

DRAFT Environmental and Social Impact Assessment Report

Project Number: 50182-001
November 2018

INO: Riau Natural Gas Power Project ESIA Vol.5_Technical Appendices Part B

Prepared by ESC for the Asian Development Bank

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Appendix B. Detailed Process Description



Riau 275 MW Gas Combined Cycle Power Plant IPP - ESIA

Medco Ratch Power Riau

Technical Report – Process Description

AM039100-400-GN-RPT-1002 | 4

DATE – 9 November 2018

Riau 275 MW Gas Combined Cycle Power Plant IPP - ESIA

Project no: AM039100
Document title: Process Description
Document No.: AM039100-400-GN-RPT-1002
Revision: 4
Date: 9 November 2018
Client name: Medco Ratch Power Riau
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Document history and status

Revision	Date	Description	By	Review	Approved
0	18/04/2018	For ESIA	Jacobs	Bruce Clarke	Eamonn Morrissey
1	17 May 2018	Revised Transmission Line Route	Jacobs	Eamonn Morrissey	Eamonn Morrissey
2	9 July 2018	Revised transmission line and gas pipeline routes. Other minor changes	Jacobs	Eamonn Morrissey	Eamonn Morrissey
3	16 October 2018	Changed estimated blowdown temp, section 10.4.4, updated river flow data sections 9 and 10, added construction method for swampy area to Appendix F	Jacobs	Eamonn Morrissey	Eamonn Morrissey
4	9 November 2018	Minor changes to section 8 regarding pipeline construction.	Jacobs	Eamonn Morrissey	Eamonn Morrissey

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Abbreviations

AMDAL	Analisis Mengenai Dampak Lingkungan
amsl	Above Mean Sea Level
CEMP	Construction Environmental Management Plan
CEMS	Continuous Environmental Monitoring Station
CCGT	Combined cycle gas turbine
CFPS	Coal fired power station
CPI	Corrugated plate interceptor
CRH	Cold reheat
dB	decibels
EPC	Engineering, procurement and construction
ESIA	Environmental and Social Impact Assessment
GFPP	Gas fired power plant
GT / GTG	Gas turbine / Gas turbine generator
H&SP	Health and Safety Plan
ha	Hectare
HHV	High Heating Value
HP	High pressure
HRSG	Heat recovery steam generator
H&SP	Health and Safety Plan
IP	Intermediate pressure
km	Kilometres
kg/s	Kilograms per second
kV	Kilovolt
L	litre
lp	Low pressure
m	Metres
mg/L	Milligrams per litre
mm	millimetre
m/s	Metres per second
m ³ /h	Metres cubed per hour
mAMSL	Meters above mean sea level
MRPR	Medco Ratch Power Riau
MW	Megawatt
NFPA	National fire protection association (of America)
NO _x	Oxides of Nitrogen
OHL	Overhead Line
OPGW	Optical Ground Wire
PLN	Perusahaan Listrik Negara
PPA	Power Purchase Agreement
ppmvd	Part per million by volume, dry

RoW	Right of way
SO _x	Oxides of sulphur, as SO ₂
ST / STG	Steam turbine / Steam turbine generator
T	Tonnes
PT TGI	PT Transportasi Gas Indonesia
UKL/UPL	Upaya Pengelolaan Lingkungan dan Upaya Pemantauan Lingkungan
wt/vol	Weight per volume

1. Introduction

1.1 Purpose

This document provides a process description of the construction and operation of the Riau 275MW Combined Cycle Gas Fired Power Plant IPP Project (Riau 275MW GPPP). The project consists of a 275MW combined cycle power plant and ancillary facilities, a 40 km long 12-inch gas pipeline, and a switchyard and 150kV transmission line - collectively comprising the "Project".

This report provides a brief description of the location and environmental setting, followed by key details of the proposed design in respect to construction and operation of the Project. This report is one of several technical reports prepared for the Environmental and Social Impacts Assessment (ESIA) and other permitting work associated with the Project. It is based on preliminary engineering work, including the EPC Contractor's (Lotte E&C) preliminary design of the power plant.

1.2 Background

The Riau 275MW GFPP will be a new, greenfield power station.

The Project Sponsors (being PT Medco Power Indonesia (MEDCO) and Ratchaburi Electricity Generating Holding PCL (RATCH), have formed PT Medco Ratch Power Riau (MRPR) to build, own and operate the plant under the terms of the Power Purchase Agreement (PPA) which has been agreed with PLN.

The key components of the Project include a 275MW combined cycle power plant (CCPP), a 40km long gas supply pipeline which will bring fuel to the site, a 150kV switchyard, and an approximately 750m long transmission line to connect the power plant to the PLN grid. Once constructed, ownership of the switchyard and transmission line collectively known as the Special Facilities will be transferred to PLN. At the end of the 20-year term of the PPA, PLN will take ownership of the power plant and gas supply pipeline.

The Project will be located approximately 10 km due east of Pekanbaru city, approximately 5 km south of the Siak River. The power plant and switchyard will be comfortably accommodated inside the 9 ha of land being procured by MRPR. The power plant is a 2 x 1 combined cycle plant, designed to deliver up to 275MW over the 20-year term of the PPA. It will burn gas fuel only. It will consist of:

- 2 x GE 6F.03 gas turbine (GT) generator sets;
- 2 x supplementary fired heat recovery steam generators (HRSGs);
- 1 x steam turbine (ST) generator set;
- A wet mechanical draft cooling tower;
- Gas reception area; and
- All normal balance of plant systems.

In addition, there will be:

- a 150kV switchyard at the plant, with an approximately 750 m double-phi connection to intercept the Tenayan – Pasir Putih 150 kV transmission line;
- A 40km gas pipeline running from the gas connection point at an offtake location known as SV1401 on the main Grissik-Duri gas pipeline; and
- Water supply and discharge pipelines to and from the Siak River.

2. Location and Environmental Setting

2.1 Site location

The power plant site is located in the Sail Sub District, Tenayan Raya District, Pekanbaru City, and Province of Riau.

The power plant is located approximately

- 10 km due east of the city of Pekanbaru in central Sumatra, Indonesia;
- 3 km south of the Siak River; and
- 2 km south of PLN's 2 x 110MW RIAU Coal Fired Power Station (CFPS).

At the moment, the power plant site is part of a privately owned palm oil plantation. According to Pekanbaru City's Spatial Plan, the land is in a zone allocated for Industrial and Warehousing use.

Drawings in Appendix A show:

- Preliminary, conceptual layout for plant and equipment on the site; and
- The setting of the Site relative to Pekanbaru City and PLN's existing coal fired power station, along with proposed routes for connections to the Grid, existing road, Siak River, and a pipeline corridor between the site and the Siak River.

2.2 Environmental Setting

2.2.1 Climate

Pekanbaru has a tropical climate. The design and general site climate conditions are provided in **Table 1**.

Table 1: General site ambient climate conditions

Parameter	Value
Ambient air temperature range	20°C-37°C
Design ambient air temperature	28°C
Relative humidity range	40%-100%
Design Relative humidity	80%
River water temperature	Approximately 30°C
Average annual rainfall	Approximately 3,000 mm - rainy season between November and April
Maximum rainfall	Approximately 136mm/h
Average wind speed	Less than 3m/s, predominantly from the south or west
Site elevation	Approximately 25 mAMSL

2.2.2 Site Investigation

MRPR has conducted a site investigation of the power plant site. The final report is provided in Appendix C and includes a topographical map and geotechnical characteristics.

2.3 Socio-economic Setting

Riau province has a population of approximately 7 million people, of which approximately one million live in Pekanbaru City.

The majority of the population living close to the power plant site are likely to be involved in the palm oil plantation business, fishing and farming.

The proposed site is currently part of a privately owned palm oil plantation. The palm trees appear to be around 5 – 7 years old.

The closest settlement is around 2 km to the west of the site.

2.4 Project Land Requirements

MRPR plans to build the power plant and switchyard on a 9.1ha plot of land. Land surrounding the site is generally used for palm oil plantations.

There are no dwellings located at the power plant site so no physical relocation or resettlement of inhabitants will be necessary.

The total land requirements for the power plant and switchyard are estimated at approximately 5.4 ha as outlined in Table 2. Preliminary Site layout plans are provided in the Appendix A.

Table 2: Riau 275MW GFPP power plant land requirements

Riau 275MW CCPP power plant land area requirements	Approximate Area, ha
Power plant and main plant buildings (GTGs, HRSGs, STG & Control Room)	1.2
Cooling tower	0.2
Balance of plant area	2.5
Switchyard (150kV) (part of the Special Facilities to be owned by PLN)	1.5
Total	5.4

During construction, there will be further land requirements for laydown areas, offices, and the construction workforce. The additional area estimated at a further 3.7 ha, will be within the site area, as shown on the drawings. (The area currently allocated for the future expansion of the switchyard will be available for laydown purposes during construction.)

There will also likely be a need for a temporary jetty to be built on or on the banks of the Siak River, expected to be located close to PLN's existing Tenayan Coal Fired Power Station (CFPS).

In addition, the Project will have land requirements for the water abstraction point at the River, water supply pipelines to and from the power plant site, the gas supply pipeline, and the 150kV transmission line, estimated as shown in Table 3.

See Appendix A for details of potential off-site land requirements (excluding the gas pipeline.)

Table 3: Estimated land requirements in addition to the power plant Riau 275MW CCPP power plant – off-site area requirements

Equipment item	Approximate dimensions, m x m	Approximate Area, ha
River water pump house plus local building	50 x 40	0.2
Water supply and discharge pipeline corridor	6 x 3,000	1.8
Gas supply pipeline, though very little, if any, of this will actually need to be acquired by MRPR. Extent is to be confirmed. MRPR may also need to acquire or gain access to some land at the point of connection to the main pipeline. This would be for a valve and pig launching station.	2 x 40,000	8
Transmission Line (including 4 towers not on the main power plant site) – normally via an easement.	75 x 750	5.6
Transmission line towers (off the main power plant site, straddled by transmission line)	4 x 40 x 40	4 x 0.16 ha
Access road (assume 400m)	8 x 400	0.32
Temporary Jetty	100 x 70	0.7

It is not expected that any physical relocation or resettlement of inhabitants will be necessary as:

- There are no dwellings located at the site or along the transmission line, and
- The gas and water pipelines will run along the road reserve or within easements which will be agreed with the affected landowners.

3. Project Schedule

3.1 Project stages

The Project will span three primary stages, being pre-construction, construction and operation, generally as follows:

- **Pre-construction:** The pre-construction stage involves project development activities, including selection of contractors, field surveys and permitting, and land acquisition works.
- **Construction:** The construction stage will involve land preparation (including site clearance, backfilling and land drainage) followed by construction and commissioning of the power plant, gas pipeline and grid interconnection.
- **Operation:** The operation stage will involve the full operation of the power plant – first of all over the 20-year term of the PPA and then, as determined by PLN after ownership transfers to PLN.

3.2 Project Timescales

The proposed project timescales for major construction activities are provided in **Table 4**.

Table 4: Estimated duration (in months) of activities required for Project construction

Activity	Estimated Duration (months)
Site clearance and levelling (may commence before financial close)	6 months
Gas pipeline construction	12 months
Power plant and switchyard engineering, procurement and construction	24 months
Construction of water pipelines (to and from site)	8 months
Transmission line construction	8 months
Commissioning	6 months

The total construction and commissioning time from financial close is to be 30 months.

4. Power Plant Pre-Construction Works

4.1 Introduction

The pre-construction stage involves project development activities, including selection of contractors, field surveys and permitting, and land acquisition works.

4.2 Contractor Selection

MRPR has have already selected the main Contractors, as follows:

Table 5: Estimated duration (in months) of activities required for Project construction

Scope	Contractor
Power Plant, switchyard, transmission line, water supply and discharge structures and pipelines	Lotte Engineering & Construction of South Korea
Gas pipeline	PT Citra Panji Manunggal (CPM) of Indonesia

These contractors will be responsible for identifying and recruiting workers with the appropriate skills and qualifications required for the construction stage of the Project.

Note: peak labour requirements for the construction of the power plant and Special Facilities will be approximately 1,000 people, with the expectation that the local community will be able to provide the bulk of this work-force.

4.3 Field surveys, permitting and land acquisition

In order to collect the data required to finalise the location and design of the Project, MRPR has been conducting field surveys of the site, including topographical survey, geological and geotechnical investigations of the soil.

Additional surveying activities will include those necessary for securing the permits and approvals – AMDAL for the Power Plant, UKL-UPL for the gas pipeline, UKL-UPL for the Switchyard and transmission line, Environmental and Social Impact Assessment (ESIA) for the Project.

Requirements for land acquisition will be identified as part of the process. Land will be acquired for the Power Plant, Switchyard and transmission line. Land for the water intake and pumphouse etc. will be leased. Some land may be needed for the gas pipeline (e.g. at the point of connection to the main gas pipeline at SV1401). Otherwise, the gas pipeline will run along the road reserve, or follow easements to be agreed with any affected landowners.

Nor is it expected that it will be necessary to acquire land for the water supply or wastewater discharge pipelines because it is anticipated that these will either follow road reserves or easements to be agreed with any affected landowners.

5. Power Plant and Transmission Line Construction

5.1 Introduction

The construction phase of the Project is scheduled to last from late early 2018 to the end of 2020.

The following stages are envisaged.

- Site clearance, levelling and general preparation;
- Construction of access road;
- Gas pipeline construction (see later section of this report);
- Power plant and switchyard construction, including construction of water pipelines (to and from site)
- Transmission line construction; and
- Commissioning.

5.2 Site clearance, levelling and general preparation

5.2.1 Site Clearance and levelling

The site area for the Power Plant and Switchyard will need to be cleared of vegetation and any debris prior to levelling. Site clearance works will include felling, trimming, and cutting trees, and disposing of vegetation and debris off-site. Voids and water ponds will be dried and filled with suitable material.

Vegetation, roots, debris, stones, and other materials will be removed from the areas to be stripped by mowing, grubbing, raking, etc.

Topsoil will be stripped from the surface. Excavated topsoil will be transported to and stockpiled in designated topsoil storage areas. Prior to being filled, any sub-grade surfaces will be freed of standing water and unsatisfactory soil materials will be removed. All unnecessary excavated materials will be transported and deposited off-site at an approved facility.

The site will then be levelled. Ideally, the cut and fill will be balanced, to minimise the need to import or export material from the site area. Based on the site topography, preliminary estimates show that if the site elevation is set at 28m, then the cut and fill / backfilling volumes will be reasonably well balanced at approximately 165,000m³ each.

Notwithstanding this, it is likely that approximately 45,000m³ of soil will need to be disposed of offsite. At 20m³ per truck, this will require 2,250 truck movements over approximately 3 months. The proposed soil disposal area is within the overall area designated for industrial and commercial uses. Currently, the proposed disposal area is rough bush and is swampy and it is not being used for any productive activity.

5.2.2 Flood Risk

According to investigations for the site originally proposed for the project, it was determined that a site level of 3 mAMSL would be adequate to ensure the site would be above the 100-year return period flood level of the Siak River. The lowest point of the current site for the project is more than 20 mAMSL.

Therefore, the site will not be subject to flooding via the Siak River.

During the engineering stage, the site elevation will be set to ensure stormwater from adjacent properties cannot cause the site to flood and to ensure that stormwater falling on the site does not flood neighbouring land.

5.3 Construction of Access Road

The construction stage includes the development of an access road which will be approximately 400 m long and run from the main road to the north of the Site.

The access road will be a permanently sealed two-lane 8m road.

5.4 Power plant and switchyard construction, including construction of water pipelines (to and from site)

5.4.1 Excavations

A range of excavations will be carried out at the site, primarily:

- Excavation for structures (footings and foundations);
- Excavation of ditches, gutters, and channels;
- Excavation for drainage structures; and
- Trench excavation.

Where excavated material is suitable to be used for fill and backfill, the material will be segregated and transported to a stockpile location at the power plant site. Unless specified or directed otherwise, all unnecessary excavated materials will be transported and deposited outside the power plant site. This material will be disposed in a location not to disturb the environment and which is permitted by municipal authorities.

Soil on site will be deposited and compacted, and the slopes will be trimmed to ensure that the soil is stable and free of surface depressions, and that the slopes drain freely and do not interfere with natural drainage to or from the surrounding area.

5.4.2 Piling

Piling will be undertaken as part of the construction activities. Piling methods will likely include pile driving and bored cast-in-place piling.

Pile driving will be used to pile the main power station foundations. Driving shall be done with fixed leads to hold the pile firmly in position and in axial alignment with the hammer. Piles will be driven continuously and without interruption to or below the calculated tip elevation to reach a driving resistance based on load test results.

Pile driving will not be carried out at night.

Bored, cast-in place piles may be used for lighter structures. With this technique, the pile hole is bored out, a steel cast is placed in the hole and the pile is formed using reinforcing steel and concrete.

Sheet piling may be used to protect shallow excavations which are normally backfilled once the equipment is installed.

5.4.3 Foundations

Reinforced concrete foundations and base building slabs will be prepared prior to the installation of large items of equipment and the erection of buildings. The required volume of concrete will depend on the final design. However, it has been estimated that in the range of 20,000 to 30,000 m³ of concrete will be required. Concrete for the foundations and building slabs will either be batched at the power plant site or brought on to the site in a ready-mixed form by concrete trucks. If batching on site is selected, then sand and cement will be brought to the power plant site and stored in bins and bags next to the batching plant. Water required for concrete batching would be approximately 45m³/day. If delivered by mixer truck, then it has been estimated that between 2,000 to 3,000 deliveries will be required.

5.4.4 Equipment Installation

Once the foundations are prepared the plant equipment can be installed.

Some equipment will be installed outdoors – e.g. the gas turbine generator sets, the HRSGs, the step-up transformers. Other equipment, including the steam turbine generator set and the condenser, will be installed in purpose built buildings.

The Contractor is likely to pre-fabricate as much of the plant and equipment in factory conditions off-site, in order to minimise site work. For example, the HRSG modules will likely be shipped to site complete, so that site welding requirements are reduced.

Normal construction processes and techniques will be used. In addition to the workers needed for the site preparation and civil works, the workforce will include:

- Steel erectors
- Mechanical fitters
- Pipefitters
- Welders
- Electricians
- Instrumentation technicians
- Crane-drivers
- Scaffolders
- Painters
- Labourers, and
- Support staff.

Specialists will also be necessary from time to time e.g. for radiography and other non-destructive testing, and for high voltage work.

5.4.5 Off-site work

Off-site work associated with this stage of the project will include the following:

- The construction of the water intake at the Siak River, as well as the pipeline to take the water from the River to the site. Preliminary details of the proposed structures for this are included in the Appendix A.
- The construction of the water discharge pipeline, which will run alongside the water supply pipeline.
- The construction of a temporary jetty to serve as a berth for ships or barges delivering plant items and construction materials and equipment – e.g. the gas and steam turbines, generators, transformers, HRSG modules. The jetty will be located approximately 4km to the north of the power plant site, close to PLN's 2 x 110 MW coal fired plant. See Appendix A for further details of the possible location and Appendix E for the preliminary Transportation Plan.

Construction of the jetty will involve sheet piling for the "tunnel", while rock and sandbagging will be used for the head area. The tunnel will be dredged where required, the scope of which will depend on the exact location and local depth and conditions. The construction period will be approximately four months. After construction of the

Project is complete and assuming there is no reason for the jetty to remain in place, it will be removed. This will take approximately one month.

The roadway from the temporary Jetty past the CFPS and up to the power plant site is narrow in places and some widening of or improvements to the route may also be required.

