Indonesia

(Indonesia)
THE PREPARATORY SURVEY ON SMALL HYDRO PROJECTS IN SUMATRA AND SULAWESI IN REPUBLIC OF INDONESIA
Final Report

＜Nasal＞

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Independent Administrative Corporation

Japan International Cooperation Agency

Industrial Decisions, Inc.

Hokuden Sougou Sekkei, Inc.

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Glossary

Abbreviation	English	Indonesian
AMDAL	Environmental Impact Assessment (EIA)	Analisis Mengenai Dampak Lingkungan
ASEAN	Association of South-East Asian Nations	
ARGR	Automatic Rain Gauge Recorder	
AVR	Automatic Voltage Regulator	
AWLR	Automatic Water Level Recorder	
BMG	The Bureau of Meteorology and Geophysics	
BPN	National Land Agency	Badan Pertanahan Nasional
BPPT	Agency for Assessment and Application of Technology	Badan Pengkajian dan Penerapan Teknologi (BPPT)
CDM	Clean Development Mechanism	
CER	Certified Emission Reduction (Unit for CDM)	
CF	Capacity Factor	
COD	Commercial Operation Date	
DESDM	Ministry of Energy and Mineral Resources (MEMR)	Departemen Energi dan Sumber Daya Mineral
EIA	Environmental Impact Assessment	AMDAL
EPC	Engineering, Procurement and Construction	
FIN	Feed In Tariff	
FS	Feasibility Study	
FTP	Fast Track Program	Crash Program (Another name)
GDP	Gross Domestic Product	
GHG	Greenhouse Gas	
GP	General Partnership	
GW	Gigawatt	
HEPCO	Hokkaido Electric Power Co., Inc	
HEPP	Hydro Electric Power Project	
IDI	Industrial Decisions Inc.	
IDI-I	IDI Infrastructures Inc.	

IDC	Interest During Construction	
IDX	Indonesia Stock Exchange	Bursa Efek Indonesia
IEA	International Energy Agency	
IEE	Initial Environmental Evaluation	
IMB	Indonesian building permit	Izin Mindirikan Banyunan Bupati
IMF	International Monetary Fund	
IPO	Initial Public Offering	
IPP	Independent Power Producers	
IT	Information Technology	
JICA	Japan International Cooperation Agency	
KKO		Kata Kerja Operational
kW	kilowatt	
kWh	kilowatt-hour	
LP	Limited Partnership	
M&A	Merger and Acquisition	
MEMR	Ministry of Energy and Mineral Resources	
MW	Megawatt	
MWh	Megawatt-hour	
NEF	New Energy Foundation	
NJOP	Selling Value of Taxed-Object	
NRECA	National Rural Electric Cooperative Association	
ODA	Official Development Assistance	
Perpres	Presidential Regulation (PR)	Peraturan Presiden
IIGF	Indonesian Infrastructure Guarantee Fund	PT Penjaminan Infrastruktur Indonesia
PIP		Pusat Investasi Pemerintah
PLN	State Electricity Company	Perusahaan Listik Negara
PP	Government Regulation	Peraturan Pemerintah
PPA	Power Purchase Agreement	
PPP	Public-Private Partnership	
SMI		Sarana Multi Infrastruktur
SPC	Special Purpose Company	
TWh	Terawatt-hour	

UKL	Environmental Management Procedure	
UPL	Environmental Monitoring Procedure	
WL	Water Level	

Chapter.1 Introduction

1-1. Background of the Preparatory Survey Regarding the Small Hydro Power Project in Sumatra and Sulawesi

The purpose of implementing the Preparatory survey (hereafter “the Survey”) regarding the small hydro-power project in Sumatra and Sulawesi (hereafter “the Target Project”) is to accelerate the development of the small hydro-power project in Indonesia. The Survey will be conducted according to the following viewpoints: business / project development plan of the Target Project, possibility of installing Japanese technology and equipment and possibility of utilizing funding (capital/loan).

The Survey has been led to start as the electricity demand in Indonesia is soaring and the Indonesian government has considerable expectations for the development of the small hydro-power plants. Sumatra and Sulawesi islands have growing demand in particular (see 1-1-1 for details), leading to higher power purchase price (see 2-4-1 for details), and preliminary study found project owners with intention to run the business for long time instead of planning to sell off the projects.

At the beginning of the Survey, two projects in Sumatra and one project in Sulawesi were selected as the Target Projects. After the project owner conducted the third party review by international technical consulting company and found that the generation capacity would be significantly smaller than previously assumed by the feasibility study, the project owner gave up development of the project. Thus, the Survey has replaced the Target Project from this Sulawesi project to the other in South Sumatra with high possibility of going forward, and the Survey has all three projects in Sumatra.

1-1-1. Development issues and situations of infrastructures and electricity demands in Indonesia

Although the electricity demand in Indonesia has steadily grown since the Economic Crisis in 1997, it has been recognized that electricity supply in the country is scarce compared to the commercial and industrial electricity demand, which is one of the bottleneck for the country’s economic growth. For example, PLN does not have enough capacity to meet the rapidly growing electricity demand. In addition, the country’s electrification ratio is mere 71.2% (as of 2011), which means that nearly 20 Million[1] households do not have publicly supplied electricity. In the case of Indonesia, it is projected that due to its rapid economic and population growth, the electricity demand will grow 7-9% p.a., which makes the electricity supply even more urgent.

The maximum electricity demand in Sumatra-grid is 4,601MW as of 2011, and is reaching 9,641MW by 2020. The maximum electricity demand in Sulawesi-grid is 1,087MW as of 2011, and is expected to grow by 2,718MW by 2020. It is essential for both grids to develop new power plants to meet the above demand, especially factoring in sudden stoppage due to decrepit existing facilities.

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[1] Price Waterhouse Coopers ”Electricity in Indonesia-Investment and Taxation Guide”

1-1-2. Necessity of developing the Target Project as Public Private Project

The fundamental of the governmental policy for the electricity issues is that the government has restrained the retail sales price of electricity in order to reduce the payment burden of households. Therefore, the cost of power generation is higher than the cost of electricity price in Indonesia. This has caused PLN some cash shortage and it is obvious that PLN has difficulty to develop the power generation plants by itself to meet country's growing electricity demand. Thus, the government of Indonesia amends Electricity Business Act, consolidates a legal system such as enacting FIT, and expects private capital emergence which can be seen in 'Fast Track Program'.

1-2. The Aim of the Survey

Although the policy pertaining to support renewable energy projects has been put into place, the development of the small hydro-power project has not seen much progress as expected. This is because that the local financial institutions usually do not provide the loan by project finance scheme, and instead assess projects by credit of the company. And most project owners of small hydro-power projects are small and medium size enterprises that they have difficulty even to get approval for Power Purchase Agreement (PPA) or other permission and authorization due to their low creditworthiness.

Hence, the aim of the Survey is to see how the small hydro-power projects can be developed by utilizing Japanese technology, equipment and funding and is to help the steady economic growth in Sumatra and Sulawesi by developing the small hydro power in both islands.

The survey report uses 111.200IDR/YEN as the reference rate of IDR/YEN as of December 31, 2012.

Chapter.2 Confirmation of the Current Status and Future Projections of Small Hydroelectric Power Projects in Indonesia

2-1. Current status, Challenges and the Future Plan of the Indonesian Electricity Sector with Some Focus on Renewable Energy

Indonesia possesses abundant oil, natural gas and coal. As a result, it is largely dependent on thermal power generation. As of 2010, generating capacity was 33.2GW and the gross generation was 169.8TWh. During the 20 years from 2010 to 2030, the gross generation will increase at the rate of approximately 9.1% per year.

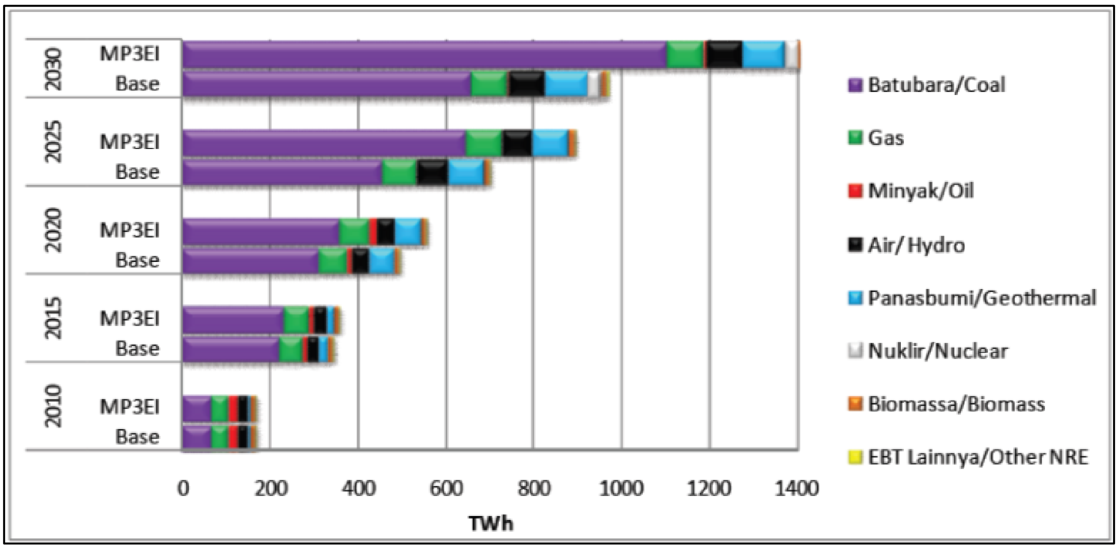

Figure 2-1 Trend of Gross Generation (By Fuel Type)[2]

Source: BPPT. "Outlook Energy Indonesia 2012"

However, due to the rapid economic development, since 2004 Indonesia has become a net-importer of oil. Combined with the rising global oil prices, the Indonesian government has stated that it will strive to reduce its dependency on oil[3]. Therefore, in order to compensate for the electricity demand, growing at the rate of more than 9% per year, Indonesian government has planned and executed "Fast Track Program", aiming for the large scale development and construction of power generating plants by using coal and renewable energy sources.

[2] "MP33EI" is an abbreviation of "Masterplan Percepatan dan Perluasan Pembangunan Ekonomi Indonesia"
[3] Ministry of Energy and Resources, "UPDATES ON POLICY TO PROMOTE RENEWABLE ENERGY DEVELOPMENT AND ENERGY CONSERVATION IN INDONESIA, November 2011"

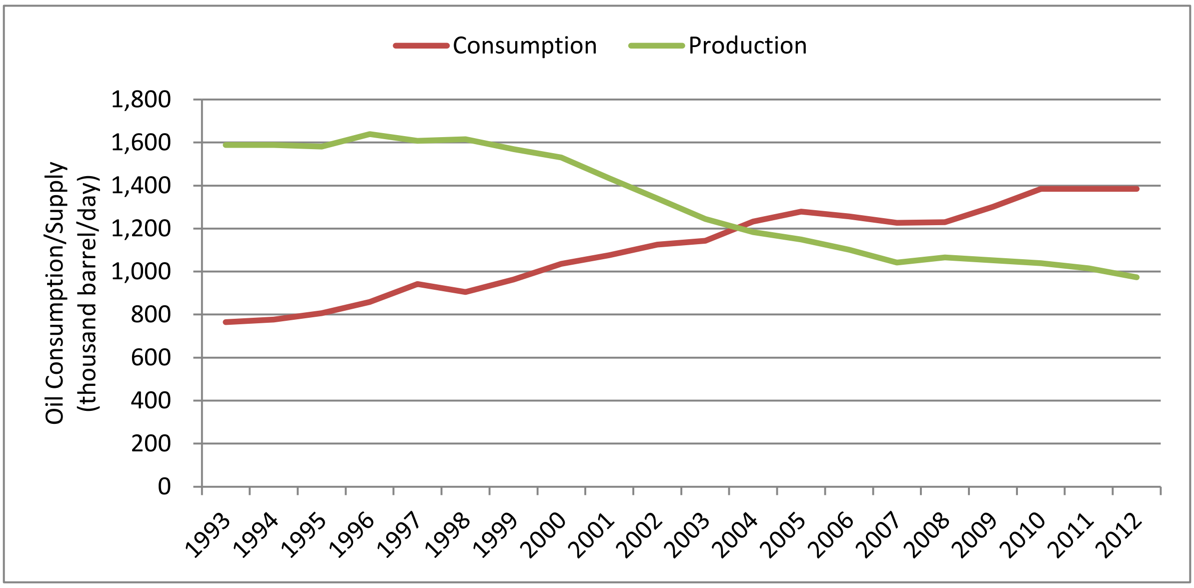

Figure 2-2 Volume of Oil Consumption and Supply

Source: Energy Information Association (U.S.A.)

In order to meet the expanding electricity demand, the "First Fast Track Program" planned to meet the electric development capacity target solely through coal-fired power plants. However, facing the environmental concerns, the government was requested to revisit the power development plan focusing on coal-fired power plants. Although the "First Fast Track Program" was executed by the PLN, the "Second Fast Track Program" outlined a plan to utilize Independent Power Producer (IPP). The "Second Fast Track Program" also planned to utilize renewable energy sources, with a development target of 18.1GW, close to four times as much as that of nowadays, by 2030[4].

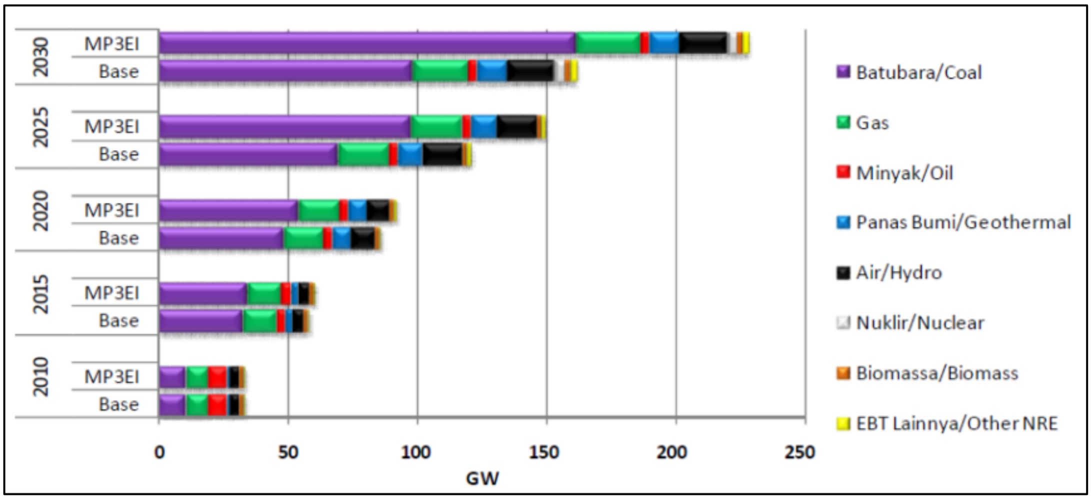

Figure 2-3 Estimated Composition of Generation Capacity by Fuel

Source: BPPT "Outlook Energi Indonesia 2012"

[4] Badan Pengkajian dan Penerapan Teknologi(BPPT), "Outlook Energy Indonesia 2011"

Table 2-1 Fast Track Programs

	First Fast Track Program	Second Fast Track Program
Period	2006～2009	2010～2014
Scale of Development	10,000MW	10,153MW
Type of Fuel	Coal 10,000 MW (100%)	Coal 3,312 MW (33%) Gas 1,660 MW (16%) Geo-thermal 3,977 MW (39%) Hydro 1,204 MW (12%)

Source: PLN

Indonesia has the highest potential in developing geo-thermal power plants. Due to this, many companies, including Japanese companies, are actively engaged in the development of boring geo-thermal and geo-thermal power plants projects. It has been pointed out that the development of the geothermal power generation generally takes much time and cost, from geological survey to the start of operations, therefore, limiting the potential developers to those companies which have abundant capital to implement the projects.

Table 2-2 Potential of Development of Thermal Power Plants

Country	Number of Active Volcanoes	Volume of Geo-thermal Source（MW）
Indonesia	150	27,791
USA	133	23,000
Japan	100	20,540
Philippine	53	6,000
Mexico	35	6,000
Iceland	33	58,000
New Zealand	19	3,650
Italy	14	3,267

Source: The Agency of Energy and Resource, “On the development of thermal resource”, Oct.2011

On the other hand, although the development cost of large size the hydraulic power plants with sufficiently abundant resources is likewise costly, the construction of small hydroelectric generation projects of 10MW or less does not require such high costs, thus, keeping initial investment low and having the development period short. Due to these reasons, considering the increasing electricity demand, small-scale hydroelectric power is considered to be the most suitable means to meet the demands.

Table 2-3 Development Potential of Hydro Power Plants (MW)

Type	Development Potential	Existing Generation Capacity	Rate
Hydro	75,769 MW	7,571 MW	9.99%
Geothermal	29,164 MW	1,341 MW	4.6%
Biomass	49,810 MW	1,644 MW	3.3%
Solar PV	4.80 $kWh/m^2/day$	42.78 MW	-
Wind	3 – 6 m/s	1.87 MW	-
Ocean	49 GW	0.01 MW	0%

Source：MEMR “Country Report: Renewable Energy in Indonesia (2012)”

2-2. Present Conditions and Challenges Facing the Electricity Sector and Future Development Plans with Some Focus on Renewable Energy of Sumatra

As of October 2011, according to the announcement of PLN, the electrification rate of Indonesia is 71.2%. Depending on the region, the electrification rate in and around the main urban areas such as Java and Sumatra is high, while there are still many under-developed regions, remote place of the mountains or the eastern Nusa Tenggara/ Papua area which have not been electrified. Although, originally, it was the deemed the responsibility of PLN to construct and maintain the electric infrastructure of these rural areas, due to the implementation of the Electricity Act in 2009, under the direction of the central and local governments, governmental/private enterprises and cooperatives were allowed to enter the market.

As of 2010, the electrification rate of Sumatra Island is about 62.5%. Its rate is higher than other areas except Java Island and Bali Island. The Sumatra grid system is a developed one which is synchronized by linking northern and southern grid systems with 150 kV power transmission line.[5] It is planned to further develop 275kV and 500kV grid system by PLN as shown in Figure 2-4.

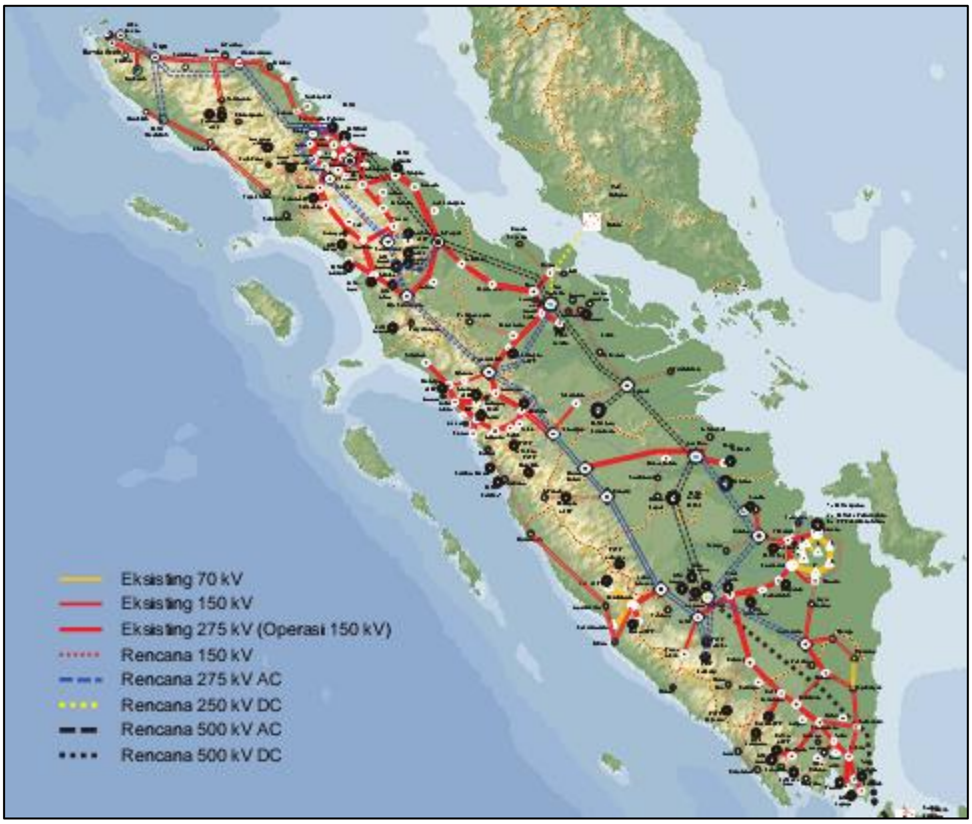

Figure 2-4 Sumatra Grid System Development Plan

Source: PLN "2012-2021 Power Development Plan (RUPTL)" Dec 2012

For this reason, to construct and maintain the electric infrastructure of its rural areas show sound

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[5] Ministry of Energy and Mineral Resource, "2008-2027 National Electricity Global Planning 2008-2027"

progress. Bengkulu Province, the place where our project in the research conduct, record 54.6% at electrification rate. On the other hand, Riau Province and Jambi Province record 40.2% and 31.7% respectively, and they still have many unelectrified areas.

Table 2-4 Each Province's Electrification Rate in Sumatra Island（2012）

Name of Province	Population (Thousand)	Household （Thousand）	Electrification Rate （%）
Ache	4,693.9	1,105.1	88.55
North Sumatra	13,215.4	3,112.5	84.61
West Sumatra	4,957.7	1,182.5	72.98
South Sumatra	7,701.5	1,870.2	63.09
Bengkulu	1,766.8	445.5	71.02
Riau Islands	811.5	192.1	72.13
Lampung	7,767.3	1,985.0	65.29
Bangka Belitung	1,298.2	324.6	73.94
Riau	5,929.2	1,394.7	56.52
Jambi	3,242.8	800.4	58.05
Total	51,384.3	12,412.6	71.69

Source: PLN. "PLN Statistics 2012" Mar 2013

According to 2012-2021 Power Development Plan (RUPTL) stated by PLN, the electricity demand in Sumatra is projected to increase to 65.4TWh by 2021 along with 7.1% annual average economic growth and an annual average increase of 8.2% in electric demand.

Moreover, this plan sets out a target of 97.6% electrification rate by 2021.

Table 2-5 Average Indexes in Sumatra

Population Growth Rate	Annual Average Economic Growth Rate	Annual Average Electricity Demand Growth	Electricity Demand As of 2021 (MW)	Electricity Demand As of 2021 (GWh)
1.8%	7.1%	10%	10,516MW	55,272GWh

Source: PLN "2012-2021 Power Development Plan (RUPTL)" Dec 2012

According to PLN's 2012-2021 Power Development Plan (RUPTL), its baseline plans that while coal-fired thermal power remains as the nucleus of future development of power sources in Sumatra, 1.6 GW of hydro power is expected to be generated by 2021 and total hydro power installed capacity will be 2.6GW and shared 15.7%. Therefore, it is forecast that there will be certain hydro power development in Indonesia.

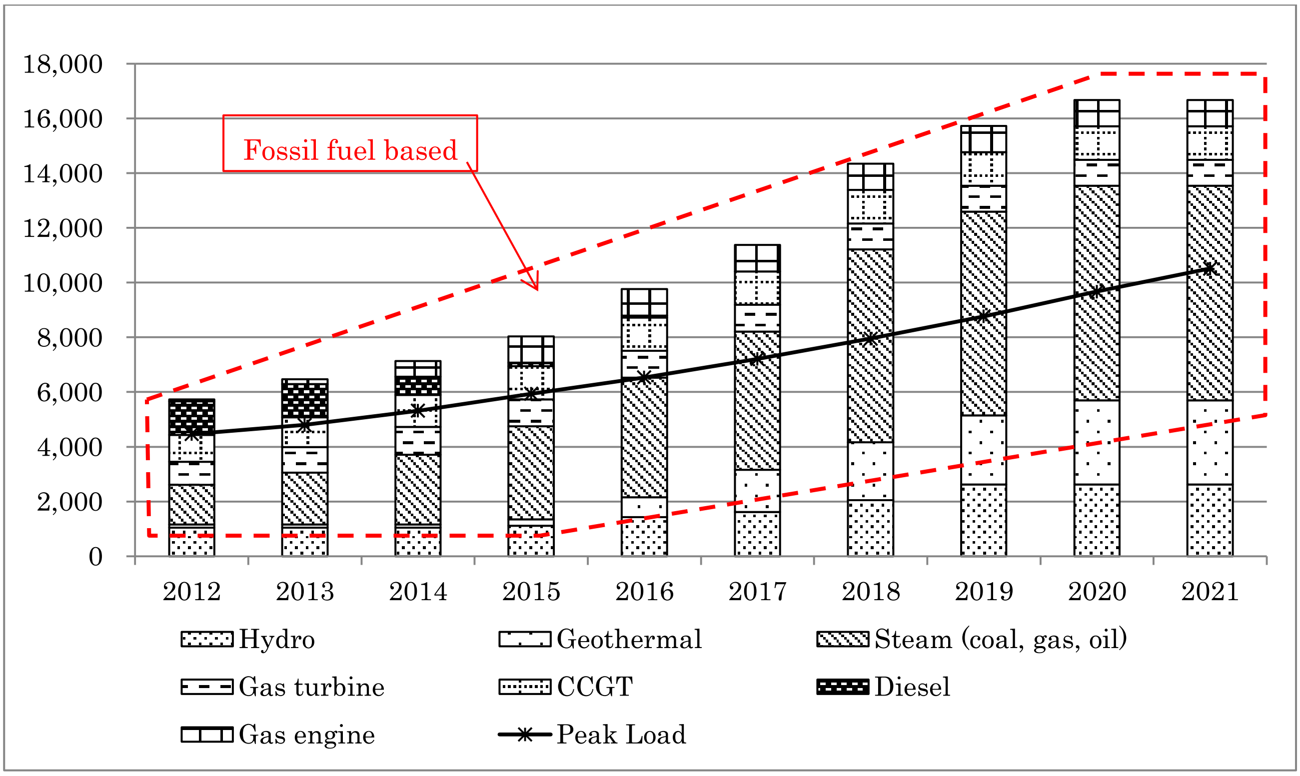

Figure 2-5 Forecast of Generation Capacity and Peak Load

Source: PLN "2012-2021 Power Development Plan (RUPTL)" Dec 2012

However, as shown in the figure below, generation cost of fossil fuel based power plants, given increased fuel cost, is much higher than hydro. Therefore, small hydro power is supposed to be prioritized for generation as it has competitive advantage in generation cost, over other plants.[6]

[6] PLN, as an off-taker of the electricity produced by small hydro power plants, is obligated to purchase all electricity during the contract period. Thus, regardless of the cost comparison with other power plants, electricity produced by small hydro will be purchased.

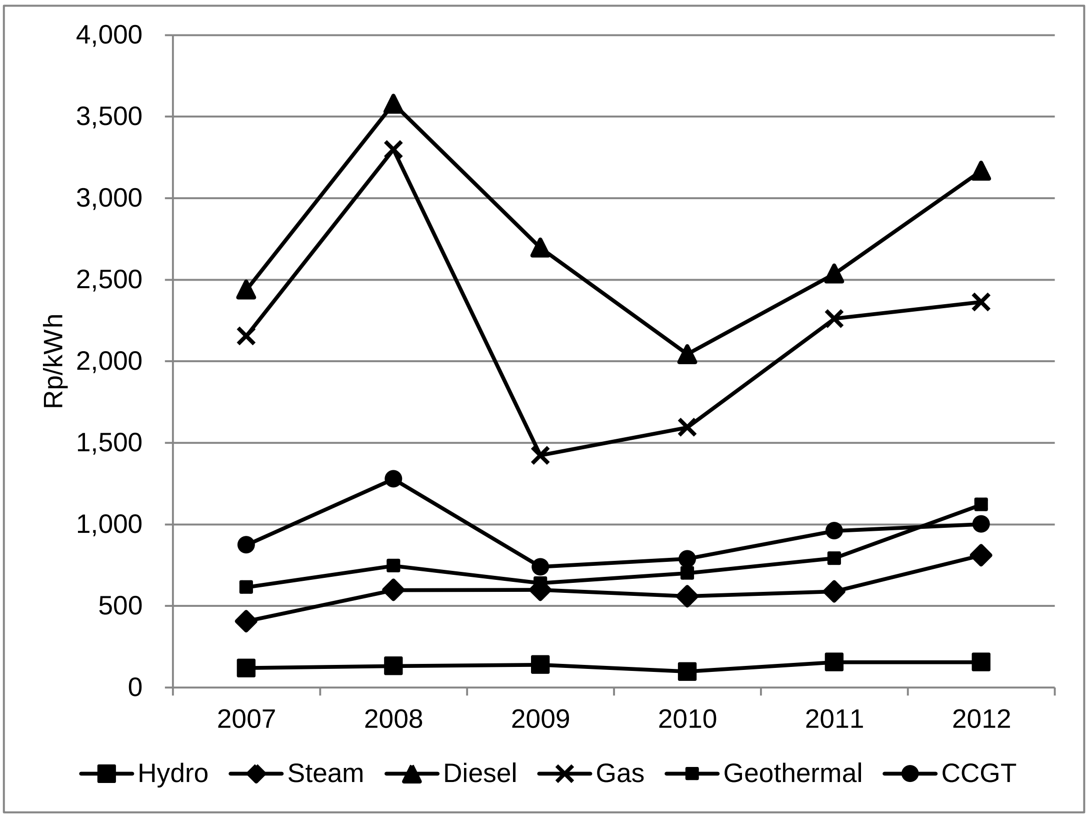

Figure 2-6 Generation Cost Comparison

Source: PLN "PLN Statistics 2012" Mar 2013

According to RUPTL, the following table is the power development plan in Bengkulu.

Table 2-6 Power Development Plan in Bengkulu (2012 – 2021)

Plant Name	Fuel	Capacity	Scheduled commencement of operations	Owner
Ipuh	Coal	6 MW	2013	PLN
Muko Muko	Coal	8 MW	2013	IPP
Simpang Aur	Hydro	23 MW	2015	IPP
Hululais	Geothermal	110 MW	2016	PLN
Ketahun-3	Hydro	61 MW	2019	PLN
Kepahiyang	Geothermal	220 MW	2020	PLN

Source: PLN "2012-2021 Power Development Plan (RUPTL)" Dec 2012

2-3. Summary of the Indonesian Laws Regulations, Policy and Structure Relating to Electricity Focusing on Renewable Energy and Public-Private Partnerships (PPP)

2-3-1. Background and summary of PPP structure and policy in Indonesia[7]

When the Yudhoyono administration was established, the Indonesian government was in a tight economic situation. To promote the growth of the national economy and the furtherance of infrastructure development, the government implemented PPP policies. By opening the areas previously controlled by the public sector such as 1) transport 2)high way 3)irrigation 4)water-works 5)refuse disposal 6)communication 7)electricity 8)oil and natural gas infrastructure to private investments, through the PPP scheme, the Indonesian government hopes to attract both the capital and expertise of foreign companies.

In January 2005, President Yudhoyono invited domestic and overseas investors to 'the Infrastructure Summit 2005'. In November of the same year, Presidential Regulation (PR) number 67/2005 concerning Public Private Partnership in Infrastructure Development was issued to promote PPPs. The objective of the PR 67/2005 was to develop the national infrastructure by utilizing the PPP system. Yet, despite having published 91 candidates for PPPs and selecting 10 model projects, due to the ambiguity of the government's responsibilities under the PR 67/2005, foreign investors failed to show interest and consequently feasibility studies of many of the PPP projects were not conducted. Subsequently, during the first Yudhoyono regime, no PPPs were formed.

However during Yudhoyono's second term of office (October 2009 to September 2014), PR 67/2005 was revised and PR 13/2010 was issued, which clearly defined the Indonesian government's responsibility with regard to PPP projects, including terms regarding the acquisition of land, government subsidies, governmental guarantee on loans. Consequently, the private sector's risks in entering the PPP projects have been greatly reduced.

Table 2-7 Modification from PR67th / 2005 to PR13th / 2010

Modification	PR 67/2005	PR 13/2010
Contracting Agent/Office	No designation regarding Contracting Agent Executing Agent limited to respective ministers, commissioners, the local government chairman	Executing Agent is also designated as the Contracting Agent (which includes provincial/state governments' development authorities)
Share Transfer	➢ No transferal of shares before commercial operation	➢ All or a part of shares are permitted to be transferred
Form and Range of the	Ambiguous terms of government support for projects	Defined the terms of government: ① Government responsibility:

[7] Mizuho Research Institute Ltd, "Indonesia, accelerating the investments for infrastructures with PPP", Oct.18th 2011.

Government Support		(e.g. expropriation of land, approval and license, provision of basic infrastructure) ② Government subsidies (e.g. operating cost) ③ Government guarantee for contingent liabilities
Funding procedures	No particular provisions	The project owner must complete funding within 12 months after the signing of the agreement If one of the following conditions are met, funding shall be deemed complete. ① All documents of all funding for this business are signed. ② The pre-determined amount specified in the finance contract has been spent.

Source：Engineering & Consulting Firms Association

In April 2011, Indonesian Infrastructure Guarantee Fund (IIGF) was established as a solely owned subsidiary of Indonesian Department of Finance with the aim of strengthening government guarantee. IIGF aims to cover government risks that private company cannot control, such as delay in decision making, default of contract and occurrence of events that lie outside the jurisdictions of existing ministries.

As a result of the implementation of policies and framework for the promotion of PPPs, combined with the economic growth driven by the domestic demand and the political stability, the Indonesian market has begun to attract more attention as a potential investment target.. In January 2012, Indonesia's investment rating was raised to BBB-.

2-3-2. Outline of Legal System Related to Electric Power in Indonesia

Regulations related to the electric power business in Indonesia are mainly defined in the Electricity Act of 2009 that was published in September 2009.

The Act defines the electricity supply business as power procurement through power generation, transmission, distribution, and sale to consumers[8]. Indonesian Government assumes principal

[8] The Electricity Act 30/2009, Article 1.

responsibility of power supply[9], but local government is also involved in making various plans and responsible for issuing certain permits necessary for the IPP developers. Under the act, National Electricity General Plan (RUKN) is developed based on the national energy policy through the process participated by the local government as well. In addition, based on the RUKN, local government makes Regional Electricity General Plan after discussion with local parliament.

PLN lost its complete exclusive rights over power supply by the Electricity Act 30/2009, and government owned company, publicly owned company, private company, cooperative, or NGO with power supply business permit (IUPTL) are allowed to conduct generation, transmission, distribution, and retail businesses. However, PLN has the priority to supply electricity to the public[10]. In transmission and distribution sector, the entry barrior could be high because PLN has dominated the market developing infrastructures.

As to the electrification of rural area, it is defined that central government and local government establish the fund for the people in poverty and develop power facilities, power supply to remote and rural area, and rural electrification facilities.

For the renewable energy projects with certain capacity size, Feed in Tariff system where it is possible to sign PPA with PLN for long term fixed price without price negotiation is installed by the MEMR Ministerial Regulation 31/2009 and 04/2012 (see 2-4-1 for details). FIT is based on the Electricity Act of 2009, which allows government owned company, publicly owned company, private company, cooperative, or NGO to conduct electricity supply business, and obligate PLN to purchase electricity produced by the renewable energy source of up to 10MW, developed by the project owners mentioned above.

