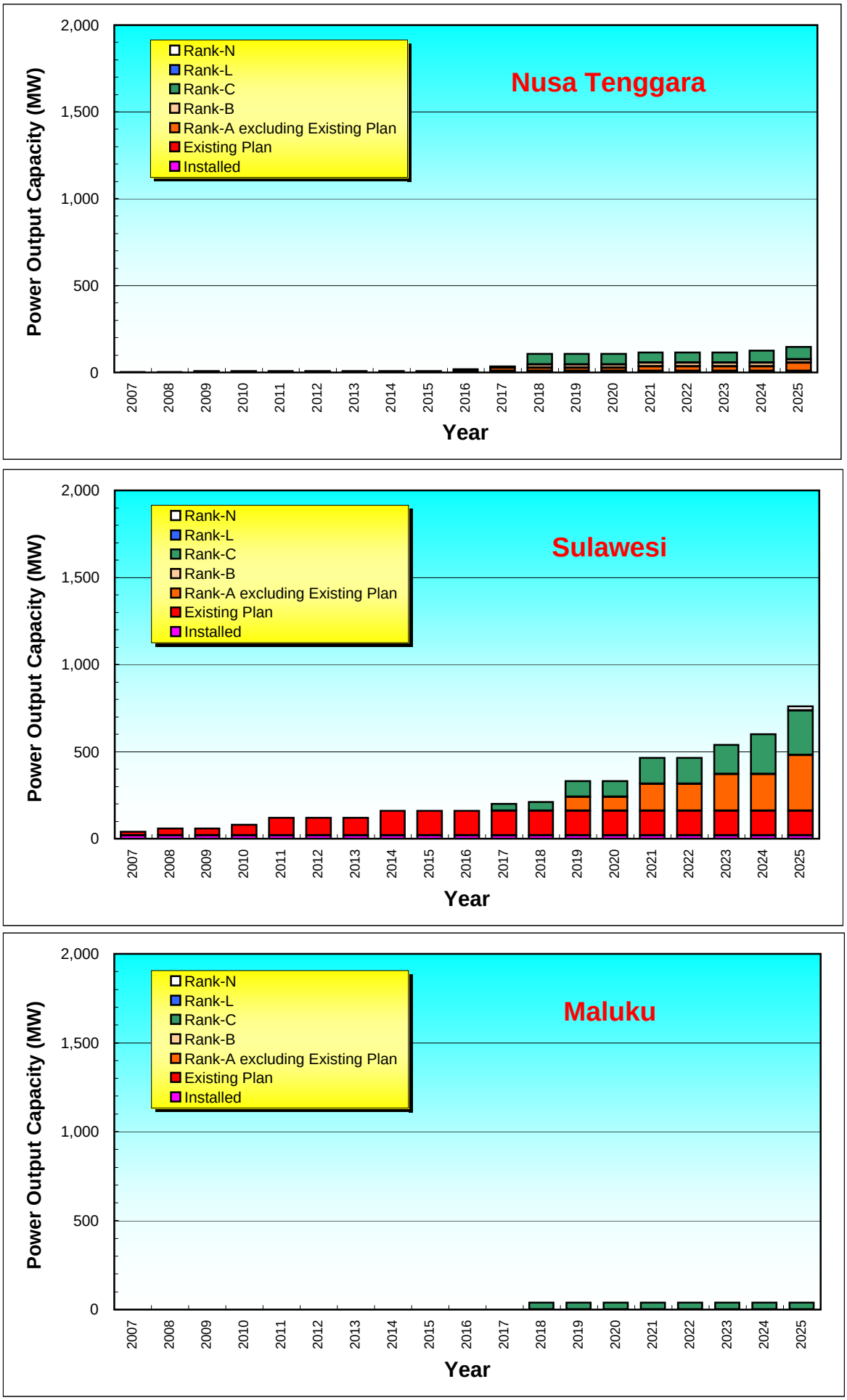


Fig. 7.1.10-3 Histogram for Development Capacity in Each Region
(Practical Case: Nusa Tenggara, Sulawesi and Maluku)

Table 7.1.10-1 Geothermal Development Master Plan (Fastest Case)

Region	No	Field name	Development Rank	Existing	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total (MW)
N.Sumatra	8	SARULA	A							300					110			110			110			630
N.Sumatra	9	SIBUAL BUALI	A																					
Lampung	27	ULUBELU	A						110			110					110			110				440
W.Java	32	KAMOJANG	A	140		60			60					60										320
W.Java	33	G. SALAK	A	380												60		60						500
W.Java	34	DARAJAT	A	145		110									75									330
W.Java	36	G. PATUHA	A							60				60			110			110			160	500
W.Java	37	G. WAYANG - WINDU	A	110		110									110		70							400
W.Java	38	G. KARAHA	A											30				55			110		110	305
W.Java	39	G. TELAGABODAS	A														55		40					95
C.Java	44	DIENG	A	60						60				60				110		110				400
N.Sulawesi	61	LAHENDONG	A	20	20	20		20	40								25		30		55		110	340
N.Sulawesi	63	TOMPASO	A																					
Bali	52	BEDUGUL	A										10		55		55		55					175
N.Sumatra	7	LAU DEBUK-DEBUK / SIBAYAK	A	2	8										30									40
E.Nusa Tenggara	55	ULUMBU	A				6								10				10				10	36
E.Nusa Tenggara	56	BENA - MATALOKO	A		2.5										8								10	20
Jambi	17	SUNGAI PENUH	A									55						110			110		80	355
S.Sumatra	25	LUMUT BALAI	A						110			110					110			110		180		620
Bengkulu	21	B. GEDUNG HULU LAIS	A									110						220			220		60	610
Bengkulu	22	TAMBANG SAWAH	A																220				80	300
N.Sulawesi	62	KOTAMOBAGU	A									40					55		45					140
Jambi	15	LEMPUR / KERINCI	B			T				20														20
W.Sumatra	13	MUARALABUH	B				T							55			55		55		75			240
Lampung	28	SUOH ANTATAI	B				T								110		110			110				330
W.Java	35	CISOLOK - CISUKARAME	B				T							55			55		70					180
C.Java	47	UNGARAN	B				T							55			55		70					180
Lampung	29	G. SEKINCAU	B				T							30		30								60
E.Java	50	WILIS / NGEBEL	B				T							55			65							120
N.Sumatra	10	S. MERAPI - SAMPURAGA	B				T							55			45							100
E.Nusa Tenggara	57	SOKORIA - MUTUBUSA	B				T							10		10								20
Aceh	3	SEULAWAH AGAM	C				T							55			55		55		110			275
Lampung	30	RAJABASA	C				T							40		40		40						120
Lampung	31	WAI RATAI	C				T							40		40		40						120
S.Sumatra	24	MARGA BAYUR	C				T							55			55			60				170
C.Sulawesi	65	MERANA	C				T							40		40		60			60			200
Golontaro	73	SUWAWA-GORONTALO	C									T				10					20		25	55
Aceh	1	IBOIH - JABOI	C				T							10										10
W.Sumatra	14	G. TALANG	C				T							30										30
W.Java	40	TANGKUBANPERAHU	C				T							20										20
E.Java	51	IJEN	C				T							20		20								40
W.Nusa Tenggara	53	HU'U DAHA	C				T							30										30
E.Nusa Tenggara	54	WAI SANO	C				T							10										10
E.Nusa Tenggara	58	OKA - LARANTUKA	C				T							10						10				20
E.Nusa Tenggara	60	ATADEI	C				T							10										10
Maluku	69	TULEHU	C				T							20										20
N.Maluku	70	JAILOLO	C				T							20										20
C.Java	46	TELOMOYO	L													T							50	50
N.Sumatra	71	SIPAHOLON-TARUTUNG	L											T							20		30	50
Banten	42	CITAMAN - G. KARANG	L													T							20	20
Aceh	2	LHO PRIA LAOT	N																					
Aceh	4	G. GEUREUDONG	N																					
Aceh	5	G. KEMBAR	N																					
N.Sumatra	6	G. SINABUNG	N																					
N.Sumatra	11	PUSUK BUKIT - DANAU TOBA	N																					
N.Sumatra	12	SIMBOLON - SAMOSIR	N																					
Jambi	16	SUNGAI TENANG	N																					
Jambi	18	SUNGAI BETUNG	N																					
Jambi	19	AIR DIKIT	N																					
Jambi	20	G. KACA	N																					
Bengkulu	23	BUKIT DAUN	N													T							424	424
S.Sumatra	26	RANTAU DADAP - SEGAMIT	N																					
Banten	41	BATUKUWUNG	N																					
Banten	43	G. ENDUT	N																					
C.Java	45	MANGUNAN	N																					
C.Java	48	G. SLAMET	N																					
E.Java	49	G. ARJUNO - WELIRANG	N																					
E.Java	72	IYANG ARGOPURO	N																					
E.Nusa Tenggara	59	ILI LABALEKEN	N																					
C.Sulawesi	64	BORA	N																					
S.Sulawesi	66	BITUANG	N																					
S.Sulawesi	67	LAINEA	N																					
N.Maluku	68	TONGA WAYANA	N																					
		TOTAL (MW)		857	31	300	6	20	320	440	0	425	10	935	508	250	1,085	805	650	620	890	180	1,169	9,500
		Cumulative Capacity (MW)		857	888	1,188	1,194	1,214	1,534	1,974	1,974	2,399	2,409	3,344	3,851	4,101	5,186	5,991	6,641	7,261	8,151	8,331	9,500	9,500
		Total of Minimum Demand (MW)			8,433	8,974	9,691	10,478	11,194	12,095	13,040	13,996	15,135	16,140	17,358	18,631	19,975	21,335	22,568	24,135	25,803	27,584	29,486	
		Milestone of the Road Map (MW)				2,000				3,442				4,600				6,000					9,500	
		Shortage (MW)				813				1,469				1,257				9					0	

Red Font : exisiting geothermal development plan

Preliminary Study (Surface Survey by Government) | T Tendering | Exploration Stage | Exploitation Stage | Blue Font: Existing Working Area of PERTAMINA

Table 7.1.10-2 Geothermal Development Master Plan (Practical Case)

Region	No	Field name	Development Rank	Existing	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total (MW)
N.Sumatra	8	SARULA	A							300					110			110			110			630
N.Sumatra	9	SIBUAL BUALI	A																					
Lampung	27	ULUBELU	A						110			110					110			110				440
W.Java	32	KAMOJANG	A	140		60			60					60										320
W.Java	33	G. SALAK	A	380												60		60						500
W.Java	34	DARAJAT	A	145		110									75									330
W.Java	36	G. PATUHA	A							60				60			110			110			160	500
W.Java	37	G. WAYANG - WINDU	A	110		110									110		70							400
W.Java	38	G. KARAHA	A											30				55			110		110	305
W.Java	39	G. TELAGABODAS	A														55		40					95
C.Java	44	DIENG	A	60						60				60				110		110				400
N.Sulawesi	61	LAHENDONG	A	20	20	20		20	40								25		30		55		110	340
N.Sulawesi	63	TOMPASO	A																					
Bali	52	BEDUGUL	A										10		55		55		55					175
N.Sumatra	7	LAU DEBUK-DEBUK / SIBAYAK	A	2	8										30									40
E.Nusa Tenggara	55	ULUMBU	A				6								10				10				10	36
E.Nusa Tenggara	56	BENA - MATALOKO	A		2.5										8								10	20
Jambi	17	SUNGAI PENUH	A									55						110			110		80	355
S.Sumatra	25	LUMUT BALAI	A						110			110					110			110		180		620
Bengkulu	21	B. GEDUNG HULU LAIS	A									110						220			220		60	610
Bengkulu	22	TAMBANG SAWAH	A																220				80	300
N.Sulawesi	62	KOTAMOBAGU	A									40					55		45					140
Jambi	15	LEMPUR / KERINCI	B			T				20														20
W.Sumatra	13	MUARALABUH	B				T							55			55		55		75			240
Lampung	28	SUOH ANTATAI	B				T								110		110			110				330
W.Java	35	CISOLOK - CISUKARAME	B				T							55			55		70					180
C.Java	47	UNGARAN	B				T							55			55		70					180
Lampung	29	G. SEKINCAU	B				T							30		30								60
E.Java	50	WILIS / NGEBEL	B				T							55			65							120
N.Sumatra	10	S. MERAPI - SAMPURAGA	B				T							55			45							100
E.Nusa Tenggara	57	SOKORIA - MUTUBUSA	B				T							10		10								20
Aceh	3	SEULAWAH AGAM	C					T							55			55		55		110		275
Lampung	30	RAJABASA	C					T							40		40		40					120
Lampung	31	WAI RATAI	C					T							40		40		40					120
S.Sumatra	24	MARGA BAYUR	C					T							55			55			60			170
C.Sulawesi	65	MERANA	C					T							40		40		60			60		200
Golontaro	73	SUWAWA-GORONTALO	C									T				10					20		25	55
Aceh	1	IBOIH - JABOI	C					T							10									10
W.Sumatra	14	G. TALANG	C					T							30									30
W.Java	40	TANGKUBANPERAHU	C						T							20								20
E.Java	51	IJEN	C						T							20		20						40
W.Nusa Tenggara	53	HU'U DAHA	C						T							30								30
E.Nusa Tenggara	54	WAI SANO	C						T							10								10
E.Nusa Tenggara	58	OKA - LARANTUKA	C						T							10						10		20
E.Nusa Tenggara	60	ATADEI	C						T							10								10
Maluku	69	TULEHU	C						T							20								20
N.Maluku	70	JAILOLO	C						T							20								20
C.Java	46	TELOMOYO	L													T							50	50
N.Sumatra	71	SIPAHOLON-TARUTUNG	L											T							20		30	50
Banten	42	CITAMAN - G. KARANG	L													T							20	20
Aceh	2	LHO PRIA LAOT	N																					
Aceh	4	G. GEUREUDONG	N																					
Aceh	5	G. KEMBAR	N																					
N.Sumatra	6	G. SINABUNG	N																					
N.Sumatra	11	PUSUK BUKIT - DANAU TOBA	N																					
N.Sumatra	12	SIMBOLON - SAMOSIR	N																					
Jambi	16	SUNGAI TENANG	N																					
Jambi	18	SUNGAI BETUNG	N																					
Jambi	19	AIR DIKIT	N																					
Jambi	20	G. KACA	N																					
Bengkulu	23	BUKIT DAUN	N													T							424	424
S.Sumatra	26	RANTAU DADAP - SEGAMIT	N																					
Banten	41	BATUKUWUNG	N																					
Banten	43	G. ENDUT	N																					
C.Java	45	MANGUNAN	N																					
C.Java	48	G. SLAMET	N																					
E.Java	49	G. ARJUNO - WELIRANG	N																					
E.Java	72	IYANG ARGOPURO	N																					
E.Nusa Tenggara	59	ILI LABALEKEN	N																					
C.Sulawesi	64	BORA	N																					
S.Sulawesi	66	BITUANG	N																					
S.Sulawesi	67	LAINEA	N																					
N.Maluku	68	TONGA WAYANA	N																					
		TOTAL (MW)		857	31	300	6	20	320	440	0	425	10	525	778	250	1,095	795	735	605	780	360	1,169	9,500
		Cumulative Capacity (MW)		857	888	1,188	1,194	1,214	1,534	1,974	1,974	2,399	2,409	2,934	3,711	3,961	5,056	5,851	6,586	7,191	7,971	8,331	9,500	9,500
		Total of Minimum Demand (MW)			8,433	8,974	9,691	10,478	11,194	12,095	13,040	13,996	15,135	16,140	17,358	18,631	19,975	21,335	22,568	24,135	25,803	27,584	29,486	
		Milestone of the Road Map (MW)				2,000				3,442				4,600				6,000					9,500	
		Shortage (MW)				813				1,469				1,667				149					0	

Red Font : exisiting geothermal development plan

Preliminary Study (Surface Survey by Government) | T Tendering | Exploration Stage | Exploitation Stage | Blue Font Existing Working Area of PERTAMINA

Table 7.1.10-3 Geothermal Development Master Plan in Each Region (Practical Case; Sumatra and Java-Bali)

Sumatra

Region	No	Field name	Development Rank	Existing	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total(MW)
N.Sumatra	8	SARULA	A							300					110			110			110			630
N.Sumatra	9	SIBUAL BUALI	A																					
Lampung	27	ULUBELU	A						110			110					110			110				440
N.Sumatra	7	LAU DEBUK-DEBUK / SIBAYAK	A	2	8										30									40
Jambi	17	SUNGAI PENUH	A									55						110			110		80	355
S.Sumatra	25	LUMUT BALAI	A						110			110					110			110		180		620
Bengkulu	21	B. GEDUNG HULU LAIS	A									110						220			220		60	610
Bengkulu	22	TAMBANG SAWAH	A																220				80	300
Jambi	15	LEMPUR / KERINCI	B			T				20														20
W.Sumatra	13	MUARALABUH	B				T							55			55		55		75			240
Lampung	28	SUOH ANTATAI	B				T								110		110			110				330
Lampung	29	G. SEKINCAU	B				T							30		30								60
N.Sumatra	10	S. MERAPI - SAMPURAGA	B				T							55			45							100
Aceh	3	SEULAWAH AGAM	C					T							55			55		55		110		275
Lampung	30	RAJABASA	C					T							40		40		40					120
Lampung	31	WAI RATAI	C					T							40		40		40					120
S.Sumatra	24	MARGA BAYUR	C					T							55			55			60			170
Aceh	1	IBOIH - JABOI	C					T							10									10
W.Sumatra	14	G. TALANG	C					T							30									30
N.Sumatra	71	SIPAHOLON-TARUTUNG	L											T							20		30	50
Aceh	2	LHO PRIA LAOT	N																					
Aceh	4	G. GEUREUDONG	N																					
Aceh	5	G. KEMBAR	N																					
N.Sumatra	6	G. SINABUNG	N																					
N.Sumatra	11	PUSUK BUKIT - DANAU TOBA	N																					
N.Sumatra	12	SIMBOLON - SAMOSIR	N													T							200	200
Jambi	16	SUNGAI TENANG	N																					
Jambi	18	SUNGAI BETUNG	N																					
Jambi	19	AIR DIKIT	N																					
Jambi	20	G. KACA	N																					
Bengkulu	23	BUKIT DAUN	N																					
S.Sumatra	26	RANTAU DADAP - SEGAMIT	N																					
		TOTAL (MW)		2	8				220	320		385		140	480	30	510	550	355	385	595	290	450	
		Cumulative Capacity (MW)		2	10	10	10	10	230	550	550	935	935	1075	1555	1585	2095	2645	3000	3385	3980	4270	4720	4720
		Minimum Demand (MW)			1159.6	1234.4	1336	1425.6	3634.8	3754.8	3859.6	4002	4158.8	4318	4488.4	4662.4	4848	5005.2	5198.4	5418.8	5653.2	5903.6	6170.4	