5.4.6 Landscaping

After construction and erection work are completed, the power plant site will be landscaped for visual appearance and to limit erosion from surface water during heavy rains. The upper, organic layer of soil temporarily removed and stored during construction, will be used to provide fertile soil for landscaping, where possible.

5.5 Transmission line construction

The construction of the transmission line will likely be labour-intensive with simple hand tools rather than through the use of cranes and/or helicopters.

The major steps are:

- Survey and tower staking;
- Construction of foundations (typically cast in place);
- Erection of towers (i.e. assembly of tower members);
- Conductor, shieldwire, and OPGW stringing;
- Clean up; and
- Testing and commissioning.

Teams can work on separate towers or line sections simultaneously if necessary to reduce the construction schedule. However, this is unlikely to be necessary as the connection is so short.

Smaller vehicles will be used to transport materials (e.g. steel members) to and from each tower location in order to avoid the need for large access tracks or roads.

Inspection, testing, and commissioning will follow PLN's specification requirements.

Further details are included later in this report and the proposed connection route is shown in Appendix A.

5.6 Commissioning

After construction of the power plant is complete, the plant and equipment will be commissioned and set to work. The commissioning process involves:

- Calibrating and setting control and protection devices to ensure the safety of plant, equipment and personnel;
- Energising equipment for the first time;
- Checking individual components work correctly;
- Checking individual systems work correctly;
- Checking that the systems are properly integrated and work together as designed; and

- Testing the plant for compliance with the EPC Contract, including for compliance with the Grid Code and environmental requirements.

5.7 Construction Workforce and Equipment

As mentioned earlier, the labour force is expected to peak at close to 1,000, providing an estimated 10,000 man-months of work. Many of the work force are likely to come from the local community.

See Appendix D for a preliminary labour mobilisation schedule for the construction of the power plant and Special Facilities.

A range of equipment will be used in the construction of the plant. The principal type of equipment to be used includes the items listed in the following table.

Table 6: Construction equipment details

Equipment	Estimated No. units
Backhoe	5
Bulldozer	3
Trailer	2
Dump truck / Mixer truck	28
Cranes	12
Crane barge	1
Pile driver	6
Forklift	7
Welding machines	111
Electricity generators	8

Appendix D also contains further details of the proposed equipment mobilisation schedule.

5.8 HSE precautions during construction

All Contractors involved in the Project will be required to comply with all local health and safety requirements, as well as the requirements of any environmental permits issued for the Project.

Provisions will include developing and then following Construction Environmental Management Plans (CEMPs) and Health and Safety Plans (H&SPs) to reduce the risk of harm to staff, the environment or the local community. This will include drainage and sediment controls.

MRPR will monitor and supervise every contractor to ensure they are fulfilling the rights of workers in accordance with applicable laws and regulations.

Temporary construction offices and facilities for the labour force will be erected close to the Site. This will include areas for

- Food preparation and consumption;
- Ablutions; and
- First aid.

There will also be a prayer room.

There is no plan to construct a worker's camp at or close to the site. Lotte and its subcontractors expect to rent any accommodation necessary to house workers not from the area.

5.9 Construction Phase Noise

The major source of noise emissions will be through heavy machinery such as pile drivers, earthmoving equipment and transport vehicles.

As part of the ESIA and AMDAL process, procedures will be defined to reduce the potential for construction noise to impact on the community. Potential mitigation measures are likely to include

- Restricting hours of work to reduce the possibility of nuisance to neighbours;
- The use of modularisation, and encouraging the EPC Contractor to fabricate as much of the plant offsite as possible – e.g. the HRSG harp sections may be delivered fully assembled, reducing the need for site-work;
- Use of low noise and low vibration equipment to reduce the potential impact of piling operations; and
- Use of silencers during steam blowing exercises.

5.10 Transportation Impacts

The transportation of power station components to site via road could lead to temporary noise impacts on residential areas due to the proximity of the roads to the houses.

A mitigation measure for the transport noise is to transport the equipment to site via barges on the Siak River. This will remove the noise impact on residents in two ways. Firstly, the jetty is further from the residents and any noise would have a lower impact. Secondly, the barges are comparatively less noisy than trucks. The road from the Jetty area to the site may need to be improved. It should not be necessary to acquire any land for these improvements as the widened road would still be within the current road reserve.

General construction traffic and other deliveries will inevitably come by road from the area surrounding the Plant. In addition to traffic associated with the workforce coming to and from the site, there are likely to be in the order of 10 light trucks and 50 to 60 heavy trucks per day, bringing equipment and material such as concrete, rebar and construction raw materials.

As part of the CEMP, traffic management plans will be developed to minimise any potential impact on nearby residents, including:

- A truck wheel wash facility will be constructed to clean truck wheels prior to exiting the site in order to prevent dust and spoil being transported on to the public road. The wheel wash facility will be used through-out the construction phase of the power plant. The washing facility (pit) will not connect to a drain or watercourse and therefore will not filter the water; it will be manually cleaned out as required.
- Timing of deliveries to avoid peak travel times for residents, and in particular hours when children are scheduled to be going to or returning from school.

See Appendix E for a preliminary Transportation Plan.

5.11 Waste management during construction

While it is clearly in a construction contractor's interest to minimise waste, construction activities will inevitably generate waste streams. These will be handled in accordance with the legal and environmental requirements and good industry practice. The following table summarises the expected types of waste streams and likely disposal methods.

Table 7: Waste Management

Waste type	Management Method
Storm water	Temporary or permanent storm water system, depending on location and stage of the work
Effluents from cleaning and flushing	Temporary or permanent waste water treatment plant system, depending on stage of the work
Process effluents during commissioning	Permanent systems
HRSG chemical clean waste effluents	Permanent waste water treatment plant or off-site disposal via licensed facility if necessary
Metals – e.g. off-cuts of pipework and structural steel Cable – e.g. off-cuts of electrical cables	Recycle where possible – as these represent a potential revenue stream for the contractor – or dispose to local landfill or via licensed facility.
Consumable items e.g. oil and air filters;	Via licensed facility nearby
Other miscellaneous wastes – e.g. rags, containers for paints or chemicals, office waste	Via licensed facility nearby

6. Plant Operation

6.1 Introduction

The section provides

- A general overview of the power plant process;
- More detailed descriptions of the main power plant components
- A general description of resource requirements and environmental impacts; and
- General information about labour requirement.

6.2 General plant description

The power plant is a 2 x 1 combined cycle plant, designed to deliver up to 275MW over the 20-year term of the PPA. It will burn natural gas fuel only. The plant will consist of:

- 2 x GE 6F.03 gas turbine (GT) generator sets
- 2 x supplementary fired heat recovery steam generators (HRSGs).
- 1 x steam turbine (ST) generator set
- A wet mechanical draft cooling tower
- Normal balance of plant systems will also be provided, including:
 - Gas compression (if required) and conditioning system
 - Demineralised water treatment plant to treat raw water before it is added to the water steam cycle to make up for water lost from the cycle.
 - Closed cycle cooling water system to cool plant and equipment such as lubricating oil coolers, generator coolers, boiler feed pumps
 - Systems to dose and sample the water and steam
 - Compressed air system
 - Fire protection system, in accordance with local requirements with scope and design generally in accordance with NFPA 850
 - Emissions monitoring system
 - Drainage systems
 - Overall plant distributed control system
 - Metering and protection systems
 - Enclosures to house the plant and equipment as required
 - Control room and office space for the O&M staff
 - Black start diesel generators and system
 - HV switchyard.

The Appendix A includes the following conceptual drawings and information, including:

- Conceptual layout

- Water balance
- Single line diagram.

6.3 General process description

In a combined cycle plant, ambient air is filtered and led to the compressor of the gas turbine, where it is compressed. Fuel is added and combusted in the combustors and the hot gas fed to the turbine which drives the generator to generate electricity.

The exhaust gas leaving the turbine may still be in the order of 600°C. In an open cycle (or simple cycle) plant, the exhaust gas flows back to the atmosphere and so a good deal of useful energy is lost. However, in a combined cycle plant, the exhaust gas is fed to a HRSG and is used to generate steam. This is why a combined cycle plant is more efficient than an open cycle plant.

From the HRSG the superheated high pressure (HP) steam is fed to the high pressure section of the steam turbine where it expands before being returned to the HRSG for re-heating. The reheated steam is mixed with intermediate pressure steam also generated in the HRSG and fed to the intermediate pressure section of the steam turbine. Steam leaving this section is fed to the low pressure section of the turbine where it is supplemented with further low pressure steam from the HRSG. All steam exhausts to the condenser where it is condensed to water before returning to the HRSG to be converted to steam once again.

A schematic diagram of the process is provided in the figure below.

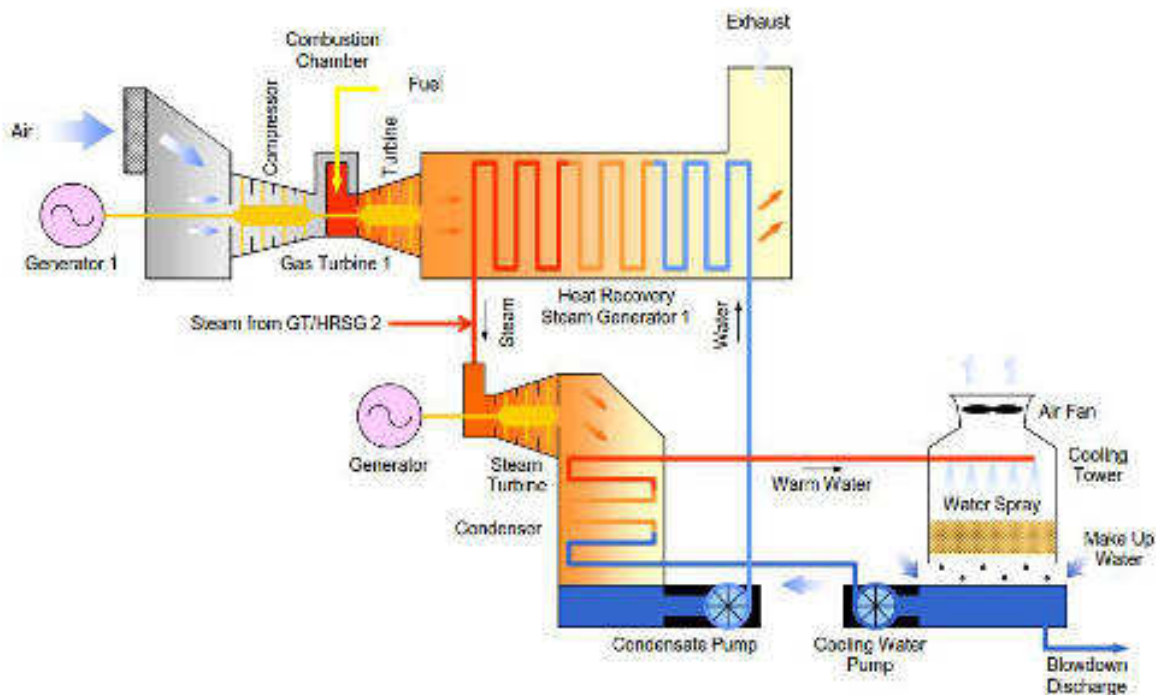


Figure 1: Schematic of General Process

6.4 Gas Turbine Generators

The gas turbine generators will be a 6F.03 model supplied by GE. This is an "F" Class, heavy duty, single shaft, industrial type of gas turbine, of proven design. Each unit will have a capacity of approximately 81MW.

The gas turbines will be equipped with lean-premix dry low NO_x combustion systems. No water or diluent injection will be necessary to control NO_x emissions.

The turbine generators will be installed outdoors, though within acoustic, ventilated enclosures incorporating fire detection and protection facilities. They will be provided with all associated ancillary and auxiliary equipment and systems for safe, efficient, and reliable operation. They will fire natural gas only.

6.5 Heat Recovery Steam Generator (HRSG)

The HRSGs will be triple pressure with reheat design.

In order to generate additional steam to boost power from the steam turbine from time to time, as desired by PLN, the HRSGs will be fitted with low NOx duct burners.

The HRSGs will include economizer, evaporator, and super-heater tube bank sections with finned tubing, as appropriate, to maximize heat transfer. The thermal cycle will be designed to suit the specific requirements of this Project.

Pressure parts will be designed, manufactured and tested in accordance with "ASME Boiler and Pressure Vessel Code, Section 1, Power Boilers" or equivalent. The HRSG stack height and the flue gas exit temperature will be sufficient to ensure adequate dispersion of the flue gases in accordance with the relevant environmental standards and requirements. At present, a stack height of 45m is anticipated.

The design steam conditions at full load are as follows:

Table 8: HRSG Design Steam Conditions

Parameter	Unit	HP	IP	HRH	LP
Steam pressure at HRSG outlet	Bar	142.0	27.9	22.0	5.3
Steam pressure at steam turbine	Bar	136.7		21.3	4.8
Steam temperature at HRSG outlet	°C	571	298	576	295
Steam temperature at steam turbine	°C	569	314 (CRH)	574	290
Steam flow per HRSG	kg/s	37.7	2	39.5	2

The HRSGs will be installed outdoors.

6.6 Steam Turbine and condenser

Steam from the two HRSGs will be combined, and fed to the steam turbine generator set to generate more electricity. It will be provided with all associated ancillary and auxiliary equipment and systems for safe, efficient, and reliable operation.

The steam turbine will produce approximately 126MW at the design point.

Steam will be condensed in the condenser which will be cooled using water fed from a wet mechanical draught cooling tower.

Preliminary condenser design conditions are:

Table 9: Steam Turbine and condenser details

Parameter	Unit	Value
Steam pressure at inlet	bar	0.0949
Steam temperature	°C	44.8
Steam flow	Kg/s	83.9

Parameter	Unit	Value
Cooling water temperature increase across condenser	°C	10.3
Cooling water flow	Kg/s	4,756

The steam turbine generator and condenser will be installed within a building.

6.7 Major Balance of Plant Systems

6.7.1 Cooling Water Systems

The condenser will be cooled by a closed cycle cooling system with a wet (evaporative) mechanical draught cooling tower.

In a wet tower, the cooling effect is obtained by presenting a large surface of the heated water returning from the condenser to the atmosphere, allowing heat loss to occur predominantly by evaporation. On this project, the mechanical draft tower will comprise a number of "cells" arranged in a line above a basin. The large surface area for the water will be obtained by the use of "fill", likely to consist of a plastic honeycomb or slats installed in each cell. The heated water will descend from upper trays through the fill. Some of it (approximately 2%) will be evaporated, and in the process, the temperature of the remaining water will be reduced. The remaining water will be collected in a concrete basin below, and then pumped back to the condenser to condense steam once again.

The water lost to evaporation and blowdown will have to be replaced, with make-up water extracted from the Siak River.

Ventilation through the fill to allow effective evaporation will be obtained by installing large fans at the top of each cell.

Preliminary cooling tower design parameters are:

Table 10: Cooling Tower parameter details

Parameter	Unit	Value
Cold water temperature (to the condenser)	°C	31.6
Cold water temperature (from the condenser)	°C	41
Water flow	kg/s	5,114

A chemical dosing system will be provided to control the water quality in the cooling water system to prevent fouling, scaling or corrosion. The cooling water treatment will include at least:

- Addition of an acid to the makeup water to reduce the carbonate concentration in the makeup water in order to prevent deposition of calcium carbonate scale particularly on the condenser tubes. Alternatively, the addition of a dispersant along with acid dosing may be used, as long as the dispersant has no adverse impacts on the environment.
- Dosing with organic biocide or NaOCl to control organic growth in the cooling system. A system capable of dosing both continuously and via shock treatment (approximately 20 minutes every 8 hours) will be provided.

Final details will be confirmed once the river water quality and cooling tower design are confirmed.

6.7.2 Gas reception area

The pressure of the gas supplied to the gas turbines must be controlled to be within a set range. On arriving at the site, the gas may be above, within or below the correct range. Therefore, the following facilities will be installed in order to ensure the gas pressure at the gas turbines is correct:

- Gas compressors will be installed, to boost the gas pressure if it is too low. (If it is confirmed that the gas pressure at the supply point (SV1401) will never be so low as require gas compression on site, then these may be removed from the scope of the project.)
- Pressure regulators will be installed to reduce the pressure on occasions when it is too high. Depending on the design, this system may need to incorporate a system to heat the gas before the pressure is reduced. Any such temperature control system is likely to use natural gas to heat water to heat the gas flowing to the plant.

Other equipment in the gas reception area will include:

- An emergency shut down valve, to isolate the plant in the event of a problem (perhaps installed as part of the gas pipeline project);
- A pig receiver station (perhaps installed as part of the gas pipeline project) which will be used to help maintain the cleanliness of the gas pipeline;
- A gas chromatograph to check the composition of the gas arriving at the site; and
- A system to control the pressure of the gas to be used by the HRSG supplementary firing system.

6.7.3 Water treatment

This section describes the process expected to be used for the handling and treatment of the raw water when it arrives on site. Refer to the water balance diagram in Appendix B for further details as well as the preliminary P&ID.

Water will be taken from the Siak River for use in the power generation process.

On arrival at site, the water will enter a raw water reservoir / settling pond, be clarified and filtered, and then stored in a filtered water tank. This initial system shall be sized to store enough water to allow the plant to run at full load for two days without and make-up – approximately 17,700 m³.

The filtration process will involve dosing with caustic soda and alum.

Preliminary details are as follows:

Table 11: Water treatment details

Parameter	Description / value / comment
Clarification and filtration technologies	Clarifier+ Gravity Filter or Sand filter
Number of streams	Clarifier 50% x 2 Gravity Filter 100% x 2 or Sand filter 100% x 2
Rated capacity of each stream	160m ³ /h
Raw Water storage capacity	17,700m ³
Potable Water System	2m ³ /h, Activated carbon filter + NaOCl dosing

The raw river water may be dosed with chlorine (as a biocide) in order to prevent biological growth while to water is stored in the raw water reservoir – especially during outages.

Filtered water will be used

- As make-up for the cooling tower (see above);
- As make-up to the demineralised water treatment plant;
- To generate potable water; and
- As a fire water supply.

It is expected that the demineralisation plant will be a conventional ion exchange based plant with a mixed bed polisher.

Preliminary details are as follows:

Table 12: Filtered water details

Parameter	Description / value / comment
Type	Ion Exchanger
Stages of treatment	Activated carbon + 2B3T ion exchange + Mixed Bed Polisher
Number of Streams	2
Rated Capacity of Each Stream	12 m ³ /h
Demineralised water storage tank capacity	500 m ³

Preliminary details for the potable water system are as follows:

Table 13: Potable water system details

Parameter	Description / value / comment
Type	Ion Exchanger
Stages of treatment	Activated carbon filtration plus NaOCl dosing
Capacity	2 m ³ /h

6.7.4 Water steam cycle chemical treatment

Chemicals will also be used to help control the chemistry of the water and steam in the water/steam cycle. Preliminary details are as follows:

Table 14: Chemical treatment details

Parameter	Description / value / comment
HRSG chemical treatment programme	Ammonia, Phosphate, Carbohydrazide
Ammonia	
Injection point	CEP discharge & HP/IP feed pump suction (provision
Chemical strength	1% wt/vol
Dosage per litre of product water	3 mL/L

Parameter	Description / value / comment
Phosphate	
Injection location	HRSG HP and IP drums
Chemical strength	1% wt/vol
Dosage per litre of product water	3 mL/L
Carbohydrazide or equivalent	
Injection location	Deaerator outlet & provision for dosing at CEP discharge
Chemical strength	1~2% wt/vol
Usage per litre of product water	0.1 mL/L

A sampling system will monitor the quality of the water and steam in the system. The station staff will use the sample results to adjust the dosing systems, so that the chemistry is acceptable while minimising chemical usage.

