Environmental and Social Impact Assessment (Draft)

March 2018

THA: Chonburi Power Plant Project
(Part 1 of 6)

Prepared by Gulf SRC Company Limited for the Asian Development Bank.

CHAPTER 1

EXECUTIVE SUMMARY

The Sriracha Power Plant of Gulf SRC Co., Ltd. covers area of 450 rais (1 rai = 1,600 m^2) in the Hemaraj Eastern Seaboard Industrial Estate (Hemaraj ESIE) at Khao Khansong Sub-district, Si Racha District, Chon Buri Province. The power plant is estimated 140 km east of Bangkok. The proposed Sriracha Power Plant will utilize natural gas as main fuel and diesel oil as back up fuel. The total installed capacity of this power plant is 2,650 MW which will be sold to the Electricity Generating Authority of Thailand (EGAT). Major machineries and equipment of the Uthai Power Plant will be four combustion turbine generators (CTG), four heat recovery steam generators (HRSG) and four steam turbine generators (STG). The generated electricity to be sold to EGAT will be dispatched via the 500 kV Pluak Daeng Sub-station. The natural gas for the project to be supplied by PTT (Public) Co., Ltd. is approximately 368 Mft^3/day and the diesel oil supply as contingency fuel, is approximately 8,500 m^3/day. Raw water will be provided by the Eastern Water Resources Development and Management PCL with rate of 63,000 m^3/day and stored in the 189,000 m^3 reservoir. The wastewater of the power plant is derived from 2 sources: cooling system and production processes. The effluent discharged from the cooling tower will be drained into the cooling water holding pond of the power plant before discharging into the cooling water holding pond for power plant of Hemaraj ESIE. However, properties of discharged cooling water have to meet standards such as Notification of Ministry of Industry No. 2 (B.E. 2539) re: wastewater discharge criteria for factory and standard of discharged wastewater quality to irrigation water route of Rayal Irrigation Department. Wastewater from production processes will be treated prior to discharge into the project's wastewater holding pond for further discharge into Hemaraj ESIE central wastewater treatment system. The properties of discharged wastewater into the central wastewater treatment plant have to meet the requirements of Hemaraj Eastern Seaboard Industrial Estate.

The study of alternative consideration was conducted in accordance with the Office of the Natural Resources and Environmental Policy and Planning (ONEP) Guideline. Alternative consideration is an important step in order to mitigate environmental impact

to the lowest level, increase possibility of the project design and investment. The principle criteria for alternation consideration are as follows:

- Mainly utilize the areas of the industrial estate to mitigate impacts on people's land use
- Avoid historic areas or archaeological sites
- Located in the areas with energy network or natural gas pipeline
- Have feasible engineering for both construction and maintenance
- Have enough basic infrastructure to support the need of the project
- Cause the least impact on sensitive environmental areas such as communities, religious places, schools, governmental offices and hospitals
- Avoid the areas specified in the attachment of the Notification of the Ministry of Natural Resources and Environment as specific conservative areas which have been protected by laws.

The Sriracha Power Plant Project is subjected to the requirements on the preparation and submission of the EIA report to the ONEP for review and approval (under the Notification of the Ministry of Science, Technology and Environment of 24 August B.E. 2535 (1992) No.2 and No.3 B.E. 2539 (1996)). Therefore, TEAM Consulting Engineering and Management Co., Ltd. was engaged to conduct the required EIA study. The EIA study for Sriracha Power Plant Project is fully complied with applicable Thai laws i.e. ONEP guidelines for EIA report for Power Plant which include environmental standards/regulations of Department of Industrial Works, Ministry of Industry, Ministry of Natural Resource and Environment, Ministry of Interior, Ministry of Transport and Communications, and Ministry of Labor.

As the project shall create temporary and permanent employments for skilled and unskilled labors, the project will fully comply with ADB's Social Protection Strategy (2001) which upholds international recognized labor standards and/or national labor laws, particularly on the following conventions: (1) no harmful or exploitative forms of forced labor, (2) no child labor, (3) no discrimination in respect of employment and occupation, and (4) no restrictions of freedom of association and the effective recognition of the right to collective bargaining. In addition, the Sriracha Power Plant project will fully comply with the relevant ADB's safeguard policy throughout the project operation period. Objectives of ADB's environmental and social safeguards are to: (i) avoid adverse impacts of projects on the environment and affected people, where possible; (ii) minimize, mitigate, and/or compensate for adverse project impacts on the

environment and affected people when avoidance is not possible, and (iii) help borrowers/clients to strengthen their safeguard systems and develop the capacity to manage environmental and social risks. Since the project is Category A for environment, Safeguard Requirements 1: Environmental and eleven policy principles have been triggered (referred to page 16 of the SPS, 2009).

The results of the study (including the summarized key environmental & social baseline data, anticipated impacts and associated mitigation measures) and recommendations in the EIA study are summarizied as follows:

1.1 AIR QUALITY

The potential air quality impacts from the Sriracha Power Plant Project during the construction and operation periods will be from dust dispersion during the construction phase and stack emissions during the operation phase.

During the project construction, the main activities leading to the dispersion of suspended particulate are the activities in the preparation of the ground for foundation works and the building works which need to excavate, plough, backfill, grade and compress the soil. According to the forecast of the impacts from the project construction on 21 sensitive areas, the highest 24-hr average TSP is found at the construction area with the concentration of 190.46 µg/m³. When it is added to the highest concentration measured from the field study (153 µg/m³), the result was 343.46 µg/m³. Nevertheless, the project has established environmental impact mitigation and preventive measures on air quality during the construction period by spraying water within the construction area at least twice a day, and installing shading nets around the construction area to reduce the total suspended particulate (TSP) to 95.23 µg/m³. When this is added to the highest concentration measured from the field study (153 µg/m³), the result was 248.23 µg/m³ or 73.83 % of the standard level.

During the operation period, the air quality impact will be from the use of natural gas as main fuel and diesel oil as backup fuel to generate the electricity. The combustion of these fuels will generate major air pollutants including primary oxides of nitrogen (NO_x), sulfur dioxide (SO_2), and particulate matters (PM). However, there will be small amount of SO_2 emission and PM because of the composition of selected fuel of the project. The impacts on the air quality in the atmosphere from the project operation were forecasted by using the mathematical model AERMOD. Results showed that the concentration of nitrogen dioxide (NO_2), sulfur dioxide (SO_2) and total suspended

particulate (TSP) in the atmosphere from the project operation in all six scenarios within 15 km from the project area is within the standard level (**Table 1**). When adding this to the existing measured results, the concentration of various pollutants in all of the 21 sensitive areas are within the stipulated standard level. This shows the potential of the studied areas to accommodate the Sriracha Power Plant Development Project in the future. Therefore, it is expected that the project operation will have moderate impacts on the air quality. The project can further reduce the impacts on air quality by implementing the environmental impact monitoring measures to minimize impacts on air quality.

TABLE 1

FORCASED AIR QUALITY IN VARIOUS SENERIOS OF USING NATURAL GAS AND DIESEL OIL AS A FUEL

Pollutants	NO_2	SO_2	TSP	PM-10
Case 1 : natural gas (operation with 100% load + present in ambient air)				
1 hour	174.15	169.12	-	-
24 hours	-	65.34	182.68	113.82
Case 2 : natural gas (operation with 60% load + present in ambient air)				
1 hour	148.54	155.40	-	-
24 hours	-	63.74	180.63	111.77
Case 3 : natural gas (operation with 100% load + background[1/] + present in ambient air)				
1 hour	**289.93**	191.26	-	-
24 hours	-	68.44	186.28	117.42
Case 4 : diesel oil (operation with 100% load + present in ambient air)				
1 hour	146.72	223.29	-	-
24 hours	-	75.35	182.60	113.74
Case 5 : diesel oil (operation with 69% load + present in ambient air)				
1 hour	143.68	221.18	-	-
24 hours	-	73.92	181.80	112.94
Case 6 : diesel oil (operation with 100% load + background[1/] + present in ambient air)				
1 hour	283.16	**223.61**	-	-
24 hours	-	78.12	185.60	116.74
Ambien air qualiy standard				
1 hour	320	780	-	-
24 hours	-	300	330	120

Remark : 1/ concentration from other factories that have been approved in the EIA report but have not released air pollutants yet.

In additional, EPA has set up the National Ambient Air Quality Standards (40 CFR part 50) for pollutants considered harmful to public health and the environment. Two types of national ambient air quality standards were identified. **Primary standards** provided public health protection, including protecting the health of "sensitive" populations such as asthmatics, children, and the elderly. **Secondary standards** provided public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

Air pollutions from the proposed project (both in case of gas and diesel oil firing) plus those from other plants and the planned future power plants of Gulf Group within 15-km radius from the project site, would have maximum concentrations of NO_2 1 year and SO_2 3 hrs with values of 21.62 and 179.50 µg/m^3 or 21.70 and 35.90% of USA's ambient air quality secondary standard value. Therefore, the project operation will not pose impacts on decreased visibility and damage to animals, crops, vegetation, and buildings.

Accordingingly, the potential impact is considered to be as insignificant.

1.2 NOISE LEVEL

The project's construction activities may cause disturbed noise. The activity causing the highest level of noise is the foundation work. During that activity, the predicted 24-hour equivalent sound pressure level (Leq24) at the four Sensitive areas namely Chumchon Borisat Namtan Tawan-aok School, the Child Development Center of Chomphon Chao Phraya Sub-district Municipality, Wat Chomphon Chao Phraya and The Praow village is below the standard level. As for disturbed noise, all four sensitive receptors have higher level of disturbed noise than the standard level. Therefore, the project set up measure to reduce that disturbed noise by installing temporary noise barrier at the site of the foundation piling in the northeast and south sides. The noise barrier is made from 1.27-mm metal materials (steel 18 ga) or thicker having sound transmission loss (TL) of 25 dB(A). The height of the noise barrier is approximately 3 m in the northeast side and approximately 5 m in the south side which will bring the specific noise to a level lower than the standard. It is anticipated that the noise from the project's construction activities will have temporary and low impact on the everyday life of the nearby receptors.

During the Operation Period, the machines of the power plant are a source of noise. They will generate noise, more than 85 dB(A) at the distance of 1 m from the

noise source. Considering the power generating activities which is continuous throughout 24 hr, for consideration of the impacts of noise from the project's power generating activities. When this is added to the existing ambient noise level, the noise level produced is within the standard level of the ambient noise level. Likewise, the specific noise level in all four sensitive receptors are within the standard level. Thus, it is showed that the noise level from the operation of the project will expose low impact on the living condition of the receptors.

The unusual operation includes plant start-up, plant shut-down and equipment failure or unit trip. Generally, the IPPs will be operated as a base load plant (EGAT usually dispatches to IPPs 24/7, varying the load, but not starting up/shutting down the plants). Therefore, these unusual operations are not likely to happen.

During the shut-down operation for maintenance purposes, the duration is about 60 minutes for turbine bypass valves operation. For the cold start-up (start-up after more than 45 hrs shut-down), the duration is up to 210 minutes for start up vent and turbine bypass valves operation. However, these occurrences will be only for scheduled maintenance shut-down (every 12,000 equivalent operating hours for MHI Gas Turbine). Therefore, it is only about once a year or less per one block. In addition, this is a planned shut-down and start-up which the community can be informed in advance. In case of warm start, or hot start, or unit trip, the duration would be about 90 minutes or less. In case of equipment failure (and safety valve opens), the duration would be about 5 minutes. However, these occurrences are seldom happen.

1.3 SURFACE HYDROLOGY AND SURFACE WATER QUALITY

The Project's primary source of wastewater during the construction period comes from workers' wash rooms and toilets. The rest is wastewater from construction activities. The uncontaminated volume is sent to wastewater holding ponds for quality checking according to the requirements of Hemaraj ESIE prior to discharging into Hemaraj ESIE's central wastewater treatment system. Wastewater from wash rooms and toilets is drained into the septic tanks. During the construction period, it is estimated that there will be 179.2 m^3 of wastewater per day. With this regard, the Project requires that the contractors provide bathrooms and toilets to their workers and staff with the ratio of 15 persons to one room. As for the hydrostatic test water discharge of about 250 m^3 will be measured for pH, temperature, and volume of suspended solids, oil and grease to

ensure that the values of these indices are within Hemaraj ESIE's specified criteria prior to discharging into Hemaraj ESIE's central wastewater treatment system. In terms of rainwater, it is likely to be contaminated with deposits of soil, sand or debris from the construction so it will be drained into temporary sedimentation pond for soil or sand sedimentation before draining clear water into rain gutter drainage system of Hemaraj ESIE later. As a result, the impact level on surface hydrology during the construction period of the project is low while there is no impact on surface water quality.

During the operation period, discharged water will come from two sources: 1) the electricity generating process and 2) the cooling system. The wastewater discharged from the process consists of wastewater from the water treatment system, the operation room and the office building at the maximum volume of 48 m^3/day. This discharged water will be initially treated before sending to the project's wastewater holding pond which has the capacity to retain the discharged water for at least one day. The pond will be equipped with online monitoring of water quality to check the temperature, pH and conductivity (to find Total Dissolved Solid) in accordance with the requirement of the industrial estate before sending it for treatment in Hemaraj ESIE's central wastewater treatment system.

Water discharged from the cooling tower of 12,232 m^3/day maximum is uncontaminated and free from substances from the production process, and it will be retained at the project's two cooling water holding ponds with the holding capacity of 19,000 m^3 each. Each pond can retain the water for at least one day. While one of the ponds is being used, the other pond will serve as the emergency pond. The discharged water is retained here before being released into the cooling water holding pond of Hemaraj ESIE which can take in the water for another one day. The project has installed a water quality online monitoring system to check temperature, pH and conductivity (for the purpose of the detection of the total dissolved solid (TDS)) in the cooling water holding pond in accordance with Ministry of Industry's Quality Standards of Discharged Water where the level of total dissolved solid must be within the standards of the Royal Irrigation Department on the quality of discharged water in the waterways and temperature not exceeding 34 °C. The cooling water is finally drained into Kram canal flowing through Hemaraj ESIE.

Moreover, the water quality in Kram canal, Rawoeng canal and Nong Pla Lai reservoir, which connect to each other, was forecasted to evaluate the impact from the cooling water drained from the cooling water holding pond of Hemaraj ESIE into Kram canal. The water quality forecast was conducted by calculation of SAR, and BOD and TDS concentration in (1) Kram canal after receiving the cooling water, (2) Rawoeng canal after meeting Kram canal, and (3) Nong Pla Lai reservoir after receiving water from Rawoeng canal. The quality of the cooling water was taken from that of Kaeng Khoi power plant 2 which is IPP power plant of Gulf Group and currently operating. The results show that SAR, and BOD and TDS concentration in Kram canal, Rawoeng canal (during wet season) and Nong Pla Lai reservoir do not change significantly while those in Rawoeng canal during dry season, considering BOD, the water quality has changed the classification from class 3 to class 4. However, the water in those water resources after receiving the project's cooling water still could be used for water use for agriculture and production of potable water.

Therefore, the impacts from the discharged cooling water on Kram canal, Rawoeng canal, and Nong Pla Lai reservoir are low to moderate. Nevertheless, to monitor the water quality in the water sources adjacent to the project and Hemaraj ESIE, the project will continue with examination of the level of SAR and Chlorophyll A to monitor the environmental impacts throughout the duration of the project.

1.4 AQUATIC ECOLOGY

During the construction period the Project will produce scraps that can be washed out of the Project site and affecting the ecology of water resources in the surrounding areas. Apart from wastewater management as above, the Project, thus, has established mitigation measures, such as washing tire of the trucks leaving the construction area or construction-related areas to prevent dirt and sand from potential stains on the roads both inside and outside of the Project area. This will eventually avert the dirt and debris from various construction projects, from being washed directly into the public waterways. Storm water within the construction site will be collected in the rain gutter drainage system and drained into temporary sedimentation pond for retention and sedimentation inside the Project site. The solid sediments are separated from the rainwater and the clear water is recirculated for use to spray roads to reduce suspended particulate levels in the Project site. The remaining volume will be drained into Hemaraj

ESIE's rain gutter drainage system. Therefore, it can be estimated that the construction activities of the Project will have low impact on an aquatic ecology in the areas surrounding the Project site.

During operation period, the impact assessment on aquatic ecology is not only considered wastewater treatment of the project and Hemaraj ESIE as mentioned in impact assessment on surface water quality, but also considered the use of chemical substances in the process. The chemical substances are considered to affect the aquatic ecology, namely, chlorine dioxide (ClO_2), ammonia (NH_3) and phosphate (PO_4^{3-}).

The project has selected the ClO_2, the substance that will not generate Trihalomethane (THMs), or other compounds that have been studied or confirmed not to cause any environmental impact, to dispose biofilms and microorganisms in the cooling blowdown. However, there may be some impacts on aquatic ecology that may affect aquatic lives because ClO_2 will change to chlorite (ClO_2^-). From the calculation showed that Kram canal, Rawoeng canal and Nong Pla Lai reservoir after receiving the cooling water from the project, which yields the concentration of chlorite of less than 1 mg/l, will have chlorite with concentration of 0.25, 1.03 and 0.10 mg/l. This concentration of chlorite is too low to cause the impact on fish, mysid shrimp and phytoplankton as relevant reference document.

Sriracha Power Plant uses trisodium phosphate (Na_3PO_4) in its boilers to prevent slag formation. The remaining water in the boilers will be blowdown and mix with the cooling blowdown. Regarding the rate of phosphate use of the 10 % concentration substrate, the annual use is 30 m^3. If phosphate dissolution from the heat does not occur, the boiler blowdown when mixing with the cooling blowdown will produce phosphate of the concentration of 0.38 mg/l to be discharged into the canal. The concentration of phosphate will be diluted when mixing with Kram canal, when Kram canal meets Rawoeng canal, and when water in Rawoeng canal flows into Nong Pla Lai reservoir. Whereas the concentration of nitrogen (TKN) in Kram and Rawoeng canal is 0.75 mg/l. The concentration of phosphate that will cause eutrophication is 1.3 mg/l with the nitrogen (TKN) concentration in water of about 9.1 mg/l. As the result, the assessment of phosphate can be concluded that the concentration of phosphate and nitrogen were not at the levels that may pose a problem of eutrophication.

Ammonia used in the project is to (1) control nitrogen oxides produced by the fuel firing and (2) control water quality in the boilers/boiler pipeline system, which later

will be the blowdown mixing with the cooling blowdown. From calculation ammonia concentration in the cooling blowdown of Siracha Power Plants and other power plants in Hemaraj ESIE will be equal to 0.49 mg/l. After cooling blowdown from Sriracha Power Plant is discharged into Kram canal the average of ammonia concentration in Kram canal will be 0.12 mg/l. When the mixing water from Kram canal merging with Rawoeng canal ammonia concentration will be 0.055 mg/l. In light of the standard of non-marine surface water quality as prescribed in the National Environment Board's Notification No. 8 B.E. 2537 re: Prescribing Ammonia Values of Surface Water Classes 1 – 3 for the clean water suitable for the living of aquatic lives with the limitation of ammonia value of not exceeding 0.5 mg/L, it can be concluded that ammonia as a result from the operation activities of Sriracha Power Plant, together with other power plants in Hemaraj ESIE will not have an impact on the aquatic ecology.

1.5 TRANSPORTATION

The impact on transportation is evaluated by using the traffic data on the main routes such as highways and local roads around the project site as well as the nearby communities. In addition, the increase in traffic volume as a result from the project will also be used to calculate the ratio of increased traffic to the traffic capacity of the related highways and roads. The impacts are presented in V/C Ratio for the current traffic mobility in the local communities and during the project construction and operation period. The transportation activities during construction period include the transportation of equipment and machinery, workers, and materials, while those during operation period include the commutation of power plant employees, transportation of sediments arisen from the initial water naturalization system, and chemicals. These activities may have an impact on the traffic volume in the local area.

When comparing the increased traffic volume resulting from the transportation during construction and operation period with the traffic parameter of each highway and road, the V/C ratio is in the same range as existing condition, meaning that the activities during the construction period will not cause any impact on the level of mobility and traffic conditions of the transportation routes.

Thus, the impact on traffic condition during the construction and operation periods was considered to be low.

1.6 WATER USE

Water to be used during the construction period includes water for consumption by the construction workers at maximum volume of 224 m³/day, water for cleaning construction equipment of approximately 55 m³/day and water for spraying of the project area of approximately 1,058 m³/day. Therefore, the volume of water usage during the construction period will be 1,337 m³/day. Water to be used for the hydrostatic test is approximately 250 m³ per session (only when the test is performed). The contractors will supply the water which is expected to come from the potable water production system of Hemaraj ESIE. Thus, the Sriracha Power Plant Project will no cause impacts on water use of the estate.

During the operation period, water will be used in various activities, such as, cooling system and production process. The maximum quantity of water usage is estimated to be 63,000 m³/day. The project will obtain water from Hemaraj ESIE that receives water from the Eastern Water Resources Development and Management (Public) Company Limited at the rate of 95,996 m³/day. Such amount of water already included the quantity of water allocated to the project (as reported in the amendment of the Hemaraj ESIE's Environmental Impacts Assessment report 2nd Edition, 2015). This means that after the estate has allocated some water to the project, the remaining quantity of water is still sufficient for production of potable water in the estate. Therefore, there will be no impacts on water use of the estate.

1.7 SOLID WASTE MANAGEMENT

During the construction phase, the maximum of 3,200 workers will generate approximately 2.72 tons of garbage per day (based on the criterion of approximately 0.85 kilogram of garbage per person per day). Other solid waste generated during construction will include debris from soil excavation (e.g., dirt, broken brick, etc.), scraps of construction materials (e.g., debris from structure parts, or used materials, etc.) hazardous wastes (e.g., batteries, motor oil, hydraulic oil, filters, mineral oil, cleaning agents or used solvents) as well as defected coating products or rejected paints. The project has provided specific area for storing garbage and each type of solid wastes separately, and used suitable containers for collecting each type of solid wastes. The recyclable wastes will be reused and recycled or sold to waste buyers. The hazardous wastes will be collected and further disposed by the company authorized by the

Department of Industrial Works (DIW). Therefore, it can be estimated that the construction of the Project will not cause any impact of solid waste management on the surrounding communities.

During the operation phase, 2 types of solid waste will be properly managed or disposed of including general garbage from the office building, and discarded materials such as used air filter, used lubricating oil and oil from the oil separators, used resins, and sludge from water pre-treatment system.

The project will manage and dispose the solid wastes according to the notification of Ministry of Industry, B.E.2548 re: Disposal of Garbage or Discarded Materials as well as other related regulations prescribed by the government. In addition, the collection, storage and transportation, including the facilities responsible for the disposal are handled by the industrial waste management organization authorized by DIW. Therefore, it can be estimated that the operation of the project will cause low impact of solid waste management.

1.8 SOCIO-ECONOMIC

The socio-economics study involved the secondary data collection from government agencies and relevant reference document, as well as opinion survey of relevant government officers, enterprises, community headmen and households within 5-km radius around the project site. The questionnaire for opinion survey focuses on human utilization values, quality of life and local concerned issues. The survey samples are 675 in total. From the survey results, the potential social impact for project development stages can be summarized as follows:

Pre-construction period: about 85 percent of interviewees do not worry about the project development because the project is located in an industrial estate and at present, most people have a better understanding about natural gas, which is used as the project's fuel, from several media publicized by related agencies, following the government policy to promote the use of NGV over the past years. The rest of interviewee worry about the impact from the project development such as air pollutants, discharged water quality, fight over water, traffic during the construction period, security of life and property, impacts on the community environment, and failure to follow the established measured strictly, etc.

Construction period: the positive impact such as increase of employment opportunities for local workers, promotion of the local economy, occupation, power development fund benefits to the community, community relation activities can be expected. Moreover, the project has also established public policy under the strategies of "proactive corporate social responsibility on a consistent and continual basis". This is done by appropriately providing support and assistance to community activities to build good relationships and give benefits in return to communities and society. However, there are some interviewees worry and expect to be affected by the construction. The expected impacts include particulate emissions from the construction, traffic accidents, water conflicts, and community safety, etc.

Operation period: the positive impacts, namely, increased the country power generation and local administration organization income, returned benefit to communities from electricity development fund, development of local people's potential and community relations activities. However, some interviewees worry about prevention of environmental pollution, traffic volume in the areas, drainage of wastewater from the project, environmental impacts, monitoring measure monitoring of the project and lack of confidence in the project's working system. According to the above, the cause of the concerns of the community leaders is analyzed. The consultant found that the areas under the supervision of these community heads already have existing problems being the operation of some establishments causing a negative impact on the communities nearby.

Moreover, the potential impact are expected to be at a low level since the project has a plan to strictly implement the mitigation measure and monitoring program and promote understanding of communities. It is scheduled to conduct several activities to enhance local participation and support efficiency of the Project's Environmental Impact Monitoring Committee. The proposed activities will be relevant to communities' needs which will make the project development sustained.

1.9 INFORMATION DISCLOSURE, PUBLIC CONSULTATIONS AND PARTICIPATIONS

Public consultation process in EIA study was conducted in accordance with Constitution of the Kingdom of Thailand B.E. 2550 in regard to the right to information and complaints under Sections 56, 57 and the right of community under Section 67, Regulation of the Office of the Prime Minister on Public Hearing B.E. 2548, and the guidelines for public participation and social impact assessment in EIA process set up by Office of Natural Resources and Environmental Policy and Planning (ONEP) (2014). Public consultations were held twice in six sub-districts and one sub-district municipality in four districts of Chon Buri and Rayong Province. Those sub-districts and sub-district municipality are within the study area of the project (5-km radius around the project site). The participants consist of agencies at provincial, district and sub-district level, community leaders, local people, representatives of local educational institutes and environmental NGOs, local mass media, fisherman group utilizing the Nong Pla Lai reservoir, and interested general public with the total of 1,452 and 1,710 in the first and the second public consultation, respectively.

The concerns and recommendations expressed in the public consultations can be categorized into main 7 aspects: cumulative impact from air pollution on long term agricultural sector and people's health, impact on water quality in Kram canal and Nong Pla Lai reservoir, traffic accident and inconvenient transportation, safety system of the project, water use, fishery, benefit to the community and public participation to monitor the project implementation. All of the concerned were considered and incorporated in the project's environmental impact mitigation measures.

In addition, power plant visit was arranged to create the learning process from a direct personal experience of the public target group and to create the understanding with one another which would be beneficial to the coexistence between the community and the Project. The participants were community headmen and local people within the study area. For this reason, a power plant visit was arranged for the public in the vicinity of the Project and within the study area with the objective of creating knowledge and understanding about the operation of power plant. A group of 648 participants were taken to visit Kaeng Khoi Power Plant 2, Kaeng Khoi District, Saraburi Province.

To ensure the representatives of communities receive sufficient knowledge from the field trip, Gulf SRC Co., Ltd. arranged activities during the visit to the power

plant and the natural gas pipeline system within the power plant. The participants viewed a video presentation and listened to briefing from the personnel of the Kaeng Khoi Power Plant 2. The briefing included the information on background of Kaeng Koi Power Plant 2, the power generating process, the pollutant and water controls followed the generating process, the policy on the supervision of the environment and the conduct of the community relations activity. Additionally, stage was opened for participants to ask questions and the representatives of the Project including environment unit, community relations unit, personnel of Kaeng Khoi Power Plant 2 jointly answered all questions.

1.10 PUBLIC HEALTH

The health impact assessment was conducted within the concentration on local people in sensitive receptors within 5 km radius around the project site, including the project staff and workers. The study was conducted in accordance with Guidelines for HIA in Thailand's EIA Report and Thailand's EIA Manual by Environmental Impact Evaluation Bureau, Office of Natural Resources and Environmental Policy and Planning (ONEP), Ministry of Natural Resources and Environment (June 2008) and carried out according to the notification of Ministry of Natural Resources and Environment prescribing rule, method, regulations and EIA guideline for project may cause severe impact to communities, environmental quality and health B.E.2552 (2009), 29 December 2009).

According to the public health personnel survey from 18 medical centers in the study area, 94.4% of public health officers indicate that public health personnel is inadequate while 77.8% think that medical equipment is insufficient. 72.7% of interviewees indicate that people's illness is an impact resulting from the current environmental condition (air quality, water quality, solid waste, etc.). 72.2% of interviewees indicate that social problems in the study area are crimes involving thief/robbry, drug abuse, violence and teenage pregnancy.