Java-Bali

W.Java	32	KAMOJANG	A	140		60			60					60										320
W.Java	33	G. SALAK	A	380												60		60						500
W.Java	34	DARAJAT	A	145		110									75									330
W.Java	36	G. PATUHA	A							60				60			110			110			160	500
W.Java	37	G. WAYANG - WINDU	A	110		110									110		70							400
W.Java	38	G. KARAHA	A											30				55			110		110	305
W.Java	39	G. TELAGABODAS	A														55		40					95
C.Java	44	DIENG	A	60						60				60				110		110				400
Bali	52	BEDUGUL	A										10		55		55		55					175
W.Java	35	CISOLOK - CISUKARAME	B				T							55			55		70					180
C.Java	47	UNGARAN	B				T							55			55		70					180
E.Java	50	WILIS / NGEBEL	B				T							55			65							120
W.Java	40	TANGKUBANPERAHU	C						T							20								20
E.Java	51	IJEN	C						T							20		20						40
C.Java	46	TELOMOYO	L													T							50	50
Banten	42	CITAMAN - G. KARANG	L													T							20	20
Banten	41	BATUKUWUNG	N																					
Banten	43	G. ENDUT	N																					
C.Java	45	MANGUNAN	N													T							200	200
C.Java	48	G. SLAMET	N																					
E.Java	49	G. ARJUNO - WELIRANG	N																					
E.Java	72	IYANG ARGOPURO	N																					
		TOTAL (MW)		835		280			60	120			10	375	240	100	465	245	235	220	110		540	
		Cumulative Capacity (MW)		835	835	1115	1115	1115	1175	1295	1295	1295	1305	1680	1920	2020	2485	2730	2965	3185	3295	3295	3835	3835
		Minimum Demand (MW)			6803.2	7236	7810	8460.8	6925.2	7657.2	8444.8	9204.8	10130	10903.6	11882.8	12907.6	13986	15107.2	16054.4	17300.8	18626	20037.2	21542.8	

Red Font : exisiting geothermal development plan

Preliminary Study (Surface Survey by Government) | T Tendering | Exploration Stage | Exploitation Stage | Blue Font Existing Working Area of PERTAMINA

Table 7.1.10-3 Geothermal Development Master Plan in Each Region (Practical Case; Nusa Tenggara, Sulawesi and Maluku)

West Nusa Tenggara

W.Nusa Tenggara	53	HU'U DAHA	C						T							30								30
		TOTAL (MW)		0												30								
		Cumulative Capacity (MW)		0												30	30	30	30	30	30	30	30	30
		Minimum Demand (MW)			58.4	64.8	71.6	79.2	87.2	95.6	104.8	114	124	132.4	141.2	150.4	160.8	170.4	180.4	190.8	202	214	227.2	

East Nusa Tenggara

E.Nusa Tenggara	55	ULUMBU	A				6									10				10				10	36
E.Nusa Tenggara	56	BENA - MATALOKO	A		2.5											8								10	20
E.Nusa Tenggara	57	SOKORIA - MUTUBUSA	B				T								10		10								20
E.Nusa Tenggara	54	WAI SANO	C						T								10								10
E.Nusa Tenggara	58	OKA - LARANTUKA	C						T								10							10	20
E.Nusa Tenggara	60	ATADEI	C						T								10								10
E.Nusa Tenggara	59	ILI LABALEKEN	N																						
		TOTAL (MW)		0	3		6								10	18	40				10			10	20	
		Cumulative Capacity (MW)		0	3	3	9	9	9	9	9	9	9	19	36	76	76	76	86	86	86	96	116	116
		Minimum Demand (MW)			32.6	35.92	39.64	43.72	47.8	52.32	57.28	62.16	67.52	70.68	74.08	77.72	81.6	85.76	92.36	99.56	107.4	115.96	125.36	

North Sulawesi

N.Sulawesi	61	LAHENDONG	A	20	20	20		20	40								25		30		55		110	340
N.Sulawesi	63	TOMPASO	A																					
N.Sulawesi	62	KOTAMOBAGU	A									40					55		45					140
Golontaro	73	SUWAWA-GORONTALO	C									T				10					20		25	55
		TOTAL (MW)		20	20	20		20	40			40				10	80		75		75		135	
		Cumulative Capacity (MW)		20	40	60	60	80	120	120	120	160	160	160	160	170	250	250	325	325	400	400	535	535
		Minimum Demand (MW)			101.2	107.2	116	126	134.8	147.2	161.2	174	188	208	230.8	256	284	314.8	349.2	388	431.2	480	534.4	

Centaral, South and Southeast Sulawesi

C.Sulawesi	65	MERANA	C					T							40		40		60			60		200
C.Sulawesi	64	BORA	N																					
S.Sulawesi	66	BITUANG	N													T							24	24
SE.Sulawesi	67	LAINEA	N																					
		TOTAL (MW)		0											40		40		60			60	24	
		Cumulative Capacity (MW)		0											40	40	80	80	140	140	140	200	224	224
		Minimum Demand (MW)			252	268.8	289.6	312	332.8	354.8	378	402.4	428.4	466.4	497.2	530.4	565.2	599.2	636.8	676.8	719.2	764.4	812.4	

Maluku and North Maluku

Maluku	69	TULEHU	C						T							20								20
N.Maluku	70	JAILOLO	C						T							20								20
N.Maluku	68	TONGA WAYANA	N																					
		TOTAL (MW)		0												40								
		Cumulative Capacity (MW)		0		0	0	0	0	0	0	0	0	0	0	40	40	40	40	40	40	40	40	40
		Minimum Demand (MW)			25.6	26.8	28.4	30.4	31.6	33.2	34.8	36.4	38	40.8	43.6	46.4	49.6	52.8	56.4	60.4	64.4	68.8	73.6	

Red Font : exisiting geothermal development plan

TOTAL (MW)

TOTAL (MW)	857	31	300	6	20	320	440	0	425	10	525	778	250	1,095	795	735	605	780	360	1,169	9,500
Cumulative Capacity (MW)	857	888	1,188	1,194	1,214	1,534	1,974	1,974	2,399	2,409	2,934	3,711	3,961	5,056	5,851	6,586	7,191	7,971	8,331	9,500	9,500
Total of Minimum Demand (MW)		8,433	8,974	9,691	10,478	11,194	12,095	13,040	13,996	15,135	16,140	17,358	18,631	19,975	21,335	22,568	24,135	25,803	27,584	29,486	
Milestone of the Road Map (MW)			2,000				3,442				4,600				6,000					9,500	
Shortage (MW)			813				1,469				1,667				149					0	

Preliminary Study (Surface Survey by Government) | T Tendering | Exploration Stage | Exploitation Stage | Blue Font Existing Working Area of PERTAMINA

Table 7.1.10-4 Sammary of Geothermal Development Master Plan

Region	Development Rank	Number of Field	Installed Capacity (MW)	Development Plan by 2008 (MW)	Development Plan by 2012 (MW)	Development Plan by 2016 (MW)	Development Plan by 2020 (MW)	Development Plan by 2025 (MW)
Sumatra	A	8	2	10	530	915	1,715	2,995
	B	5	-	0	20	160	510	750
	C	6	-	0	0	0	420	725
	L	1	-	0	0	0	0	50
	N	12	-	0	0	0	0	200
	Total	**32**	**2**	**10**	**550**	**1,075**	**2,645**	**4,720**
Java-Bali	A	9	835	1,115	1,295	1,515	2,330	3,025
	B	3	-	0	0	165	340	480
	C	2	-	0	0	0	60	60
	L	2	-	0	0	0	0	70
	N	6	-	0	0	0	0	200
	Total	**22**	**835**	**1,115**	**1,295**	**1,680**	**2,730**	**3,835**
Nusa Tenggara	A	2	-	3	9	9	26	56
	B	1	-	0	0	10	20	20
	C	4	-	0	0	0	60	70
	N	1	-	0	0	0	0	0
	Total	**8**	**0**	**3**	**9**	**19**	**106**	**146**
Sulawesi	A	3	20	60	120	160	240	480
	C	2	-	0	0	0	90	255
	N	3	-	0	0	0	0	24
	Total	**8**	**20**	**60**	**120**	**160**	**330**	**759**
Maluku	C	2	-	0	0	0	40	40
	N	1	-	0	0	0	0	0
	Total	**3**	**0**	**0**	**0**	**0**	**40**	**40**
Total		**73**	**857**	**1,188**	**1,974**	**2,934**	**5,851**	**9,500**
The Road Map		-	857	2,000	3,442	4,600	6,000	9,500

(Practical Case)

Table 7.1.11-1 Power Plant Mix in 2025 by RUKN

Power Plant	MW	Existing (2004) (a) (*1)		New Plant (2005-2025) (b) (*2)		Total (as of 2025) (c) (*3)	
Hydro Power	MW	3,199	(14.6%)	2,666	(3.5%)	5,865	(6.3%)
Gas Turbine	MW	1,494	(6.8%)	6,235	(8.2%)	7,285	(7.8%)
Combined cycle	MW	6,561	(30.0%)	16,665	(21.9%)	21,756	(23.3%)
Steam	MW	6,900	(31.5%)	36,637	(48.1%)	41,982	(45.0%)
Geothermal	MW	807	(3.7%)	1,429	(1.9%)	2,286	(2.5%)
Diesel	MW	2,921	(13.4%)	583	(0.8%)	2,089	(2.2%)
Nuclear	MW	0	(0.0%)	12,000	(15.7%)	12,000	(12.9%)
Total	MW	21,882	(100.0%)	76,214	(100.0%)	93,263	(100.0%)

(Source) *1 from PLN Statistics 2004, Pertamina Geothermal Energy Boucher
*2 from RUKN (2005)
(Note) *3 (C) is not equall to (a)+(b) due to decommission of power plants.

Table 7.1.11-2 Energy Mix in Electricity Production in 2004 and 2025 by RUKN

Energy Source		Current (2005)		Plan (2025)	
Hydro	GWh	7,845	(6.4%)	20,556	(3.8%)
Gas	GWh	35,427	(29.1%)	146,978	(27.1%)
Coal	GWh	45,472	(37.3%)	278,383	(51.3%)
Geothemral	GWh	6,560	(5.4%)	20,323	(3.7%)
Oil	GWh	26,442	(21.7%)	37,606	(6.9%)
Nuclear	GWh	0	(0.0%)	38,752	(7.1%)
Total	GWh	121,746	(100.0%)	542,598	(100.0%)

(Source) RUKN (2005), Pertamina Geothermal Energy Broucher

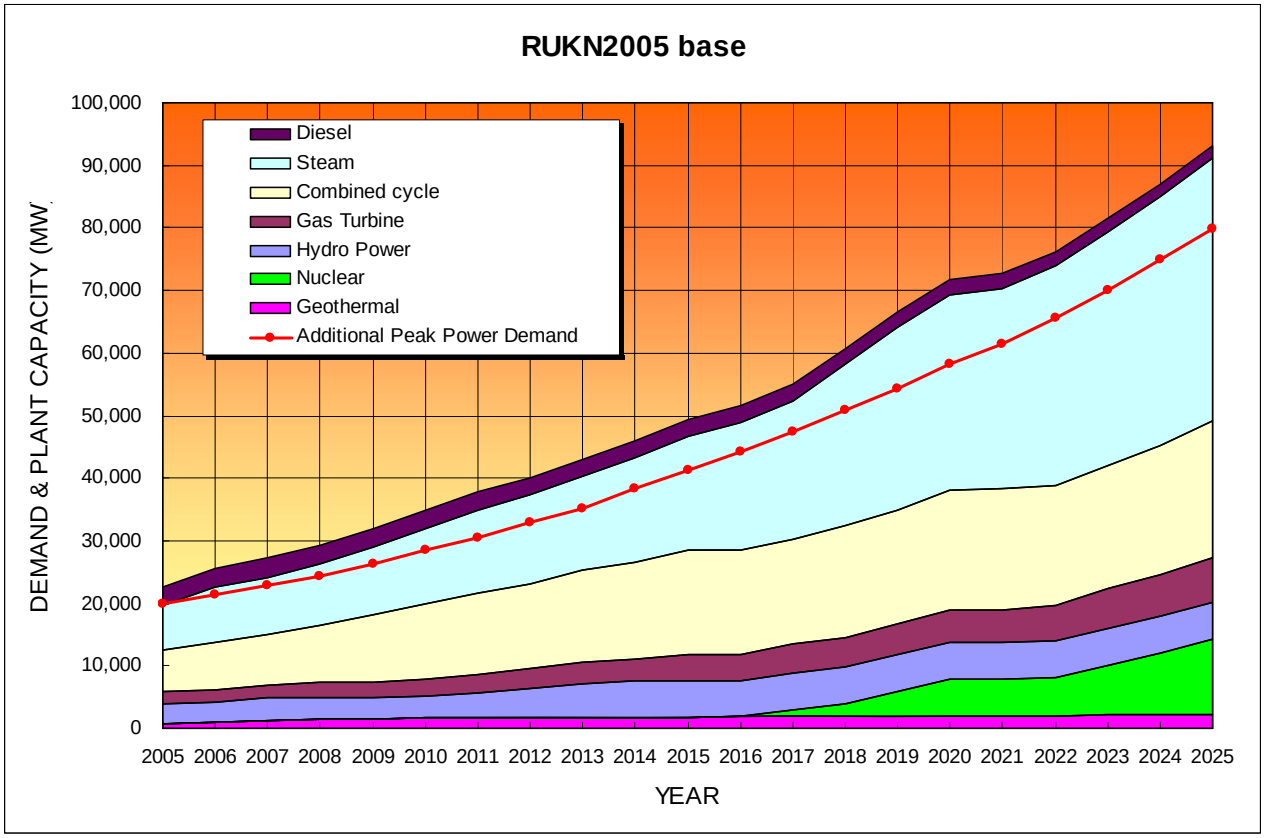


Fig. 7.1.11-1 Power Plant Development Plan by RUKN

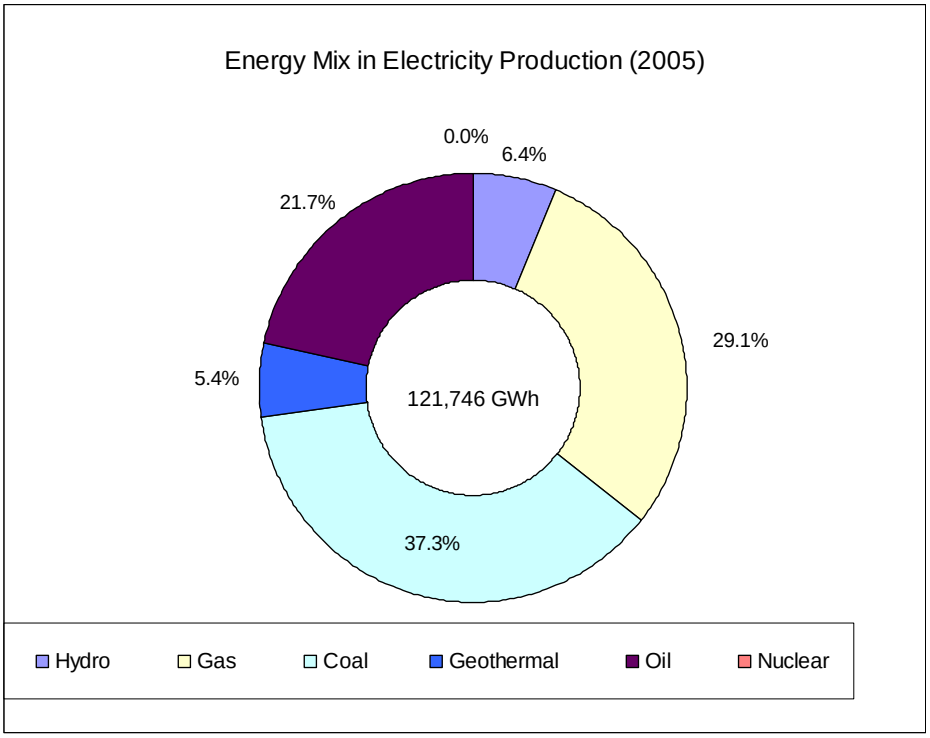


Fig. 7.1.11-2 Energy Mix in Electricity Production in 2004

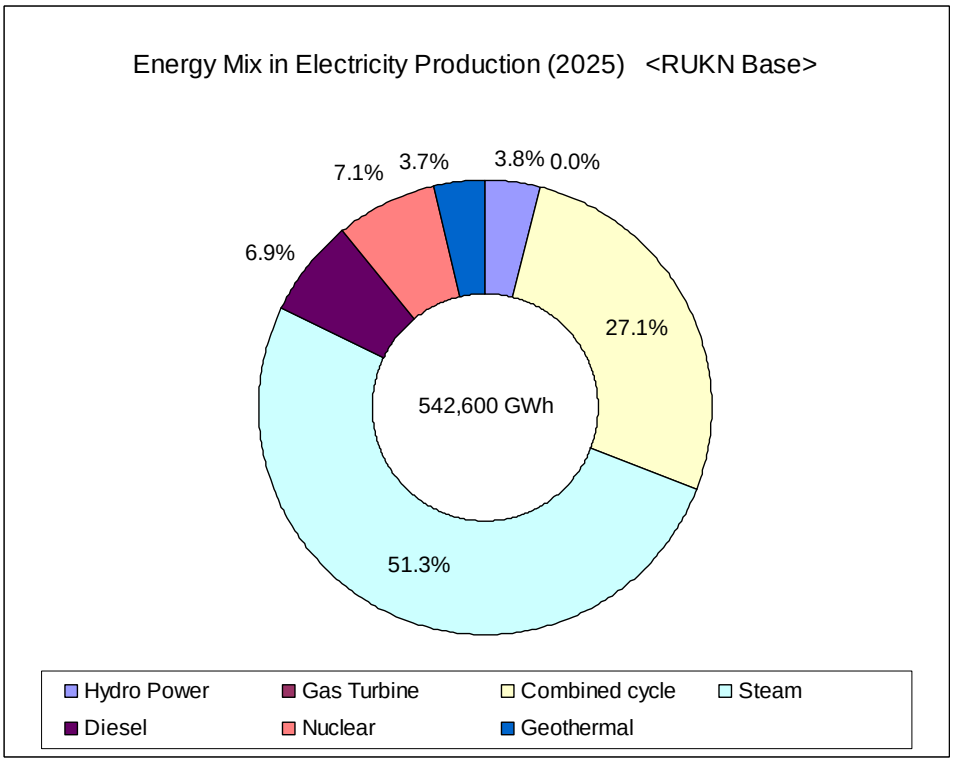


Fig. 7.1.11-3 Energy Mix in Electricity Production in 2025 by RUKN

Table 7.1.11-3 Model Power Plant Specification of various Energy Sources

Power Source	Plant Capacity (MW)	Initial Investment (m$)	Unit Cost ($/kW)	Construction Years (Yrs.)	Plant Factor (%)	Fuel Price ($/MMBTU)	Heat rate (%)	Remarks
Geothermal	55	136	2,500	5	85	-	-	
Coal	600	510	850	3	85	1.8 (35$/t)	38	include port, coal yard, ash disposal pond etc.
	50	79	1,580					
Natural Gas CC	600	300	500	3	85	8.6 (50$/B)	50	not include gas pipeline
	50	60	1,200					
Diesel	10	16	1,550	2	85	12.9 (50$/B)	38	
Hydropower	20	44	2,200	4	60	-	-	

(Note) Initial investment does not include Interest during Construction (IDC).