6.7.5 Wastewater treatment

The plant's onsite wastewater treatment systems will include systems for non-clean stormwater, normal wastewater, abnormal waste water, oily waste water and sanitary water. A preliminary P&ID for the system is included in Appendix B.

The following systems are envisaged:

Table 15: Wastewater treatment details

System / parameter	Description / value / comment
Stormwater	Oily or potentially oily stormwater will drain to the oily water pond where the oil will be separated in a CPI type separator, after which the clean water may be discharged from Site
	The design will avoid or minimise the potential for stormwater to become contaminated with chemicals other than oil. Where this is not possible, stormwater from those areas will be collected and sent to the normal waste water pond.
	Clean stormwater will be collected and either re-used in the process – perhaps in the cooling water system, to reduce make-up water requirements – or discharged from Site with the other effluents.
Oily Drains	Oily drains will be sent to the oil water separator
Process drains – e.g. from the water steam cycle, the demineralisation water treatment plant, blowdown from the cooling tower	Process drains will be sent to the waste water pond for pH adjustment and further treatment before being discharged off site.
Compressor water wash effluents	Effluents from the compressor water washing systems will be collected in a dedicated tank to be emptied via road tanker and disposed of separately.
Sanitary wastewater	These effluents will be treated in a package sewage

System / parameter	Description / value / comment
	treatment plant

6.7.6 Fire Fighting System

The plant fire detection and protection system will be designed in accordance with the local fire codes and the requirements of NFPA 850.

The following systems are envisaged:

Table 16: Firefighting details

System / parameter	Description / value / comment
Deluge systems	GT-Generator Step Up Transformer
	ST- Generator Step Up Transformer
	Main oil tank for Black Start Diesel Generator
	Unit Aux Transformer
Sprinkler systems	Cable room
	Workshop
Gaseous systems	Electronic room
	Control Room
	Switchgear Room
	Gas turbine enclosures

In addition to these systems, there will be

- A ring main with hydrants; and
- Portable fire extinguishers located strategically around the installation.

6.7.7 Lighting

Outdoor artificial lighting including flood lights will be installed at suitable locations. Pole mounted, high pressure sodium vapour lamp fixtures will be used for the approach and work roads. A combination of high pressure sodium vapour, fluorescent, and incandescent fixtures will be used for the turbine hall, HRSG platforms and galleries as necessary. The illumination levels at the various locations will be maintained as stipulated in internationally accepted codes.

A suitable number of lighting panels will be supplied and installed at the convenient locations throughout the Plant. In addition to the normal illumination scheme, an emergency AC and DC lighting scheme will be provided.

Aircraft warning lights will be provided on the chimney stack in accordance with local regulations and/or FAA standards. The uppermost set of lamp fittings will be located as close as practicable to the top of the chimney and further sets of twin lamp fittings will be located on the chimney as required by the applicable regulation / standard.

6.7.8 Security

The site will be enclosed by a security fence. Security guards will be employed undertaking regular security patrols of the boundary fence. A gatehouse will be provided and this will be located on the access road prior to entering the site.

6.8 Labour requirements

The operation of the plant will require approximately 60 full time employees. The expected organisation chart is included in the Appendix G.

Staff will receive comprehensive training during the construction phase – and ongoing training over the lifetime of the Project.

Where possible, labour will be sourced locally.

During scheduled maintenance there will be additional temporary workers on site which can increase the total up to approximately 200.

7. Transmission Line

7.1 Introduction

An approximately 750m long, 150kV overhead line transmission (OHL) will be installed. The line will include eight transmission towers and will intercept the existing transmission line between Tenayan Switchyard and the Pasir Putih Switchyard via a double phi connection. See Figure 2 below for the for the proposed line route.

The following section provides a description of the route, pre-construction, construction and operation of the transmission line.

7.2 Transmission Line Route

Due to the short length of the proposed transmission line, no route option study will be necessary. The proposed route will be straight forward selected based on the following criteria:

- Maximum 500m wind span, 700m weight span, and 350m basic span;
- Maximising span lengths; and
- Land under spans will be cleared as required to meet conductor clearance to ground requirement.

The transmission line will be connected to existing line by a double phi connection method depicted in the following figure.

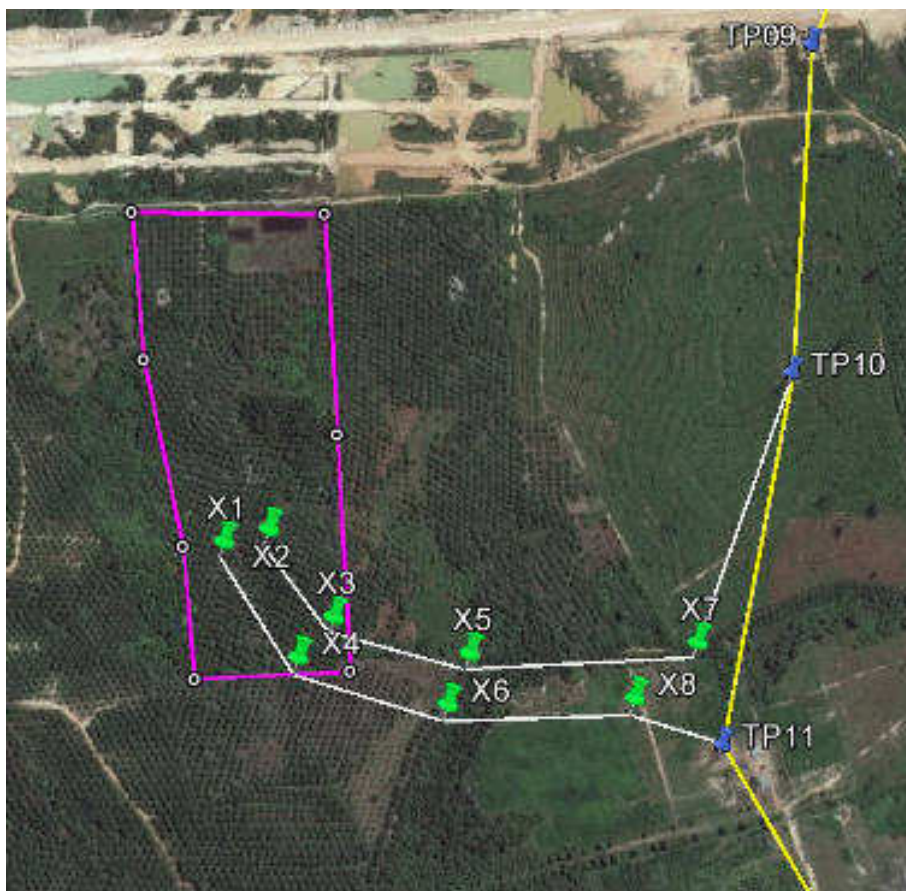


Figure 2: 150kV Double Phi Connection

The land for the four off-site towers is currently owned by a single private landowner.

The estimated co-ordinates of the towers and other preliminary details are provided in the following table.

Table 17: Preliminary Details for the Towers

Tower Number	Co-ordinates	Number of circuits	Ownership
X.1	780,535mE	2	MRPR
	59,583mN		
X.2	780,582mE	2	MRPR
	59,594mN		
X.3	780,651mE	2	MRPR
	59,504mN		
X.4	780,615mE	2	MRPR
	59,459mN		
X.5	780,795mE	2	Private
	59,456mN		
X.6	780,774mE	2	Private
	59,411mN		
X.7	781,036mE	2	Private
	59,477mN		
X.8	780,970mE	2	Private
	59,417mN		

Notes:

- the route/corridor depicted above is almost finalised. The line will run in this general area. It could be that there may need to be one or two more towers off-site, but they would be in this general area.
- TP.9, TP.10, and TP.11 already exist and maybe modified as part of the project.

The Right of Way (RoW) for the transmission line will be approximately 25m wide. The towers will require footings covering approximately 40m x 40m each. Tall vegetation will be trimmed in the RoW to obtain the necessary conductor clearance of 8.5m as per SNI 04-6918-2002.

7.3 Pre-Construction and Field Surveys

Prior to construction commencing, field surveys and land acquisition works will be carried out

MRPR will conduct field surveys of the site, including topographical survey, geological and geotechnical investigations of the soil, in order to collect the data required to finalise the location and design of the transmission line. There will also be baseline survey activities for the preparation of the Environmental and Social Impact Assessment (ESIA) and UKL-UPL for the Special Facilities.

There are no settlements or residences along the route.

7.4 Construction

7.4.1 General

The design and construction of the transmission line will take approximately 8 months.

The construction workforce will be approximately 50 and it is expected the bulk will come from the local community. The workforce will include:

- Civil works
- Steel erectors
- Mechanical fitters
- Welders
- Electricians and linesmen
- Instrumentation technicians
- Crane-drivers
- Scaffolders
- Painters
- Labourers, and
- Support staff

The staffing schedule in Appendix D includes the workforce associated with the construction of the transmission line.

Materials required for the construction of the transmission line include the conductors (ACSR 250mm²), earth wire, insulators, and steelwork for the tower sections. Other materials such as sand, stone, portland cement and reinforcement will be required for the foundations.

7.4.2 Erection of Towers

Erection of the lattice towers will occur once the foundations are completely hardened.

Erection is undertaken following the steps:

- Installation of the stub (foot tower) gradually section-by-section;
- Installation of a criss-cross (diagonal) tower; and
- Installation of cross arms on the tower.

The towers will be lattice type, with the following preliminary technical specifications:

- Voltage: 150kV (Max = 170kV);
- Path length: approximately 750m;
- Line Configuration: Double Circuit, Twin Conductor

- Tower type: lattice / tower steel frame;
- High of towers: 32 – 40 m;
- Conductor / phase: 2 x 250mm² ACSR;
- Insulator / insulator: Ceramics
- Carrying capacity: 300MVA / circuit.

In general, the transmission towers consist of the following components:

- Stub: the bottom of the foot of the tower, mounted in conjunction with the installation of the foundation and fastened to the foundation.
- Leg: tower foot which is connected between the stub and the tower body.
- Common body: the bottom of the tower body which is connected between the leg and the top of the tower body (super structure).
- Super structure: tower upper body connected to the common body and the cross arm phase wire and lightning wire.
- Cross arm: the part of the tower which supports the insulators and conductors.

Typical 2-circuit transmission tower designs are presented in the following Figures.

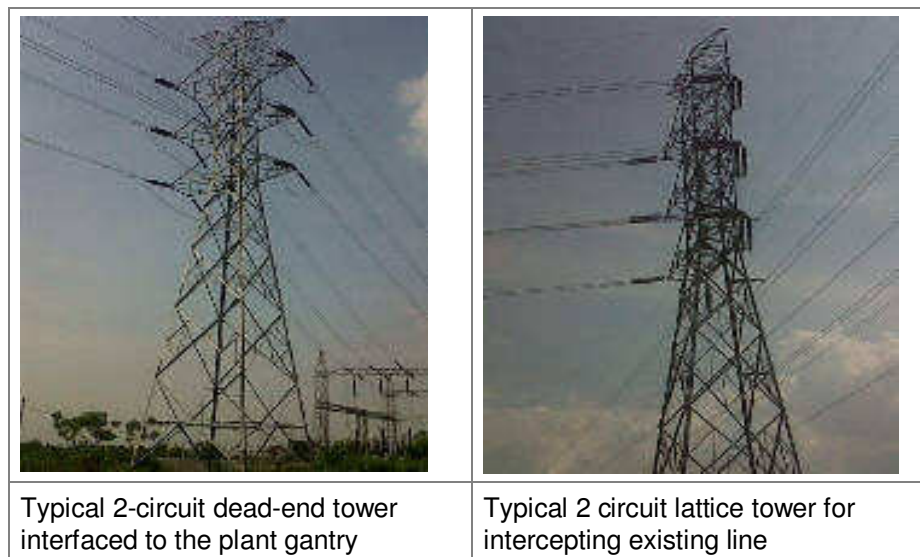


Figure 3: Typical 2-circuit tower designs

7.4.3 Conductor Wire Stringing

Conductor wire drawing activities carried out in the following order:

- Installation of insulators and equipment;
- Stringing of the wire conductors, wire retaining lightning and ground wire; and
- Setting sag and tension.

Stringing the conductor wires between the towers will be carried out using pullies and winches. Stringing is undertaken once the insulators are mounted in place on the towers.

Stringing of conductor wires will be performed per phase, for each bundle there are two (2) wire conductors per phase. The stringing is undertaken for two (2) conductors simultaneously. Because the conductor should not touch the ground, it is necessary to maintain tension (pull so that the conductor is always tense), therefore in addition to the winch machine, it is necessary brake machine that maintains the conductor sag at the correct amount. To obtain the desired tension this is done by pulling the conductor slowly while removing the armature slowly from the conductor drum.

7.4.4 Safety Inspection prior to operation

Once the electrical installation work has been completed, it will be tested before it is operated. The scope of testing activities is as follows:

a. Visual Examination:

- Check the condition of the tower (e.g. everything is in good condition, no parts are rusty, including its nuts and bolts);
- Check the condition of the insulators, (e.g. whether everything is in good condition and clean, nothing is broken or cracked, no deformation); and
- Check the condition of conductors, ground wires and joint sleeves.

b. Construction inspection:

- Examine all components installed and compare them with specifications and regulations.

c. For certain work items that cannot be seen by naked eye, then testing using test equipment or measuring devices will need to be undertaken:

- Testing isolation insulators, insulation resistance between phase to phase and phase insulation resistance between the neutral wire. Test equipment includes Mega Ohm Meter / Megger / Insulation Resistance Tester.
- Ground earthing, using test equipment or measuring devices such as Earth Resistance Tester.

After the inspection and testing activities have been carried out and the lines are certified safe for operation they may be energised for operation.

7.5 Operation

Once constructed and operational, the transmission line will be transferred as an asset for PLN to own to operate. Maintenance activities will be carried out to ensure the line and equipment are functioning properly. Maintenance will also include maintaining the space under the transmission line by trimming any plant growth.

8. Gas Pipeline

8.1 General

The fuel for the project will be dry natural gas. It will be supplied via a 40km long pipeline which will connect to the Grissik-Duri transmission pipeline (operated by PT. TGI) at an offtake location known as SV1401. A custody gas metering facility will be installed by PT. TGI just upstream of the point of interconnection. Downstream of the metering skid, the pipeline size will transfer gas to the plant.

This section of this report addresses the pipeline downstream of the metering point.

Process conditions for the pipeline as follows:

Table 18 : Gas Main Process Parameters

Parameter	Unit	Value
Tie-in point		SV1401
Distance	km	Approximately 40
Gross Heating Value	Btu/SCF	950 - 1250
Diameter	inch	12
Flowrate	MMSCFD	Up to 46
Pipeline design pressure	barg	79.3
Supply pressure at tie-in point	barg	Approximately 50
Delivery Pressure	Barg	Estimated at between 24 and 50

The pipeline will be buried and will mostly follow the existing road.

The arrival pressure will depend on the pressure of the main pipeline at the delivery point and the flowrate. The flow rate will depend on the level of dispatch of the plant, as determined by PLN.

The pipeline design will be equipped with a pigging facility, mainly intended for piping cleaning and integrity checking. A Pig launcher will be installed at the tie-in point to the Grissik–Duri pipeline, and the receiver will be at the power station site. Sectional valves will be installed to allow pipeline isolation for maintenance or during an emergency.

At the power plant, the gas will enter the gas reception area – described earlier.

8.2 Pipeline Route

The pipeline route is shown in the following figure.¹

¹ MRPR is currently going through the process of land acquisition / rental, endeavouring to obtain approval from the relevant stakeholders. Thus, minor rerouting may be required in order to avoid permanent damage or land settlement, all in accordance with the prevailing regulations and approvals by MIGAS.

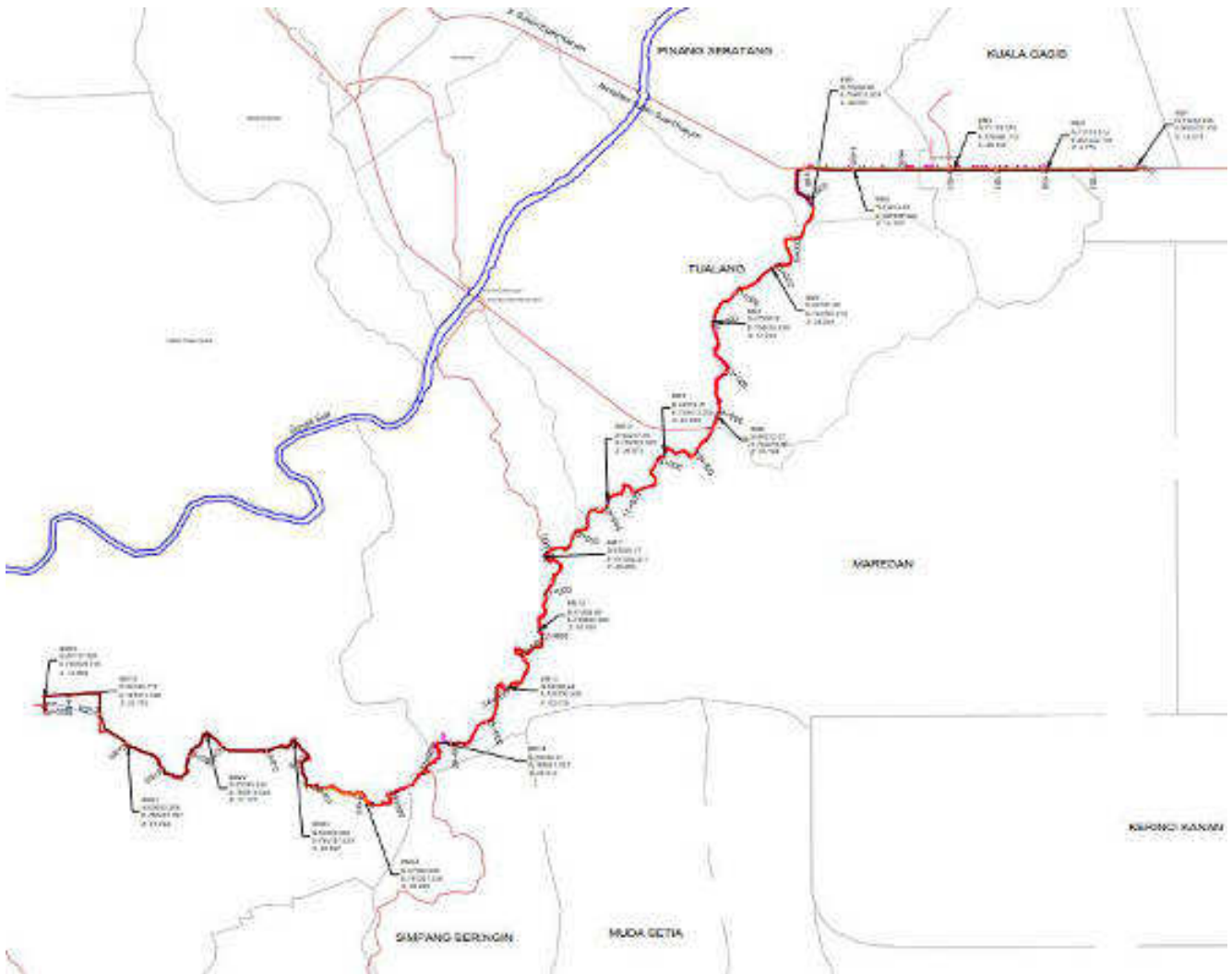


Figure 4: Gas Pipeline Route

The bulk of the route follows roadways, approximately 5 km of which pass close to habited areas. Approximately 8 km is through palm oil plantation land.