Foreign investment in power generation sector is regulated by Negative Investment List (Presidential Regulation 36/2010) shown as the following. It is necessary to pay attention to the on-going discussion on its revision.

Table 2-8 Negative Investment List in Power Sector

Business Sector	Conditions
Generation (< 1MW)	Closed; Only for UMKMK[11]
Generation (1-10MW)	Partnership; no limitation for foregin investment but cooperation with UMKMK required (investment, outsourcing, rental or any kind of participation)

9 The Electricity Act 30/2009, Article 3
10 The Electricity Act 30/2009, Article 11
11 UMKMK is a private or company satisfied with low No. 20/2008 concerning micro, small and medium enterprises and low No. 25/1992 concerning cooperatives.

Generation (> 10MW)	Foreign capital raito is up to 90%
Gepthermal plant operation and maintenance	Foreign capital raito is up to95%
Geothermal power	Foreign capital raito is up to 95%

Source：Presidential Regulation 36/2010

2-4. The Objectives, Policies and Institutions of the Central and the Local Government for Financial Resource and Subsidy System of Renewable Energy Development with a focus on Small Hydro Power

2-4-1. Summary of the government objectives for hydroelectric power

As noted earlier, the second Fast Track Program aimed to develop 1204MW by hydroelectric power and to introduce Feed-in-Tariff (FIT) for renewable energy of 10MW or less including small hydro.

The term for power purchase is not defined in the regulation, but about 10-20 years can be seen in the power purchase agreement generally, providing long-term stable power sales expectations. The FIT is applied to all renewable energy of 10MW or less, excluding geo-thermal which could be bigger to be qualified. Power plants over 10MW must negotiate directly with PLN for a PPA price. As the negotiation is often protracted, the risk of the project failing for those over 10MW is larger than those of 10MW and less. It is said that the size to be qualified for FIT may expand up to 15MW from 10MW.

At the conference held in September 2013, senior official of MEMR explained that FIT price for small hydro is being reviewed to be revised soon. The discussion is continued between MEMR and PLN where MEMR shoots for about 20% increase while PLN hopes to minimize the level of increase. Consequently, there is a need to seek timely information from the government and authorities concerned.

Table 2-9 FIT Pricing Structure

System	Hydro Wind Solar Power etc. (<10MW)		Biomass (<10MW) (*)		Thermal
	Medium Voltage (Rp/kWh)	Low Voltage (Rp/kWh)	Medium Voltage (Rp/kWh)	Low Voltage (Rp/kWh)	High Voltage (USD/kWh)
Java, Maudra, Bali	656	1,004	975	1,325	9.7cent ⇒11～15cent
Sumatera, Sulawesi	787	1,205	1,170	1,590	
Kalimantan, Nusa Tenggara	853	1,305	1,268	1,723	
Maluku, Papua	984	1,506	1,463	1,988	

Source: The Regulation of Ministry of Energy and Mineral Resources No. 4 Year 2012

(*) The price varies if final disposal technology is used.

2-4-2. Preferential Tax Treatment

In order to promote the second Fast Track Program, which focuses on renewable energy, the Indonesian government issued preferential tax treatments for renewable energy power producers through the regulation of the Minister of Finance number 24/PMK.011/2011 dated January 29th 2010. The target businesses were those of geo-thermal, wind, biomass, solar PV, hydro, ocean current and ocean thermal generation. The preferential treatments are defined as a deduction of 30% of investment amount from taxable income, the shortening of the depreciation period of assets, exemption of value-added tax and import duties for imported machinery and equipment.

Table 2-10 Preferential Tax Treatment

Income Tax Credit	Deduction from taxable amount which is 30% of investments (Each year 5% deduction for 6 years)
	Shortening of amortization period of fixed assets
	Lower 10% of withholding tax against overseas profit transfer
	The period of carry-over of losses extends up to 10 years.
Exemption from Value-Added Tax	Exemption from Value-Added Tax when strategic related machines and equipment are imported
Exemption from Customs Duty	Exemption from customs duty of related machines and equipment

Source: JETRO Website[12]

The tax rate on the fund transfer is defined as the following by the Tax Treaty between Japan and Indonesia.

Table 2-11 Tax Treaty between Japan and Indonesia

Interest Tax		10%
Distribution Tax	Investment ratio over 25%	10%
	Investment ratio under 25%	15%
Royalty Tax on Transfer		10%

Source: JETRO Website[13]

In the Economic Partnership Agreement between Japan and Indonesia, elimination of tariffs in the power sector was put on hold, but it stated that 1) there will be no tightening of the regulation in the future and 2) there will be revisit to the regulation every three years.

[12] JETRO Website "http://www.jetro.go.jp/jfile/report/07000456/indonesia_kankyo_seisaku.pdf" (Jan 21st 2014)
[13] JETRO Website "http://www.jetro.go.jp/world/asia/idn/invest_04/" (Jan 21st 2014)

2-5. Interests and Trends of Domestic and Foreign Investors in Renewable Energy Development, Especially in the Small Hydroelectricity Sector

It has been confirmed that Pusat Investasi Pemerintah (PIP - the Indonesian Investment Agency) whose main task is to invest infrastructures and PLN are currently supporting constructions of renewable energy power plants in Indonesia. Among the various renewable energy sources, they place a strong emphasis on small hydro and biomass projects in addition to geothermal. PIP can consider providing loans to IPP projects having PPAs with PLN[14]. However, PIP's area of focus for project support may change every year. Up to December 2013, PIP has not made any investment into renewable energy power project including small hydro.

There are some local energy companies in fossil fuel related business that plan to come into the renewable energy business including small hydro for corporate social responsibility or portfolio diversification. PT Sumberdaya Sewatama, which is one of the major local energy companies and subsidiary of PT ABM Investama Tbk, a public listed company with coal value chain from coal mining concession to coal fired IPP, is one example of local energy company planning to penetrate into renewable energy business[15].

On the other hand, although some support programs for renewable energy are being developed as explained above, the development of small hydro power projects by local companies has not necessarily seen much of the progress. There are mainly two issues behind this situation. Firstly, as explained in 1-2, project finance scheme is not regularly utilized, and local banks look at credit of the project owner rather than the project itself, creating difficult environment for small and medium size companies. There are local banks financing to small scale project owners for around 8 years with about 13% interest. However, it is difficult for the project owner to pay back the debt immediately after commencement of commercial operation. Therefore, it is necessary for the project to be financed with balloon type loan in order not to go default.

Secondly, because small hydro power business became open for private company recently, many of the project owners are new entrants without good understanding of the importance of the engineering in the project. In order to meet the formal requirements, some project owners assign local technical consulting companies who can provide a report very quickly regardless of quality. Proceeding with this kind of FS is likely to create problems such as re-doing surveys, changing layouts, or acquiring additional land, resulting in longer time to actually develop it the project. As such, the financial and technical issues are there while some support programs and investments from overseas have been deployed.

The United States Department of Energy has indicated their intention to invest 1.2 million U.S.

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14 Kabar24 HP, Access Aug,16th 2012
15 ABM Investama. "Annual Report 2012"

dollars in the renewable energy sector through the Sustainable Energy for Remote Indonesia Grids (SERIG), and is planning to cooperate with the Indonesian government in this field[16]. United States Agency for International Development (USAID) also agreed with the National Development Planning Agency (BAPPENAS) that they would invest renewable energy sectors in USD 332 million through the Green Prosperity Project by Millenium Challenge Corporation.[17]

In Germany, one of the leading countries in the field of renewable energy, 8 companies (EnBW AG, Ribelga Deutschland GmbH, Schnell Motoren AG, Suma GmbH, Consulectra GmbH, Maxxtec AG, Putmeister Solid Pumps GmbH, Pto2 Anlagentechnik GmbH) participated in German-Indonesia renewable energy conference in 2011, with many showing a strong interest in this field for investments in Indonesia[18].

As examples of foreign investments into Indonesian renewable energy projects, some state owned companies including following countries have made investments in IPP business. From China, China Power Investment, a Chinese state-owned company, announced its plan to invest about Rp. 17 billion together with the Chinese cement company into some hydro IPP projects in North Kalimantan totaling about 7GW[19]. From Korea, Korea Midland Power, a state owned generation company, is developing 284MW hydro power plant, Muara Juloi hydro power project, and signed MOU with PLN in April 2013.

As for Multilateral Development Bank, Asian Development Bank (ADB) is planning to actively become involved in the power sector in Indonesia by providing loans. ADB is planning to give USD 250 million loan to Sarulla geothermal power project (330MW) in North Sumatra developed by the Japanese companies and US plant manufacturer and also USD 2 million technical support grant to three hydro power repowering projects in West Papua in East Indonesia. ADB also approved providing a loan of USD 4.95 million to 220km 500kV transmission line in the Java-Bali grid along with substations, as well as 145km transmission line in West Kalimantan which enables electricity supply from hydro power plants in Malaysia. Other trend includes IFC's investment into Indonesian and foreign private equity funds so as to support renewable energy development[20] and IFC also announced its plan to support wind IPP last year.

As described above, the field of renewable energy in Indonesia is becoming recognized as having a high potentially both government agencies and private companies worldwide.

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[16] Eco-Business. "http://www.eco-business.com/news/indonesia-aims-boost-electricity-capacity-renewable-energy/" 24th Jan 2014
[17] US Department of State. Website. "http://www.state.gov/r/pa/prs/ps/2012/09/197980.htm" 24th Jan 2014
[18] The Jakarta Post, Oct, 25th 2011
[19] The Jakarta Glove, May 29th 2013
[20] IFC Website, Accessed 2013

Chapter.3 Selection Process of the Project

In this Survey, the Target Project is called Nasal project[21] with its development led by PT. Pramata Indah Lestari (PIL). Kencana Agri Limited (Kencana Agri)'s Chairman and CEO is the main shareholder of the PIL. Nasal project has already obtained Izin Princip (Survey Permit) and Izin Lokasi (Location Permit) from Bupati (local government regent), and also obtained a letter regarding Prequalification Process Status (dated January 14th, 2013) from local PLN. It was chosen due to above conditions that the project has high possibility of being implemented.

The project owner initially planed to install 12MW equipments, but as explained in the Chapter 4, (1) according to the technical review, 10MW is more appropriate option for this project site than 12MW because of the decreased effective head making it impossible for the 12MW output based on the current layout, (2) according to the economic feasibility study, 8MW project IRR is the best option due to reduced civil and mechanical/electrical costs, therefore a discussion with the project owner has been held. The project owner has a policy to expand its portfolio, generation capacity and revenue size, thus 8MW will be too small for them. As a result, the project owner has an intention to further develop the project with 10MW generation capacity.

Table 3-1 Researched Projects

Name of Project	Location	Generating Method	Output	Maximum Discharge	Effective Head Differences	Electricity Generation
			MW	m^3/s	m	MWh/y
Nasal	Bengkulu	Run of River	10.0	17.36	69.0	53,753

[21] It is also called "Air Palawan Small Hydro Project"

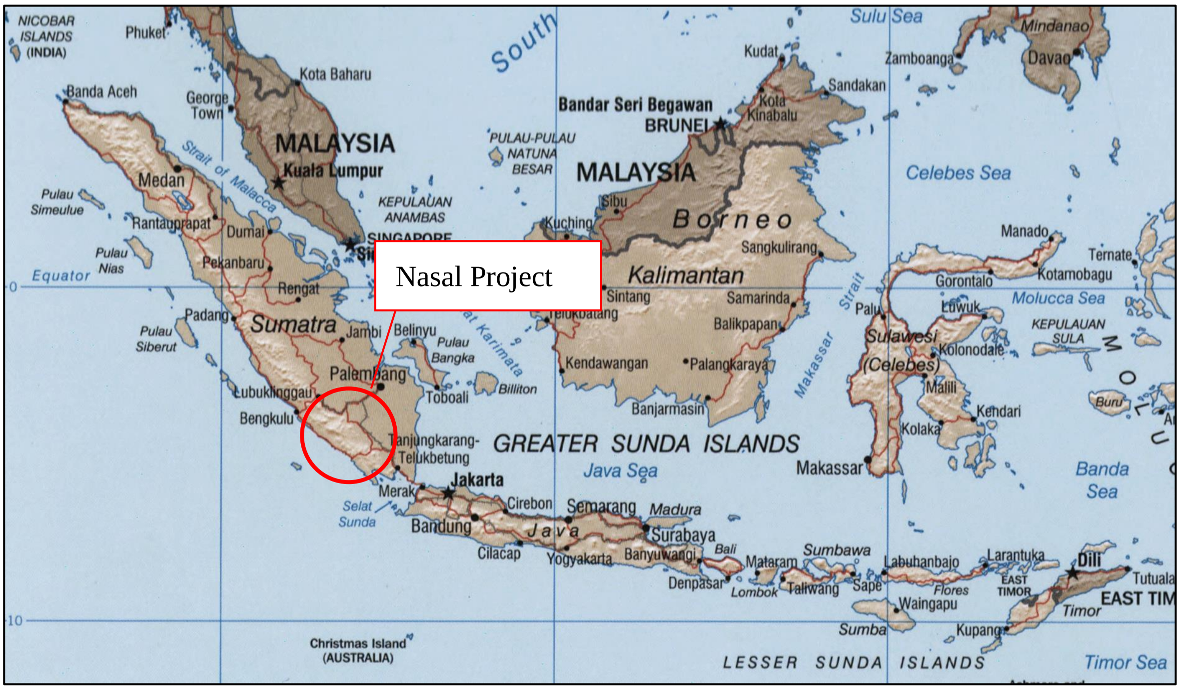

Figure 3-1 Location of Nasal Project

Chapter.4 Nasal Project

4-1. Planning of Business and Funding Scheme

In order to identify and solve the challenges facing the realization of candidate projects, this section aims to evaluate the business scheme of the candidate projects and the validity of the funding schemes available to them, including JICA Private Sector Investment Finance Scheme.

4-1-1. Business Scheme Evaluation

4-1-1-1. Identifying the Optimum Project Structure

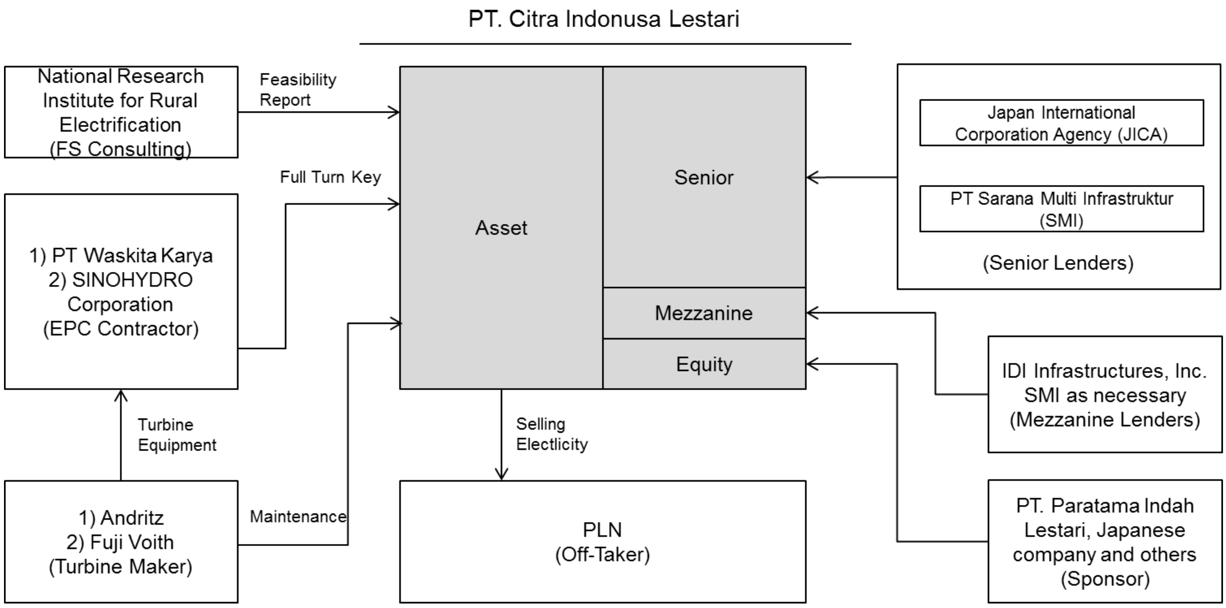

Figure 4-1 Finance Scheme

The Nasal project is the hydropower project with its installed capacity of 10,000kW, where the project owner is PT Citra Indonusa Lestari (CIL) and the off-taker is PLN. PIL and the shareholders of PIL, the sponsor, has the experience in the small hydropower projects, the Pakkat 12.6MW project in North Sumatra and the Airputih 21MW project in Bengkulu, both are in construction. Highlighted features of the project are that: 1) CIL is planning to obtain a 20 years fixed price PPA with PLN in March 2014, 2) the main contractor will be assigned with a full-turnkey contract by PT Waskita Karya from Indonesia or SINOHYDRO Corporation from China, 3) the turbine will be provided by either Andritz from Europe or Fuji Voith Hydro from Japan, 4) the financing structure will be with JICA and SMI as the senior lenders and IDI Infrastructures Inc. (IDI-I) as the mezzanine lender, or JICA as the senior lender and SMI and IDI-I as the mezzanine lenders, under the current circumstance. SMI has already provided loan to the Airputih project currently in construction by PIL, and it is possible for SMI to further consider the financing. As for the equity, it is expected that PIL and other indivisuals will inject approximately 25% of the total project cost.

4-1-1-2. Status of Permits, Licenses and a PPA

In general, project owners of a small power look for potential sites through personal networks such as influential in local communities, local PLN and Bupati (local government regent). After the potential site is identified, first step is to apply for the Izin Princip (Research Permit) for a field survey. It approximately takes 1 or 2 months to be formally approved by Bupati in the application process. Depending on the project, the owners may apply for the Izin Lokasi (Location Permit) issued by Bupati to secure the land usage of the potential site. The environmental assessment (UKL/UPL) is subsequently required. It shall be made by the owners and approved by Bupati.

Bupati shall not allow issuing the Research Permit and the Location Permit for several owners at the same location. In other words, it is important to obtain these permits to secure the project and prevent from others taking over. Next step is to apply for an IUKU issued by the Ministry of Energy and Mineral Resources (MEMR) for the purpose of public electricity business license. Simultaneously, the owners discuss with local PLN regarding grid connection prior to a PPA signing. Lastly, the owners must obtain an IMB (Izin Mindirikan Banyunan Bupati), a construction permit, before the commencement of constructing works.

In Nasal project, the status of permits is as follows.

Table 4-1 List of CIL's Obtaining Progress of Approval and License

Types of Approval and License	Issuer	Outline	Progress
Research Permit	Bupati	Permit for conducting Pre-FS and FS	Already Obtained (Expired, yet Location Permit already obtained)
Location Permit	Bupati	Permit for doing business in the specified area[22]	Already Obtained (Issued date: 12 Jul 2013 Expiry date: 12 Jul 2014)
UKL/UPL	Bupati	Plan for environment management and environment monitoring that requires approval for project implementation	To be obtained (Expected by Mar 2014)
IUKU/IUPTL	MEMR	Permit for doing electricity sup ply business for public interest	To be obtained (Expected by Mar 2014)
PPA	PPA	Power purchase agreement with PLN	To be obtained (Expected by Mar 2014)
IPPKH (Land leasing permit)	Forestry Ministry	Permit necessary in case of lea sing area of land belonging to Foreign Ministry	Unnecessary
IMB (Building Permit)	Bupati	Permit for detailed designs and start construction	To be obtained

[22] Location permit is not a requirement for conducting electricity supply business, but in order to prevent someone else also acquiring the land and develop for the same purpose, a developer usually obtain the permit for the business in the area from ti

4-1-2. Evaluation of the Project Owner

4-1-2-1. Company Overview

The following is the overview of the stracture.

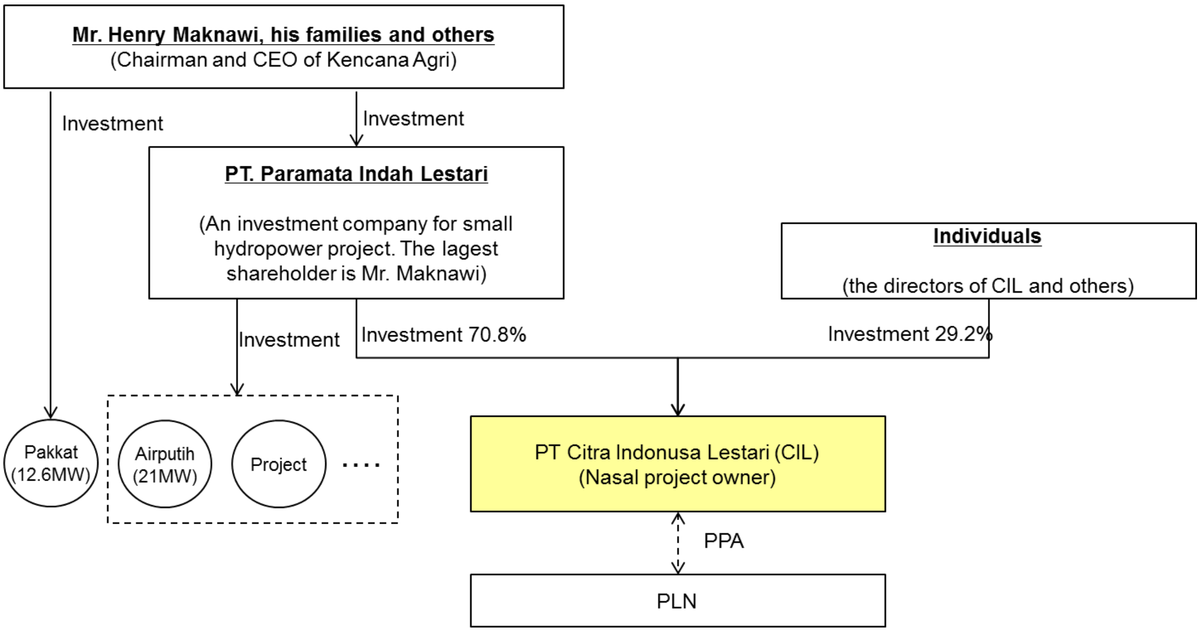

Figure 4-2 Structure of Nasal Project

The overview of the project related companies are as follows.

Table 4-2 Company overview of CIA

1	Company Name	✓ PT Citra Indonusa Lestari (CIL)
2	Type of Business	✓ Nasal Project development and operation
3	Loccation of Head Ofiice	✓ Jakarta Barat (West Jakarta)
4	Establishment	✓ 26 Mar 2010
5	Managements	✓ President Director: Mr. Rusmin Cahyadi ✓ Director: Mr. Daniaal ✓ Director: Mr Edy Suroso ✓ President Commissioner: Mr. Albert Maknawi ✓ Commissioner: Mrs. Imiyati.
6	Employees	✓ Only Management (5 persons)
7	Shareholder Composition	✓ PT Paratama Indah Lastari (PIL): IDR 184,000,000 (70.8%) ✓ Private individuals: IDR 76,000,000 (29.2%) ✓ The amount of Issued shares: IDR 260,000,000 (100%)

Table 4-3 Company overview of PIL

1	Company Name	✓ PT Paratama Indah Lastari (PIL)
2	Type of Business	✓ Small hydro project investment and development
3	Loccation of Head Office	✓ Jakarta Selatan (South Jakarta)
4	Establishment	✓ 16 Apr 2010
5	Managements	✓ President Director: Eddy Maknawi ✓ Director: Johan Maknawi ✓ President Commissioner: Henry Maknawi ✓ Commissioner: Jeanny Maknawi
6	Employees	✓ 15 persons (appropriately)
7	Shareholder Composition[23]	✓ Mr Henry Maknawi：IDR 2,500,000,000 (50%) ✓ Other private individuals：IDR 2,500,000,000 (50%） ✓ The amount of the issued shares：IDR 5,000,000,000 (100%)

Table 4-4 Company overview of Kencana Agri

1	Company Name	✓ Kencana Agri Limited（Kencana Agri）
2	Type of Business	✓ Parm oil plantation, processing, distribution and biomass generation
3	Loccation of Head Office	✓ Kencana Tower, Business Park Kebon Jeruk, Jalan Raya Meruya Ilir No.88, Jakarta Barat 11620, Indonesia
4	Establishment	✓ Acquisition of Land for the plantation business on 1995
5	Managements	✓ Mr. Henry Maknawi（Chairman and Chief Executive Officer） ✓ Mr. Tengku Alwin Aziz（Vice-Chairman and Non-Executive Director） ✓ Ms. Ratna Maknawi（Deputy Chief Executive Officer） ✓ Mr. Kent Surya（Finance Director） ✓ Mr. Soh Yew Hock（Lead Independent Director） ✓ Mr. Sim Idrus Munandar（Independent Director） ✓ Mr. Darwin（Non-Executive Director）
6	Employees	✓ 1,009 persons (Sep 2013)
7	Shareholders Composition[24]	✓ Kencana Holding PTE LTD：53.13% ✓ New Bloom PTE LTD：20% ✓ CITI Bank：3.34% and others
8	Stock Market	✓ Singapore Exchange (Jul 2008)

[23] Notarized document "Pernyataan Keputusan Rapat, PT Paramata Indah Lestari, 28 December 2011"
[24] 「Pernyataan Keputusan Rapat, PT Paramata Indah Lestari, 28 December 2011」

4-1-2-2. Financial Status

According to the audited financial statements of PIL, total assets are approximately IDR 5,039 million as of December 31, 2011 (approximately JPY 43 million under the exchange rate of December 31 2011).

Kencana Agrril is the plantation company listed on the Singapore exchange. The followings are the last balance sheet and profit and loss statement. PIL is the sponsor of this project. Mr. Henry Maknawi is the major shareholder of PIL as well as the owner and the management of Kencana Agri.

Kencana Agri's sales in parm oil business in the financial result for the third quarter in 2013 were USD 195 million that is about 5% decrease from the previous year. The palm oil price is not stable, but there is steady demand for crude palm oil in China and India for biodeasel. Therefore, Kencana Agri plans to continuously increase palm oil production and productivity for stable profit. Kencana Agri owns 198.935ha land for plantation business but 69% of the land still remains unused.

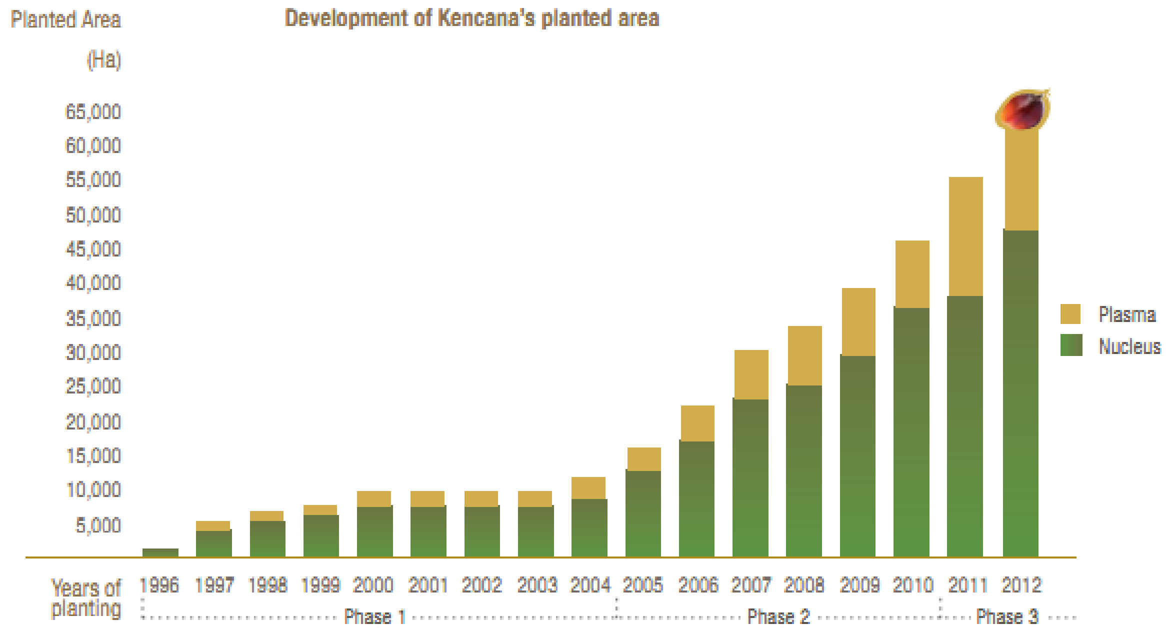

Figure 4-3 Area for Plantation Business of Kencana Agri

The recent profit loss statement and balance sheet of Kencana Agri and PIL are as follows.

Table 4-5 Financial Status of Kencana Agri

Unit：USD1000

Kencana Agri Profit and Loss Statement			
Ordinary income section	FY2010	FY2011	FY2012
Sales	151,984	314,726	301,886
Cost of sales	124,272	279,146	264,037
Gross profit on sales	27,712	35,580	37,849
Operating income	34,983	40,309	30,971
Net income for the period	22,782	23,181	17,304

Unit：USD1000

Kencana Agri Consolidated Balance Sheet							
Assets	FY2010	FY2011	FY2012	Liabilities	FY2010	FY2011	FY2012
Current assets	86,180	97,695	86,961	Current liabilities	39,260	64,901	108,301
Fixed assets	301,363	380,728	439,508	Fixed liabilities	138,165	185,730	190,955
				Shareholders' Equity	210,118	227,792	227,213
Total	387,543	478,423	526,469	Total	387,543	478,423	526,469

Table 4-6 Financial Status of PIL

Unit：IDR MM

PIL Profit and Loss Statement			
Ordinary income section	FY2010	FY2011	FY2012
Sales	0	0	0
Cost of sales	0	0	0
Gross profit on sales	0	0	0
Operating income	0	-8	-651
Net income for the period	0	-7	-650

Unit：IDR MM

PIL Consolidated Balance Sheet							
Assets	FY2010	FY2011	FY2012	Liabilities	FY2010	FY2011	FY2012
Current assets	29	2,222	26,335	Current liabilities	0	0	6
Fixed assets	21	2,816	5,542	Fixed liabilities	0	46	2,779
				Shareholders' Equity	50	4,993	29,093
Total	50	5,039	31,877	Total	50	5,039	31,877

PIL also has majority shares in PT. BANGUN TIRTA LESTARI (BTL) established for Airputih project. The estimated PIL financials include recording a loss until the development and construction phase finish and dividend comes in. The following is the overview of the Airputih project.

Table 4-7 Overview of the Airputih project

1	Company name	✓ PT. BANGUN TIRTA LESTARI (BTL)
2	Maximum Power	✓ 21MW (planned)
3	Location	✓ Lebong, Bengkulu, Sumatera
4	Scheme	✓ Senior lender: United Overseas Bank (UOB) / SMI ✓ Civil contractor: SINOHYDRO Corporation ✓ Turbine maker: Hangzhou Hangfa Electrical Equipment Co., Ltd.
5	Financing	✓ Senior loan: USD 35million (approximately) ✓ Equity: USD 7million (approximately)
6	Schedule	✓ Start of work: the latter half of 2012 ✓ Completion: the latter half of 2015
7	Income	✓ Sales is estimated about USD 10million per year

4-1-2-3. Track record

PIL and PIL's shareholders have experiences in small hydro projects. It is expected that around 25% out of the total project cost will be covered by PIL. Mr Henry Maknawi, the founder of Kencana Agri, owns 50% of the PIL shares. Hence, PIL, as the sponsor of the project, seem to have financial capability in the execution of this project.

It is noted that PIL and PIL's shareholders have the experience in developing and constructing two small hydro power plants in Indonesia. Mr. Rusmin Cahyadi, the person in charge of the project, has led the business since the development of Pakkat 12.6MW small hydropower project. Kencana Agri also has some experience in owning and operating biomass power plants using its own internal engineers, demonstrating its capability to carry out the project in terms of technical aspects.

PIL itself focus on the small hydro power business, thus it does not have biomass business track record. Kencana Agri owns and operates 2 biomass power plant, 6MW at Bangka operating from 2005 and 7.5MW operating from 2009. About 80% of the project cost is financed by the loan from financial institutions, and it sells all electricity to PLN.

4-1-2-4. Mid-term Strategy and Business plan

PIL and its shareholders currently develop not only the small hydro projects with FIT scheme but also larger scale hydro project of around 100MW in Sulawesi. They have already begun consultation on the permits with the loal government.

As PPA is effective for 15 to 20 years for IPP, PIL plans to develop generation business for at least next 10 years from now on.

4-1-3. Evaluation of the Off-taker

In this project, the off-taker is the state electricity company of Indonesia, the Perusahaan Listrik Negara ("PLN")

- Date of Establishment: October 27, 1945
- Shareholder Composition: 100% Indonesian Government

- Numbers of employees: 47,615 (December 2011)
- Management profile: Composed of seven directors. The president commissioner is from the MEMR, with other commissioners from the former vice-president of the International Monetary Fund (IMF) to the head of the Jakarta Police Department, showing the wide variety of personnel from various backgrounds.
- Business overview: PLN is legally authorized to have power generation, transmission line, and distribution line in a vertical integration business structure dominating the power market of Indonesia. Power generation is managed by its subsidiary companies and IPPs (Independent Power Producer) whereas PLN has a monopoly over power transmission and power distribution. PLN's market share for the capacity of power generation capacity in Indonesia is 85% (4,934MW) and its share in power transmission is 100% (36,741km of transmission network) and power distribution is also 100% (685,785km network). Currently, in order to promote private investment, Indonesian Government is supporting investment for IPPs by implementing a long term PPA.[25]
- Financial status as of 2012 fiscal year: Sales – approximately IDR 232 trillion, net income approximately IDR 3.2 trillion (approximately JPY 2.1 trillion and JPY 28.8 billion, respectively under the exchange rate of December 31 2012).
- Indonesian Government keeps the electricity price low based on the Ministry of Finance Decree No. 111/PKM.02/2007 as amended by Ministry of Finance Decree No.167/PMK.02/2007. Indonesian Government subsidizes the difference between selling price and production costs. In 2008, when crude oil price went up significantly, PLN received subsidies of about half of oprating income. For the IPP business, it is necessary to watch closely the Indonesian government policy.