Table 7.1.11-4 Selling Price of Model Power Plant of various Energy Sources

(¢/kWh)

Power Plant	(MW)	Fixed Cost	Variable Cost	Total
Geothermal	55	7.0	0.0	7.0
Coal	600	3.0	1.8	4.8
	50	5.1	1.8	6.9
Gas CC	600	1.2	5.9	7.1
	50	3.6	5.9	9.5
Diesel	10	4.4	11.6	16.0
Hydro	20	9.1	0.0	9.1

1. Expected IRR is 15%.
2. VAT is 0% for geothermal case.
3. Plant factor is 85%. (60% for Hydro plant)
4. Fixed cost includes investment cost, interest, O&M cost and return on investment
5. Variable cost is fuel cost.

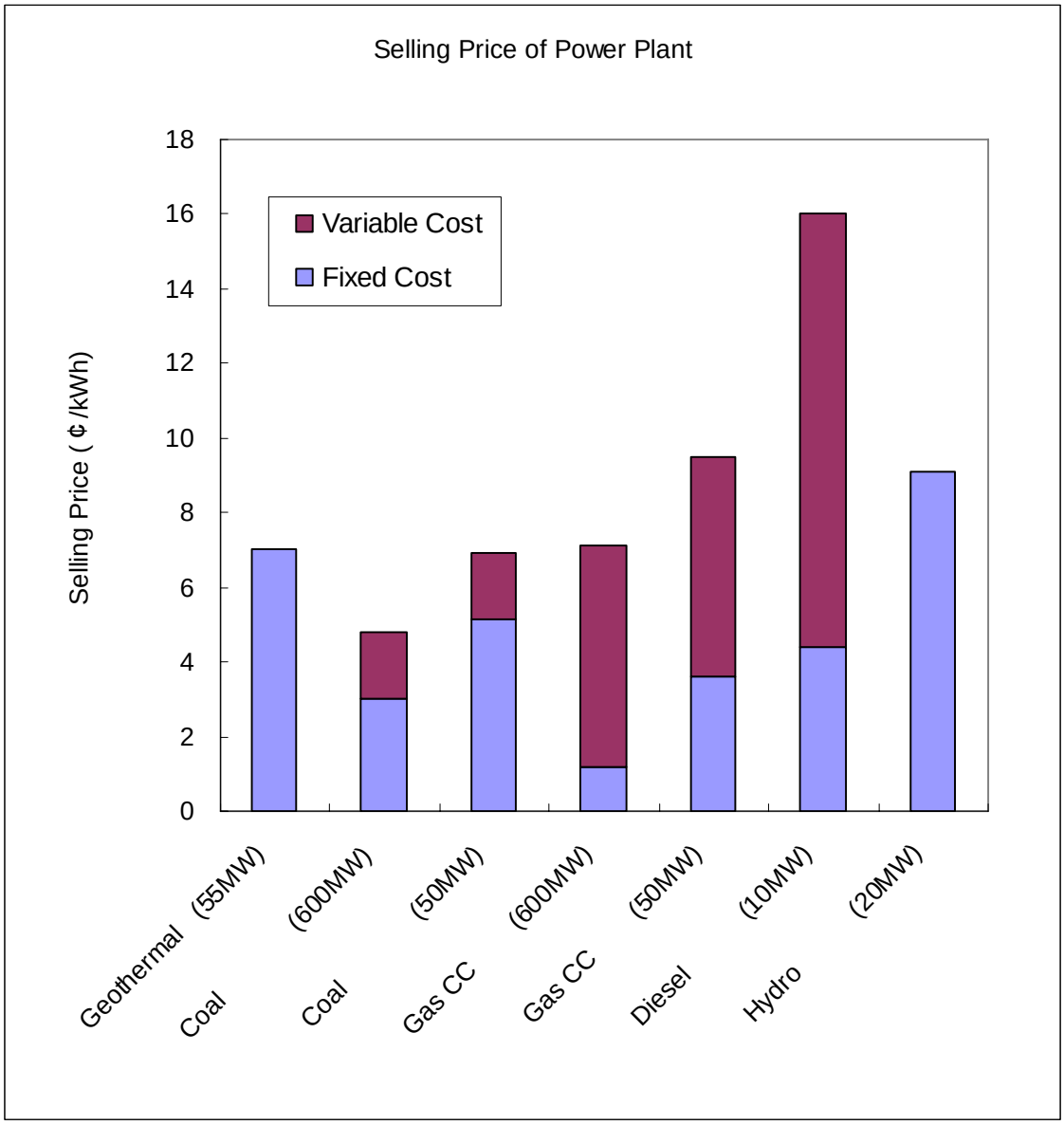


Fig. 7.1.11-4 Selling Price of Model Power Plant of various Energy Sources

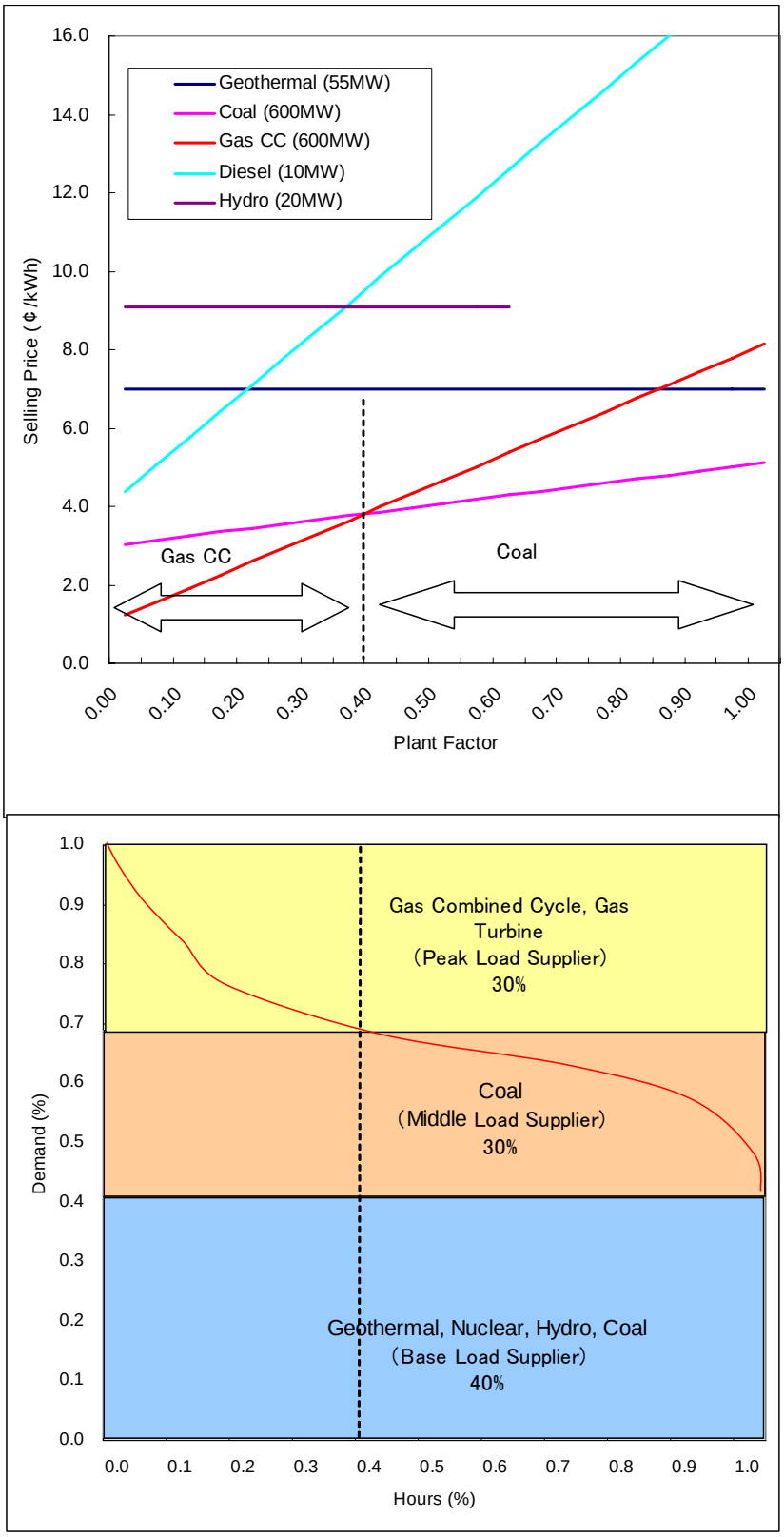


Fig. 7.1.11-5 The Role of Power Plant and Composition in Java-Bali System

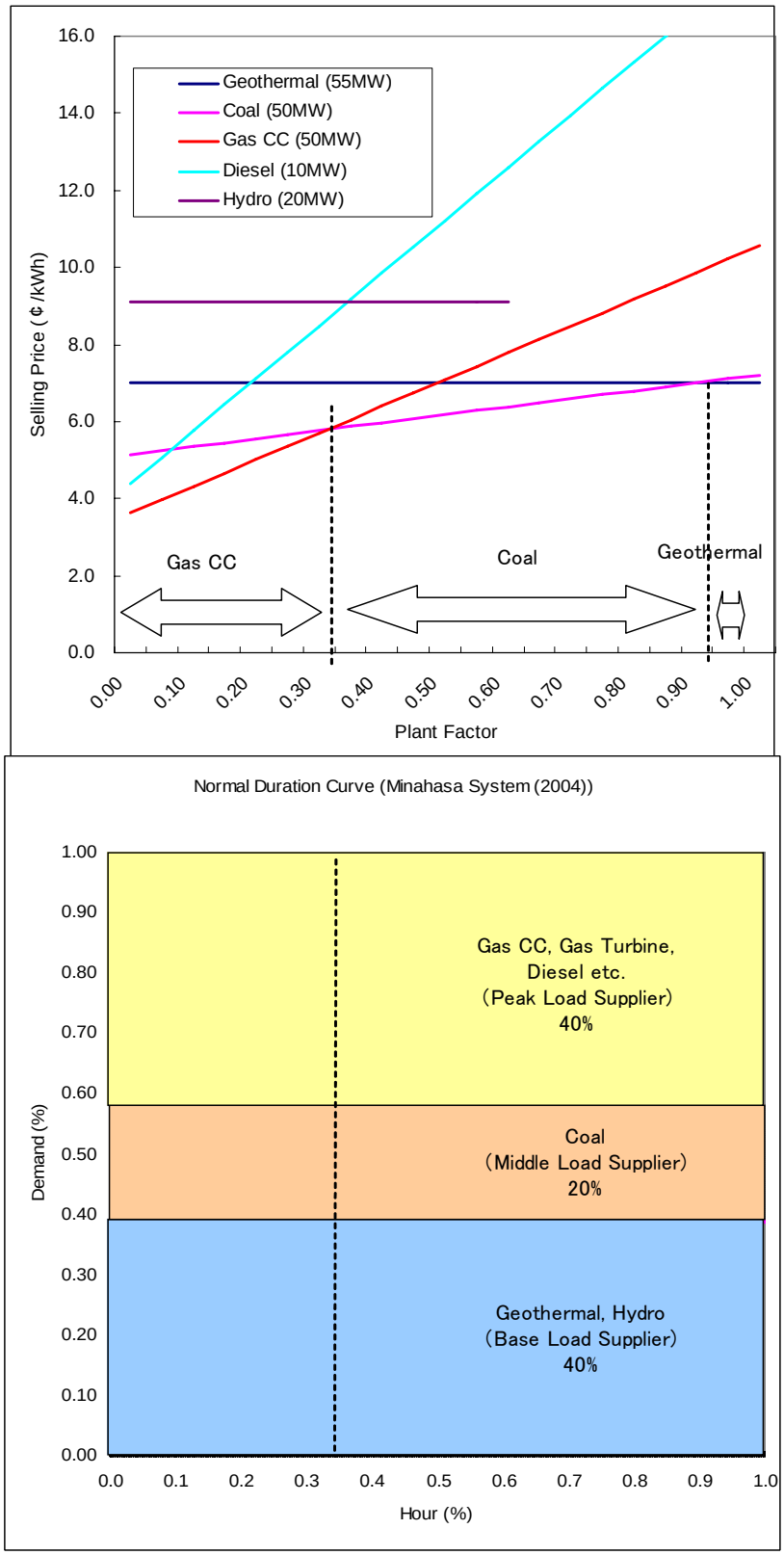


Fig. 7.1.11-6 The Role of Power Plant and Composition in Small-Scale System (Minahasa System Example)

Table 7.1.11-5 Power Plant Mix in Geothermal Development Scenario in Master Plan

(MW)

System	Existing (2004) (a) (*1)		New Plant (2005-2025) (b) (*2)		Total (as of 2025) (C) (*3)		RUKN (2025) (d)		Difference (c)-(d)
Sumetra									
Peak Demand	2,531		-		10,176		10,176		-
Minimum Demand	1,012		-		6,170		6,170		-
Power Plant	3,352	(100%)	10,357	(100%)	12,530	(100%)	12,530	(100%)	0
Hydro Power	566	(17%)	1,062	(10%)	1,628	(13%)	1,628	(13%)	0
Gas Turbine	377	(11%)	1,080	(10%)	1,297	(10%)	1,297	(10%)	0
Combined cycle	818	(24%)	900	(9%)	1,372	(11%)	1,372	(11%)	0
Steam	745	(22%)	2,597	(25%)	3,027	(24%)	7,195	(57%)	-4,168
Geothermal	2	(0%)	4,718	(46%)	4,720	(38%)	552	(4%)	4,168
Diesel	844	(25%)	0	(0%)	486	(4%)	486	(4%)	0
Nuclear	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0
Java-Bali									
Peak Demand	14,310		-		59,107		59,107		-
Minimum Demand	5,724		-		21,543		21,543		-
Power Plant	15,908	(100%)	54,555	(100%)	68,092	(100%)	68,092	(100%)	0
Hydro Power	2,409	(15%)	1,000	(2%)	3,409	(5%)	3,409	(5%)	0
Gas Turbine	927	(6%)	2,800	(5%)	3,550	(5%)	3,550	(5%)	0
Combined cycle	5,683	(36%)	14,015	(26%)	18,616	(27%)	18,616	(27%)	0
Steam	6,000	(38%)	23,740	(44%)	28,598	(42%)	28,938	(42%)	-340
Geothermal	785	(5%)	3,000	(5%)	3,835	(6%)	1,495	(2%)	2,340
Diesel	103	(1%)	0	(0%)	84	(0%)	84	(0%)	0
Nuclear	0	(0%)	10,000	(18%)	10000	(15%)	12000	(18%)	-2,000
Surawesi & Gorontalo									
Peak Demand	242		-		1,336		1,336		-
Minimum Demand	97		-		534		534		-
Power Plant	344	(100%)	1,540	(100%)	1,661	(100%)	1,661	(100%)	0
Hydro Power	61	(18%)	50	(3%)	111	(7%)	111	(7%)	0
Gas Turbine	0	(0%)	290	(19%)	290	(17%)	290	(17%)	0
Combined cycle	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0
Steam	0	(0%)	645	(42%)	645	(39%)	950	(57%)	-305
Geothermal	20	(6%)	515	(33%)	535	(32%)	230	(14%)	305
Diesel	263	(77%)	40	(3%)	80	(5%)	80	(5%)	0
Nuclear	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0
S_Sulawesi									
Peak Demand	490		-		2,031		2,031		-
Minimum Demand	196		-		812		812		-
Power Plant	464	(100%)	2,181	(100%)	2,399	(100%)	2,399	(100%)	0
Hydro Power	129	(28%)	370	(17%)	499	(21%)	499	(21%)	0
Gas Turbine	123	(26%)	465	(21%)	498	(21%)	498	(21%)	0
Combined cycle	0	(0%)	240	(11%)	240	(10%)	240	(10%)	0
Steam	25	(5%)	826	(38%)	833	(35%)	1,057	(44%)	-224
Geothermal	0	(0%)	224	(10%)	224	(9%)	0	(0%)	224
Diesel	187	(40%)	56	(3%)	106	(4%)	106	(4%)	0
Nuclear	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0
NTB									
Peak Demand	105		-		568		568		-
Minimum Demand	42		-		227		227		-
Power Plant	148	(100%)	585	(100%)	679	(100%)	679	(100%)	0
Hydro Power	0	(0%)	1	(0%)	1	(0%)	1	(0%)	0
Gas Turbine	0	(0%)	140	(24%)	140	(21%)	155	(23%)	-15
Combined cycle	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0
Steam	0	(0%)	367	(63%)	367	(54%)	367	(54%)	0
Geothermal	0	(0%)	30	(5%)	30	(4%)	0	(0%)	30
Diesel	147	(100%)	47	(8%)	140	(21%)	155	(23%)	-15
Nuclear	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0
NTT									
Peak Demand	62		-		313		313		-
Minimum Demand	25		-		125		125		-
Power Plant	128	(100%)	329	(100%)	374	(100%)	374	(100%)	0
Hydro Power	0	(0%)	12	(4%)	12	(3%)	12	(3%)	0
Gas Turbine	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0
Combined cycle	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0
Steam	0	(0%)	114	(35%)	114	(30%)	221	(59%)	-107
Geothermal	0	(0%)	116	(35%)	116	(31%)	9	(2%)	107
Diesel	128	(100%)	87	(26%)	132	(35%)	132	(35%)	0
Nuclear	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0
Maluku									
Peak Demand	78		-		184		184		-
Minimum Demand	31		-		74		74		-
Power Plant	170	(100%)	202	(100%)	258	(100%)	258	(100%)	0
Hydro Power	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0
Gas Turbine	0	(0%)	20	(10%)	20	(8%)	40	(16%)	-20
Combined cycle	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0
Steam	0	(0%)	92	(46%)	92	(36%)	92	(36%)	0
Geothermal	0	(0%)	40	(20%)	40	(16%)	0	(0%)	40
Diesel	170	(100%)	50	(25%)	106	(41%)	126	(49%)	-20
Nuclear	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0
Total									
Peak Demand	17,818		-		73,715		73,715		-
Minimum Demand	7,127		-		29,486		29,486		-
Power Plant	20,512	(100%)	69,749	(100%)	85,993	(100%)	85,993	(100%)	0
Hydro Power	3,166	(15%)	2,495	(4%)	5,661	(7%)	5,661	(7%)	0
Gas Turbine	1,427	(7%)	4,795	(7%)	5,796	(7%)	5,830	(7%)	-35
Combined cycle	6,501	(32%)	15,155	(22%)	20,228	(24%)	20,228	(24%)	0
Steam	6,770	(33%)	28,381	(41%)	33,675	(39%)	38,819	(45%)	-5,144
Geothermal	807	(4%)	8,643	(12%)	9,500	(11%)	2,286	(3%)	7,214
Diesel	1,841	(9%)	279	(0%)	1,133	(1%)	1,169	(1%)	-35
Nuclear	0	(0%)	10,000	(14%)	10,000	(12%)	12,000	(14%)	-2,000

(Note) *1 from PLN Statistics 2004, Pertamina Geothermal Energy Boucher
*2 Geothermal capacity is increased according to development plan.
Other power plant capacities are adjusted considering the role of plant type.
*3 (C) is not equall to (a)+(b) due to decommission of power plants.