During the design stage, the pipeline classification will be determined in accordance with Mining and Energy Ministerial Decree no. 300 (KEPMEN 300) and relevant international guidelines and standards. This process will ensure that there is adequate separation between the pipeline and residents, businesses or other services (e.g. other pipelines for oil, water, gas etc. or power lines) close to the route. Additional safety provisions will be implemented where deemed necessary for public safety.

The pipeline will cross several roads and streams and may run close to or under other existing services (including oil and gas pipelines and power lines). The design will incorporate safeguards in accordance with the regulations and good industrial practice in order to minimise the risk of harm or damage from construction works.

8.3 Construction

8.3.1 Introduction

The pipeline will be installed by CPM, a contractor with substantial experience of this type of work.

The pipeline route extends over a significant area and particular attention will be paid to matters of:

- Maintaining good relations and communication with the communities which could be affected by the work;
- Public safety;
- Traffic control; and
- Environmental protection.

8.3.2 Construction

Construction will involve:

- Preparing the pipeline route by clearing vegetation and grading the immediate area;
- Transporting the pipe sections to the workfront;
- Welding the pipeline sections together, followed by non-destructive testing of the welds to check for flaws. Any flaws will be repaired.
- Digging and preparing the trench for the pipe – with the maximum open trench at any time likely to be 500m;
- Lowering the pipe into the trench;
- Backfilling the trench and compaction; and
- General area reinstatement.

A typical Construction Execution Plan has been provided by CPM and is included in Appendix F for reference. This will be updated once the route is finalised.

Note, as the plan was originally prepared for a pipeline route which included a crossing under the Siak River, it still includes references to Horizontal Directional Drilling (HDD). As the pipeline does not now follow that route and no HDD will be required for the selected route, these references will be removed from the final plan.

8.3.3 Tie-ins and final testing

The various sections of pipe will be welded together at what are referred to as tie-ins. These tie-in welds will also undergo non-destructive testing.

Eventually, after the pipeline is complete and has been cleaned, the entire length will undergo a hydro test to check the integrity of the pipeline.

Cleaning will include

- Pigging - no chemicals are used in this process;
- Flushing with clean water. Depending on the quality of the water available, some pre-treatment of the water may be required. No chemicals are used in the flushing process. The water discharged from the pipeline after cleaning will be filtered of debris; and
- For the hydro-test, typically, potable water is used. As with the cleaning water, some pre-treatment of the water may be required. No chemicals are used. The water discharged from the pipeline after cleaning will be filtered of debris.

Once complete, the pipeline will be dried and then preserved until the power plant is ready to accept gas. Drying is achieved by blowing air into the pipeline. Preservation will be by filling the pipeline with an inert substance, likely Nitrogen.

8.3.4 Construction crew and equipment

The construction team will include:

- Pipefitters
- Welders
- Crane operators and riggers, and
- General labourers.

Construction equipment will include:

- Excavators
- Bulldozers
- Dump trucks
- Cranes
- Welding machines
- Water pumps for temporary drainage systems, and

Appendix F contains further details of the estimated labour requirements and equipment mobilisation schedule.

Construction activities at night time will be limited insofar as possible, to reduce any potential impact on local residents and fauna.

8.4 Operation

MRPR will operate the pipeline over the term of the PPA.

In general, the pipeline will be in service at all times. The timing of any shutdowns will have to be co-ordinated carefully with the gas supplier and PLN as any shutdown will result in an inability of the power station to operate.

At the end of the PPA, ownership of the pipeline will pass to PLN.

9. Power Plant Resource Requirements

9.1 Natural Gas

The amount of natural gas fuel required from day to day will vary depending on ambient conditions and the level of generation requested by PLN.

Maximum daily fuel demand is estimated as follows:

Table 19: Fuel demand details

Item	Unit	Value
Heat rate at 100% load	Btu/kWh, HHV	6,920
Net output at full load	kW	275,000
Fuel flow per hour at full load	Btu/h	1,903,000,000
CV of fuel, HHV	Btu/scf	1,039
Hours per day	h	24
Use per day	mmscf/d	44

PLN have a nominal target annual net capacity factor (NCF) of 60%. The fuel needed to achieve this annual NCF will depend on the load mix used to deliver the energy. If the 60% AF is achieved using the load mix PLN used during the IPP selection process, then fuel use over the term of the PPA is estimated as follows:

Table 20: Fuel use details

Item	Unit	Value
Capacity at base load	kW	275,000
Hours per normal year	h	8,760
AF	%	0.6
Generation required per year	kWh	1,445,400,000
Average heat rate at evaluation load mix	Btu/kWh, HHV	6,942
Fuel use per year	Btu, HHV	10,033,966,800,000
Fuel use per year	PJ, HHV	10.5
Fuel use over PPA	PJ, HHV	211.7

9.2 Water

9.2.1 General

The plant will extract raw water from the Siak River for use on site. The main water consumption will be for the following:

- Cooling water to cooling towers;
- Demineralised water makeup for the steam cycle;

- Potable water for plant use; and
- Firewater.

The raw water requirements when the plant is at full load are predicted to be approximately 370m³/h with the predominant usage being for the cooling system. Maximum demand will be in the order of 400m³/h. Most of the losses from the cooling system will be due to evaporation from the cooling tower. Evaporation losses will vary with steam turbine load and ambient conditions. With the evaporation of water from the cooling water system, the concentration of the salts and impurities in the circulating water increases. In order to control these, additional water is drained from the cooling water system. Such drained water is called blowdown. The blowdown rate depends on the quality of the water and the design of the cooling tower fill. All requirements will be finalised during detailed design.

The following table presents expected demands:

Table 21: Raw water demand details

User	Nominal demand at full load, m ³ /h
Cooling tower evaporation and blowdown	340
Water steam cycle	10
Other users and losses	20
Total	370

To minimise make-up requirements, where possible, water will be recycled – for example clean stormwater and some process wastes can go to the cooling tower basin to reduce the need for make-up from the River.

A preliminary water balance / flow diagram for the plant is provided in the Appendix B.

9.2.2 Plant demand in context of Siak River water flow

Daily river flow data for 24 years have been reviewed and the data yields the following results:

Table 22: Plant demand versus Siak River Flows

Item	Unit	Value
Minimum flow	m ³ /h	81,000
Average flow	m ³ /h	795,600
Average take required	m ³ /h	370
Take as a % of minimum flow	%	0.46
Take as a % of average flow	%	0.05

10. Power Plant Environmental Discharges

10.1 Exhaust Stack Emissions

10.1.1 General

Emissions estimates are presented for NO_x, CO, SO_x, PM, and CO₂ as these are the emissions of interest from a gas fired power station.

Table 23: Exhaust Stack Emissions – Per Stack

STACK Emissions	Basis		100% Load
Stacks in service		-	2
NO _x	51 mg/Nm ³ = 25 ppmvd, guaranteed by GE /Lotte	g/s per stack	12.1
CO	30 mg/Nm ³ = 23 ppm	g/s per stack	6.5
SO _x	30 ppm by weight, sulphur in fuel ²	g/s per stack	0.47
PM	30mg/Nm ³ , allowed by local regulations and guaranteed by GE/Lotte	g/s per stack	7.4
CO ₂	Heat Balances, Design Fuel composition, and 52.5 TCO ₂ /TJ, HHV	g/kWh	383
Temperature	Heat Balances	°C	82.4
Exhaust Gas Velocity	Estimated based on 3.8 m diameter stack	m/s	20 m/s

Stack concentrations (mg/Nm³ and ppm) and are based on 15% O₂, dry gas. Each stack will have a continuous emissions monitoring system (CEMS) in order to monitor emissions during plant operation.

All emissions will be within the limits outlined in the IFC/World bank guidelines and within the requirements of the Indonesian regulations.

The following table shows the maximum possible annual emissions, in tonnes/year, based on a Net Capacity Factor (NCF) of 93%.

Table 24: Estimated Maximum Annual CCGT Exhaust Stack Emissions,

STACK Emissions		100% Load and 93% NCF
NO _x	t/year	355
CO	t/year	191
SO _x	t/year	499
PM, based on PM content in gas	t/year	217
PM, based on PM concentration allowed	t/year	355
CO ₂	t/year	860,000

² Indonesian regulations permit exhaust concentrations of up to 30mg/Nm³. This would increase the emission rate by a factor of approximately 20.

10.1.2 Stack Parameters

The height of the exhaust stack is assumed to be 45m.

The diameter of the exhaust stack is estimated at 3.8m.

The final height and diameter will be determined once the dispersion modelling is completed to make sure that ground level concentrations of the various pollutants do not exceed permitted levels.

10.2 Emissions to air from the cooling tower

There will be emissions to air from the cooling tower, estimated as follows:

Table 25: Emissions to air estimation details

Parameter	Value
Hot humid air	3,000 kg/s of air heated by about 9.7C above ambient at 100% relative humidity
Drift	Less than 1 kg/s

Expected conditions at the top of the cooling tower are:

Table 26: Cooling tower condition details

Parameter	Value
exhaust temperature	35.8°C
exhaust flow	3,800 kg/s
volumetric flow rate	3,500 m ³ /s
Exhaust velocity	10.4 m/s
Geometry of cooling tower	73 m long x 18 m wide x 10.1 m high (top deck)
Discharge height	13 m

The cooling towers will be fitted with a drift eliminator. As such, the emission of water droplet from the top of the cooling towers (drift) will be minimal.

However, because the drift droplets will contain the same chemical impurities as the water circulating through the tower (concentrated salts from the incoming supply plus traces of chemicals added for process control) the particulate matter constituent of the drift droplets may be classified as an emission. The magnitude of the drift loss will be influenced by the number and size of droplets produced within the tower, which are determined by the tower fill design, tower design, the air and water patterns, and design of the drift eliminators.

Chemicals used in the cooling tower shall be of a type

- That will have no significant adverse effect on the environment or local community; and
- Which decompose faster than deposited on the surrounding land (and thus do not accumulate)

During the permitting process, these emissions will be modelled.

10.3 Other Air Emissions

The great majority of plant emission to air will be via the exhaust stacks. However, for completeness, the following emissions may also be considered during the permitting process.

- Condenser: Very small quantities from the air ejectors - equivalent to the dissolved gases in the steam cycle make-up - of steam and dissolved air from water.
- Heat: from generator, oil and other cooling systems.
- Steam, gas and air from vents and drains;
- Intermittent steam from emergency relief valves, CO₂ if released for fire protection, etc. (although emergencies are not expected to occur).
- Intermittent combustion gases from the Black Start Diesel Generator and the Fire Water Diesel Driven Pump.
- Minor discharges (e.g. SF₆ from electrical equipment) during maintenance.

These emissions occur in trace amounts and are generally non harmful. Therefore, further mitigation measures beyond good utility practice are not normally considered necessary.

10.4 Liquid Effluents

10.4.1 General

The power generation process does not produce any hazardous liquid wastes. Preliminary P&IDs for the wastewater treatment system are included in Appendix B.

The primary liquid waste streams will be treated as required before being discharged into the Siak River.

- Clean stormwater will be collected and sent to the cooling tower basin or discharged from site.
- Stormwater which could be contaminated with oil will be collected and sent to a separator, before being discharged to the River.
- Stormwater which could be contaminated with chemicals will be collected and sent to the wastewater treatment plant.
- Effluent from the raw water settling and filtration process will be thickened and dehydrated. The solids will be disposed of off-site via truck. Liquid effluents will be discharged to the wastewater treatment plant.
- Effluents from the water treatment plant (the demineralised water plant) will be discharged to the wastewater treatment plant.
- It should be possible to maintain the chemistry of blowdown from the cooling tower to be within the effluent discharge limits, and so this may not be treated before discharge. In the event any such treatment is necessary, it will be carried out in the wastewater treatment plant.
- Areas storing oils and chemicals will be bunded and drained to an operational wastewater pit for treatment before discharge.
- Compressor water wash water will be collected in a dedicated tank and then trucked off site for disposal.
- The design and chemical treatment regimes will be finalised once adequate river water samples are available.

10.4.2 Effluent Volumes

The following table presents expected discharge volumes.

Table 27: Discharge volume details

User	Nominal discharge at full load, m ³ /h
Cooling tower	56
Water steam cycle	2
Other users including losses from water filtration and treatment	22
Total	80

The volume of solids removed in the raw water settling and filtration process will depend on the level suspended solids (TSS) in the incoming water. Based on the samples available (analyses are included in Appendix B) the maximum TSS level in the River was 56mg/l. At an average intake flowrate of 370m³/h, approximately 21kg/h of solids will be removed and will have to be disposed of.

10.4.3 Effluent Volumes in context of Siak River water flow

Daily river flow data for 24 years have been reviewed and the data yields the following results:

Table 28: Estimated Discharge volumes compared with River Water Flow

Item	Unit	Value
Minimum flow	m ³ /h	81,000
Average flow	m ³ /h	795,600
Average discharge	m ³ /h	80
Discharge as a % of minimum flow	%	0.10
Discharge as a % of average flow	%	0.01

10.4.4 Effluent quality

The quality of the main effluent – blowdown from the cooling tower - will depend on the

- Incoming water quality. Salts in the original River water will likely be concentrated approximately 6 times.
- Chemicals added to the cooling water system to control biocides, scaling, and (perhaps, if necessary from time to time) deposits.

Water samples have been taken from the river and the results are included in Appendix B. The following table lists the parameters to which discharge limits apply and the relevant limits, lists the maximum incoming value for that parameter based on the samples taken, and predicts the discharge concentration for that parameter, based on the cooling tower operating at 6 cycles of concentration.

No allowance is made for chemicals added in the raw water treatment process or cooling water system dosing. These are normally dosed in small quantities (compared with the circulating water flow rate), and are chosen or controlled so that they cannot cause discharges to exceed environmental limits.

Table 29 Estimated Cooling Tower Blowdown quality based on incoming water quality

Parameter	Unit	Local Standard	IFC/World Bank Guideline	Max incoming	Discharge quality, assuming 6 cycles of concentration
pH value	-	6 - 9	6 - 9	6.88	controlled
Suspended Solids	mg/L	100	50	56	Removed in filtration system
Chromium (Total)	mg/L	0.5	0.5	<0.002	< 0.012
Copper (Cu)	mg/L	1	0.5	<0.01	< 0.06
Zinc (Zn)	mg/L	1	1	0.05	< 0.3
Iron (Fe)	mg/L	3	1	1.168	< 1
Free Chlorine (Cl ₂)	mg/L	0.5	0.2		controllable
Oil and grease	mg/L	10	10	2.4	Removed in separator
Phosphate (PO ₄ ⁴⁻)**	mg/L	10	silent	0.862	5.172
Lead (Pb)	mg/L	silent	0.5	<0.005	< 0.03
Cadmium (Cd)	mg/L	silent	0.1	<0.002	< 0.012
Mercury (Hg)	mg/L	silent	0.005	<0.0005	< 0.003
Arsenic (As)	mg/L	silent	0.5	<0.005	< 0.03
Temperature	°C	silent	Less than 3°C above ambient water temperature at edge of mixing zone at discharge. This Zone shall be established during permitting.		Raw blowdown temperature will be 31.6 at design case, and temperature will drop between site and river

Note, the measured incoming Iron level exceeds the effluent guideline value. The non-soluble content will be removed by filtration. The soluble content will be removed by aeration, clarifying (coagulation / flocculation / sedimentation) and filtration. It is expected that the iron level entering the cooling tower basin will be between 0.05 ~ 0.10 ppm. Even after concentrating 6 times, the iron content in any discharge will be lower than 1.0 mg/L as Fe, and so will comply with the guidelines. The iron level will be monitored and effluent may be routed to the wastewater treatment system if it happens that the discharge limit will not be met. The wastewater treatment system also has aeration, clarifying and filtration facilities and these would reduce the iron content to meet the specification.

The blowdown will be taken from the cold water stream leaving the cooling tower rather than the hot water stream flowing to it from the plant. The temperature of the blowdown will depend on several factors, most notably:

- The thermal load on the condenser. This which will depend on the steam flow which is a function of the plant output at the time.
- Ambient wet bulb temperature at the time. The ambient wet bulb temperature sets the absolute lower limit for the cold water temperature. The temperature by which the cold water will exceed this is known as the approach and this is normally in the order of 5 to 8°C. For this project, the preliminary design is

based on an approach of approximately 6.3°C. As ambient conditions vary, the wet bulb varies but the approach remains almost constant.

At the design conditions (plant operating at full load, at 28°C and 85% RH) the wet bulb temperature is 25.2°C and it is estimated the blowdown will be 31.6°C. At the hottest ambient conditions (estimated to be 35°C and 50% RH), the wet bulb will drop to 26.2°C and it is estimated the blowdown will be 32.2°C if the plant is operating at full load at the time.

All effluents will be collected and neutralised as required so that the effluent quality will meet the local and IFC / World Bank EHS Guidelines.

10.4.5 Estimated annual water use and discharges

Likely maximum annual water use and discharge volumes are:

Table 30: Annual water use and discharge details

		100% Load and 93% AF
Water Use	m ³ /year	2,6000,000
Effluent	m ³ /year	650,000

10.5 Noise emissions

10.5.1 General

The power plant will generate noise when in operation. Noise levels from the Project will not exceed the Indonesia and World Bank / IFC noise limits. The noise level in the control room will not exceed 55dB(a). Warning sites will be provided at all entrances to rooms and operating areas where the noise levels exceed 75dB(A). The noise emissions are outlined in the Table below.

Table 31: Noise emissions details

Project location	Allowable Noise emissions
At the plant boundary under normal operation	70dB(A)
1 m from major equipment	85dB(A)
Within central control rooms	55dB(A)

10.5.2 Impact on neighbours

The project site boundary is located approximately 2 km from the nearest residential areas. There is little likelihood of a significant noise impact on these areas from the power station during the operational stage.

In any case, the plant will follow good design and construction practices and implement the mitigation measures including those described below.

The main sources of noise emissions will be the:

- Gas Turbines;
- Gas Compressors (if required);
- HRSG;
- Cooling tower; and

- Transformers

Noise reduction measures in the design will include:

- Silencing of the gas turbine inlets;
- Locating the steam turbine inside a building;
- Limiting noise emissions from any gas compressors, building ventilation fans, transformers etc.;
- Buildings will be lined and cladded as required;
- Safety valves will have silencers fitted, where necessary; and
- Noise sources will be directed away from the most sensitive receptors.

The EPC Contractor will implement measures to achieve the maximum allowable noise levels of 85dBA at 1m from the equipment and 70dBA at the plant boundary.

Noise will be monitored during operation to check that, other than during emergencies, noise emissions are within the acceptable limits, identified below.

Table 32: Noise limits

Source of Noise Criteria	Noise Criteria	Day-time	Night-time
		L _{Aeq} 1 hr	L _{Aeq} 1 hr
World Bank Guidelines	Industrial / Commercial	70 dB(A)	70 dB(A)
	Residential	55 dB(A)	45 dB(A)

10.6 Solid Waste management

The power plant will not produce any bulk solid wastes such as ash or sludge as are generated in a coal fired power station or some industrial processing facilities. Solid wastes are minimal and will generally be as the result of maintenance or housekeeping activities and may include items such as

- Old pipework, steel work, cabling, instrumentation etc., replaced due to upgrades or modifications;
- Consumable items e.g. oil and air filters; and
- Maintenance items, e.g. rags, containers for paints or chemicals etc.