Pro and cons, concerns and suggestions of project during construction period: 94.4% of interviwees indicate that project development leads to improvement of socio-economic in the area. However, concern issues are project may cause impact of health, environment, social, traffic, etc.

Pro and cons, concerns and suggestions of project during operation period: 77.8% of interviwees indicate that project development leads to improvement of socio-economic in the area as well as may cause impact of health environment, traffic, social, safety, etc.

The resulting of the mentioned agencies consist of 6 sub-district health promoting hospitals which can provide only the primary medical care. In case that public health agencies cannot provide medical care, the patient will be transferred to other local hospitals such as Laem Chabung Hospital, Nong Yai Hospial, Ban Bueng Hospital and Pluak Daeng Hospital.

In addition, collection of cause and mobidity of out-patient (ROR NGOR.504) found that respiratory diseases are common disorder among the local people. The project development both during construction and operation periods may increase number of patients and severity of diseases. However, the project's pollution prevention and impact mitigation measures such as Dry Low NO_x and air quality monitoring system both NO_x, SO_2 and total suspended particulates (TSP) as well as the diesel oil with low content of sulfur used as backup fuel can mitigate the potential health impacts on local residents. As the Project has already proposed prevention and mitigation measures for environment and environmental monitoring, public health impacts are reduced at low level.

Since the project site is located in Hemaraj Eastern Seaboard Industrial Estate with all facilities and utilities for industries, the project development will therefore not affect the local food, utility sources for surrounding communities.

1.19 OCCUPATIONAL HEALTH AND SAFETY

All of the concerned project activities will be conducted according to the project's occupational health, safety and environment plans and concerned laws and regulations. Action plans and trainings on occupational health, safety, and environment have been prepared for all project staffs to encourage their awareness and understanding of appropriate and safe operation according to the project's stated policy, covering all sub-contractors under the project. The project will perform all necessary maintenance to all machines and vehicles according to the manufacturers' recommendations. With regards to the fire prevention, smoking is strictly prohibited in the project site and allowed only in arranged smoking areas. Staff will need to use Personal Protective Equipment (PPE) e.g. safety helmet, ear plug, as appropriate. The project has also prepared emergency plans to handle any accidents. Medical care unit was also set up in the project area with the first aid and basic medical kit, including emergency transport must be available in accordance with the regulation of Ministry of Labour re: Provision of Welfare in Work Places B.E. 2548.

1.20 MAJOR HAZARD ASSESSMENT

The simulation of any leak and flammable of chemical substances such as natural gas, diesel oil and aqueous ammonia by BREEZE HAZ model, consideration is taken on leak characters (instantaneously or slowly) and ignition characters (instantaneous ignition or delay ignition). For the studied results of impacts to be occurred to adjacent areas including natural gas transmission pipeline system, diesel transportation pipeline system, diesel and aqueous ammonia storage tank, consideration was taken on areas with any leakages and ignition.

It is found that when natural gas/diesel oil/ aqueous ammonia is assumed to be leaked and ignited, the radius of heat radiation is mostly in the power plant site. From risk probability, it is found that the project risk is at a low level.

For the chemicals and boiler explosion hazard, it is found that the probability is at a low level. In addition, the project has prepared safety management measure from the design period through installation to operation and annual examination for maximum safety benefit will be regularly conducted. The detail of major hazard assessment can see in **item 5.1.4 Chapter 5**.

Although the risk analysis indicated that the project has low level risk, the project development will strictly follow international standards for the design, construction, operation and maintenance. In addition, the project has prepared emergency plans and training program to be able to handle the emergency situation at all time.

1.21 GRIEVANCE REDRESS MECHANISM

Complaints related to communities' inconvenience caused by the project implementation shall be handled and prioritized for rapid solution. The first stage of complaint procedure is starting with filling of a complaint form by the affected residents.

(1) After the complainant made a complaint via one of the channels to the complaint center or to the power plant, the responsible personnel will investigate the cause. If the issue did not originate from the project, then complainant must be informed within 24 hours.

(2) If the issue is indeed from the project, the complaint officer will forward the complaint to the site manager if it is during construction period or to the power plant manager if it is during operation period. A meeting to rectify the issue will be held

and personnel assigned to rectify the issue. Progress must be informed to the complainant every 2 days or as agreed upon with the complainant.

(3) Site manager or the power plant manager is responsible for ordering corrective actions to being taken and report on the progress to the complainant every week or as agree upon period. The Occupational Health, Safety & Environment Committee must also be informed. The complaint officer and the complainant shall also inspect the rectification together.

1.22 ENVIRONMENTAL MANAGEMENT PLAN

The Gulf SRC Co., Ltd. has planned to construct Sriracha Power Plant, which is a combined cycle power plant using natural gas as a fuel. The power plant has capacity of 2,650 MW. According to the EIA study, it was found that the project may cause impacts to environment at low to medium levels. Thus, the project has formulated the preventive and mitigation measures for environment, including measures for monitoring environmental quality which aim to reduce environmental impacts at the lowest levels.

The action plans proposed the details for mitigation measures and responsible party for both construction and operation periods. There are 14 action plans as follows:

(1) Air Quality Action Plan
(2) Noise Action Plan
(3) Surface Water Quality and Groundwater Quality Action Plans
(4) Water Use Action Plan
(5) Transportation Action Plan
(6) Waste Management Action Plan
(7) Drainage and Flood Control Action Plans
(8) Socio-economic Action Plan
(9) Public Participation and Relation Action Plan
(10) Public Health/Occupational Health and Safety Action Plan
(11) Major Hazard Action Plan
(12) Monitoring Action Plan on the Heat Generated from the Power Plant
(13) Green Area and Aesthetics Action Plan
(14) pH of Rainwater and Sulfate Radicals in Soil Monitoring Action Plan

In addition, the monitoring of action plan implementation will be conducted by qualified external monitoring bodies according to ONEP qualification. The semi-annual and the annual monitoring reports will be submitted to ADB during construction and operation periods, respectively.

During the construction period, the Gulf SRC Co., Ltd. will be obliged with applicable labor laws in relation to the GSRC Project, and take the measures to comply with the core labor standards[1] for the ADB financed portion of the Project.

1.23 RECOMMENDATIONS

Based on the results of the EIA study, the necessary recommendations can be emphasized as follows:

(1) The project shall be under all conditions, strictly enforce the implementation of the proposed environmental measures designed for the construction and operation phases in order to avoid or minimize both environmental and social impacts on the surrounding communities and general public.

(2) The project shall always conduct an environmental study for any modification of the project design and/or the environmental action plan to find out the environmental feasibility before making the decision.

(3) The public praticipations are the ongoing activities throughout the project implementation. The comments, concerns and suggestions from concerned stakeholders shall be considered and incorporated into the project environmental management plan as appropriate.

[1] The core labor standards are the elimination of all forms of forced or compulsory labor; the abolition of child labor; elimination of discrimination in respect of employment and occupation; and freedom of association and the effective recognition of the right to collective bargaining, as per the relevant conventions of the International Labor Organization.

CHAPTER 2

POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

The environmental impact assessment for Sriracha Power Plant Project (by Gulf SRC Co., Ltd.) is prepared to support the increasing demand for electricity and industrial developments. This project is a 2,650 Megawatt (MW) combine cycle power plant within the area of the Hemaraj Eastern Seaboard Industrial Estate (Hemaraj ESIE) at Sriracha District, Chon Buri Province. This project uses natural gas as its primary fuel and diesel as a backup source. The Sriracha Power Plant Project is required to have the environmental impact assessment prepared in accordance with the Notification of the Ministry of Natural Resource and Environment on 20 June B.E.2555 (2012) which specified that a thermal power plant of more than 10 MW shall have the Environmental Impact Assessment (EIA) prepared and submitted to the Office of Natural Resources and Environmental Policy and Planning (ONEP) for approval and to Department of Industrial Works for construction permission. Therefore, Gulf SRC Co., Ltd. engaged TEAM Consulting Engineering and Management Co., Ltd. to study and prepare the EIA report for the project. The ONEP review and approval procedure scheme for EIA report is presented in section 2.4.

2.1 POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK

The EIA study for Sriracha Power Plant Project is fully complied with applicable Thai laws i.e. ONEP guidelines for EIA report for Power Plant which include environmental standards/regulations of Department of Industrial Works, Ministry of Industry, Ministry of Natural Resource and Environment, Ministry of Interior, Ministry of Transport and Communications, and Ministry of Labor.

For the Natural Gas Pipeline to Sriracha Power Plant Project, Gulf SRC Co., Ltd. engaged TEAM Consulting Engineering and Management Co., Ltd. to conduct the study and prepare the EIA report. The natural gas pipeline is also required to have EIA

prepared and approved by ONEP under the Notification of the Ministry of Natural Resource and Environment on 2 0 June B.E.2555 (2012). The EIA study is also corresponding with the conditions in the proposal for independent power procedure (IPP) submitted to and approved by the Ministry of Energy. Gulf SRC Co., Ltd. is responsible for the EIA studies and construction of the power plant and its associated Natural Gas Pipeline (NGP), and must adopt the mitigation and monitoring programs of the anticipated environmental impacts during the project construction and operation. In case that Gulf SRC Co., Ltd. would transfer the natural gas pipeline to PTT Plc. after construction, PTT Plc. shall be responsible for the environmental mitigation measure and environmental monitoring program during operation.

2.1.1 RELEVANT THAI REGULATIONS

(1) Thai Environmental Standard/Regulations

(a) Ambient air quality standard

Notification of National Environmental Committee Vol. 10 B.E.2538 (1995)

Standard of Ambient Air Pollutant Concentration (µg/m^3)				
TSP average 24 hrs. (µg/m^3)	PM-10 average 24 hrs. (µg/m^3)	NO_2 average 1 hr. (µg/m^3)	SO_2 average 24 hrs. (µg/m^3)	SO_2 average 1 hr. (µg/m^3)
330	120	320	300	780

(b) Noise level standard

Notification of National Environmental Committee Vol.15 B.E.2540 (1997)

Standard of Noise Level, Decibel (A)			
Leq (24 hrs.)	L_{max}	Ldn	L_{90}
70.0	115.0	-	-

(c) Surface water quality standard

- Notification of National Environmental Committee Vol. 8 B.E.2537 (1994) in accordance with the National Environmental conservation and enhancement Act B.E.2535 (1992), subjected to the standard of surface water quality, published in Royal Gazette Vol. 111 Special Part 16D, dated 24 February 1994.

- The Royal Irrigation Department Order no. 73/2554 re: Amending of Preventive and Solutions on Poor Quality of Discharged Water into Irrigation Canal and Connected Part of the Irrigated Areas, dated 1 April 2011.

The surface water quality standard is shown in **Table 2.1-1.**

Table 2.1-1

Surface Water Quality Standard

Quality	Measurement Index	Unit	Standard Quality of Surface Water[1/]				Standard Quality of Water Discharged to Irrigation Canal[2/]
			2	3	4	5	
Physical	Depth	m	-	-	-	-	-
	Flow rate	,/s	-	-	-	-	-
	Temperature	°C	n'	n'	n'	n'	〈 40
	pH	-	5.0	5-9	5-9	5-9	6.5-8.5
	Suspended Solids	mg/l	-	-	-	-	30
	Total Dissolved Solids	mg/l	-	-	-	-	1,300
	Conductivity	micromonh/cm	-	-	-	-	2,000
Chemical	Dissolved Oxygen	mg/l	〉6	〉4	〉2	-	2.0
	BOD	mg/l	〈 1.5	〈 2	〈 4	-	20
	COD	mg/l	-	-	-	-	100
	Oil & Grease	mg/l	-	-	-	-	5
	Chloride	mg/l	-	-	-	-	-
Biological	Total Coliform Bacteria	MPN/100 ml	〈 5,000	〈 20,000	-	-	-
	Fecal Coliform Bacteria	MPN/100 ml	〈 1,000	〈 4,000	-	-	-

Source : [1/] The notification of National Environmental Committee Vol.8 B.E.2537 (1994) in accordance with the National Environmental conservation and enhancement Act B.E. 2535 (1992), re: Standard Quality of Surface Water, published in Royal Gazette Vol.111 Special Part 16 D, dated 24 February 1994

[2/] The Royal Irrigation Department Order no. 73/2554 re: Amending of Preventive and Solutions on Poor Quality of Discharged Water into Irrigation Canal and Connected Part of the Irrigated Areas, dated 1 April 2011

Remark: n' = naturally but changing not more than 3°C

[1/] Classification of surface water quality

Class 1 Extra clean fresh surface water resources used for:

(1) Conservation not necessary pass through water treatment process require only ordinary process for pathogenic destruction

(2) Ecosystem conservation where basic organisms can breed naturally.

Class 2 Very clean fresh surface water resources used for:

(1) Consumption which requires ordinary water treatment process before use

(2) Aquatic organism of conservation

(3) Fisheries

(4) Recreation

Class 3 Medium clean fresh surface water resources used for:

(1) Consumption, but passing through an ordinary treatment process before using

(2) Agriculture

Class 4 Fairly clean fresh surface water resources used for:

(1) Consumption, but requires special water treatment process before using

(2) Industry

Class 5 The sources which are not classification in class 1-4 and used for navigation.

(d) Groundwater quality standard

The results of groundwater quality measurement were compared with the standards for groundwater quality as prescribed in the Notification of National Environment Board No. 20 B.E. 2543 re: Prescribing Standards for Groundwater Quality. In addition, the measured parameters were compared with the suitable and maximum allowable concentration for consumption water as prescribed in the Notification of Ministry of Natural Resources and Environment re: Prescribing Academic Standards for Protection of Public Health and Environmental Pollution B.E. 2551 as shown in **Table 2.1-2.**

TABLE 2.1-2

Groundwater Quality Standard

No.	Prameters	Unit	Standard		
			(1)	(2)	(3)
1.	pH	-	-	7.0-8.5	6.5-9.2
2.	Water Temperature	°C	-	-	-
3.	Conductivity	µS/cm	-	-	-
4.	Turbidity	NTU	-	5	20
5.	Total dissolved solids (TDS)	mg/L	-	600	1,200
6.	Suspended solids (SS)	mg/L	-	-	-

No.	Prameters	Unit	Standard		
			(1)	(2)	(3)
7.	Total Hardness	Mg/L as $CaCO_3$	-	300	500
8.	Carbonate Hardness	Mg/L as $CaCO_3$	-	-	-
9.	Sulfate (SO_4)	mg/L	-	200	250
10.	Manganese (Mn)	mg/L	0.5	0.3	0.5
11.	Iron (Fe)	mg/L	-	0.5	1.0
12.	Copper (Cu)	mg/L	1.0	1.0	1.5
13.	Zinc (Zn)	mg/L	5.0	5.0	15
14.	Magnesium (Mg)	mg/L	-	-	-
15.	Calcium (Ca)	mg/L	-	-	-
16.	*E.Coli*	MPN/100 ml	-	None	-
17.	Total Coliform Bacteria	MPN/100 ml	-	<2.2	-
18.	Fecal Coliform Bacteria	MPN/100 ml	-	<2.2	-

Standard : (1) The standards for groundwater quality as prescribed in the Notification of National Environment Board No. 20 B.E. 2543 re: Prescribing Standards for Groundwater Quality

(2) The suitable concentration for consumption water as prescribed in the Notification of Ministry of Natural Resources and Environment re: Prescribing Academic Standards for Protection of Public Health and Environmental Pollution B.E. 2551

(3) The maximum allowable concentration for consumption water as prescribed in the Notification of Ministry of Natural Resources and Environment re: Prescribing Academic Standards for Protection of Public Health and Environmental Pollution B.E. 2551

(2) Power Plant Standard/Regulations

Environmental standards in Thailand for gas and oil fired thermal power plants.

(a) Air emission standard

- Notification of MNRE on emission standard for a new power plant, 20 December B.E.2552 (2009).
- Notification of Ministry of industry B.E.2547 (2004) on regulation of air pollutant quantity released from power plants and power distributors.
- Pollutant quantity released from power plants and power distributors

Type of Fuel	Standard of Air Pollutant Emission Concentration		
	TSP (mg/m^3)	NO_2 (ppm)	SO_2 (ppm)
Gas	60	120	20
Oil	120	180	260

(b) Discharge standards

b1) Discharge standards for cooling water

Blowdown cooling water - 12,232 cubic meters/day – is the cooling water held to cool down in the cooling tower basin which has a capacity of greater than 12,232 cubic meters and thus able to receive 1 day's worth of used cooling water from the cooling tower. After this water is cooled, it is sent to one of two the cooling water holding pond with 19,000 cubic meters capacity each. At any one time, only one pond is used while the other is reserved for emergencies. Afterwards, the water here will be discharged into the Hemaraj Eastern Seaboard Industrial Estate cooling water holding pond for 1 more day as per Hemaraj Eastern Seaboard Industrial Estate Amended EIA report No.2 (2015).

Moreover, the wastewater from the cooling water will meet applicable government standards such as the Notification of Ministry of Industry No. 2 (B.E. 2539) re: Prescribing Factory Wastewater Standards. Total Dissolved Solids (TDS) will meet the requirement of the Royal Irrigation Department of no more than 1,300 milligrams/liter with temperature of no more than 34 degree Celsius.

Water Quality Index	Wastewater quality from cooling tower discharge to cooling water holding pond of Hemaraj Eastern Seaboard Industrial Estate	
	The Project	Ministry of Industry[1/]
Temperature (°C)	Not over 34	Not over 40
Acidity-alkalinity (pH)	5.5-9.0	5.5-9.0
Total dissolved solid (TDS, mg/l)	Not over 1,300 [2/]	Not over 3,000

Remarks : [1/]Notification of Ministry of Industry No.2 1996, Subject : stipulate of wastewater quality discharged from industries

[2/] Standard of water quality discharged in watercourse of Ministry of Irrigation

The project is to implement an online water quality monitoring system to monitor the water in the cooling water holding pond these parameters: temperature, pH, Dissolved Oxygen (DO) and conductivity (to determine TDS). The wastewater from the cooling water will meet applicable government standards such as the Notification of Ministry of Industry No. 2 (B.E. 2539) re: Prescribing Factory Wastewater Standards. Total Dissolved Solids (TDS) will meet the requirement of the Royal Irrigation Department of no more than 1,300 milligrams/liter. Moreover, the wastewater management will comply with requirements as specified in Hemaraj Eastern Seaboard Industrial Estate Amended EIA report No. 2 approved by the Office of Natural Resources and Environmental Policy and Planning (ONEP), reference TorSor 1009.3/10241 dated 26 August 2015. The Hemaraj Eastern Seaboard Industrial Estate Revised has established an environmental protection, mitigation and monitoring plan (for the operational phase) for independent power producers (IPP).

b2) Discharge standards for process water

Wastewater from the processes include wastewater from the water treatment plant (water demineralization) coming from wastewater in the process of mixed bed regeneration and wastewater from the laboratory and consumption. Wastewater from the process will be held in one of two wastewater holding ponds with a capacity of 75 cubic meters each. Each pond can hold wastewater up to 1.5 days prior to discharge into Hemaraj Eastern Seaboard Industrial Estate central wastewater treatment system. The wastewater discharge will meet the requirements of Hemaraj Eastern Seaboard Industrial Estate as per **Table 2.1-3** using online water quality monitoring system to continuously monitor temperature, pH levels and conductivity prior to discharging from the project.

The discharge water from Hemaraj Eastern Seaboard Industrial Estate central wastewater treatment system will meet applicable government standards such as the Notification of Ministry of Industry No. 2, B.E. 2539 (1996) re: Prescribing Factory Wastewater Standards as shown in **Table 2.1-4**.

TABLE 2.1-3

Property Of Wastewater From The Industry Allowing To Discharge Into Central Wastewater Of Hemaraj Eastern Seaboard Industrial Estate

No.	Water Quality Index	Unit	Standard Index
1	Biological Oxygen Demand (BOD_5 as 20 °C)	mg/l	≤500
2	Chemical Oxygen Demand (COD)	mg/l	≤750
3	pH		5.5-9.0
4	Total Dissolved Solid (TDS)	mg/l	≤3,000
5	Suspended Solid (SS)	mg/l	≤200
6	Total Kjeldahl Nitrogen: TKN	mg/l	≤100
7	Heavy Metals		
	7.1 Mercury (as Hg)	mg/l	≤0.005
	7.2 Selenium (as Se)	mg/l	≤0.02
	7.3 Cadmium (as Cd)	mg/l	≤0.03
	7.4 Lead (as Pb)	mg/l	≤0.20
	7.5 Arsenic (as As)	mg/l	≤0.25
	7.6 Trivalent Chromium (Cr^{3+})	mg/l	≤0.75
	7.7 Hexavalent Chromium (Cr^{6+})	mg/l	≤0.25
	7.8 Barium (as Ba)	mg/l	≤1
	7.9 Nickel (Ni)	mg/l	≤1
	7.10 Copper (as Cu)	mg/l	≤2
	7.11 Zinc (as Zn)	mg/l	≤5
	7.12 Manganese (Mn)	mg/l	≤5
	7.13 Silver (as Ag)	mg/l	≤1
	7.14 Total Iron (as Fe)	mg/l	≤10
8	Sulphide (as H_2S)	mg/l	≤1
9	Cyanide as HCN	mg/l	≤0.2
10	Formaldehyde	mg/l	≤1
11	Phenols Compound	mg/l	≤1
12	Free Chlorine	mg/l	≤1
13	Chloride as Chlorine	mg/l	≤2,000
14	Fluoride	mg/l	≤5
15	Pesticide	mg/l	None
16	Temperature	°C	≤45 °C
17	Color		Color is not an abomination

No.	Water Quality Index	Unit	Standard Index
18	Odor		Color is not an abomination
19	Oil & Grease	mg/l	≤10
20	Surfactants	mg/l	≤30

Source: Notification of Industrial Estate Authority of Thailand no.78/2011 Subject : Property of wastewater from the industry allowing to discharge into central wastewater of Industrial Estate

Table 2.1-4

Industrial Effluent Standards

No.	Parameter	Standard Values
1.	pH	5.5-9.0
2.	Total Dissolved Solids (TDS)	- Not more than 3,000 mg/l or under office's consideration but not more than 5,000 mg/l
3.	Temperature	Not more than 40 °C.
4.	Suspended Solids (SS)	Not more than 50 mg/l or under office's consideration but not more than 150 mg/l
5.	Color and Odor	None
6.	Sulphide as H_2S	Not more than 1.0 mg/l.
7.	Cyanide as HCN	Not more than 0.2 mg/l.
8.	Fat. Oil & Grease (FOG)	Not more than 5.0 mg/l or under office's consideration but not more than 15 mg/l
9.	Formaldehyde	Not more than 1.0 mg/l.
10.	Phenols	Not more than 1.0 mg/l.
11.	Free Chlorine	Not more than 1.0 mg/l.
12.	Pesticides	None
13.	Biochemical Oxygen Demand (BOD)	Not more than 20 mg/l depending on physical geography or under office's consideration but not more than 60 mg/l
14.	Total Kjedahl Nitrogen (TKN)	Not more than 100 mg/l depending on office's consideration but not more than 200 mg/l
15.	Chemical Oxygen Demand (COD)	Not more than 120 mg/l depending on office's consideration but not more than 400 mg/l
16.	Heavy metals	
16.1	Zinc (Zn)	Not more than 5.0 mg/l.
16.2	Chromium (Hexavalent)	Not more than 0.25 mg/l.
16.3	Chromium (Trivalent)	Not more than 0.75 mg/l.
16.4	Copper (Cu)	Not more than 2.0 mg/l.
16.5	Cadmium (Cd)	Not more than 0.03 mg/l.
16.6	Barium (Br)	Not more than 1.0 mg/l.
16.7	Lead (Pb)	Not more than 0.2 mg/l.
16.8	Nickel (Ni)	Not more than 1.0 mg/l.
16.9	Manganese (Mn)	Not more than 5.0 mg/l.

No.	Parameter	Standard Values
16.10	Arsenic (As)	Not more than 0.25 mg/l.
16.11	Selenium (Se)	Not more than 0.02 mg/l.
16.12	Mercury (Hg)	Not more than 0.005 mg/l.

Sources: Notification of the Ministry of Industry, No. 2, B.E.2539 (1996) issued under the Factory Act B.E.2535 (1992)

(3) IEAT Regulations

The Sriracha Power Plant Project will follow IEAT regulations. Construction and operation phase of Sriracha Power Plant must correspond to Hemaraj ESIE regulation.

(4) EIA Regulations

Notification of Natural Resources and Environmental Ministry B.E.2555 (2012) on regulation of types and specifications of projects or businesses that requires an environment impact assessment (EIA) including the principles, procedures, practices and guidelines of EIA preparation.

2.1.2 CONCERNED ADB REGULATIONS

(1) Social Protection Strategies (2001)

As the project shall create temporary and permanent employments for skilled and unskilled labors, the project will fully comply with ADB's Social Protection Strategy (2001) which upholds international recognized labor standards and/or national labor laws, particularly on the following conventions: (1) no harmful or exploitative forms of forced labor, (2) no child labor, (3) no discrimination in respect of employment and occupation, and (4) no restrictions of freedom of association and the effective recognition of the right to collective bargaining.

(2) Safeguard Policy Statement (2009)

ADB's safeguard policy statement (SPS) was issued in 2009 and applies to all projects funded by ADB since 20 January 2010. This operational policy revision

resulted in a consolidated policy outlining common objectives of ADB's safeguards, policy principles, and delivery process for the SPS. It also outlines a set of specific safeguard requirements when addressing social and environmental impacts and risks. The Sriracha Power Plant project will fully comply with the relevant ADB's safeguard policy throughout the project operation period.

ADB's safeguard policy statement consists of three operational policies on the Environment, Indigenous Peoples, and Involuntary Resettlement. Objectives of ADB's environmental and social safeguards are to: (i) avoid adverse impacts of projects on the environment and affected people, where possible; (ii) minimize, mitigate, and/or compensate for adverse project impacts on the environment and affected people when avoidance is not possible, and (iii) help borrowers/clients to strengthen their safeguard systems and develop the capacity to manage environmental and social risks. Since the project is Category A for environment, Safeguard Requirements 1: Environmental and eleven policy principles have been triggered (referred to page 16 of the SPS, 2009).

2.2 SCOPE OF THE EIA STUDY

The study of the project's environmental resources is mainly relied on the methods of environmental impact assessment defined by the Office of Natural Resources and Environmental Policy and Planning. The methods are composed of reviewing secondary data from related governmental agencies, compiling relevant reports and conducting field survey. In addition, the study of the project is chiefly emphasized on potential impact associated to the project which is expected to be affected by the project and/or generated impact to the project during construction and operation periods.

Environmental resources are studied as follow:

(1) Physical Resources consisting of

- Topography/Geology and Seismic
- Soil Resources
- Climate and Air Quality

- Noise
- Surface Water Hydrology
- Surface Water Quality
- Hydrogeology
- Groundwater Quality

(2) Biological Resources consisting of

- Aquatic Ecology
- Terrestrial Ecology

(3) Human Use Values consisting of

- Land Use
- Transportation
- Water Use
- Electricity Use
- Drainage and Flood Control
- Solid Waste Management

(4) Quality of Life Values consisting of

- Socio-Economics
- Public health/Occupational health and safety
- Historical and Archaeological Sites
- Aesthetic and Tourism
- Major Hazard Assessment

The study of environmental aspects are based on compilation of related data, documents and reports such as mitigation measure and impact relief report, monitoring program and examination of environmental impact assessment during construction period of the Hemaraj ESIE and other related reports. Besides, activity of public

participation has been implemented by coordinating with local government agencies and local dwellers in order to continuously disseminate information of the project. Meanwhile, the study of health impact assessment has been based on compiled public health implementation reports from relevant government agencies.

2.3 METHODOLOGY

The information used in this study comprises both primary and secondary data as shown in **Table 2.3-1**.

TABLE 2.3-1

Methods of the study and data compilation for the Sriracha Power Plant Project

Potential Impact	Studied Areas	Source of data
1. Topography/Geology/Seismic	• 5-km radius from the project location and project location	• Collected data from topographic map at scale 1:50,000 and conducted field survey. • Collected data from the Department of Geology and the Department of Meteorology.
2. Soil resources	• 5-km radius from the project location and project location	• Collected data from topographic map at scale 1:50,000. • Collected secondary data from geographic information system (GIS) of the Land Development Department. • Collected 5 soil samples on 14 January 2015
3. Climate and air quality	• Climate of eastern part, especially at the project location. The data was from the nearest meteorological station.	• Collected secondary data from meteorological station near the project area. • Measured air quality for 5 stations including project area, child development center of Chomphon Chao Phraya Sub-district Municipality, Ban Khlong Kram School, Wat Rawoeng Rangsan and Ban Nong Kang Pla for 7 consecutive days covering 2 seasons: dry season during 4-11 February 2014 and wet season during 14-21 August 2014.