Table 7.1.11-6 Power Plant Mix in Geothermal Development Scenario in Master Plan (2025)

Power Plant	MW	Existing (2004) (a) (*1)		New Plant (2005-2025) (b) (*2)		Total (as of 2025) (c) (*3)		RUKN (2025)		Difference
Hydro Power	MW	3,199	(14.6%)	2,666	(3.5%)	5,865	(6.3%)	5,865	(6.3%)	0
Gas Turbine	MW	1,494	(6.8%)	6,200	(8.1%)	7,251	(7.8%)	7,285	(7.8%)	-35
Combined cycle	MW	6,561	(30.0%)	16,665	(21.9%)	21,756	(23.3%)	21,756	(23.3%)	0
Steam	MW	6,900	(31.5%)	31,493	(41.3%)	36,838	(39.5%)	41,982	(45.0%)	-5,144
Geothermal	MW	807	(3.7%)	8,643	(11.3%)	9,500	(10.2%)	2,286	(2.5%)	7,214
Diesel	MW	2,921	(13.4%)	547	(0.7%)	2,054	(2.2%)	2,089	(2.2%)	-35
Nuclear	MW	0	(0.0%)	10,000	(13.1%)	10,000	(10.7%)	12,000	(12.9%)	-2,000
Total	MW	21,882	(100.0%)	76,214	(100.0%)	93,263	(100.0%)	93,263	(100.0%)	0

(Note) *1 from PLN Statistics 2004, Pertamina Geothermal Energy Boucher

*2 Geothermal capacity is increased according to development plan.
Other power plant capacities are adjusted considering the role of plant type.

*3 (C) is not equal to (a)+(b) due to decommission of power plants.

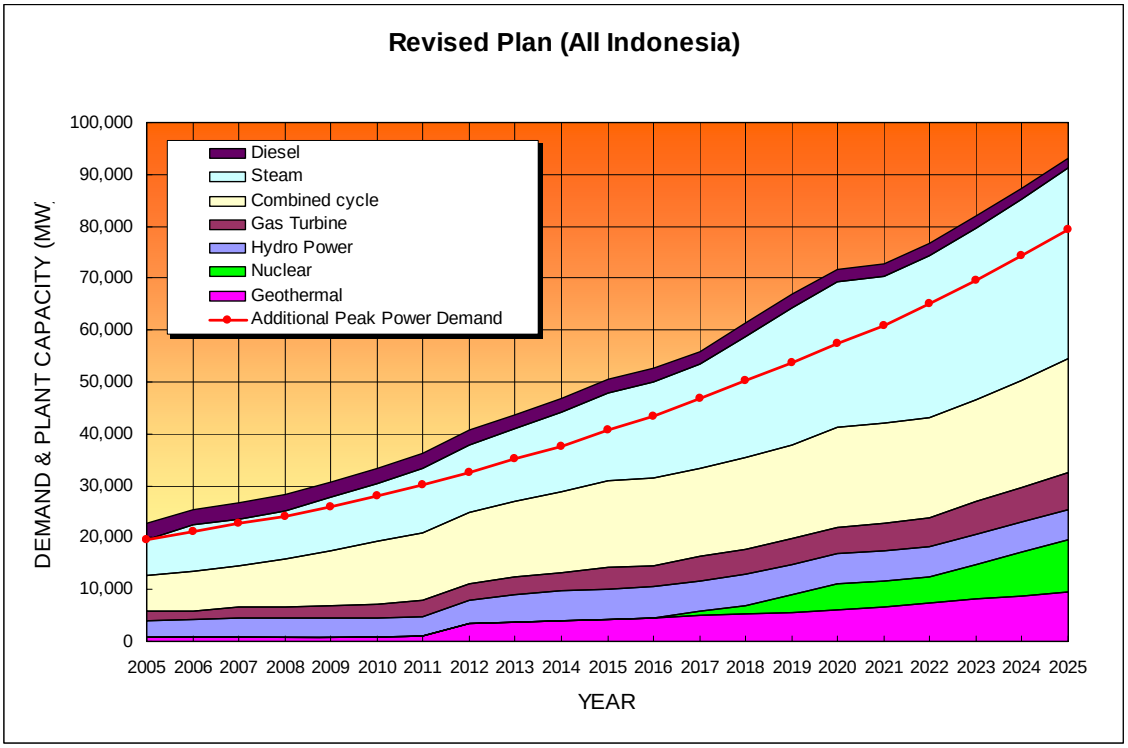


Fig. 7.1.11-7 Power Plant Development Plan by Geothermal Development Scenario

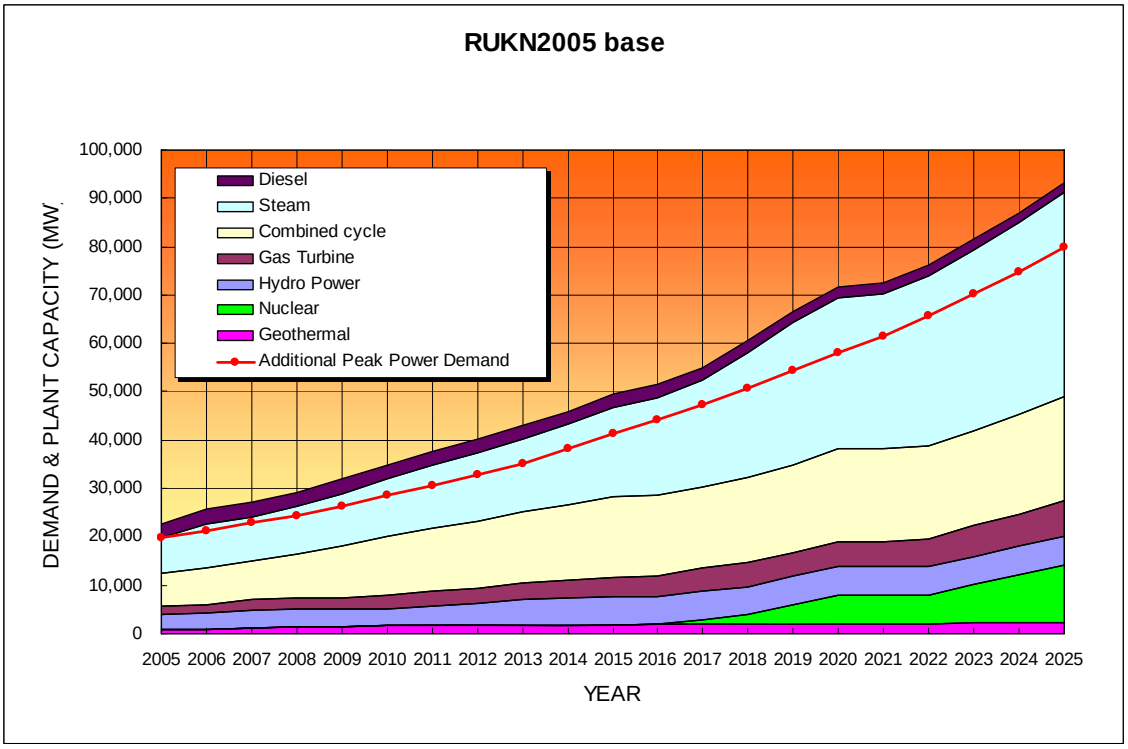


Fig. 7.1.11-8 Power Plant Development Plan by RUKN (Fig 7.a re-posted)

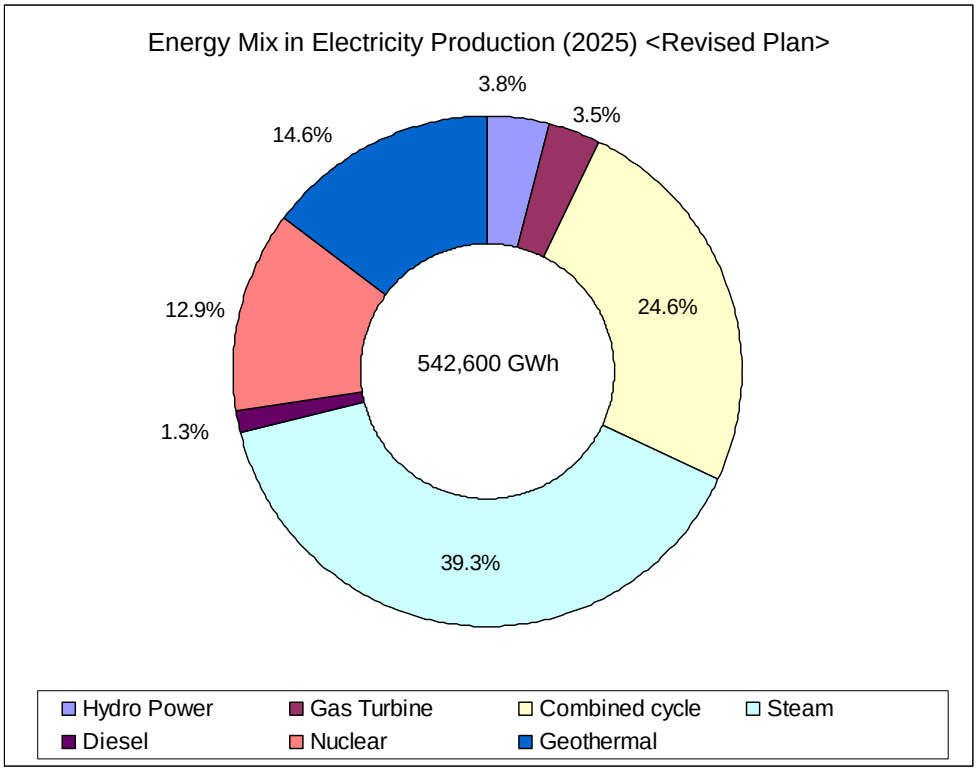


Fig. 7.1.11-9 Energy Mix in Electricity Production in 2025 by Geothermal Development Scenario

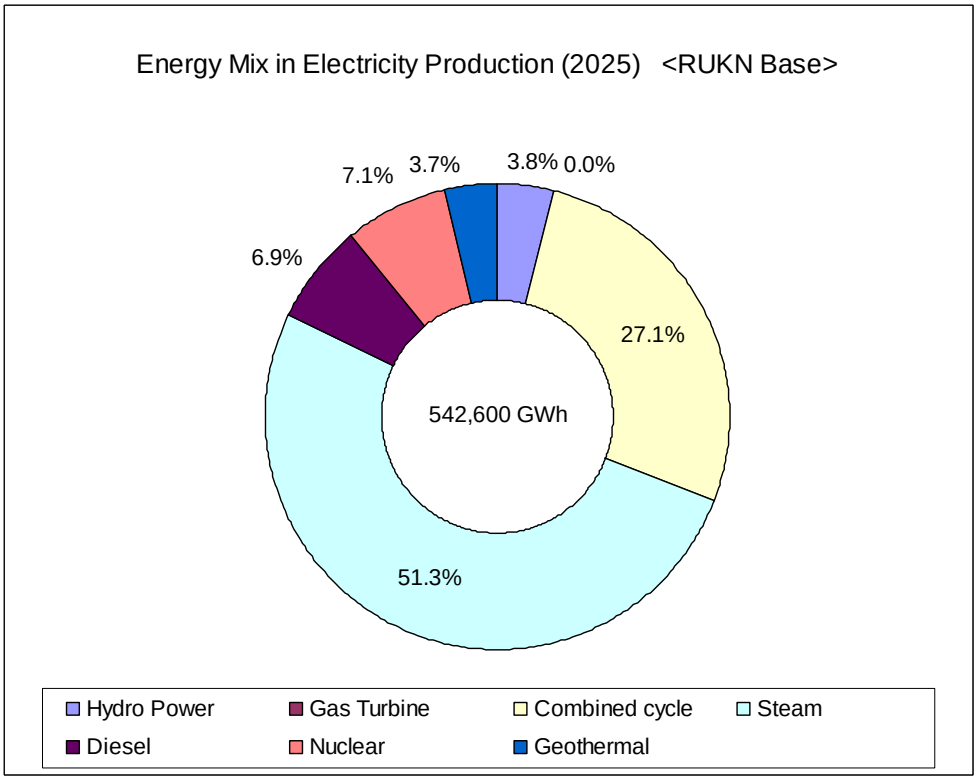


Fig. 7.1.11-10 Energy Mix in Electricity Production in 2025 by RUKN (Fig. 7.1.11-3 re-posted)

Table 7.1.11-7 Electric Power Development Plan in Geothermal Power Development Master Plan (Sumatra)

Sumatra System Demand & Supply Balance Table

項目	Item	Unit	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	New Plant Total	
電力需要	Energy Demand	GWh	14,260	15,421	16,692	18,088	19,474	20,997	22,667	24,502	26,521	28,827	31,045	33,306	35,718	38,333	41,070	43,989	47,099	50415	53950		
増加率	Growth		8.1%	8.1%	8.2%	8.4%	7.7%	7.8%	8.0%	8.1%	8.2%	8.7%	7.7%	7.3%	7.2%	7.3%	7.1%	7.1%	7.1%	7.0%	7.0%		
負荷率	Annual Road Factor	%	63%	64%	64%	65%	65%	65%	66%	66%	66%	66%	66%	66%	66%	67%	67%	67%	67%	67%	67%		
発電電力量	Energy Generation	GWh	16,000	17,303	18,728	20,294	21,849	23,559	25,432	27,492	29,756	32,056	34,522	37,036	39,718	42,627	45,464	48,695	52,138	55,809	59,722		
最大電力	Peak Power Demand	MW	2,899	3,086	3,340	3,564	3,837	4,137	4,399	4,755	5,147	5,545	5,971	6,406	6,870	7,263	7,746	8,297	8,883	9,509	10,176		
増加率	Growth		8.1%	6.5%	8.2%	6.7%	7.7%	7.8%	6.3%	8.1%	8.2%	7.7%	7.7%	7.3%	7.2%	5.7%	6.7%	7.1%	7.1%	7.0%	7.0%		
設備容量（既設）	Installed Generation Capacity (Exist.)	MW	3,229	3,229	3,229	3,229	3,229	3,229	3,132	3,038	2,947	2,859	2,773	2,690	2,609	2,531	2,455	2,381	2,310	2,240	2,173		
RUKN (2005)電源開発計画	**Power Dev't Plan by RUKN (2005)**																						
発電所増設計画(Committed)	Power Plant Const. Plan (Committed)	MW	480	135	260	200	180	154	136	0	0	0	0	0	0	0	0	0	0	0	0		
PLN分	PLN	MW	410	100	200	0	0	154	136	0	0	0	0	0	0	0	0	0	0	0	0		
水力	Hydro Power	MW	210					154	86														
ガスタービン	Gas Turbine	MW	100						50														
コンバインドサイクル	Combined cycle	MW																					
汽力	Steam	MW	100	100	200																		
地熱	Geothermal	MW																					
ディーゼル	Diesel	MW																					
IPP	IPP	MW	70	35	60	200	180	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
水力	Hydro Power	MW					180																
ガスタービン	Gas Turbine	MW			60																		
コンバインドサイクル	Combined cycle	MW																					
汽力	Steam	MW	70	35		200																	
地熱	Geothermal	MW																					
ディーゼル	Diesel	MW																					
新規増設計画	New Power Plant Plan	MW	100	100	100	310	155	200	310	350	550	555	400	1,060	660	400	660	310	1,060	760	670	10,357	(100.0%)
水力	Hydro Power	MW								350												1,062	(10.3%)
ガスタービン	Gas Turbine	MW	100								50	200		200				200		100		1,080	(10.4%)
コンバインドサイクル	Combined cycle	MW				100	100				100			200					400			900	(8.7%)
汽力	Steam	MW		100	100	100		200	200		400	300	400	660	660	400	660		660	660	560	6,765	(65.3%)
地熱	Geothermal	MW				*110*	*55*		110			55						110			110	550	(5.3%)
ディーゼル	Diesel	MW																				0	(0.0%)
原子力	Nuclear	MW																				0	(0.0%)
増設設備量累計	New Power Plant Capacity (cum.)	MW	682	917	1,277	1,787	2,122	2,476	2,922	3,272	3,822	4,377	4,777	5,837	6,497	6,897	7,557	7,867	8,927	9,687	10,357		
系統設備量合計	Total Installed Generation Capacity	MW	3,911	4,146	4,506	5,016	5,351	5,705	6,054	6,310	6,769	7,236	7,550	8,527	9,106	9,428	10,012	10,248	11,237	11,927	12,530		
予備率	Reserve Margin	%	35%	34%	35%	41%	39%	38%	38%	33%	32%	30%	26%	33%	33%	30%	29%	24%	27%	25%	23%		
地熱発電所（既設）	Geothermal Power Plant (Exist.)	MW	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2		
修正発電所開発計画	**Revised Power Plant Development Plan**																						
発電所増設計画(Committed)	Power Plant Const. Plan (Committed)	MW																					
新規増設計画	New Power Plant Plan	MW	588	235	360	400	500	534	196	735	260	420	590	610	690	660	535	585	1,175	570	612	10,357	(100.0%)
水力	Hydro Power	MW	210				180	154	86	350												1,062	(10.3%)
ガスタービン	Gas Turbine	MW	200		60				50		50	200		200				200		100		1,080	(10.4%)
コンバインドサイクル	Combined cycle	MW				100	100				100			200					400			900	(8.7%)
汽力	Steam	MW	170	235	300	300		60	60		110	80	110	180	180	110	180		180	180	162	2,597	(25.1%)
地熱	Geothermal	MW	8				220	320		385		140	480	30	510	550	355	385	595	290	450	4,718	(45.6%)
ディーゼル	Diesel	MW																				0	(0.0%)
原子力	Nuclear	MW																				0	(0.0%)
増設設備量累計	New Power Plant Capacity (cum.)	MW	690	925	1,285	1,685	2,185	2,719	2,915	3,650	3,910	4,330	4,920	5,530	6,220	6,880	7,415	8,000	9,175	9,745	10,357		
系統設備量合計	Total Installed Generation Capacity	MW	3,919	4,154	4,514	4,914	5,414	5,948	6,047	6,688	6,857	7,189	7,693	8,220	8,829	9,411	9,870	10,381	11,485	11,985	12,530		
予備率	Reserve Margin	%	35%	35%	35%	38%	41%	44%	37%	41%	33%	30%	29%	28%	29%	30%	27%	25%	29%	26%	23%		

Table 7.1.11-8 Electric Power Development Plan in Geothermal Power Development Master Plan (Java-Bali)