Where possible, items will be recycled. Otherwise, solid wastes will be disposed to a licensed facility nearby.

10.7 Hazardous and toxic substances

According to the Indonesian Government Regulation No. 101 Year 2014 on the Treatment of Hazardous and Toxic Waste, a hazardous substance is a substance, energy, and/or other components that is due to its properties, concentration and/or quantity, either directly or indirectly, can pollute and/or damage the environment, and/or endanger the environment, the health and well-being of human and other living creatures.

The following is a list of typical chemicals and their storage quantities for CCGT plant of this size.

Table 33 - Sample list of Chemicals Stored Onsite for a Typical Combined Cycle Plant

Chemical/Product	Storage Quantity	General Use of Chemical
Sulphuric acid	10,000 L	Demineralisation system
Hydrochloric acid	10,000 L	Demineralisation and cooling water systems
Scale inhibitor	10,000 L	Cooling water systems
Caustic (e.g. NaOH)	10,000 L	Demineralisation system
Turbine oils (e.g. Terrestic 32 or 68, Exxon)	5,000 L	Turbines, pumps, air compressor, lubrication
SAE 15 W - 40 Oil	600 L	Diesel fire pumps
Hydraulic fluid	1,000 L	Steam turbine electrohydraulic fluid
Ammonia (NH ₃)		Boiler water treatment
Trisodium Phosphate	100 kg	Boiler water treatment
Sodium Hypochlorite	100 L	Water treatment biocide for raw water and possible for cooling water
Insulating Oil (non PCB)	1,000 L	Transformers
O ₂ Scavenger	500 L	Deaerator tanks
Misc. Chemical Reagents for Water Laboratory	50 kg	Water testing lab chemicals
Water Wash Liquid	1,000 L	GT water wash
CO ₂	4,000 kg	Fire protection
Miscellaneous oils, reagents, chemicals, thinners etc. used for O&M activities		

The hazardous substances listed are not waste products but chemicals used in the general maintenance of the station.

All chemicals and hazardous substances will be stored in secure locations on site and waste materials will be trucked from site for proper disposal where appropriate.

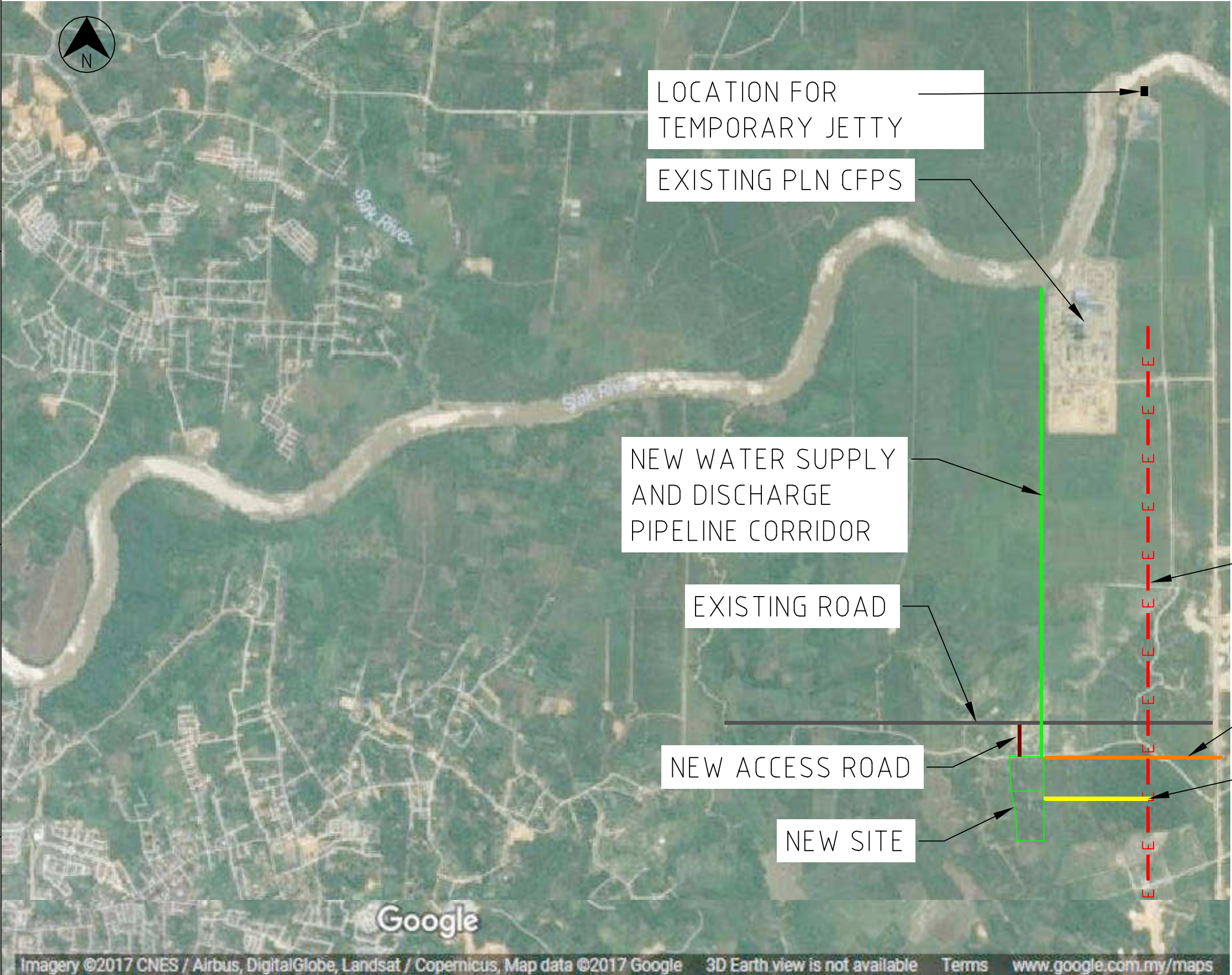
Appendix A. Power Plant Site Location and Layout Drawings

A

B

C

D



PRELIMINARY FOR INFORMATION ONLY

F	16.10.18	JL	EM	EM	REVISED WATER PIPELINE
E	22.03.18	JL	EM	EM	REVISED WATER PIPELINE
D	18/01/18	JL	EM	EM	REVISED WATER PIPELINE
C	08/01/18	JL	EM	EM	REVISED GRID CONNECTION
B	06/12/17	JL	EM	EM	REVISED ISSUE
A	29/06/17	JL	EM	EM	PRELIMINARY ISSUE
REV	DATE	DRAWN	REV'D	APP'D	REVISION

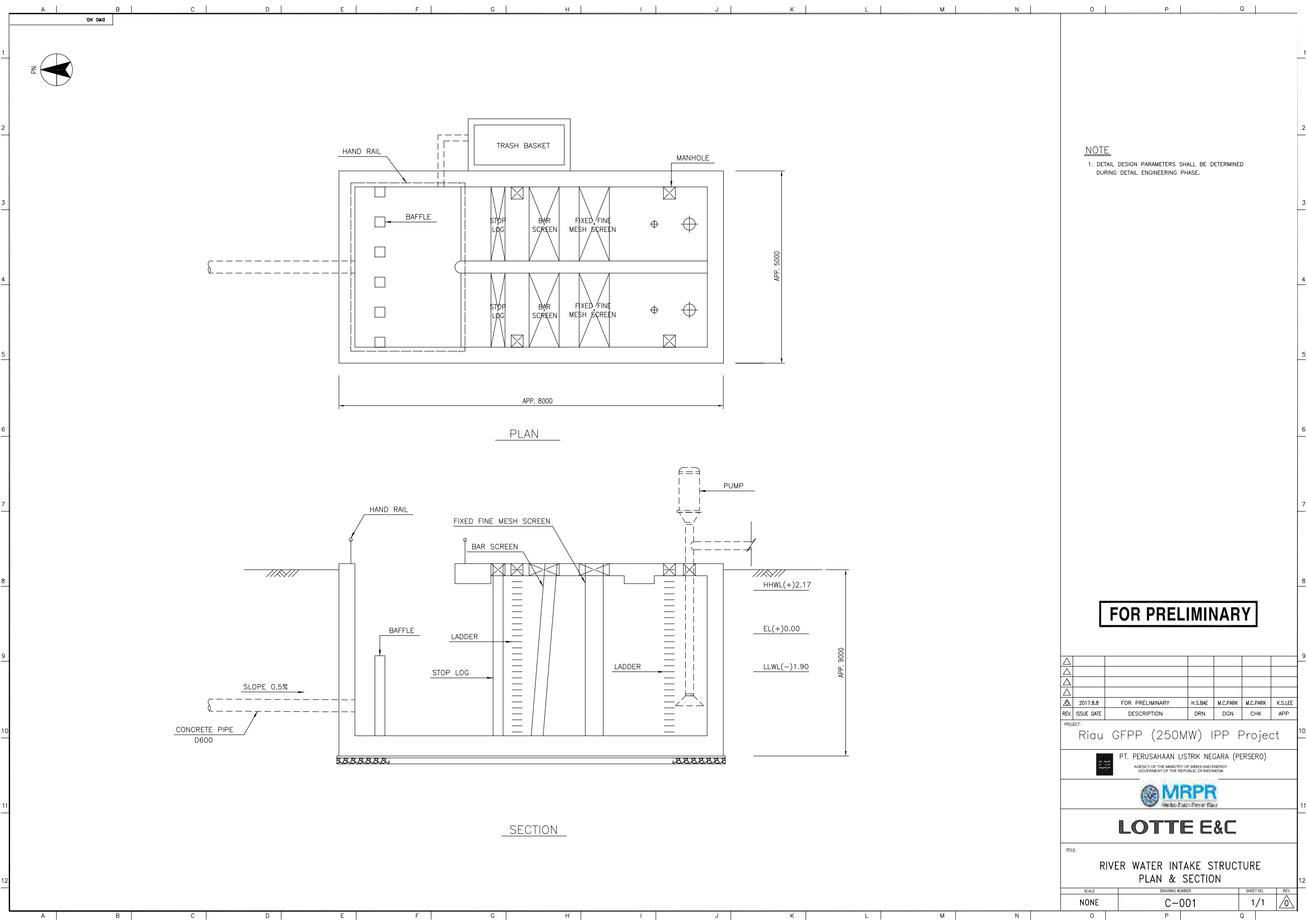
JACOBS

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Mont' Kiara, KUALA LUMPUR 50480
MALAYSIA

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Fax: +60 3 6204 6698
Web: www.jacobsskm.com

CLIENT MEDCO RATCH POWER RIAU			
PROJECT RIAU 275 MW GFPP			
DRAWN JL	DRAWING CHECK .	REVIEWED .	APPROVED EM
DESIGNED EM	DESIGN REVIEW .	DATE .	DATE .

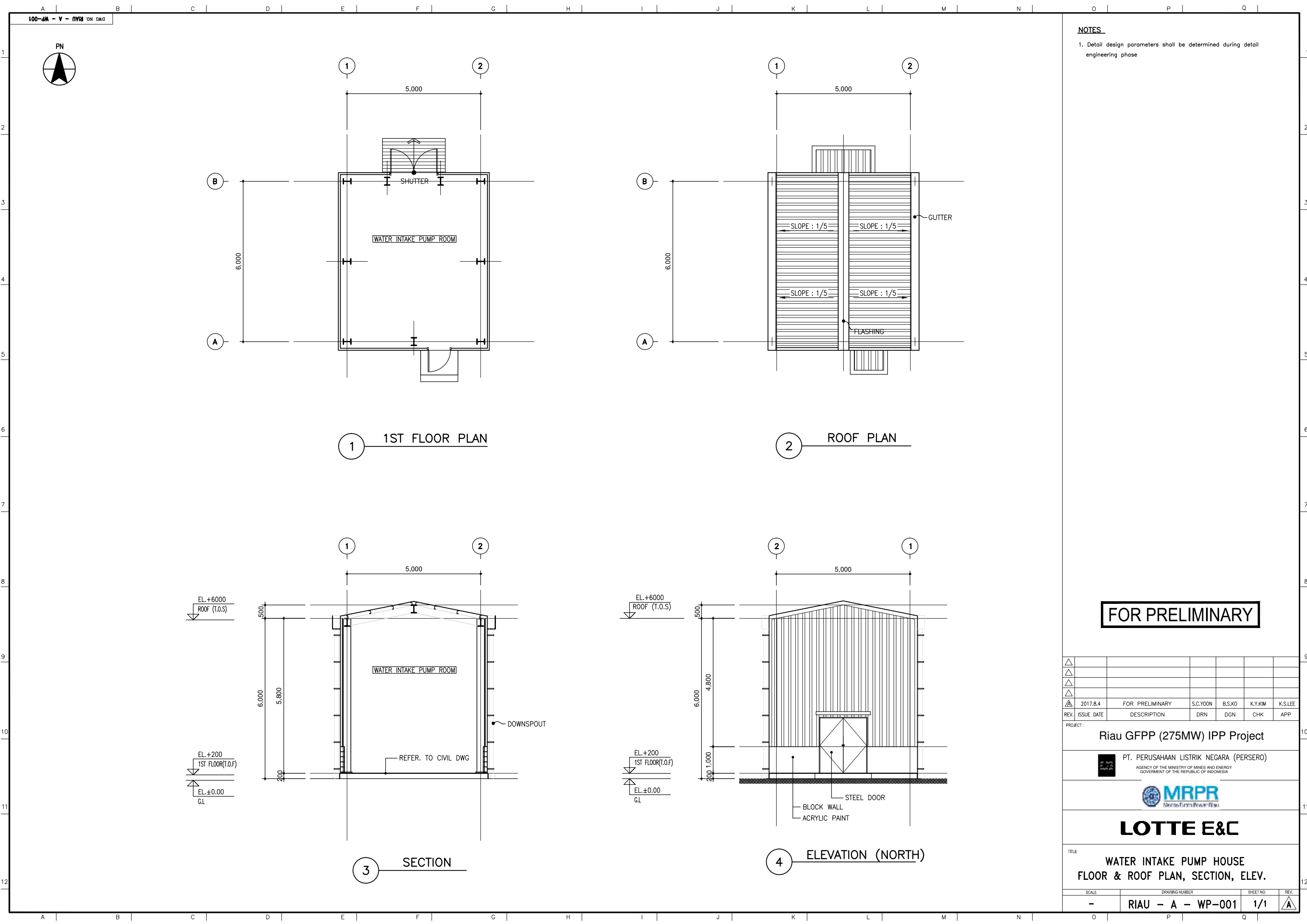
TITLE GENERAL AREA, FOOTPRINT, AND SERVICE CONNECTIONS		
SCALE AS SHOWN	DRAWING No AM039100-300-GN-DRG-0001	REV F



NOTE
1. DETAIL DESIGN PARAMETERS SHALL BE DETERMINED DURING DETAIL ENGINEERING PHASE.

FOR PRELIMINARY

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△	2017.8.8	FOR PRELIMINARY	H.S.BAE	M.C.PARK	M.C.PARK	K.S.LEE
REV.	ISSUE DATE	DESCRIPTION	DRN	DGN	CHK	APP
PROJECT: Riau GFPP (250MW) IPP Project						
<div></div> <div>PT. PERUSAHAAN LISTRIK NEGARA (PERSERO) AGENCY OF THE MINISTRY OF MINES AND ENERGY GOVERNMENT OF THE REPUBLIC OF INDONESIA</div>						
<div></div> <div>MRPR Mekong River Power Project</div>						
LOTTE E&C						
TITLE: RIVER WATER INTAKE STRUCTURE PLAN & SECTION						
SCALE		DRAWING NUMBER		SHEET NO.	REV.	
NONE		C-001		1/1	△	



NOTES

1. Detail design parameters shall be determined during detail engineering phase

FOR PRELIMINARY

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△	2017.8.4	FOR PRELIMINARY	S.C.YOON	B.S.KO	K.Y.KIM
REV.	ISSUE DATE	DESCRIPTION	DRN	DGN	CHK

PROJECT: Riau GFPP (275MW) IPP Project

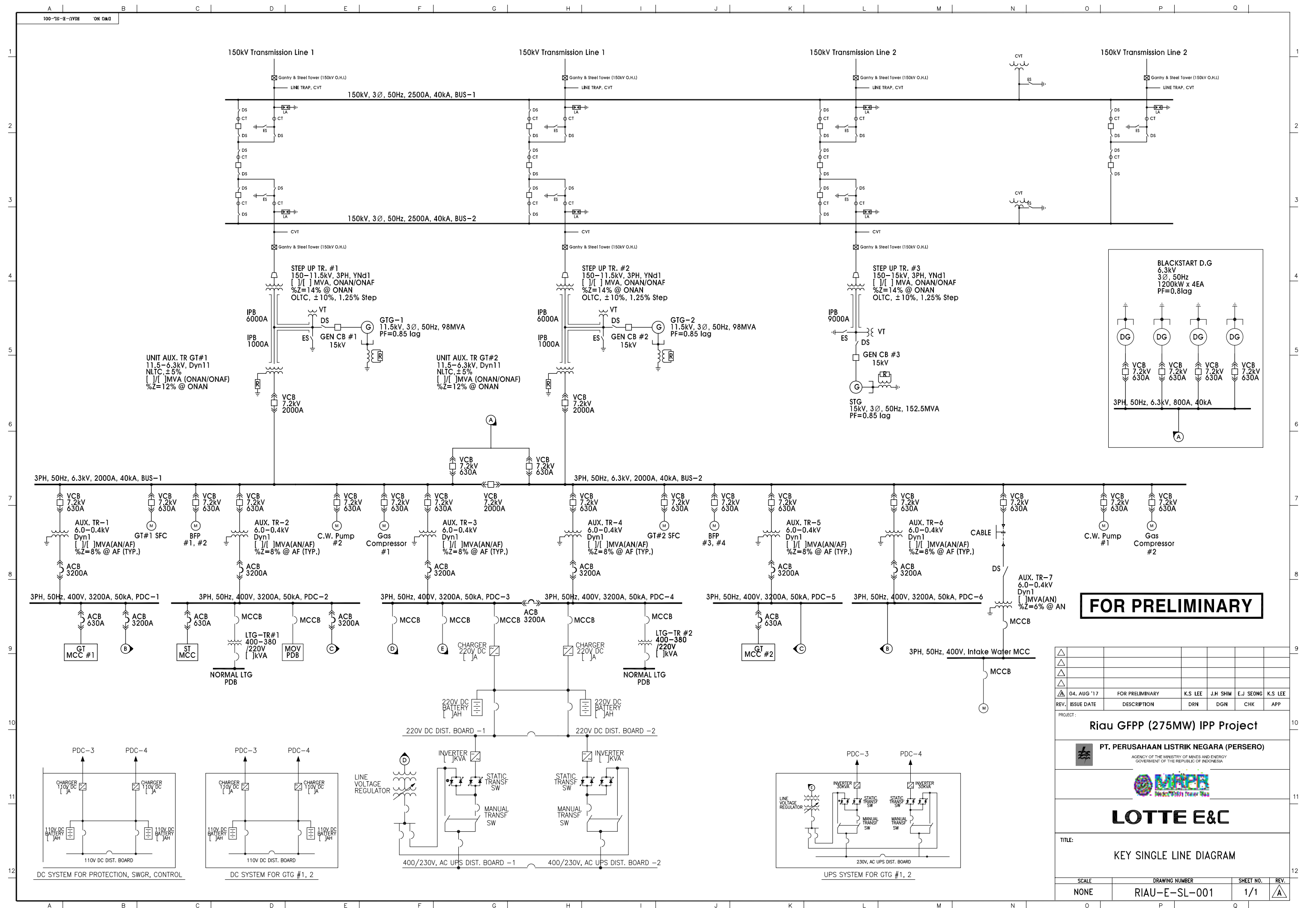
PT. PERUSAHAAN LISTRIK NEGARA (PERSERO)
AGENCY OF THE MINISTRY OF MINES AND ENERGY
GOVERNMENT OF THE REPUBLIC OF INDONESIA





LOTTE E&C

TITLE: WATER INTAKE PUMP HOUSE
FLOOR & ROOF PLAN, SECTION, ELEV.