TABLE 2.3-1 (Cont'd)

Potential Impact	Studied Areas	Source of data
4. Noise	• 5-km radius from the project location	• Collected data from relevant documents and reports. • Measured noise level for 3 stations including project area, Chumchon Borisat Namtan Tawan-aok School and Wat Chomphon Chao Phraya for 5 consecutive days during 5-10 February 2014.
5. Surface water hydrology	• 5-km radius from the project location	• Collected data from relevant documents and reports.
6. Surface water quality	• Collected water samples from surface water sources within 5-km radius from the project location	• Collected data from relevant documents and reports. • Collected water sample from Khlong Kram at 5 locations including at 500 meters before project area, Mab Kra Don marsh, potable water pumping station of Chompon Chao Phraya Sub-district Municipality, effluent outlet of Hemarag ESIE and at 500 meter downward from the effluent outlet covering 2 seasons: dry season on 20 February 2014 and wet season on 18 August 2014.
7. Hydrogeology	• Collected data from relevant documents and reports.	• Collected data from relevant documents and reports.
8. Groundwater quality	• Collected groundwater samples from	• Collected data from relevant documents and reports.

TABLE 2.3-1 (Cont'd)

Potential Impact	Studied Areas	Source of data
	groundwater wells within 5-km radius from the project location	• Collected groundwater samples from 2 utilized wells near the project area including well in Wat Chompon Chao Phraya and Ban Surasak School covering 2 seasons: dry season on 21 February 2014 and wet season on 8 May 2015.
9. Aquatic ecology	• Collected plankton and benthos from surface water sources within 5-km radius from the project location	• Collected plankton and benthos from Khlong Kram at 5 locations including at 500 meters before project area, Mab Kra Don marsh, potable water pumping station of Chompon Chao Phraya Sub-district Municipality, effluent outlet of Hemarag ESIE and at 500 meter downward from the effluent outlet covering 2 seasons: dry season on 20 Febuary 2014 and wet season on 18 August 2014.
10. Terrestrial ecologh	• 5-km radius from the project location	• Collected data from relevant documents and reports and conducted field survey.
11. Land use	• 5-km radius from the project location	• Collected relevant secondary data. • Conducted field survey during 9-13 February 2014.
12. Transportation	• Traffic around the project area and the nearby area	• Collected secondary data of traffic from the Department of Highways. • Traffic count at rural road RorYor.0403 (Pluak Daeng-Sugar factory) during 2-3 March 2014.

TABLE 2.3-1 (Cont'd)

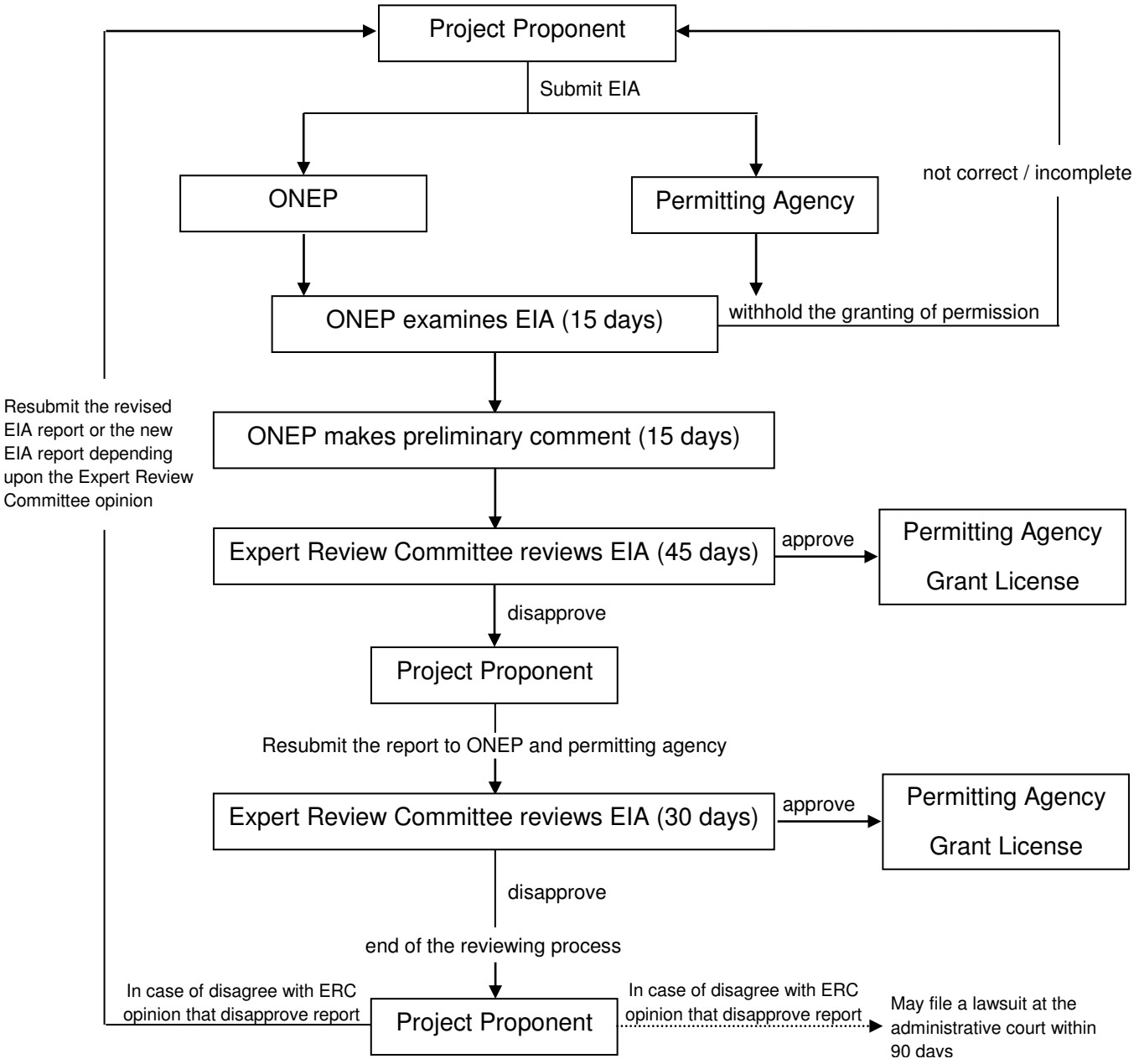
Potential Impact	Studied Areas	Source of data
13. Water use	• 5-km radius from the project location	• Collected water use data from the project and relevant agencies.
14. Electricity use	• 5-km radius from the project location	• Collected data from the Provincial Electricity Authority.
15. Drainage and flood control	• 5-km radius from the project location	• Collected relevant secondary data. • Conducted field survey.
16. Solid waste management	• 5-km radius from the project location	• Collected solid waste management from the project and relevant local agencies.
17. Socio-economics	• Communities within 5-km radius from the project location	• Collected socio-economics data of communities from Si Racha District, Nong Yai District, Ban Bueng District and Pluak Daeng District as well as from all Sub-district Administrative Organization within the study area. • Interviewed entrepreneurs, head of education institutions and community headmen within the nearby area to obtain socio-economics data and opinions toward the project development. The interview conducted during 8-11 September 2014 and conducted additional interview on community headmen in February 2015.
18. Public health/ Occupational health and safety	• Communities within 5-km radius from the project location	• Collect secondary data from hospitals, District Public Health Office including Si Racha District, Ban Bueng Ddistrict, Nong Yai District and Pluak Daeng District as well as Tambon Health

TABLE 2.3-1 (Cont'd)

Potential Impact	Studied Areas	Source of data
		Promoting Hospitals. • Interviewed local public health officers within the study area, and obtain health status data of local people from household interview.
19. Historical and archeological sites	• 5-km radius from the project location	• Collected relevant secondary data. • Conducted field survey during 9-13 February 2014.
20. Aesthetic and tourism	• 5-km radius from the project location	• Collected relevant secondary data. • Conducted field survey during 9-13 February 2014.
21. Public participation	• 5-km radius from the project location	• Consulted with governmental agencies, educational institutions, religious institutions and community headmen. • Held meeting 2 times including the first during 21 July– 7 August 2014 and the second during 25 – 29 May 2015.

2.4 ONEP EIA REVIEW AND APPROVAL PROCESS

The EIA report of Natural Gas Pipeline to Sriracha Power Plant Project must be submitted to ONEP for review and approval according to the following procedural scheme;



2.5 EIA APPROVAL

This EIA report submitted to ADB was rearranged from EIA report prepared under the requirement of regulation, issued by Ministry of Natural Resources and Environment (MNRE) of Thailand, specifying type and size of projects that will need detail EIA report to meet outline of an environmental impact assessment report (part of the Safeguard Requirement 1) of ADB. The contents of Thai EIA report in comparison with those of ADB EIA report are shown in **Table 2.5-1**. According to **Table 2.5-1**, although contents of Thai EIA do not cover all those of ADB EIA report, the missing contents were fulfilled.

The status of EIA approval is as follows:

- The EIA report of Sriracha Power Plant Project was approved on 2 December 2015.

- The EIA report of Natural Gas Pipeline to Sriracha Power Plant is in the stage of EIA study and report preparation.

TABLE 2.5-1

Comparison between Contents of Thai EIA Report and those of ADB EIA Report

Content of Thai EIA Report	Content of ADB EIA Report
1. Introduction This section describes background information, purpose of the project, justification and essence of project operation, objective of report as well as content and methodology of studies.	-

TABLE 2.5-1 (Cont'd)

Content of Thai EIA Report	Content of ADB EIA Report
-	**2. Policy, Legal, and Administrative Framework** This section discusses the national and local legal and institutional framework within which the environmental assessment is carried out. It also identifies project-relevant international environmental agreements to which the country is a party.
2. Project Description This section describes the project in a way that the project can be clearly understood and visualized. Detailed information shall include project type, project location, project operation method and its supporting activities as well as plant layout with appropriate scale and direction. If the project will cause major impacts to the environmental resource and human life quality, there should be consideration for alternative ways to develop project, including no action. For each alternative, consideration must be based on project engineering, economic and environmental impacts equally. Comparison of advantage and disadvantage of each alternative must be pointed out, e.g. project site for port.	**3. Description of the Project** This section describes the proposed project; its major components; and its geographic, ecological, social and temporal context, including any associated facility required by and for the project (for example, access roads, power plants, water supply, quarries and borrow pits, and spoil disposal). It normally includes drawings and maps showing the project's layout and components, the project site, and the project's area of influence. **6. Analysis of Alternatives** This section examines alternatives to the proposed project site, technology, design, and operation-including the no project alternative-in terms of their potential environmental impact; the feasibility of mitigating these impacts;

TABLE 2.5-1 (Cont'd)

Content of Thai EIA Report	Content of ADB EIA Report
Several sites must be studied. It should give description to show suitability of each site. The study must also consider alternatives that serve similar purpose but have different impacts to environment.	their capital and recurrent costs; their suitability under local conditions; and their institutional, training, and monitoring requirements. It also states the basis for selecting the particular project design proposed, and justifies recommended emission levels and approaches to pollution prevention and abatement.
3. Existing Environmental Condition This section provides detailed information and related photos of non-restorable and restorable physical and biological natural resources and environment, describes details about human using value and quality of life value including existed problems within the surrounding area of the project and provides maps displaying existing environment conditions and land using surrounding the project as well as potentially impacted areas for both short and long terms.	**4. Description of the Environment (Baseline Data)** This section describes relevant physical, biological, and socio-economic conditions within the study area. It also looks at current and proposed development activities within the project's area of influence, including those not directly connected to the project. It indicates the accuracy, reliability, and sources of the data.
4. Public Participation This section describes the process undertaken during EIA process for engaging stakeholders, including information disclosure and consultation with affected people and other	**7. Information Disclosure, Consultation, and Participation** This section: (i) describes the process undertaken during project design and prepare action for engaging stakeholders,

TABLE 2.5-1 (Cont'd)

Content of Thai EIA Report	Content of ADB EIA Report
stakeholders; and summarizes comments and concerns received from affected people and other stakeholders and how these comments have been addressed.	including information disclosure and consultation with affected people and other stakeholders; (ii) summarizes comments and concerns received from affected people and other stakeholders and how these comments have been addressed in project design and mitigation measures, with special attention paid to the needs and concerns of vulnerable groups, including women, the poor, and indigenous peoples; and (iii) describes the planned information disclosure measures (including the type of information to be disseminated and the method of dissemination) and the process for carrying out consultation with affected people and facilitating their participation during project implementation.

TABLE 2.5-1 (Cont'd)

Content of Thai EIA Report	Content of ADB EIA Report
5. Environmental Impact Assessment Direct and indirect, short and long term environmental impacts from the project must be assessed. Application for construction permit must include study on the impacts during construction period. The study should address the severity of the impact to human in each element listed in Chapter 3. It should also include irreversible and irretrievable loss of environmental value, based on present assessment and future predicted impacts, resulting from technical basis. Prediction of impacts on complex environmental conditions can be predicted by using mathematics model to improve accuracy.	**5. Anticipated Environmental Impacts and Mitigation Measures** This section predicts and assesses the project's likely positive and negative direct and indirect impacts to physical, biological, socio-economic (including occupational health and safety, community health and safety, vulnerable groups and gender issues, and impacts on livelihoods through environmental media, and physical cultural resources in the project's area of influence, in quantitative terms to the extent Possible; identifies mitigation measures and any residual negative impacts that cannot be mitigated; explores opportunities for enhancement; identifies and estimates the extent and quality of available data, key data gaps, and uncertainties associated with predictions and specifies topics that do not require further attention; and examines global, transboundary, and cumulative impacts as appropriate.
6. Health Impact Assessment This section focuses on impacts from	-

TABLE 2.5-1 (Cont'd)

Content of Thai EIA Report	Content of ADB EIA Report
project development on health by using the result from chapter 4 and data from medical centers around project site to assess health impact of sensitive groups.	
7. Environmental Action Plan This section must describe project operation to prevent and correct impacts to environmental resources and value as described in Chapter 4 and engage recommendation and suggestion from the community to action plan. In case of irreversible and irretrievable environmental damage, the report must suggest practical plan to compensate for this damage. The plan must describe in the practical method to replaced destroyed resources. This section must also describe the monitoring plan, and confirm the effectiveness of the measures to prevent and control pollution as presented in the report, in a suitable, systematic, continuous and technological way. Monitoring plan should aim at measuring the environmental impacts from project construction through to project operation. The plan should include description of monitoring site,	**8. Grievance Redress Mechanism** This section describes the grievance redress framework (both informal and formal channels), setting out the time frame and mechanisms for resolving complaints about environmental performance. **9. Environmental Management Plan** This section deals with the set of mitigation and management measures to be taken during project implementation to avoid, reduce, mitigate, or compensate for adverse environmental impacts (in that order of priority). It may include multiple management plans and actions. It includes the following key components (with the level of detail commensurate with the project's impacts and risks): (i) Mitigation: (a) identifies and summarizes anticipated significant adverse environmental impacts and risks; (b) describes each mitigation measure

TABLE 2.5-1 (Cont'd)

Content of Thai EIA Report	Content of ADB EIA Report
parameters, frequency, environmental standard and measuring method, and period of reporting.	with technical details, including the type of impact to which it relates and the conditions under which it is required (for instance, continuously or in the event of contingencies), together with designs, equipment descriptions, and operating procedures, as appropriate; and (c) provides links to any other mitigation plans (for example, for involuntary resettlement, indigenous peoples, or emergency response) required for the project. (ii) Monitoring: (a) describes monitoring measures with technical details, including parameters to be measured, method to be used, sampling locations, frequency of measurements, detection limits and definition of thresholds that will signal the need for corrective actions; and (b) describes monitoring and reporting procedures to ensure early detection of conditions that necessitate particular mitigation measures and document the progress and results of mitigation. (iii) Implementation arrangements:

TABLE 2.5-1 (Cont'd)

Content of Thai EIA Report	Content of ADB EIA Report
	(a) specifies the implementation schedule showing phasing and coordination with overall project implementation; (b) describes institutional or organizational arrangements, namely, who is responsible for carrying out the mitigation and monitoring measures, which may include one or more of the following additional topics to strengthen environmental management capability: technical assistance programs, training programs, procurement of equipment and supplies related to environmental management and monitoring, and organizational changes; and (c) estimates capital and recurrent costs and describes sources of funds for implementing the environmental management plan. (iv) Performance indicators: describes the desired outcomes as measurable events to the extent possible, such as performance indicators, targets, or acceptance criteria that can be tracked over defined time periods.

TABLE 2.5-1 (Cont'd)

Content of Thai EIA Report	Content of ADB EIA Report
Summary report must be prepared and shall contain the following substantial matters: 1. Type and size of the project including related activities 2. Project location with picture and map together with related maps demonstrating environmental components in the area that may be impacted by the project in scale of 1:50,000 or other appropriate scales 3. Alternative for project location and operation method that supported justification and consideration of selecting such proposed alternatives.	**1. Executive Summary** This section describes concisely the critical facts, significant findings, and recommended action.
-	**10. Conclusion and Recommendation** This section provides the conclusions drawn from the assessment and provides recommendations.

CHAPTER 3

DESCRIPTION OF THE PROJECT

3.1 PROJECT LOCATION

The Sriracha Power Plant Project covers an area of 441 rai or approximately 450 rai. The whole site is comprised of 24 plots of land with legal land title deeds as per **Table 3.1-1**, **Figure 3.1-1** and **Appendix 2A**. The site is located within the Hemaraj Eastern Seaboard Industrial Estate (Hemaraj ESIE), Khao Khansong Sub-district, Si Racha District, Chon Buri Province. It is approximately 140 km east of Bangkok as per **Figure 3.1-2** and **Figure 3.1-3**. The Hemaraj ESIE is showed in **Figure 3.1-4**. The sensitive areas in study area of project is shown in **Table 3.1-2**. The project boundaries adjoining the following:

- North - adjoins Map Kradon pond.
- South - adjoins a gravel road, next is Wat Chomphon Chaophraya.
- East - adjoins road number RorYor 0403 (Pluak Daeng – Rong Namtan).
- West – adjoins HESIE 1 road and LLIT Thailand Co., Ltd.

Directions from Bangkok to the project area: take highway number 7 (motorway), turn left at Laem Chabang interchange onto highway 331 for 16 km, go under another interchange then keep left and turn left towards Pluak Daeng District on rural highway number ChorBor 3027 for 5 km. Turn right onto highway number 3574 for 2.4 km, at the intersection turn right onto HESIE 1 road for 1.7 km until the bridge over Khlong Kram where the project location begins at raw water pond that is located on the left as shown in **Figure 3.1-5**.

3.2 CONSIDERATION OF PROJECT IMPLEMENTATION ALTERNATIVES

The consideration on alternatives of the project implementation has been conducted based on Annex 3: the guideline for conducting an environmental impact assessment report following the Notification of the Ministry of Natural Resources and Environment dated June 20, 2012 re: prescribing categories, sizes and procedures of projects or businesses which are required to prepare environmental impact assessment report and to appraise project implementation alternatives on either site selection or method of project implementation.

TABLE 3.1-1

THE SUMMARY OF LEGAL LAND TITLE DEEDS OF SRIRACHA POWER PLANT PROJECT

Project area			
No.	No. of title deed	Total area (Rai)	Remark
1	156490	16.72950	
2	156489	16.90775	
3	170379	1.47150	
4	170383	23.63600	
5	156488	1.55675	
6	170384	3.80700	
7	170386	16.73625	
8	170385	16.73525	
9	170373	15.90975	
10	170374	0.05775	
11	170375	2.72625	
12	170376	0.53525	
13	170387	15.01000	
14	170388	6.80550	
15	170390	9.51575	
16	170377	2.91550	
17	179895	123.66575	
18	179890	0.57450	
19	179892	29.69325	A part of No. title deed 179892
20	170402	3.70100	A part of No. title deed 170402
21	170393	132.26275	A part of No. title deed 170393
22	179892	0.06675	A part of No. title deed 179892
23	170393	9.65700	A part of No. title deed 170393
24	170402	0.37875	A part of No. title deed 170402
Total of Buffer Zone		**10.10250**	
Total Area		**451.05550**	