Java-Madura-Bali System Demand & Supply Balance Table

項目	Item	Unit	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	New Plant Total	
電力需要	Energy Demand	GWh	93,779	101,166	109,269	118,418	128,131	138,576	149,861	162,085	175,350	189,013	203,243	218,143	233,814	250,114	267,400	285,756	305,275	326065	348239		
増加率	Growth		7.7%	7.9%	8.0%	8.4%	8.2%	8.2%	8.1%	8.2%	8.2%	7.8%	7.5%	7.3%	7.2%	7.0%	6.9%	6.9%	6.8%	6.8%	6.8%		
負荷率	Annual Road Factor	%	72%	73%	73%	73%	74%	74%	74%	74%	74%	75%	75%	75%	75%	75%	76%	76%	76%	76%	76%		
発電電力量	Energy Generation	GWh	107,274	115,680	124,861	135,264	146,262	158,125	170,889	183,208	198,201	213,585	229,665	246,501	264,210	282,628	302,162	322,904	344,961	368,453	393,511		
最大電力	Peak Power Demand	MW	17,008	18,090	19,525	21,152	22,563	24,393	26,362	28,262	30,575	32,509	34,957	37,519	40,215	43,018	45,386	48,502	51,815	55,343	59,107		
増加率	Growth		7.1%	6.4%	7.9%	8.3%	6.7%	8.1%	8.1%	7.2%	8.2%	6.3%	7.5%	7.3%	7.2%	7.0%	5.5%	6.9%	6.8%	6.8%	6.8%		
設備容量（既設）	Installed Generation Capacity (Exist.)	MW	18,658	18,658	18,658	18,658	18,658	18,471	18,287	18,288	18,289	17,740	17,208	16,692	16,191	15,705	15,234	14,777	14,334	13,904	13,487		
RUKN (2005)電源開発計画	**Power Dev't Plan by RUKN (2005)**																						
発電所増設計画(Committed)	Power Plant Const. Plan (Committed)	MW	350	1,525	720	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
PLN分	PLN	MW	60	945	720	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
水力	Hydro Power	MW																					
ガスタービン	Gas Turbine	MW																					
コンバインドサイクル	Combined cycle	MW	50	945	720																		
汽力	Steam	MW																					
地熱	Geothermal	MW	*10*																				
ディーゼル	Diesel	MW																					
IPP	IPP	MW	290	580	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
水力	Hydro Power	MW																					
ガスタービン	Gas Turbine	MW																					
コンバインドサイクル	Combined cycle	MW		400																			
汽力	Steam	MW																					
地熱	Geothermal	MW	*290*	*180*																			
ディーゼル	Diesel	MW																					
新規増設計画	New Power Plant Plan	MW	375	0	1,230	2,380	2,330	1,890	2,360	2,320	2,720	1,320	2,720	4,640	4,640	4,320	0	2,640	3,920	4,320	4,920	54,555	(100.0%)
水力	Hydro Power	MW						500	500													1,000	(1.8%)
ガスタービン	Gas Turbine	MW				200	400		200		400		400							600		600	2,800	(5.1%)
コンバインドサイクル	Combined cycle	MW	375		730	1,460	730	730	1,000	1,000	1,000			1,000		1,000				1,000	1,000	14,015	(25.7%)
汽力	Steam	MW			500	660	1,200	660	660	1,320	1,320	1,320	1,320	2,640	2,640	1,320		2,640	1,320	1,320	1,320	24,080	(44.1%)
地熱	Geothermal	MW				60																660	(1.2%)
ディーゼル	Diesel	MW																				0	(0.0%)
原子力	Nuclear	MW											1,000	1,000	2,000	2,000			2,000	2,000	2,000	12,000	(22.0%)
増設設備量累計	New Power Plant Capacity (cum.)	MW	3,640	5,165	7,115	9,495	11,825	13,715	16,075	18,395	21,115	22,435	25,155	29,795	34,435	38,755	38,755	41,395	45,315	49,635	54,555		
系統設備量合計	Total Installed Generation Capacity	MW	22,298	23,823	25,773	28,153	30,483	32,186	34,362	36,683	39,404	40,175	42,363	46,487	50,626	54,460	53,989	56,172	59,649	63,539	68,042		
予備率	Reserve Margin	%	31%	32%	32%	33%	35%	32%	30%	30%	29%	24%	21%	24%	26%	27%	19%	16%	15%	15%	15%		
地熱発電所（既設）	Geothermal Power Plant (Exist.)	MW	835	835	835	835	835	835	835	835	835	835	835	835	835	835	835	835	835	835	835		
修正発電所開発計画	**Revised Power Plant Development Plan**																						
発電所増設計画(Committed)	Power Plant Const. Plan (Committed)	MW																					
新規増設計画	New Power Plant Plan	MW	425	1,625	1,940	2,310	2,370	2,000	2,350	2,300	2,710	1,675	2,940	4,700	4,065	4,545	235	2,820	4,010	4,300	4,467	54,555	(100.0%)
水力	Hydro Power	MW						500	500													1,000	(1.8%)
ガスタービン	Gas Turbine	MW				200	400		200		400		400						600		600	2,800	(5.1%)
コンバインドサイクル	Combined cycle	MW	425	1,345	1,450	1,460	730	730	1,000	1,000	1,000			1,000		1,000				1,000	1,000	14,015	(25.7%)
汽力	Steam	MW			490	650	1,180	650	650	1,300	1,300	1,300	1,300	2,600	2,600	1,300		2,600	1,300	1,300	1,327	23,740	(43.5%)
地熱	Geothermal	MW		280			60	120			10	375	240	100	465	245	235	220	110		540	3,000	(5.5%)
ディーゼル	Diesel	MW																				0	(0.0%)
原子力	Nuclear	MW											1,000	1,000	1,000	2,000			2,000	2,000	1,000	10,000	(18.3%)
増設設備量累計	New Power Plant Capacity (cum.)	MW	3,193	4,818	6,758	9,068	11,438	13,438	15,788	18,088	20,798	22,473	25,413	30,113	34,178	38,723	38,958	41,778	45,788	50,088	54,555		
系統設備量合計	Total Installed Generation Capacity	MW	21,851	23,476	25,416	27,726	30,096	31,909	34,075	36,376	39,087	40,213	42,621	46,805	50,369	54,428	54,192	56,555	60,122	63,992	68,042		
予備率	Reserve Margin	%	28%	30%	30%	31%	33%	31%	29%	29%	28%	24%	22%	25%	25%	27%	19%	17%	16%	16%	15%		

Table 7.1.11-9 Electric Power Development Plan in Geothermal Power Development Master Plan (North and Central Sulawesi and Gorontalo)

North / Central Sulawesi & Gorontalo System Demand & Supply Balance Table

項目	Item	Unit	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	New Plant Total	
電力需要	Energy Demand	GWh	1,035	1,114	1,206	1,313	1,429	1,562	1,711	1,880	2,069	2,271	2,495	2,742	3,017	3,314	3,646	4,015	4,426	4883	5393		
増加率	Growth		6.9%	7.6%	8.3%	8.9%	8.8%	9.3%	9.5%	9.9%	10.1%	9.8%	9.9%	9.9%	10.0%	9.8%	10.0%	10.1%	10.2%	10.3%	10.4%		
負荷率	Annual Road Factor	%	51%	52%	52%	52%	53%	53%	53%	54%	55%	55%	55%	55%	55%	55%	55%	55%	55%	55%	55%		
発電電力量	Energy Generation	GWh	1,132	1,219	1,319	1,436	1,564	1,708	1,872	2,056	2,264	2,507	2,779	3,083	3,421	3,791	4,207	4,673	5,196	5,782	6,439		
最大電力	Peak Power Demand	MW	253	268	290	315	337	368	403	435	470	520	577	640	710	787	873	970	1,078	1,200	1,336		
増加率	Growth		6.3%	5.9%	8.2%	8.6%	7.0%	9.2%	9.5%	7.9%	8.0%	10.6%	11.0%	10.9%	10.9%	10.8%	10.9%	11.1%	11.1%	11.3%	11.3%		
設備容量（既設）	Installed Generation Capacity (Exist.)	MW	214	164	164	164	164	164	164	164	164	159	154	150	145	141	137	133	129	125	121		
RUKN (2005)電源開発計画	**Power Dev't Plan by RUKN (2005)**																						
発電所増設計画(Committed)	Power Plant Const. Plan (Committed)	MW	6	0	23	120	0	0	55	0	55	0	0	0	0	0	0	0	0	0	0		
PLN分	PLN	MW	6	0	23	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
水力	Hydro Power	MW	1																				
ガスタービン	Gas Turbine	MW																					
コンバインドサイクル	Combined cycle	MW																					
汽力	Steam	MW																					
地熱	Geothermal	MW			20	20																	
ディーゼル	Diesel	MW	5		3																		
IPP	IPP	MW	0	0	0	100	0	0	55	0	55	0	0	0	0	0	0	0	0	0	0		
水力	Hydro Power	MW																					
ガスタービン	Gas Turbine	MW																					
コンバインドサイクル	Combined cycle	MW																					
汽力	Steam	MW				100			55		55												
地熱	Geothermal	MW																					
ディーゼル	Diesel	MW																					
新規増設計画	New Power Plant Plan	MW	27	40	10	0	20	30	0	40	10	30	50	120	70	100	100	105	255	100	100	1,540	(100.0%)
水力	Hydro Power	MW	17																			50	(3.2%)
ガスタービン	Gas Turbine	MW		20			10			20		30			50			50		100		290	(18.8%)
コンバインドサイクル	Combined cycle	MW																				0	(0.0%)
汽力	Steam	MW		20	10			30		20			50	100		100	100		200		100	950	(61.7%)
地熱	Geothermal	MW					10				10			20	20			55	55			210	(13.6%)
ディーゼル	Diesel	MW	10																			40	(2.6%)
原子力	Nuclear	MW																				0	(0.0%)
増設設備量累計	New Power Plant Capacity (cum.)	MW	108	148	180	300	320	350	405	445	510	540	590	710	780	880	980	1,085	1,340	1,440	1,540		
系統設備量合計	Total Installed Generation Capacity	MW	322	312	344	464	484	514	569	609	674	699	744	860	925	1,021	1,117	1,218	1,469	1,565	1,661		
予備率	Reserve Margin	%	27%	16%	19%	47%	44%	40%	41%	40%	43%	34%	29%	34%	30%	30%	28%	26%	36%	30%	24%		
地熱発電所（既設）	Geothermal Power Plant (Exist.)	MW	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20		
修正発電所開発計画	**Revised Power Plant Development Plan**																						
発電所増設計画(Committed)	Power Plant Const. Plan (Committed)	MW																					
新規増設計画	New Power Plant Plan	MW	53	60	13	120	50	20	30	60	40	30	30	110	130	60	135	80	205	100	143	1,540	(100.0%)
水力	Hydro Power	MW	18																			50	(3.2%)
ガスタービン	Gas Turbine	MW		20			10			20		30			50			50		100		290	(18.8%)
コンバインドサイクル	Combined cycle	MW																				0	(0.0%)
汽力	Steam	MW		20	10	100		20	30		40		30	100		60	60	30	130		8	645	(41.9%)
地熱	Geothermal	MW	20	20		20	40			40				10	80		75		75		135	515	(33.4%)
ディーゼル	Diesel	MW	15		3																	40	(2.6%)
原子力	Nuclear	MW																				0	(0.0%)
増設設備量累計	New Power Plant Capacity (cum.)	MW	124	184	197	317	367	387	417	477	517	547	577	687	817	877	1,012	1,092	1,297	1,397	1,540		
系統設備量合計	Total Installed Generation Capacity	MW	338	348	361	481	531	551	581	641	681	706	731	837	962	1,018	1,149	1,225	1,426	1,522	1,661		
予備率	Reserve Margin	%	34%	30%	24%	53%	58%	50%	44%	47%	45%	36%	27%	31%	35%	29%	32%	26%	32%	27%	24%		

Table 7.1.11-10 Electric Power Development Plan in Geothermal Power Development Master Plan (South and South East Sulawesi)

South & South East Sulawesi System Demand & Supply Balance Table

項目	Item	Unit	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	New Plant Total	
電力需要	Energy Demand	GWh	2,758	2,987	3,233	3,505	3,756	4,023	4,308	4,611	4,934	5,323	5,628	5,950	6,289	6,610	6,966	7,341	7,738	8158	8603		
増加率	Growth		8.4%	8.3%	8.2%	8.4%	7.2%	7.1%	7.1%	7.0%	7.0%	7.9%	5.7%	5.7%	5.7%	5.1%	5.4%	5.4%	5.4%	5.4%	5.5%		
負荷率	Annual Road Factor	%	58%	58%	58%	58%	59%	59%	59%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%		
発電電力量	Energy Generation	GWh	3,176	3,400	3,683	3,993	4,279	4,583	4,911	5,252	5,621	6,177	6,524	6,956	7,415	7,860	8,353	8,877	9,434	10,027	10,660		
最大電力	Peak Power Demand	MW	630	672	724	780	832	887	945	1,006	1,071	1,166	1,243	1,326	1,413	1,498	1,592	1,692	1,798	1,911	2,031		
増加率	Growth		7.7%	6.7%	7.7%	7.7%	6.7%	6.6%	6.5%	6.5%	6.5%	8.9%	6.6%	6.7%	6.6%	6.0%	6.3%	6.3%	6.3%	6.3%	6.3%		
設備容量（既設）	Installed Generation Capacity (Exist.)	MW	296	296	296	296	296	296	296	296	296	287	278	270	262	254	246	239	232	225	218		
RUKN (2005)電源開発計画	**Power Dev't Plan by RUKN (2005)**																						
発電所増設計画(Committed)	Power Plant Const. Plan (Committed)	MW	92	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
PLN分	PLN	MW	27	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
水力	Hydro Power	MW	20																				
ガスタービン	Gas Turbine	MW																					
コンバインドサイクル	Combined cycle	MW																					
汽力	Steam	MW																					
地熱	Geothermal	MW																					
ディーゼル	Diesel	MW	7				3																
IPP	IPP	MW	65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
水力	Hydro Power	MW																					
ガスタービン	Gas Turbine	MW	65																				
コンバインドサイクル	Combined cycle	MW																					
汽力	Steam	MW																					
地熱	Geothermal	MW																					
ディーゼル	Diesel	MW																					
新規増設計画	New Power Plant Plan	MW	19	310	200	102	50	100	60	100	150	0	100	150	0	100	100	100	150	100	100	2,181	(100.0%)
水力	Hydro Power	MW						100		100	150											370	(17.0%)
ガスタービン	Gas Turbine	MW		100			50		30					50				100	50			465	(21.3%)
コンバインドサイクル	Combined cycle	MW														100			100			240	(11.0%)
汽力	Steam	MW		200	200	100			30				100	100			100			100	100	1,050	(48.1%)
地熱	Geothermal	MW																				0	(0.0%)
ディーゼル	Diesel	MW	19	10		2																56	(2.6%)
原子力	Nuclear	MW																				0	(0.0%)
増設設備量累計	New Power Plant Capacity (cum.)	MW	206	516	716	818	871	971	1,031	1,131	1,281	1,281	1,381	1,531	1,531	1,631	1,731	1,831	1,981	2,081	2,181		
系統設備量合計	Total Installed Generation Capacity	MW	502	812	1,012	1,114	1,167	1,267	1,327	1,427	1,577	1,568	1,659	1,801	1,793	1,885	1,977	2,070	2,213	2,306	2,399		
予備率	Reserve Margin	%	-20%	21%	40%	43%	40%	43%	40%	42%	47%	34%	33%	36%	27%	26%	24%	22%	23%	21%	18%		
地熱発電所（既設）	Geothermal Power Plant (Exist.)	MW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
修正発電所開発計画	**Revised Power Plant Development Plan**																						
発電所増設計画(Committed)	Power Plant Const. Plan (Committed)	MW																					
新規増設計画	New Power Plant Plan	MW	111	310	200	102	53	100	50	100	150	0	100	110	40	100	120	100	150	120	74	2,181	(100.0%)
水力	Hydro Power	MW	20					100		100	150											370	(17.0%)
ガスタービン	Gas Turbine	MW	65	100			50		30					50				100	50			465	(21.3%)
コンバインドサイクル	Combined cycle	MW														100			100			240	(11.0%)
汽力	Steam	MW		200	200	100			20				60	60			60			60	50	826	(37.9%)
地熱	Geothermal	MW											40		40		60			60	24	224	(10.3%)
ディーゼル	Diesel	MW	26	10		2	3															56	(2.6%)
原子力	Nuclear	MW																				0	(0.0%)
増設設備量累計	New Power Plant Capacity (cum.)	MW	202	512	712	814	867	967	1,017	1,117	1,267	1,267	1,367	1,477	1,517	1,617	1,737	1,837	1,987	2,107	2,181		
系統設備量合計	Total Installed Generation Capacity	MW	498	808	1,008	1,110	1,163	1,263	1,313	1,413	1,563	1,554	1,645	1,747	1,779	1,871	1,983	2,076	2,219	2,332	2,399		
予備率	Reserve Margin	%	-21%	20%	39%	42%	40%	42%	39%	40%	46%	33%	32%	32%	26%	25%	25%	23%	23%	22%	18%		

Table 7.1.11-11 Electric Power Development Plan in Geothermal Power Development Master Plan (West Nusa Tenggara)