SCALE	DRAWING NUMBER	SHEET NO.	REV.
-	RIAU - A - WP-001	1/1	△



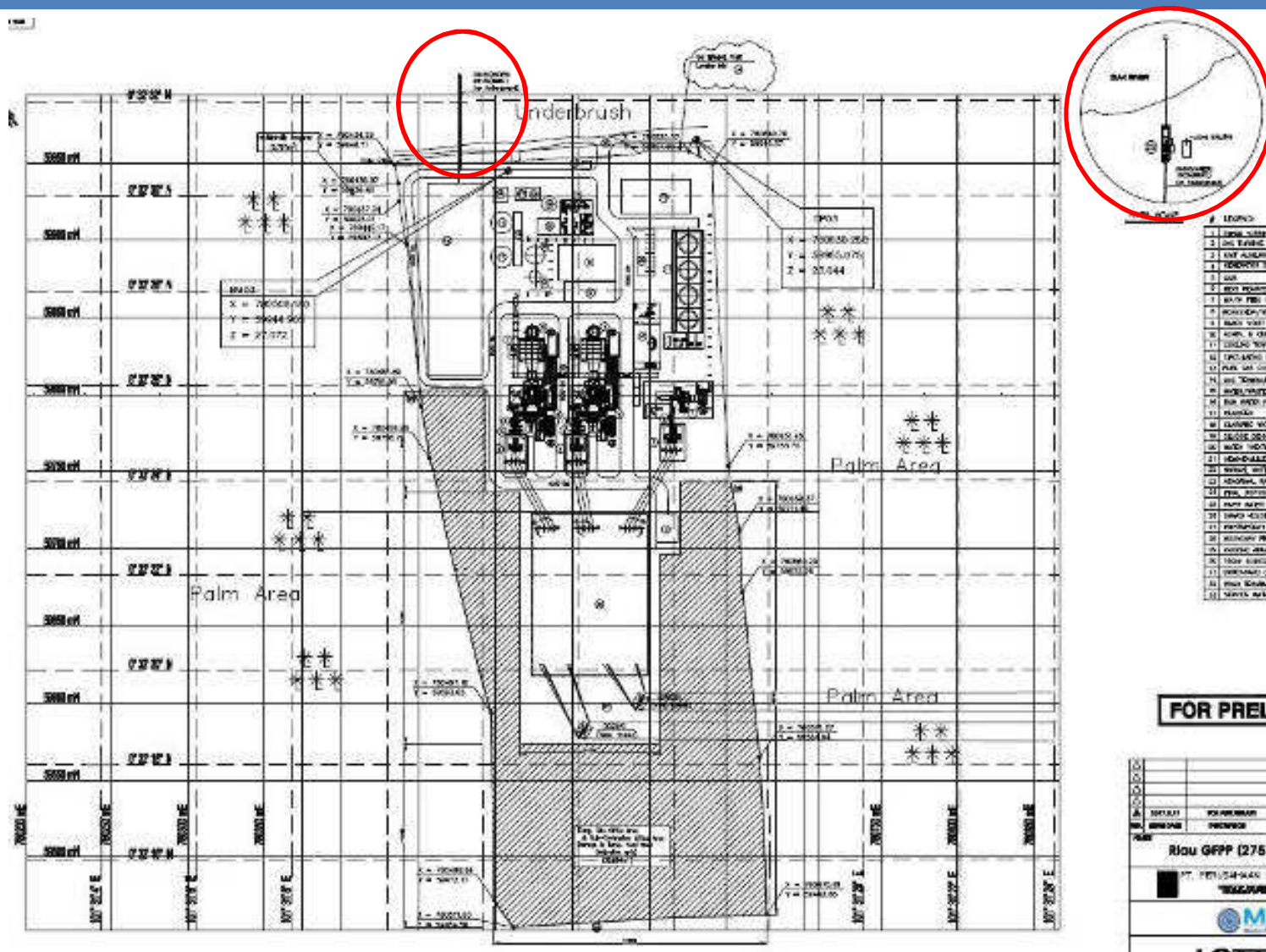
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Riau GFPP (275MW) IPP Project							
 PT. PERUSAHAAN LISTRIK NEGARA (PERSERO) AGENCY OF THE MINISTRY OF MINES AND GEOLOGY OF THE REPUBLIC OF INDONESIA							
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LOTTE E&C							
TITLE:							12
KEY SINGLE LINE DIAGRAM							
SCALE		DRAWING NUMBER			SHEET NO.	REV.	
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Riau Gas- Fired Power Plant (275MW) IPP Project

Oct 2017

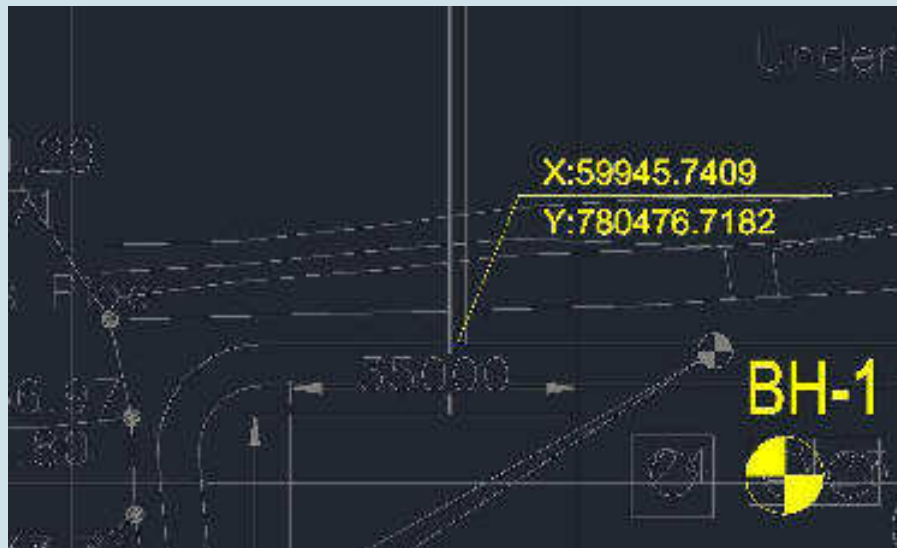
◆ Location for Water intake facility and pipe line / RoW



Water Intake Pipeline 3km x 6m width (2m for pipe + 4m for workway)

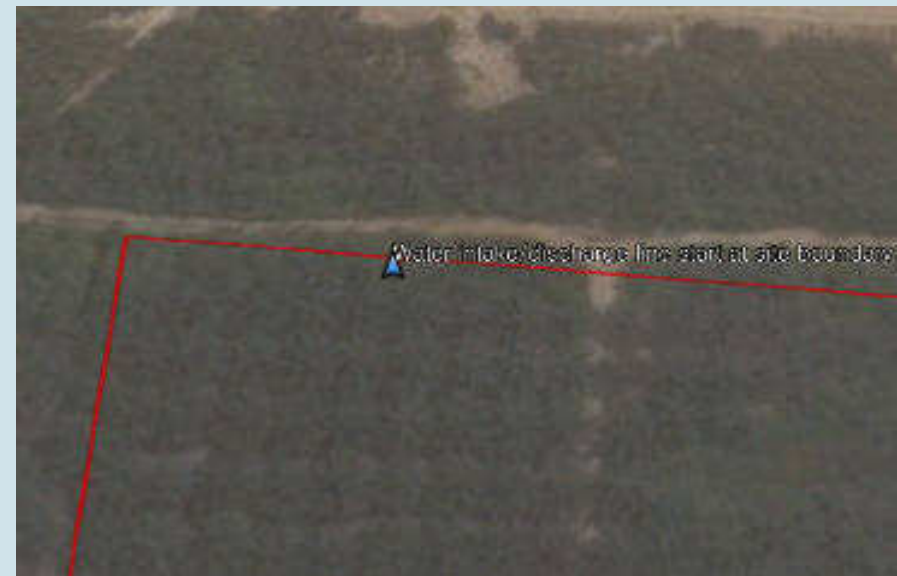
◆ Location for Water intake pipe line / RoW

Start point at site boundary



Coordinate of center between intake and discharge line at site boundary

Google map



the same location from Google earth snapshot

◆ Location for Water intake pipe line / RoW

Finish point at site boundary



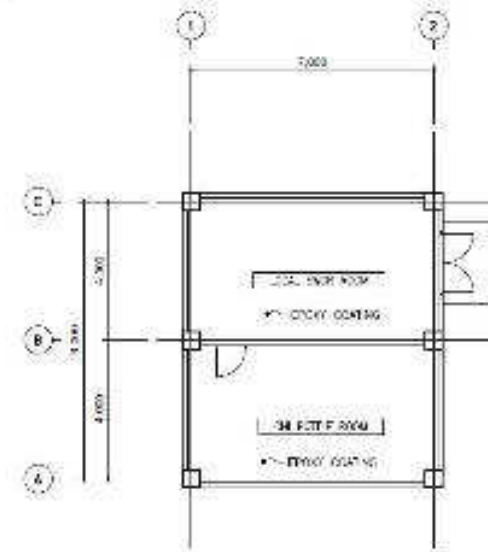
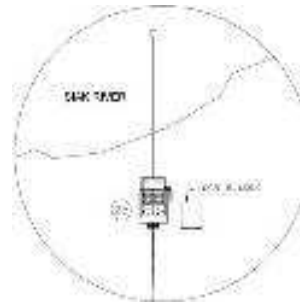
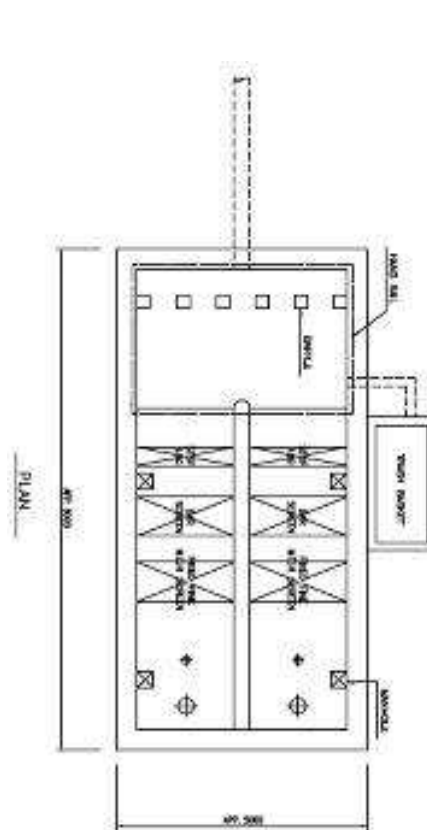
Coordinate of center of Water intake facility

Google Earth Snapshot



Coordinates :
780476.00 m E
62685.00 m N

◆ Location for Water intake facility and building / RoW



River Water Intake Structure / underground

Water Intake Building

Considering interconnection between both structures, area (50 m x 40 m) is required.

◆ Possible Location for temporary jetty / RoW

Inside Tenayan CFPP



To use permanent or temporary jetty in Tenayan CFPP

Area adjacent to labor camp in Tenayan



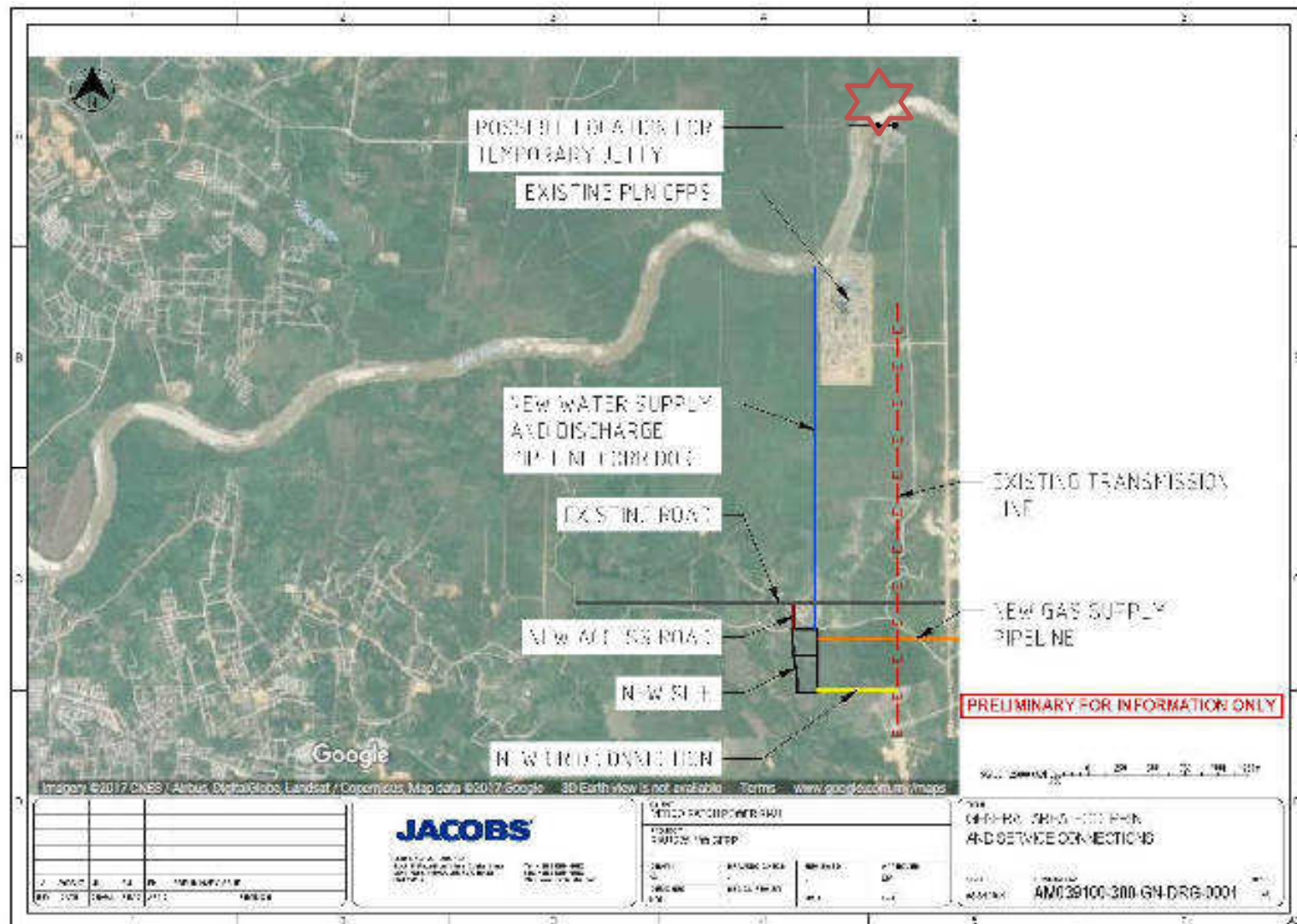
To build temporary jetty in siak river bank adjacent to Tenayan CFPP

Coordinate : 781196.00 m E 63803.00 m N
(Location is indicated as above “ ”)



Temp. Jetty / 70 m x 100 m

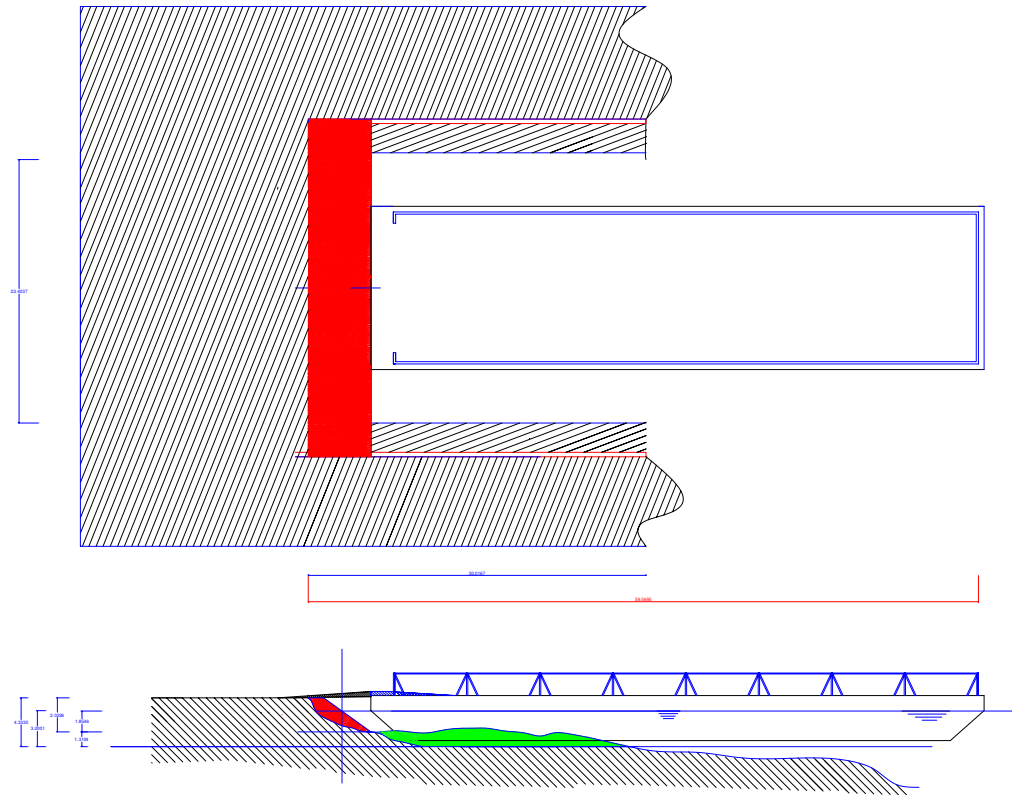
◆ Possible Location for temporary jetty



◆ Temporary Jetty to Site Route / RoW (5.3 km)



◆ Preliminary Temporary Jetty Design



<Permit>

1. Temporary jetty/dredging permit from...
 - Dept. of Transportation
 - Directorate of River transportation
 - Directorate of port and dredging facilities
 - Local port & authorities in Riau
2. Evaluation of safety for environmental impact by local NGO(s) and local leaders

<Description>

For tunnel, sheet pile & wire sling for stud will be installed in both wall of tunnel.
For head (red area), splitstone and sandbag will be installed in river bank.
Dredging will be required subject to siak river condition of river bottom. (green area)
To construct temporary jetty, it takes 3~ 4 months. (To remove jetty, 1 month to be required)
Temporary jetty's capacity is upto 270ft barge available.

◆ Area to be required (preliminary)

Item	Dimension	Area (m2)	Remark
Water Intake line	3 km x 6 m	18,000 m2	Permanent
Water Intake Facility (including water intake building)	50 m x 40 m	2,000 m2	Ditto
T/L (from gantry tower)	1 km x 20 m	20,000 m2	Ditto
Tower	30 m x 30 m x 3EA (No.3,4,5)	2,700 m2	Ditto
Temp.Jetty in Siak river	100 m x 70 m	7,000 m2	Temporary (during construction period)
Road (Jetty to Site)	5.3 km x 7 m	37,100 m2	

(Note) Tower No. 1 ~ 2 will be located inside laydown area of plant site. Thus, this area is not included above.