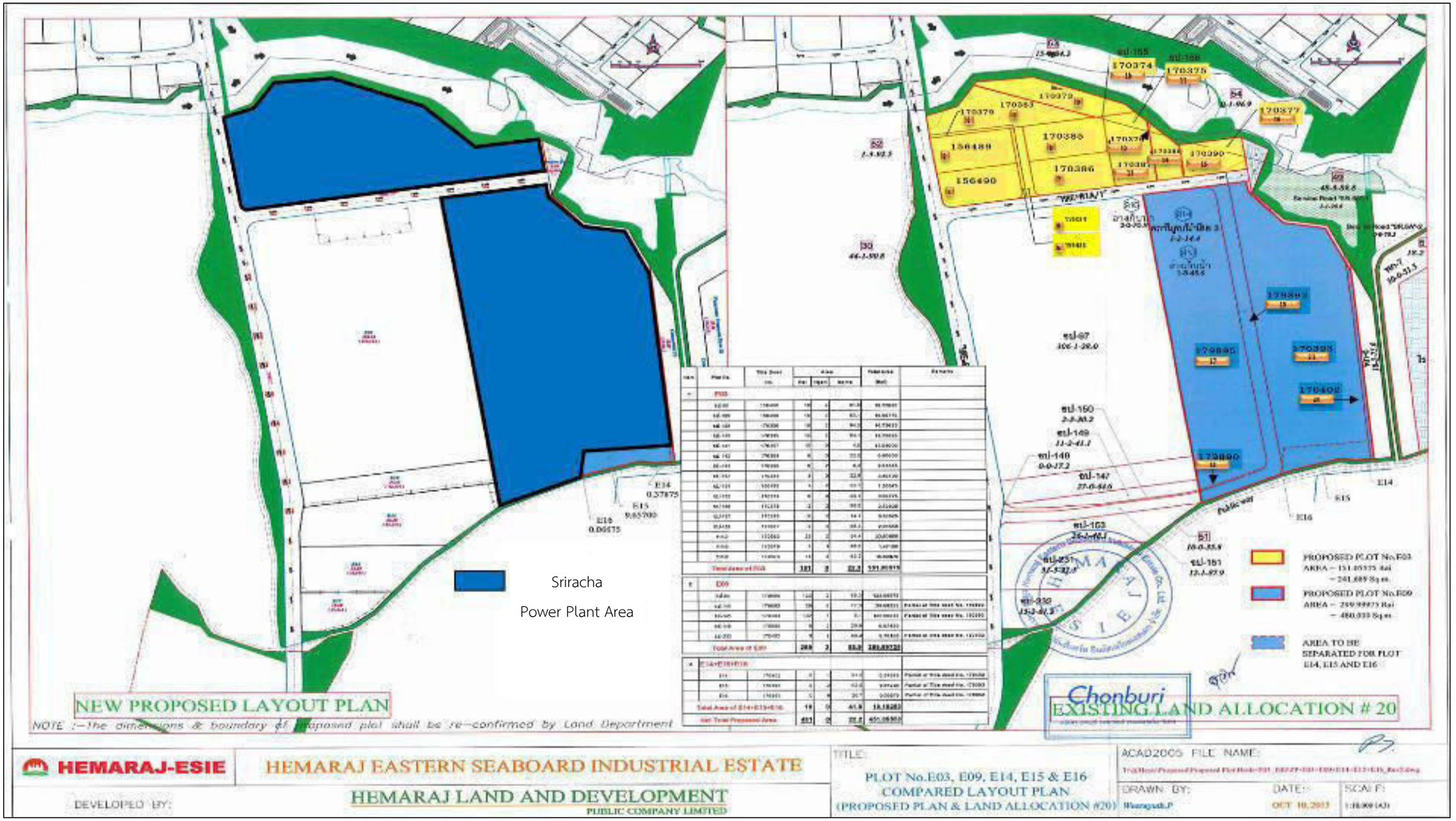


FIGURE 3.1-1 : SRIRACHA POWER PLANT PROJECT LAYOUT PLAN WITH LAND TITLE DEEDS

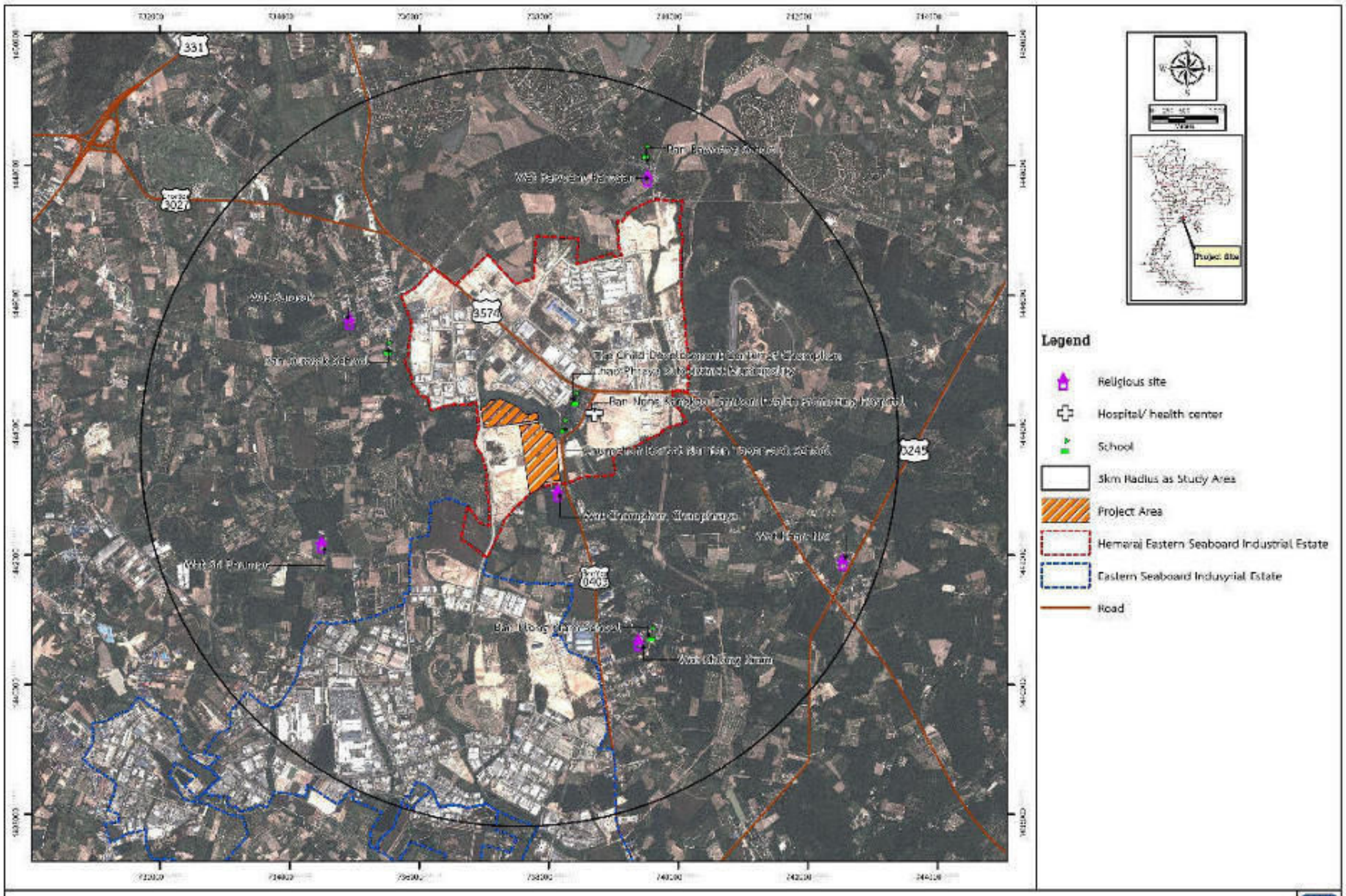


FIGURE 3.1-2 : SRIRACHA POWER PLANT LOCATION

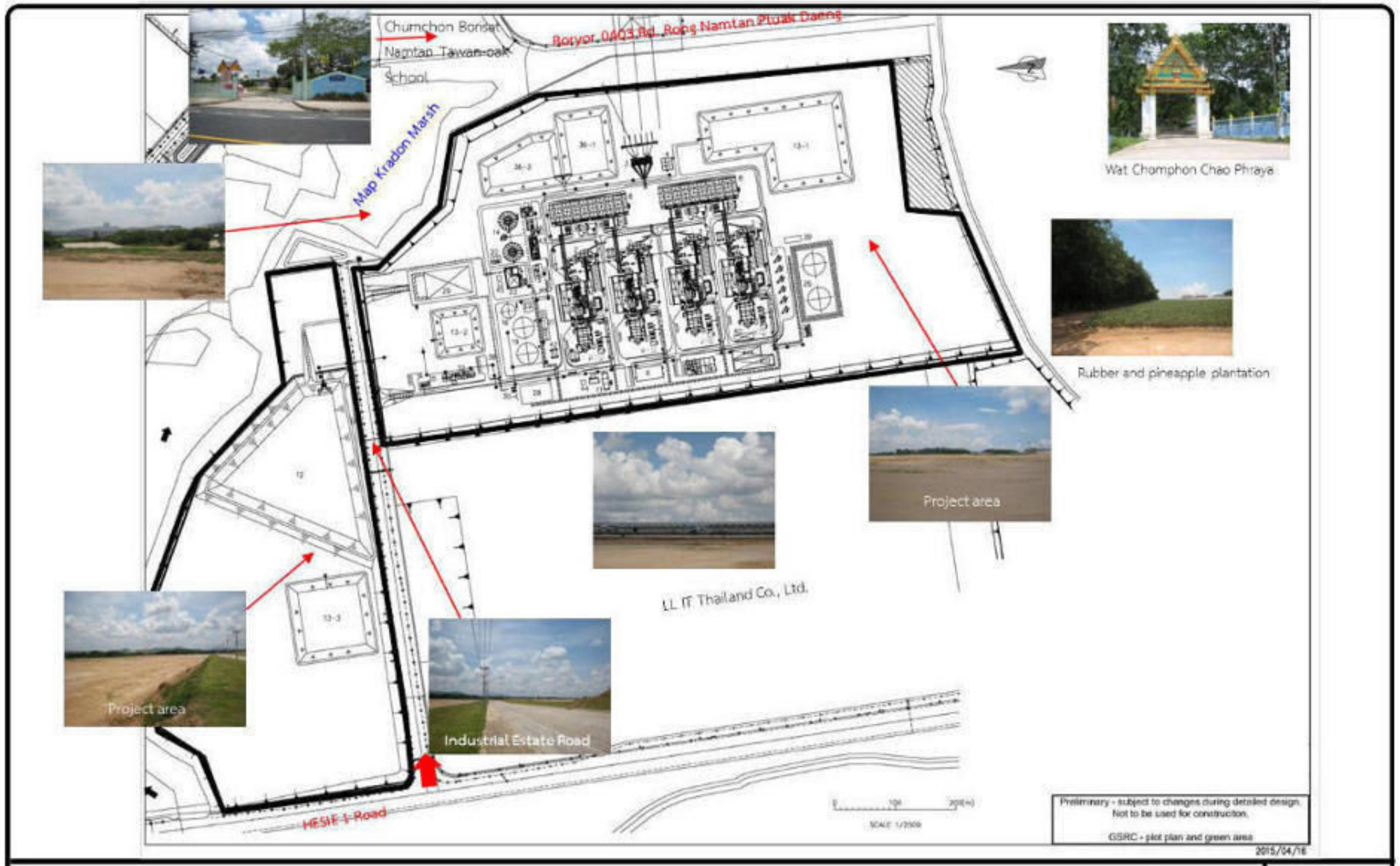


FIGURE 3.1-3 : PHOTOS OF CURRENT PROJECT LOCATION AND ITS BOUNDARIES IN ALL 4 DIRECTIONS

TEAM

FIGURE 3.1-4 : MASTER PLAN OF HEMARAJ EASTERN SEABOARD INDUSTRIAL ESTATE

TABLE 3.1-2

DETAIL OF SENSITIVE AREA OF PROJECT

No.	Sensitive area	Coordinate		Distance from edge of project (km) / direction
1	Ban Nong Kangkao Tambon Health Promoting Hospital	0736670 E	1444193 N	0.72 km / NE
2	The Child Development Center of Chomphon Chao Phraya Sub-district Municipality	0738385 E	1444332 N	0.59 km / NE
3	Ban Rawoeng School	0739465 E	1447937 N	4.15 km / NE
4	Ban Surasak School	0735513 E	1445160 N	1.70 km / NW
5	Chumchon Borisat Namtan Tawan-aok School	0738240 E	1443962 N	0.25 km / NE
6	Ban Khlong Kram School	0739608 E	1440828 N	2.70 km / SE
7	Wat Rawoeng Rangsan	0734481 E	1447753 N	4.00 km / NE
8	Wat Surasak	0734982 E	1445653 N	2.47 km / NW
9	Wat Chompon Chao Phraya	0738141 E	1442890 N	0.21 km / S
10	The Praow Village	0737840 E	1442928 N	0.08 km / S
11	Wat Khlong Kram	0739585 E	1440745 N	2.77 km / SE
12	Wat Khao Noi	0742503 E	1441962 N	4.50 km / SE
13	Wat Sri Phumpo	0734479 E	1442349 N	2.99 km / SW
14	Moo 7 Ban Rawoeng, Khao Kansong Sub-district	0739638 E	1447844 N	4.77 km / NE
15	Moo 5 Ban Surasak, Khao Kansong Sub-district	0735432 E	1445557 N	3.23 km / NW
16	Moo 7 Ban Nong Kang Pla, Bo Win Sub-district	0734933E	1443371N	2.90 km / W
17	Moo 3 Ban Nong Kangkao, Tasit Sub-district	0736244E	1446493N	3.43 km / NW
18	Moo 2 Ban Kaorakang, Tasit Sub-district	0740242E	1440895N	3.47 km / SE
19	Moo 1 Ban Khlongkram, Tasit Sub-district	0739736E	1440895N	3.12 km / SE
20	Chaophraya Community, Chompon Chaophraya Sub-district Municipality	0738415E	1444169N	0.88 km / NE
21	Chompon Community, Chompon Chaophraya Sub-district Municipality	0738514E	1444249N	1.00 km / NE

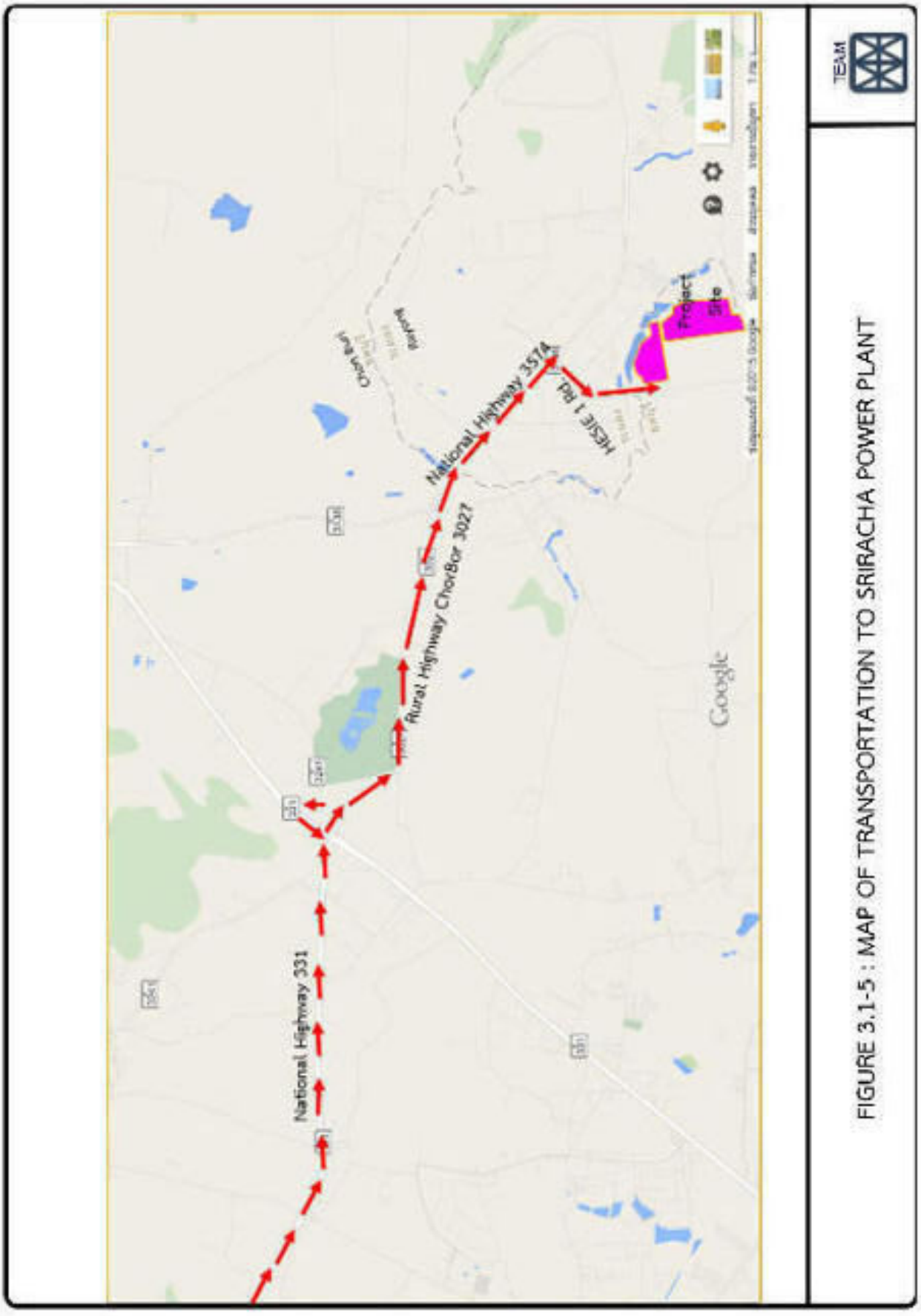


FIGURE 3.1-5 : MAP OF TRANSPORTATION TO SRIRACHA POWER PLANT

3.2.1 CONSIDERATION OF PROJECT SITE LOCATION CRITERIA

The reasons for alternative consideration of the project implementation within Chon Buri and Rayong Provinces are mainly due to high electricity demand of the provinces and the target area located is in vicinity of Bangkok, the national economic center. The advantages of such location for the provinces and for the entire nation are as follows:

- Majority of the Small Power Producers (SPP) are mostly located in the area of Industrial Estate or Industrial Park, where high electricity demand from industries in the area exists. Insufficient electricity in the Industrial area may cause black-out or electricity shortage which directly affects the industries, and local people.
- All of the Independent Power Producers (IPP) supply their electricity to EGAT to help maintaining national power stability.

In order to conduct the project implementation with least impacts to the environment and make feasible the design and investment, the consideration of project location alternatives is an extremely important procedure. Meanwhile, the Office of the Natural Resources and Environmental Policy and Planning has specified the concept for studying alternative of project location which is a process for initial screening for making decision to choose the most suitable location of the project area. However, the project implementation may cause direct impacts to environmental quality and any vulnerable environmental parameters such as air quality, water quality, and community etc., during the construction period and operation period. Those impacts may result in concerns about wastewater quality and air quality. Thus, the project location selection must be thoughtfully conducted to prevent and mitigate any impacts to community and its environment. In addition, the selected location must possess feasible engineering, construction and maintenance as well as appropriate investment. Accordingly, the criteria of the project location consideration are specified as follows:

- Mainly utilize the areas of the industrial estates or industrial parks to mitigate impacts on people's land use
- Avoid historic areas or archaeological sites
- Located in the areas with energy network or natural gas pipeline
- Have feasible engineering for both construction and maintenance
- Have enough basic infrastructure to support the need of the project

- Cause the least impact on sensitive environmental areas such as communities, religious places, schools, governmental offices, hospitals, etc.
- Avoid the areas specified in the attachment of the Notification of the Ministry of Natural Resources and Environment as specific conservative areas which have been protected by laws.

The project location selection has been conducted based on the above mentioned criteria. The selected project location is in the area of the Hemaraj ESIE which has been developed to support and facilitate industrial plants with provided basic infrastructure facilities.

Furthermore, the environmental impact assessment report of the Hemaraj ESIE was amended the project description and was approved by the Office of the Natural Resources and Environmental Policy and Planning as indicated in the official letter No. TorSor 1009.3/10241 dated August 26, 2015. Moreover, further consideration on other related issues can be summarized as follows:

- According to a consideration on laws of city planning and prescription on future land use of Chon Buri and Rayong Provinces, the project location is not included in the boundary of the Comprehensive Master Plan. In addition, the location of the project is within the area which has been specifically developed for industry. Hence, this mitigates any impacts on community and other areas.
- According to a consideration of areas with energy network or natural gas pipeline, the location of the project is near the natural gas pipeline of the Petroleum Authority of Thailand (PPT) Co., Ltd. (Public). Additionally, the project location is near the electricity transmission line of the Electricity Generating Authority of Thailand.

3.2.2 TECHNIQUES AND METHODS OF THE PROJECT

(1) Principle and Considering Methods

According to the project location consideration coupling with the project development friendly to environment and community for sustainability, the project has adopted the criteria for alternative consideration defined by the Office of Natural Resources and Environmental Policy and Planning (ONEP) to appraise alternative methods

of the project implementation. So, factors adopted by the project for consideration on methods of project implementation are as follows:

(a) Electricity Generation Technologies

Currently, electricity generation technologies are divided into 3 main types and the details of each alternative power plant are as follows:

- **Fossil Fuel Power Plant**

Recently, fossil fuel power plant is mostly utilized. This power plant is a system of devices for the conversion of fossil fuel energy to mechanical energy that drives electric generator. Fossil fuel power plant can be divided by types of machinery as the following:

- **Steam Turbine Power Plant**

A principle of steam turbine power plant is to boil water to become superheated steam at extremely high temperature and high pressure in order that the steam drives the steam turbine connecting to an electric generator for generating electricity. After the steam expands through the turbine, it exits the turbine, then, it is cooled and condensed back to water in the cooling system. This condensate is then pumped to the boiler for boiling in order that steam repeatedly drives the steam turbine.

- **Combined Cycle Power Plant**

Combined cycle power plant is more efficient than steam turbine power plant because the combined cycle power plant has 2 steps for transmitting heat energy to mechanical energy. An additional part of the combined cycle power plant, which is more than steam turbine power plant, is a gas turbine. Commonly used fuel is natural gas or diesel oil. At first step, natural gas or diesel oil will be injected into combustion chamber, generating hot gas with high pressure exhausts. The hot gas will drive gas turbine; consequently, it produces two-third of energy. Hot gas which passes through gas turbine is still high in temperature. Consequently, it can be used for boiling water (Heat Recovery Steam Generator). Then, vapor is used for driving gas turbine and generating one-third of energy. This type of power plant is commonly found in Thailand such as Rayong, Wang Noi and Kheang Koi 2 power plants.

- **Gas Turbine Power Plant**

Gas turbine power plant is composed of gas turbine which is similar to a combined cycle power plant, but without boiler. However, hot gas exhausted by the gas turbine is discharged without reuse. Accordingly, producing cost of this power plant is

high if it uses diesel oil as fuel. However, producing cost of the power plant will be a little cheaper if it uses natural gas as fuel. This type of power plant will be operated only during high demand of electricity because it can be rapidly started as well as stopped. However, the efficiency of this power plant is lower than that of a steam turbine power plant and that of a combined cycle power plant. This power plant is low in efficiency, nevertheless, electric generating system still needs this power plant to generate electricity during short period of peak electricity demand. The gas turbine will stop generating electricity when electricity demand becomes low. Currently, gas turbine power plants in operation are such as Lan Krabue Power Plant, Surat Thani Power Plant, Wellgrow SPP2 Rayong Province power plants, etc.

- **Diesel Engine Power Plant**

Diesel engine power plant uses diesel engine as a source of energy. This type of power plant is small in size, and electricity producing cost is high. Currently, in Thailand, this type of power plant is no longer used excepted for the power plant of the Electricity Generating Authority of Thailand in Mae Hong Son Province. Besides, industries or big building often has emergency generator when the main generator is out of order. This emergency generator uses diesel engine to generate electricity.

- **Hydro Power Plant**

Principle of hydro power plant is to store water at high level by constructing dam connected to water pipe lining down to the hydro power plant at lower level. The water flowing through the pipe at high pressure directs through a turbine to generate electricity. The hydro power plant generates electricity without gas emissions such as nitrogen oxides, sulfur dioxide, etc. In addition, the hydro power plant has no cost of fuel for generating electricity. Besides, water discharged from the process of electric generating can be used for consumption and irrigation. Hydro power plants in Thailand are such as Bhumibol Hydro Power Plant, Sirikit Hydro Power Plant, Srinakarin Hydro Power Plant and Lamtakong Jolabha Vadhana Hydro Power Plant, etc.

- **Alternative Power Plant**
  - **Wind Power Plant**

Wind power plant or wind turbine is classified as alternative energy by using only wind as a source of energy to generate electricity. Thus, a location of the plant is mainly located in an area where strong wind could be expected for the whole year. Recently, this type of the power plant is not popular and needs further development.

A wind power plant is currently operating at Laem Phromthep, Phuket Province with capacity of 192 kilowatt (kW), West Huay bong 2 and 3 wind power plant, Dan Khun Thot District Nakhon Ratchasima Province with capacity of 103.5 MW.

- **Solar Cell Power Plant**

Solar cell power plant is classified as alternative energy similar to wind power plant. Electricity generation will be by placing sets of solar cells on the roof or open areas for receiving sunlight as much as possible. As a result, the electricity is direct current, so it cannot be used with electric equipment in household. Direct current electricity must be converted to alternating current prior to the uses. The generated power can be transmitted via transmission lines of the Metropolitan Electricity Authority and Provincial Electricity Authority.

Technology which is selected for the project is a combined cycle power plant. This type of the power plant utilizes efficient technology to generate electricity as it uses residual energy from combustion as energy for the next step of electricity generation. Consequently, this technology efficiently utilizes resource.

(b) Controlling Technology

Air pollution which arises during the operation period of a combined cycle power plant is a result of fuel combustion activity during the operation of gas turbine (Combustion Turbine). The main contaminant of air pollution is nitrogen oxides (NOx). Volume of nitrogen oxides will be more or less depending mainly on nitrogen oxides control technology of gas turbine. Nitrogen oxides is produced from the combustion where nitrogen reacts with oxygen during combustion process. Nitrogen is derived from two sources: atmospheric nitrogen and fuel-bound nitrogen. Most nitrogen oxides are derived from combustion of atmospheric nitrogen (called Thermal NOx); meanwhile, nitrogen oxides which comes from fuel-bound nitrogen is little especially when there is small amount of nitrogen in natural gas or diesel oil. Thus, a developed technology of nitrogen oxides control is mainly for controlling nitrogen oxides from combustion of thermal NOx.

This project selected Dry Low NOx (DLN) technology to control nitrogen oxides derived from using natural gas as fuel of electricity generation. In addition, water injection technology will be used to control nitrogen oxides arising from using diesel oil as fuel.

Dry Low NOx combustor technology can better control occurrence of nitrogen oxides in accordance with principle that the lower temperature of combustion,

the less occurrence of thermal NOx. This Dry Low NOx combustor technology is designed to mix fuel with air before combustion (Lean Premix) resulting in lower temperature than using diffusion combustor technology. In diffusion combustor, fuel is directly injected into the air combustion causing higher temperature of combustion. Thus, combustion at lower temperature results in decreasing of nitrogen oxides.

The water injection technology which the project selected to use to control nitrogen oxides arising from using diesel oil as fuel can better control occurrence of nitrogen oxides in accordance with principle that the lower temperature of combustion, the less occurrence of thermal NOx as mentioned above. Injection of water manages to decrease temperature from diesel oil combustion and reduces the occurrence of NOx.

Moreover, the project will install Selective Catalytic Reduction (SCR) to further reduce nitrogen oxides from the combustion. The exhaust gas from the combustion chamber of gas turbine using Dry Low NO_x Combustor (in case of natural gas) or Water Injection (in case of diesel) technology shall contain low levels of nitrogen oxides. The hot gas will also be treated with the SCR to further reduce nitrogen oxides. The principle of the SCR is to inject ammonia into the exhaust, the resultant catalytic reaction will convert nitrogen oxides into nitrogen gas and water without emitting any pollution from said reaction.

3.3 LAYOUT OF THE PROJECT COMPONENTS

The Sriracha Power Plant Project has a layout for installing both engines and equipment including office buildings and infrastructure facilities on the area of 450 rais as shown in **Figure 3.3-1**. The details of land use proportion are illustrated in **Table 3.3-1**.

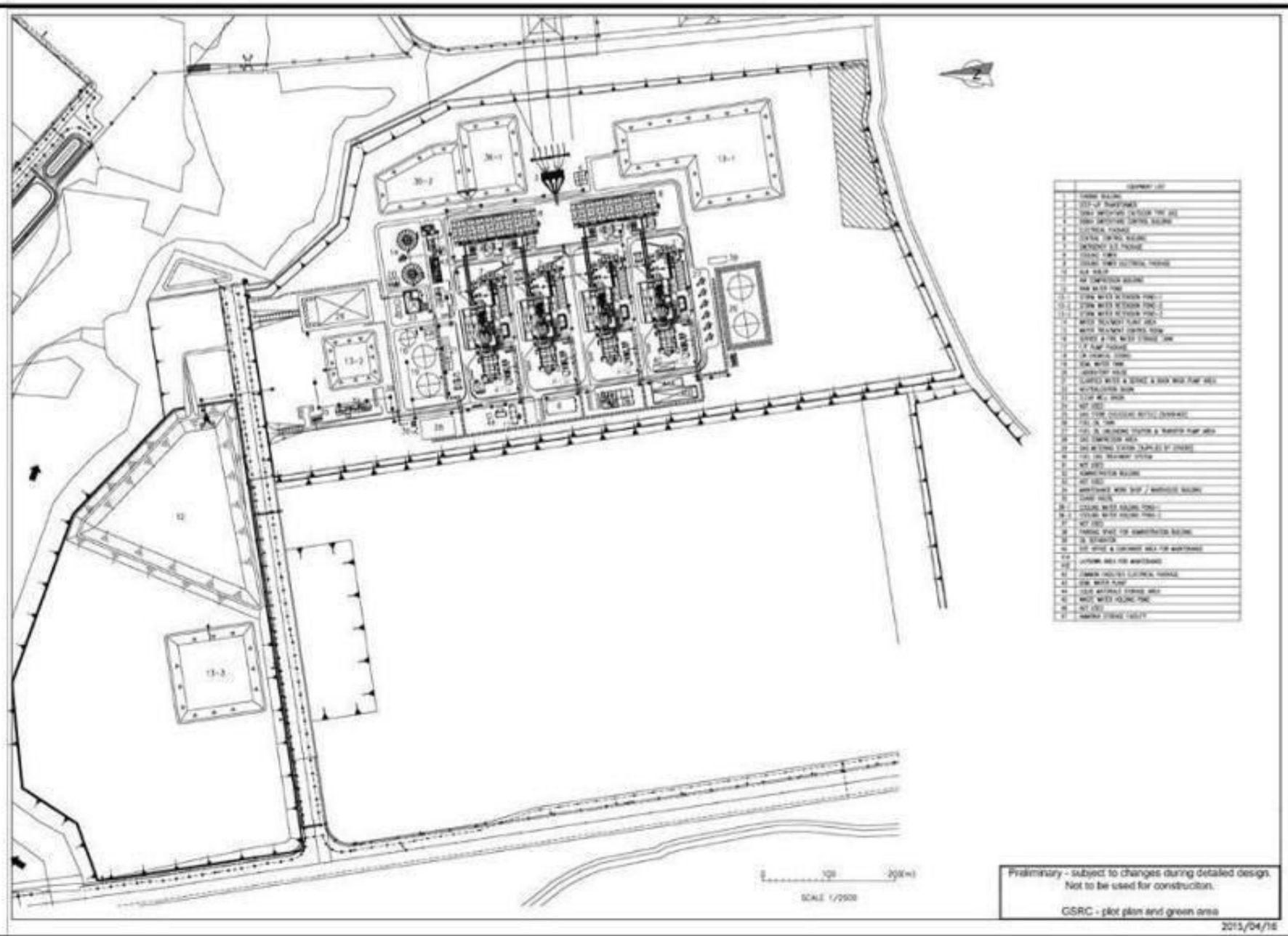


FIGURE 3.3-1 : PLOT PLAN – SRIRACHA POWER PLANT PROJECT

TEAM

TABLE 3.3-1

DETAILS OF LAND USE IN THE AREA OF SRIRACHA POWER PLANT

Components Within the Project Area	Estimated Area (m²)	Percentage of Total Areas (%)
(1) Power Block Area and transmission system		
– Power Block	67,600	9.6 %
– Transformer	1,560	0.2 %
Total (1)	**64,160**	**9.8 %**
(2) Balance of Plant Area		
– Gas Metering Station Area	6,100	0.9 %
– Gas Compressor Area	1,600	0.2 %
– Diesel Storage Tank Area	6,726	1.0 %
– Water Treatment and Wastewater Treatment Area	26,200	3.7 %
– Cooling Water Area	24,200	3.4 %
Total (2)	**64,826**	**9.2 %**
(3) Pond Area		
– Raw Water Pond	43,300	6.1 %
– Cooling Water Holding Pond	19,600	2.8 %
– Wastewater Holding Pond	100	0.01 %
– Storm Water Pond	43,200	6.1 %
Total (3)	**106,200**	**15.1 %**
(4) Area of Buildings		
– Control Building	1,000	0.1 %
– Workshop & Warehouse Building	1,200	0.2 %
– Administration Building and Guardhouse	800	0.1 %
Total (4)	**3,000**	**0.4 %**
(5) Green Area	**35,300**	**5.0 %**
(6) Other areas such as road water discharging canal, pipe lining area, right of Way for electricity transmission line, etc.	**289,341**	**41.0 %**
(7) Space area (Undeveloped area)	**137,773**	**19.5 %**
Total area (m²)	**705,600**	**100 %**

Source : Gulf SRC Co., Ltd, 2015.

3.4 FUEL

3.4.1 FUEL SOURCE AND FUEL TRANSPORTATION TO THE POWER PLANT

The Sriracha Power Plant is an Independent Power Producer (IPP) as a results of winning a procurement bid as per the Notification of the Energy Regulatory Commission in 2012. According to the Power Purchase Agreement, the power plant use natural gas as a primary fuel and must be able to operate on diesel as secondary fuel. Moreover, it is stipulated that the power plant may run on diesel only by approval of the Electricity Generating Authority of Thailand (EGAT). Running on diesel is reserved as a contingency measure in case transportation of natural gas is disrupted.

The Sriracha Power Plant is designed to be able to run on two types of fuel: natural gas and diesel. The primary fuel is natural gas while diesel will be used as backup fuel pending approval from EGAT or when natural gas supply is disrupted.

Natural gas is the primary fuel for the combustion turbines (CTs) and is to be supplied by *PTT Public Company Limited* via gas pipeline to be connected to the project area. The natural gas pressure at the transfer point shall be no less than 450 psig at 60-83 °F. Existing natural gas pipeline network near the project area is illustrated in **Figure 3.4-1**.