NTB System Demand & Supply Balance Table

項目	Item	Unit	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	New Plant Total	
電力需要	Energy Demand	GWh	533	590	652	721	791	868	953	1,036	1,126	1,215	1,312	1,416	1,529	1,639	1,753	1,876	2,008	2149	2300		
増加率	Growth		10.6%	10.7%	10.5%	10.6%	9.7%	9.7%	9.8%	8.7%	8.7%	7.9%	8.0%	7.9%	8.0%	7.2%	7.0%	7.0%	7.0%	7.0%	7.0%		
負荷率	Annual Road Factor	%	46%	46%	46%	46%	46%	46%	46%	46%	46%	47%	48%	49%	50%	51%	52%	53%	54%	55%	56%		
発電電力量	Energy Generation	GWh	591	654	724	800	878	964	1,058	1,150	1,250	1,361	1,482	1,615	1,758	1,901	2,051	2,214	2,389	2,579	2,783		
最大電力	Peak Power Demand	MW	146	162	179	198	218	239	262	285	310	331	353	376	402	426	451	477	505	535	568		
増加率	Growth		10.6%	11.0%	10.5%	10.6%	10.1%	9.6%	9.6%	8.8%	8.8%	6.8%	6.6%	6.5%	6.9%	6.0%	5.9%	5.8%	5.9%	5.9%	6.2%		
設備容量（既設）	Installed Generation Capacity (Exist.)	MW	162	158	153	148	144	139	135	131	127	124	120	117	113	110	106	103	100	97	94		
RUKN (2005)電源開発計画	**Power Dev't Plan by RUKN (2005)**																						
発電所増設計画(Committed)	Power Plant Const. Plan (Committed)	MW	26	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
PLN分	PLN	MW	26	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
水力	Hydro Power	MW	1																				
ガスタービン	Gas Turbine	MW			20																		
コンバインドサイクル	Combined cycle	MW																					
汽力	Steam	MW																					
地熱	Geothermal	MW																					
ディーゼル	Diesel	MW	25		10																		
IPP	IPP	MW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
水力	Hydro Power	MW																					
ガスタービン	Gas Turbine	MW																					
コンバインドサイクル	Combined cycle	MW																					
汽力	Steam	MW																					
地熱	Geothermal	MW																					
ディーゼル	Diesel	MW																					
新規増設計画	New Power Plant Plan	MW	2	25	0	37	25	40	40	30	40	0	20	65	0	60	10	20	20	60	20	585	(100.0%)
水力	Hydro Power	MW																				1	(0.2%)
ガスタービン	Gas Turbine	MW						20	20	10	20			20				20			20	155	(26.5%)
コンバインドサイクル	Combined cycle	MW																				0	(0.0%)
汽力	Steam	MW		25		37	25	20	20	20	20		20	40		60			20	60		367	(62.8%)
地熱	Geothermal	MW																				0	(0.0%)
ディーゼル	Diesel	MW	2											5			10					62	(10.5%)
原子力	Nuclear	MW																				0	(0.0%)
増設設備量累計	New Power Plant Capacity (cum.)	MW	43	68	98	135	160	200	240	270	310	310	330	395	395	455	465	485	505	565	585		
系統設備量合計	Total Installed Generation Capacity	MW	205	226	251	283	304	339	375	401	437	434	450	512	508	565	571	588	605	662	679		
予備率	Reserve Margin	%	40%	39%	40%	43%	39%	42%	43%	41%	41%	31%	27%	36%	26%	33%	27%	23%	20%	24%	19%		
地熱発電所（既設）	Geothermal Power Plant (Exist.)	MW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
修正発電所開発計画	**Revised Power Plant Development Plan**																						
発電所増設計画(Committed)	Power Plant Const. Plan (Committed)	MW																					
新規増設計画	New Power Plant Plan	MW	28	25	28	37	25	40	40	30	40	0	20	94	0	60	1	20	20	60	5	585	(100.0%)
水力	Hydro Power	MW	1																			1	(0.2%)
ガスタービン	Gas Turbine	MW			20			20	20	10	20			20				20			5	140	(23.9%)
コンバインドサイクル	Combined cycle	MW																				0	(0.0%)
汽力	Steam	MW		25		37	25	20	20	20	20		20	40		60			20	60		367	(62.8%)
地熱	Geothermal	MW												30								30	(5.1%)
ディーゼル	Diesel	MW	27		8									4			1					47	(8.0%)
原子力	Nuclear	MW																				0	(0.0%)
増設設備量累計	New Power Plant Capacity (cum.)	MW	40	65	93	130	155	195	235	265	305	305	325	419	419	479	479	500	520	580	585		
系統設備量合計	Total Installed Generation Capacity	MW	202	223	246	278	299	334	370	396	432	429	445	536	532	589	585	603	620	677	679		
予備率	Reserve Margin	%	38%	38%	37%	40%	37%	40%	41%	39%	39%	30%	26%	43%	32%	38%	30%	26%	23%	26%	19%		

Table 7.1.11-12 Electric Power Development Plan in Geothermal Power Development Master Plan (East Nusa Tenggara)

NTT System Demand & Supply Balance Table

項目	Item	Unit	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	New Plant Total	
電力需要	Energy Demand	GWh	309	340	375	414	453	496	543	589	640	678	718	762	808	859	934	1,016	1,107	1207	1316		
増加率	Growth		10.4%	10.0%	10.3%	10.4%	9.4%	9.5%	9.5%	8.5%	8.7%	5.9%	5.9%	6.1%	6.0%	6.3%	8.7%	8.8%	9.0%	9.0%	9.0%		
負荷率	Annual Road Factor	%	48%	48%	48%	48%	48%	48%	48%	48%	48%	49%	50%	51%	52%	53%	54%	55%	56%	57%	58%		
発電電力量	Energy Generation	GWh	343	378	417	460	503	550	602	654	710	759	811	868	929	996	1,092	1,199	1,317	1,448	1,592		
最大電力	Peak Power Demand	MW	82	90	99	109	120	131	143	155	169	177	185	194	204	214	231	249	269	290	313		
増加率	Growth		10.3%	10.2%	10.4%	10.3%	9.3%	9.5%	9.5%	8.5%	8.6%	4.7%	4.8%	4.9%	5.0%	5.1%	7.7%	7.8%	7.9%	8.0%	8.1%		
設備容量（既設）	Installed Generation Capacity (Exist.)	MW	79	76	74	72	70	68	66	64	62	60	58	56	55	53	51	50	48	47	45		
RUKN (2005)電源開発計画	**Power Dev't Plan by RUKN (2005)**																						
発電所増設計画(Committed)	Power Plant Const. Plan (Committed)	MW	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
PLN分	PLN	MW	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
水力	Hydro Power	MW	2																				
ガスタービン	Gas Turbine	MW																					
コンバインドサイクル	Combined cycle	MW																					
汽力	Steam	MW																					
地熱	Geothermal	MW	6																				
ディーゼル	Diesel	MW	14																				
IPP	IPP	MW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
水力	Hydro Power	MW																					
ガスタービン	Gas Turbine	MW																					
コンバインドサイクル	Combined cycle	MW																					
汽力	Steam	MW																					
地熱	Geothermal	MW																					
ディーゼル	Diesel	MW																					
新規増設計画	New Power Plant Plan	MW	35	10	6	13	0	20	30	0	40	30	0	0	20	0	30	0	30	40	0	329	(100.0%)
水力	Hydro Power	MW							10													12	(3.6%)
ガスタービン	Gas Turbine	MW																				0	(0.0%)
コンバインドサイクル	Combined cycle	MW																				0	(0.0%)
汽力	Steam	MW		5	6	10		10			40	30			20		30		30	40		221	(67.2%)
地熱	Geothermal	MW																				9	(2.7%)
ディーゼル	Diesel	MW	35	5		3		10	20													87	(26.5%)
原子力	Nuclear	MW																				0	(0.0%)
増設設備量累計	New Power Plant Capacity (cum.)	MW	61	71	77	89	89	109	139	139	179	209	209	209	229	229	259	259	289	329	329		
系統設備量合計	Total Installed Generation Capacity	MW	139	147	151	161	159	177	205	203	241	269	267	265	284	282	310	309	337	376	374		
予備率	Reserve Margin	%	71%	64%	52%	47%	33%	35%	43%	30%	43%	52%	44%	36%	39%	32%	34%	24%	26%	30%	19%		
地熱発電所（既設）	Geothermal Power Plant (Exist.)	MW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
修正発電所開発計画	**Revised Power Plant Development Plan**																						
発電所増設計画(Committed)	Power Plant Const. Plan (Committed)	MW																					
新規増設計画	New Power Plant Plan	MW	53	15	16	13	0	10	30	0	20	20	18	40	10	0	20	0	20	24	20	329	(100.0%)
水力	Hydro Power	MW	2						10													12	(3.6%)
ガスタービン	Gas Turbine	MW																				0	(0.0%)
コンバインドサイクル	Combined cycle	MW																				0	(0.0%)
汽力	Steam	MW		10	10	10					20	10			10		10		20	14		114	(34.6%)
地熱	Geothermal	MW	3		6							10	18	40			10			10	20	116	(35.2%)
ディーゼル	Diesel	MW	49	5		3		10	20													87	(26.5%)
原子力	Nuclear	MW																					(0.0%)
増設設備量累計	New Power Plant Capacity (cum.)	MW	54	69	85	98	98	108	138	138	158	178	195	235	245	245	265	265	285	309	329		
系統設備量合計	Total Installed Generation Capacity	MW	133	145	159	169	167	175	203	201	219	238	253	291	300	298	316	315	333	356	374		
予備率	Reserve Margin	%	63%	62%	61%	55%	40%	34%	42%	29%	30%	34%	37%	50%	47%	39%	37%	27%	24%	23%	19%		

Table 7.1.11-13 Electric Power Development Plan in Geothermal Power Development Master Plan (Maluku and North Maluku)

Maluku & N. Muluku System Demand & Supply Balance Table

項目	Item	Unit	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	New Plant Total	
電力需要	Energy Demand	GWh	267	283	300	318	335	353	372	392	413	441	470	502	536	571	610	652	697	745	796		
増加率	Growth		6.0%	6.0%	6.0%	6.0%	5.3%	5.4%	5.4%	5.4%	5.4%	6.8%	6.6%	6.8%	6.8%	6.5%	6.8%	6.9%	6.9%	6.9%	6.8%		
負荷率	Annual Road Factor	%	54%	54%	54%	54%	54%	54%	54%	55%	55%	55%	54%	55%	55%	55%	55%	55%	55%	55%	55%		
発電電力量	Energy Generation	GWh	302	319	337	357	375	394	414	435	457	488	520	555	593	633	676	722	771	824	881		
最大電力	Peak Power Demand	MW	64	67	71	76	79	83	87	91	95	102	109	116	124	132	141	151	161	172	184		
増加率	Growth		6.7%	4.7%	6.0%	7.0%	3.9%	5.1%	4.8%	4.6%	4.4%	7.4%	6.9%	6.4%	6.9%	6.5%	6.8%	7.1%	6.6%	6.8%	7.0%		
設備容量（既設）	Installed Generation Capacity (Exist.)	MW	76	76	76	76	76	76	76	76	76	74	72	69	67	65	63	61	60	58	56		
RUKN (2005)電源開発計画	**Power Dev't Plan by RUKN (2005)**																						
発電所増設計画(Committed)	Power Plant Const. Plan (Committed)	MW	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
PLN分	PLN	MW	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
水力	Hydro Power	MW																					
ガスタービン	Gas Turbine	MW																					
コンバインドサイクル	Combined cycle	MW																					
汽力	Steam	MW																					
地熱	Geothermal	MW																					
ディーゼル	Diesel	MW	17																				
IPP	IPP	MW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
水力	Hydro Power	MW																					
ガスタービン	Gas Turbine	MW																					
コンバインドサイクル	Combined cycle	MW																					
汽力	Steam	MW																					
地熱	Geothermal	MW																					
ディーゼル	Diesel	MW																					
新規増設計画	New Power Plant Plan	MW	12	5	5	5	5	2	5	5	10	5	5	15	20	15	0	15	20	15	15	202	(100.0%)
水力	Hydro Power	MW																				0	(0.0%)
ガスタービン	Gas Turbine	MW													20				20			40	(19.8%)
コンバインドサイクル	Combined cycle	MW																				0	(0.0%)
汽力	Steam	MW			5	5	5	2		5	5	5		10		10		10		15	15	92	(45.5%)
地熱	Geothermal	MW																				0	(0.0%)
ディーゼル	Diesel	MW	12	5					5		5		5	5		5		5				70	(34.7%)
原子力	Nuclear	MW																				0	(0.0%)
増設設備量累計	New Power Plant Capacity (cum.)	MW	35	40	45	50	55	57	62	67	77	82	87	102	122	137	137	152	172	187	202		
系統設備量合計	Total Installed Generation Capacity	MW	111	116	121	126	131	133	138	143	153	156	159	171	189	202	200	213	232	245	258		
予備率	Reserve Margin	%	73%	73%	70%	66%	66%	60%	59%	57%	61%	53%	46%	47%	52%	53%	42%	41%	44%	42%	40%		
地熱発電所（既設）	Geothermal Power Plant (Exist.)	MW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
修正発電所開発計画	**Revised Power Plant Development Plan**																						
発電所増設計画(Committed)	Power Plant Const. Plan (Committed)	MW																					
新規増設計画	New Power Plant Plan	MW	21	4	5	5	5	2	4	5	9	5	9	49	10	14	0	14	10	15	15	202	(100.0%)
水力	Hydro Power	MW																				0	(0.0%)
ガスタービン	Gas Turbine	MW													10				10			20	(10.1%)
コンバインドサイクル	Combined cycle	MW																				0	(0.0%)
汽力	Steam	MW			5	5	5	2		5	5	5	5	5		10		10		15	15	92	(45.5%)
地熱	Geothermal	MW												40								40	(19.8%)
ディーゼル	Diesel	MW	21	4					4		4		4	4		4		4				50	(24.5%)
原子力	Nuclear	MW																					
増設設備量累計	New Power Plant Capacity (cum.)	MW	25	28	33	38	43	45	49	54	62	67	76	124	135	148	148	162	172	187	202		
系統設備量合計	Total Installed Generation Capacity	MW	101	104	109	114	119	121	125	130	138	141	148	193	202	213	211	223	232	245	258		
予備率	Reserve Margin	%	57%	56%	54%	50%	51%	46%	43%	43%	46%	39%	36%	67%	63%	62%	50%	48%	44%	42%	40%		