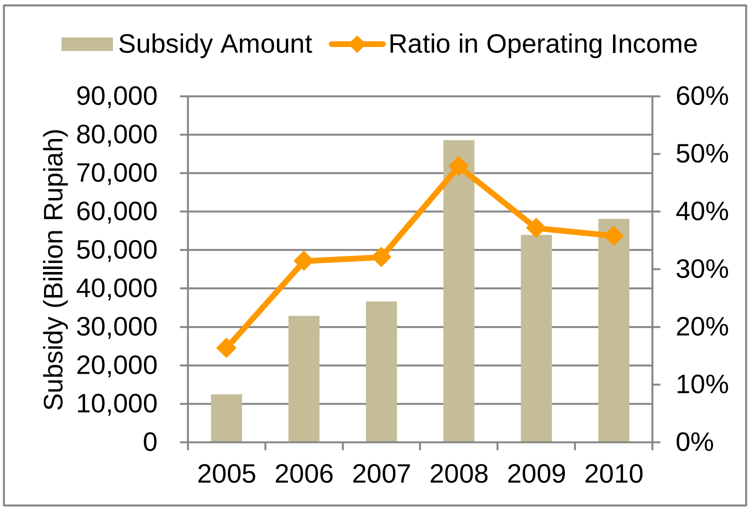

Figure 4-4 Subsidy PLN Receive from Government and its Ratio in Operating Income

Source：PLN “Full Year 2012 Consolidated Financial Statement” Apr 2013

25 Japan Electric Power Information Center, Inc. "Kaigai Syokoku no Denkijigyou (2011)"

Table 4-8 Outline of PLN Financial Statement

Unit: millions of Rupiah

Profit and Loss Statement		
Ordinary income section	FY2011	FY2012
Sales	208,017,823	232,656,456
Operating expense	185,639,600	203,115,450
Gross profit on sales	22,378,223	29,541,006
Operating income	5,514,995	1,031,728
Net income for the period	5,426,115	3,205,524

Unit: millions of Rupiah

Consolidated Balance Sheet(FY2012)			
Assets		Liabilities	
Current assets	68,639,956	Current liabilities	74,602,903
Fixed assets	472,065,808	Fixed liabilities	315,503,191
		Shareholders' Equity	150,599,670
Total	540,705,764	Total	540,705,764

Source: PLN "Full Year 2012 Consolidated Financial Statement" (April 2013)

The credit rating of the Indonesian government bond has been raised to investment grade by multiple rating agencies. Macroeconomics indicators such as government debt and foreign exchange reserves have shown improvements in recent years. The Indonesian government has increased the price of fuel in order to decrease the fuel subsidy, which had been a major policy issue for many years. On the other hand, FIT was established by law, obligating the sole state-owned power company, PLN, to buy electricity, therefore it is difficult to imagine a situation where the government will ignore PLN breaching PPA signed under FIT scheme.

Table 4-9 Credit Rating of Indonesian Government Bond

Rating Company	Rating	Forecast
Standard & Poor's	BB + (Investment Grade -1)	Stable
Moody's	Baa 3 (Investment Grade)	Stable
Fitch	BBB - (Investment Grade)	Stable

Source: Websites of Rating Companies

4-1-4. Evaluation of the Current Project's EPC Contractor and Turbine Manufacturer

The EPC contractor and turbine manufacturer candidates of this project are as follows:

4-1-4-1. EPC Contractor

(1) PT WASKITA KARYA[26]

- Company Overview: the company was established in 1961 to carry out engineering and construction business. In the 1990s, it has constructed many high-rise buildings such as BNI City Indonesia Office Building, Graha Niaga Tower, Mandiri Plaza Tower and Shangri-La Hotel. Its engineering capability is also used for bridge projects as Raja Mandala, Rantau Beragin and Barelang IV. The company also constructed approximately 30 dam including Pondok, Grogkak, Tilong, Gapit and Sumi, and was involved in approximately 10 power plant projects. The company obtained ISO 9002 in November 1995, ISO 9001 in June 2003. In 2006 it started to open branches in Middle East as Dubai, Abu Dhabi and Jeddah. The company has an experience the international yen loan project of JICA "Lower Solo River Improvement Project".
- Shareholder composition: N/A (the Indonesian government holds more than half of the total share)
- Financial Status: As of Dec. 31, 2012 Sales – IDR 8.808 trillion. Operating profit – IDR 459.9 billion. Total assets: IDR 8.366 trillion. (Approximately JPY 79.2 billion, JPY 4.1 billion and JPY 75.2 billion respectively, based on the exchange rate of December 31 2012)

(2) SINOHYDRO Corporation[27]

- Company Overview: the company was established in 1954. Initially, it started by providing the hydropower business in China. It has the track record of approximately 90,000MW hydro power plants in China including the big dam projects such as the Three Gorges Dam (22,400MW) and the Xiaowan Dam (4,220MW). It also has the track record of hydro power plant construction in Malaysia, Thailand, Nepal, Bangladesh, Iran and Sri Lanka. In Indonesia, it construction track record includeds coal-fired thermal power plants such as PLTU Nagan Raya NAD (2x110MW) and PLTU Kaltim Teluk Balikpapan (2x110MW). It has branches and representative offices in 62 countries.
- Shareholder composition: N/A
- Financial Status: As of FY 2011 Total Assets: USD 25,200 million. Capital: USD 1,000 million. The on-going contract amount: USD 2,910 million.

In this project, CIL selected 1) PT Waskita Karya and 2) Sinohydro Corporation as potential candidates. Further consideration is necessary, and it is important to confirm the track record of small hydro projects, background of engineers to be deployed, and contract type in addition to the information above.

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[26] PT WASKITA KARYA HP, "http://www.waskita.co.id"
[27] "sinohydro presentation" received by the company

4-1-4-2. Turbine Manufacturer

(1) ANDRITZ Ltd[28]

- Company Overview: the company was established in Austria in 1852. The core business covers production of turbines for hydro power plant, production and maintenance for metal and paper-making pulp plants. ANDRITZ HYDRO, a group company of ANDRITZ Ltd, is developing oversea business in more than 20 countries and 50 locations. It provides variety of equipments as big and small hydro power plant generators, facilities for irrigation, and pumps. The total amount of the turbines supplied by the company is 30,000 (400,000MW). In 2012, it holds 40% shares of the hydro power plant market globally, as it has experience in turbine design more than 170 years and strong business foundation. The company is listed on Wiener Börse AG in 2001.
- Maintenance: Analysis by NDT team, testing services, and training serice are proided by the Service and Rehabilitatin Team.
- Shareholder: Mr. Wolfgang Leitner, Chairman of ANDRITZ, and Mr. Certus Beteiligungas -GmbH, Managing Director, hold approximately 30%. Other shares are held by institutional investors in USA and UK and individual investors in Austria and Germany.
- Number of Employees: approximately 17,900 (as of April 2013, based on its website)
- Management Profile: the executive committee consists of 5 members, including 4 members who have work experience in ANDRITZ more than 16 years. Mr. Wolfgang Leitner has been Chairman and CEO over 19 years.
- Financial Status: As of FY 2012 Sales – EUR 51 billion. Operating Profit – EUR 242.2 million. Total Assets: EUR 5.1 billion. (Approximately JPY 592 billion, JPY 27.6 billion and JPY 590.2 billion respectively, based on the exchange rate of December 31 2012)

(2) Fuji-Voith Hydro

- Company Overview: the company was established in 1997 as a joint venture company between Voith Siemens and Fuji Electric. This company widely manufactures in the size of 50kW-Micro water turbine up to 500MW scale of large water turbine including power generator and peripheral equipments. Fuji-Voith Hydro acquired the line of business of hydropower equipment from EBARA Corporation in June 2011. Currently, the company reinforces marketing and sales forces in Asia, aiming at the annual sales of 10 billion yen. The company has rich track record of installations in small hydro power projects in Southeast Asia including Riam Kanan Project (11MW×3) and Wadaslintang Project (9.7MW×2) in Indonesia and many more in other countries such as Thailand, Philippines, Vietnam. Globally, Fuji-Voith has strong market presence in South Asia, East Asia, North America, Latin America, Europe, and Middle East.
- Maintenance: The Company provides various services by maintenance service contract including maintenance, spair parts, 24h hotline, testing, analysis, and trouble shooting. It plans to build up

[28] ANDRITZ HP, "http://www.andritz.com/", 13th August 2012

local engineering system for the service business.

- Shareholder Composition: Fuji Electric and Voith Hydro, each owns half of stocks.
- Employee: N/A
- Management Profile: N/A
- Financial Status: Sales－Approximately 6 billion JPY(No Disclosure regarding other financial status)

In this project, CIL selects 1) ANDRITZ Ltd and 2) Fuji-Voith Hydro as potential candidates. Further consideration is necessary, and it is important to confirm with background of engineers in the project team and track record of small hydro installment in addition to the information above.

4-1-5. Analysis of Financials and Investment Effect

4-1-5-1. Analysis of Cash flow of the Business

(1) Financial Arrangements

CIL is planning to construct 10,000kW small hydro power plant and to sell electricy to PLN. CIL initially planned to construct 12,000kW based on the technical report conducted by National Research Institute for Rural Electrification from China. However, the result of the analysis on power generation capacity by the research team (see section 4-2 for detail), (1) according to the technical review, 10MW is more appropriate option for this project site than 12MW because of the decreased effective head making it impossible for the 12MW output based on the current layout, (2) according to the economic feasibility study, 8MW project IRR is the best option due to reduced civil and mechanical/electrical costs, therefore a discussion with the project owner has been held. Parties confirmed it does not make sense technically to introduce 12,000kW plant. The project owner has a policy to expand its portfolio, generation capacity and revenue size, thus 8MW will be too small for them. As a result, the project owner has an intention to further develop the project with 10MW generation capacity, thus financial scheme analyzed in this Survery is based on the 10MW project.

As the project with 10,000kW capacity, the EPC cost including interest during construction is IDR 294,001 million. In the financial structure, SMI, a state owned financial institution, and JICA are potential candidates for senior lenders. SMI has already financed the Airputih small hydro project owned by PIL as the sponsor of this project with UOB, a major commercial bank in Singapore. SMI is also able to consider financing the following projects.

PIP confirmed that financing small hydropower project as senior lender is possible even though it would take a long time for confirmation of parties and contracts of the projects.

IDI-I is a potential candidate for mezzanine lender. For the senior and mezzanine finance, the prospective lender’s terms are: 2 years grace period during construction, 8 years repayment period after the commercial operation date. The analysis assumes the interest during construction (IDC) will be provided by the senior and mezzanine lenders. The type of mezzanine finance considered at this time is that CIL issues the subordinated bonds with convertible rights, and IDI-I underwrites them all.

Overall capital structure at this stage assumes around 65% of total project cost is financed by the senior lenders; the potential candidates are JICA and SMI providing same amount of pricipal to the project. Around 10% of total project cost is to be covered by IDI-I through mezzanine finance, and around 25% of total project cost, to make cash flow positive, is to be injected by current existing shareholders.

Detail information regarding financial structure is shown below.

Table 4-10 Details of Financial Arrangement

PT Citra Indonusa Lestari (CIL) - Nasal Project Capital Structure (10MW)

Unit IDR MM

Asset		Liability	
EPC	256,337	Senior loan (Principle)	
IDC		SMI	85,240
SMI	11,562	JICA	85,240
JICA	11,562	Senior loan (IDC)	
IDI-I	5,820	SMI	10,314
		JICA	10,314
		Mezzanine loan (Principle)	
		IDI-I	24,537
		Mezzanine loan (IDC)	
		IDI-I	4,858
DSRA	5,470	Equity	
Others	3,250	Equity	73,498
Total Asset	294,001	Total Liability & Equity	294,001

Unit IDR MM

Financed by	amount	%
SMI	95,554	32.50%
JICA	95,554	32.50%
IDI-I	29,395	10.00%
Sponsors	73,498	25.00%
Total	294,001	100.00%

Unit IDR MM

Financed by	amount	%
Senior Loan (SMI+JICA)	191,108	65.00%
Mezzanine Loan (IDI-I)	29,395	10.00%
Equity (Sponsors)	73,498	25.00%
Total	294,001	100.00%

As another financing structure, overall capital structure at this stage assumes around 63% of total project cost is financed by the senior lenders; the potential candidate is only JICA, and around 12% of total project cost will be covered by SMI and IDI-I through mezzanine finance with each entity providing same amount to the project, and around 25% of total project cost is to be injected by current existing shareholders.

Detail information regarding financial structure is listed below.

Table 4-11 Details of Financial Arrangement (another structure)

PT Citra Indonusa Lestari (CIL) - Nasal Project Capital Structure (10MW)

Unit IDR MM

Asset		Liability	
EPC	256,337	Senior loan (Principle)	
IDC		SMI	172,660
SMI	23,420	JICA	0
JICA	0	Senior loan (IDC)	
IDI-I	5,897	SMI	20,892
		JICA	0
		Mezzanine loan (Principle)	
		IDI-I	24,860
		Mezzanine loan (IDC)	
		IDI-I	4,922
DSRA	9,496	Equity	
Others	2,626	Equity	74,442
Total Asset	297,776	Total Liability & Equity	297,776

Unit IDR MM

Financed by	amount	%
SMI	193,552	65.00%
JICA	0	0.00%
IDI-I	29,782	10.00%
Sponsors	74,442	25.00%
Total	297,776	100.00%

Unit IDR MM

Financed by	amount	%
Senior Loan (SMI+JICA)	193,552	65.00%
Mezzanine Loan (IDI-I)	29,782	10.00%
Equity (Sponsors)	74,442	25.00%
Total	297,776	100.00%

The total project cost breakdown is as follows. The research team calculates the costs by reviewing the information obtained from CIL. The EPC cost is calculated by Guangzhou Design Institute from China applying the local standard cost. However, the costs for turbine and ancillary electric facilities are calculated by referring to similar project’s contract in Indonesia. In this case, reserve funds are not included because of the assumption that CIL will sign fixed lump-sum contract.

Table 4-12 Total project cost breakdown

Unit: IDR MM

Total project cost breakdown	Cost amount
Development cost	16,580
EPC cost	239,757
waterway	88,459
intake, weir	45,616
power house, turbines	60,949
penstocks	23,311
tailrace, etc.	19,423
IDC (SMI, JICA, IDI-I)	28,944
DSRA	5,470
Others	3,250
Total project cost	294,001

(2) Basic Assumptions

Basic assumptions are listed below. It is important to note that the assumptions are based on information provided by the owner or by a reasonable estimation at this moment.

Table 4-13 Detailed Conditions

Base Item	Details	Unit	Value	Detail
Basic Specification				
	Installed capacity	kW	10,000	reference by conducted study *table4-41 Results on Comparison of Output
	Annual power production	kWh	53,753,000	reference by conducted study *table4-39 Annual Available Power Energy
	Power selling Price	IDR / kWh	945	based on informaton provided by the owner
	Power selling years	Year	20	based on informaton provided by the owner
	Annual power selling revenues	million IDR	50,797	
Loan Condition				
	Senior Loan (SMI)			
	The Amount of Loan	million IDR	95,554	*detail shall be discussed (JICA and SMI provide same amount of principle)
	Interest	% / year	11.00%	*detail shall be discussed
	Period of deferment for Principle	Year	2	expected construction period
	Repayment Period	Year	8	usual repayment period
	Senior Loan (JICA)			
	The Amount of Loan	million IDR	95,554	*detail shall be discussed (JICA and SMI provide same amount of principle)
	Interest (Yen Rate 3%+SWAP rate7% addition)	% / year	11.00%	*detail shall be discussed
	Period of deferment for Principle	Year	2	expected construction period
	Repayment Period	Year	8	usual repayment period
	Mezzanine Loan (IDI-I)			
	The Amount of Loan	million IDR	29,395	*detail shall be discussed (IDI-I provids 10% amount out of total project cost
	Interest	% / year	18.00%	*detail shall be discussed
	Period of deferment for Principle	Year	2	expected construction period
	Repayment Period	Year	8	usual repayment period
Opearational Cost				
	Cost of water-use	IDR / kWh	5	based on informaton provided by the owner
	Maintenace Cost	million IDR	3,800	referece by other similar project cost
	Insurance Cost	million IDR	650	referece by other similar project cost
Others				
	Price increase	% / yer	5.00%	reference by IMF "World Economy Outlook(April 2013)"
	※Ther taegets are Operation cost (except cost of water-use)			
	DSRA	month (next month's ir	6	reference by JICA loan condition
	Dividend policy			there is no dividend until clearing off senior loans
	Up-front Fee	%	0.30%	0.3% of the total loan amount (reference by JICA loan condition)

Operation cost is estimated referring to 7.5MW small hydro project in West Sumatera invested by IDI-I. The estimation can be considered as reasonable because it is located in the same island, Sumatra, and the generation capacity is similar. DSRA is estimated as 6 times of interests of senior loan according to JICA’s loan condition. As it is not common for senior lenders in Indonesia to ask for reserve other than DSRA, it is not taken into account in this projection.

(3) Business Plan（Financial Statements）

The 10 years after the commercial operation business forecasts of the project consisting of an income statement, a balance statement, and a cash flow statement are shown below. If the operation of the plant runs well along with the predication, the repayment of senior and mezzanine would be made throughout the periods by the source of stable income selling electricity to PLN. The revenue of this project is heavily relied on selling electricity to PLN, and its selling price is IDR 945 /kWh under assumption of increasing FIT rate.

Table 4-14 Business Plan(Financial Statements）

Income Statement		Y 2014	Y 2015	Y 2016	Y 2017	Y 2018	Y 2019	Y 2020	Y 2021	Y 2022	Y 2023	Y 2024	Y 2025
Unit: million IDR		-2 nd	-1 st	1 st	2 nd	3 rd	4 th	5 th	6 th	7 th	8 th	9 th	10 th
Income	Revenue	0	0	50,797	50,797	50,797	50,797	50,797	50,797	50,797	50,797	50,797	50,797
	Expenses	0	0	33,422	33,639	33,868	34,108	34,359	34,624	34,901	35,193	35,499	35,818
	Gross Profit	0	0	17,375	17,157	16,929	16,689	16,437	16,173	15,895	15,604	15,298	14,978
	Sales Administrative Expense	100	100	100	105	110	116	122	128	134	141	148	155
	Operational Profit	-100	-100	17,275	17,052	16,819	16,573	16,316	16,045	15,761	15,463	15,150	14,823
	Non-Operating Expense	0	0	27,893	26,499	23,988	20,641	17,294	13,389	9,484	4,742	-0	0
	current earnings	-100	-100	-10,618	-9,446	-7,170	-4,068	-978	2,657	6,278	10,721	15,150	14,823
	Corporate Tax	0	0	0	0	0	0	0	0	0	0	581	3,706
	After-tax Income	-100	-100	-10,618	-9,446	-7,170	-4,068	-978	2,657	6,278	10,721	14,569	11,117

Balance Sheet		Y 2014	Y 2015	Y 2016	Y 2017	Y 2018	Y 2019	Y 2020	Y 2021	Y 2022	Y 2023	Y 2024	Y 2025
Unit: million IDR		-2 nd	-1 st	1 st	2 nd	3 rd	4 th	5 th	6 th	7 th	8 th	9 th	10 th
Assets	Total Assets	95,448	293,801	272,157	242,865	209,236	178,707	146,859	118,645	87,437	60,673	73,656	74,825
Liabilities	Long-term Debts （Senior）	19,111	191,108	181,553	164,353	141,420	118,487	91,732	64,977	32,488	-0	0	0
	Long-term Debts （Mezzanine）	2,939	29,395	27,925	25,280	21,752	18,225	14,110	9,994	4,997	0	0	0
	Fixed Liabilities	22,050	220,503	209,478	189,633	163,172	136,712	105,841	74,971	37,486	-0	0	0
Capital	Total Capital	73,398	73,298	62,679	53,233	46,063	41,996	41,018	43,674	49,952	60,673	73,656	74,825
	Liabilities and Capital	95,448	293,801	272,157	242,865	209,236	178,707	146,859	118,645	87,437	60,673	73,656	74,825

Cash Flow Statements		Y 2014	Y 2015	Y 2016	Y 2017	Y 2018	Y 2019	Y 2020	Y 2021	Y 2022	Y 2023	Y 2024	Y 2025
Unit: million IDR		-2 nd	-1 st	1 st	2 nd	3 rd	4 th	5 th	6 th	7 th	8 th	9 th	10 th
Operational Cash Flow		-100	-100	18,185	19,357	21,634	24,735	27,825	31,460	35,081	39,524	43,372	39,919
Investment Cash Flow		-54,057	-233,974	0	0	0	0	0	0	0	0	0	0
	EPC Cost	-51,267	-205,070	0	0	0	0	0	0	0	0	0	0
	IDC（Senior）	-2,102	-21,022	0	0	0	0	0	0	0	0	0	0
	IDC（Mezzanine）	-529	-5,291	0	0	0	0	0	0	0	0	0	0
	Others	-158	-2,592	0	0	0	0	0	0	0	0	0	0
Financial Cash Flow		95,548	192,983	-10,752	-19,353	-25,804	-25,804	-30,105	-30,105	-36,556	-36,556	-1,586	-9,948
	Long-term Debts （Senior）	19,111	171,997	-9,555	-17,200	-22,933	-22,933	-26,755	-26,755	-32,488	-32,488	0	0
	Long-term Debts （Mezzanine）	2,939	26,455	-1,470	-2,646	-3,527	-3,527	-4,115	-4,115	-4,997	-4,997	0	0
	Others	0	-5,470	273	492	656	656	766	766	930	930	-0	0
	Capital	73,498	0	0	0	0	0	0	0	0	0	0	0
	Dividend Payment	0	0	0	0	0	0	0	0	0	0	1,586	9,948
Changes in Cash		41,391	-41,091	7,433	4	-4,170	-1,069	-2,280	1,355	-1,475	2,969	41,786	29,970
Cash at the beginning		0	41,391	300	7,733	7,737	3,566	2,498	218	1,573	98	3,067	44,853
Cash at the end		41,391	300	7,733	7,737	3,566	2,498	218	1,573	98	3,067	44,853	74,823

(4) Investment return and sensitivity analysis

Based on the business plan as the base case, Equity IRR, average DSCR (senior) and Financial IRR will be calculated with conducting of sensitivity analysis shown as follows:

There is only one generation capacity case considered in this sensitivity analysis with the maximum power output of 10MW. The case with 12MW has negative cash flow, making it difficult to secure economic feasibility, and CIL agreed that the base case shall use 10MW.

Table 4-15 Investment return and sensitivity analysis

Case	Equity IRR	Average DSCR (senior)	Financial IRR
Base case	11.27%	1.25	12.83%
EPC cost increased by 10%	9.65%	1.24	11.20%
Price increased by 10%	9.86%	1.22	11.89%
SWAP rate increased by 10%	11.11%	1.23	12.80%
Power production decreased by 10%	9.50%	1.11	10.93%

In case of the event of power production decreased by 10%, Equity IRR is below 10%; average DSCR is less than 1.13. It is necessary to improve the project feasibility by evaluating the rate of operation, improving capacity factor, or reduce EPC cost. It is the same for the case with FIT price decreasing by 10%.

The following is the result of the sensitivity analysis with each case' assumption is 20% worse off.

Table 4-16 Additional Investment return and sensitivity analysis

Case	Equity IRR	Average DSCR (senior)	Financial IRR
Base case	11.27%	1.25	12.83%
EPC cost increased by 10%	8.24%	1.24	9.76%
Price increased by 10%	Cost of goods sold will be overe Sales after 18th year		
SWAP rate increased by 10%	10.96%	1.21	12.77%
Power production decreased by 10%	7.60%	0.97	8.87%

In all cases above, it is necessary to change fundamental conditions such as loan conditions and DE ratio because the cash flow during the loan term goes negative.

(5) Economic analysis (Economic IRR calculation)

Economic IRR is an indicator to analyze the performance of efficiency in allocating the national economic resources. In Economic IRR, expenses are considered as something that decreases the national income; revenues are, on the other hand, considered as something that increases the national income[29]. First of all, the Standard Conversion Factor (SCF)[30], a factor that applies when converting non tradable commodities into international standardized price, shall be calculated:

$$SCF = (I+E) / [(I+Id) + (E+Ed)]$$

I：Total import amounts (CIF)
E：Total export amounts (FOB)
Id：Total import duties
Ed：Total export duties

29 JICA "Manual of IRR calculation for International yen loan"
30 Same as above

Table 4-17 Standard Conversion Factor (SCF)

Unit: billion IDR

Items	Y 2007	Y 2008	Y 2009	Y 2010	Y 2011	5 years ave.
Total import	3,961	22,764	18,105	19,759	28,856	18,689
Total export	16,976	0	0	0	25,266	8,448
Total import duties	942,431	1,032,278	932,249	1,074,569	1,221,229	1,040,551
Total export duties	756,895	833,342	708,529	831,418	942,297	814,496
SCF	0.99	0.99	0.99	0.99	0.98	0.99

Source: JETRO and World Bank, World Development Indicators

Economic expenses are calculated as follows. Civil costs are local currency expenses, and turbines and electrical equipment are foreign currency expenses. In economic expense, tax and interest expense are not considered as a decrease of national resources; hence, it can be ignored.

Table 4-18 Economic expenses

＜Economic expenses＞ Unit: million IDR

No.	Cost items	Foreign currency	Economic expense (1)	Local currency	SCF	Economic expense (2)	Total (1)+(2)
1	Civil cost	-	-	193,388	0.99	191,454	191,454
2	Electrical and turbine cost	62,949	62,949			0	62,949
3	Others (lawyers, etc.)	3,250	3,250			0	3,250
4:1+2+3	Total economic expenses	66,199	66,199	193,388		191,454	257,653

Economic revenues are defined as the value of the replacement cost reduced by the project. [31] In the Nasal project, economic revenues are based on the difference between the diesel engine generation cost and the project's weighted average of selling price for 20 years, which is the value of the reduction in the replacement cost.

Table 4-19 Economic revenues

＜Economic revenues＞

No.	Items	Unit	Value
1	Diesel engine cost	IDR / kWh	3,470
2	PPA price of small hydro	IDR / kWh	944.64
3:1-2	Replacement deduction unit revenue	IDR / kWh	2,525
4	Transmitted power generation	kWh / Year	53,753,000
5:3*4	Replacement deduction value	MM IDR / Year	135,749

Source: PLN. "PLN Statistics 2010" and PPA in the project

The cash flow statement including Economic expenses and Economic revenues is as follows.

[31] Same as above

Operational costs are based on costs in other similar projects and price escalation shall not be considered as it does not affect resource consumption.

Table 4-20 Cash Flow

<Economic expenses> Unit: million IDR

No.	Cost items	Foreign currency	Economic expense (1)	Local currency	SCF	Economic expense (2)	Total (1)+(2)
1	Civil cost	-	-	193,388	0.99	191,454	191,454
2	Electrical and turbine cost	62,949	62,949			0	62,949
3	Others (lawyers, etc.)	3,250	3,250			0	3,250
4:1+2+3	Total economic expenses	66,199	66,199	193,388		191,454	257,653

<Economic revenues>

No.	Items	Unit	Value
1	Diesel engine cost	IDR / kWh	3,470
2	PPA price of small hydro	IDR / kWh	944.64
3:1-2	Replacement deduction unit revenue	IDR / kWh	2,525
4	Transmitted power generation	kWh / Year	53,753,000
5:3*4	Replacement deduction value	MM IDR / Year	135,749

<Cash flow statement> Unit: million IDR

Year	Initial cost	Operation cost	Total cost	Revenue
1	51,531		51,531	
2	206,122		206,122	
3		2,720	2,720	135,749
4		2,720	2,720	135,749
5		2,720	2,720	135,749
6		2,720	2,720	135,749
7		2,720	2,720	135,749
8		2,720	2,720	135,749
9		2,720	2,720	135,749
10		2,720	2,720	135,749
11		2,720	2,720	135,749
12		2,720	2,720	135,749
13		2,720	2,720	135,749
14		2,720	2,720	135,749
15		2,720	2,720	135,749
16		2,720	2,720	135,749
17		2,720	2,720	135,749
18		2,720	2,720	135,749
19		2,720	2,720	135,749
20		2,720	2,720	135,749
21		2,720	2,720	135,749
22		2,720	2,720	135,749
Total	257,653	54,400	312,053	2,714,985

Economic IRR calculated by the above cash flow is 48%. Since it exceeds the average social discount rate of 12% significantly, this project shall bring added value to the national economy.

(6) Operational Performance Indicator

The following is the operational performance indicator to monitor the power plant. The down time ratio and transmission loss etc. are estimates as well as capacity factor and power generation. After the commercial operation, monthly monitoring these indicators shall be conducted.

Table 4-21 Operational Performance Indicator

Indicators	Value
Down time ratio by trouble shooting, etc.	5% of expected power generation
Transmission loss and self consumption, etc.	2% of expected power generation
Capacity factor	61.36%
Transmitted power generation (kWh)	53,753,000
Installed capacity (kW)	10,000

4-1-6. Review on Business Risks and Contract Conditions

4-1-6-1. Risks associated with projects and considerations on a security package

The general business risks and evaluations on project finance are as follows:

Table 4-22 Outline of Business Risk and Assessment

1	Sponsor risk (evaluation of sponsor)	✓ The majority shareholder is PIL. PIL relies on the credit of Mr. Henry Maknawi, the founder of Kencana Agri. There is management risk of heavy reliance on Mr. Maknawi. ✓ Mr. Henry has experience in supervising the department of production and technology of plantation business at Kencana Agri, giving him rich experiencein engineering. He has 53% of issued shares of Kencana Agri through Kencana Holdings Pte Ltd, which he owns. Therefore, it can be considered that he has high financing capability. ✓ PIL has experience in developing and constructing a 12.6MW Pakkat small hydro project and 16.5MW Airputih small hydro project. Also, Kencana Agri group has proven track record in developing, construction and operating biomass power projects as well. Kencana Agri as a group has know-how and experience in IPP businesses. ✓ SMI, a candidate for the senior lender for the project, has already financed the 21MW Airputih small hydropower project owned by PIL, and SMI indicated it is possible to consider financing for the following projects. SMI considers that PIL has sufficient credit. SMI also has experience to provide loans to a 7.5MW small hydro project in West Sumatra while the project owner does not have experience in developing IPP business as a project owner. SMI saw the project owner as the one with experience in civil works such as pipe installations for other hydro power projects. SMI also mitigated risks by asking the project owner to utilize international consulting

	company to review hydrology, FS report and construction management.
2 Construction / technical risks (evaluation of EPC contractor)	✓ At this moment, PT Waskita Karya from Indonesia and SINOHYDRO Corporation are candidates of potential EPC contractor but detail discussion has not yet conducted. ✓ SINOHYDORO Corporation is the contracter for the Airputih project owned by PIL, therefore PIL will confirm on-going problems in the project and consider in details including technical, financial and contract aspects at the step of selecting the EPC contractor. SINOHYDRO has construction experiences of hydro power plant in Asia. In Indonesia, they also have coal fired power plant experiences. ✓ Waskita Karya has construction experiences of about 30 dams and more than 10 power plants. ✓ The project is planning to take project finance structure, but by asking Mr. Henry Maknawi a personal guarantee, it aims for a structure obligating him to bear unexpected cost in case of cost overrun during the construction phase.
3 Operational risk (evaluation of operators)	✓ Operation in small hydro is simple compared to that of thermal plants. PIL plans to hire local people for security and basic operation, and will send some internal engineers with the expertise to the site a few times a month. ✓ Other small hydro projects in Indonesia also hire their own engineers and some local people for operation. Commonly, a few months prior to the completion of the construction, confirmation and evaluation on operation activities are conducted. ✓ As explained, the project is expected to take sponsor support type, thus it is planned to confirm the price and work of scope of operation as well as to evaluate the experience and ability of the internal engineers to carry out the communication, countermeasures in emergency situations, safety management in a sudden accident. ✓ Kencana Agri owns and operates biomass power plants such as 6MW Bangka and 7.5MW Beliting. The first plant has been operated from 2005, therefore Kencana Agri has valuable experience in operation with its own employees. ✓ PIL and its shareholders have no experience in operation and maintenance because all projects that they own are now in construction phase.
4 Sale, transaction and revenue risk	✓ This project is based on 20 years PPA, obligating PLN to purchase all electricity it could produce. The evaluation of PLN is written in section 4-1-3

	✓ In case of change in the FIT rate, the risk of tariff decreasing for the existing projects is quite limited because the regulations related FIT do not defined that new FIT price will be applied for existing projects. It is common to apply new tariff on only for new projects. It is also defined that the FIT rate is linked with the cost of water-use, which can be changed. Therefore, the tariff may increase according to the change of the cost of water-use.
5 Supply and fuel risk	✓ This project is a run of river type of small hydro power generation, and the risk of fuel supply is limited to the water flow of the river. For the development around the project site, it is necessary to obtain permits from Bupati. Until now, there is no major development project around the site, thus the risk of catchment area of the river decreasing is limited. ✓ In case of development of new power plant projects in the upstream, it is necessary to assess the impact on the river flow. If there will be a negative impact, it will be necessary to ask for sponsors' additional equity injection. ✓ In Indonesia, the dry season is usually from April to September while the rainy season is from October to March. If the dry season is longer than usual, planned water flow may not be realized, leaving power generation below the expectation.
6 Other risks	✓ There has been no rare species and animals found around the site, and the environmental impact by this project should be limited. The local community is cooperating with the project. For land acquisition, PILis still in discussion with some land owners, so the progress needs to be checked. ✓ Related to the infrastructure or utility risk, it is necessary to clarify the capacity of sub-station that accepts generated electricity from the plant and demand forecast around the site. PLN conducts Kata Kerja Operasional (KKO) as a feasibility study of the grid. It is necessary to confirm that PLN can purchase all power generated by the project from technical aspect. ✓ Transmission connection to the nearest PLN grid or substation is the project owner's responsibility to construct and install. Therefore, it is important to assess the risk of lightening and bird damage resulting in incapability of transmission. ✓ The price escalation will affect construction cost, operation and maintenance costs. With the construction cost, it is possible to minimize the price escalation risk by making an agreement with EPC contractor with a fix lump-sum. In terms of the operation cost, fuel is

	waterflow that comes from the river with no cost, and maintenance cost could be fixed for long term or to maintenance by themselves to minimize the risk. ✓ PIL intends to make comprehensive judgement on this project taking into account FIT price change and inviting new investor for sharing risks as the weaker Indonesian Rupiah is increasing the project cost.

Detail risks of the project are as follows:

(1) Power Purchase Agreement (PPA)

In concluding PPA, PLN tests technical acceptability of the power grid by conducting feasibility study called Kata Kerja Operational (KKO). The study not only covers technical aspect but also validates the financial aspect by checking credit of the project owner whether or not they are able to start up the project at the same time. Generally in PPA, there area a name of the project owner, generation capacity, name of substation and conditions for connection, power purchase price, duration of contract, planned date for power purchase, and so on. It is important to confirm if the PLN-owned substation has excess capacity for accepting power from the plant. In case substation capacity needs to be enhanced, it is necessary to check out the construction period and commencement day. In general, PLN substation is the interconnection point where monthly transmitted electricity is measured by the meter at the substation.

In Nasal project, PIL is discussing a PPA and KKO with local PLN office. PIL is collecting information on FIT price increase and plans to sign PPA with PLN around March 2014 as it is the estimated price increase timing.

(2) Purchase of the land

Regarding the land for small hydropower project, the cost to purchase the land is cheaper than what is in Japan. It is common to purchase, not to rental, land for the project in Indonesia. There are some cases where the land owners are Kecamatan or Ministry of Forestry while the local people are living there since long time ago. It is necessary to transfer the property rights from the owner and at the same time, to compensate the residents for resettlement and crop.

In case the purchase is not completed at the time of considering a loan, complete purchase of the land is usually defined in the conditions precedent in the loan agreement.

For Nasal project, CIL plans to acquire the entire project site. The land owner at the site is the local Kecamatan although there are local residents who were allotted the land by custom. Half of the owners have signed the transfer agreement, and CIL plans to discuss with other owners as it signs PPA with PLN. IPPKH is not needed because the land is not under control of Ministry of Forestry. The possibility of the resettlements of residents and farmers will depend on the route of waterway, which will be determined by the detail design. Area around the project is the farm area, thus necessary compensation will be confirmed.