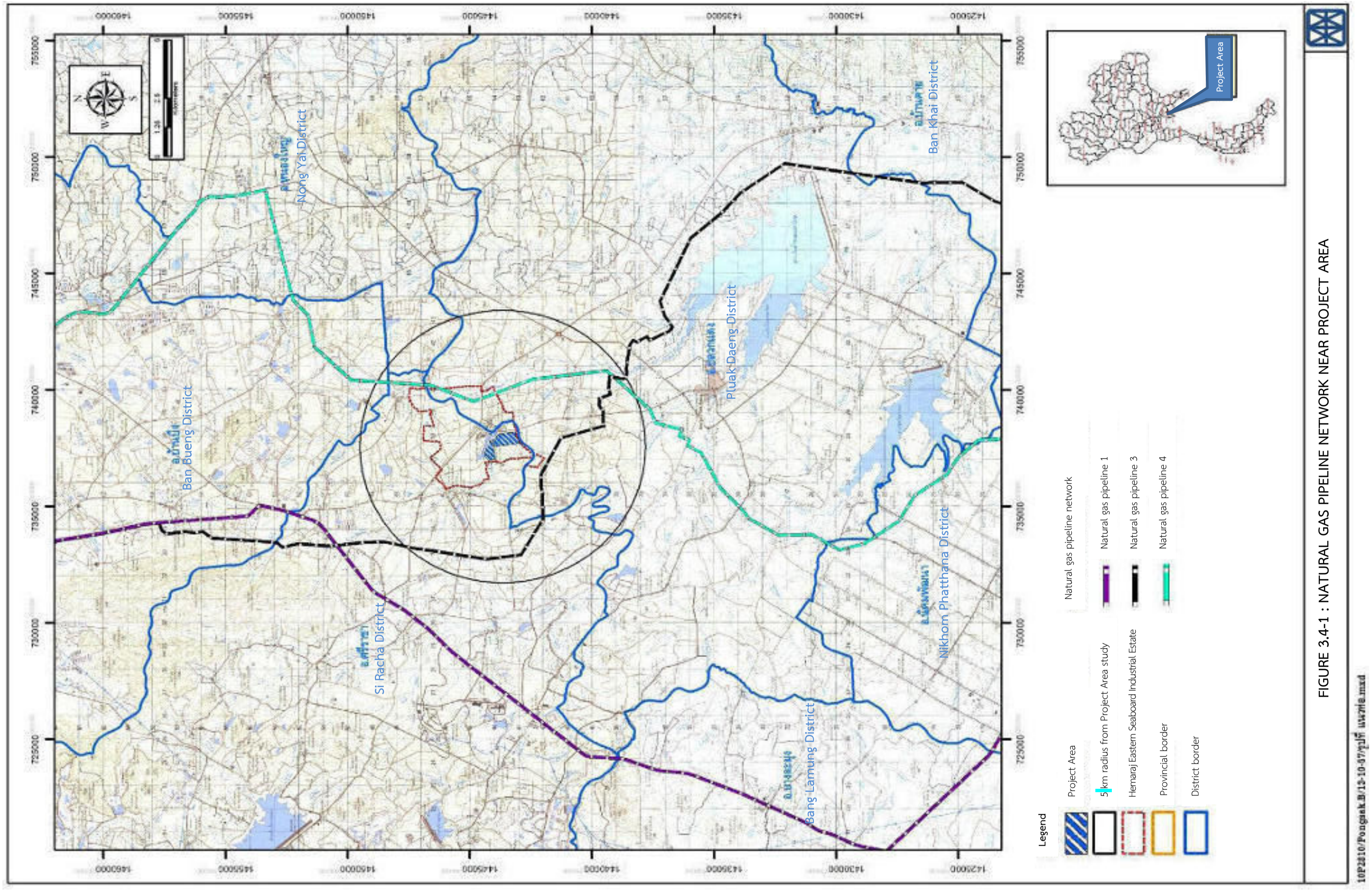


FIGURE 3.4-1 : NATURAL GAS PIPELINE NETWORK NEAR PROJECT AREA

As for transportation of diesel as backup fuel, fuel trucks shall be used to transport diesel into the project area where the fuel will be drawn into holding tanks at a loading station. The fuel will then be pumped into storage tanks with 14,300 m^3 for two tanks. The maximum permitted content of each tank shall be no more than 90 % of the tank capacity as per Ministerial Regulations re: Fuel Depot B.E. 2556. The stored amount of reserve fuel is sufficient for approximately 3 days of use. The diesel storage tanks are surrounded with a concrete dike which can receive 100 % the capacity of the largest storage tank as a safety measure in case of a tank leak or rupture as stipulated by the Ministerial Regulations re: Fuel Depot B.E. 2556.

The fuel loading station will have concrete surface surrounded with a dike to collect rain to wash oil residue or any spillages into the drainage pipe for treatment at an oil separator.

3.4.2 PROPERTY OF FUEL AND RATE OF FUEL CONSUMPTION

(1) Natural Gas (Primary Fuel)

(a) Property of Fuel

Natural gas is classified as clean fuel compared to fossil fuel. In addition, natural gas contains low volume of sulfur. Specific property of natural gas used as fuel in the project is shown in **Table 3.4-1**.

(b) Rate of Fuel Consumption

In case of full load operation, it is anticipated that the maximum consumption of natural gas is approximately 368 Mft^3/day at dry lower heating value of gas (LHV dry) of about 46,600 kJ/kg. If it use natural gas operation at 100 % annual load, the demand of expected natural gas is 134,320 Mft^3/year.

(2) Diesel Oil (contingency Fuel)

(a) Property of Fuel

In case of natural gas transporting problem, the project can still operate the power plant by using diesel oil. Specification of diesel oil used as contingency fuel is shown in **Table 3.4-2**. 26,000 m^3 of diesel oil will be stored in two tanks, at 14,300 m^3 each.

(b) Rate of Fuel Use

In case of full load operation (at maximum load) it is expected that the consumption of diesel oil is approximately 8,500 m^3/day. However, diesel oil will be used particularly for emergency case such as gas transmission problem and the operation will be required by EGAT. If the power plant operates by diesel oil for 72 h/year, the consumption of diesel oil will be 25,500 m^3.

TABLE 3.4-1

PROPERTY OF NATURAL GAS USED IN SRIRACHA POWER PLANT PROJECT

Parameter	Data Element (% Mole)		
	Minimum Value *	Probability Value *	Maximum Value *
Carbondioxide (CO_2)	4.41	1.43	0.00
Nitrogen (N_2)	2.03	1.66	0.64
Methane (C_1)	87.60	90.69	89.33
Ethane (C_2)	3.92	4.91	8.53
Propane (C_3)	1.36	0.88	1.00
Isobutane (iC_4)	0.31	0.19	0.20
Normalbutane (nC_4)	0.25	0.16	0.20
Isopentane (iC_5)	0.06	0.06	0.10
Normalpentane (nC_5)	0.03	0.01	0.00
Hexane (C_6)	0.01	0.00	0.00
Heptane (C_7)	0.01	0.00	0.00
Octane (C_8)	0.00	0.00	0.00
Total	**100.00**	**100.00**	**100.00**
Parameter	**Qualitative Data**		
HHV (Sat) Btu/scf	996	1024	1079
Specific gravity (SG)	0.6477	0.6136	0.6153
Wobbe Index -WI WI = HHV (Dry) / SQRT (SG)	1,260	1,330	1,400

Remark : * Minimum value probability value and maximum value means minimum value/probability value/maximum value of Wobbe Index.

Natural gas 1 m^3 is expected the maximum containing of mercury and H_2S less than 50 µg and 50 ppm, respectively.

Source : Gulf SRC Co., Ltd., 2015

TABLE 3.4-2

SPECIFICATION OF DIESEL OIL USED AS CONTINGENCY FUEL FOR THE PROJECT

Parameter	Qualitative Data		Testing Method
	Minimum Value	Maximum Value	
Specific Gravity at 15.6°C / 15.6°C	0.81	0.87	ASTM D 1298
Cetane Index	50	-	ASTM D 613
Viscosity (cSt) at 40°C	1.8	4.1	ASTM D 445
Pour Point (°C)	-	10	ASTM D 97
Total Sulfur (% by weight)	-	0.005	ASTM D 2622
Copper Strip Corrosion	-	No.1	ASTM D 130
Oxidation Stability (g/m^3)	-	25	ASTM D 2274
Carbon Residue (% by weight)	-	0.30	ASTM D 4530
Water and Sediment (% by volume)	-	-	ASTM D 2709
Water (mg/kg)		300	EN ISO 12937
Contaminant (mg/kg)		24	EN 12662
Ash (% by weight)	-	0.01	ASTM D 482
Flash Point (°C)	52	-	ASTM D 93
Distillation Temperature, 90% Recovered	-	357	ASTM D 86
Polycyclic Aromatic Hydrocarbons (% by weight)		11	ASTM D 2425
Color Intensity	-	4.0	ASTM D 1500
Lubricity Index (Lubricity by HFRR, μm)	-	460	CEC F-06-96

Source: The Notification of the Department of Energy business entitled specified characteristic and quality of diesel oil 2013 declared on 8 November 2013.

3.4.3 FUEL TRANSPORTATION WITHIN THE PROJECT AREA

Fuel transportation in the project area will primarily be via pipelines comprising as follows:

(1) Natural Gas Pipeline

- Major natural gas pipeline within the project area will start from gas metering station via 18-inch diameter pipe and end at gas compressors as seen in **Figure 3.4-2**. Then natural gas will be transmitted through 18 and 12-inch diameter pipe to electricity generating unit. The main transmitting pipes of the project are steel pipes with 2 diameter sizes as follows:
  - Natural gas pipeline with 18-inch diameter starts from gas metering station to gas compressor for 2 pipelines, at 125 m each. The transmission natural gas pipeline was designed to stand with maximum pressure at 50 barg at 50 °C.
  - Natural gas pipeline starts from gas compressor via 18-inch to branching point and transmits through 12-inch diameter pipe to each gas turbine. There are two pipelines from branching point to each of gas turbine. One is 150 m (before entering to gas turbine no.1 and no.2). Another is 350 m (before entering to gas turbine no.3 and no.4). The natural gas pipeline was designed to stand with maximum pressure at 60 barg at 150 °C.
  - Natural gas pipeline with 12-inch diameter pipe starts from branching point of 18-inch diameter pipe to flow meter before entering to each of gas turbine. Four pipelines is connected to turbine gas with to length of 130, 220, 130 and 220 m respectively. The natural gas pipeline was designed to stand with maximum pressure at 60 barg at 150 °C.
  - Natural gas pipeline with 12-inch diameter pipe starts from flow meter through fuel gas heater and enters to each of gas turbine. Four pipelines is connected to turbine gas with 40 m each. The natural gas pipeline was designed to stand with maximum pressure at 60 barg at 360 °C.

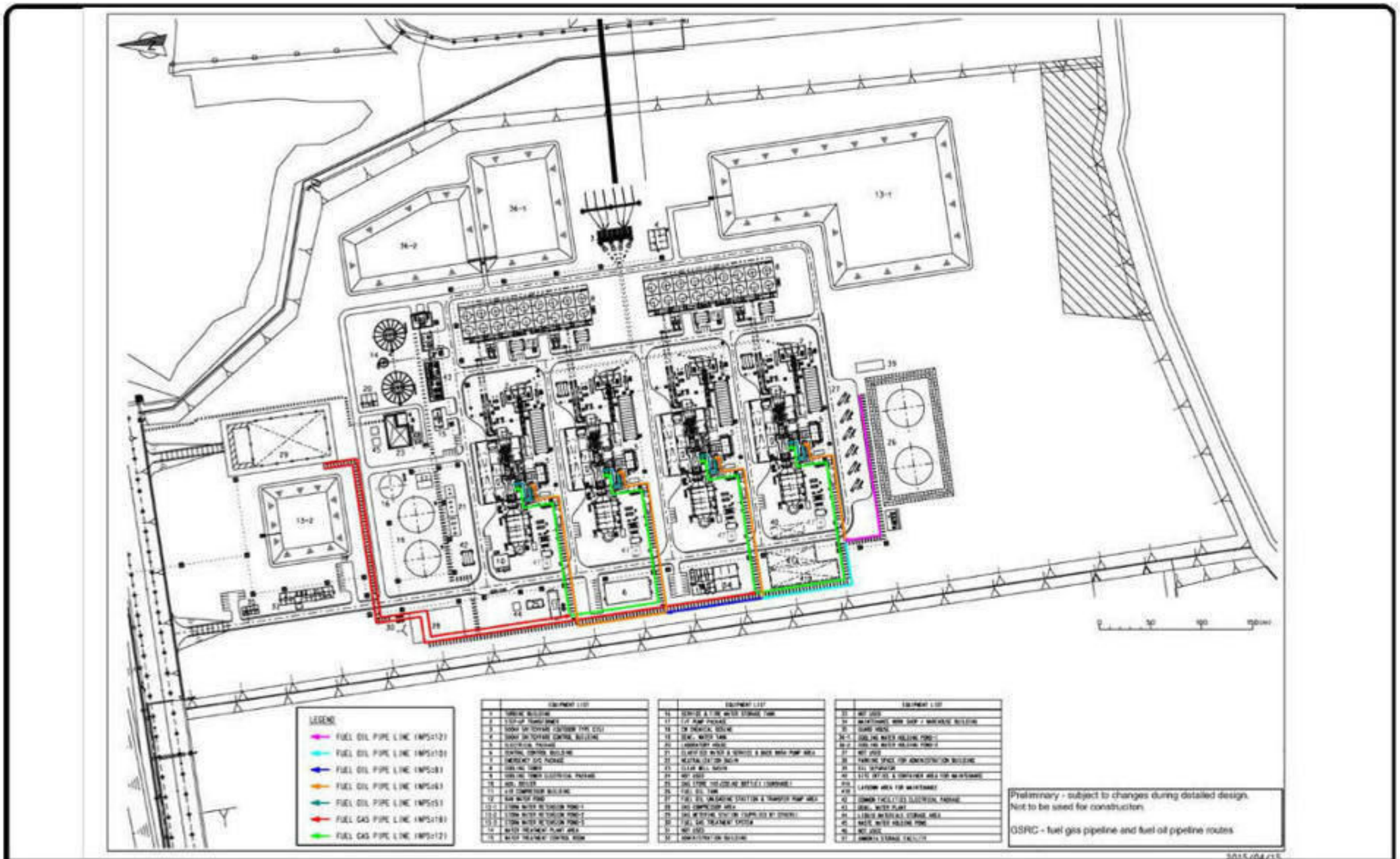


FIGURE 3.4-2 : NATURAL GAS PIPELINE AND DIESEL WITHIN THE PROJECT

TEAM

- Natural gas pipeline system is in the charge of power plant such as natural gas pipeline system connected with gas metering station to project's engines. Project has mitigation measures and reduce impacts from natural gas pipeline system in project area as follows:
  - Inspection leakage of natural gas pipelines are at connecting point above ground of gas metering station and gas compressor as indicated in guideline of safety procedure of project.
  - Install marker post for pipeline location and danger area.

(2) Oil transportation Pipeline

- Oil transportation pipeline within the project area will start from diesel oil storage tank to transport oil to electricity generating unit as shown in **Figure 3.4-2**. A 12-inch diameter pipe from oil tank will reduce to 10, 8, 6 and 5 inch when the pipe splits to electricity generating unit. The details of the pipe are as follows:
  - Oil transporting pipe of 12 inch diameter pipe is the combination pipe from diesel oil tank to electricity generating unit. The length from oil tank to fuel oil transfer pump is approximately 150 m. The pipe is designed to stand with maximum pressure at 4 barg at 50 °C.
  - Oil transporting pipe of 12-inch diameter pipe with the length of 50 m is the combination pipe from fuel oil transfer pump to branching point for entering to each gas turbine. The pipe is designed to stand with maximum pressure at 16 barg at 50 °C.
  - Oil transporting pipe of 10-inch diameter pipe with the length of 140 m is connected from above pipe (12-inch) before splitting into 8-inch (100 m) and 6-inch diameter pipe (90, 120, 120 and 210 m) for splitting to main fuel oil pump in each generating unit. The pipe is designed to stand with maximum pressure at 16 barg at 50 °C.
  - Oil transporting pipe of 5-inch diameter pipe for 4 pipes with the length of 30 m each is from main fuel oil pump to gas turbine of each generating unit. The pipe is designed to stand with maximum pressure at 120 barg at 50 °C.

For natural gas pipelines, 18 and 12-inch diameter pipes will be used. Diesel pipes will be of 5, 6, 8, 10 and 12-inch diameter. The pipelines will be installed upon steel

structure pipe racks. For the construction of the pipe racks, the top soil will be excavated to construct the foundations upon which steel sheets will be welded in stacks formation. Possible impact during construction of the pipe racks are dust from the excavation. The pipe rack construction will proceed in parallel as the construction of the power plant foundation. Upon the completion of natural gas and diesel pipelines in the project area, the pipes will be tested for leaks using hydrostatic test method at 1.5 times of the maximum allowable operating pressure (MAOP) and be left for at least 24 hours. Approximately 250 m3 of water from the industrial estate will be used for the hydrostatic test and no chemicals will be added to the test water. After the completion of the hydrostatic test, the water will be measured for pH levels, temperature, suspended solids, oil and grease. Should the results conform with the standards of the industrial estate, then the test water is discharged into the industrial estate's central wastewater treatment system. The industrial estate has confirmed its ability to distribute the required water and ability of water treatment system. The letter of confirmation on ability to distribute required water for hydrostatic test and its recovery is attached as Appendix 2B.

3.4.4 DIESEL DISTRIBUTION WITHIN THE PROJECT AREA

Diesel is used as backup fuel in the project in case that natural gas supply delivery is disrupted. The Diesel oil used will have sulfur content less than 0.005 percentage by weight, which is the requirement stated in the Annex of Notice of the Department of Energy Business on determination of Diesel Oil Characteristic and Quality B.E.2556 (2013) dated November 8, 2013, details as presented in **Table 3.4-2** and **Appendix 2C**. The details of diesel storage and distribution procedures and management plan in the project area are as follows:

(1) Diesel storage and distribution procedures

Transportation of diesel fuel will enter the project area by means of fuel trucks and unloaded at a loading station where the diesel is pumped into a holding tank before being pumped into storage tanks with 14,300 m^3 for two tanks. The maximum level of stored fuel will be no more than 90 % of the tank capacity, equivalent to 13,000 m^3 per tank as stipulated in the Ministerial Regulations re: Fuel Depot B.E.2556 by the Ministry of Energy which is published in the Royal Gazette Volume 130, Chapter 29a, Section 33, dated 27 March 2012. The above amount is sufficient for use as backup fuel for approximately 3 days. The storage tanks will be surrounded by concrete dike whose

capacity if 100 % of the largest tank as a safety measure in case of tank leak or rupture as also stipulated by Ministerial Regulations re: Fuel Depot B.E.2556 by the Ministry of Energy which is published in the Royal Gazette Volume 130, Chapter 29a, Section 23(4), dated 27 March 2013. Moreover, the fuel loading station will have concrete surface surrounded with a dike to collect rain to wash oil residue or any spillages into the drainage pipe for treatment at an oil separator before being discharged into the central wastewater treatment system of the Hemaraj ESIE. Applicable standards for the fuel storage tanks and other equipment used in the fuel distribution are as follows:

- Storage Tank Standard : API 650
- Pipeline Design Criteria : ASME B 31.1.
- Hazard Area Standard : API RP500
- Fire Extinguisher System : NFPA 850 and NFPA 11

(2) Unloading Procedure from the Tanker Truck to the Storage Tank

The procedures for unloading diesel are as follows:

- When the tanker truck arrives on-site, the power plant staff will proceed as follows:
  - Review the transportation documents from the tanker truck
  - Check the property of the diesel by using chemical substance, and record the property in the checklist form
  - Check the volume of diesel from the tanker truck, volume of the storage tank, and volume of storage tank should not exceed than 90 % of tank volume after unloading.
  - Ensure that fire extinguisher is ready for use in case of emergency
- Record the diesel volume in the storage tank prior and after the unloading
- Protect the tanker truck by blockages
- During unloading, the contractor/power plant staff must use wooden block to stop the truck from moving during diesel unloading
- The contractor/power plant staff must connect the grounding system from the truck to the provided ground connector
- Place receptors at the joint of the pump to prevent diesel dripping
- Pump diesel from tanker truck to the storage tank

- When finish, remove the receptors from the joint of the pump and dispose the diesel in temporary storage area, the fuel will be used for maintenance
- The contractor/power plant staff must check the tank for any leakages.
- In case of fire accident during transportation or unloading, all personnel must proceed according to emergency plan

3.5 CHEMICAL SUBSTANCE

Chemical substance used in the producing process of the Sriracha Power Plant is the substance for improving water quality to be suitable for uses. In addition, it help reducing precipitate and sediment in the water pipe. None of these is toxic substance as data referred to Material Safety Data Sheet (MSDS) as seen in **Appendix 2D.**

Details on sources, consumption quantities, storage quantities and applications of each chemical are shown in **Table 3.5-1** and from the material safety data sheet (MSDS) for chemicals controlled by relevant statutes as shown **Table 3.5-2**.

TABLE 3.5-1

TYPES AND QUANTITIES OF CHEMICALS FOR USE IN THE PROJECT

Name of chemical	Quantity of use (m^3/year)	Material and size of container	No. of tank	Application/ distribution within project	Secondary containment area	Chemical source and transportation method
Raw water treatment system						
$NaClO_2$ 25 %	20	PE, approx. 40 m^3	1	Precursor to Chlorine Dioxide for water treatment/ closed pipe system	Raw water treatment building/ concrete dike around tank	Purchased domestically, transported by chemical truck (liquid form)
HCl 35 %	20	FRP, approx. 40 m^3	1	Precursor to Chlorine Dioxide for water treatment/ closed pipe system	Raw water treatment building/ concrete dike around tank	Purchased domestically, transported by chemical truck (liquid form)
Ferric Chloride 40 %	1,120	FRP , approx. 120 m^3	1	For sedimentation in the water treatment system/ closed pipe system	Raw water treatment building/ concrete dike around tank	Purchased domestically, transported by chemical truck (liquid form))
Polymer	40	In bags and FRP mixing drum approx. 16 m^3	1	For sedimentation in the water treatment system/ closed pipe system	Raw water treatment building/ concrete dike around tank	Purchased domestically, transported in 25 kilograms bags
Sodium Hydroxide (NaOH, 50 %)	245	FRP, approx. 30 m^3	1	To adjust pH level of raw water, to regenerate resin in the water demineralization facility (Mixed Bed Regeneration) and to adjust pH level in the neutralization pit in the water demineralization facility)/ closed pipe system	Raw water treatment building/ concrete dike around tank	Purchased domestically, transported by chemical truck (liquid form)

TABLE 3.5-1 (Cont'd)

TYPES AND QUANTITIES OF CHEMICALS FOR USE IN THE PROJECT

Name of chemical	Quantity of use (m^3/year)	Material and size of container	No. of tank	Application/ distribution within project	Secondary containment area	Chemical source and transportation method
Demineralized water production and discharge water treatment by neutralization						
Sodium Bisulfite 1 % ($Na_2S_2O_5 + H_2O \longrightarrow 2NaHSO_3$) (SMBS) (SBS)	15	PE, approx. 1 m^3	1	To protect RO membrane from free chlorine/ closed pipe system	Water demineralization facility/ concrete dike around tank	Purchased domestically, transported in 25 kilograms bags
RO Antiscalant (100 %)	5	PE, approx. 0.1 m^3	1	To prevent calcification on RO membrane/ closed pipe system	Water demineralization facility/ concrete dike around tank	Purchased domestically, transported in 25 liters tanks
Sulfuric Acid (H_2SO_4, 98 %)	10	Carbon steel, approx. 3 m^3	1	To adjust pH level of raw water, to regenerate resin in the water demineralization facility (Mixed Bed Regeneration) and to adjust pH level in the neutralization pit in the water demineralization facility)/ closed pipe system	Water demineralization facility/ concrete dike around tank	Purchased domestically, transported by chemical truck (liquid form)
Citric Acid ($C_6H_8O_7$, 15 %)	10	PE, approx. 2 m^3	1	To clean RO membrane / closed pipe system	Water demineralization facility/ concrete moat around tank	Purchased domestically, transported in 25 kilograms bags
Steam recirculation system						
Oxygen Scavenger (Elimin - OX)	15	Stainless steel, 1,000 L.	4	Boiler water quality control/ closed pipe system	Chemical storage building/ tray	Purchased domestically, transported in 25 liters tanks
Aqueous Ammonia (NH_3-25 %)	45	Stainless steel, 1,000 L.	4	Boiler water quality control/ closed pipe system	Chemical storage building/ tray	Purchased domestically, transported in 25 liters tanks

TABLE 3.5-1 (Cont'd)

TYPES AND QUANTITIES OF CHEMICALS FOR USE IN THE PROJECT

Name of chemical	Quantity of use (m^3/year)	Material and size of container	No. of tank	Application/ distribution within project	Secondary containment area	Chemical source and transportation method
Trisodium Phosphate ($Na_3PO_4.12H_2O$)	30	Stainless steel, 1,000 L.	4	Boiler water quality control/ closed pipe system	Chemical storage building/ tray	Purchased domestically, transported in 25 kilograms bags
Cooling system						
Corrosion Inhibitor and Scale Inhibitor	120	PE, approx. 2 m^3	2	Prevent calcification in cooling system/ closed pipe system	Chemical storage building/ concrete barrier	Purchased domestically, transported in 1 m^3 tanks
$NaClO_2$ 25 %	20	PE, approx. 40 m^3	2	Precursor to Chlorine Dioxide for water treatment/ closed pipe system	Raw water treatment building/concrete dike around tank	Purchased domestically, transported by chemical truck (liquid form)
HCL 35 %	20	FRP, approx. 40 m^3	2	Precursor to Chlorine Dioxide for water treatment/ closed pipe system	Raw water treatment building/ concrete dike around tank	Purchased domestically, transported by chemical truck (liquid form)
SCR						
Aqueous Ammonia (NH_3-25 %)	6,900	Stainless steel, 80 m^3	4	To limit NO_X in exhaust gas from gas turbine/ closed pipe system	Chemical storage building/ concrete barrier	Purchased domestically, transported by chemical truck (liquid form)

Source : Gulf SRC Co., Ltd., 2015.

TABLE 3.5-2

COMPARISON OF USE OF CHEMICALS IN ACCORDANCE WITH RELATED ACTS AND TOXICITY (LD_{50})

Chemical Name/Common Chemical Name	Status	Hazardous Act B.E.2535 (1992) (Type)	Military Hardware Act B.E.2530 (1987)	Chemical Name/Common Chemical Name	Toxicity (LD_{50})
Sodium Chlorite 25 %	Liquid	-	-	-	Acute oral toxicity (LD_{50})=165mg/kg [Rat]
HCL 35 %	Liquid	3	-	✓	Acute oral toxicity (LD_{50})=900mg/kg [Rabbit]
Ferric Chloride 40 %	Liquid	-	-	-	Oral toxicity (LD_{50})=316mg/kg [Rat]
Polymer	Solid	-	-	-	Acute oral toxicity (LD_{50})=3,500mg/kg [Mouse]
Sulfuric Acid	Liquid	3	-	✓	Oral toxicity (LD_{50})=2,140mg/kg [Rat]
Sodium Metabisulfite	Solid	-	-	-	Acute oral toxicity (LD_{50})=1,131mg/kg [Rat]
RO Anti Scale	Liquid	No data	No data	No data	LD_{50}=7,400mg/kg [Rat]
Oxygen Scavenger	Liquid	-	-	-	Acute oral toxicity (LD_{50})=5g/kg [Rat]
Aqueous Ammonia	Liquid	-	-	-	Oral toxicity (LD_{50})=350mg/kg [Rat]
Trisodium Phosphate	Solid	No data	No data	No data	-*
Corrosion Inhibitor and Scale Inhibitor (type: Organic Phosphate Acid)	Liquid	3	-	✓	-*
Sodium Hydroxide	Liquid	1	-	✓	-*
Citric Acid	Solid	No data	No data	No data	Acute oral toxicity (LD_{50})=3,000mg/kg [Rat]

Remark: - Not specified as hazardous material in Hazardous Act B.E.2535 (1992), Military Act B.E.2530 (1987) and Labor Protection Act B.E.2541 (1998).

Type 1 hazardous materials for producing, import, export or ownership must comply with the principle and methods require.

Type 2 hazardous materials for producing, import, export or ownership must be declared to an official for recognition and comply with the principle and methods require.

Type 3 hazardous materials for producing, import, export or ownership must receive permission.