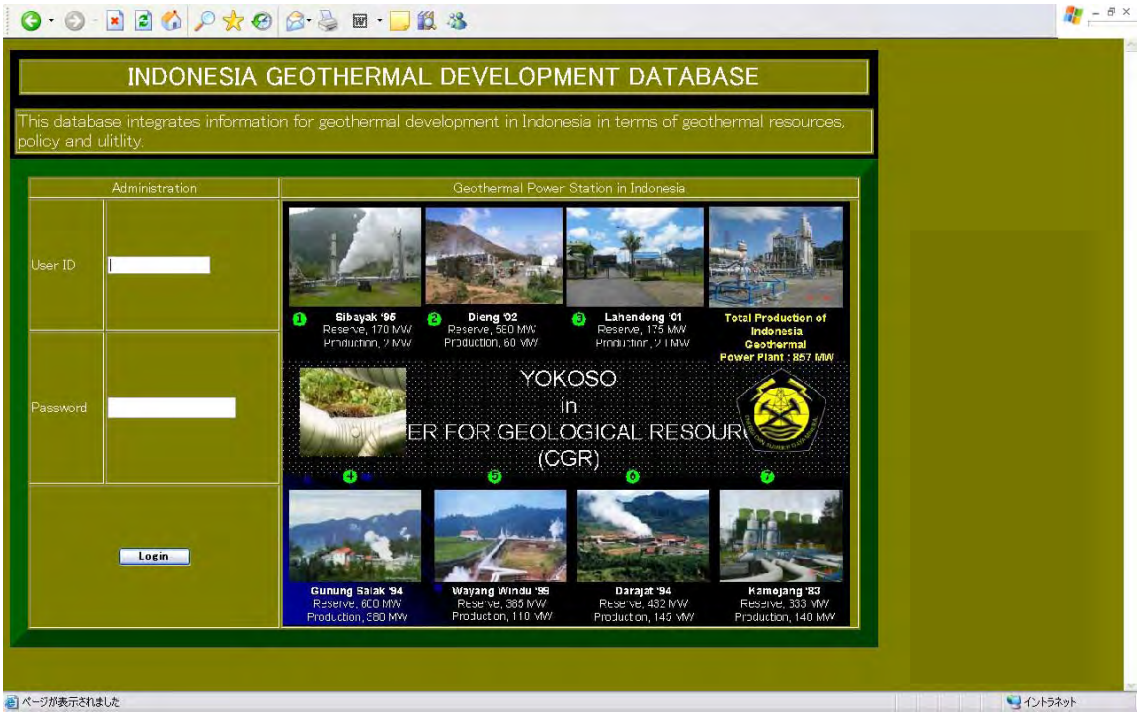


Fig.7.2.2-1 Log-in View of Indonesia Geothermal Development Database

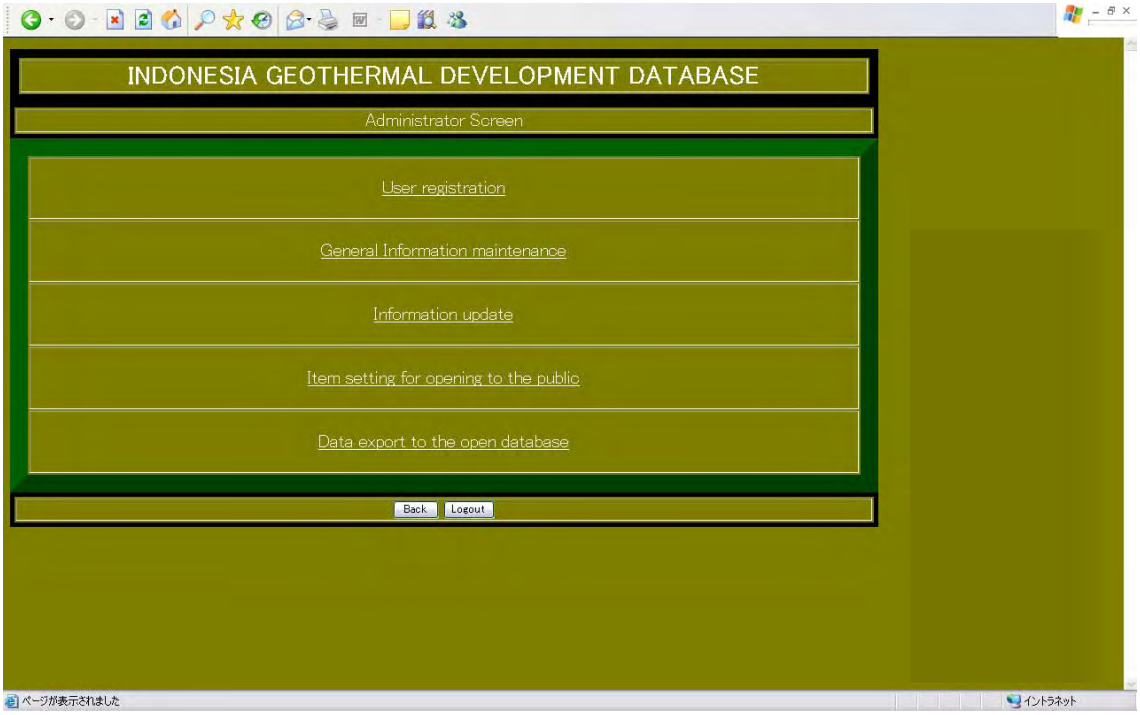


Fig.7.2.2-2 Main menu of Indonesia Geothermal Development Database

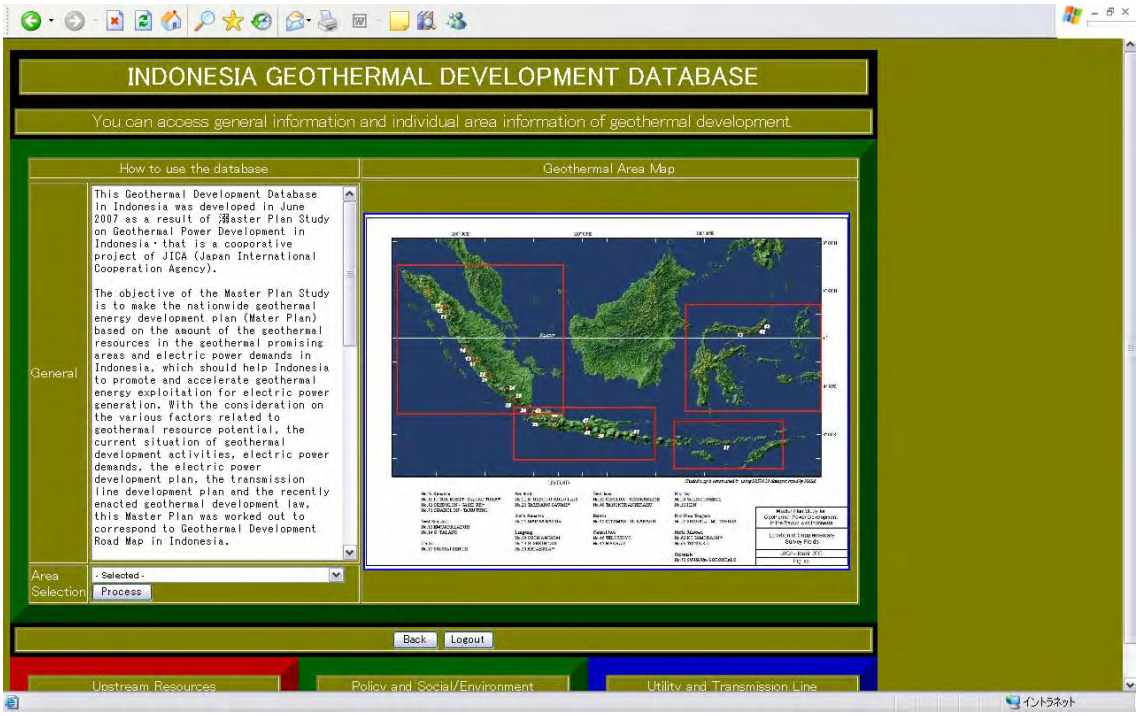


Fig.7.2.2-3 General Information of Geothermal Power Development in Indonesia

Fig.7.2.2-4 General Information of Geothermal Resources in Indonesia

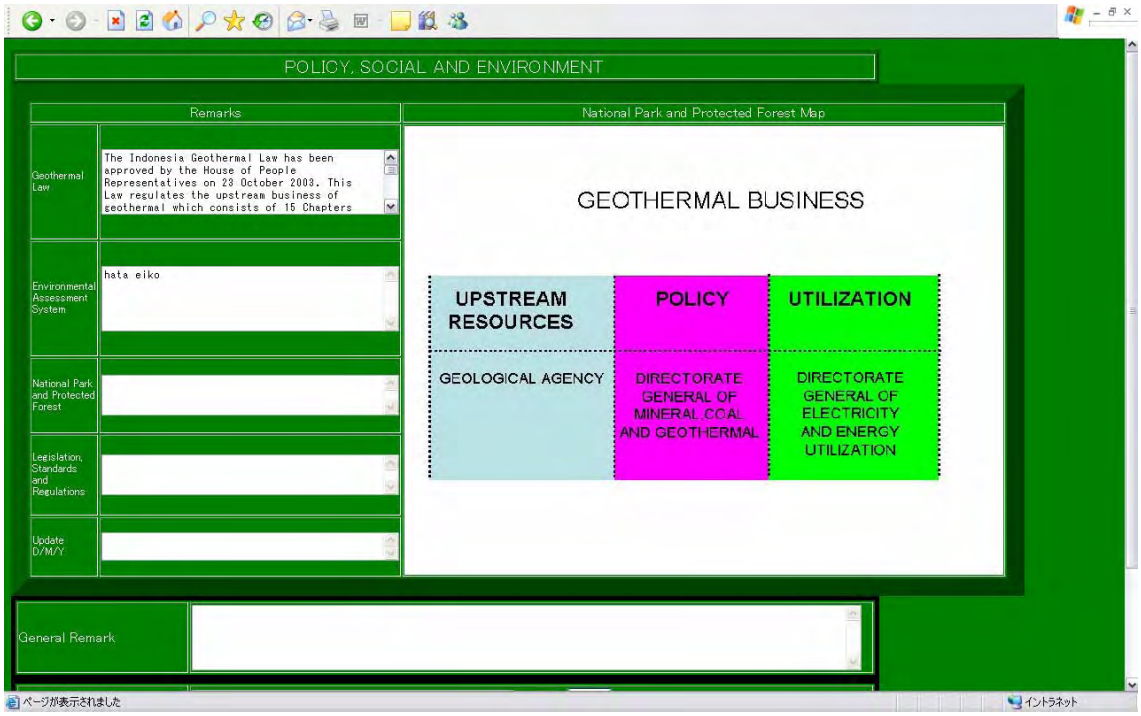


Fig.7.2.2-5 General Information of Social/Environment in Indonesia

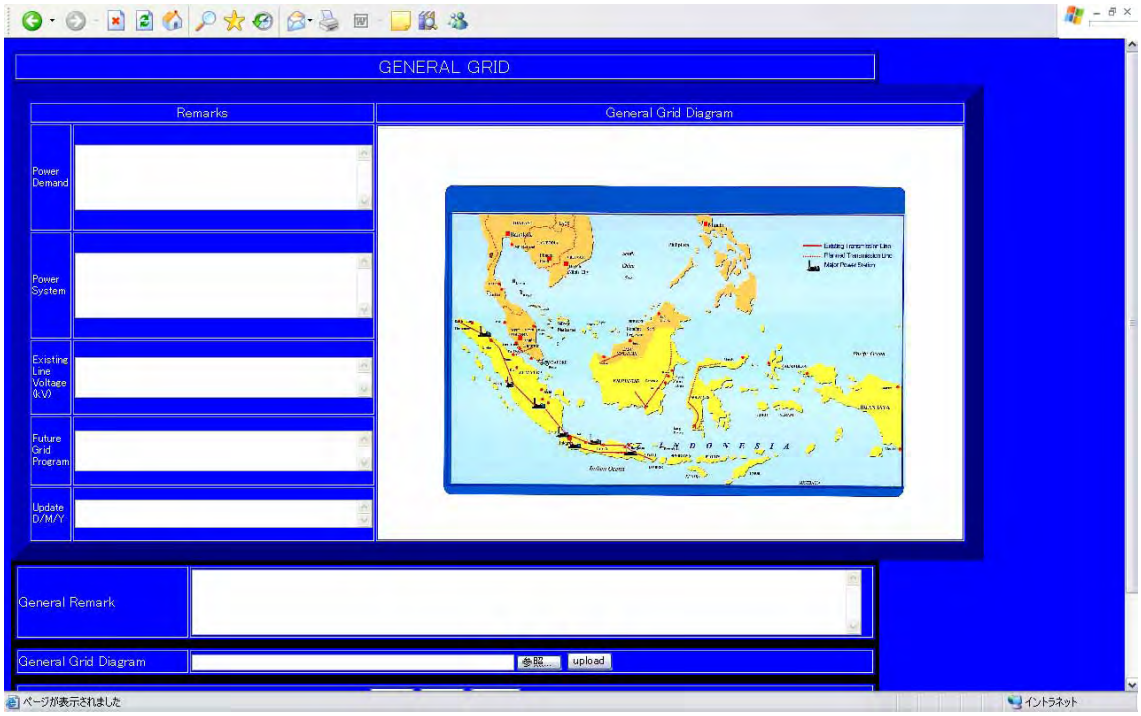


Fig.7.2.2-6 General Information of Transmission Line in Indonesia

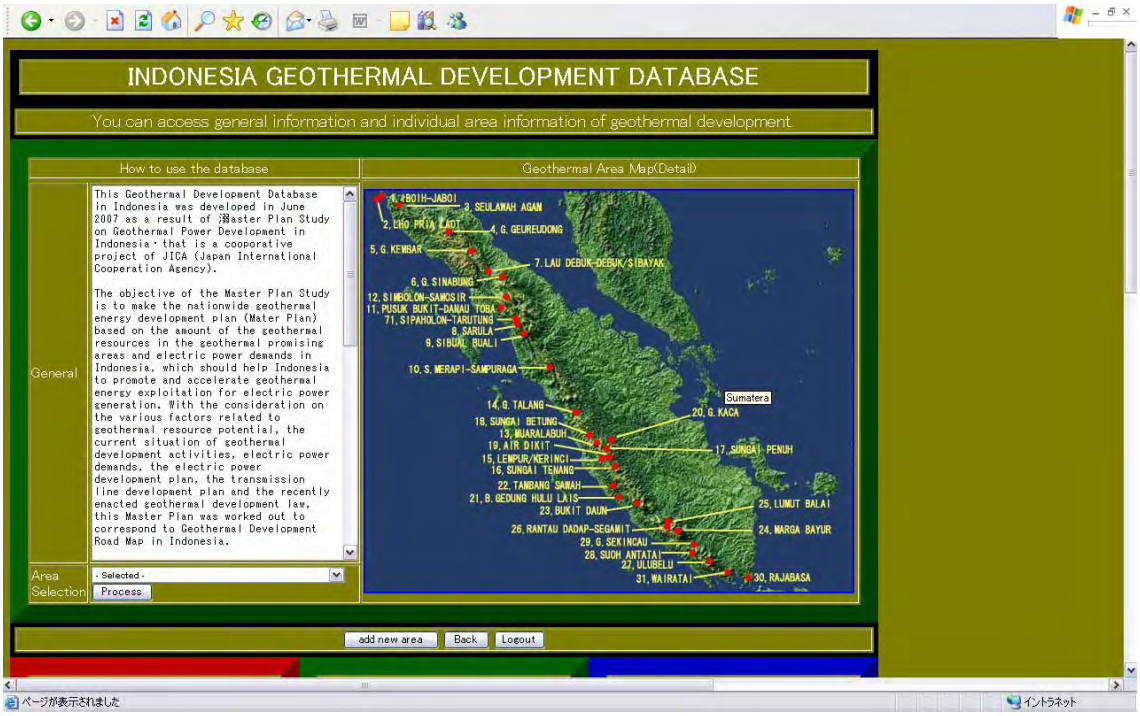


Fig.7.2.2-7 Prospective Geothermal Fields in Sumatera Inland

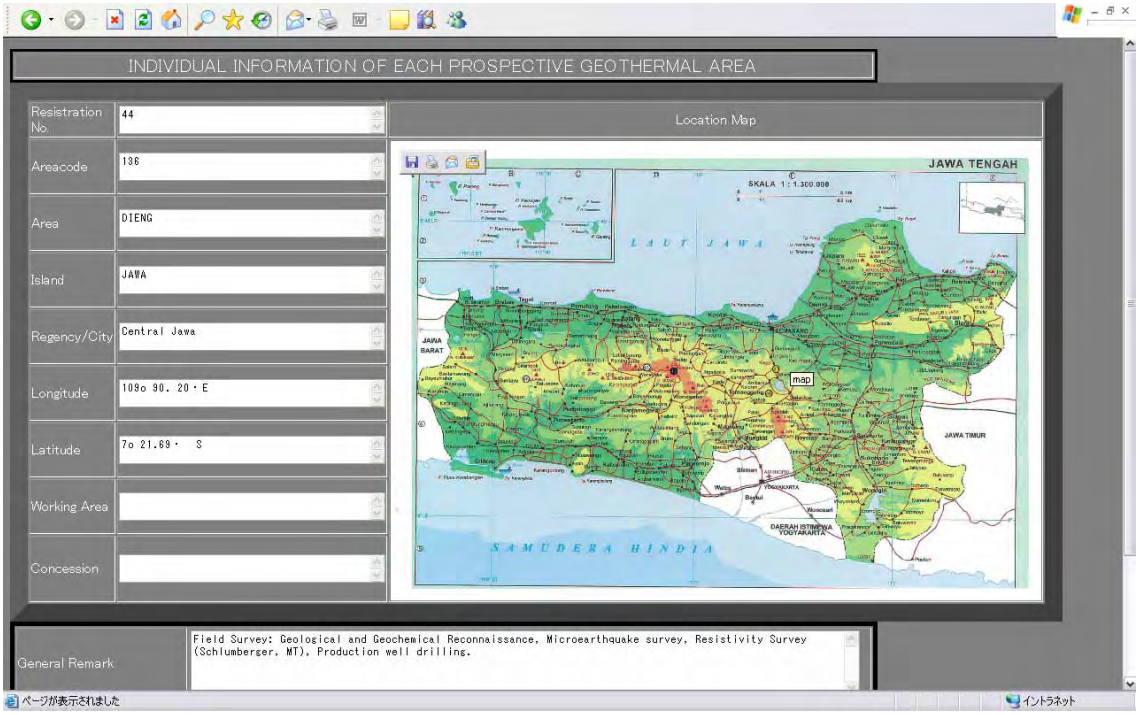


Fig.7.2.2-8 General Information of Individual Field in Sumatera Island

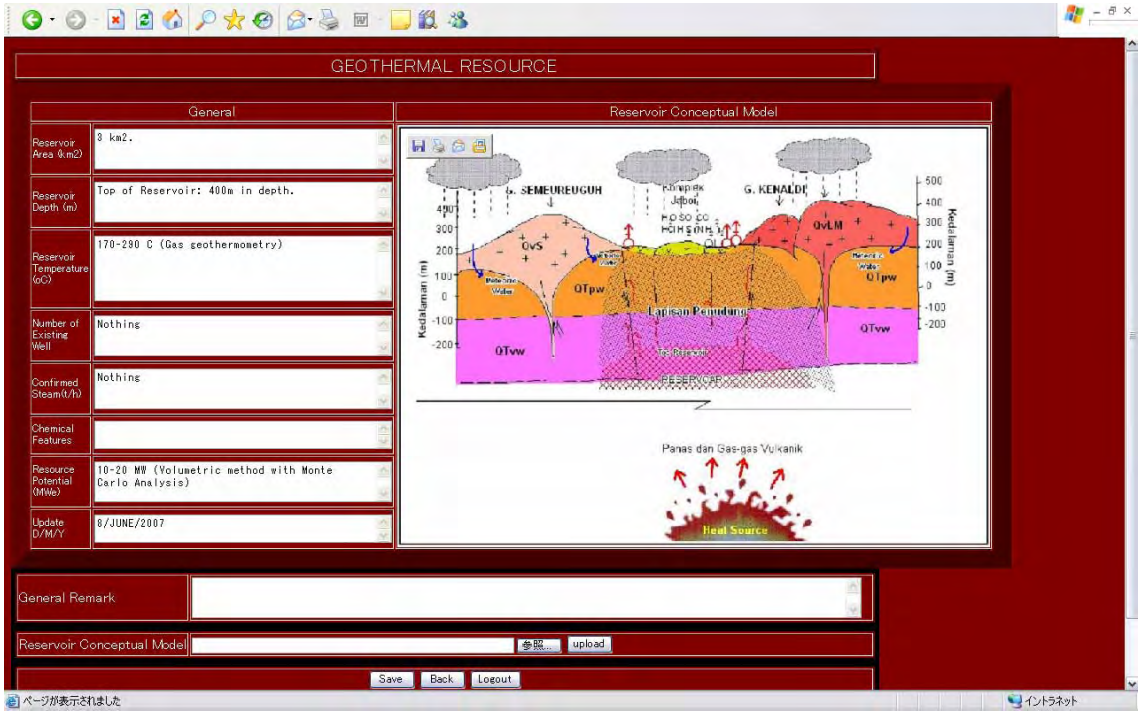


Fig.7.2.2-9 Geothermal Resources Information of Individual Field

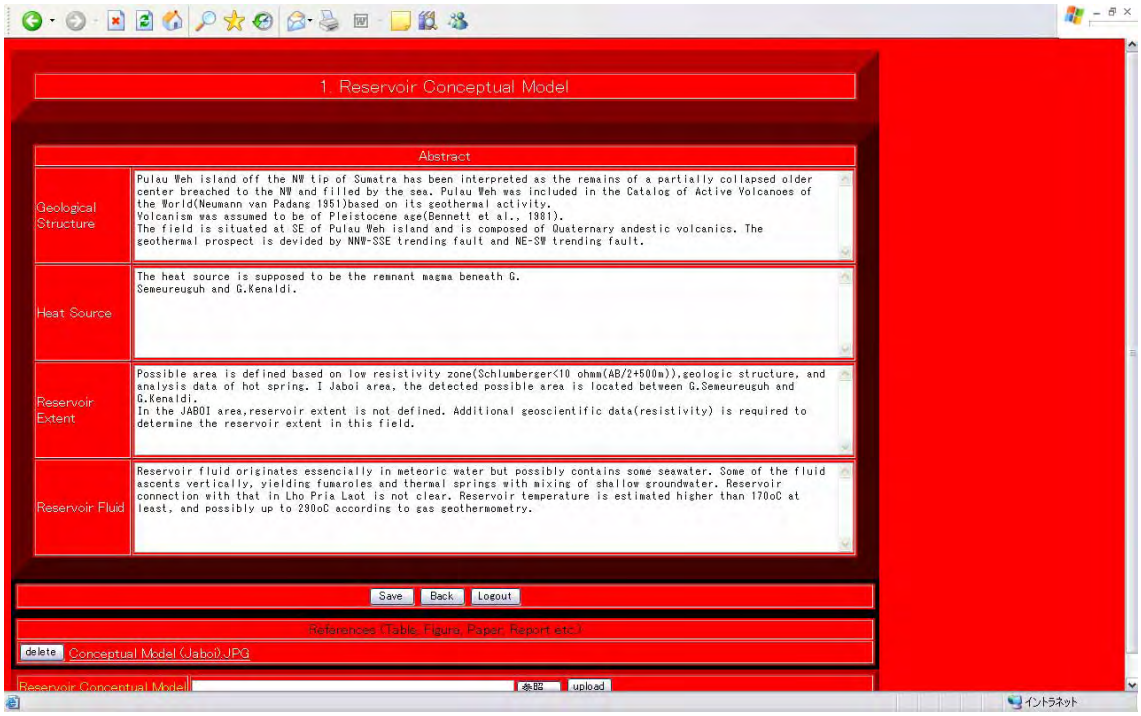


Fig. 7.2.2-10 Geothermal Structure, Geochemistry, Well and Geothermal Resources Information of Individual Field