(3) River flow rate

There are two approaches to forecast river flow rate; 1) forecast based on rainfall rate in the neighboring gauging stations, 2) forecast based on actual river flow rate at gauging stations in the target river. It should be noted that it is common to see sluice maintenance flow required. Therefore, it needs to be factored in when calculating the annual power generation. If the forecast river flow rate is different from the actual rate, the power generation would be lower than the predicted value. Stress test assuming risk scenario of lower-than-forecasted river flow rate leading to lower power generation needs to be conducted. By identifying acceptable range of risk, examination on the feasibility of this project with reasonable capital structure needs to be conducted.

(4) Consensus building in the local community

Because a small hydropower generation project is a long-term project with PPA of about 20 years using local resources, the river, it is important to obtain general consent from local residents and to build a consensus with them.

(5) Engineering

Prior to signing PPA, a technical consulting company conducts basic design in terms of hydrology and master plan designing, and an EPC contractor or an engineering company conducts detailed engineering after signing PPA. It is necessary to conduct the status check of the construction whether or not it is conducted according to the detailed engineering design. An third party engineering company or members who are familiar with engineering tasks within the company deal with it. .

Nasal project plans to use an EPC contractor with a full turnkey contract. It is planned to hire some engineering experts as internal stuff to manage the progress of construction; however appropriateness of the proposed engineers in terms of their track record and experience needs to be carefully checked upon.

(6) EPC contractor

In choosing an EPC contractor for a small hydro power project in Indonesia, it is important to look at their track record, particularly on construction of hydropower facilities in order to determine their capability to keep to the schedule and execute the contract. However, small hydro power projects are usually not a full turnkey, and thus there are few EPC contractors with the experience. Moreover, there are some cases where large national construction company with rich experience in large scale hydro delays its construction. Therefore, it is necessary to confirm handling with the risk of delay, nonperforming risk, and risk of guarantee against defects, before discussing the contracts.

There are candidates for EPC contractor for Nasal project; CIL has considered to utilize ether PT Waskita Karya or SINOHYDRO Corporation, so the EPC contactors' detail in technical, financial and contract, will be confirmed and evaluated in the selection timing

- PT Waskita Karya was established in 1961 to carry out engineering and construction business. In the 1990s, it has constructed many high-rise buildings such as BNI City Indonesia Office Building, Graha Niaga Tower, Mandiri Plaza Tower and Shangri-La Hotel. Its engineering capability is also used for bridge projects as Raja Mandala, Rantau Beragin and Barelang IV. The company also constructed approximately 30 dam including Pondok, Grogkak, Tilong, Gapit and Sumi, and was involved in approximately 10 power plant projects. PT Waskita Karya has a track record of being awarded of EPC contract for Genyem Power Plant Project (20MW) as Waskita-Gxed/Tkl consortium, and it is supposed to have the know-how as EPC contractor.
- SINOHYDRO Corporation was established in 1954. Initially, it started by providing the hydropower business in China. It has the track record of approximately 90,000MW hydro power plants in China including the big dam projects such as the Three Gorges Dam (22,400MW) and the Xiaowan Dam (4,220MW). It also has the track record of hydro power plant construction in Malaysia, Thailand, Nepal, Bangladesh, Iran and Sri Lanka. In Indonesia, it construction track record mainly includeds coal-fired thermal power plants. It also has the track record of conducting EPC contract base projects such as Jatigete Hydro Power Plant Project (110MW) in West Java. Other experience include the following.

Table 4-23 Sinohydro Track Record of EPC Contract in Hydro Power Plant Construction

Country	Project	Term	Size
Gabon	Grand Poubara Hydro Power Plant	2008-2013 (plan)	160MW
Malaysia	Bakun Hydro Power Plant	2003-2010	2400MW
Mali	Felou Hydro Power Plant	2009-2012	63MW
Thailand	Chao Phraya Hydro Power Plant	2007-2012	12MW
Zambia	Kariba Hydro Power Plant, Expansion North Part	2008-2012	360MW
Zambia	the ITEZHI TEZHI Hydro Power Plant	2011-2015 (plan)	120MW
Indonesia	Jatigede Hydro Power Plant	2007-2013 (plan)	110MW
Ghana	Bui Hydro Power Plant	2007-2013	400MW

Source: Sinohydro Website.[32]

(7) Turbine manufacturer / maintenance

Selection of turbines falls into 2 categories; 1) widely used yet relatively expensive turbines made in EU or Japan, 2) limitedly used yet less expensive ones made in China. The selection depends on preference of owners but it is highly preferred to meet certain quality standard as a turbine is expected to use for a long period in small hydro power projects. Since it is possible to have turbine trouble just

[32] Sinohydro. Website. “http://eng.sinohydro.com/” (accessed on January 21, 2014)

after start of commercial operation, it often requires the turbine manufacturer to guarantee spare parts. For several years after the end of guarantee period, one idea is to sign a maintenance contract with the turbine manufacturer until maintenance capability can be internalized.

In selection of the turbine manufacturer, maintenance framework for supporting the project needs to be confirmed. Especially, it is important to clarify risks related to the local maintenance support system for trouble shooting and the scope of services for being capable of.

There are 2 candidates for turbine manufacturer for Nasal project; Andritz and Fuji Voith Hydro. The detail discussion has not been conducted yet.

1. Andritz Hydro was established in Austria in 1852. The core business covers production of turbines for hydro power plant, production and maintenance for metal and paper-making pulp plants. In 2012, it holds 40% shares of the hydro power plant market globally, as it has experience in turbine design more than 170 years and strong business foundation.
2. Fuji-Voith Hydro was established as a joint venture between German Voit Semens and Fuji Electric in 1997, and its sales are recorded all over the world.

The technical advantage of the Japanese turbine manufacturers are in general: 1) reliability, 2) efficiency and 3) after services.

Firstly, Japanese turbine manufacturer has experiences of designing systems and manufacturing equipments for the purpose of stable supply of electricity under the guidance of Ministry of Economics, Trade and Industry for a long time. Their facilities are designed and manufactured under strict quality management, therefore they keep high global quality standard.

Secondly, the high efficiency of each equipment leads to more power sales. The Japanese turbine manufacturer continues to develop high-efficient hydro turbine, generator, and other facilities continuously.

Lastly, Japanese turbine manufacturers set up a system for after-service in order to easily maintain equipments by establishing a company or a team for maintenance in the local country for providing stable availability factor.

Therefore, CIL recognizes the high quality of the Japanese turbines and thus it is considering to use Japanese turbine whose facilities in Nasal project.

(8) Operation

The daily operation and maintenance is usually conducted either by hiring internal employees or to outsource. The main operation works consist of monitoring the operation, maintaining and cleaning equipment, making daily or weekly reports, preparing the necessary documents at the site in the case of insurance claims, etc.

In Nasal Project, CIL plans to hire several local staff for operation work and to send own engineers to the site to coordinate maintenance work for a few times a month. Daily work is not complicated compared to thermal power plants. However, it is necessary to confirm their capability to carry out communication, countermeasures in emergency situations, safety management in a sudden accident.

(9) Insurance Contract

The most commonly used insurances in a small hydro power generation are marine transit insurance, assembling insurance, and third party liability insurance during the construction phase. It is usually the case that EPC contractor covers marine insurance, assembling insurance and third party liability insurance. After construction, there are property insurance, business interruption insurance, and third party liability insurance, but some project owners do not contract for business interruption insurance. In some cases, some financial institutions require them to do so. It would be a problem if the insurance firm would be incapable of paying the sum insured. Therefore it is needed to select the insurance firm by checking their financial strength, ratings and solvency margin. Sometimes the lenders may have the requirement to enter in a contract with an insurance firm which has the rating above certain level.

First of all, it is necessary to confirm which original insurance firm project owner is selecting and the contents of the insurance. Assembling insurance during the construction period is for making compensation for the property losses caused by sudden accidents in the site and natural disaster. It is necessary to confirm what are the risks not covered by the policy clause. Also, The coverage of property insurance contracted after construction should be confirmed likewise.

It is desirable that the sum insured for physical damage is basically Full Replacement Value which enables reconstruction of a power plant. However if the sum insured is enlarged, the premium would be raised. Therefore the project owner sometimes does not choose Full Replacement Value to restrain the premium cost. For the lender, if it is possible to prove the damage is limited in scope based on Maximum Probable Loss calculated by the Trusted Third Party, it may be acceptable to apply Maximum Probable Loss as the sum insured.

As for any other important matters, it is necessary to confirm the deductible amount within an accident. If the exemption from responsibility is quite large within an accident, physical damage amount becomes less than the amount of the exemption from responsibility. Then, the insurance cannot be claimed. If the exemption from responsibility is decreased, the premium tends to be increased. Therefore it is important to consult with the project owner about the optimum exemption from responsibility.

In Nasal II project, insurance has not been contracted, and at the moment there is no candidate. Thus, this matter shall be closely followed up.

4-1-6-2. Outline of Various Contracts (Off-take, EPC, O&M, etc)

(1) PPA（Off-take Agreement）

In Nasal project, PPA is in discussion with PLN. Below summary only lists main confirmations.

Table 4-24 PPA detail information

1	Party in Charge	✓ PLN and CIL enter into PPA
2	Plant Output	✓ 10MW planned
3	Selling Price	✓ From the first year of commercial operation to its 20th year, the selling price is IDR 945 /kWh ✓ The current FIT price is IDR 787 /kWh, however it will be increased by around 20% according to PLN
4	Selling Term	✓ Twenty years are the typical term for the commercial operation.
5	Expected Day of Selling Electricity	✓ The plan is to have the commercial operations two years after signing of PPA.
6	System Connection Conditions	✓ CIL, the project owner of this project, has to construct the transmission line to connect to PLN's transmission network at the nearest point from this project site. The ownership of the transmission line shall be transferred to PLN after the construction is complete.
7	Other Conditions	✓ CIL charges electric power selling to PLN every month, and PLN is obliged to pay within twelve business days after receiving the invoice from CIL.

(2) EPC Contracts

In Nasal project, ECP contract has not been discussed in details yet. Details of contracts need to be confirmed later. For that reason, below summary only lists main confirmations.

Table 4-25 EPC contracts detail confirmation

1.	Party in Charge	✓ Ordering Party：CIL ✓ Contractor: Name of EPC contractor (To Be Confirmed)
2.	Scope of Contractor Service	✓ It's necessary to list a range of jurisdiction so that every item is covered as a full turnkey contract consisting of procurement, construction, trial run duties, the training, machine parts necessary for the completion of this generation facilities. ✓ More specifically, the work of assisting all business approvals, report generation facilities, electrical equipment, and related construction, civil works, installation of equipment, procurement of spare parts, training of operating personnel, all the other necessary tasks to fulfill the contract.
3.	Contract Amount	✓ Needs to be confirmed, it is desirable for (fixed price) fix lump-sum.
4.	Payment Conditions	✓ Payment based on the construction progress or the payment based on the set date is common. The refund bond (guarantee of

	repayment of advanced payment) in the form of bank guarantee is seen by a large-scale international bid project, but it is not common in a small hydro project in Indonesia.
5. Delivery Conditions	✓ Define the date of delivery and the final completion date (Warranty period starts from the time of completion of construction).
6. Reporting Requirement	✓ It is desirable that the contractor makes a progress report monthly.
7. Insurance	✓ Policy holder：Contractor ✓ Insured: the project owner, the contractor, subcontractors, lenders, etc. ✓ Type of Insurance ➢ Transport Insurance ➢ Assembling Insurance ➢ Third Party Compensation Insurance
8. Guarantee Against Defects	✓ Necessary to set the term of the insurance
9. Performance Guarantee	✓ Necessary to have a guarantee for output(kW) capacity of generators
10. Liquidated Damages	✓ Liquidated Damages（Set the amount of compensation per day delay. The amount of compensation per day is expected to be calculated on the basis of expected annual sales ÷ annual operational days, however, it is necessary to confirm.）

(3) Maintenance Contract

In Nasal project, maintenance contract has not been discussed in details yet. Details of contracts need to be confirmed later. For that reason, below summary only lists main confirmations.

Table 4-26 Maintenance contracts detail confirmation

1. Party in Charge	✓ Generally, consignor is the project operator. ✓ Consignee is the maintenance company.
2. Term of Contract	✓ Generally speaking, turbine manufacturers offer necessary materials and parts for maintenance for one year after the start of commercial operation and it is expected to have the contract for the maintenance for several years after the end of the warranty period. Then it is expected to reduce the cost by establishing its own maintenance structure afterward. It is necessary to confirm that project operator actually follow above scenario.
3. Expense for Commission	✓ Total annual payment is divided by 12 and the payment is commonly made monthly.

4. Scope of Service and Obligation	✓ The periodical maintenance is assumed as regular maintenance to the project related facilities in line with the maintenance manual provided by the manufacture（including the making necessary documents, commissioning and supervising outside supplier and so on）. Scope of maintenance needs to be confirmed. ✓ Large-scale maintenance duties are a large-scale maintenance work planned in a long-term operation maintenance plan. It is expected to inform the details of work, schedule and additional cost in advance. It is common to create a set of documents to report the results.
5. Acceptance	✓ It has to be accepted by the project owner. It is necessary to check the results with the consignor within the several days after the completion of the periodical and the large-scale maintenance.
6. Guarantee for Service	✓ The warranty against defects guarantees that there are no defects in the services or products offered. It is necessary to confirm warranty coverage and period. ✓ At the time of violation of the guarantee, the trustee pays the cost at his own expense, and it is common to carry out the necessary repairs or replacements. ✓ The performance warranty has to be set to compensate the amount to cover the damage caused by failing to achieve the insured output capacity to the consignor.

4-1-7. Conditions and Issues toward Building Financial Scheme

4-1-7-1. Confirmation of Available Equity Amount for the Project Owner

Firstly, it needs to be confirmed that what kind of scheme the project owner intends. Generally, a Holding Company (HD) is established, and Special Purpose Company (SPC) is also established for each project. It is often the case that the equity is injected from the HD. This is because it is difficult to sign PPA for several projects under the same project company name with PLN. From PLN's point of view, there are many failed projects due to funding issues in a small hydropower, and thus PLN thinks it should be difficult for the same company to finance multiple projects at the same time. Therefore, project owner is required to take above scheme.

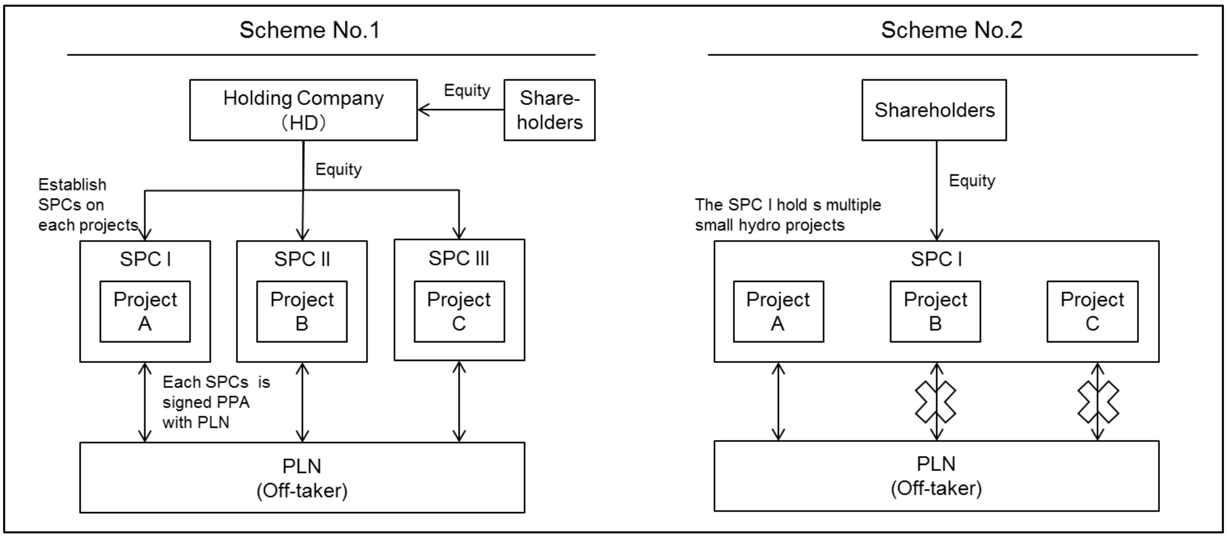


Figure 4-5 Project Schemes

However occasionally, there are some cases where project owners attain permits and develop with the same SPC name in the multiple projects without establishing HD (See above scheme(2)). Therefore it needs to be confirmed that the project owner raise the capital for SPC through HD or the equity holders provide the capital directly without HD if it is the first project for the project owner. In addition, it also needs to be confirmed that how much equity portion the project owner can provide for the project. Even though the project owners have sufficient capital, in case they have several projects in the pipeline, they may intend to leverage by reducing equity amount and increasing the debt amount. On the other hand, the project owners who do not have enough funding ability may have their limitations, and then the equity amount should be determined accordingly.

In Nasal project, it is the case of scheme (1) where equity holders, PIL as HD, invested in CIL. PIL also established other companies and received finance for 12.6MW Pakkat small hydropower project in North Sumatra and 16.5MW Airputih small hydropower project in Bengkulu.

4-1-7-2. Confirmation of available debt amount from senior lenders

It is extremely important to confirm whether local, governmental, and foreign-affiliated financial institutions in Indonesia can provide loans during construction period of a small hydropower generation. After introduction of FIT, small hydropower is starting to be expanded as a base power source, but there are only a few financial institutions which have provided loans for a small hydropower. Therefore, many institutions generally provide loans as a corporate finance depending on the credit of the project owners, a private guarantee and collateral. In fact financial institutions which can provide project finance type loan, taking construction risk, are quite limited.

The financial institutions which can tolerate risks during the construction period mention that their internal regulation permits to provide up to 80% of total project cost. Thus project owners with high credit also have to provide equity for at least 20%. However in case that they have to allocate the limited capital to other pipeline, or they cannot provide their own equity for 20% of total project cost, they have to call up mezzanine lenders which are subordinated lender.

SMI, a candidate for a senior lender, has financed Airputih small hydropower project, and it is possible to consider financing their following projects. SMI will discuss with the project owner when the necessary conditions for consideration of the loan are on the table.

4-1-7-3. Possibility of inviting mezzanine lenders

There is a finance method called mezzanine other than equity and senior loan mentioned above. Though mezzanine finance is given low-priority to senior finance, it has a priority to equity finance. Therefore, it stands in the middle between the two as a finance method. When the project owner has limitation in their equity amount they can provide and so does senior lenders, in the case where the total sum of both parties does not cover the total project cost, the project owner needs to consider inviting mezzanine lenders. Hence, there is a need to invite mezzanine lenders from both project owner and senior lenders.

The typical way of Mezzanine is an investment by mezzanine loans and class shares. Both instruments are inferior to senior lenders in the ranking of repayment. That means that repayment for senior lender has a priority to be repaid from the sales of electricity except for tax or necessary expenses. Therefore, from the senior lender's point of view, inviting mezzanine means capital enhancement. On the other hand, from the project owner's point of view, as it is not an investment by ordinary share, the project owner can avoid lowering the return on equity, dilution of voting share, and at the same time, is able to keep the flexibility in the management.

Candidates for mezzanine lenders are local governmental financial institutions such as securities company type or investment bank type, or mezzanine section of foreign-affiliated financial institutions. However, such financial institutions that take risks aggressively during construction are quite limited.

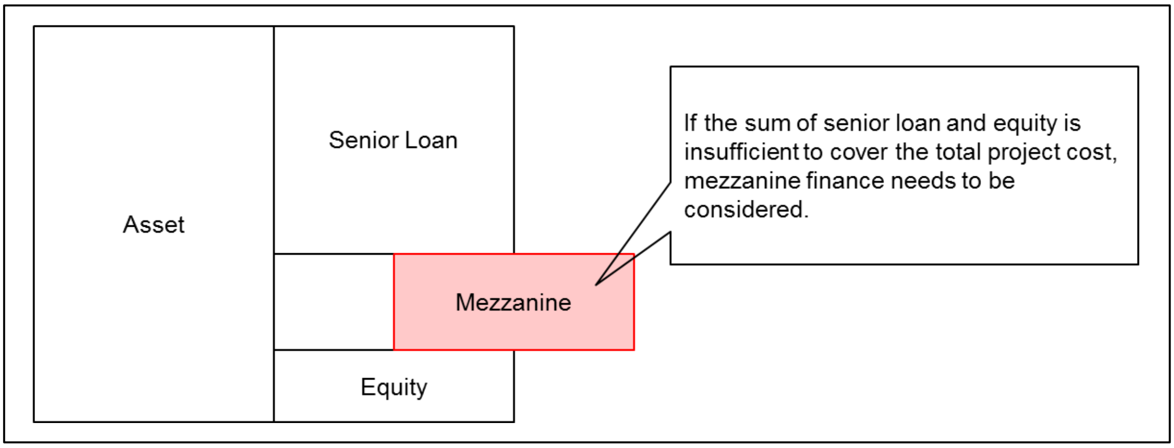


Figure 4-6 Structure of Mezzanine Financing

PIL already started the discussion regarding the financial arrangements with IDI-I which is a mezzanine lender candidate. Discussion on detail terms and conditions is planned to commence after FIT price increase, inviting new investors, conclusion of PPA and selection EPC contractor.

4-1-7-4. Terms and Conditions of Possible Loans from Local Financial Institutions / Governmental Financial Institutions

In Lae Ordi II project, discussion with financial institutions, expected senior lenders, has not advanced in details yet. Details of contracts need to be confirmed later. For that reason, below summary only lists main confirmations.

Table 4-27 Maintenance Contracts Detail Confirmation

1. Party in Charge	✓ Lessor : Senior Lender ✓ Lessee : CIL
2. Loan Amount	✓ Necessary to confirm whether IDC amounts can be added to the loan amount.
3. Period of Repayment	✓ During the construction period (2-3 years), the repayment is deferred. The repayment on principal will begin after the start of commercial operation. The repayment period is usually was during 5 years to 8 years.
4. Interest	✓ It varies depending on the creditworthiness of the project owners and projects.
5. Repayment Terms	✓ Phased payment along with the progress of constructions
6. Up-Front Fee and Agent Fee	✓ It is necessary to confirm possible fees such as up front and agent fee
7. Prepayment prior to the maturity date	✓ There are cases where the penalties may be required for repayment (total amount or a part of the loan)prior to the maturity date of the loan..
8. Default Charge	✓ When return of an interest rate or the capital is delayed, default charges are caused.
9. Cash water fall mechanism	✓ In case of Project Finance, Cash waterfall mechanism is adopted and priority of payment is decided beforehand. Dedicated account is opened, managed and operated by the agent (General accounts are as follows). ➢ Account for Project ➢ Account for tax payment ➢ Account for Payment Expenses ➢ Account for Repayment Senior Debt ➢ Account for Debt Service Reserved ➢ Account for Repayment Mezzanine ➢ Account for Sponsor Release ➢ Deposit Account for taxes and insurance fund

10. Covenants	✓ Commonly, there are positive covenants defining what project owner has to abide by the agreement and negative covenants defining what it is prohibited. ✓ In Indonesia, it is common to define positive convenants such as to maintain required permits and licenses, to submit a set of financial statements, to maintain financial covenants including debt service coverage ratio, etc that need to be checked upon. ✓ It is also common to define negative covenants such as selling and leasing assets, signing loan agreements, transfering the rights of ownership and repayment in terms of the agreement without approval of lenders.
11. Forfeiture of benefit of time	✓ If the violation of covenants not corrected the above situation will continue for a certain period of time, the operator is prompted for a lump-sum repayment from the lender.
12. Mortgage	✓ Senior Lenders usually get the first priority security interest in the assets of such a set of land and equipment needed to operate a small hydro project.

4-1-7-5. Clarification of terms and conditions in executing loans

Financial institutions generally enter into a loan agreement with stipulating Conditions Precedent, and if the Conditions Precedent is not satisfied in advance, the loan is not executed. The subjective contracts are a complete set of the project related contracts, such as acquisition of land, EPC, contract to purchase turbines, PPA, and insurances.

For Nasal Project, consultation with financial institutions in detail has not started, therefore it is necessary to check the Conditions Precedent in agreements. The following is a summary of main issues for clarification.

Table 4-28 Classification of Necessary Conditions for Investment Execution

1. Contracts of Project	✓ Agreement must be entered into a set of related projects that are necessary to continue to operate on small hydro projects.
2. Guarantee	✓ Personal guarantee of such a representative, if necessary
3. Mortgage	✓ Must be assured of the security interest set of assets, including land and equipment
4. Environmental impact assessment	✓ Small hydro projects below 10MW, but in many cases it does not need (AMDAL) environmental impact assessment. Approval of UKL / UPL's (Environmental Management Efforts and Environmental Monitoring Efforts) is required by lenders, so it needs to be confirmed.

5. Financing Payment	✓	Third-party engineering firm render was ordered to check the progress of construction, make loan payments depending on their progress.
6. Director	✓	In some cases, it is required to appoint directors in the mezzanine lender.

4-1-7-6. Clarification of terms and condition of loans for JICA Private Sector Investment Finance Scheme

In the case of utilizing JICA Private Sector Investment Finance Scheme, above terms and conditions of loans from the local commercial banks and government financial institutions may be required as well. A form of loan by project finance is assumed, thus terms and the way of repayment should be examined under the consideration of the project. In the case of loan from JICA independently, it is anticipated that there will be quite some efforts required in negotiating with the project owners such as monitoring after the execution of the loan and resolving troubles. Therefore one idea is to co-finance with local financial institutions, or to offer a packaged proposal by inviting mezzanine lenders who are having a good relationship with the project owners in order to reduce the risk.

Table 4-29 Clarification of the Specific Terms of Investment and Loans

1. Party in Charge	✓ ✓	Lessor : Independent Administrative Corporation Japan International Cooperation Agency (JICA) Lessee : PT Citra Indonusa Lestari (CIL)
2. Loan Amount	✓	It is desirable to add it to a financing amount of money, and to contribute the-based average interest rate (Interest During Construction)
3. Pay-Back Period	✓	<Assumption> 2 years grace period during construction and 8 years repayment period
4. Interest	✓	To Be Settled
5. Financing Payment	✓	It is desirable to pay depending on construction progress progressively
6. Up Front Fees and Agent Fees	✓ ✓	The agent duties assume that they depend on a local financial institution or the governmental financial institution Loan related fees such as legal cost are assumed to be borne by CIL. In this case, up front fee will be 0.3%.
7. Repayment Before Maturity	✓	Assuming the same conditions as the local financial institutions or government-affiliated financial institutions
8. Late Payment Charges	✓	Same as the above
9. Cash Waterfall Mechanism	✓	Same as the above

10. Covenants	✓ Same as the above
11. Forfeiture of Benefit of Time	✓ Same as the above
12. Mortgage	✓ Same as the above

4-2. Survey overview

4-2-1. Descriptions of proposed locations for the survey

4-2-1-1. Site information

The planned site of the Nasal small hydropower project lies in the area near to Air Palawan village along Nasal river – Nasal county, Kaur Bengkulu province (for planned layout: see Figure 4-7)The site lies at around 4°47-49’ north-latitude, and at 103°31-33’ east-longitude.

Figure 4-7 The area at and around the planned site

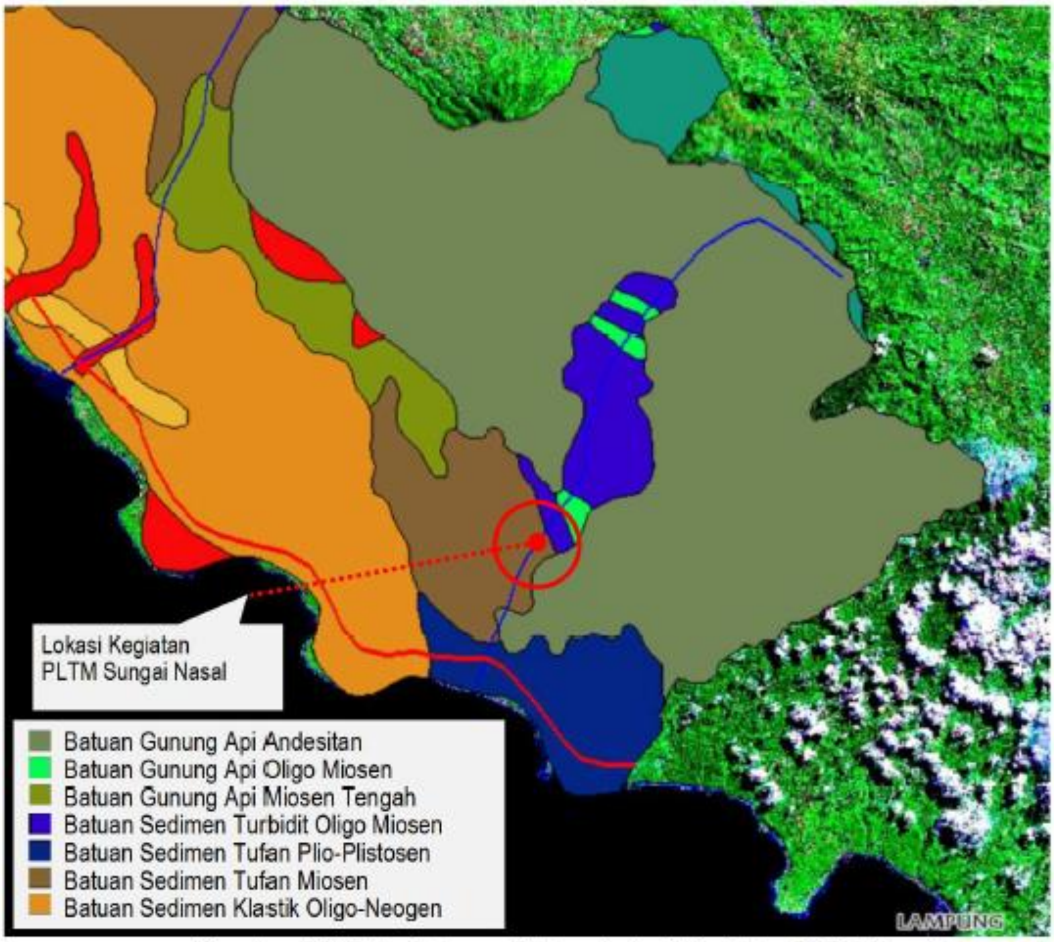
Source: PFS Report (PT. CITRA INDONUSA LESTARI. 2012.3)

4-2-1-2. Geological features

The area surrounding the site is classified, in term of angularity, into two zones: slowly undulating land under cultivation, and uncultivated land often with steep inclination. A large portion of the uncultivated land lie in mountainous area with steep inclination greater than 15%. Nasal belongs to this area and with an altitude 50-100m above sea level.

4-2-1-3. Geology

According to the geological map published by Survey Center of National Resources of the Sea (PAADAL), an organization of National Coordination Agency for Surveys and Mapping, large portion of the area for this project consists of the following geology: andesite lava, oligocene-miocene lava, mid-micene lava, Neogene lava, Pliocene-Pleistocene tuff breccias, Miocene tuff breccias and Oligocene-Neogene tuff breccias.



Gambar 2.3. Peta Sebaran Batuan Lokasi Kegiatan PLTM Nasal

(Sumber Peta : Pusat Survei Sumber Daya Alam Laut (PSSDAL) - BAKOSURTANAL)

Figure 4-8 Geological features around the planned site

4-2-1-4. Hydrology

The catchment area of the intake dam of Nasal small hydropower project measures around 307.93km^2. The basin is of radial shape, where the tributaries converge into an location of the fan-like form. The river flow arborizes in a tree-like fashion, with each branch randomly diverged with no specific bearing.

4-2-1-5. Climate

Meteorological data used in this project and survey was collected at the Pulau Baaai 2nd observatory, Bengkulu province. According to the meteorological data collected during the years from 2006 to 2010, average values for maximum and minimum temperatures are 30.7 and 23.6, and those for humidity, hours of daylight, and wind velocity are 84.1%, 67.10% and 4.76km respectively.

Rainfall data used was gathered at three observatories: Tanjung Harapan in Semidang Gumay county, Kanpil Linau in Maje county, and Diperta Kaur in South Kaur county. Based on the precipitation data from these three observatories, yearly average precipitation at the site is estimated to be 2,592mm. The maximum precipitation in a day, 163mm, was observed in Kanpil Linau rain-gauge station in South Kaur county.

Judging from the precipitation data over the past ten years, rainy season lasts on average from August to January, and dry season from February to July.

4-2-2. Overview of the power generation plan

4-2-2-1. General

The project intends to exploit untapped head of Nasal river, and the influx of water is accumulated in a reservoir before being channeled through the generator. The power generation plan proposed by PFS report (PT. CITRA INDONUSA LESTARI, 2012.3) (hereinafter referred to as “PFS Report”).
assumed the following scheme: the water for power generation (max. 17.36m3/s) withdrawn through a intake weir is conducted through an intake channel and headrace (total length: approx. 3.3km) into the reservoir.; then, it runs downward through a penstock (160m) gaining an effective head of 80.8m, creating max. 12,000kW of electric energy; finally, the water joins Nasal river.

As the PFS report, however, did not define the basic design of the power generation method, additional examination was carried out regarding possible effective head and generation capacity using the method normally employed in Japan, and with references to the latest basic drawings (2013.9). The examination revealed that, if the maximum usable quantity of water is assumed to be the same with that postulated by PFS report, the effective head decreased to 69.0m, reducing the maximum output down to=10,000kW.

After PT. CITRA INDONUSALESTARI published PFS report in March, 2013, they published a detailed design, the Basic Design Drawing (PT. CITRA INDONUSALESTARI, 2013.9) (hereinafter referred to as “Basic Design Drawing”). Based on these materials, this power generation plan in Nasal was implemented.

The planning specifications of this power generation project are summarized inTable 4-30. Note that “Japanese method” in a table below is the method to examine complying with laws used in Japan, and the PFS report estimated annual available output capacity with fixed power generation efficiency (0.8). However, in Japanese method, annual available output capacity is estimated with the power generation efficiency that fluctuates due to flow rate.