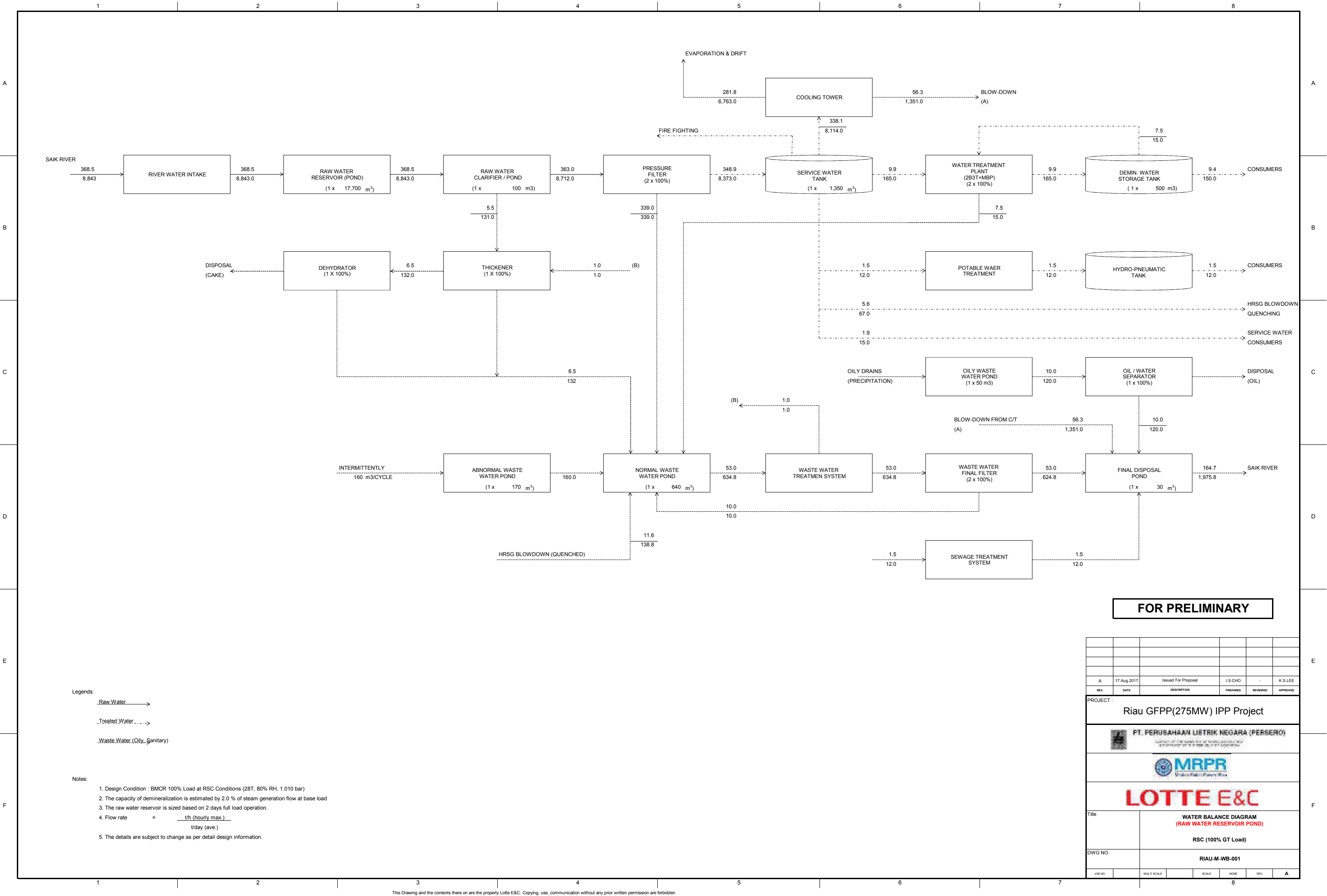
롯데그룹의 미션

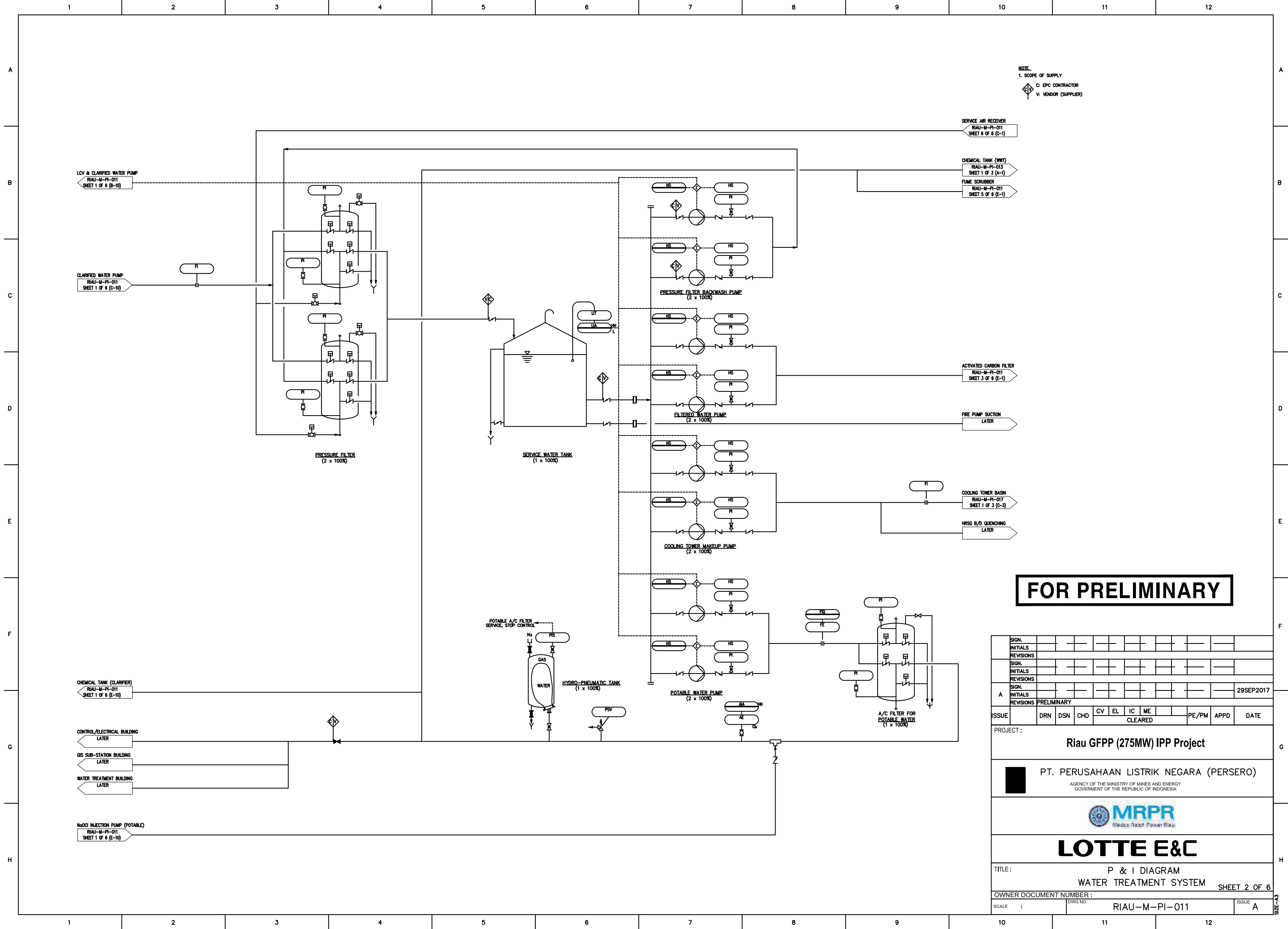
**사랑과 신뢰를 받는 제품과 서비스를 제공하여
인류의 풍요로운 삶에 기여한다**

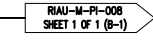
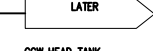
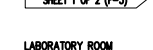
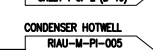
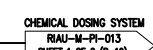
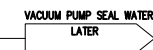
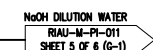
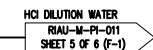
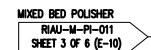
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superior products and services that
our customers love and trust**

LOTTE

Appendix B. Water Flow / Balance Diagram and Other Water Related Drawings and Information







SIGN.									
INITIALS									
REVISIONS									
SIGN.									
INITIALS									
REVISIONS									
SIGN.									
INITIALS									29SEP2017
REVISIONS	PRELIMINARY								

PT. PERUSAHAAN LISTRIK NEGARA (PERSERO)
AGENCY OF THE MINISTRY OF MINES AND ENERGY
GOVERNMENT OF THE REPUBLIC OF INDONESIA

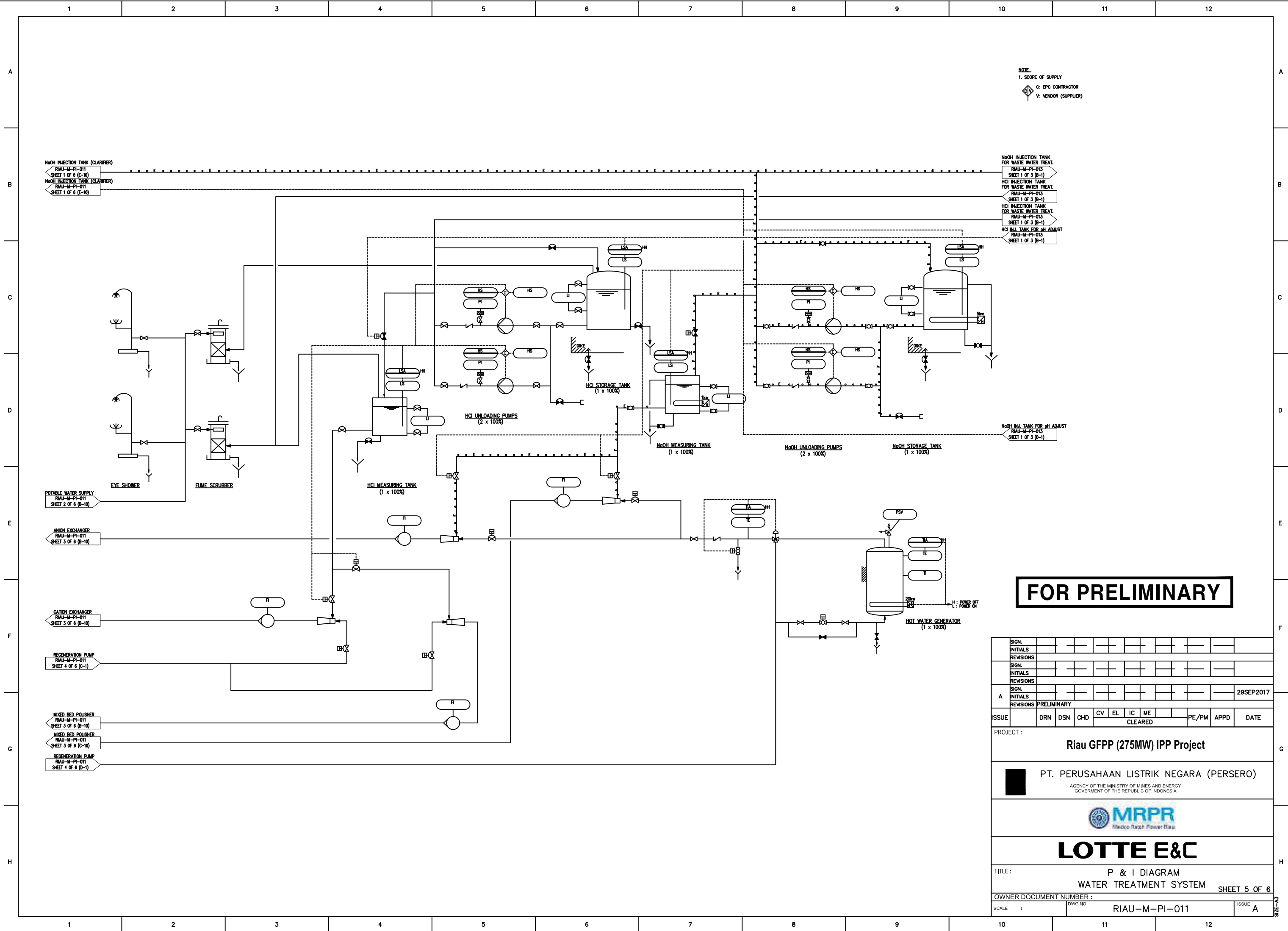


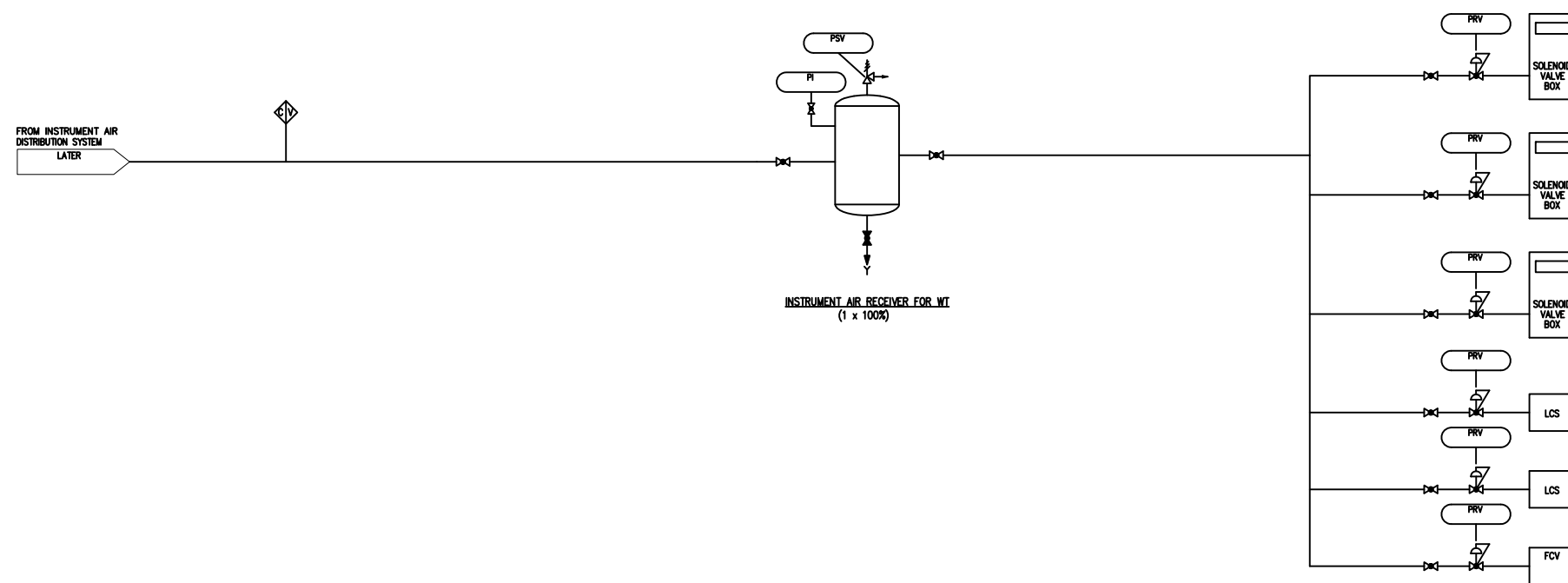
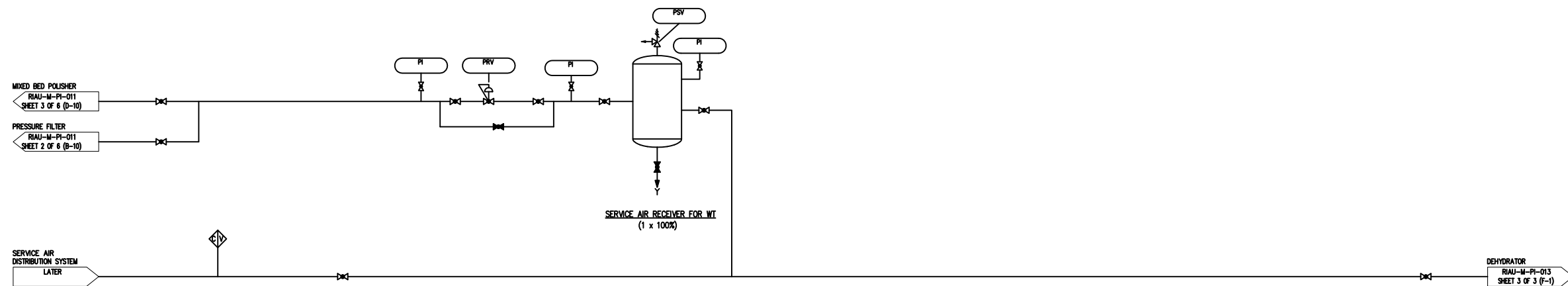
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SCALE :	DWG NO. RIAU-M-PI-011	ISSUE A
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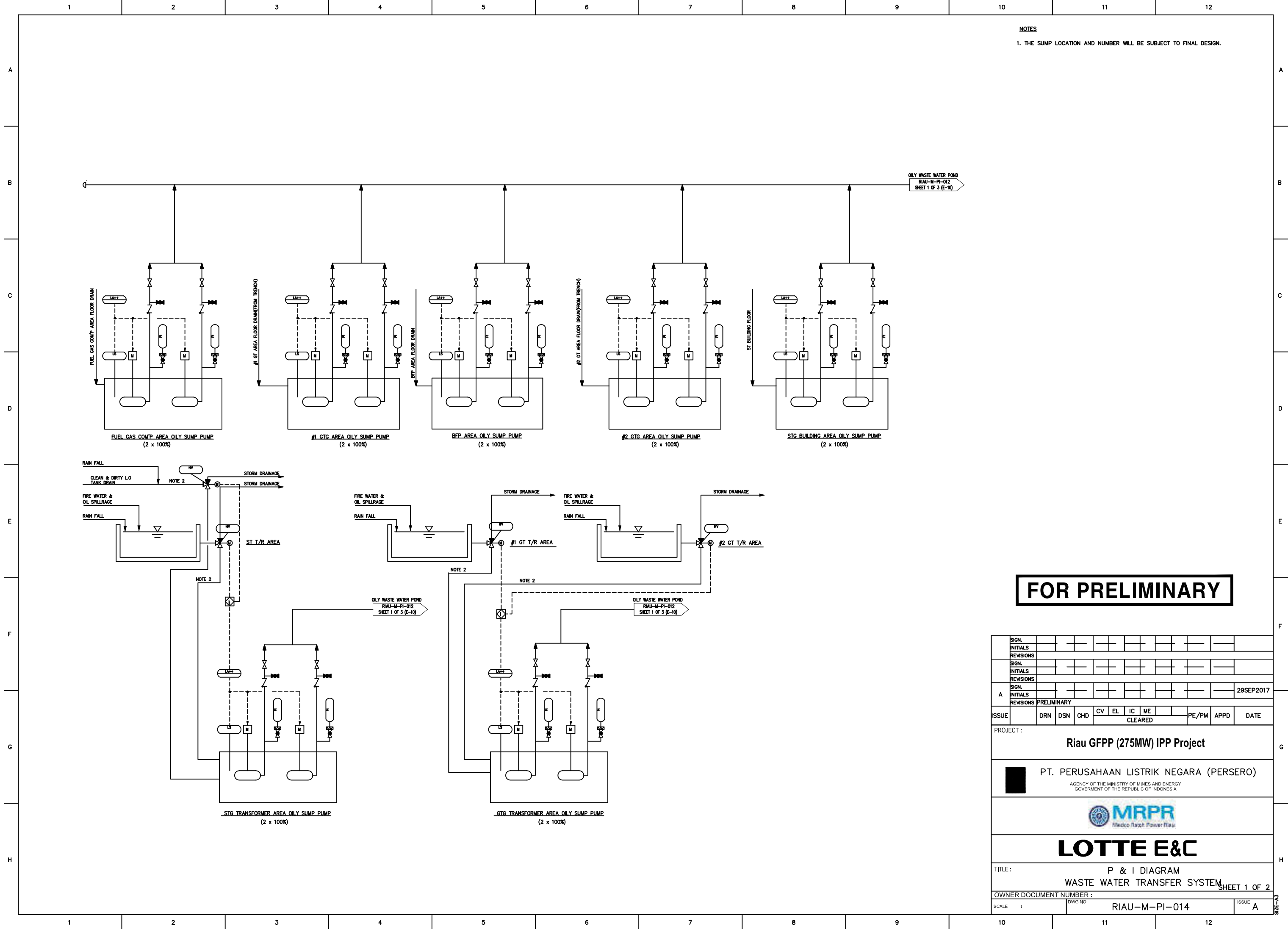
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FOR PRELIMINARY