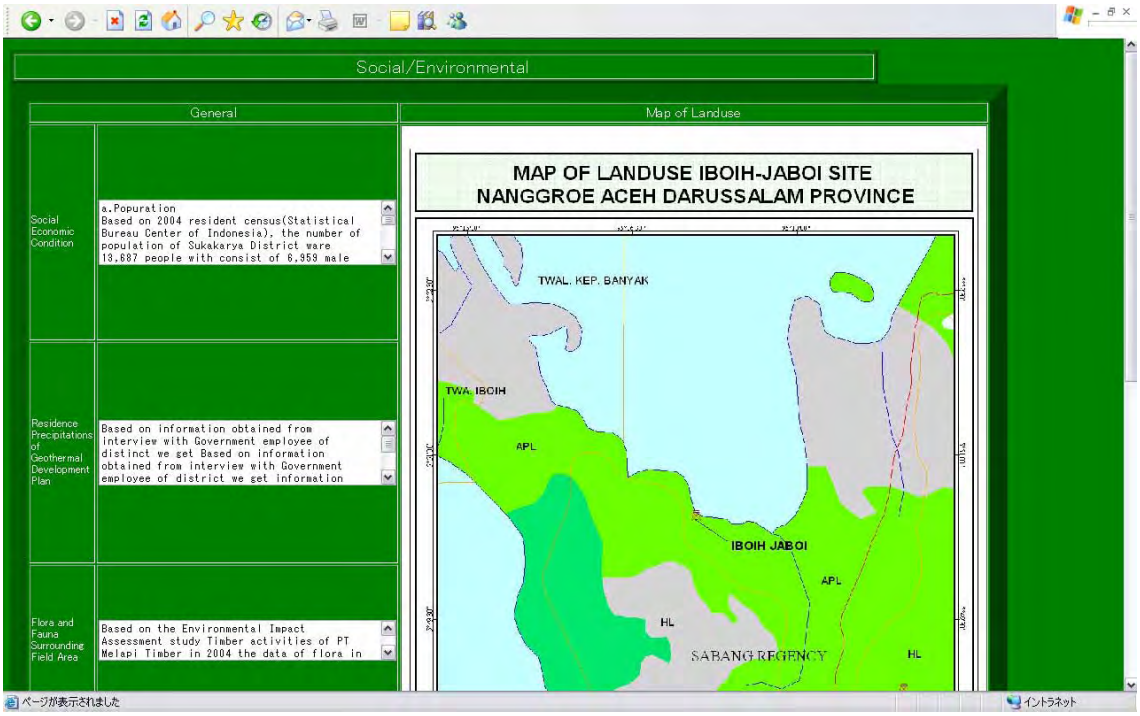


Fig.7.2.2-11 Social/Environmental Information of Individual Field

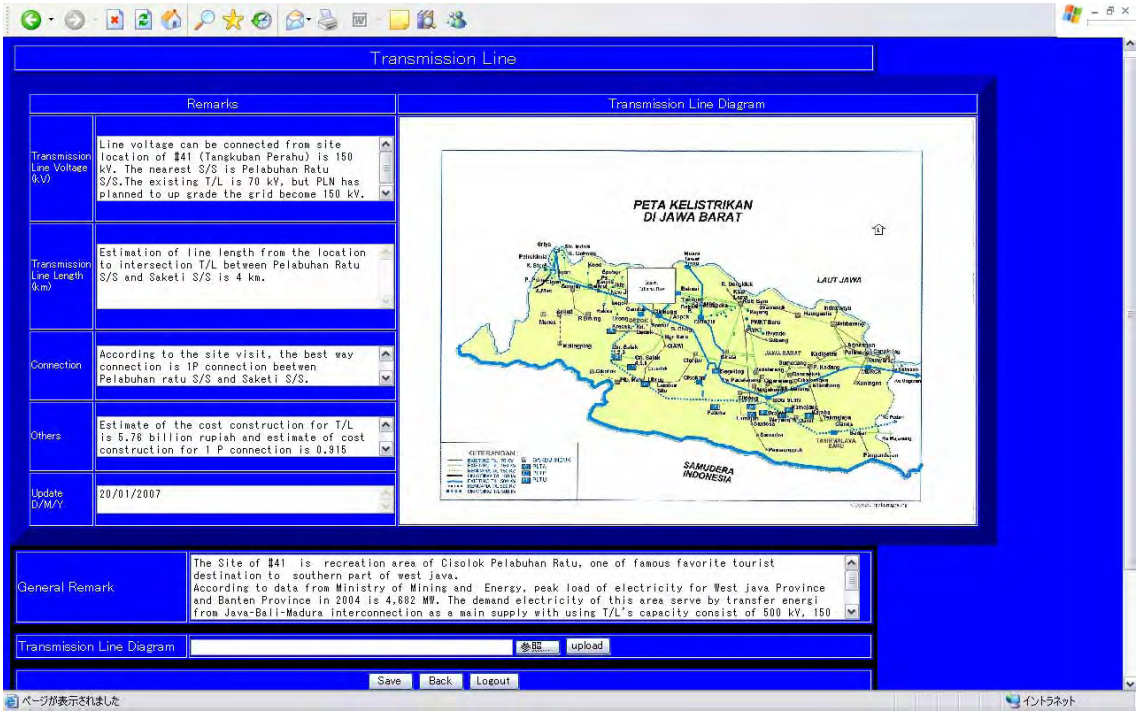


Fig. 7.2.2-12 Transmission Line Information of Individual Field

Table 7.2.2-1 Information Items of Geothermal development Database

	General Information	**Geothermal Resources**	**Policy, Social and Environment**	**Utility and Transmission Line**
Whole Indonesia	How to use the Database	a. Resource Potentials b. Geothermal Power Plant c. Prospective Area d. Development Process e. Business Scheme f. Investigation Status g. Load Map and Action Plan	a. Geothermal Law b. Environmental Assessment c. National park and Protected Forest d. Registration, Standards, and Regulations	a. Power Demand b. Power System c. Existing Power voltage d. Future Grid program
Individual Field	a. Area Code b. Latitude, Longitude c. Working Area d. Concession	a. Reservoir Conceptual Model b. Chemical Condition c. Well Productivity d. Resource Potential	a. Social and Economic Condition b. Residence Precipitations c. Flora and Fauna d. Climate Condition e. Land use	a. Transmission Line (T/L) Voltage b. T/L Length c. T/L Connection d. T/L Diagram e. Others

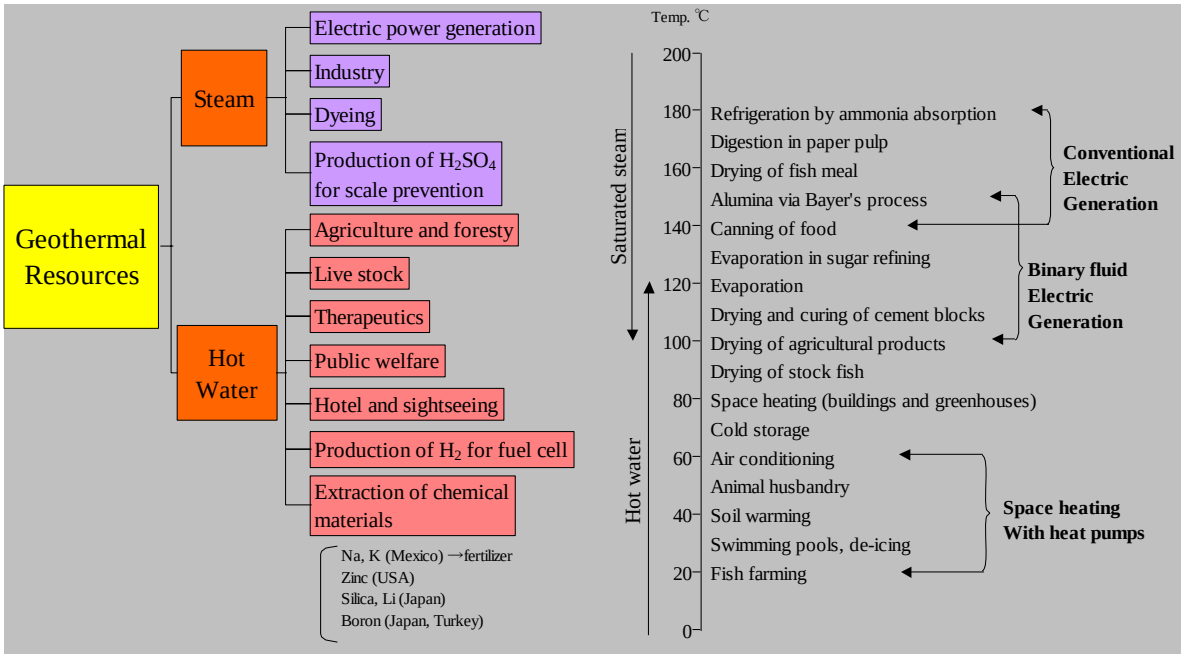


Fig. 7.4.1-1 Various Multipurpose Utilization of Geothermal Energy

Table 7.4.1-1 Case examples of geothermal multipurpose utilization in Oita, Japan

Location	Product	Use facilities
Beppu	Vegetable and floriculture..	The glass house and plastic greenhouse
	Floriculture, facilities heating, distribution hot water, and soil disinfection	Greenhouse and facilities
	bamboo shoots	Hot spring tube
Oita	Vegetable (Ohba)	
Shonai	Vegetable (Ohba)	
Yufuin	Vegetable (lion tow, mini Lycopersicon esculentum, and Ohba)	Plastic greenhouse and plastic house
	Floriculture (Western orchid etc.)	Plastic greenhouse and plastic house
	Zngiber mioga Roscoe.	Plastic greenhouse and plastic house
	Boiling log	Hot water tank
Naoiri	Vegetable	Greenhouse
Kusu	Fish breeding (Tilapia)	Hot spring pond
Kokonoe Kokonoemachi	Floriculture (Rosa hybrida hort. and Cyclamen persicum Mill., etc.)	The glass house
	Mushroom	Plastic greenhouse
	Tree	Greenhouse
	Fish breeding (Viviparus)	Greenhouse and water tank
Amagase	Floriculture (Rosa hybrida hort.)	The glass house and plastic house
	Fish breeding (soft-shelled turtle)	Greenhouse and water tank
	Vegetable dryness	Greenhouse
Yabakei	Fish breeding (soft-shelled turtle)	Greenhouse and water tank
Ajimu	Fish breeding (soft-shelled turtle)	Greenhouse and water tank

(a) At Cibodas

(b) At Darajat

Fig. 7.4.1-2 Traditional Bathing with Geothermal Hot Water

Fig. 7.4.1-3 Hot Water Swimming Pool in Cipanas

(a) Mushroom in Kamojang

(b) Copra in Way Ratai

Fig. 7.4.1-4 Geothermal Direct Use for Agriculture

Fig. 7.4.1-5 Geothermal Direct Use for Large Catfishes Growing in Lampung

Fig. 7.4.1-6 Geothermal Direct Use for Space Heating in Patuha Geothermal Field

Table 7.4.2-1 Summary of Direct Use Data from Individual Countries

Country	Capacity MWt	Use TJ/yr	Use GWh/yr	Capacity Factor
Albania	9.6	8.5	2.4	0.03
Algeria	152.3	2,417.0	671.4	0.50
Argentina	149.9	609.1	169.2	0.13
Armenia	1.0	15.0	4.2	0.48
Australia	109.5	2,968.0	824.5	0.86
Austria	352.0	352.0	2,229.9	0.20
Belarus	1.0	13.3	3.7	0.42
Belgium	63.9	431.2	119.8	0.21
Brazil	360.1	6,622.4	1,839.7	0.58
Bulgaria	109.6	1,671.5	464.3	0.48
Canada	461.0	2,546.0	707.3	0.18
Caribbean Islands	0.1	2.8	0.8	0.89
Chile	8.7	131.1	36.4	0.48
China	3,687.0	45,373.0	12,604.6	0.39
Columbia	14.4	287.0	79.7	0.63
Costa Rica	1.0	21.0	5.8	0.67
Croatia	114.0	681.7	189.4	0.19
Czech Republic	204.5	1,220.0	338.9	0.19
Denmark	821.2	4,360.0	1,211.2	0.17
Ecuador	5.2	102.4	28.4	0.62
Egypt	1.0	15.0	4.2	0.48
Ethiopia	1.0	15.0	4.2	0.48
Finland	260.0	1,950.0	541.7	0.24
France	308.0	5,195.7	1,443.4	0.53
Georgia	250.0	6,307.0	1,752.1	0.80
Germany	504.6	2,909.8	808.3	0.18
Greece	74.8	567.2	157.6	0.24
Guatemala	2.1	52.5	14.6	0.79
Honduras	0.7	17.0	4.7	0.77
Hungary	694.2	7,939.8	2,205.7	0.36
Iceland	1,791.0	23,813.0	6,615.3	0.42
India	203.0	1,606.3	446.2	0.25
Indonesia	2.3	42.6	11.8	0.59
Iran	30.1	752.3	209.0	0.79
Ireland	20.0	104.1	28.9	0.17
Israel	82.4	2,193.0	609.2	0.84
Italy	606.6	7,554.0	2,098.5	0.39
Japan	413.4	5,161.1	1,433.8	0.40
Jordan	153.3	1,540.0	427.8	0.32
Kenya	10.0	79.1	22.0	0.25
Korea (South)	16.9	175.2	48.7	0.33
Lithuania	21.3	458.0	127.2	0.68
Macedonia	62.3	598.6	166.3	0.30
Mexico	164.7	1,931.8	536.7	0.37
Mongolia	6.8	213.2	59.2	0.99
Nepal	2.1	51.4	14.3	0.78
Netherlands	253.5	685.0	190.3	0.09
New Zealand	308.1	7,086.0	1,968.5	0.73
Norway	450.0	2,314.0	642.8	0.16
Papua New Guinea	0.1	1.0	0.3	0.32
Peru	2.4	49.0	13.6	0.65
Philippines	3.3	39.5	11.0	0.38
Poland	170.9	838.3	232.9	0.16
Portugal	30.6	385.3	107.0	0.40
Romania	145.1	2,841.0	789.2	0.62
Russia	308.2	6,143.5	1,706.7	0.63
Serbia	88.8	2,375.0	659.8	0.85
Slovak Republic	187.7	3,034.0	842.8	0.51
Slovenia	48.6	712.5	197.9	0.46
Spain	22.3	347.2	96.5	0.49
Sweden	3,840.0	36,000.0	10,000.8	0.30
Switzerland	581.6	4,229.3	1,174.9	0.23

Thailand	1.7	28.7	8.0	0.54
Tunisia	25.4	219.1	60.9	0.27
Turkey	1,177.0	19,623.1	5,451.3	0.53
Ukraine	10.9	118.8	33.0	0.35
United Kingdom	10.2	45.6	12.7	0.14
United States	7,817.4	31,239.0	8,678.2	0.13
Venezuela	0.7	14.0	3.9	0.63
Vietnam	30.7	80.5	22.4	0.08
Yemen	1.0	15.0	4.2	0.48
GRAND TOTAL	**27,824.8**	**261,418.0**	**72,621.9**	**0.30**

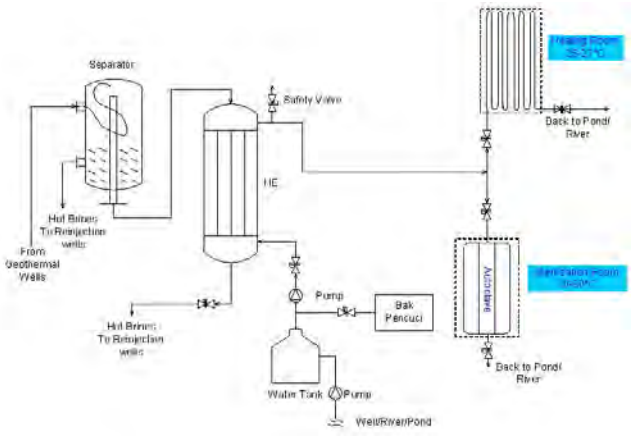


Fig. 7.4.3-1 Schematic Diagram of Mushroom Growing Direct Use in Kamojang Geothermal Field

(a) Steam Generator

(b) Autoclave

(c) Baglogs

(d) Production Houses

Fig. 7.4.3-2 Direct Use Facility for Mushroom Growing in Kamojang

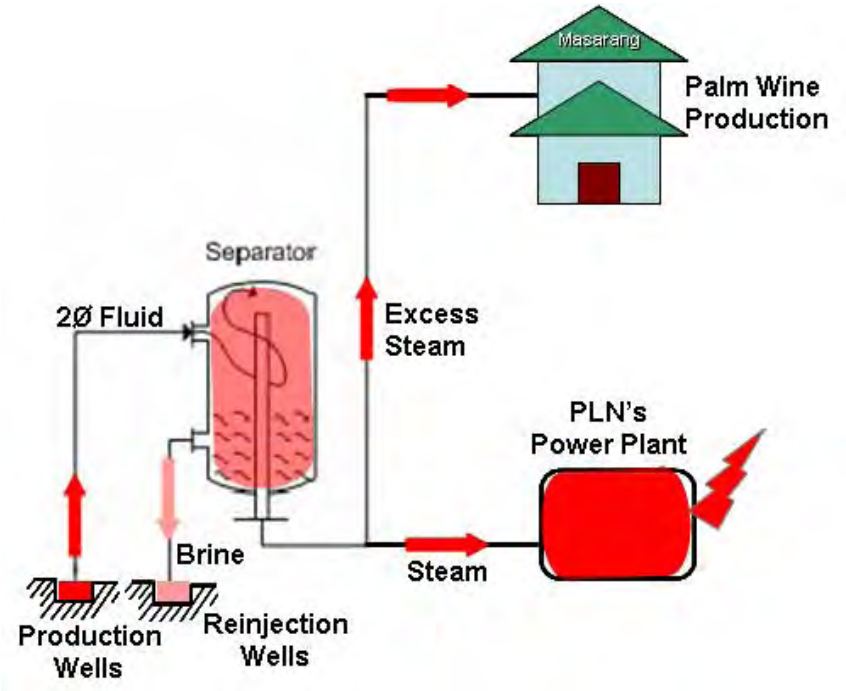


Fig. 7.4.3-3 Schematic Diagram of Palm Wine Production in Lahendong

Fig. 7.4.3-4 Direct Use for Palm Wine Production in Lahendong

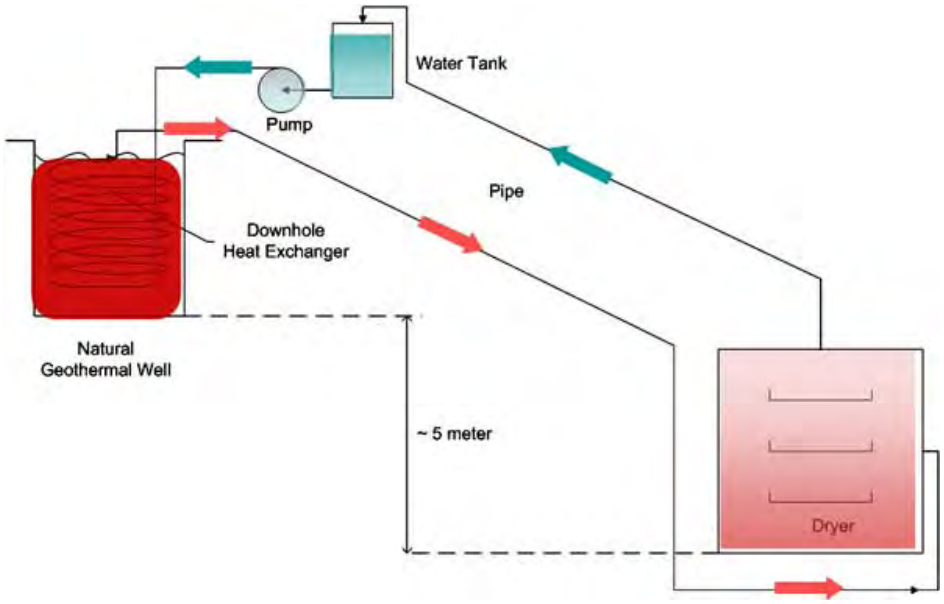


Fig. 7.4.3-5 Schematic Diagram of Direct Use for Copra Production in Way Ratai Geothermal Field

(a) Down hole Heat Exchanger in Natural Geothermal Well

(b) Copra Drying Room

Fig. 7.4.4-1 Direct Use Facility for Copra Production

Fig. 7.4.4-2 Wayang Windu Geothermal Power Plant Located in Tea Plantation