Table 4-30 Specifics of power plant project (Nasal)

Contents			Features(Japanese Method)	Features(PFS Report)
Name of River			Nasal River	
Basin area			307.93 km²	
River flow (m^3/s)			Conversion flow by Tank model of rain gauge station(average from2001-2010)	
			Maximum 120.36 High water 17.54 Average water 12.29	
			Low water 9.68 Dry weather water 7.85 Minimum 7.66 Annual average 15.98	
Electric power planning	Type of power generation		Run-of river, Conduit	
	Intake water level		134.50 m	136.00 m
	Tailwater level		59.50 m	50.50 m
	Gross head		75.00 m	85.50 m
	Effective head		69.00 m	80.80 m
	Maximum water discharge		17.36 m^3/s	17.36 m^3/s
	Output		10,000 kW	12,000 kW
	Annually electricity		57,737 MWh	56,320 MWh
General equipment	Intake weir		Height 19.5m、dike peak length 52.0m	Height 10.0m、dike peak length 48.0m
	Intake		Height 8.4m、Width 9.0m	Height 3.6m、Width 5.4m
	Settling basin		Height 5.9m、Width 14.8m、Length 8.5m	Height 5.3m、Width 6.0m Length 70.0m
	Head tank		Height 5.3～10.2m、Width 20m、Lentgh50m	Height 4.4～9.1m、Width 18.5m、Length 46.5m
	Waterway	Intake channel	3.5m×3.5m L=1,060m、I=1/1,667	4.0m×4.0m L=915m、I=1/4,000
		Headrace	3.5m×3.5m L=3,108m、I=1/1,667	3.5m×3.5m L=2,875m、I=1/2,326
		Penstock	Inner diameter 2.55m 、L=226.72m	Inner diameter 2.6m 、L=160.0m
		Tailwater way	-	Width 6.0m 、L=12.5m
	Power plant		Above ground type	Above ground type
	Turbine type		Francis horizontal shaft 2 turbines	Francis horizontal shaft 2 turbines
	Generator type		5,000kW×2 units	6,000kW×2 units
River utilization	Water for river maintenance		0.92 m^3/s	0.92 m^3/s
	Plan factor		65.9%	53.6%
	River utilization rate		78.1%	-

4-2-2-2. Power output capacity

The output capacity in the PFS report was compared with that calculated, as described above, using the Japanese standard method. Both results – power output capacities calculated in this review and in the PFS report – despite differences in calculation conditions, agreed relatively well: the difference between them is around 1,000 to 4,000MWh.

(Major differences in calculation condition)

・ Power generation efficiency
・ Maximum output
・ Method to establish the maintenance flow

① Power generation capacity in the PFS report

Power generation capacity in a year = 56,320MWh/yr

② Power generation capacity as calculated using Japanese method

Table 4-31 Power generation capacity

Unit:MWh

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Plan 1	5,378	4,736	4,624	4,226	4,285	3,731	3,628	3,716	3,728	3,948	4,986	5,470	52,457
Plan 2	6,253	5,547	5,091	4,468	4,407	3,825	3,726	3,878	3,896	4,369	5,871	6,406	57,737
PFS Report	-												56,320

Details of study cases using Japanese method are as shown below.

・Plan 1 Study case using Japanese method with power generation capacity of 8,000kW
・Plan 2 Study case of 10,000kW of power generating capacity using Japanese method applied with plant discharge (17,36 m^3/s) of PFS report

4-2-2-3. Estimated cost of construction

On the basis of generating power output (12MW) and plant discharge (17.36m^3/s), the construction cost is estimated as 262,688 million rupiah under these conditions below.

・Preparatory construction cost is fixed without being affected by generating power or plant discharge

・Civil works cost increase and decrease in proportion to generating power or plant discharge

・Electrical construction cost increase and decrease in proportion to generating power or plant discharge

・Engineering cost is estimated by the quotation for the similar project from the grobal major technical consulting company

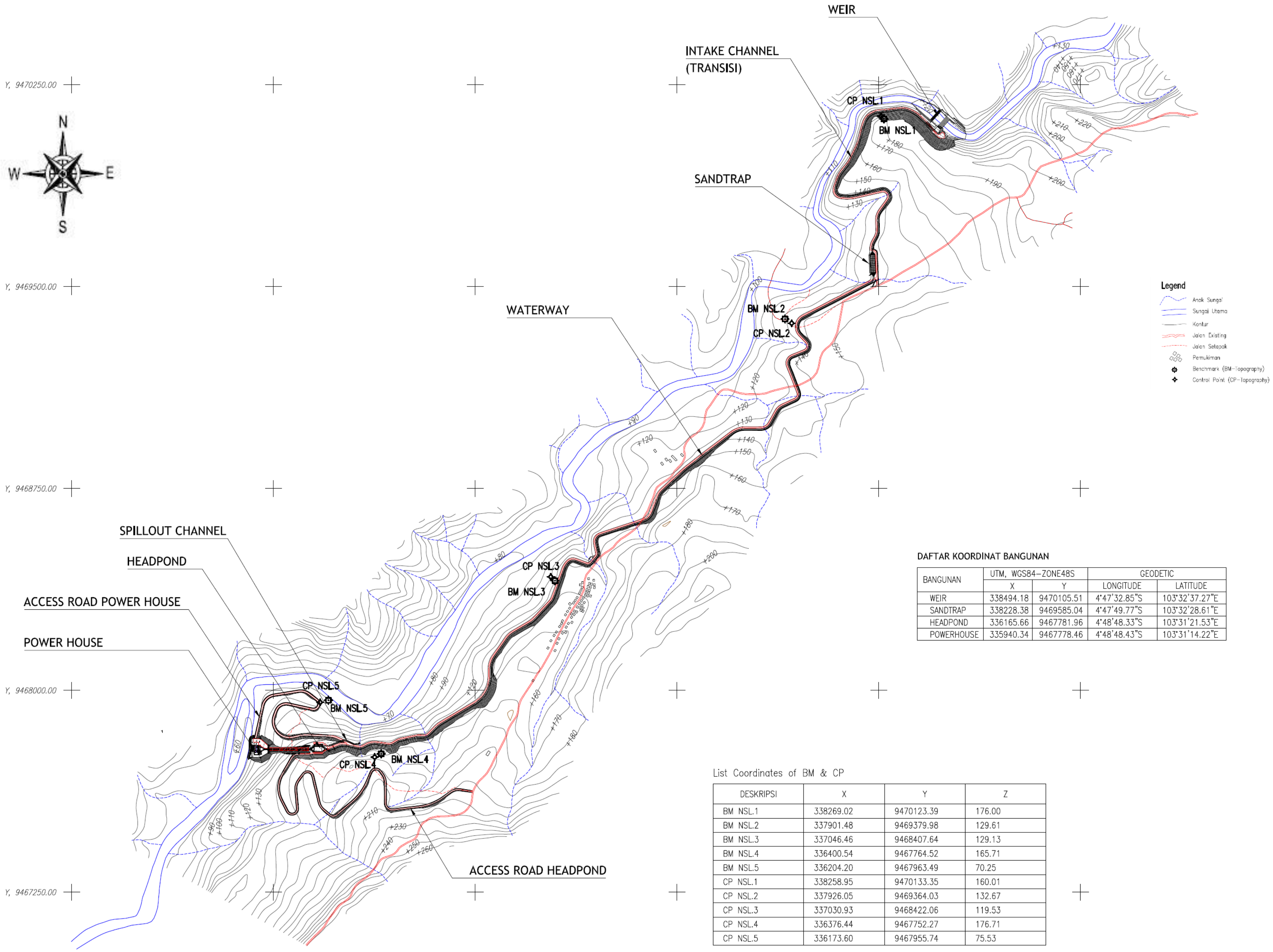
A project expense of PFS report was compared to a hydropower project in North Sumatra in the Survey, similar both in type and scale, which indicated that the level of construction cost was nearly the same. Therefore, the construction cost is considered to be at a proper level for a project undertaken in Indonesia.

Table 4-32 Comparison in terms of project expenses and economy: Nasal and North Sumatra Project in the Survey

Project name		Nasal	North Sumatra PJ in the Survey
Max output	kW	12,000	10,000
Plant discharge	m^3/s	17.36	10.63
Effective head	m	80.8	106.4
Total construction cost	Million Rp	275,382	226,140
Construction cost/kW	Rp/kW	22,948,500	22,614,000

4-2-3. Review of power generation plan

4-2-3-1. Waterway route



DAFTAR KOORDINAT BANGUNAN

BANGUNAN	UTM, WGS84–ZONE48S		GEODETIC	
	X	Y	LONGITUDE	LATITUDE
WEIR	338494.18	9470105.51	4°47'32.85"S	103°32'37.27"E
SANDTRAP	338228.38	9469585.04	4°47'49.77"S	103°32'28.61"E
HEADPOND	336165.66	9467781.96	4°48'48.33"S	103°31'21.53"E
POWERHOUSE	335940.34	9467778.46	4°48'48.43"S	103°31'14.22"E

List Coordinates of BM & CP

DESKRIPSI	X	Y	Z
BM NSL.1	338269.02	9470123.39	176.00
BM NSL.2	337901.48	9469379.98	129.61
BM NSL.3	337046.46	9468407.64	129.13
BM NSL.4	336400.54	9467764.52	165.71
BM NSL.5	336204.20	9467963.49	70.25
CP NSL.1	338258.95	9470133.35	160.01
CP NSL.2	337926.05	9469364.03	132.67
CP NSL.3	337030.93	9468422.06	119.53
CP NSL.4	336376.44	9467752.27	176.71
CP NSL.5	336173.60	9467955.74	75.53

Figure 4-9 Waterway route map

4-2-3-2. Stream regime at the water intake

In this section, an attempt is made to sort out the stream regime information on and around the project site, and to establish a guideline to figure out the amount of water to be used.

(1) Flow rate data

1) Method used on site

As there exists no water-gauging facility in the neighborhood of the projection site, flow rate data was prepared by converting – using NRECA model and tank model - the sets of precipitation data gathered in the areas surrounding the project site.

Three observatories - Tanjung Harapan in Semidang Gumay county, Kanpil Linau in Maje county, and Diperta Kaur in South Kaur county - are located in the surrounding area of the project site, and precipitation data from 1993 to 2008 was available. In this review, these sets of precipitation data were converted to flow rate through application of NRECA model.

Table 4-33 Precipitation station in the area surrounding the project site

Precipitation station	Period of available data	Note
TJ Harapan	2001- 2010	
Dinas Pertanian Kaur	2007 – 2010	
Kanpil Linau	2006 - 2010	

The locations of these precipitation stations, as well as the project site, are shown in Figure 4-10.

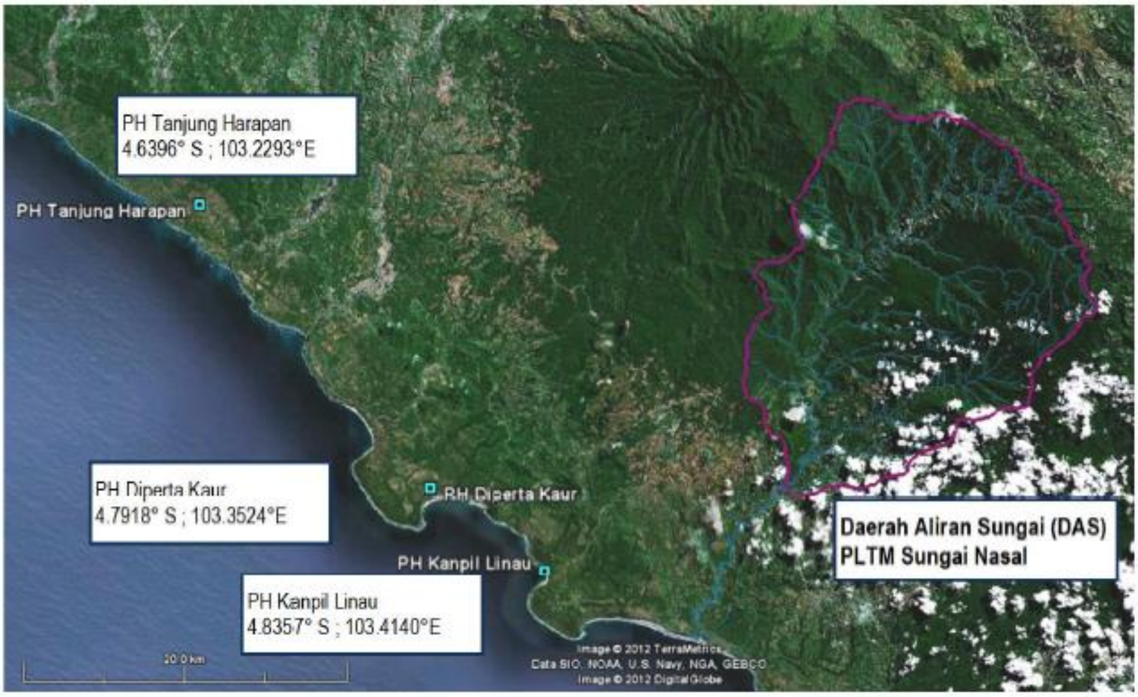


Figure 4-10 Locations of precipitation gauging statio

2) Methods used in Japan

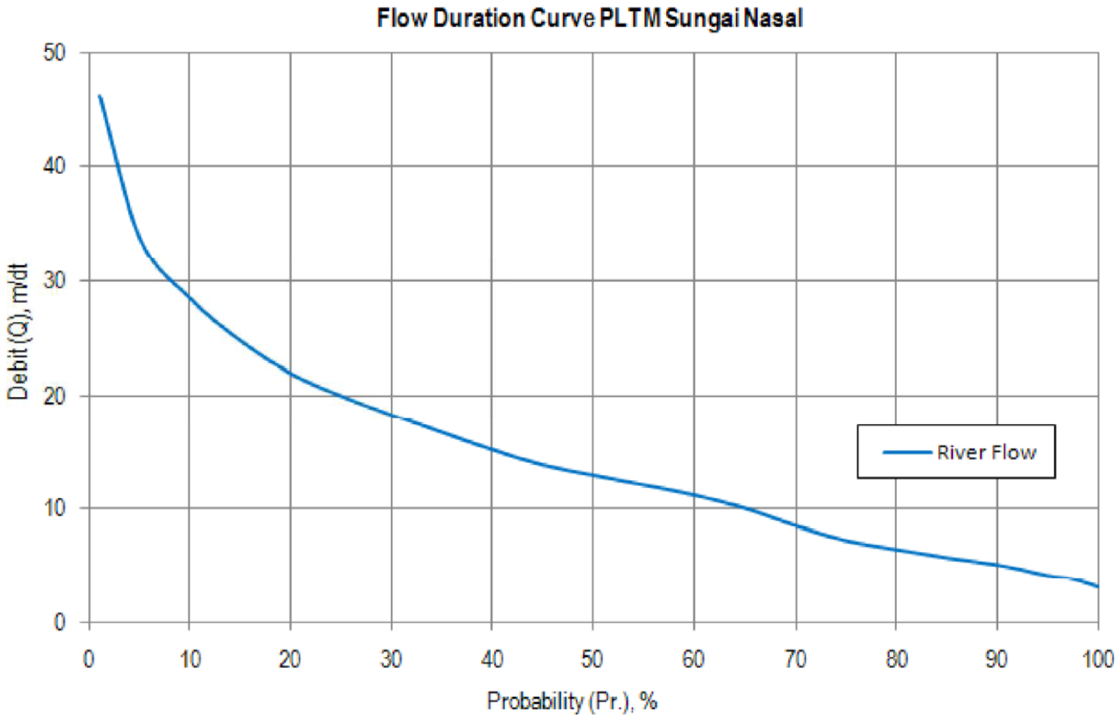
The guideline applied to hydropower constructions in Japan prescribes that, in case no water-gauging facility is available in the immediate or moderate neighborhood of the project site, a simplified precipitation measurement should be taken for a year to figure out the flow rate. Based on the measured flow rate and the data obtained from the water-gauging facilities along the neighboring rivers, correlation among them should be examined for feasibility of regression analysis. If the examination concludes in favor of mutually complementary use of these sets of data, flow rate is forecast using regression analysis for the period of ten years.

Therefore, in the light of the method used in Japan, flow data must be measured on site.

Although an accuracy check of the flow rate data is deemed necessary, measured flow rate data is not available from the neighborhood of the project site. Given this situation, tank model is applied as the flow rate data of project site in this review.

(2) Stream regime

Because the numeric on-site data (NRECA model) is not available as of now, the stream regime chart that appears in PFS report is reprinted below.



Gambar 4.12. *Flow Duration Curve* PLTM Sungai Nasal

Figure 4-11 Stream regime – local method (Nasal)

Stream regime data is calculated using the adopte method (Tank model) and shown below (Table and Chart).

Table 4-34 Stream regime, at Nasal, estimated using the adopted method

Year	Maximum	High water	Average	Low water	Dry weather discharge	Minimum	Annual average
[2001]	137.57	15.51	8.81	6.32	5.21	5.16	13.00
[2002]	130.43	12.59	8.33	5.83	4.62	4.40	12.14
[2003]	30.12	9.76	6.52	5.28	3.89	3.85	8.20
[2004]	48.97	6.31	4.34	3.96	3.19	3.17	7.18
[2005]	104.97	13.75	8.58	7.25	5.40	5.37	12.00
[2006]	171.37	19.76	14.86	13.41	9.42	9.31	18.52
[2007]	315.93	20.83	16.00	12.00	10.43	10.27	19.54
[2008]	79.29	22.85	14.65	10.83	8.72	8.55	18.32
[2009]	67.50	28.81	19.33	12.64	11.32	11.09	21.53
[2010]	117.44	25.23	21.44	19.32	16.26	15.46	23.38
Average	120.36	17.54	12.29	9.68	7.85	7.66	15.38

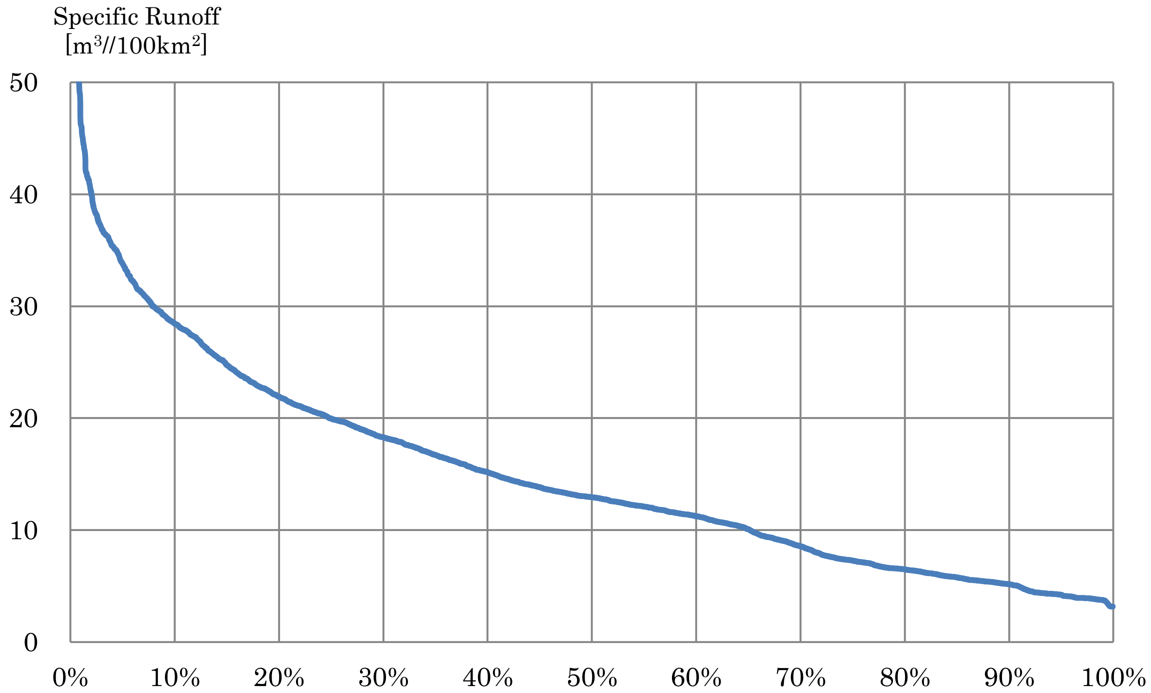


Figure 4-12 Stream regime, at Nasal, estimated using the adopted method

4-2-3-3. Review of power generation capacity

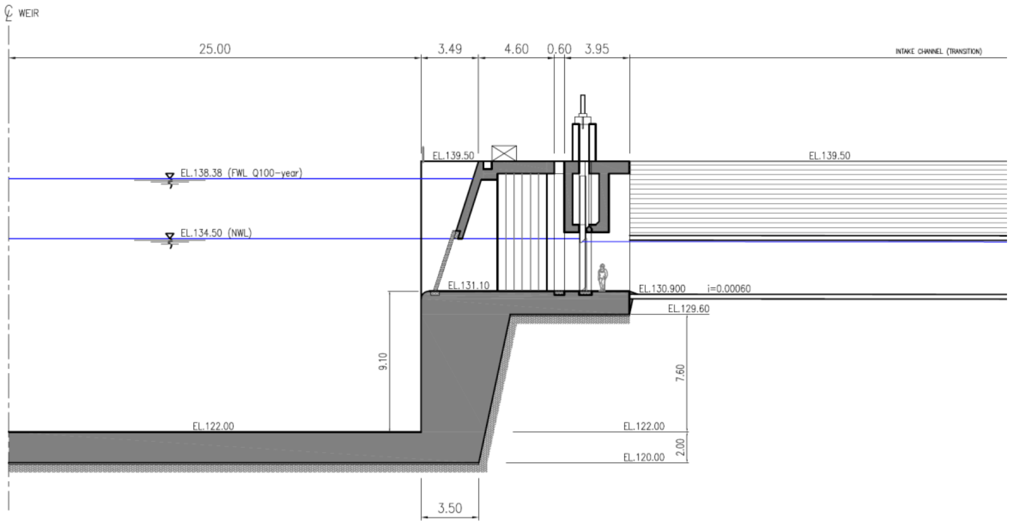
According to PFS report, possible power generation capacity at the project site was estimated to be up to 12,000kW with the flow rate 17.36m3/s. However, close examination of the effective head and power generation capacity based on basic design drawing, using the same planning flow rate with that of PFS report, resulted in a reduced maximum output of approx. 10,000kW, whereby calculation methods normally used in Japan were employed.

In the following sections, detailed discussion will be made on the capacity of power generation with reference to the normal method used for the projects undertaken in Japan. In addition, each specification items is examined for applicability and validity.

(1) Intake level, tail water level, and effective head

1) Intake level

Figure 4-13 shows a cross-section and a plane view of the intake weir. The intake weir (height 12.50m) is constructed on a river bed whose altitude is 122.00m above sea level, and its intake level is set to the altitude of the overflow weir, 134.50m. The dimensional conditions of the intake - width 9.0m, inflow depth no less than 3.4m – renders the approximate flow rate no greater than 0.57m/s, which is considered appropriate dimension for intake compared to general flow velocity , 0.3 ～ 1.0m/s..



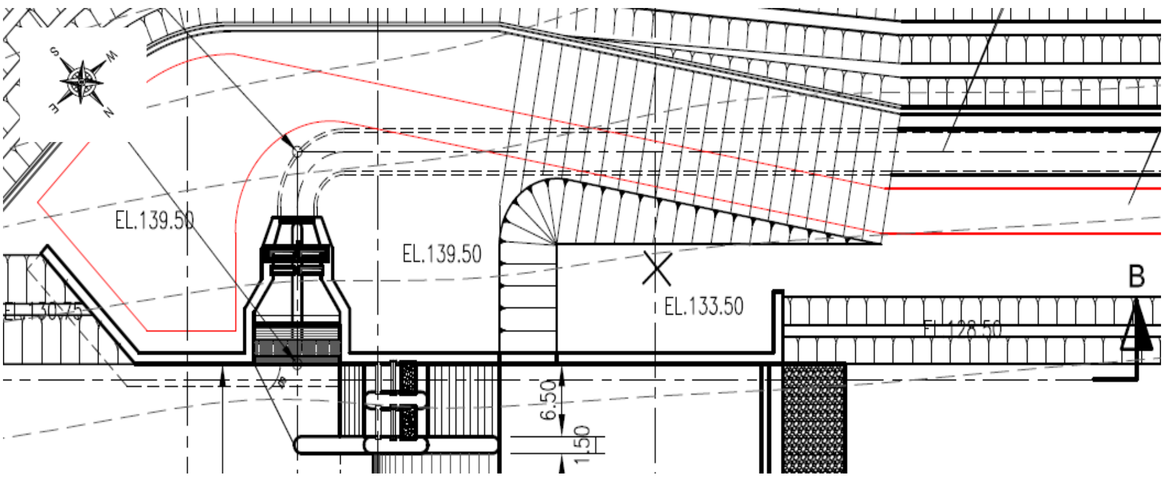


Figure 4-13 Design drawings of the intake weir (above: cross section, below: plane view)

3) Tail water level

Figure 4-14 shows a cross-section and a plane view of the power station. Tail water level is set to 59.50m, which is roughly the same with the river level when high water flow rate (95 days flow rate) discharges.

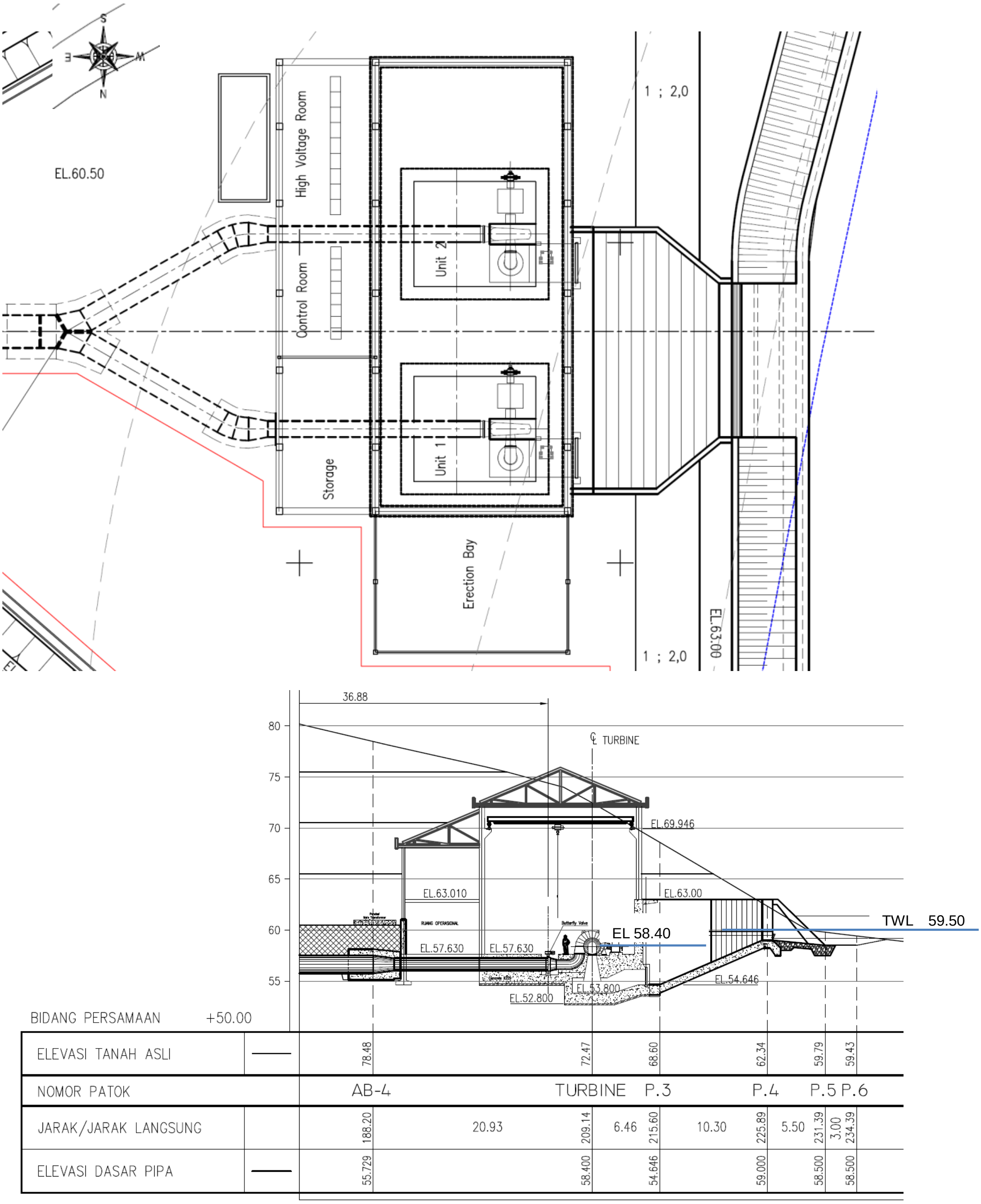


Figure 4-14 Design drawings of the power plant (above: plane view, below: cross section)

4) Effective head

(A) Method used to examine validity of the effective head

Normal procedure in Japan to calculate an effective head is: "Effective head = Intake level – Tail water level – Loss head". Here, loss head is calculated using the normal procedure employed in Japan, and the result is applied to check validity of the effective head.

- Intake level: 134.50 m
- Head tank level: 131.508 m
- Tail water level: 59.50 m
- Gross head: 75.00 m

(B) Calculation of loss head

Table 4-35 shows the results of loss head calculation done in this review, and Table 4-36 the results of effective loss calculation.

The flow runs through the facility in the following sequence: intake weir → intake gate → intake channel → settling basin → headrace channel → head tank → penstock → powerhouse. The portion of loss head that arises upstream of the head tank and upstream end of the intake channel was calculated using backwater analysis, wherein the head tank level was used as the base level. The results of analysis indicated an allowance of 0.641m, enabling the flow to run through without a hitch.

The portion of loss head downstream of the head tank indicated a loss while running through the penstock. These concluded a net head loss of 6.0m (an allowance of 0.32m inclusive).

For further information on the calculations, see Appendix N4-1.

Table 4-35 Head loss calculations (Nasal) (unit: m)

Facility	Part	Loss head
Intake gate	Inflow	0.020
	Screen	0.003
	Pier	0.008
	Intake gate	0.641
Intake channel	Friction	0.591
Settling basin	Cross-section change	0.000
	Inflow	0.173
Headrace	Friction	1.556
Head tank	Cross-section expansion	0
Penstock	Inflow	0.029
	Friction	1.308
	Y branch	0.295
	Bending	0.128
	Cross-section change	0.120
Tailrace	Submerged weir	0.166
	Cross-section change	0.239
	End of Draft tube	0.403
	Surplus	0.320
Total		6.000

Table 4-36 Effective loss calculations (Nasal)

Item	Unit	Max.	Normal
Plant discharge	m^3/s	17.360	7.850
Intake level	*m*	134.500	134.500
Tail water level	*m*	59.500	59.500
Gross head	*m*	75.000	75.000
Head loss	*m*	6.000	4.100
Effective head	*m*	69.000	70.900

(2) Turbine-generator coupling efficiency

1) Selection of a type of water turbine

The type of turbine to be employed should be determined in view of the effective head and discharge on site. In the projects undertaken in Japan, the type of a turbine to be employed is determined at the design stage with the help of a turbine selection nomogram such as the one shown in Figure 4-15.

As the project goes into the execution design stage, it is a normal practice to grasp detailed information – turbine shape, loading efficiency and others - through extensive hearings from the manufacturer, which will be reflected in the analysis of power generation capacity.

- A horizontal shaft Francis turbine is selected in PFS report.

Effective head and useable discharge at the site of this project are:

Effective head: 69.0m

Flow rate: 17.36 m^3/s （8.68m^3/s×2 units）

From these data, a horizontal shaft Francis turbine should be a proper choice in reference to the nomogram used in Japan.

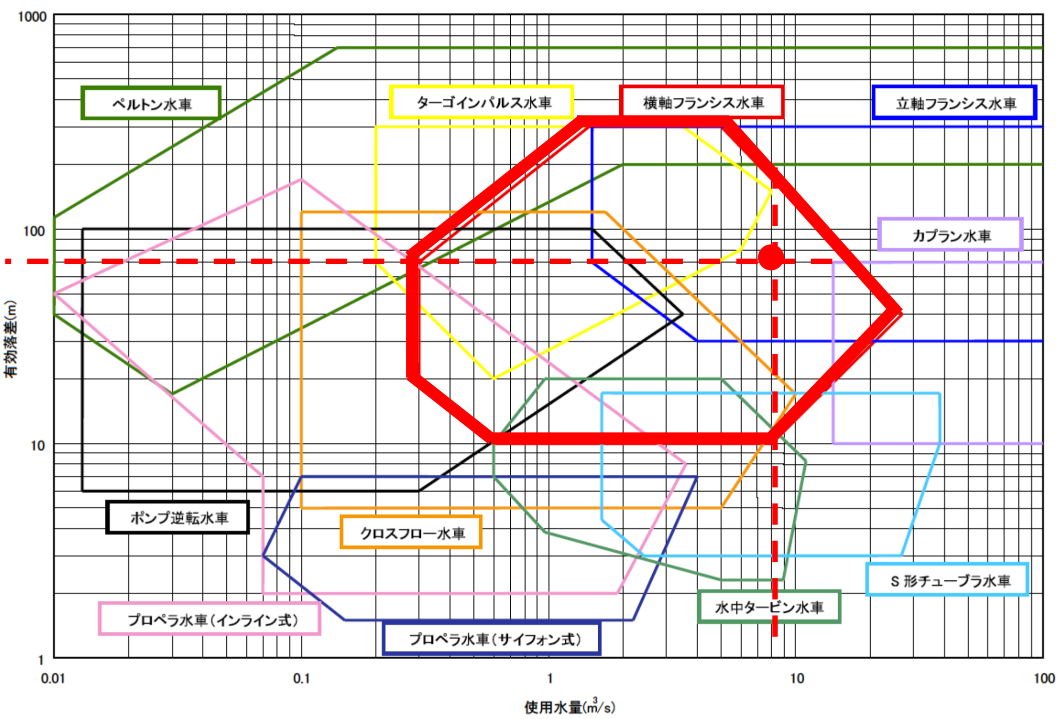


Figure 4-15 Nomogram for turbine selection

Source: "Hydro Valley plan guidebook" (New energy foundation)

2) Efficiency of turbine and generator

Turbine-generator coupling efficiency – an essential factor for the analysis of power output capacity - is calculated using the data obtained through hearings from the turbine manufacturer. Figure 4-16 shows the coupling efficiency curve prepared based on hearings from the turbine manufacturer, as well as the one prepared following the steps prescribed by "Small and medium hydroelectric guidebook, Ver.5" (New Energy Foundation). (The approximation formula shown in the figure is based of the values provided by the manufacturer.)

Efficiency values based on manufacturer information is consistently higher than those of NEF design. In this examination, the coupling efficiency curve based on the manufacturer data is adopted as it is considered more practical for real application.

The minimum discharge for power generation is set to be 40% of its maximum in view of track records in the past.