SIGN.										SIGN.									A	SIGN.								29SEP2017
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PRELIMINARY																												
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<div><div></div><div>MRPR Medico Ranch Power Plant</div></div>																												
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TITLE : P & I DIAGRAM WATER TREATMENT SYSTEM																												
OWNER DOCUMENT NUMBER : SHEET 6 OF 6																												
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RIAU-M-PI-011																												
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{Nomor Sertifikat}
Date: February 25, 2016

Issuing Office:
Jl. Jend. A. Yani No. 79, Pekanbaru 28115, Indonesia
Phone/Fax: +62 761 35881/848709
Email: skl.pku@sucofindo.co.id

REPORT OF SAMPLING AND ANALYSIS

PRINCIPAL	: MEDCO POWER INDONESIA, PT. Gd. The Energy Lt. 50 Jl. Jend Sudirman Kav. 52-53 Lot 11A SCBD Senayan Kebayoran Baru Jakarta Selatan DKI – Jakarta Raya
SUBJECT	: RIVER WATER
RECEIVED DATE	: 15/02/2016
REFERENCE	: 085/PKU-I/B03/2016
SAMPLING LOCATION	: Sungai Siak Area Pelabuhan Sungai Duku
COORDINATE	: N 00°32'48.9" E 101°27'57.7"
TESTED FOR	: Dissolved Solid, Suspended Solid, pH, BOD, COD, Iron, Chloride, Conductivity, Total Hardness, Magnesium, Calcium, Sodium, Silica, Total Coliform (as per client request) *) Comparison of parameter as tested with Government Regulation of Republic Indonesia No.82/2001
SAMPLE DESCRIPTION	: Sample was drawn by Sucofindo Laboratory at February 10, 2016.
ANALYSIS DATE	: 15/02/2016 to 23/02/2015

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Dept. Of Testing, Consultancy and Other Services

PKU.B03.2016.00163

Adi Nuryantono

{Nomor Sertifikat}
Date: February 25, 2016

Issuing Office:
Jl. Jend. A. Yani No. 79, Pekanbaru 28115, Indonesia
Phone/Fax: +62 761 35681/849709
Email: kki.pku@sucofindo.co.id

Parameter	Unit	Test Result	Water Quality Classification Threshold Limit Value #)				Methods *)
			I	II	III	IV	
Dissolved Solid	mg/L	31.0	1000	1000	1000	2000	2540 C
Suspended Solid	mg/L	14.0	50	50	400	400	2540 D
pH (on site)	-	4.96	6 - 9	6 - 9	6 - 9	5 - 9	4500-H ¹ -B
BOD ₅ days 20 °C	mg/L	16.3	2	3	6	12	5210 B
COD by K ₂ Cr ₂ O ₇	mg/L	54.0	10	25	50	100	5220 B
• Iron Dissolved	mg/L		0.3	-	-	-	3120 B, 3030 E
Chloride	mg/L	5.96	600	-	-	-	4500-C1 ¹ -D
Conductivity	mg/L	44.5	-	-	-	-	
Total Hardness	mg/L	32.0	-	-	-	-	
Magnesium	mg/L	0.071	-	-	-	-	
• Calcium	mg/L		-	-	-	-	
• Sodium	mg/L		-	-	-	-	
• Silica	mg/L		-	-	-	-	
• Total Coliform	Per 100 mL		1000	5000	10000	10000	9222 B

*) Standard Methods, 22nd Edition 2012, APHA-AWWA-WEF

#) Requirement means = Threshold limit value of parameter as tested comply with Government Regulation of Republic Indonesia No.82/2001.

• di Subkon ke Lab Cilitung

c = Less than the detection limit indicated

Note :

Requirement means = Threshold limit value of parameter as tested comply with Government Regulation of Republic Indonesia No.82/2001. Water quality classification specific as 4 (four) class i.e.

- First class (I) : Raw water which can be used for raw drinking water, and / or similar usage.
- Second class (II) : Raw water which can be used for recreation infrastructure, river fishery cultivation, animal husbandry, irrigation and / or similar usage.
- Third class (III) : Raw water which can be used for river fishery cultivation, animal husbandry, irrigation and / or similar usage.
- Fourth class (IV) : Raw water which can be used for irrigation and / or similar usage

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Dept. Of Testing, Consultancy and Other Services

PKU.B03.2016.00163

Adi Nuryantono



CERTIFICATE OF ANALYSIS

NO : GS.COA.03.2016.031
TESTING FACILITY : BANDUNG

COA 5.8

Terbitan : A

Revisi : 00

JOB NO. : **16/031**
CLIENT : **PT. HEXA INTEGRA ELECTRICA**
DATE RECEIVED : 03 March 2016
SAMPLED BY : Client.
TIME OF ANALYSIS : Commenced 04 March 2016 until 17 March 2016.
TEST METHOD : Waters analyzed in accordance with the procedures published by the American Public Health Association (APHA, 2012), PT. Geoservices Environmental Laboratories WILAB 5.0.

Lab. No : **B 001**
Client ID : **AIR SUNGAI**

Parameter	Unit	Result	Method
Physical			
pH (25°C)		6.0	APHA 4500 H ⁺ B - 2012
Electrical Conductivity	µS/cm	49	APHA 2510 B - 2012
Turbidity	NTU	17	APHA 2130 B - 2012
Total Suspended Solids (TSS)	mg/L	< 10	APHA 2540 D - 2012
Chemical			
Total Hardness (as CaCO ₃)	mg/L	10	APHA 2340 B - 2012
Total Alkalinity (as CaCO ₃)	mg/L	9	APHA 2320 B - 2012
Chloride (Cl)	mg/L	6	APHA 4500 Cl ⁻ C - 2012
Sulfate (SO ₄)	mg/L	9	APHA 4500 SO ₄ E - 2012
Dissolved Silica (SiO ₂)	mg/L	18	APHA 3111 B - 2012
Dissolved Iron (Fe)	mg/L	1.1	APHA 3113 B - 2012
Dissolved Aluminum (Al)	mg/L	3.9	APHA 3113 B - 2012
Dissolved Manganese (Mn)	mg/L	< 0.02	APHA 3111 B - 2012
Dissolved Calcium (Ca)	mg/L	2.8	APHA 3111 D - 2012
Dissolved Magnesium (Mg)	mg/L	0.8	APHA 3111 B - 2012
Dissolved Sodium (Na)	mg/L	3.9	APHA 3111 B - 2012
Dissolved Potassium (K)	mg/L	2.2	APHA 3111 B - 2012
Nitrate (NO ₃)	mg/L	1.2	APHA 4500 NO ₃ E - 2012
Nitrite (NO ₂)	mg/L	0.043	APHA 4500 NO ₂ B - 2012
Bicarbonate (HCO ₃)	mg/L	11	APHA 2320 B - 2012
Carbonate (CO ₃)	mg/L	< 1	APHA 2320 B - 2012
Hydroxide (OH)	mg/L	< 1	APHA 2320 B - 2012
Total Phosphate (PO ₄) – P	mg/L	0.19	APHA 4500 E - 2012
Chemical Oxygen Demand (COD)	mg/L	27	APHA 5220 D - 2012
Dissolved Oxygen (DO)	mg/L	7	APHA 4500 O - C



CERTIFICATE OF ANALYSIS

NO : GS.COA.03.2016.031
TESTING FACILITY : BANDUNG

COA 5.8

Terbitan : A

Revisi : 00

JOB NO. : **16/031**
CLIENT : **PT. HEXA INTEGRA ELECTRICA**
DATE RECEIVED : 03 March 2016
SAMPLED BY : Client.
TIME OF ANALYSIS : Commenced 04 March 2016 until 17 March 2016.
TEST METHOD : Waters analyzed in accordance with the procedures published by the American Public Health Association (APHA, 2012), PT. Geoservices Environmental Laboratories WILAB 5.0.

Lab. No : **B 001**
Client ID : **AIR SUNGAI**

Parameter	Unit	Result	Method
Physical			
Biochemical Oxygen Demand (BOD)	mg/L	< 1	IK 5 – 6.71
Total Dissolved Solids (TDS)	mg/L	25	IK 5 – 6.2

Bandung, 17 March 2016

Checked
Nengsih
Analyst

Approved Signatory
Lasmijati Kosasih
Laboratory Manager

Additional Sak River water quality information

No.	Analyzed items	Unit	Result
1	Turbidity	NTU	26.7
2	Total suspended solids	mg/l	41.0
2a	Total dissolved solids	mg/l	48.2
3	pH	----	6.16
4	Total Hardness	Meq/l	
5	Total Alkalinity: CaCO ₃	mg/l	
6	Dissolved Silica: SiO ₂	mg/l	
7	Iron (Fe ^{+2 +3})	mg/l	1.168
8	Aluminum (Al ⁺³)	mg/l	
9	Manganese (Mn ⁺)	mg/l	0.067
10	Calcium (Ca ⁺²)	mg/l	
11	Magnesium (Mg ⁺²)	mg/l	
12	Sodium & Potassium (Na ⁺ + K ⁺)	mg/l	
13	Chloride (Cl ⁻)	mg/l	
14	Sulfate (SO ₄ ⁻)	mg/l	0.022
15	Nitrate (NO ₃ ⁻)	mg/l	1.204
16	Nitrite (NO ₂ ⁻)	mg/l	0.083
17	Bicarbonate (HCO ₃ ⁻²)	mg/l	
18	Carbonate (CO ₃ ⁻²)	mg/l	
19	Hydroxide (OH ⁻)	mg/l	
20	Phosphate (PO ₄ ⁻³)	mg/l	0.862
21	Total Dissolved Solids	mg/l	48.2
22	Dissolved Oxygen	mg/l	5.1
23	BOD	mg/l	20.3
24	COD	mg/l	81.1
25	Conductivity	µS/cm	

Source:

Vol. 1: Final Master Plan – Pekanbaru Report of the IndII Wastewater Investment Master Plan - Package III Project 2011 (Data of sample ST 1: Siak I Bridge (Jl. Satrio – Rejosari):

LABORATORY ANALYSIS REPORT

RESULT OF ANALYSIS

Laboratory Sample Number		Customer Sample Identity		Matrix	
Date of Sampling		Time of Sampling		Sampling Method	
Sampling Point Coordinate		Ambient Temperature			
Parameters of Analysis	Method	Unit	Detection Limit	Regulation Limit	Result
Temperature	APHA 22nd edition, Method 2550B (2012)	°C	-	+ 3	31,2
pH	SNI 06-6989.11 (2004)	-	-	6-9	6,88
Total Suspended Solids (TSS)	SNI 06-6989.3 (2004)	mg/L	1	50	56
Conductivity	SNI 06-6989.4 (2004)	µS/cm	1	NA ¹	48
Turbidity	APHA 22nd edition, Method 2130 A&B (2012)	NTU	0,5	NA ¹	30,9
Disinfectant: Oxygen Demand (BOD)	APHA 22nd edition, Method 5210 C (2012)		2	3	< 2
Chemical Oxygen Demand (COD)	APHA 22nd edition, Method 5220 D (2012)		3	25	92
Ammonia (as NH ₃ -N)	APHA 22nd edition, Method 4500 NH ₃ F (2012)	mg/L	0,07	(-)	0,23
Nitrate (NO ₃)	APHA 22nd edition, Method 4500 NO ₃ E (2012)		0,003	10	0,544
Nitrite (NO ₂)	APHA 22nd edition, Method 4500 NO ₂ B (2012)		0,005	0,36	< 0,025
Total Nitrogen	APHA 22nd edition, Method 4500 N (2012)		0,06	NA ¹	1,56
Fluoride (F)	APHA 22nd edition, Method 4500 F D (2012)		0,1	1,5	0,4
Phosphorus (P)	APHA 22nd edition, Method 4500 P A, B&E (2012)		0,03	0,2	< 0,02
Total Coliform ¹	SNI 3564 (2016)	colony/100mL	-	5000	720

Note(s):

¹ Subcontracted

² Regulation refers to AP 82/2002 class II.

³ Not Applicable or Not Available.

PT Organo Science Laboratory (USL1707053) / Page 2 of 5

Sentul City

Paras Ancelrindam Blok A No. 7, Bogor, INDONESIA 16810 Phone: +62 21 8796 2710 - Fax: +62 21 8796 2711
http://www.organolabs.com, e-mail: info@organolabs.com

LABORATORY ANALYSIS REPORT

RESULT OF ANALYSIS

Laboratory Sample Number		OSL1707053-1		OSL1707053-2		OSL1707053-3	
Customer Sample Identity		WQ-2 PP Sungai Siak		WQ-3 PP Sungai Siak		WQ-4 PP Anak Sungai Siak (Muarah)	
Matrix		Surface Water		Surface Water		Surface Water	
Date of Sampling		19-07-2017		19-07-2017		19-07-2017	
Time of Sampling		12:10 WIB		13:51 WIB		13:51 WIB	
Sampling Method		NA ?		NA ?		NA ?	
Sampling Point Coordinate		N : 00° 34' 10,1"		N : 00° 34' 01,1"		N : 00° 33' 37,7"	
Ambient Temperature		E : 101° 30' 47,0"		E : 101° 31' 16,4"		E : 101° 30' 19,5"	
		35,2°C		37,8°C		37,1°C	
Parameter(s) of Analysis	Method	Unit	Detection Limit	Regulation Limit ²	Result		
Oil and Grease	EPA Method 1664, Revision 9 (2012)	µg/L	1000	1300	2400		
Organochlorine Pesticides (OCP)	USEPA SW 846 Method 32700, 3510C ('98); 1995)		0,4	NA ?	< 0,4		
Polychlorinated Biphenyls (PCB)			0,005	NA ?	< 0,005		
Polycyclic Aromatic Hydrocarbons (PAHs)			0,04	NA ?	< 0,04		
PCDDs ¹	USEPA Method 1613B (GC HRMS)	pg/L	50	NA ?	< 50		
PCDFs ¹			50	NA ?	< 50		

Notes:

- ¹ Subcontracted
² Regulation refers to PP 82/2001 class II.
³ Not Applicable or Not Available

LABORATORY ANALYSIS REPORT

RESULT OF ANALYSIS

RESULT OF ANALYSIS						
Laboratory Sample Number		Customer Sample Identity		OSL17070533-1		
Customer Sample Identity		Customer Sample Identity		OSL17070533-2		
Matrix		Matrix		OSL17070533-3		
Date of Sampling		Date of Sampling		OSL17070533-4		
Time of Sampling		Time of Sampling		OSL17070533-5		
Sampling Method		Sampling Method		OSL17070533-6		
Sampling Point Coordinate		Sampling Point Coordinate		OSL17070533-7		
Ambient Temperature		Ambient Temperature		OSL17070533-8		
Parameter(s) of Analysis	Method	Unit	Detection Limit	Regulation Limit	Result	
Total Boron (B)	APHA 22 nd edition, Method 4500 B-C (2012)	mg/L	0.04	NA	0.62	0.75
Total Mercury (Hg)	USEPA SW 846, Method 7470A (1994)		0.0005	NA	< 0.0005	< 0.0005
Total Arsenic (As)	USEPA SW 846, Method 7062 (1994); 3005A (1992)		0.005	NA	< 0.005	< 0.005
Total Cadmium (Cd)	USEPA SW 846, Method 7000B (2007); 3005A (1992)		0.002	NA	< 0.002	< 0.002
Total Chromium Hexavalent (Cr ⁶⁺)	USEPA SW 846, Method 7190A (1992)		0.004	NA	< 0.004	< 0.004
Total Chromium (Cr)			0.02	NA	< 0.02	< 0.02
Total Copper (Cu)			0.01	NA	< 0.01	< 0.01
Total Iron (Fe)			0.005	NA	1.03	0.809
Total Lead (Pb)	USEPA SW 846, Method 7030B (2007); 3005A (1992)		0.005	NA	< 0.005	< 0.005
Total Manganese (Mn)			0.01	NA	< 0.01	0.05
Total Nickel (Ni)		0.01	NA	0.03	< 0.01	
Total Zinc (Zn)		0.02	NA	0.02	0.05	

Notes:

This parameter (for the described nutrient) / this matrix has not been corrected by NAW model(s).

Regulation refers to pp 82/2007 class 6.

² Not Applicable or Not Available.

LABORATORY ANALYSIS REPORT

RESULT OF ANALYSIS

Laboratory Sample Number		OSL1707053-1	OSL1707053-2	OSL1707053-3
Customer Sample Identity		WO-2 PP Sungai Siak	WO-3 PP Sungai Siak	WO-4 PP Anak Sungai Siak (Muar)
Matrix		Surface Water	Surface Water	Surface Water
Date of Sampling		19-07-2017	19-07-2017	19-07-2017
Time of Sampling		12:10 WIB	13:51 WIB	05:11 WIB
Sampling Method		NA ⁷	NA ⁷	NA ⁷
Sampling Point Coordinate		N : 00° 34' 10,1"	N : 00° 34' 01,1"	N : 00° 33' 37,0"
Ambient Temperature		E : 101° 30' 47,0"	E : 101° 31' 16,4"	E : 101° 30' 19,0"
Method		35,7°C	37,6°C	32,0°C
Parameter(s) of Analysis	Unit	Detection Limit	Regulation Limit ¹	Result
Dissolve Boron (B)	mg/L	0,04	1	0,50
Dissolve Mercury (Hg)		0,0005	0,002	< 0,0005
Dissolve Arsenic (As)		0,005	1	< 0,005
Dissolve Cadmium (Cd) ²		0,002	0,01	< 0,002
Dissolve Chromium Hexavalent (Cr ⁶⁺)		0,004	0,05	< 0,004
Dissolve Chromium (Cr)		0,02	NA ⁷	< 0,02
Dissolve Copper (Cu)		0,01	0,02	< 0,01
Dissolve Iron (Fe)		0,05	(-)	0,445
Dissolve Lead (Pb) ²		0,005	0,03	< 0,005
Dissolve Manganese (Mn)		0,01	(-)	< 0,01
Dissolve Nickel (Ni)		0,01	NA ⁷	< 0,01
Dissolve Zinc (Zn)		0,02	0,05	< 0,02

Notes:

¹ This parameter (in the described matrix) / this method has not been accredited by KAN

² Regulation refers to PP 82/2003 class II.

⁷ Not Applicable or Not Available.