Type 4 hazardous materials are prohibited for producing, import, export or ownership

-* No information of toxicity in animal test and impact to human health in MSDS

3.6 TECHNICAL INFORMATION OF THE POWER PLANT

3.6.1 DESIGN OF THE POWER PLANT

Requirement of climate and location used for designing the Sriracha Power Plant are as follows:

- Atmospheric temperature
  - Dry bulb temperature (average) at 32.5 °C
- Relative Humidity 76 %
- Air pressure 1,000.9 mbar
- Altitude of the project area (above MSL) 78 m

3.6.2 MACHINERY AND PRODUCTION EQUIPMENT

Main machinery and equipment of the Sriracha Power Plant are composed of Combustion Turbine, Generators, Heat Recovery Steam Generator, Steam Turbine, Condenser and Cooling Tower. Technical details of each type of machinery and equipment are as follows:

(1) Combustion Turbine: CTs

The Sriracha Power Plant Project will have 4 sets of CTs capable of operating on both natural gas and diesel. However, natural gas will be the primary fuel while diesel will be used only as a backup fuel. Fuel will combust in a mixture with air creating pressure to drive the CTs. These CTs will be equipped with Dry Low-Nitrogen Oxides Combustion System (DLN) when natural gas is used and a Water Injection System to control NO_x emissions when diesel is used.

(2) Generators

The Sriracha Power Plant Project will have 4 sets of generators which will be driven by the combustion turbines and steam turbines combined for converting mechanical energy into electrical energy by means of electromagnetic induction principal.

(3) Heat Recovery Steam Generator: HRSG

The Sriracha Power Plant Project has 4 sets of HRSG powered by the exhaust of the gas turbines (1 set of HRSG per 1 gas turbine). It utilizes thermal energy from the CT exhaust gas to create steam then the steam is used to propel the steam turbine to drive the generator (1 set of HRSG per 1 steam turbine). A HRSG is comprised of 3 components: an Economizer to heat up the water to be turned into steam, an Evaporator

to generate steam and a Superheater to increase temperature and enthalpy of the steam. Each HRSG has a tank to receive Blowdown water which is release for reducing the concentration of dissolved solids in the boiler and supported by chemical feeding system to control the water quality feeding into the HRSG.

Furthermore, safety valves will be installed in Evaporator, Superheater and Re-heater in order to prevent over pressure. Based on preliminary design, pressure and temperature of steam exhausted from HRSG are estimated as follows:

- High pressure steam from Superheater has pressure about 15.88 MPa (a), at 602 °C.
- Intermediate pressure steam from Superheater has pressure about 4.45 MPa (a), at 281 °C.
- Intermediate pressure steam from Re-heater has pressure about 3.51 MPa (a), at 602 °C.
- Low pressure steam from Superheater has pressure about 0.71 MPa (a), temperature of 256 °C.

Exhaust gas from the each gas turbine is fed into the HRSG via a Selective Catalytic Reduction (SCR) to reduce the nitrogen oxides in the exhaust before being released through a 60 m stack. The height of the stack helps to reduce air and noise pollution in the locality and also equipped with a Continuous Emission Monitoring System (CEMs) to constantly monitor and control pollutant levels being emitted into the atmosphere.

(4) Steam Turbine: STs

The Sriracha Power Plant Project has 4 sets of STs, with 3 different levels of steam pressure, to propel the steam turbine.

High pressure steam from the HRSG HP Superheater will have a pressure of approximately 15.54 MPa (a) and a temperature of 600 °C when it reaches the ST. The high pressure steam will propel the high pressure steam turbine, the exhaust steam from the high pressure steam turbine will be directed to merge with intermediate pressure steam from the HRSG IP Superheater to feed back to the HRSG Reheater. Then, the exhaust steam is directed to the intermediate pressure steam turbine at approximately 3.42 MPa (a) of pressure and temperature of 580 °C for propelling turbine. The exhaust steam from the intermediate pressure steam turbine will then be merged with low pressure steam from the HRSG LP Superheater before entering the low pressure steam turbine at approximately 0.65 MPa (a) pressure and at 254 °C. The exhaust steam will then be fed to the condenser.

(5) Condenser

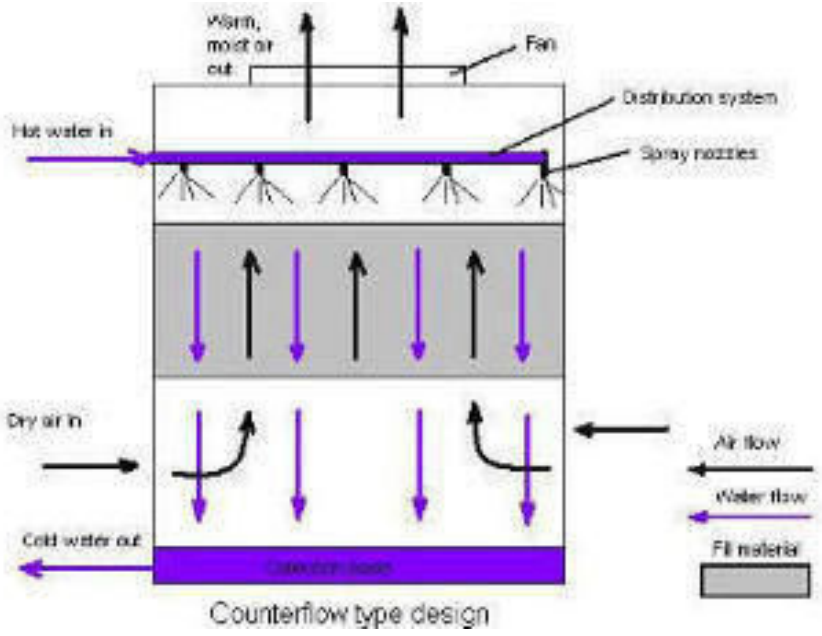
The project has 4 sets of condensers. The steam from steam turbine will be sent to condenser in which exchange of heat between steam from STG and cooling water takes place in order to decrease pressure and temperature of steam until it becomes condensate returning to HRSG to further steam generation. The condenser is designed to operate at estimated pressure of 9.47 kPa(a). In addition, the condenser manages to increase temperature of cooling water up to 9 °C.

(6) Cooling Water System

The project has 4 Cooling Water Systems to cool down the cooling water. Heated coolant water from the condenser is sent to the cooling tower for cooling and the cooled water is then collected in the Cooling Tower Basin for recirculation. A certain amount of cooled water will be discharged into Cooling Water Holding pond to maintain quality of the water in the system.

The cooling tower has the role of exchanging heat out of the water by means of air flow blown against the direction of the water flow. The heat exchange results in some of the water evaporating into the air and the cooling water loses heat as depicted in **Figure 3.6-1**. Preliminary design information of the cooling system is summarized in **Table 3.6-1**.

The relevant machinery and key equipment is listed in **Table 3.6-2**.



(**Source:** http://thai-draftman.blogspot.com/2010/10/cooling-tower.html)

FIGURE 3.6-1 : FLOW DIAGRAM OF COOLING TOWER

TABLE 3.6-1

SUMMARY OF PRELIMINARY DESIGN INFORMATION FOR THE COOLING SYSTEM

Type of cooling tower:	**Counter Flow Wet Type Cooling Tower**	
System cooling water capacity	m^3/h	37,000
Temp. of hot water enter to the cooling tower	°C	42.4
Temp. of hot water drain from the cooling tower	°C	33.7
Cooling Range	°C	8.7
Wet bulb temperature	°C	28.8
Dry bulb temperature	°C	32.5
Atmospheric pressure	°C	1000.9
Relative humidity	%	76
Evaporation rate	m^3/day	49,072 (@ design condition)
Make-up water rate	m^3/day	61,304 (@ design condition)
Discharged water rate	m^3/day	12,232 (@ design condition)

Remarks : 1) The above information is from the preliminary system design. During the actual design process, the design will be tested to ensure efficient operation.

2) The total make-up water amount is comprised of make-up water from the water treatment system (60,560 m^3/day) and reused water from other systems amounting to 744 m^3/day.

TABLE 3.6-2

LIST OF MACHINERY AND KEY EQUIPMENT FOR THE SRIRACHA POWER PLANT PROJECT

Machinery	No. (sets)	Function	Productivity per set
Gas Turbine	4	Burn fuel to propel gas turbine to drive the power generator	440 MW
Heat Recovery Steam Generator	4	Generate steam from gas turbine exhaust	- High pressure steam from the Superheater has a pressure of 15.88 MPa (a) and a temperature of 602 °C - Intermediate pressure steam from the Superheater has a pressure of 4.45 MPa (a) and a temperature of 281 °C - Intermediate pressure steam from the Reheater has a pressure of 3.51 MPa (a) and a temperature of 602 °C - Low pressure steam from the Superheater a pressure of 0.71 MPa (a) and a temperature of 256 °C.
Steam Turbine	4	Receives steam from the HRSG to propel the steam turbine and power the generator	222.5 MW
Generator	4	Powered by gas turbine and steam turbine to convert mechanical energy in to electrical energy	662.5 MW
Condenser	4	Heat exchange equipment, which cooling water will draw heat away from steam turbine exhaust resulting in condensing steam to be condensed water	The condenser operates with a pressure of 9.47 kPa (a)
Cooling tower	4	To reduce temperature of cooling water	

Source: Gulf SRC Co., Ltd., 2015

3.7 GENERATING PROCESS AND CAPACITY

3.7.1 GENERATING PROCESS

The Sriracha Power Plant consists of 4 sets of generators. Working process of these generators is shown in **Figure 3.7-1** to **3.7-6** and can be explained as follows:

(1) Heat energy exhaust from natural gas combustion is directly transmitted for operating 4 sets of combustion turbine gas in order to generate electricity (in case of using natural gas as fuel as shown in **Figure 3.7-1** to **Figure 3.7-3** and in case of using diesel oil as fuel as shown in **Figure 3.7-4** to **Figure 3.7-6**).

(2) Hot gas still has heat energy left. This will be fed into Heat Recovery Steam Generator (HRSG) in order to further generate steam.

(3) Steam coming from HRSG will be used for driving 4 sets of steam turbine generator in order to generate electricity (in case of using natural gas as fuel as shown in **Figure 3.7-1** to **Figure 3.7-3** and in case of using diesel oil as fuel as shown in **Figure 3.7-4** to **Figure 3.7-6**).

(4) Used steam from steam turbine generator will turn into water in order to be reused in the steam generating process again by expanding the used steam into a condenser to exchange heat with cooling water from cooling tower causing steam to condense into water. Meanwhile, temperature of cooling water will increase and this water will be fed back to cooling tower to decrease its temperature.

(5) Hot water released from a condenser or cooling water will be cooled down in cooling tower. As the water is falling down from the cooling tower, it will be blown by fan in the tower to eject heat from water. Nevertheless, temperature of cooling water passing through a condenser will increase up to 40 °C from the inlet water's temperature. After passing through cooling tower, water temperature will be decreased to 34 °C. Cool water will be retained in cooling tower basin for reusing. Some proportion of blowdown water will be discharged in order to keep water quality stable. Before releasing, blowdown water will be kept in 2 cooling water holding ponds, each of which has a capacity of 19,000 m^3 and can retain cooling water for 1 day. Temperature of effluent water shall comply with standard of the Hemaraj ESIE.

(6) Volume of nitrogen oxides (NOx) in the exhaust from combustion of natural gas will be controlled by Dry Low NOx System in case of using natural gas as fuel or by water injection system in case of using diesel oil as fuel. Then, controlled exhaust will be sent to selective catalytic reduction system for reducing nitrogen oxides (NOx) before emitting out through a stack of HRSG.

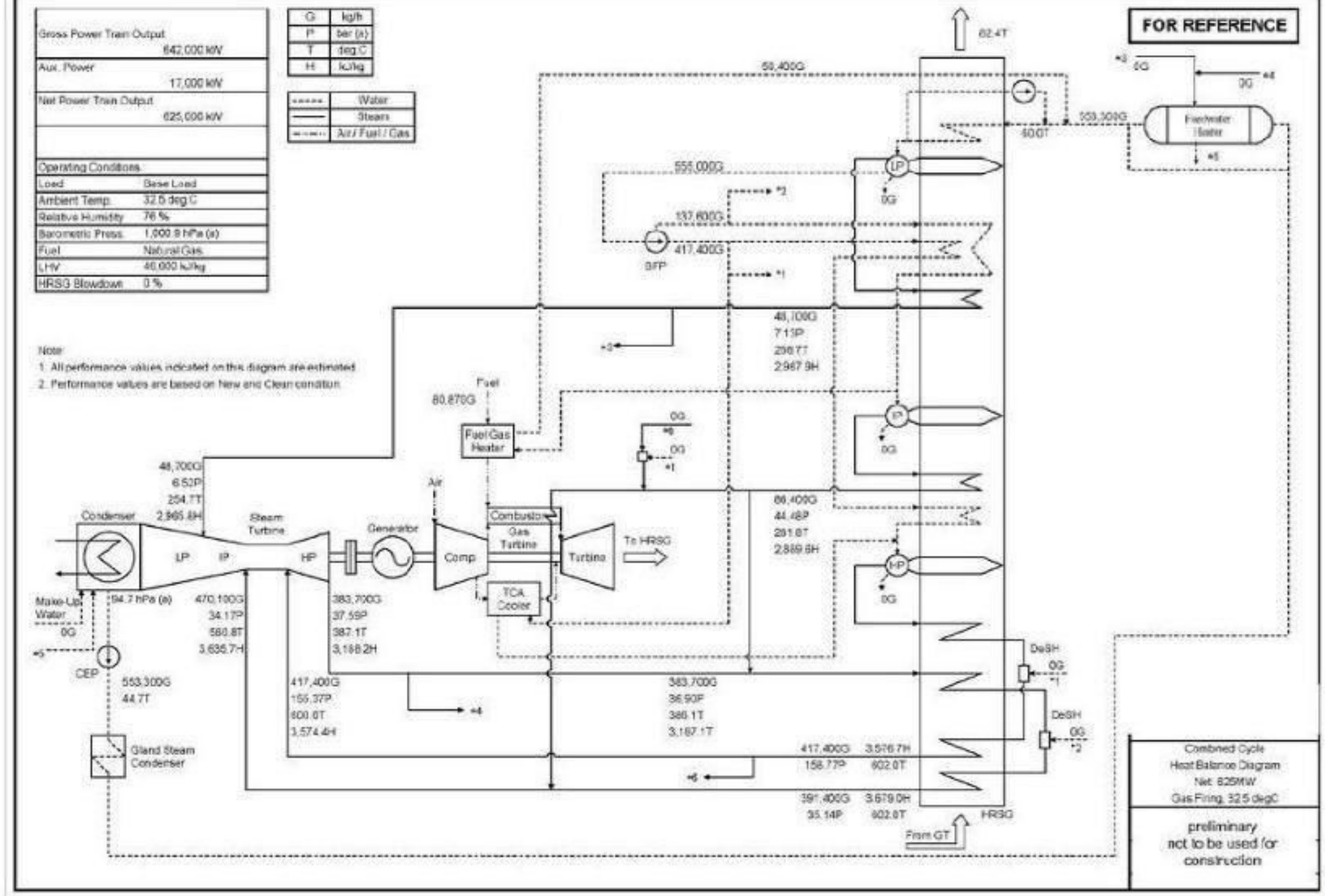


FIGURE 3.7-1 : ELECTRICITY GENERATION AND HEAT BALANCE OF THE SRIRACHA POWER PLANT WHEN USING NATURAL GAS AT 100%

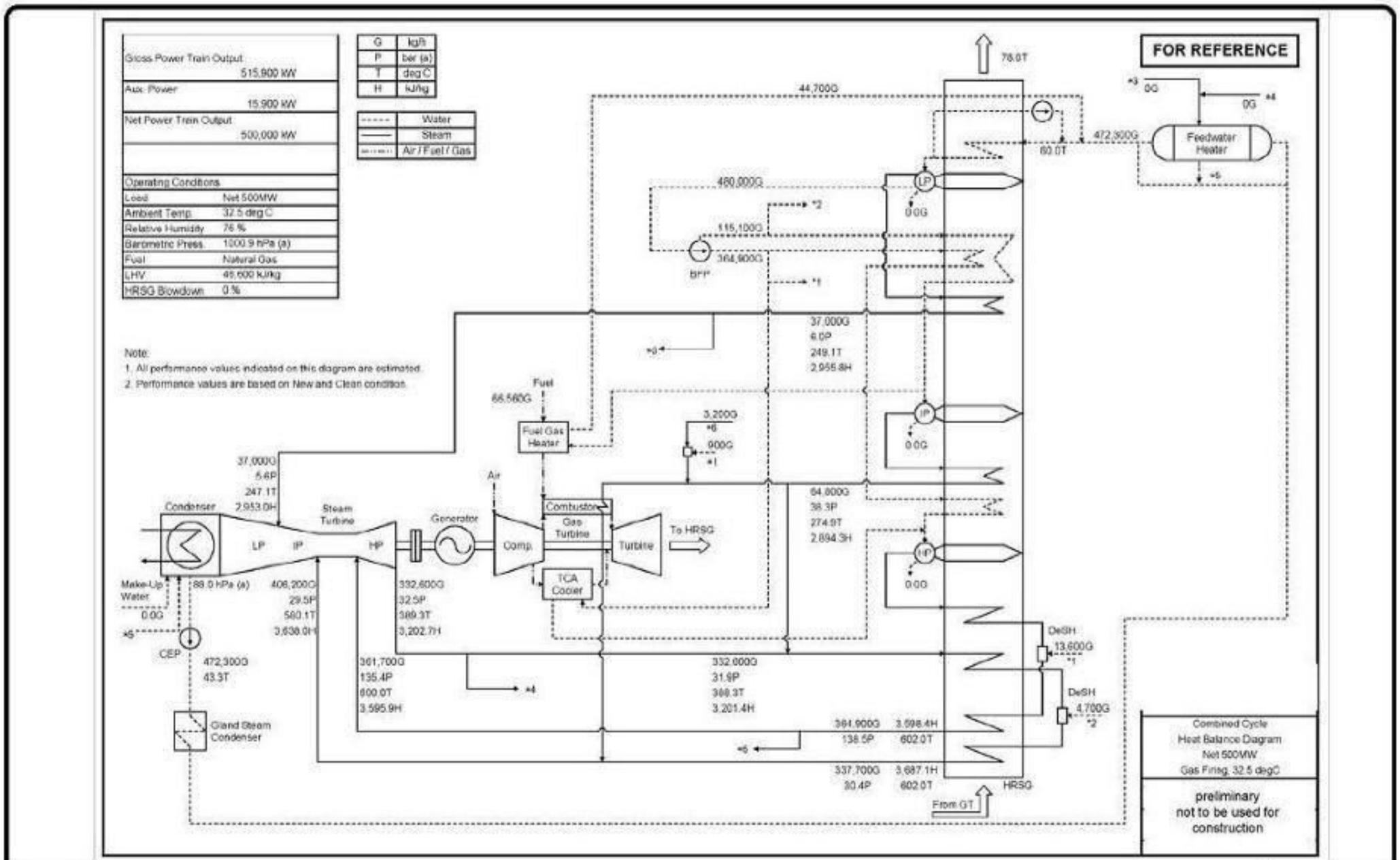


FIGURE 3.7-2 : ELECTRICITY GENERATION PROCESS AND HEAT BALANCE OF THE SRIRACHA POWER PLANT WHEN USING NATURAL GAS AT 80% LOAD

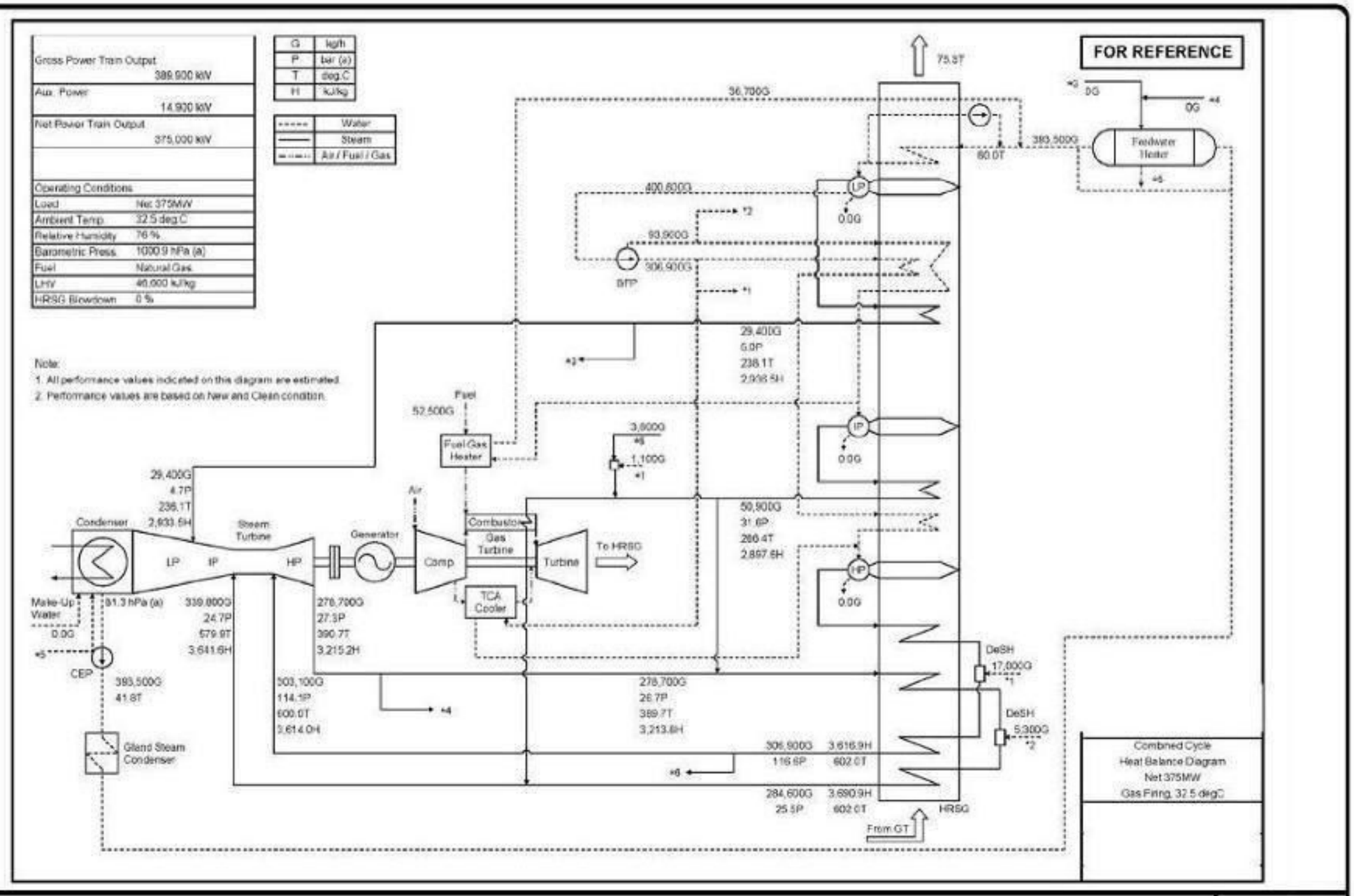


FIGURE 3.7-3 : ELECTRICITY GENERATION PROCESS AND HEAT BALANCE OF THE SRIRACHA POWER PLANT WHEN USING NATURAL GAS AT 60% LOAD

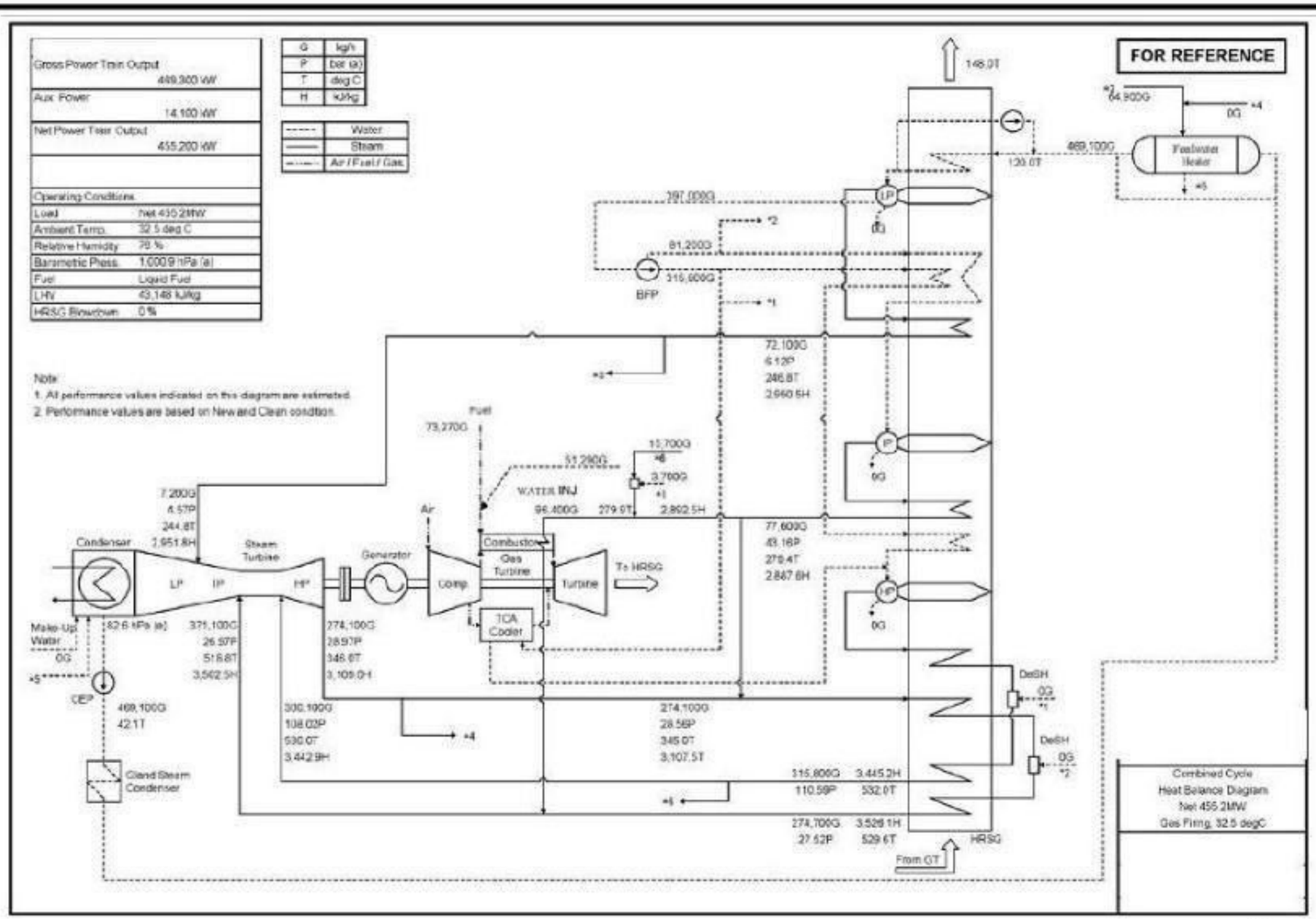


FIGURE 3.7-4 : ELECTRICITY GENERATION PROCESS AND HEAT BALANCE OF THE SRIRACHA POWER PLANT WHEN USING DIESEL AT 100% LOAD