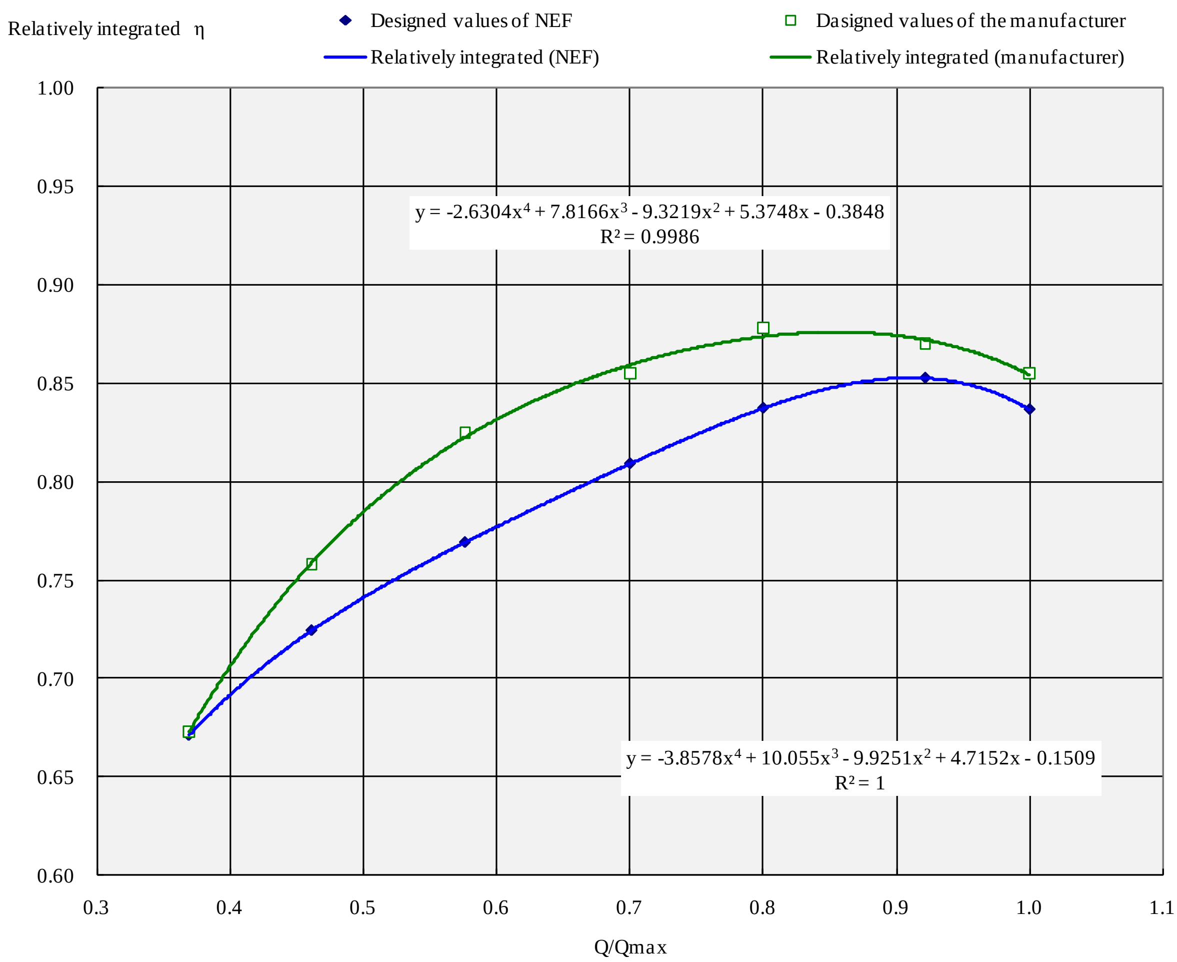


Figure 4-16 Turbine-generator coupling efficiency curve

(3) Case study: examination on power generation capacity

Following the standard procedure in place in Japan, an examination was made to evaluate power generation capacity of the project: important parameters (generator output, electric energy generated, and estimated construction cost) were figured out by varying maximum flow rate available in view of the characteristics of the stream regime.

The set of data used in the case study is listed inTable 4-37.

Regarding water discharge, the examination based on the Basic Design Drawing prove the capability of water conduction without any difficulties in next section.

Table 4-37 Specifics used to estimate power generation capacity

Contents			Japanese Method		PFS Report
Name of River			Nasal River		
Basin area			307.93 km^2		
Intake level			EL. 134.50 m		
Tailrace level			EL. 59.50 m		
Gross head			75.00 m		
Effective head			69.00 m		
Maximum water discharge			Plan 1	Plan 2	Local features
			14.0 m^3/s	17.36 m^3/s	17.36 m^3/s
Maximum output			8,000 kW	10,000 kW	12,000 kW
Water for river maintenance			0.92 m^3/s		
General equipment	Intake weir		Height 19.5m、 dyke peak length 52.0m		
General equipment	Waterway	Headrace	3.5m×3.5m L=3,108m、 I=1/1,667		
General equipment	Waterway	Penstock	Inner diameter 2.55m 、 L=226.72m		
General equipment	Power		Above-ground		
General equipment	Turbine type		Francis with horizontal shaft x 2 units		
General equipment	Generator type		Synchronous generator x 2 units		

(4) Power generation capacity

1) Maximum annual electricity generation

The calculations were carried out using the set of data shown in the table above (Specifics used in the evaluation of power generation capacity). Maximum annual electricity generation is shown in Table 4-38. In Case 2, where the flow rate reaches maximum value (17.36m^3/s) in this project, the maximum annual electricity generation show a similar value, 1,417MWh, as compared with that contained in the PFS Report. Note, however, conditions applied to the calculations have certain discrepancies as listed below.

(Major differences in calculation condition)

- Power generation efficiency
- Maximum output
- Method to establish the maintenance flow

Table 4-38 Maximum annual electricity generation

Unit:MWh

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Plan 1	5,378	4,736	4,624	4,226	4,285	3,731	3,628	3,716	3,728	3,948	4,986	5,470	52,457
Plan 2	6,253	5,547	5,091	4,468	4,407	3,825	3,726	3,878	3,896	4,369	5,871	6,406	57,737
PFS Report	-												56,320

2) Annual electricity generation

The FS report prepared by local engineers does not contain any mention on in-house electricity consumption within the power plant, nor downtime ratio – due to failures, inspections, and maintenance/repair.

The guideline used in Japan ("Small and medium hydroelectric guidebook") assumes the downtime ratio as 5% (at generating end). Assuming further that in-house consumption and transmission loss factor adds up to 2% (at receiving end), calculation of annual electricity generations for each case result in the values shown in Table 4-39.

Annual electricity generation (generating end) = maximum annual electricity generation ×0.95
Annual electricity generation (receiving end) = maximum annual electricity generation ×0.95×0.98

Table 4-39 Annual electricity generation

Unit:MWh

	Annually Available Power Energy	Annually Available Power Energy (Generating Terminal)	Annually Available Power Energy (Receiving Terminal)
Plan 1	52,457	49,834	48,837
Plan 2	57,737	54,850	53,753
PFS Report	56,320	54,067	52,986

(5) Estimated cost of construction

The construction cost is estimated considered followings below and based on generating power output (12MW) and plant discharge (17.36m^3/s) from a plan of PFS report.

・Preparatory construction cost is fixed without being affected by generating power or plant discharge

・Civil works cost increase and decrease in proportion to generating power or plant discharge

・Electrical construction cost increase and decrease in proportion to generating power or plant discharge

However, since the Plan 2 has same amount of water discharge as the plan of PFS report, the civil works cost is not changed.

Refer to Appendix N4-4 for detail of construction cost.

Table 4-40 Rough estimate of construction cost

Work Item	Plan 1 Output 8MW (2 x 4MW) Cost (Rp)	Plan 2 Output 10MW (2 x 5MW) Cost (Rp)
Prepatory Works	16,580,000,000	16,580,000,000
Weir, Intake and Gates	40,488,702,000	50,205,989,000
Sandtrap and Waterway	71,337,546,000	88,458,556,000
Headpond and Spillway	11,132,907,000	13,804,804,000
Penstock	15,097,234,000	18,720,570,000
Powerhouse and Tailrace	4,530,627,000	5,617,977,000
Turbine, Generator, and Electric Facilities	51,559,360,000	60,949,200,000
Engineering Service Fee	2,000,000,000	2,000,000,000
Amount	212,726,376,000	256,337,096,000

(6) Review summary: capacity of electric generation

Table 4-41 shows the results of capacity review of the electric power generation project.

Table 4-41 Comparison and analysis of generation capacity plans

Contents			Case of Study		PFS Report
			Plan 1	Plan 2	
Name of River			Nasal River		
Basin area			307.93 km^2		
Discharge of river (m^3/s)			Conversion flow by Tank model of rain gauge station(average from2001-2010)		
			Maximum 120.36 High water 17.54 Average water 12.29		
			Low water 9.68 Dry weather water 7.85 Minimum 7.66 Annual average 15.98		
Electric power planning	Type of power generation		Run-of river, Conduit		
	Intake water level		134.50 m	134.50 m	136.00 m
	Tailwater level		59.50 m	59.50 m	50.50 m
	Gross head		75.00 m	75.00 m	85.50 m
	Effective head		69.00 m	69.00 m	80.80 m
	Maximum water discharge		14.00 m^3/s	17.36 m^3/s	17.36 m^3/s
	Output		8,000 kW	10,000 kW	12,000 kW
	Annually electricity		52,457 MWh	57,737 MWh	56,320 MWh
General equipment	Intake weir		Height 7.0m、dyke peak length 29.6m		Height 10.0m
	Intake		—		Height 3.6m
	Settling basin		Open channel、Length 56.20m、Width 9.00m		Height 5.3m
	Head tank		Open channel、Length 73.50m、Width 12.00m		Height 4.4～9.1m
	Waterway	Intake channel	3.5m×3.5m L=1,060m、I=1/1,667		4.0m×4.0m
		Headrace	3.5m×3.5m L=3,108m、I=1/1,667		3.5m×3.5m
		Penstock	Inner diameter 2.55m 、L=226.72m		Inner diameter2.6m
		Tailwater way	-		Width 6.0m
	Power plant		Above ground type		
	Turbine type		Francis horizontal shaft 2 turbines		
	Generator type		5,000kW×2 units		
River utilization	Water for river maintenance		0.92 m^3/s		0.92 m^3/s
	Plan factor		74.9%	65.9%	53.6%
	River utilization rate		58.2%	70.5%	unknown
Total cost			217,625 million Rp	256,337 million Rp	275,382 million Rp
Unit price of construction cost per kW			27,203 thousand Rp	25,634 thousand Rp	22,949 thousand Rp
Project IRR (after tax)			14.42%	12.83%	-
Average DSCR (senior)			1.36	1.25	-

Together with increase in the output capacity, total of construction cost increases. Furthermore, as the annual available electricity generation increases, power selling income will increase. Since implementation of hydropower generation is expected to be such a long-term, gaining more power selling income provides big advantage for business operator.

Profitability of individual projects is important for business operator, however for expanding the business, it should be prioritized to focus on a sales scale in conducting a number of projects by portfolios. Therefore, Plan 2 was selected for the Nasal hydropower project although Plan 1 was most likely from the point of view of economical efficiency.

4-2-4. Review of main structures

4-2-4-1. Intake weir design

(1) Location and width of the dam

As the plane view clearly indicates, the dam is laid down at right angle to the flow direction, protruding from the linear, non-bending portion of the bank, which deems to be a proper approach.

The dam is designed to cover the full width of the river, securing sufficient cross sectional area for flowing the planned flood discharge downstream.

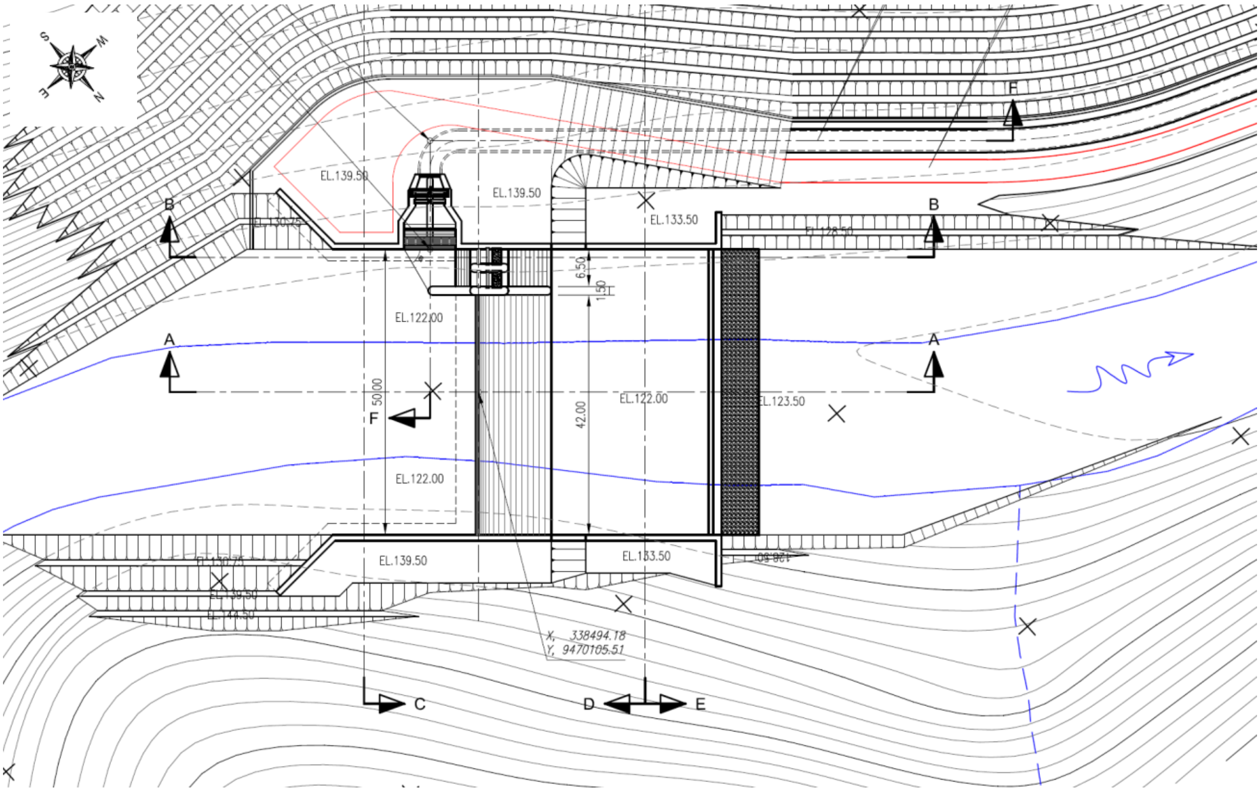


Figure 4-17 Intake weir design (plane view)

(2) Dam height

The dam has a height - from the river bed to spillway crest - of 12.50m, which is a relatively large value for a weir, and the intake is elevated from river bed by 9.10m, allowing sufficient sediment storage capacity. The dam height allows intake depth as large as 3.40m, making the height design to be considered appropriate.

A sand trap gate is incorporated in the river bank on one side of the intake enabling to discharge pebbles of the sizes up to around 10cm, which will prove to be an effective measure against difficulties in water intake.

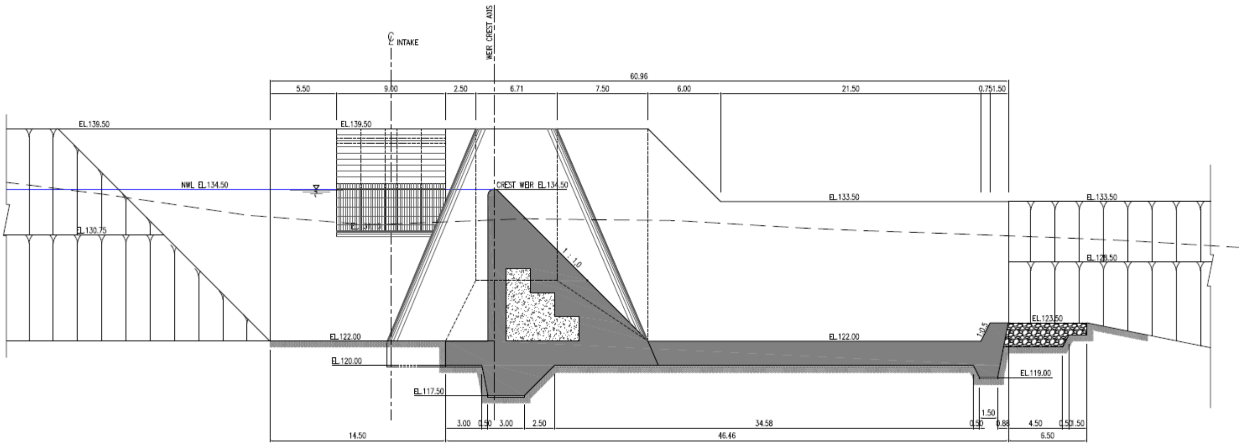


Figure 4-18 Intake weir design (spillway cross section)

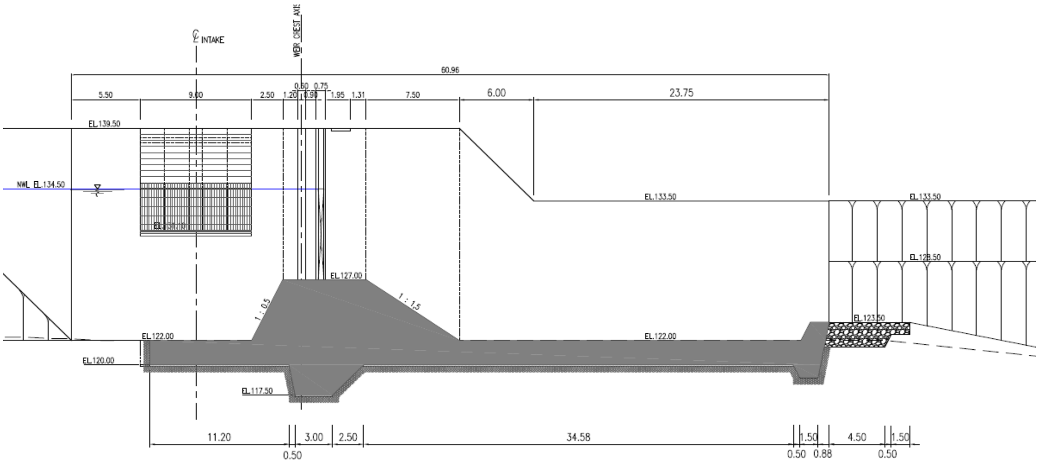


Figure 4-19 Intake weir design (sand trap gate cross section)

(3) Scouring in downstream river

The longitudinal section of the weir indicates that the front apron downstream of the dam has a sufficiently large depth of footing, also with sufficient extension, ensuring safety against scouring in the river bed and banks.

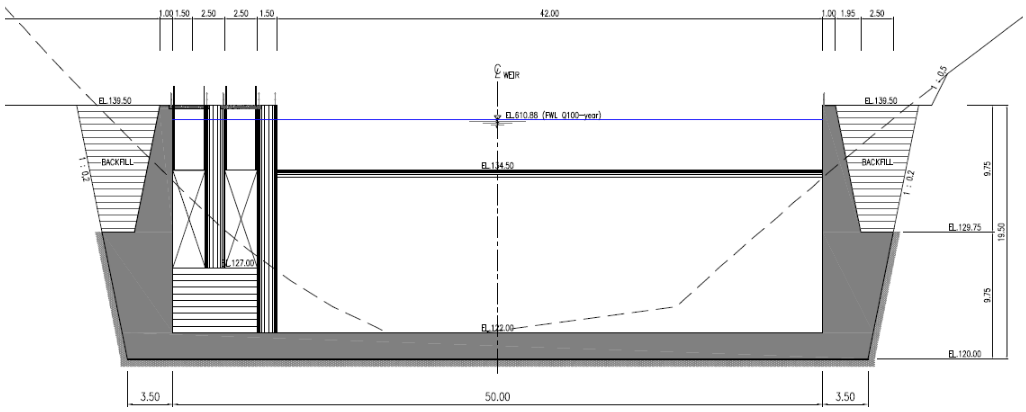


Figure 4-20 Intake weir design (front view)

4-2-4-2. Stability analysis of intake weir

(1) Discussion

In the project site, an intake weir of gravity concrete construction is located upstream of the power plant. In this section, stability of the intake weir - in terms of sliding, overturning, and bearing resistance - is analyzed based on the technology standards used in Japan.

Selection of the cross-sections used in the analysis and provisions for design were assigned based on the documents provided by Indonesian side (e.g. engineering drawings), and, for unknown specifications, additional references were made to Japanese technology standards on an as-required basis.

In this section, the conditions applied to analysis, and the results are presented: for the specifics of calculations, see Appendix N4-2.

(2) Cross-section for analysis

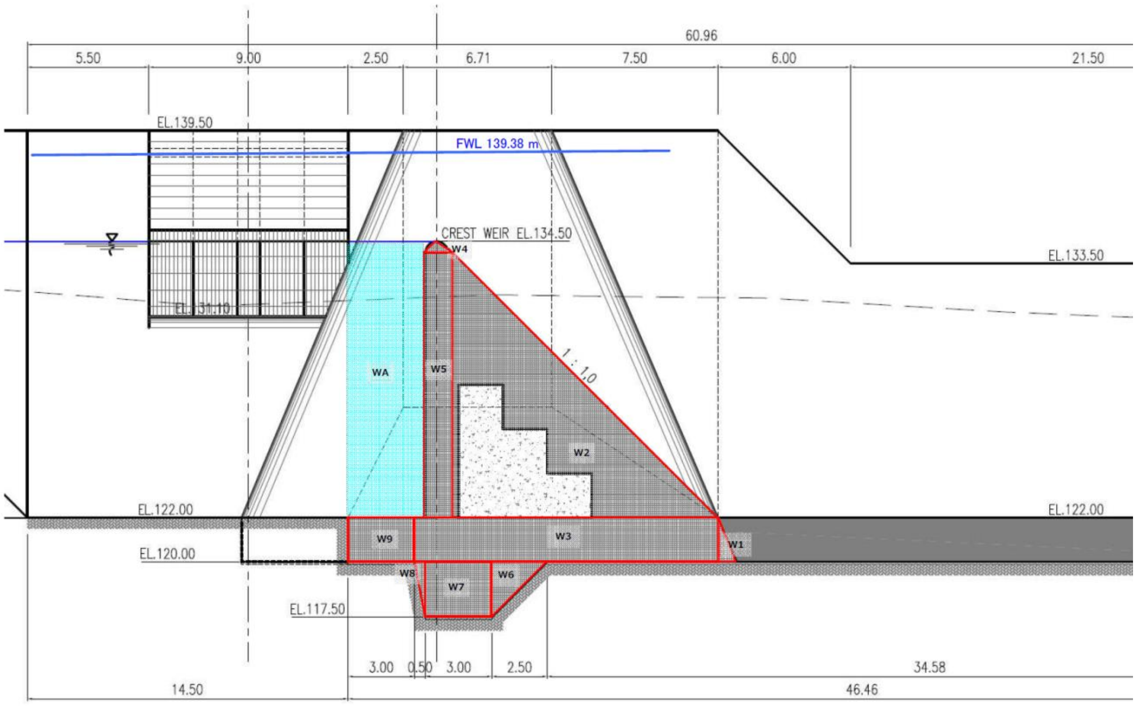


Figure 4-21 Intake weir cross section used for analysis

(3) Calculation condition

1) Standard and reference

The standards to which the design conforms, and the written materials to which the design made reference are listed in Table 4-42.

Table 4-42 Standards and written materials used in stability analysis of the dam

No	Title	Date of publication	Issued from
1	Design document submitted by local consulting firm	2013	—

2	Technological standards for hydraulic power generating installations and applications to the government for installation	Mar.2011	Electric power civil engineering association
3	Cabinet order concerning structural standards for river management facilities	Jan. 2000	Japan rivers association
4	Ministry of construction River errosion control technical standard	Oct. 1997	Japan rivers association
5	Standard specifications for concrete structures 'Structural performance verification'	Mar.2008	Japan society of civil engineer
6	The structural mechanics handbook	Jun. 1986	Japan society of civil engineer
7	Specification for highway bridges （Part I. Common, Part VI. Substructure）	Mar. 2012	Japan road association
8	Road earth work 'Retaining wall construction guideline'	Jul. 2012	Japan road association

2) Material condition

Calculation conditions for each material are shown below.

(A)Concrete

Table 4-43 Conditions for concrete calculation

Item	Symbol	Unit	Value	Ref.No.
Unit weight (Concrete)	γ_c	kN/m³	24.0	1
Unit weight（Masonry block）	γ_b	kN/m³	22.0	1
Design strength	σ_{ck}	N/mm²	—	—
Allowable bending compressive stress intensity	σ_{ca}	N/mm²	—	—
Allowable shearing stress intensity	τ_a	N/mm²	—	—

3) Natural condition

Natural conditions in and around the project site – topographical features and others

(A)Soil (sedimentary soil)

Table 4-44 Soil condition

Item	Symbol	Unit	Value	Ref. No.
Unit weight (wet)	γ_t	kN/m³	24.0	1
Unit weight (underwater)	γ_s	kN/m³	22.0	1
Unit volumetricweight of water(underwater)	γ_w	kN/m³	9.81	-

(B)Foundation ground

This review refers "River errosion control technical standard" (Construction Ministry) for the physical property values of foundation ground. In view of the geological features on the location of intake weir, this review estimates allowable bearing capacity assuming that the soil consists of rifty hard rocks.

Table 4-45 Foundation ground condition

Item	Symbol	Unit	Value	Ref. No.
Compressive strength	qu	kN/㎡	9810	4
Allowable bearing capacity (normal)	σ	kN/㎡	588	4
Allowable bearing capacity（during earthquake）	〃	kN/㎡	883	4

Table 4-46 Bearing capacity and friction factor for each type of foundation ground

基礎地盤の種類		許容支持力度 (tf/m²) {kN/m²}		摩擦係数 場所打ちコンクリートの場合の堰等の底面の滑動安定計算に用いるすべり	備考	
		常時	地震時		qu (tf/m²) {kN/m²}	N 値
岩盤	亀裂の少ない均一な硬岩	100 {981}	150 {1470}	0.7	1 000 以上 {9 810 以上}	—
	亀裂の多い硬岩	60 {558}	90 {883}	0.7	1 000 以上 {9 810 以上}	—
	軟岩，土丹	30 {294}	45 {441}	0.7	100 以上 {981 以上}	—
礫層	密なもの	60 {588}	90 {883}	0.6	—	—
	密でないもの	30 {294}	45 {441}	—	—	
砂質地震	密なもの	30 {294}	45 {441}	0.6	—	30～50
	中位なもの	20 {196}	30 {294}	0.5	—	15～30
粘性土地盤	非常に堅いもの	20 {196}	30 {294}	0.5	20～40 {196～392}	15～30
	堅いもの	10 {98.1}	15 {147}	0.45	10～ 20 {98.1～196}	8～15
	中位なもの	5 {49}	7.5 {73.5}		5～ 10 {49～ 98.1}	4～ 8

4) Loading condition

(A)Dead load

Total weight of the dam is considered as deal load.

(B)Soil and water weight

The weight of soil and water upstream of the dam need not be taken into account, because no construct, such as a dam fillet, exists upstream.

(C)Seismic inertia force

Seismic inertia force is defines as dead load (W) multiplied by design horizontal seismic coefficient (Kh), and exerts force in horizontal direction through center of gravity of the structure.

Design horizontal seismic coefficient, Kh, is calculated using the following equations. The coefficients, γ_1 andγ_2, should be determined in consideration of local information – normally the strength of earthquake and type of foundation. In this review, these values are set to be well on the safe side, because of the lack of the information on its foundation.

$$P_f = K_h \times W$$
$$K_h = \gamma_1 \times \gamma_2 \times \gamma_3 \times K_0$$

Where,

K_h : Design seismic coefficient ($K_h = 1.0 \times 1.2 \times 1.0 \times 0.2 = 0.24$)

K_0 : Standard seismic coefficient ($K_0 = 0.2$)

γ_1 : Seismic zone factor ($\gamma_1 = 1.0$, from Table 4-47)

γ_2 : Ground condition factor ($\gamma_1 = 1.2$, from Table 4-48)

γ_3 : Importance factor ($\gamma_3 = 1.0$)

Table 4-47 Seismic zone factor

Earth quake zone	Strong	Medium	Weak
Factor γ_1	1.0	0.85	0.7

Table 4-48 Ground condition factor

Ground condition	Type I	Type II	Type III
Factor γ_2	0.8	1.0	1.2

(D)Hydrostatic pressure

Hydrostatic pressure is defined as external and internal hydraulic pressure that works on the walls, and calculated using the following equation. An assumption is made for the calculation – i.e. the following three forces do not act on the wall all at the same time: earthquake inertia force, hydrodynamic pressure during earthquake, and hydraulic pressure at design flood.

$$P_w = (1/2) \times \gamma_w \times h^2$$

Where,

P_w : Total hydraulic pressure from surface to depth h (kN/㎡)

γ_w : Unit volumetric weight of water ($\gamma w = 9.8$kN/㎥)

h : Depth from surface

(E)Uplift pressure

Uplift pressure due to the water level difference between upper and lower reach of the dam axis.

Uplift at upper reach: $\{(h_1 - h_2) \times \mu + h_2\} \times \gamma_w$

Uplift at lower reach: $h_2 \times \gamma_w$

Where,

μ : Uplift coefficient (=1/3)

h_1 : Depth at upper reach

h_2 : Depth at lower reach

(F)Mud pressure

Horizontal pressure exerted by earth and sand accumulated on the base of the reservoir (mud pressure) can be calculated using the following equation.

$$P_e = (1/2) \times C_e \times \gamma_s \times d_2$$

Where,

P_e : Total mud pressure in horizontal direction at the depth of h from the surface of sedimentation

C_e : Mud pressure coefficient (=0.5)

γ_s : Unit volumetric weigh (under water) of accumulated earth and sand

d : Depth from surface

(G)Dynamic water pressure during earthquake

This value can be calculated using Westergaard’s approximation formula

$$P_d = (7/12) \times \gamma_w \times K_h \times H^{1/2} \times h^{3/2}$$

Where,

Pd : Total dynamic water pressure from surface to depth h (kN/㎡)

γ_w : Unit volumetric weight of water

K_h : Design horizontal seismic coefficient

H : Depth from surface to foundation ground

h : Depth from surface

(H)Wave pressure

Wave pressure is generally calculated using wave height caused by wind and earthquake. In this review, however, wave height caused by wind is ignored in reference to the directive contained in the Dam standard. Wave height caused by an earthquake is calculated using the formula below.

$$h_e = (K_h \cdot \tau/\pi) \times \sqrt{(g \times H)}$$

Where,

h_e : Total wave height

K_h : Design seismic coefficient

τ : Earthquake frequency (normally 1 second)

H : Depth from design water level to bottom sill level

5) Stability condition

As a part of stability calculations, an examination is made regarding sliding, overturning, and bearing capacity.

In reference to “River erosion control technical standard”(Ministry of Construction), stability condition of a concrete gravity dam is estimated as below:

①Sliding : Safety factor 1.5 is applied to Henny formula

②Overturning : Resultant external force should fall within middle-third of horizontal section of the dam body.

③Bearing capacity : Stress acting on the rock surface and inside the dam body should not exceed its allowable limit.

Item by Item examination is as follows:

(a) Stability against sliding

To maintain stability against sliding, the safety factor N, represented by Henny equation, must satisfy the following inequality (“River errosion control technical standard”, Ministry of Construction).

$$N = \frac{\text{Resistant force against sliding}}{\text{Sliding force}} = \frac{f \cdot \Sigma V + \tau \cdot L}{\Sigma H} \geqq 4$$

Where, V : Total vertical load on the bottom surface of the dam (kN/m)

ΣH : Total horizontal load on the bottom surface of the dam (kN/m)

f : Friction factor between dam bottom and bearing ground

From the natural condition described above, $f = \tan\varphi_B = 0.7$

φ_B : Friction angle between dam base bottom and bearing ground (°)

τ : Shearing strength of rock mass (kN/m^2)

Since no experiment value is available, this review uses Coulomb equation for estimation.

$\tau = C_B + \sigma \cdot \tan\varphi_B$

C_B : Adhesive force between revetment bottom and bearing ground (kN/m^2)

Using natural condition above, calculation of C_B gives a value 196(kN/m^2).
However, in cases where no experimental value is available, normal practice in Japan for stability calculations dictates that the two factors – internal friction angle and adhesive force - are not taken into account at the same time, thus

$C_B = 0(kN/m^2)$

σ : Generally interpreted as vertical stress acting on failure surface, but this

review interpret it as the bearing capacity (see natural condition above)

Normal state $\sigma = 588(kN/m^2)$
During an earthquake $\sigma = 882(kN/m^2)$

L : Bottom width of the dam (m)

(b) Stability against overturning

Stability against overturning requires that the net force of external forces (resultant force R) falls in middle-thirds – i.e. the displacement distance (e) between the resultant force R's working point and the center of the basal plate must satisfy the following relations.Normal state : $|e| \leqq B/6$

During an earthquake : $|e| \leqq B/3$

The displacement distance, e, - between the working point of R and center of basal plate – is represented by the following equation.

$$e = (L/2) - d$$

Where, d : Distance between the working point of resultant force, R, and the toe of revetment basal plate (m)

$$d = \frac{\Sigma M_r - \Sigma M_0}{\Sigma V} = \frac{\Sigma V_i \cdot a_i - \Sigma H_j \cdot b_i}{\Sigma V_i}$$

ΣM_r : Resistance moment around the toe of dam's foundation (kN・m)

ΣM_o : Overturning moment around the toe of dam's foundation (kN・m)

V_i : Vertical element of the load acting on the dam (kN/m)

a_i : Horizontal distance between the toe of dam foundation and the working point of Vi (m)

H_j : Horizontal component of the load acting on the dam (kN/m)

b_j : Vertical distance of the working point of Hj above the foundation of the dam (m)

L : In this design, L indicates the dam's basal plane width (m): see the drawing below

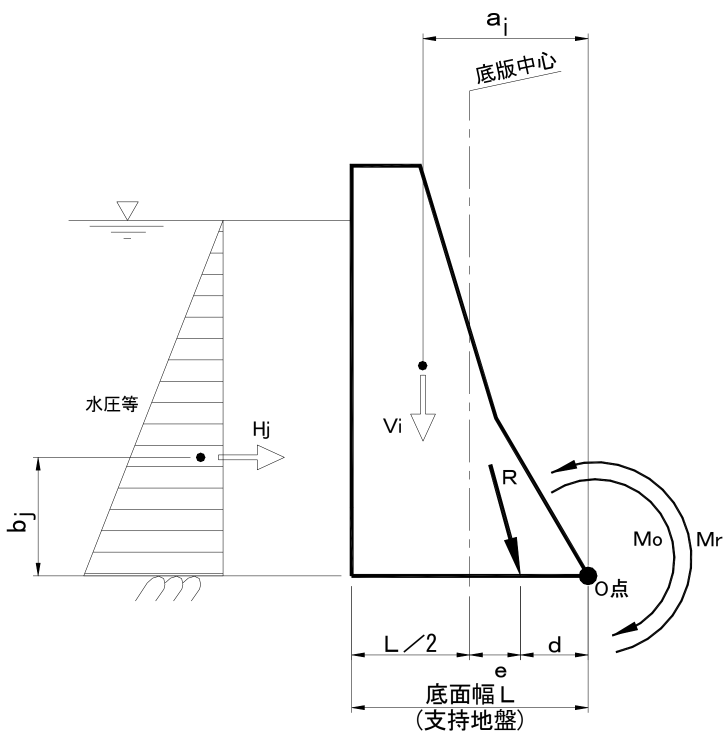


Figure 4-22 Working point of resultant force, and the basal place used for overturning resistance calculation

(c) Stability against bearing capacity of bearing ground

Stability against the bearing power from supporting soil requires that the modulus of subgrade reaction (q1, q2) satisfies the following relations (see “Road earth work, Retaining wall construction guideline”)

$$\left.\begin{array}{l} q_1 \\ q_2 \end{array}\right\} \leqq q_a$$

Where, q_a : Allowable bearing capacity of foundation (kN/m^2)

In this design, these two parameters assume the following values – see the description in “(3) Natural condition –c Foundation ground”.

Normal state : 588 kN/ m^2

During an earthquake : 882 kN/ m^2

Modulus of subgrade reaction, q1 and q2, are expressed using the following equations.

①Working point of the resultant force falls within middle-third of the basal plane width.

$$q_1 = \frac{\sum V}{L} \cdot \left(1 + \frac{6e}{L}\right)$$

$$q_2 = \frac{\sum V}{L} \cdot \left(1 - \frac{6e}{L}\right)$$

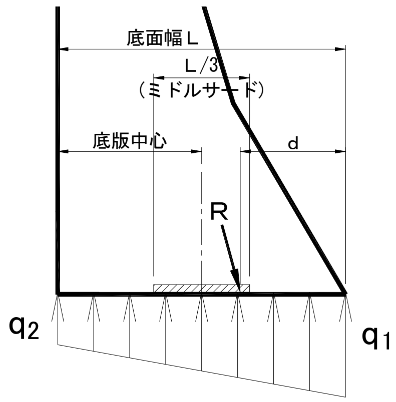


Figure 4-23 Modulus of subgrade reaction (trapezoidal distribution)

②Working point of the resultant force falls within a range between 1/3 -2/3 of basal plate width.

(and, it falls outside of middle-third of the basal plate width)

$$q_1 = \frac{2\sum V}{3d}$$

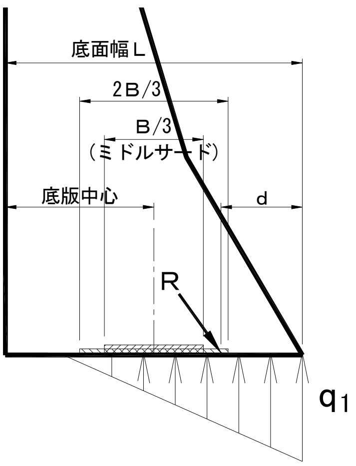


Figure 4-24 Modulus of subgrade reaction (triangular distribution)

6) Possible cases

Load conditions described in previous section produces several combinations. These cases are listed in Table 4-49.

Table 4-49 Possible loading combinations in intake weir stability calculation (Nasal)

Condition		Water level	No sand		Full sand		Note
		Sedimentation	High water level (during earthquake)	Design flood level (Normal)	High water level (during earthquake)	Design flood level (Normal)	
Primary load	Dead load		○	○	○	○	—
	Mud pressure	Vertical	—	—	○	○	—
		horizontal	—	—	○	○	—
	Weight of water (upstream)		○	○	○	○	—
	Static water pressure	Upstream	○	○	○	○	—
		Downstream	—	—	—	—	Downstream water level is set to zero
		Uplift force	○	○	○	○	—
	Vertical load		—	—	—	—	Vertical load acting upon levee crown is ignored
Secondary load	Seismic inertia force		○	—	○	—	Horizontal component must be taken into account
	Seismic dynamic water pressure		○	—	○	—	
	Seismic dynamic earth pressure		○	—	○	—	

(4)Results

Results from stability calculation of intake weir are shown in Table 4-50 and Table 4-51. Under these conditions, all cases satisfied stability criteria. However, because a part of physical properties of foundation soil used in the calculation is provisional (assumed values), additional soil test on site will be needed to make sure that these values are applicable. In addition, since safety factor results high, it is necessary to review the cross-section to be slim on the phase of design details.

Table 4-50 Results of stability calculation: Intake weir (Nasal, no sedimentation)

Cross section				High water level (normal)	Design flood level
				During earthquake	Normal
Overflow section	Acting force	Vertical force	(kN)	3,571.840	3,559.366
		Horizontal force	(kN)	1,882.111	1,472.819
		Resistance moment	(kN･m)	34,264.252	34,194.772
		Overturning moment	(kN･m)	6,977.158	8,254.844
	Sliding	Safety factor		6.810	6.350
		Required safety factor		1.200	1.500
		Result		OK	OK
	overturning	Eccentric throw	(m)	0.715	1.067
		Standard value		5.570	2.785
		Result		OK	OK
	Bearing capacity	Applied stress coefficient	(kN/m^2)	268.632	294.617
		Allowable bearing capacity	(kN/m^2)	882.000	588.000
		result		OK	OK

Table 4-51 Results of stability calculation: Intake weir (Nasal, full sedimentation)

Cross section				High water level (normal)	Design flood level
				During earthquake	Normal
Overflow section	Acting force	Vertical force	(kN)	3,571.840	3,559.366
		Horizontal force	(kN)	2,265.314	1,961.100
		Resistance moment	(kN･m)	34,264.252	34,194.772
		Overturning moment	(kN･m)	8,573.965	10,289.511
	Sliding	Safety factor		5.660	4.770
		Required safety factor		1.200	1.500
		Result		OK	OK
	overturning	Eccentric throw	(m)	1.163	1.639
		Standard value	(m)	5.570	2.785
		Result		OK	OK
	Bearing Capacity	Applied stress coefficient	(kN/m^2)	303.017	87.651
		Allowable bearing capacity	(kN/m^2)	882.000	588.000
		result		OK	OK

4-2-4-3. Intake gate

(1) Location and direction

Intake gate is built at an proper location - immediate upstream of the intake weir – enabling to prevent earth and soil sedimentation effectively. The gate is also appropriately directed – at right angle to the river flow – to prevent influx of earth, sand, and floating objects.

(2) Design of Intake gate

The intake gate is designed in such a way to ensures sufficient flow section for the influx flow rate at the maximum water intake (approx. 0.6m/s). Site altitude of the intake is designed to provide sufficient elevation – as high as 9.1m above the site altitude of intake weir, which is considered to give satisfactory protection against influx of earth and sand.

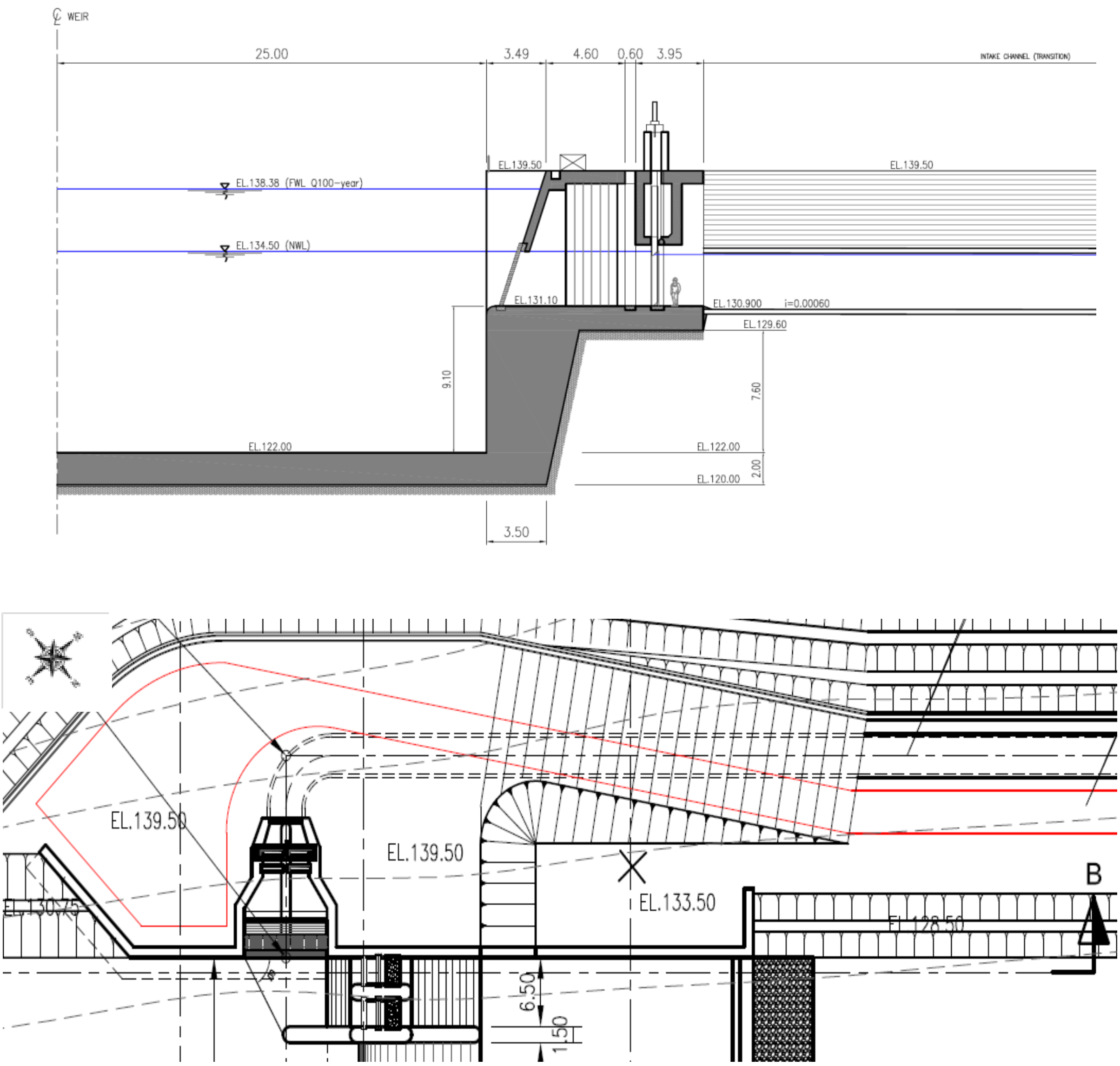


Figure 4-25 Intake gate: plane view and longitudinal section

(3) Dust arrester

A dust arrester is a device to prevent foreign objects, such as driftwoods and dusts, from entering into the water channels. The drawings submitted from Indonesian side did not allow identification of such device in place: confirmation needed for its existence.

4-2-4-4. Settling basin

(1) Location

Because of the lack of enough ground for the construction of a spacious settling basin in the immediate neighborhood of intake weir or intake gate, the settling basin is planned to be set up on a moderately separate sloped ground, which should be considered appropriate in view of reducing construction expenditure.

The intake gate and settling basin are connected by means of an intake channel that runs approximately 1km. Earth and sand sedimentation could be discharged into nearby tributaries.

(2) Flow rate inside the settling basin

Flow velocity inside the settling basin is estimated to be around 0.3m/s - flow volume Q = 17.36m3, flow section $56m^2$ (B : 7.0m×H : 4.0m × 2 channels). This is roughly same as general design flow velocity in settling basin that allows earth and sand to settle in an appropriate period of time.

The main channel of the settling basin extends for 65m, and total length reaches 80m if connecting portions with intake channel and water channels are included. The design is deemed to be appropriate in that it secures enough length.

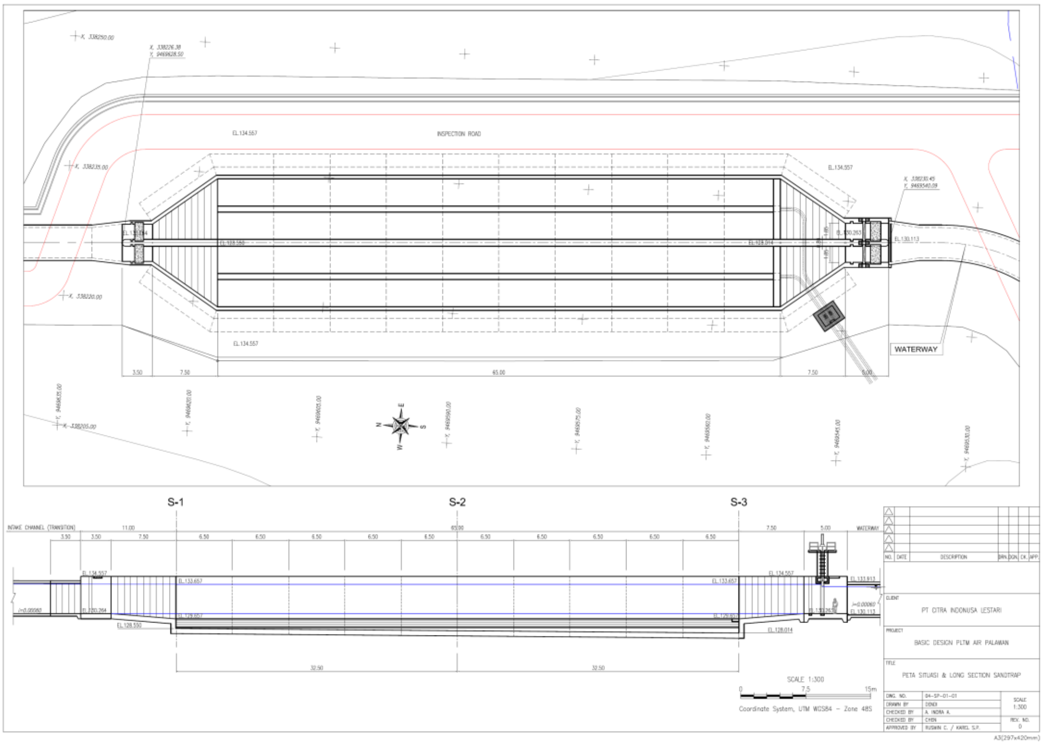


Figure 4-26 Settling basin design (plane view, longitudinal section)

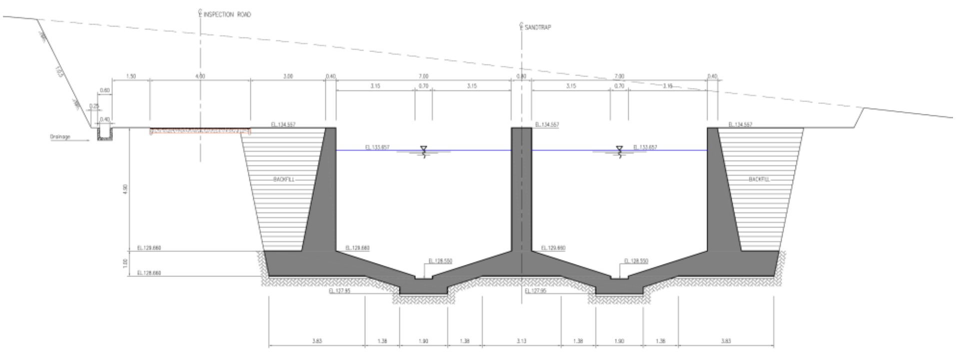


Figure 4-27 Settling basin design (typical cross-section)

4-2-4-5. Intake channel and headrace

In reference to the general drawings, the structure and dimensions of the planned intake channel and headrace are examined, through hydraulic calculations, especially in terms of their water conduction capacity.

(1) Specifics of water channel

Water channel comprises of two elements: intake channel (from the intake to settling basin) and headrace (from headrace to head tank). Water is conducted through these subsurface open channels with rectangular cross-section (3.5m×3.5m).

Linear measurements and altitude of each channel section are shown in Table 4-52. Figure 4-28 shows a typical cross-section of the headrace.

Table 4-52 Length and Height of water channels

Name	Section length, m	Slope		Start point bed height EL.m	Endpoint bed height EL.m
Intake channel	1060.00	1/1666.67	0.0600%	130.900	130.264
headrace	3108.33	1/1666.67	0.0600%	130.113	128.248

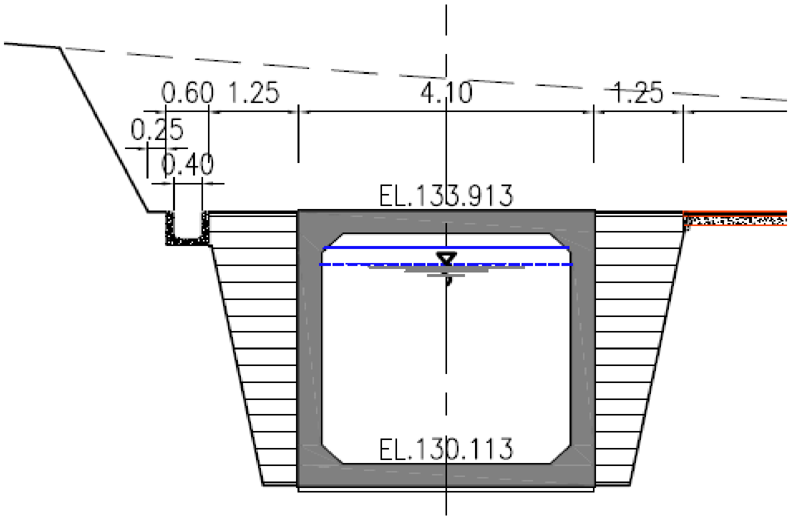


Figure 4-28 Typical cross-section of headrace

(2) Uniform flow calculation

Uniform flow depth was calculated using Manning equation. The calculation concluded uniform flow depth of 2.872m at maximum discharge, 17.36 ㎥/s – i.e. approximately 80% depth to the height of the channel (3.5m). The result indicates that the channel has a sufficiently large capacity for water conduction in view of the projected amount of water to be used.

<Uniform flow depth calculation using Manning equation>

$$AR^{2/3} = \frac{Qn}{\sqrt{I}} \quad \cdots\cdots ①$$

Uniform flow depth	$:h_o$		(m)
Plant discharge	$:Q$		(m^3/s)
Slope of headrace	$:I=$	0.0006	
Manning roughness coefficient	$:n=$	0.0150	
waterway width	$:B$	3.500	(m)
Slope of side walls	$:H$	3.500	(m)
Cross-sectional area of flow	$:A$		(m^2)
Wetted perimeter	$:S$		(m)
Hydraulic radius	$:R=A/S$		(m)

Item	Flow $Q\ (m^3/s)$	Right side $Q \cdot n/I^{0.5}$	Uniform flow depth $h_0\ (m)$	Cross-sectional area of flow $A\ (m^2)$	Wetted perimeter $S\ (m)$	Hydraulic radius $R\ (m)$	Left side $AR^{2/3}$	(Left side)-(Right side)
MAX	17.360	10.631	2.872	10.053	9.245	1.087	10.631	0.000
Regular	7.850	4.807	1.561	5.464	6.622	0.825	4.807	0.000

4-2-4-6. Head tank

(1) Location and flow rate

The head tank is directly connected to the settling basin via a length of headrace that runs approximately 1km, and is designed to be located in a relatively flat hump near the power plant, a conventional topology for setting up a head tank. No special issue is to be found in this configuration.

The cross-section of the head tank is of trapezoidal shape (B : 18~20.0m×H : 4.3m), with water flowing through at the velocity of around 0.2m/s (a value commonly found in many head tanks).

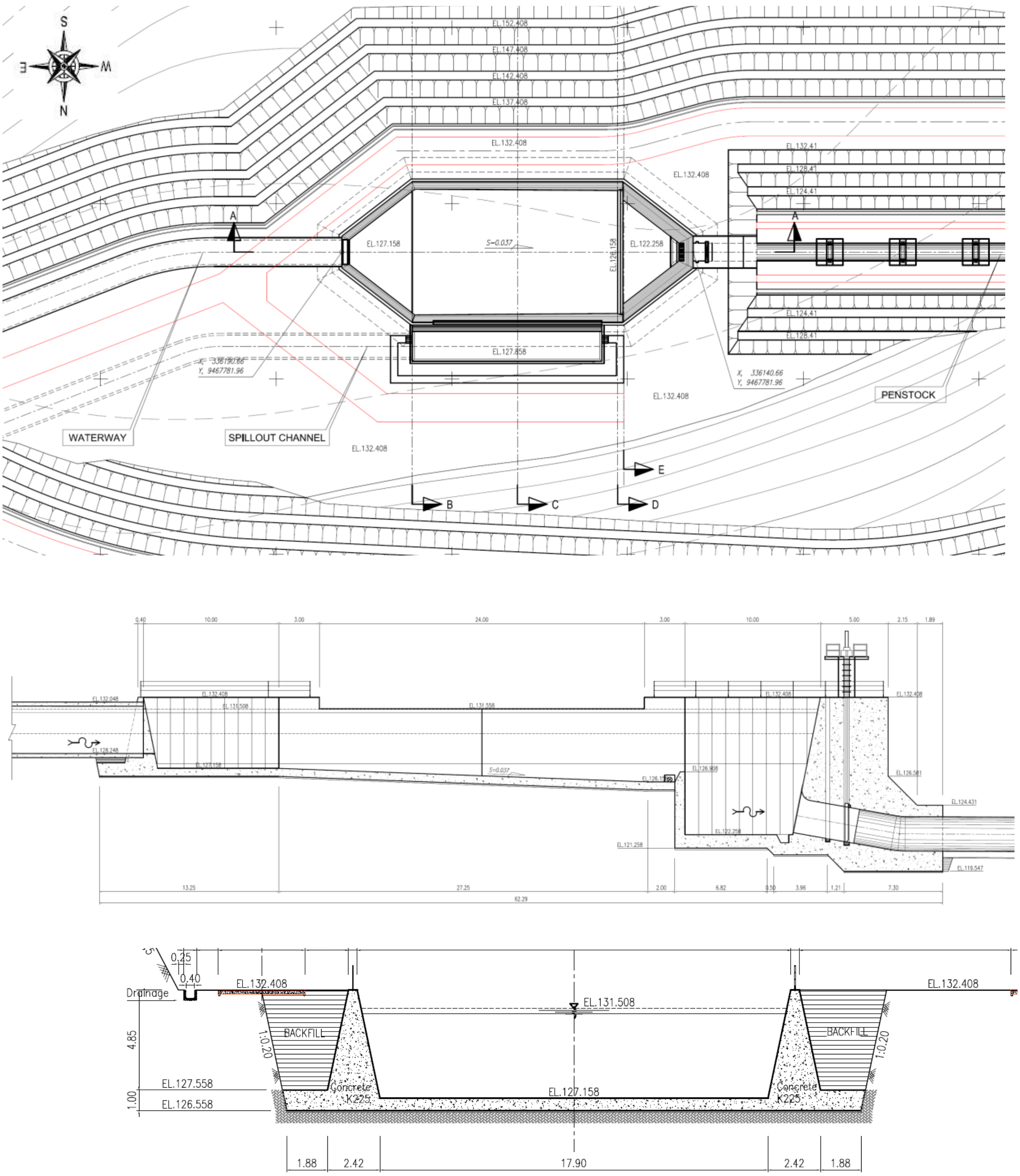


Figure 4-29 Head tank design (plane view, longitudinal section, and cross-section)

(2) Verification of the design

Many of the existing head tanks used in power stations are designed capable to store, on an empirical basis, an amount of water capable to sustain 2 to 3 minutes of operation at maximum discharge (120Qmax～180Qmax). Their configuration conventionally place emphasis on hydrological safety. Looked at from another perspective, optimized design of a head tank may lead to a reduction of its size. In this section, the design is verified, in reference to guiding principles commonly practiced in Japan ("Small and medium hydropower guidebook", New Energy Foundation), if it meets hydrological requirements.

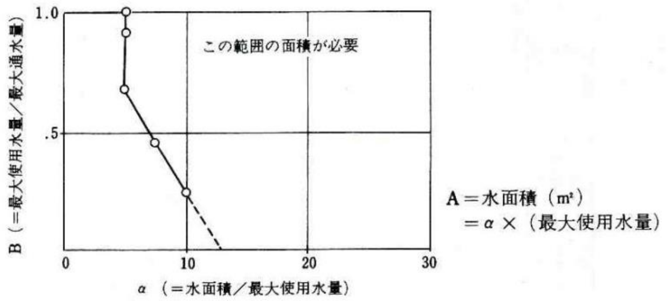
Requirements that determine the scale of head tank:

・ Water surface area large enough to prevent hunting action to occur in the level regulator
・ Capacity that allow "try-on" required for start-up and normal operation
・ Capacity for drawdown detection – allowance to be placed before emergency stop after a detection of abnormally low water level – and the capacity for emergency stop

Generally accepted water surface area required to prevent a level regulator entering into a hunting action – based on the simulations performed with consideration given to hydrological behavior of water channel system and hydraulic equipment - lies anywhere between 5 to $10Q_{max}$. This review assumes its maximum value (i.e. $10Q_{max}$) for the following verification procedures.

Therefore, the required surface area (A) of the head tank measures $173.6m^3$.

Required area $A \geqq 10Q_{max}$
Required area $A \geqq 10 \times 17.36 = 173.6$ ㎡
Where, Q_{max}: maximum discharge $= 17.36$ ㎥/s



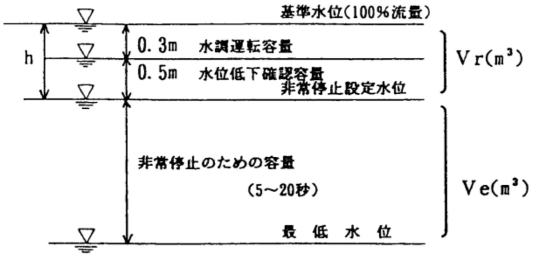
Breakdown of the head tank's required volume (V) is shown below.

・ Capacity for priming operation
・ Capacity for low level detection
・ Capacity for successful completion of emergency stop

In view of these factors, it is decide to secure capacity of 11Qmax, which translates into the required capacity of 126.5 m^3.

V ≧ Vr＋Ve

≧ 11Qmax ≧ 11×17.36＝190.96 m^3



水 調 方 式	ヘッドタンク容量
垂下率水調	11Qmax
定水位水調	7 Qmax

ヘッドタンク容量

V = Vr + Ve

= 11Q 又は 7Q (m³)

ヘッドタンク容量の条件

Dimensions of the head tank are put into review, with due consideration given to the required conditions above, and the design conditions regarding the lowest level. Base on the drawings submitted from Indonesian side, dimensions of the head tank are listed in Table 4-53.

Table 4-53 Head tank dimensions (based on the drawings submitted from Indonesian side)

Item	Unit	Local plan	Note
Effective length	m	30.00	Distance from end of enlargement area to overflow weir
Tank width	m	20.00	
Water level	m	131.508	
Lowest level	m	126.908	Considered air entrained for penstock(D:diameter) 126.908m＞124.808m＝Height of penstock 122.258m+1D：2.55m
Effective depth	m	4.600	Tank level131.508m－lowest level 126.908m
Water surface area	m^2	600.00	＞10Qmax＝173.6m^2
Effective storage	m^3	2,760.00	＞11Qmax＝190.96m^3

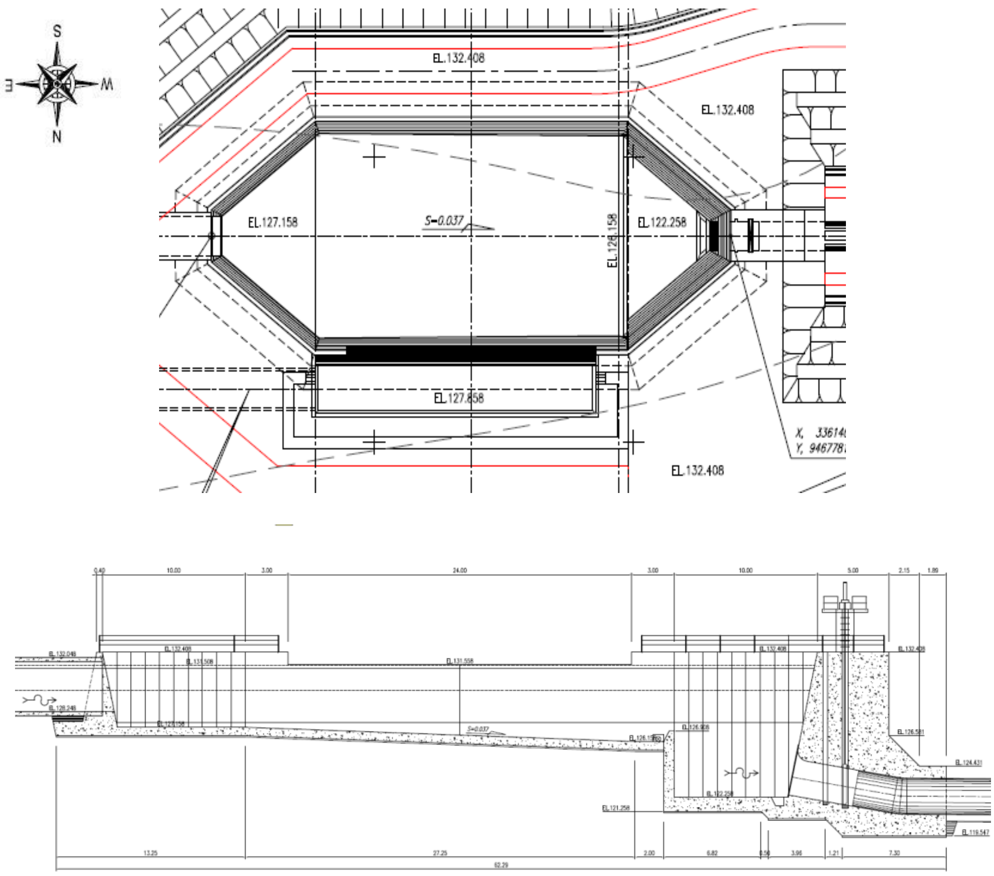


Figure 4-30 Head tank design (plane view, longitudinal section)

From the discussion above, the water surface area and effective capacity are set to 34.6Ｑmax and 159Ｑmax (see the calculations below). These values clearly surpass conventional ones (2 to 3 minutes equivalent of water at max. discharge), while satisfying required conditions with comfortable margin.

①Water surface area ＝ Tank width × Effective length ＝20×30 ＝600 ㎡（≒34.6Qmax） ≧10 Qmax

②Effective capacity＝Water surface area × Tank depth ＝600×4.60 ＝2760 ㎥（≒159Qmax）≧11 Qmax

4-2-4-7. Penstock

(1) Route and layout

Routing of penstock is shown below (plane view and longitudinal section). In the upstream side, It runs along the line of topological features, so as to minimize earthworks. Relatively deep earth cutting is required in the downstream side: this is a reasonable approach to fit the penstock height with that of power plant floor and turbine installations.

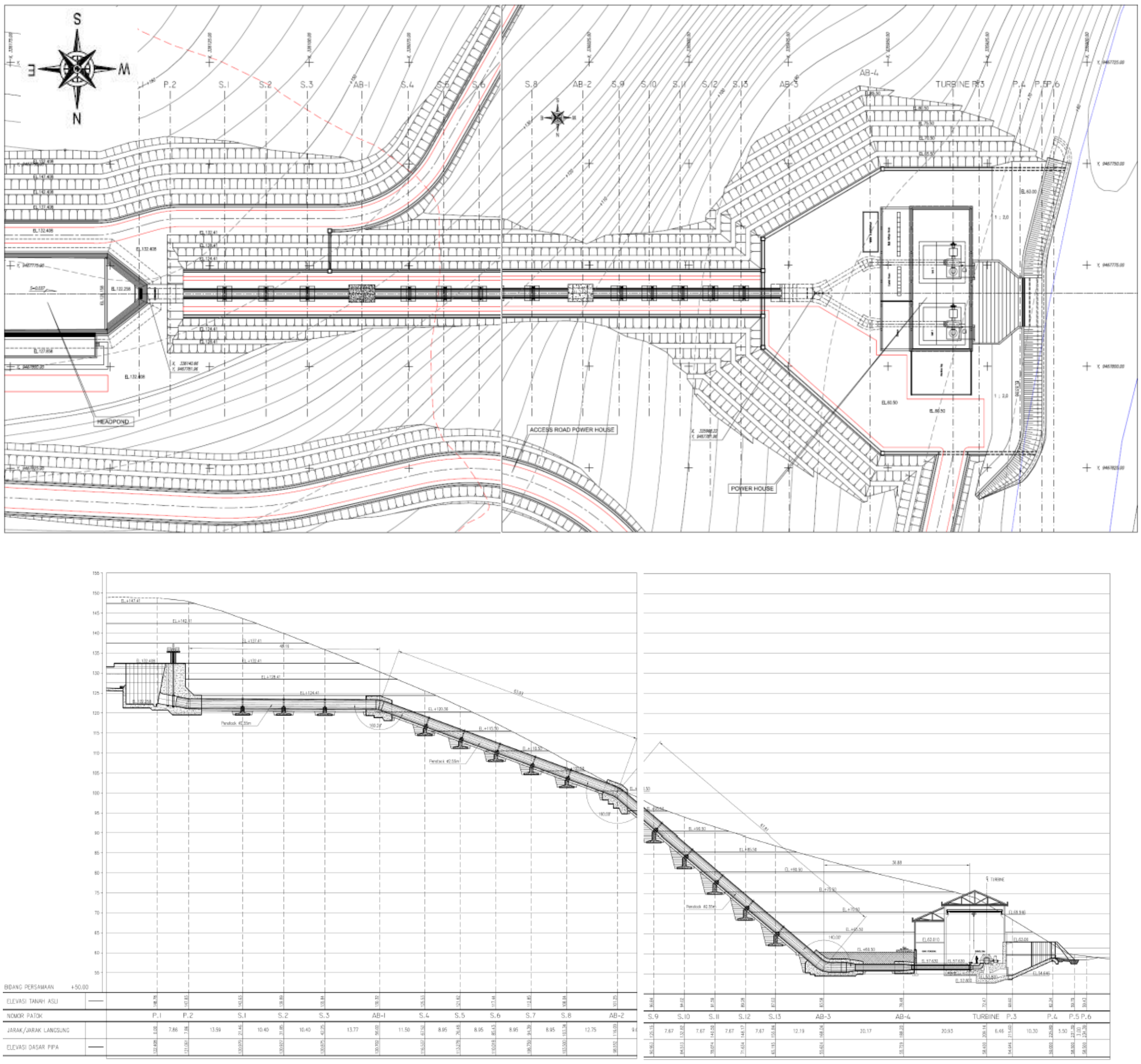


Figure 4-31 Penstock routing (plane view and longitudinal section)

(2) Verification of safety

To confirm safety of the penstock system design submitted from Indonesian side, an examination is made by performing critical calculations – intra-penstock pressure, structural verification of the pipes, and so on – based on the instructions contained in Japanese guideline ("Technology Standards of Water Gate Iron Pipes", Japan hydraulic gate & penstock association).

In this section, focus is placed on the conditions applied to analysis, and the results derived from the analysis: for specifics of calculation procedures, see Appendix N4-3.

1) Design summary

Calculations are based on Technical standards of hydropower generation facilities and Japan's domestic technical standards.

Type	:	Exposed penstock and concrete revetteed embedded penstock		
Number of pipe	:	1 waterway		
Inner diameter	:	2.550	m	
Pipe thickness	:	14～16	mm	
Pipe length	:	226.720	m	(Curve length from start of penstock to inlet valve)
Maximum static head	:	74.984	m	(Head from tank water level WL 131,508m ## to center of inlet valve EL 56.524 m)
Maximum water hammer pressure	:	18.000	m	(Center of inlet valve)
Attacck wave head	:	0.000	m	
Maximum design head	:	92.984	m	(Center of inlet valve)
Maximum discharge	:	17.360	m^3/s	
Turbine closing time	:	4	sec	
Corrosion allowance	:	1.5	mm	
Safety factor against external pressure	:	1.5	Over	
Temperature change	:	20	℃	

Type of material :

Allowable stress

Material	Thickness (mm)	Tensile stress (N/mm^2)	Compressive stress (N/mm^2)	Shearing stress (N/mm^2)	Bearing stress (N/mm^2)
ISO E275 A-D	t ≦16	150	150	85	255
	16< t ≦40	145	145	80	245
	40< t ≦63	140	140	80	235

Elastic modules of steel	:	206	kN/mm^2
Linear expansion coefficient of steel	:	1.2×10^{-5}	/℃
Poisson's ratio of steel	:	0.3	
Weld efficiency	:	Plant 0.85	Site 0.80

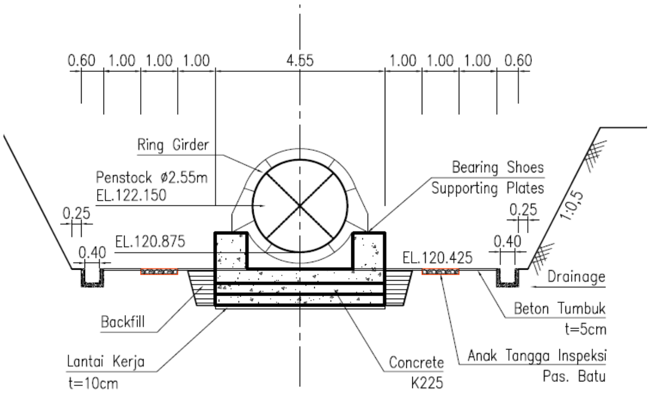


Figure 4-32 Design of penstock line (typical cross-section)

2) Results

The results from stress analysis of penstock are shown in Table 4-54. The analysis revealed that the planned wall thickness (10mm) was not enough in some part of the downstream sections of the penstock channel.