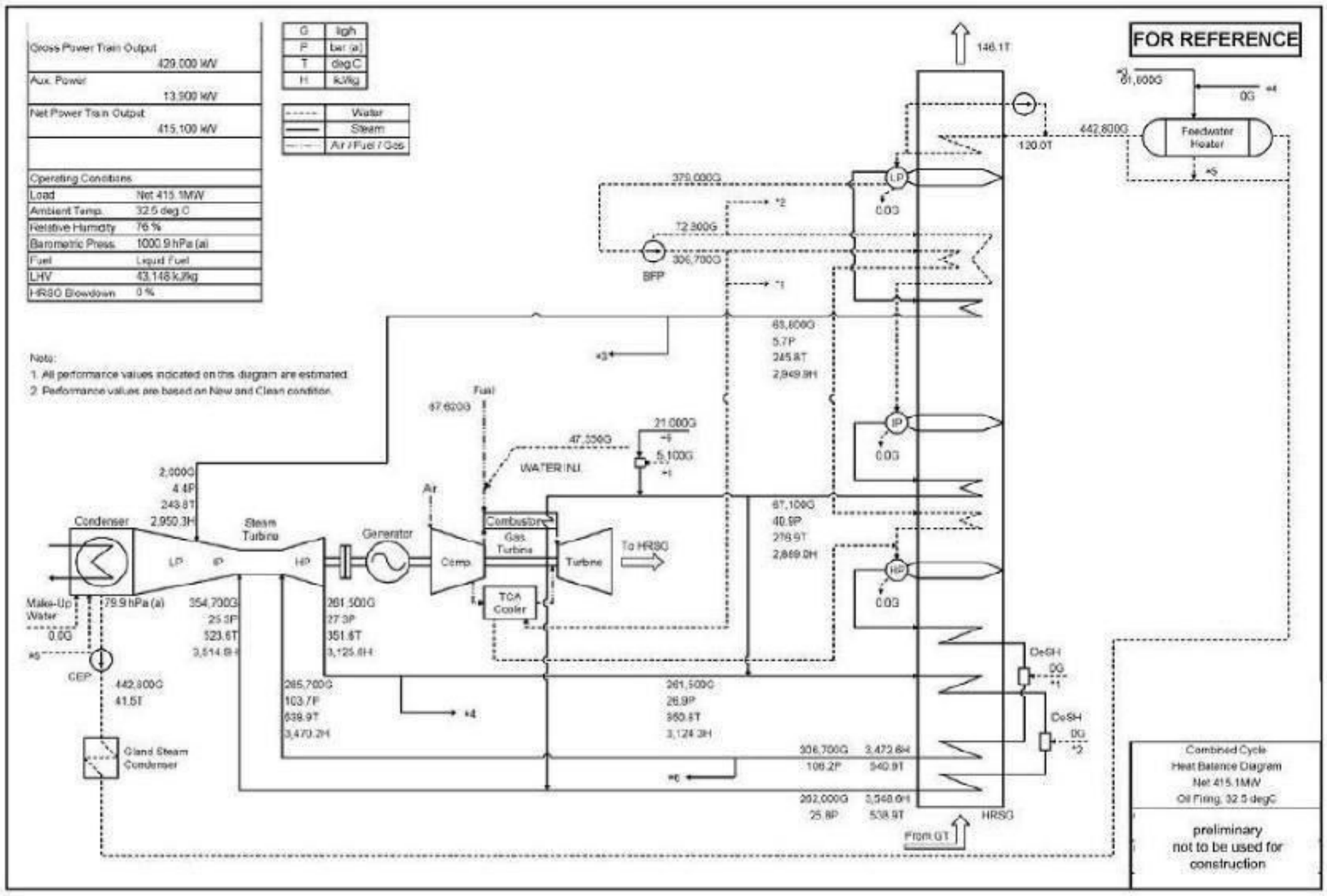


FIGURE 3.7-5 : ELECTRICITY GENERATION PROCESS AND HEAT BALANCE OF THE SRIRACHA POWER PLANT WHEN USING DIESEL AT INTERMEDIATE LOAD (415.1 MW)

TEAM

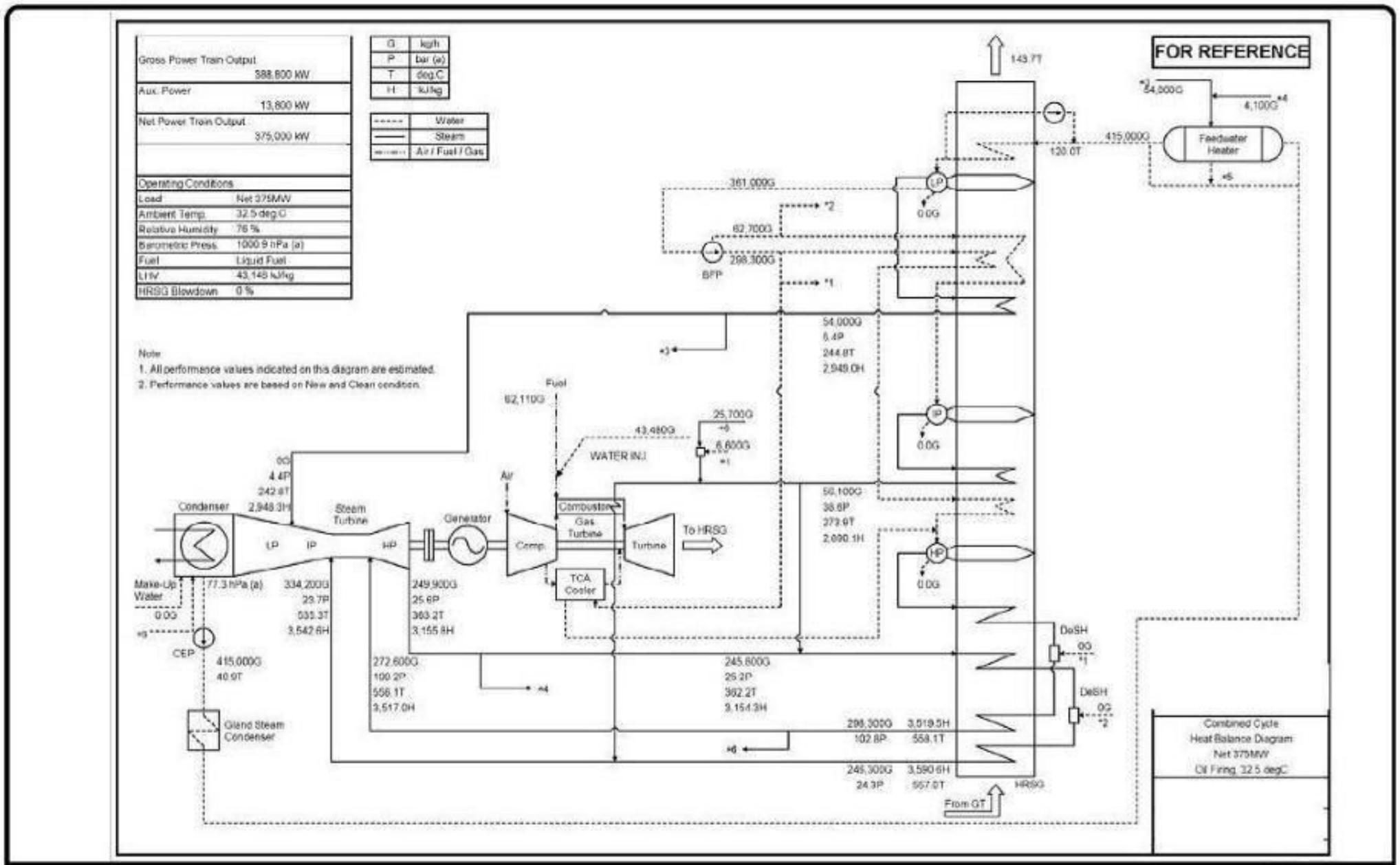


FIGURE 3.7-6 : ELECTRICITY GENERATION PROCESS AND HEAT BALANCE OF THE SRIRACHA POWER PLANT WHEN USING AT MINIMUM LOAD (375 MW)

3.7.2 Generating Capacity

The Sriracha Power Plant has generating capacity as follows:

- Installed Capacity about 2,650 MW
- Net Capacity about 2,500 MW
- Net Efficiency about 59 %

The power plant has a maximum generating capacity of approximately 2,650 MW. A portion of the generated power will be used internally with the remainder transmitted to the Electricity Generating Authority of Thailand (EGAT). Under the power purchasing agreement between EGAT and the power plant, EGAT has the rights to order the power plant to operate within the range of 1,500 MW minimum gross output up to 2,500 MW maximum gross output. Therefore, the power plant is designed to operate between the minimum production capacity and maximum production capacity according to the contract.

3.8 SUPPORTING SYSTEM FOR GENERATING AND DISPATCHING ELECTRICITY

The project will dispatch electricity to the EGAT by constructing 500 kV switchyard facilities within the project area in order to dispatch electricity to Pluak Daeng substation at 500 kV via transmission line of EGAT.

3.9 INFRASTRUCTURE AND PUBLIC FACILITY SYSTEMS

3.9.1 WATER SOURCE FOR CONSUMPTION

(1) Construction Period

Water used during construction period is mainly used for utility and consumption by the workers who reside outside the project area, and used for construction. Water used for construction in the project area is sourced from the tap water system distributed by the Hemaraj ESIE. Raw water is supplied by Eastern Water Resources Development and Management PCL and used for tap water treatment process in the Hemaraj ESIE before distributing to clients in the Hemaraj ESIE.

Workers require 224 m^3/day of water for a maximum of 3,200 workers and based on the rate of 70 liters/person/day (Kriengsak, 1996). Water usage for construction is approximately 55 m^3/day - mainly for cleaning equipment – since the project use ready-

mix concrete. A one-time use of 250 m^3 of water is required for the hydrostatic test of the natural gas and diesel pipeline. The letter of enquiry for supply of this water for hydrostatic test and its discharge is attached as **Appendix 2B**.

However, water is needed to spray onto the project grounds to reduce dispersion of dust in the construction period. Most of the dust comes from vehicles that enter and exit the construction area such as trucks, ready-mix concrete truck and foremen's vehicles. The water usage rate for spraying the surfaces is 0.75 L/m^2 (reference: http://www.erc.nu.ac.th/Project-6.asp) as shown in **Appendix 2E**. In total, 1,058 m^3 of water/day is required to spray at least twice daily the surfaces totaling 441 rai. The net water usage during construction period is 1,587 m^3/day **(Table 3.9-1).**

TABLE 3.9-1

RATE OF WATER USE DURING CONSTRUCTION PERIOD

Activities	Volume of Water Use (m^3/day)
1. Water used for workers' consumption (calculate from rate of water use is 70 liters/person/day and number of workers is 3,200 persons)	224
2. Water used for washing and cleaning equipment of constructing activities	55
3. Water used for hydrostatic test[1/]	250[1/]
4. Water used for spraying onto the ground of the project area (rate of water use for spraying onto the ground for one time per trip is 0.75 liter/m^2 by spraying at least 2 times/day for 441 rai)	1,058
Total	**1,337**

Remark : [1/]Water used for hydrostatic test will be used only one time for pipeline testing

(2) Operation Period

The Sriracha Power Plant is to receive 63,000 m^3/day of raw water from the Hemaraj ESIE and store in its 189,000 m^3 capacity raw water pond. The majority of the water will be used for cooling process of the power plant at 60,560 m^3/day and the rest is used in production. The system is designed with maximum efficiency, minimizing water usage and recycling water – details of which will be described in the next sections.

The Hemaraj ESIE has submitted a letter to the Project, confirming its ability to supply the required amount of raw water - which is supplied by Eastern Water Resources Development and Management PCL - to the power plant project as shown in **Appendix 2F**.

3.9.2 WATER USE IN GENERATING PROCESS

(1) Source and rate of water use

Water used of project will receive raw water from Hemaraj ESIE which is supplied by Eastern Water Resources Development and Management PCL as shown in **Figure 3.9-1**. Details of raw water sources are shown in follows:

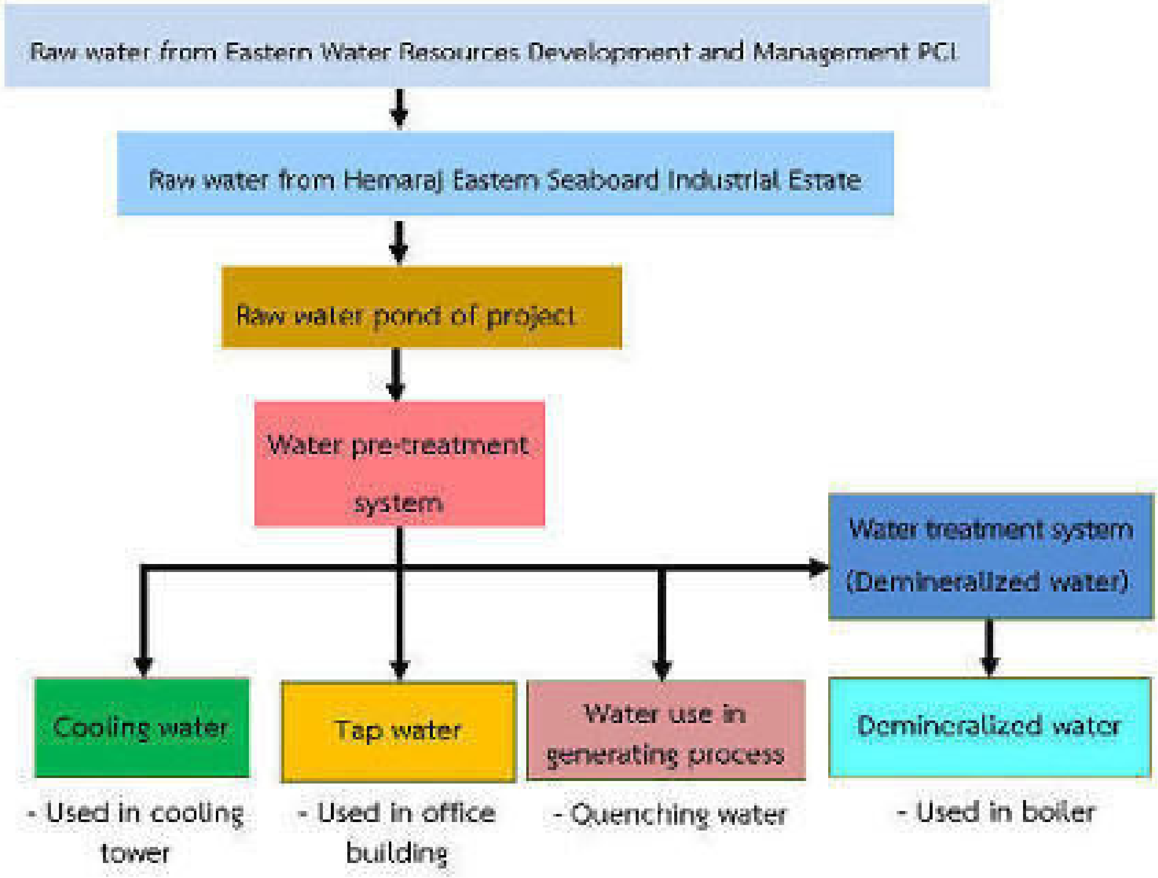


FIGURE 3.9-1 : SCHEMATIC OF WATER USED IN PROJECT

(a) Raw water is sourced by East Water Resources Development and Management PCL.:

Eastern Water Resources Development and Management PCL (East Water) was established on 12 September 1992 following the cabinet resolution. Its objective is to integrate raw water management through large scale pipeline to the industrial sector for both utility and consumption in support of the Eastern Seaboard Development Plan to promote the east coast as the country's key industrial region. The company's initial capital was THB 10 million with the Provincial Water Authority (PWA) as

the 100 % shareholder. In 1997, East Water publicly raised the capital to THB 1 billion and publicly listed in the Stock Exchange of Thailand (SET) to serve the needs of its water consuming clients. Currently, the company's capital is THB 1,663.73 million with key shareholders including the PWA, the Industrial Estate Authority of Thailand (IEAT), domestic and overseas financial institutions, The Electricity Generating Public Company Limited (EGCO) and the general public. To meet the ever increase water demand each year, East Water has invested over THB 12 billion in expanding a water pipeline network totaling 394.5 km in length. The new network is connected to many key water reservoirs in the eastern region such as the Nong Pla Lhai, Dok Krai, Klong Yai and Prasae in Rayong Province. In Chon Buri Province, they include the Nong Kho and Bang Phra reservoirs, and also the Bang Pakong River in Chachoengsao Province. The water network is aimed to be the most modern and comprehensive water grid in Thailand, able to serve raw water to communities for utility and consumption, support tourism and industries in three Provinces: Chon Buri, Rayong and Chachoengsao. (Reference: http://www.eastwater.com, Eastern Water Resources Development and Management PCL, retrieved on 20 October 2015).

- **Raw Water Sources for East Water**

Current raw water sources that East Water have access to are Dok Krai, Nong Pla Lhai, Nong Kho, Prasae reservoirs, Bang Pakong river and a few other privately-owned reservoirs. The total usable raw water is approximately 328.7 Mm^3 as described in **Table 3.9-2.**

- **Demand for Pipeline Water**

Utility and industrial water demand in Chon Buri and Rayong Provinces for the next 10 years is expected to grow continuously at a rate of 6.3 % annually. This is the results from the expansion of the industrial sector in the eastern region. The growth is also due to the migration of manufacturing bases from the central region to the eastern region in the aftermath of the big flood in 2011 and due to more power plants being built to generate another 5,000 MW. Water usage is expected to rise from the 2014 level of 298.4 Mm^3 to 395.2 Mm^3, and to 548.5 Mm^3 within 5 to 10 years as detailed in **Table 3.9-3.**

- **East Water's Water Sourcing Plan**

Its current raw water sources is able to serve the demand through 2015 **(Figure 3.9-2)**. However, current expansion to the pumping station at Bang Phra pumping station will increase water for the Bang Phra reservoir by another 18 Mm^3.

Another 20 Mm^3 will be purchased from private reservoirs in Chon Buri Province and another 30 Mm^3 from water pipeline of Khlong Phra Ong Chao Chaiyanuchit – Bang Phra. Approximately 47 Mm^3 will be available from Tab Ma reservoir (currently under construction) and another 70 Mm^3 will be available from the Prasae-Nong Pla Lai pipeline (also under construction). These developments will be able to satisfy water demands in the next 9-10 years. Moreover, East Water is currently conducting a feasibility study on the use of water from Pattaya City water treatment facility, Khlong Si Yat reservoir and other reservoirs in Klaeng District, Rayong Province as alternative water sources and to respond to the demand in the long term.

TABLE 3.9-2

CURRENT WATER SOURCES AVAILABLE TO EAST WATER

Source	Province	Capacity (Mm^3)	Water use (Mm^3/year)
1. Dok Krai reservoir	Rayong	71.4	116
2. Nong Pla Lai reservoir	Rayong	163.75	120
3. Nong Kho reservoir	Chon Buri	21.4	16.7
4. Prasae reservoir	Rayong	248.0	40.0
5. Bang Pakong river	Chachoengsao	-	26.0
6. Private reservoirs	Chon Buri	-	10.0
Total		**504.55**	**328.7**

Remarks: The water use from Dok Krai reservoir is greater than its capacity due to greater water volume entering throughout the year than its static capacity and is made available to East Water.

Source: http://www.eastwater.com, retrieved on 23 April 2015

TABLE 3.9-3

WATER DEMAND FORECAST FOR RAYONG AND CHON BURI PROVINCES

Service areas	Water demand (Mm^3/year)		
	2014	2019	2024
Rayong Province			
1. Rayong (Map Ta Phut)	185.2	238.9	296.3
2. Bowin – Pluak Daeng	29.2	52.5	120.7
Total for Rayong (1+2)	**214.4**	**291.5**	**417.0**
Chon Buri Province			
3. Chon Buri	84.0	103.7	131.6
Total for Rayong and Chon Buri (1+2+3)	**298.4**	**395.2**	**548.5**

Source : http://www.eastwater.com, retrieved on 23 April 2015.

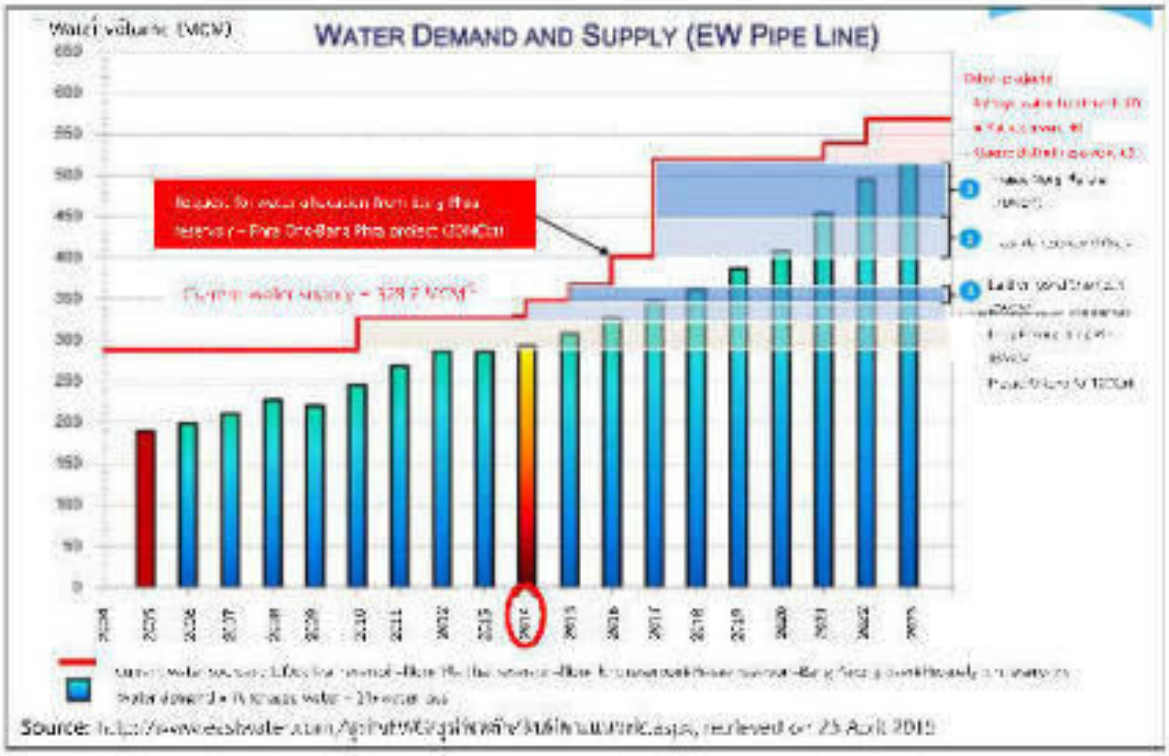


FIGURE 3.9-2 : WATER SUPPLY PLAN FOR CHON BURI, RAYONG PROVINCES.

- Water distribution from sources to East Water users

  - Rayong Province area (Map Ta Phut)

East Water pumps out raw water from Dok Krai reservoir and Nong Pla Lai reservoir, which are on the Khlong Yai river basin, to serve its customers in Map Ta Phut, Rayong Province. In the future, Rayong Province will also access water from Tap Ma reservoir and Prasae reservoir (via East Water's Prasae-Nong Pla Lai pipeline and Royal Irrigation Dept's Prasae-Khlong Yai pipeline) as per Figure 3.9-3. These will satisfy water demand in Rayong Province including Bowin-Pluak Daeng areas and even support water demand in Chon Buri Province.

  - Bowin-Pluak Daeng area

Currently, East Water pumps up raw water from Nong Pla Lai reservoir for its customers in Bowin-Pluak Daeng area. In the future, the Bowin-Pluak Daeng area will also have access 70 Mm^3 of water from Prasae reservoir via East Water's Prasae-Nong Pla Lai pipeline and another 70 Mm^3 via the Royal Irrigation Department's Prasae-Khlong Yai pipeline. Total water volume accessible from Prasae reservoir will be 140 Mm^3.

Source : http://www.eastwater.com/[illegible].aspx retrieved on 23 April 2015

FIGURE 3.9-3 : EAST WATER WATER GRID IN CHON BURI, RAYONG AND CHACHOENGSAO PROVINCES

- **Chon Buri Province area**

East Water uses water from Nong Kho and Bang Phra reservoirs (the latter is reserved from Bang Pakong river) and distributed to users in Chon Buri Province. In the future, Chon Buri users will have access to water distributed via Khlong Phra Ong Chai Chaiyanuchit-Bang Phra pipeline and privately operated reservoirs. This will result in more raw water access to users in Chon Buri and demand in water from Nong Pla Lai will decrease.

- **East Water raw water specifications**

The specifications of raw water from East Water's Nong Pla Lai pumping station are detailed as shown in **Table 3.9-4**.

TABLE 3.9-4

SPECIFICATIONS OF RAW WATER AT NONG PLA LAI PUMPING STATION FROM JANUARY - SEPTEMBER 2015

Parameters	Unit	Min.-Max.	Standard values
pH	-	7.30-8.34	5.0-9.0
DO	mg/l	3.52-5.92	≥4.0
BOD	mg/l	<1.0-2.6	≤2.0
COD	mg/l	10-15	-
Turbidity	NTU	2.36-8.15	-
Conductivity	us/cm	187-238	-
Colour	Pt-Co	7.38-11.53	Natural
Calcium	mg/l as $CaCO_3$	30-39	-
Magnesium	mg/l as $CaCO_3$	4-17	-
Chloride	mg/l	14-26	-
Total Ion	mg/l	0.06-0.23	-
Manganese	mg/l	0.05-0.27	≤1.0
Nitrate Nitrogen	mg/l	0.02-0.22	≤5.0
Sulfate	mg/l	10.21-22.29	-
Silica	mg/l	1.38-11.80	-
Total Suspended Solid	mg/l	3-14	-
Dissolved Solids	mg/l	120-148	-
Total Alkalinity	mg/l	50-65	-
Grease & Oil	mg/l	<2.0	-
Total Phosphate	mg/l	0.03-0.06	-
Phosphate	mg/l	0.09-0.18	-
Total Kjeldahl Nitrogen	mg/l	0.31-0.84	-
Ammonia Nitrogen	mg/l	<0.01	≤0.5
Copper	mg/l	<0.01	≤0.1
Zinc	mg/l	0.01-0.03	≤1.0
Fluoride	mg/l	0.20-0.42	-
Detergent	mg/l	<0.01	-

TABLE 3.9-4 (CONT'D)

SPECIFICATIONS OF RAW WATER AT NONG PLA LHAI PUMPING STATION FROM JANUARY THROUGH SEPTEMBER 2015

Parameters	Unit	Min.-Max.	Standard values
Carbonate Hardness	mg/l as $CaCO_3$	43-50	-
Non Carbonate Hardness	mg/l as $CaCO_3$	<1	-
Salinity	g/kg	0.06-0.08	-
TOC	mg/l	4.78-8.83	-
Arsenic	mg/l	0.0025-0.0032	≤0.01
Barium	mg/l	<0.05-0.09	-
Cadmium	mg/l	<0.02	≤0.005
Chromium (6+)	mg/l	<0.01	≤0.05
Lead	mg/l	<0.01	≤0.05
Mercury	mg/l	<0.0005	≤0.002
Nickel	mg/l	<0.01	≤0.1
Selenium	mg/l	<0.0005	-
Silver	mg/l	<0.01	-
Sodium	mg/l	15.03-20.56	-
Cyanide	mg/l	<0.001	≤0.005
Phenol	mg/l	<0.001	≤0.005
Fecal Coliform	MPN/100ml	49-490	≤4,000

Source : Eastern Water Resources Development and Management PCL, 2015

(b) Raw water from Hemaraj Eastern Seaboard Industrial Estate

The Hemaraj ESIE receives water from East Water sourced from Nong Pla Lai reservoir via Nong Pla Lai-Nong Kho pipeline at a rate of 95,565 m^3/day. A portion of the water received is distributed to our project while the remainder are held at its storage pond where is located near by the potable water production facility – covering an area of approximately 60 rai (96,000 m^2) - on the north side of the industrial estate. There is one raw water pond with a capacity of 70,000 m^3. It is used to produce potable water and distributed throughout the industrial estate. (**Source**: Hemaraj Eastern Seaboard Industrial Estate, 2015)

(2) Water usage rate

Maximum water usage in the project in case of natural gas is used equals to 63,000 m^3/day and in case of diesel is 47,239 m^3/day. Maximum water usage for each system is shown in **Table 3.9-5** and detailed as follows:

TABLE 3.9-5

MAXIMUM WATER USAGE DURING OPERATIONAL PERIOD

Order	Application	Natural gas as fuel[1/] (m^3/day)	Diesel as fuel[2/] (m^3/day)	Objective
1.	**Raw Water Supply comprises**	**63,000**	**47,239**	
	- Raw water being treated in Water Pre-Treatment Plant for further use in the power plant	62,618	46,857	
	- Irrigation	382	382	Irrigation
2.	**Water from the Water Pre-Treatment Plant comprises**	**63,216[3/]**	**47,455**	
	- Sludge Cake	5	4	Sludge cake will be disposed of by approved third-party.
	- Cooling water makeup	60,560	44,810	Make up for evaporation loss and vent from water cooling system.
	- Quenching water for HRSG blowdown	310	300	To reduce temperature of water vented from HRSG for recirculation in the cooling system.
	- Potable Water	30	30	For utilities and consumption in the power plant.
	- Water Treatment Plant (for demineralized water)	2,311	2,311	
3.	**Water Treatment Plant comprises**	**2,311**	**2,311**	
	- Demineralized water in the demineralized water storage tank.	1,700	1,700	
	- Re-use water sent back to water pre-treatment plant.	598	598	
	- Send wastewater to neutralization pit.	13	13	
4.	**Demineralized water storage tank comprises**	**599**	**5,615**	
	- Demineralized water for gas turbine water injection to control nitrogen oxide levels.	0	5,074	Gas turbine water injection is used to control nitrogen oxide levels in diesel fuel combustion exhaust.
	- Laboratory use	5	5	Pure water for laboratory use.