Table 4-54 Results from stress analysis of penstock (Nasal)

No.	Inner diameter	Thickness to use	Pipe length	Pipe thickness			Inner pressure		
				Design head	Alllowable head	Result	Circumferential stress	Allowable stress	Result
	D_0	t_0	Ln	H	Ha		σ 1	η・σ a	
	(mm)	(mm)	(m)	(m)	(m)		(N/mm^2)	(N/mm^2)	
1	2550	14	7.970	9.89	119.98	OK	9.90	120.00	OK
2	2550	14	48.160	13.91	119.98	OK	13.90	120.00	OK
3	2550	14	63.930	41.13	119.98	OK	41.10	120.00	OK
4	2550	14	67.810	89.45	119.98	OK	89.50	120.00	OK
5	2550	14	6.500	90.34	119.98	OK	90.40	120.00	OK
6	1800	14	15.640	90.34	169.93	OK	63.80	120.00	OK
7	1200	14	16.710	91.58	254.78	OK	43.10	120.00	OK

No.	Inner diameter	Thickness to use	Pipe length	Axial stress			
				Equivalent stress		Allowable stress	Result
	D_0	t_0	Ln	σ eq	σ eq'	σ a	
	(mm)	(mm)	(m)	(N/mm^2)	(N/mm^2)	(N/mm^2)	
1	2550	14	7.970	41.40	59.45	120	OK
2	2550	14	48.160	45.10	56.99	120	OK
3	2550	14	63.930	61.20	60.88	120	OK
4	2550	14	67.810	98.70	86.40	120	OK
5	2550	14	6.500	99.60	86.89	120	OK
6	1800	14	15.640	12.50	12.54	120	OK
7	1200	14	16.710	13.50	13.52	120	OK

4-2-4-8. Power plant and tailrace

(1) Power plant building

The power plant is located close to an effluent stream, and arrange perpendicular to the stream direction – a configuration less susceptible to damages caused by conflict of streams and flooding. In terms of topographical features, it is built on a gentle slope, and the area surrounding it provides an ample space including a plenty of work area.

The topography proves advantageous for installation of outdoor transmission facilities, such as switching station, and the arrangement plan of these facilities is deemed to be appropriate.

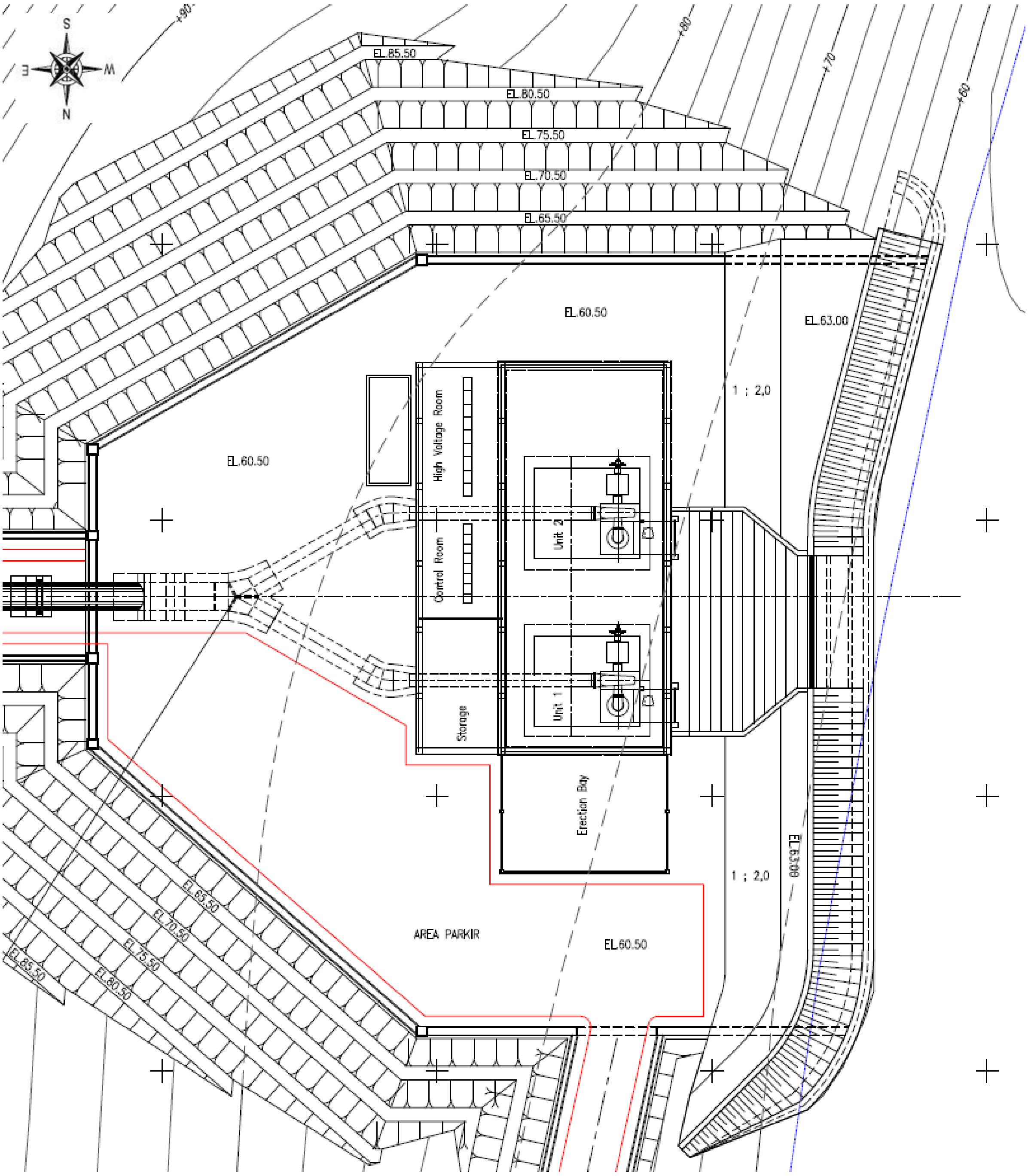


Figure 4-33 Power plant design (plane view)

(2) Foundation

To reconcile discrepancies of discharge draft height, elevation of the center of the turbine (EL.58.400) is set lower than that of tail water level (EL.59.500). This will necessitate special precautions to maintain waterproofness of the walls along the tailrace.

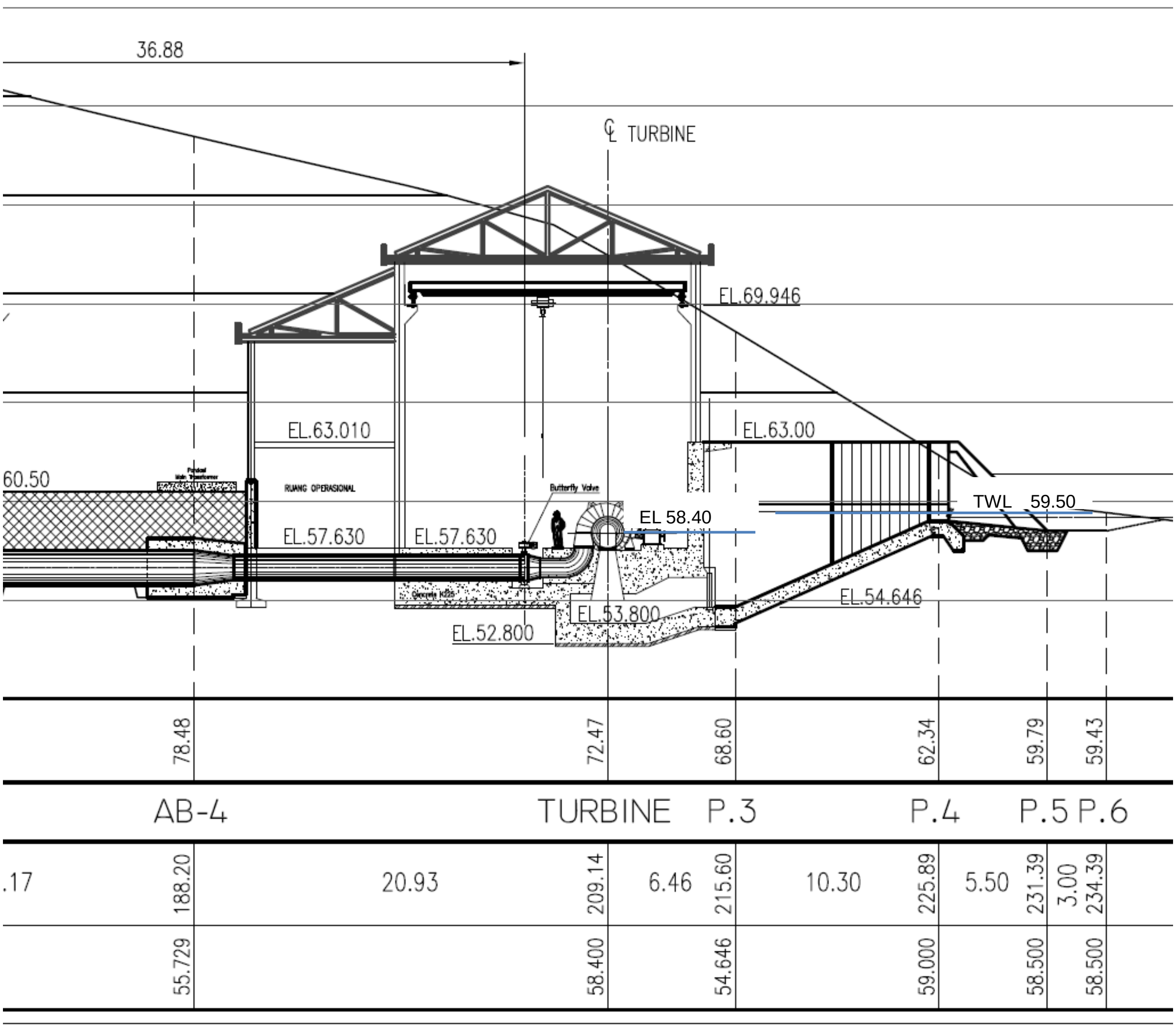


Figure 4-34 Power plant design (longitudinal section)

(3) Tailrace

The tailrace is characterized by its short extension, and the afterbay reservoir is directly connected to the effluent stream. This configuration presents no special issue to be addressed.

4-2-5. Scheme of execution

4-2-5-1. Possible issues

A scheme of execution is a comprehensive implementation planning to bring the construction to perfection economically and safely within the prescribed work period, and without compromising desired quality nor damaging the environment. It requires multifaceted considerations over labor service, construction materials, power source, utilities, building and transportation, and others. The method of setting up a scheme of execution, and related issues are described below.

(1) Planning

1) Work volume and period

Work volume is roughly represented by the following formula. Once the work period is defined, year-by-year schedule should be worked out so that work volume variations are as small as possible, and breaking it down into available months in a year and available days in a month, with due consideration given to climate and work conditions.

- (Work volume) = (Unit work volume) × (Work period)
- (Daily work volume) = (Work volume/hour) ×(Work hours/day)

Daily and hourly work volume heavily depends on the on-site conditions: performance of machinery, processing condition, availability factor, and work shift schedule. Table 4-55 shows a list of Important points of concern for setting up a well-balanced schedule.

Table 4-55 Points of concern for setting up work volume and period

Construction equipment	Consider parameters (type, performance, on-site conditions) in a comprehensive way, and select the most efficient combination
Availability	A ratio of real operating time vs. total clock hours. Availability is susceptible to such factors as: initial work setup, maintenance, and driver's skill. Meticulous management required to maintain high availability.
Working hours/day	Determined by the organization/grouping of workers. Working hours should be optimized reflecting the shift scheme (1, 2, 3 shifts/day).

2) Construction method and cost

Construction cost is largely classified into two categories: the variable cost which varies depending on the work volume, and the fixed cost which solely depends on the work period. Variable cost and fixed cost are essential elements for the analysis of prime cost and selection of work technique, because they can vary depending on the scale of construction, work technique used, and work capacity of the machines.

(2) Points of concern for selecting the construction method

1) Balance between economical speed and construction details

The fund for power plant construction is naturally accompanied by a substantial amount of interest. Therefore, In general terms, the shorter the work period the more economically advantageous in terms of interest, as well as in terms of administrative and miscellaneous expenditures. However, the effort for cutting back the work period has its own limit. An excessive cut back on the work period can incur a blown-up investment on temporally facilities and construction machines, as well as redundant labor expenditure, leading to an unexpected increase in construction cost.

One of the characteristics pertinent to power plant construction is that it requires types of long-term constructions such as a large-scale dam and long tunnels, which often determines the total period of construction works. If this is the case, the first thing to do is to streamline the long-term construction economically, and then to make up the overall schedule with due considerations given to balancing the multitude of work types.

2) Facilities and equipment

Construction work requires a variety of facilities and machines. The work schedule must take ability/capacity of these into account, with a view to achieve a balance among them.

In general terms, larger work facilities enable shorter work period. However, excessive enlargement of facilities can level off, or even damage the achievement of shortening efforts. Economy of a type of work is generally gets better as the scale of facility becomes larger (i.e. reduction of unit work cost), and normally starts to decrease as the scale surpasses a certain level (i.e. decrease in unit work cost). The turning point occurs at relatively small facility scale when the scale of the work is small, and at relatively large facility if the work scale is greater.

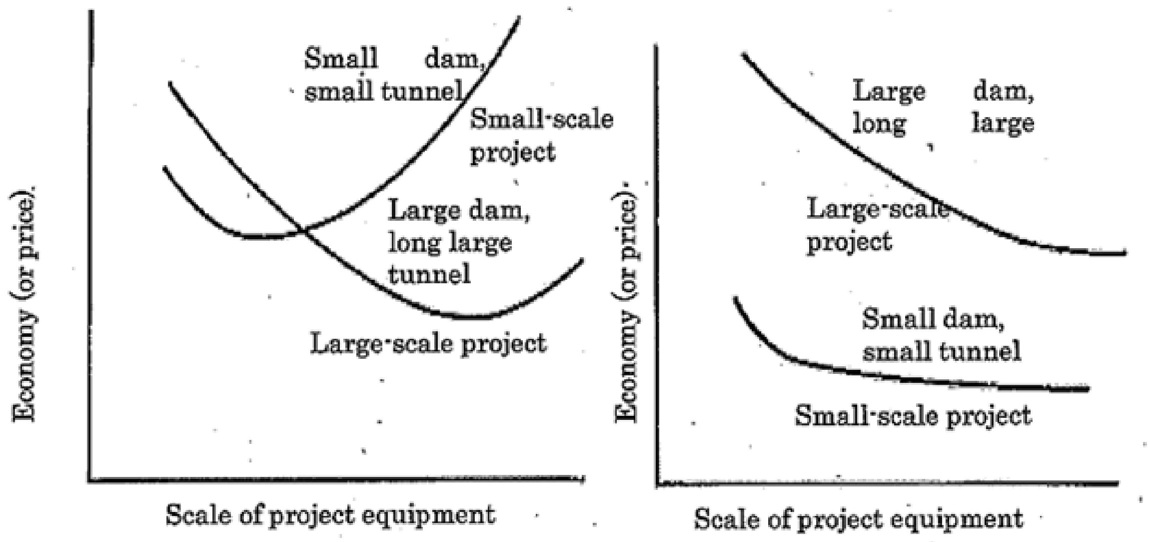


Figure 4-35 Scale of facility, economy, and work period

Source: Small and medium hydroelectric guidebook

3) Hydro-meteorological condition: timing of groundbreaking and work period

Hydro-meteorological conditions – temperature, rainfall, snow, flooding, and others – have significant effects on the construction processes. Therefore, these conditions must be taken into account for the optimum period selection for groundbreaking and construction works.

4) Allocation of workload

In reference to the work schedule plan, important items such as monthly wage, number of workers, quantity of construction materials, and major machines employed should be put into review. A significantly biased allocation, if any, should be passed into review.

5) Schedule allowance

As the construction progresses, the project may be faced with an unexpected incidence such as a large influx of spring water inside the tunnel, abnormal flooding of the river, and so on. If the impediment is serious and large in scale, all the steps and organization of the schedule may have to be reviewed. However, the schedule should be set up from the start in such a manner that it allows each step of the construction work to have an adequate margin to absorb small delay caused by a minor accident and variation of work volume.

Optimum margin depends on several factors – planning condition, type of work, and previous knowledge of the nature of the work -, thus, a study of track records in the past may help establish an adequate value.

4-2-5-2. Points of concern on Nasal hydropower project

(1) General notes on the construction work

1) Temporary work

Space must be secured temporarily for storage of construction materials and others. Due to the limited area on site, it may be difficult to secure plural of wide area at any one time. Therefore, care must be take to streamline the space layout and carrying-in/out schedule, so that a temporary space is conveniently set up in the immediate neighborhood of the structure under construction.

2) Earthworks

The construction site must be cleared of trees, roots, and weed before the earthwork starts. From the viewpoint of environment conservation around the site, it is worthwhile to consider using low-noise, low-vibration construction machines. It is also advisable to pay an attention for the reuse of the wood biomass gathered from the construction site.

Excavated soil have to be piled up temporarily in an area in or near the site before being reused (backfilling) or transferred to separate location: an temporary space for this purpose must be secured. Well-organized planning is required is required for efficient arrangement of these spaces (distance between them, and satisfactory size)

Cut-out slope and refilled land needs a surface protection measure: tree planting should be considered as a viable option in view of harmonizing with the surrounding environment.

3) Structure construction

In concrete works, every step of the process – material storage, mixing, transport, pouring, and curing- needs attention for it to exert sufficient concrete strength.

In penstock construction, a high quality penstock channel requires an rigorous control of welding and fixing operations, as well as securing an adequate assembly ground.

(2)Notes on implementing facilities in Nasal hydropower project

1) Intake weir

Earthwork for intake weir construction inherently includes implementation of access roads: a careful prior consideration must be made to cope with huge amount of excavated soil (a wide area for temporary storage required). Stabilization of slope is another concern, because the intake weir construction creates long cut-out slopes.

Dam body construction includes a temporary shutoff operation, the timing of which must be carefully selected taking climate conditions into account, and during the period when river flow is minimum. During the shutoff operation, a half of the water channel of the river is shut off. Therefore, careful prior planning is necessary to secure sufficient water passing capacity in case a flood takes place during the work.

2) Settling basin

The planned settling basin is of semi-underground structure, which require concrete pouring after excavation to the depth of around 6m. As the slope created by excavation is susceptible to the danger of collapse, an adequate protection measure must be in place with due consideration given to the soil characteristics on the site.

3) Intake channel and headrace

As the construction work accompanies a creation of long cutting slope along the channels, prior planning is required to secure wide enough area for temporary storage of excavated soil. Stabilization of the slope is another concern where the cutting slope is especially long.

Installation of intake channel and headrace requires excavation to the depth around 4m. As the slope created by excavation is susceptible to the danger of collapse before installation of the channels, an adequate protection measure must be in place with due consideration given to the soil characteristics on the site.

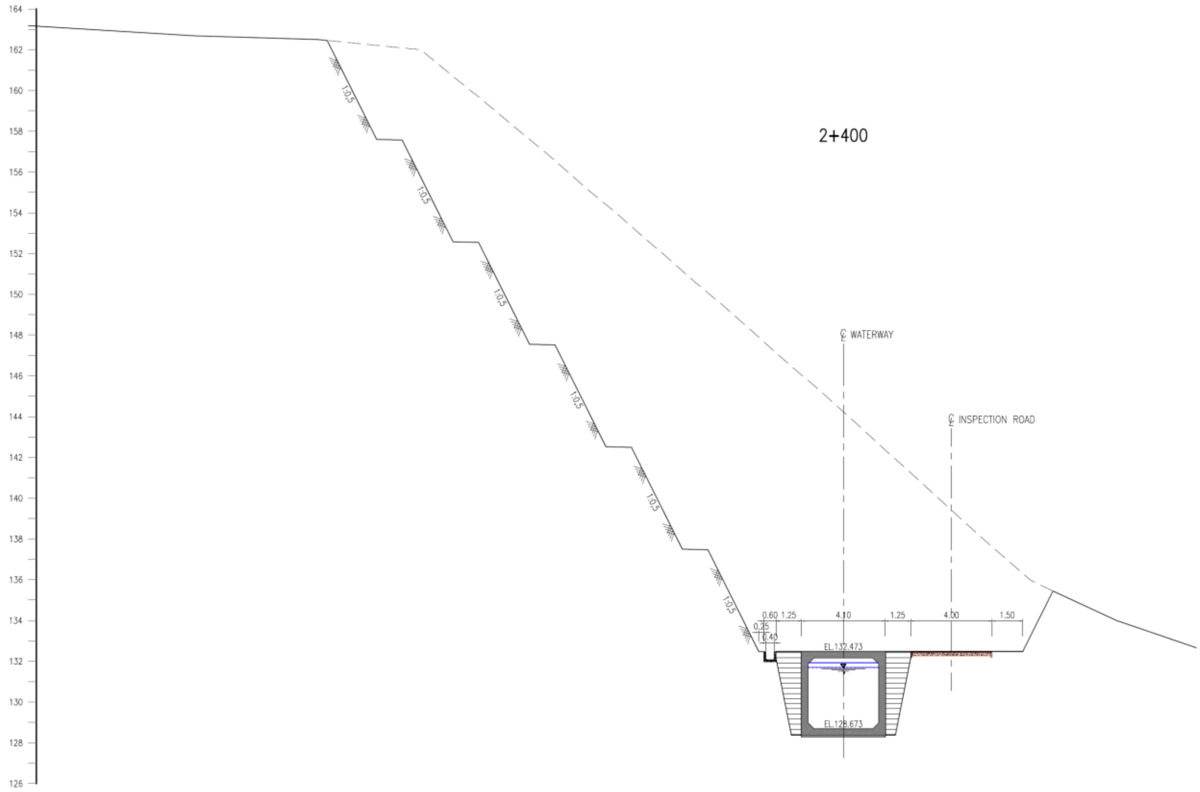


Figure 4-36 Headrace cross-section (at SP 2400)

4) Head tank

As is the case with the settling basin, the head tank has a semi-ground structure. As the maximum depth position requires excavation down to around 11m, rock bolts will be implemented in the deeper zone. Because the slope created by excavation is susceptible to the danger of collapse before structure construction, a slope protection measure may be necessary depending on the characteristics of the soil.

5) Penstock and power plant

Careful prior planning is required to secure wide area for temporary storage of excavated soil. Stabilization of the cutting slope is another concern especially in downstream portion of penstock channels and around the area of power plant construction, where cutting slope is especially long.

To reconcile discrepancies of discharge draft height, elevation of turbine installation is set lower than that of tailrace level. This will necessitate special precautions to maintain waterproofness on the discharge channel side of the power plant building at time of commissioning, as well as against the danger of water influx when flooding occurs.

4-2-5-3. Grand schedule of Nasal project

Grand schedule, including every steps involved, of Nasal project is shown in Table 4-56.

Table 4-56 Construction schedule (Nasal)

No.	WORK ITEM	2014					2015												2016									
		Dry Season			Rainy Season						Dry Season						Rainy Season						Dry Season					
		A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O
1	PREPARATION WORKS																											
	Mobilisasi Demobilisasi	■																										
	Access Road	■	■	■																								
	Base camp and Site Office		■	■																								
2	DIVERSION SYSTEM																											
	Land cleaning				■																							
	Coffering & Dewatering				■	■	■	■	■	■																		
3	Weir, Intake & Transition Channel																											
	Land cleaning				■	■																						
	Earth works					■	■	■	■																			
	Concrete and masonry works						■	■	■	■	■																	
4	KANTUNG LUMPUR (SANDTRAP)																											
	Land cleaning					■																						
	Earth works					■	■																					
	Concrete and masonry works							■	■	■																		
	Shortcrete							■	■																			
	Inspection road								■	■																		
5	WATERWAY																											
	Land cleaning							■	■																			
	Earth works								■	■	■	■	■	■	■	■	■											
	Concrete and masonry works									■	■	■	■	■	■	■	■											
	Shotcrete													■	■	■	■											
	Inspection road														■	■	■											
6	HEAD POND																											
	Land cleaning												■															
	Earth works													■	■	■												
	Concrete and masonry works														■	■	■	■										
	Shotcrete																■	■										
	Inspection road																	■										
7	PENSTOCK																											
	Land cleaning													■	■													
	Earth works														■	■	■											
	Concrete and masonry works																	■	■	■								
	Steel Penstock												■	■	■	■	■	■	■	■								
													Fabrication, Transportation, Installation, Test															
8	POWER HOUSE																											
	Land cleaning																	■	■									
	Earth works																		■	■	■							
	Concrete and masonry works																				■	■						
	Building works																				■	■	■					
	Shotcrete																					■	■					
	Inspection road																						■					
9	HYDROMECHANICAL WORKS																									Commissioning Test 3 Months		
	Gate, Trashrack and Accessories															■	■	■	■	■	■	■	■					
																Fabrication, Transportation, Installation, Test												
10	ELECTROMECHANICAL WORKS													Fabrication, Transportation, Installation														
	Turbine, Generator and Accessories													■	■	■	■	■	■	■	■	■	■	■	■			
	Switch Gear and Transmission Line																				■	■	■	■	■			
11	FINISHING WORKS																											
	Finishing works																						■	■	■			

4-2-6. Management, operation, and maintenance

4-2-6-1. General

In hydropower generation facilities, such as the one constructed in this project, a large portion of operating cost is occupied by labor cost: every effort should be made to attain unattended management/operation in as wide as possible extent. Establishment of a wide-area maintenance framework – personnel in one office administrates plural of power plants – can be a solution for efficient management and maintenance.

Focus should be placed on the efficiency of operation and maintenance that enables full-fledged use of the planned effect continuously and uninterruptedly. This strategy should include diligent performance of such routine tasks as continuous monitoring and analysis of maintenance data. Such effort will have an effect on rapid recovery from failures, and easier diagnostics of system degradation, leading to longer life of facilities and extended interval between large-scale overhauls.

4-2-6-2. Specifics of management system

The business entities in Indonesia are lacking in specific information not only to perform activities in an orchestrated and organized manner, but also track record for operation and maintenance of hydropower stations. In this context, PFS report does not provide specific descriptions on maintenance/management planning that will become necessary after completion of the construction.

However, as the general idea in the previous clause mentioned, unattended management/operation and large-scale maintenance structure are necessary for effective management.

Specifically, considering convenience of daily work, operation status in power plants could be observed from a management office in city area without any personnel working in those power plants. In the management office, maintenance workers for civil engineering and electric equipment are stationed for remote operation and periodically maintenance, and it is necessary to formulate system for immediate access to the power plant when the emergency occurs. For proper arrangement of personnel, maintenance workers should be placed minimum adjusting excess and deficiency depending on management performance.

In addition, it is important to establish collaboration system with cooperative companies in various fields in case construction work will be required, and to keep relationship to deal with normal maintenance and promptly restoration in emergency.

Furthermore, it is possible to establish the system for directions and commands that are difficult to determine in local site by sharing information via communication network with main base of development business operator.

In this section, as an example, description is made on the system and planning of operation, maintenance, and management based on the directives in place in Japan (Electricity Business Act). It is highly advisable that a similar management system be organized in Indonesia for enhanced operation and maintenance of the electricity generating facilities.

(1) Obligations prescribed by Electricity Business Act

1) Appointment of chief engineer

For effective implementation of operational management on hydropower facilities, Electricity Business Act dictates appointment of chief engineers and establishment of safety regulation based on which operation and management of the facility should be performed. At least two chief engineers must be appointed: a licensed electric engineer in charge of electric facilities (turbine, generator, transformer, and distribution board) and a hydraulic chief engineer in charge of hydraulic facilities (intake, water channels, and spillway.

Safety regulations have a requirement that they define such variety of rules as: organization and duties of administrators, maintenance education, inspection tour for maintenance, check/inspection items, operation/manipulation of power generation facilities, maintenance during a long downtime, measures to be taken at the time of emergency, record keeping of operation and maintenance, and maintenance items related to maintenance and operation of power generating facilities. The business entity responsible for the operation and maintenance of the facility must abide by the safety regulations.

2) Report and contact

The operator of a private power generation plant with output capacity greater than 1,000kW must submit an operation report once in every six months to the Minister of Economy, Trade and Industry. When an accident occurs, the chief engineer in charge of the facility, irrespective of its output capacity, must submit a quick report without delay, followed by detailed description of the accident.

3) Operation and maintenance of hydropower facility

As an accident in a hydropower facility can have a huge impact on the local society, diligent performance of maintenance activities of the facility – extraordinary inspection at the time of emergency as well as regular maintenance – is of utmost importance.

Hydraulic facilities (intake gate, water channels, and spillway) are susceptible to damages caused by natural force, and, once an accident occurs, it can have a huge impact on the local society. If an abnormal incident occurs, or any sign of it is detected, an extraordinary inspection should be given.

For hydraulic facilities, normal frequency of tours of inspection is as follows.

①Two or three times a month: in search of any sign of abnormality

②Once in every six month: detailed external inspection

③Once in every two to five years: internal inspection with the water drained out (the frequency depends on the structure of the facility, years of use, and natural conditions)

An extraordinary inspection must be given after an earthquake, flooding, and heavy rain, for early detection of cracks, damages and inflow of earth and sand. Immediate measure should be taken if the situation calls for.

Internal inspection of water channels, with the water drained out, requires special safety measures: in addition to set up a detailed plan beforehand, close contact and cooperation with relevant departments is essential to avoid unexpected accident –e.g. influx of water while the inspection is underway.

4) Operation and maintenance of electric facility

In most cases, totally unattended operation is a common practice in power generation plants. Therefore, regular tour of inspection, as well as an extraordinary inspection when an accident occurs, should be an integral part of electric facility maintenance.

Although the power plant include sources of potential danger – high-voltage electric equipment, and running heavy machines - the number of unmanned plants is on the increase owing to advance in technology. For this reason, multiple safety measures should be in place such as the safety barrier (lockable) and the device to detect intrusion of an alien.

For electric equipment (turbine, generator, transformer, distribution panel), normal frequency of tours of inspection is as follows.

①Two times a month: monitor the occurrence of abnormality

②Two or three times a year: detailed inspection of the turbine (water drained out) and electric equipment

③Once in every five to ten years: overhaul of power generating equipment

5) Operation and maintenance of power transmission/distribution facility

Power transmission and distribution facilities are classified into two categories (aerial and underground) and details of maintenance procedures differ accordingly. However, regular tour of inspection and extraordinary inspection in case of abnormal incidence should be given to both of these categories.

Aerial system is subject to damage such as: typhoon damage, salt damage, transmission tower collapse due to earth slide, mud slide, and avalanche, lightning strike, and, damage caused by wind and overgrowth of weed. Underground system is subject to such damages as: landslide and mud slide, and damages caused by small animals.

To cope with these varieties of damages, regular tour of inspection, as well as an additional extraordinary inspection at the occurrence of abnormal situation, should be an integral part of the maintenance system.

4-2-7. Summary, future issues

4-2-7-1. Summary, future issues and measures

Major conclusions derived from this review, and future issues and remedial measures are listed below:

(1) Power generation plan

1) Major results of the review, and future issues

① Flow rate data was estimated, using Tank model, from the precipitation data collected at TJ Harapan observatory from 2001 to 2010. Precision of Tank model needs to be examined. Because scarcely any flow rate data was available from the rivers in the neighborhood of the project site, the flow rate data contained in the Indonesian plan was used for review.

② Loss head was calculated based on the drawings available on-site, and this value was used to estimate effective head. The effective head thus obtained, 69.0m, was smaller than that contained in PFS report (80.8m).

③ Assuming the same maximum discharge as put forward by Indonesian plan, power output was found to be lower, 10,000kW, as compared to the initial plan, 12,000kW. Power generation efficiency reported in this review is based on the coupling efficiency curve prepared using hearing data from the turbine manufacturer.

④ Electric energy output reported in this review showed nearly the same level as that contained in Indonesian document with a margin around 1000MWh (Note that the two calculations used different conditions such as: setting methods for generator output, power generation efficiency, and maintenance flow)

2) Possible solution and remedial measure

① Flow rate data: It is to be desired to implement simplified flow rate measurement at the project site, for one year or around, to confirm accuracy of flow rate data – including reliability evaluation of data, and validity assessment of Tank model.

② Effective head: the value contained in PFS report is achievable if parameters (intake location and discharge location) are modified. However, if the current design provides sufficient economic efficiency, larger effective head is not necessarily required. (Design modification - extended water channel, enlarged cross-section – incurs greater project expenditure)

③ Electric energy output: It is desirable to verify accuracy of electric energy calculation by setting efficiency parameters based on the detailed design of turbine and generator.

④ Economic evaluation: evaluation of the construction cost remains to be worked out for the future, wherein an extensive review of the structural design and implementation planning should be taken into consideration.

(2) Safety of major civil engineering structure

1) Major results of the review, and future issues

① Stability of intake weir: Calculation based on Japanese standard proved that the intake weir is sufficiently stable.

② Intake weir location: Weir height was closely examined. Layout and design were found appropriate, presenting no immediate issue to be addressed.

③ Water conduction capacity of intake gate and penstock: Hydraulic calculation proved that the system provides sufficient water conduction capacity. However, the design assumes construction of excavated cross-sections with very long slope in many locations – including the settling basin and head tank – in the project site, which may require review in the future.

④ Head tank capacity : Current design is confirmed to provide sufficient capacity.

⑤ Wall thickness of penstock : Examination based on Japanese standard proved sufficient safety.

⑥ Penstock route : Power plant location and penstock routing were considered appropriate. However, because altitude of turbine installation is lower than that of spillway, waterproofing measures – at the time of flooding as well as normal operation – may require further review in the future.

2) Possible solution and remedial measure

① Intake weir: Although judged stable, the examination used expected values (e.g. physical properties of foundation) in a part of the calculations. Recalculation is highly desirable using measured/experimental values (this requires implementation of soil test).

② Construction work of water channel facilities (penstock and other channels) should be executed in a manner which gives due considerations to slope stability and protection during and after the completion of construction.

③ Thorough waterproofing measures should be implemented on the tailrace side of the power plant to prevent water from entering both at the time of flooding and normal operation.