TABLE 3.9-5 (Cont'd)

MAXIMUM WATER USAGE DURING OPERATIONAL PERIOD

Order	Application	Natural gas as fuel[1/] (m^3/day)	Diesel as fuel[2/] (m^3/day)	Objective
4.	**Demineralized water storage tank comprises (continue)**			
	- Sampling water through Sampling Rack	70	70	Sampling water quality from steam generating using sampling rack.
	- Make up water from water steam cycle drains)	180	180	To make up for water loss.
	- Make up water for HRSG Blowdown	344	286	To make up for HRSG blowdown.
5.	**Water going into the steam generator comprises**	**654**	**480**	
	- Make up water for HRSG Blowdown	344	286	To make up for HRSG blowdown.
	- Quenching water for HRSG Blowdown	310	300	Quenching water to cool down HRSG blowdown water for reuse.
6.	**Water in cooling system**	**61,304**	**45,540**	
	- Cooling Water Makeup	60,560	44,810	Make up water for evaporated water from cooling system
	- Re-use cooling water from various systems	744	730	
Total water usage in the power plant		**63,000**	**47,239**	

Remarks: 1/ Maximum water usage in case of using natural gas as a fuel at 100 % load.

2/ Maximum water usage in case of using diesel oil as a fuel at 100 % load.

3/ No.2 include more water from water pre-treatment plant than No.1 due to difference in reuse water (approximately 598 m^3/day) from the water treatment plant

(a) Water cooling system

The water cooling system uses water to compensate for water losses due to evaporation in the cooling tower. The cooling system is designed to recirculate water 5 times in order to keep the levels of Total Dissolved Solids (TDS) in drainage water from cooling tower at no more than 1,300 mg/l as stipulated in the Environmental Impact Mitigation and Preventive Measures of Hemaraj Eastern Seaboard Industrial Estate.

Water usage for the cooling system is 61,304 m^3/day. It includes 60,560 m^3/day of water from the primary water treatment and 744 m^3/day from recirculated water from the condensate system, excess sampling water and quenching water from the HRSG.

(b) Demineralized Water, Potable Water and Service Water

Approximately 344 m^3/day of demineralized water is used for the HRSG. Approximately 180 m^3/day is used for other steam circulation systems. Approximately, 70 m^3/day will be collected as sampling water. Approximately, 5 m^3/day is for laboratory use. When diesel is used as fuel, demineralized water will be used to control nitrogen oxide levels. The demineralized water used for this purpose is retrieved from its own dedicated tank and not involved in overall water use. Approximately 30 m^3/day of potable water will be used for consumption. Another 310 m^3/day of potable water will be used as quenching water for HRSG.

(3) The project's raw water pond

Sriracha Power Plant Project will receive 63,000 m^3/day of raw water from Hemaraj Eastern Seaboard Industrial Estate and stored in one raw water pond with a capacity of 189,000 m^3.

Raw water from Hemaraj Eastern Seaboard Industrial Estate will be held at the raw water pond prior to water pre-treatment system. In some cases, the raw water will not be held at the raw water pond but sent directly to the water treatment facility. Should the water level be too low in the raw water pond, additional raw water will be ordered from Hemaraj Eastern Seaboard Industrial Estate until sufficient level is reached.

The location of the raw water pond is indicated in **Figure 3.3-1** and the cross section of the raw water pond is shown in **Figure 3.9-4**. Included are the calculations for the water pond in the project as **Appendix 2G**.

(4) Water treatment system

The project's water treatment system is divided into two procedures: water pre-treatment and water treatment using demineralization system as shown following details:

(a) Water Pre-treatment System

Suspended sediments in raw water will be separated by adding coagulants comprising ferric chloride and polymer causing suspended solids to sink to the bottom in the clarifier tank. These suspended solids have now become sludge at the bottom of the clarifier tank before being pumped out to undergo a thickener process to reduce its volume. Thickened sludge will then be dewatered using belt filter press while the water from this process will be recirculated for reuse in the clarifier tank. Approximately 5 tons/day of dried sludge will be collected before being transported for proper disposal in accordance with the Notification of Ministry of Industry B.E. 2548 re: Disposal of Wastes and Discarded Materials or outsourced to industrial waste disposal company licensed by the Department of Industrial Works.

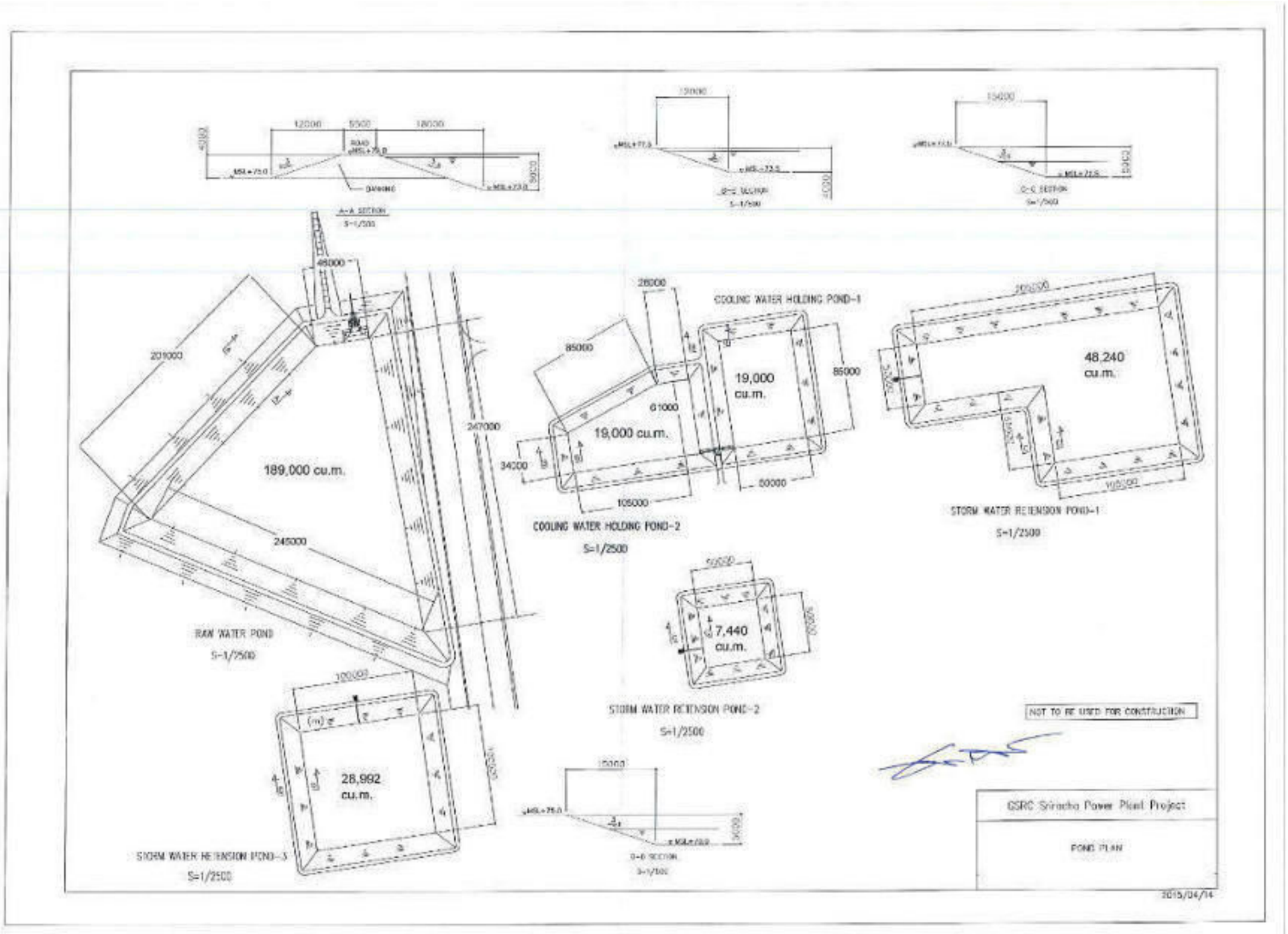


FIGURE 3.9-4 : THE CROSS SECTION OF THE RAW WATER POND

Moreover, during water treatment, sodium hydroxide is added to the water to adjust its pH level and allowing for sedimentation.

A portion of water from the pre-treatment system will be used in the cooling tower while the remainder will go to a filtering tank to further separate suspended sediments. Afterwards, the water will be stored in one of 4,200 m^3 service water tank ready to be distributed to other systems such as the water treatment system (for demineralized water), utility water and potable water system.

The water pre-treatment system has production capacity of 3, m^3/h or 72,000 m^3/day which is sufficient for use in the whole project which is calculated to require a maximum of 62,618 m^3 of water. The water pre-treatment system comprises two clarifiers, each with a capacity of 1,500 m^3/h.

Calculations for the water pre-treatment system is shown as **Appendix 2H** and calculations for the sufficiency of water storage is shown as **Appendix 2I.**

(b) Water Treatment Plant

Details of the water treatment plant or a water demineralization system are as follows.

To produce demineralized water, it uses water from the water pre-treatment system and send it through a reverse osmosis (RO) process with an addition of sodium metabisulfite to rid of excess chlorine in the water, and also, an antiscalant agent is added to prevent scaling on the RO membrane. Water that has undergone RO process is sent to mixed bed ion exchange unit to further demineralize water. The resultant water will be stored in the 6,600 m^3 demineralized water storage tank for 2 tanks. Demineralized water is used in various systems such as the HRSG blowdown system, water injection for gas turbine to control NO_x levels when diesel oil is used as fuel, etc.

Wastewater from the water treatment system comprises wastewater from the mixed bed ion exchange and is pumped into a neutralization basin to adjust pH level. Wastewater from the neutralization basin will then be discharged into the central wastewater treatment system of the Hemaraj Eastern Seaboard Industrial Estate. Prior to discharge, the wastewater will be checked for qualities as per standard set by the Hemaraj Eastern Seaboard Industrial Estate.

The water demineralization system has a production capacity of 1,800 m^3/day – sufficient for use in the project which requires a maximum of 1,700 m^3/day of demineralized water. The water demineralization system key components are the two set of reverse osmosis systems, each with a capacity of 1,800 m^3/day. However, each reverse osmosis unit take turns to run for 48 hours period at a time.

Calculations for the demineralized water treatment system is shown as **Appendix 2H** and calculations for the sufficiency of demineralized water storage is shown as **Appendix 2I**.

(4) Water consumption in the power plant

From preliminary estimation in case using natural gas as a fuel, maximum water consumption is 63,000 m^3/day and on diesel scenario the water use is 47,239 m^3/day. The water mass balance diagram running the power plant using either fuel is shown on **Figure 3.9-5** through **Figure 3.9-7** and on **Figure 3.9-8** through **Figure 3.9-10** in which water consumption can be described in brief as follows:

- Raw water is pumped into the water pre-treatment at a rate of 62,618 m^3/day for natural gas scenario and 46,857 m^3/day for diesel scenario. The raw water is pumped from the 189,000 m^3 raw water pond for pre-treatment.
- After pre-treatment, the water will be distributed for use as follows:
  - In case using natural gas as a fuel, pre-treated water will be sent to the water cooling system (at a rate of 60,560 m^3/day), potable water system (30 m^3/day), HRSG Blowdown Tank (310 m^3/day) and water demineralization plant (2,311 m^3/day).
  - In case using diesel fuel as a fuel, the pre-treated water will be sent to the water cooling system (at a rate of 44,810 m^3/day), potable water system (30 m^3/day), HRSG Blowdown Tank (300 m^3/day) and water demineralization plant (2,311 m^3/day).
- After receiving pre-treated water from the pre-treatment plant, the water will be demineralized in the water treatment plant. The demineralized water will be used as follows:
  - In the natural gas cycle, demineralized water will be stored in the demineralized water tank at a rate of 1,700 m^3/day to standby for distribution to the laboratory (5 m^3/day), make-up for sampling (70 m^3/day), make-up for steam cycle drains (180 m^3/day), make up for HRSG blowdown (344 m^3/day) with reserve in the demineralized water tank (1,101 m^3/day).
  - In the diesel cycle, demineralizes water will be pumped in at a rate of 1,700 m^3/day before sending to the laboratory (5 m^3/day), make-up for sampling (70 m^3/day), make-up for steam cycle drains (180 5 m^3/day). Drains from the steam cycle and other drains are of similar rates between natural gas and diesel cycle), but the key difference is GT water injection system to control nitrogen oxides (5,074 5 m^3/day).

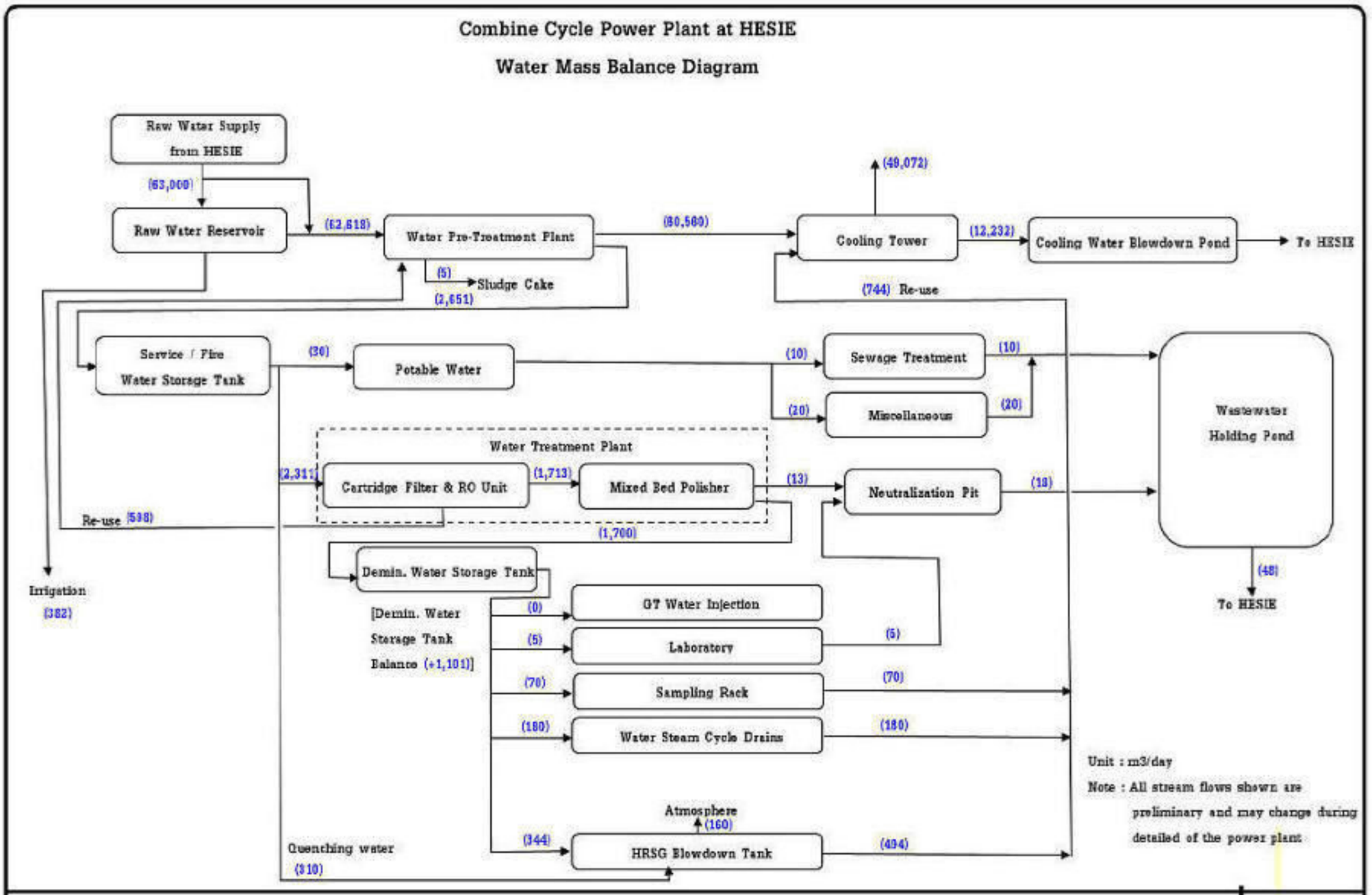


FIGURE 3.9-5: WATER MASS BALANCE OF THE SRIRACHA POWER PLANT WHEN USING NATURAL GAS AT 100% LOAD (625 MW)

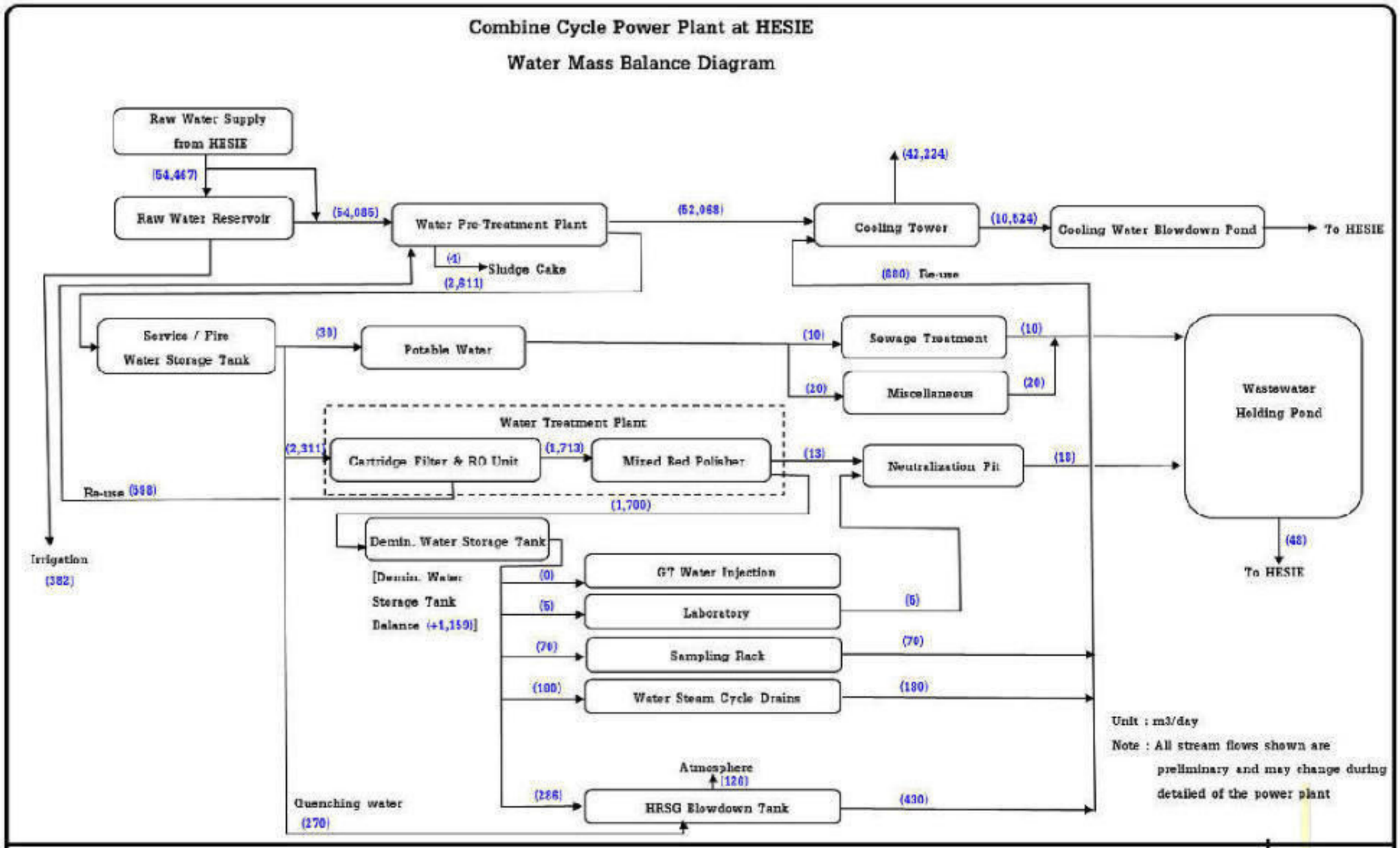


FIGURE 3.9-6: WATER MASS BALANCE OF THE SRIRACHA POWER PLANT WHEN USING NATURAL GAS AT 80% LOAD (500 MW)

TEAM

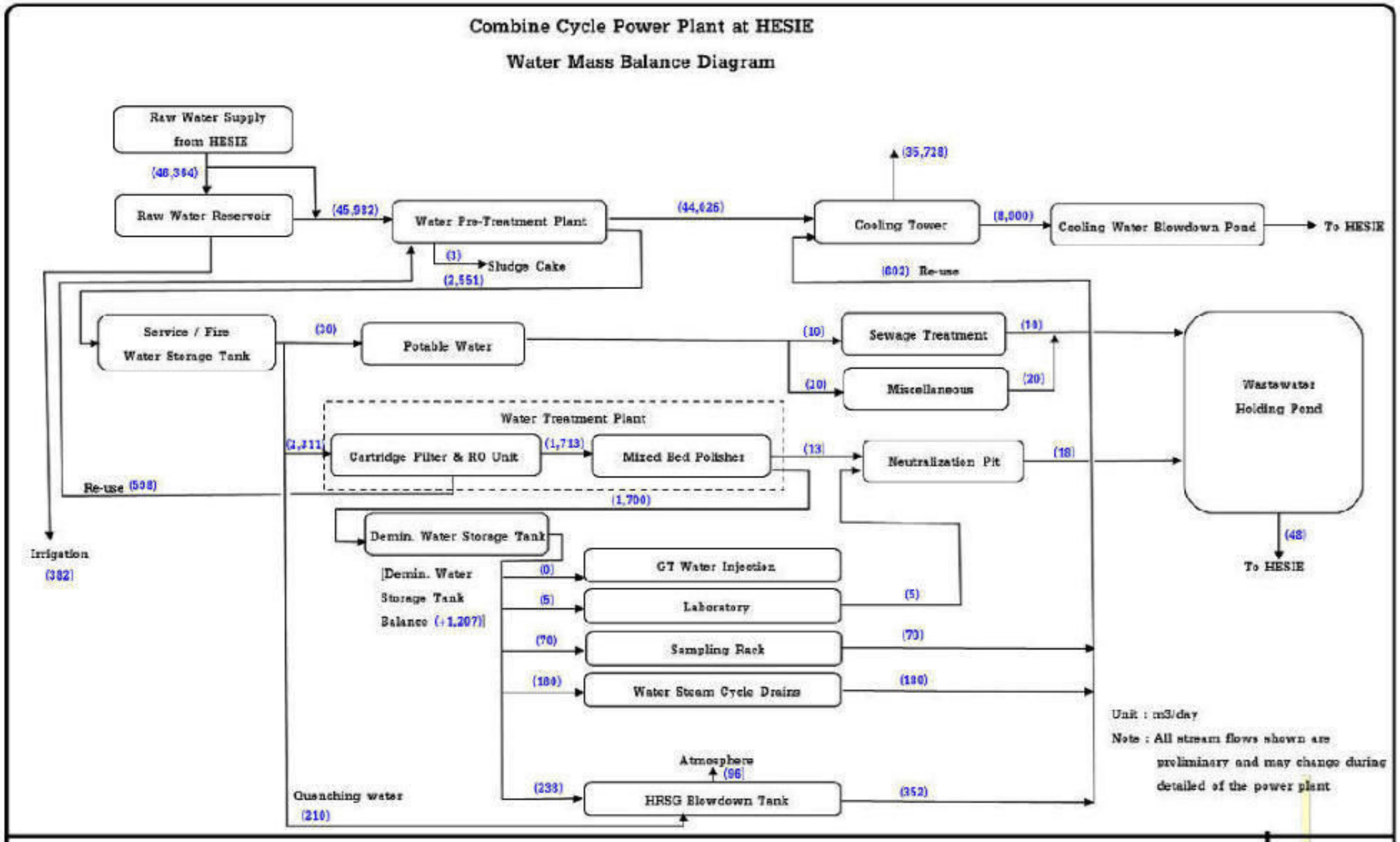


FIGURE 3.9-7: WATER MASS BALANCE OF THE SRIRACHA POWER PLANT WHEN USING NATURAL GAS AT 60% LOAD (375 MW)

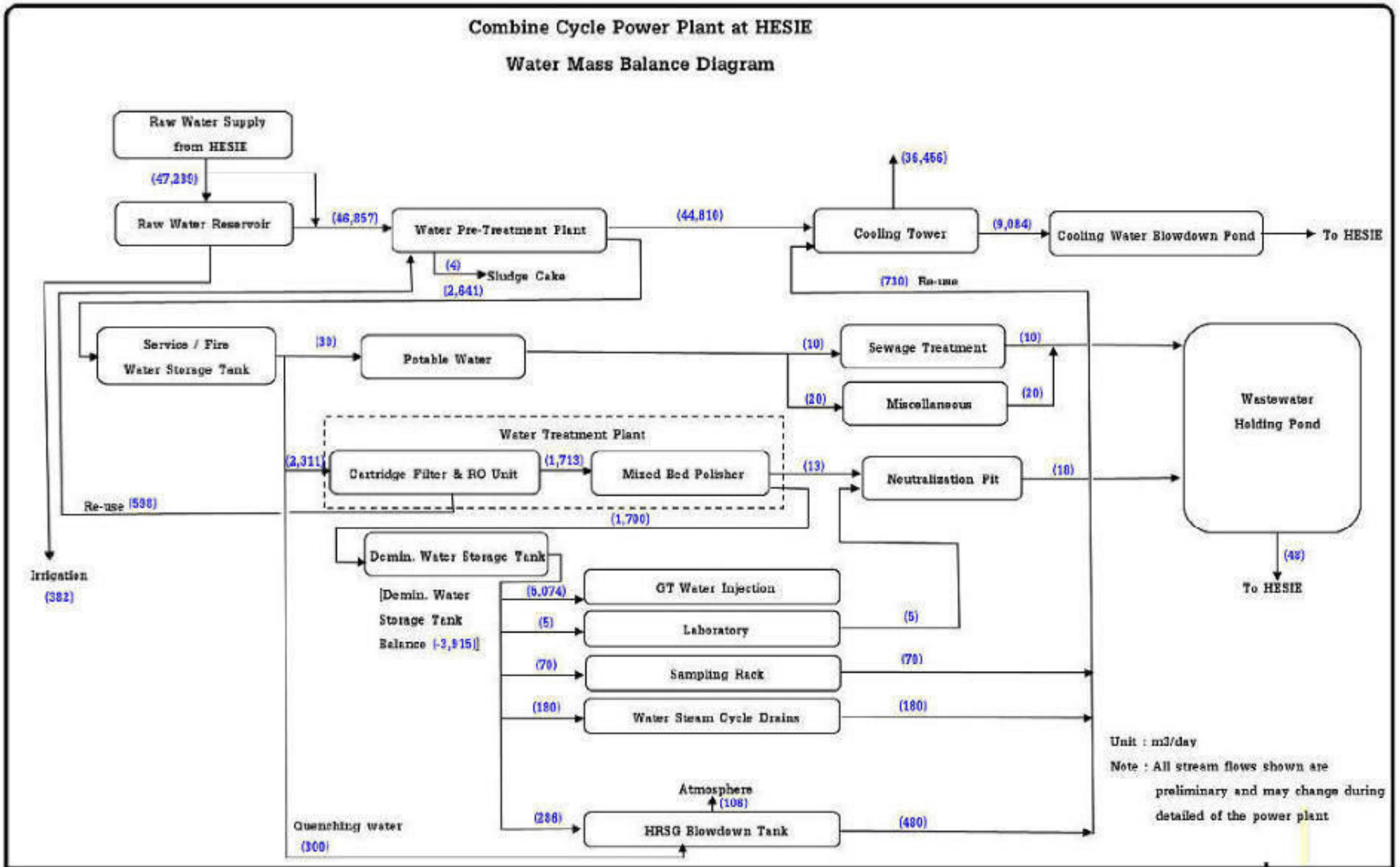


FIGURE 3.9-8: WATER MASS BALANCE OF THE SRIRACHA POWER PLANT WHEN USING DIESEL OIL AT 100% LOAD

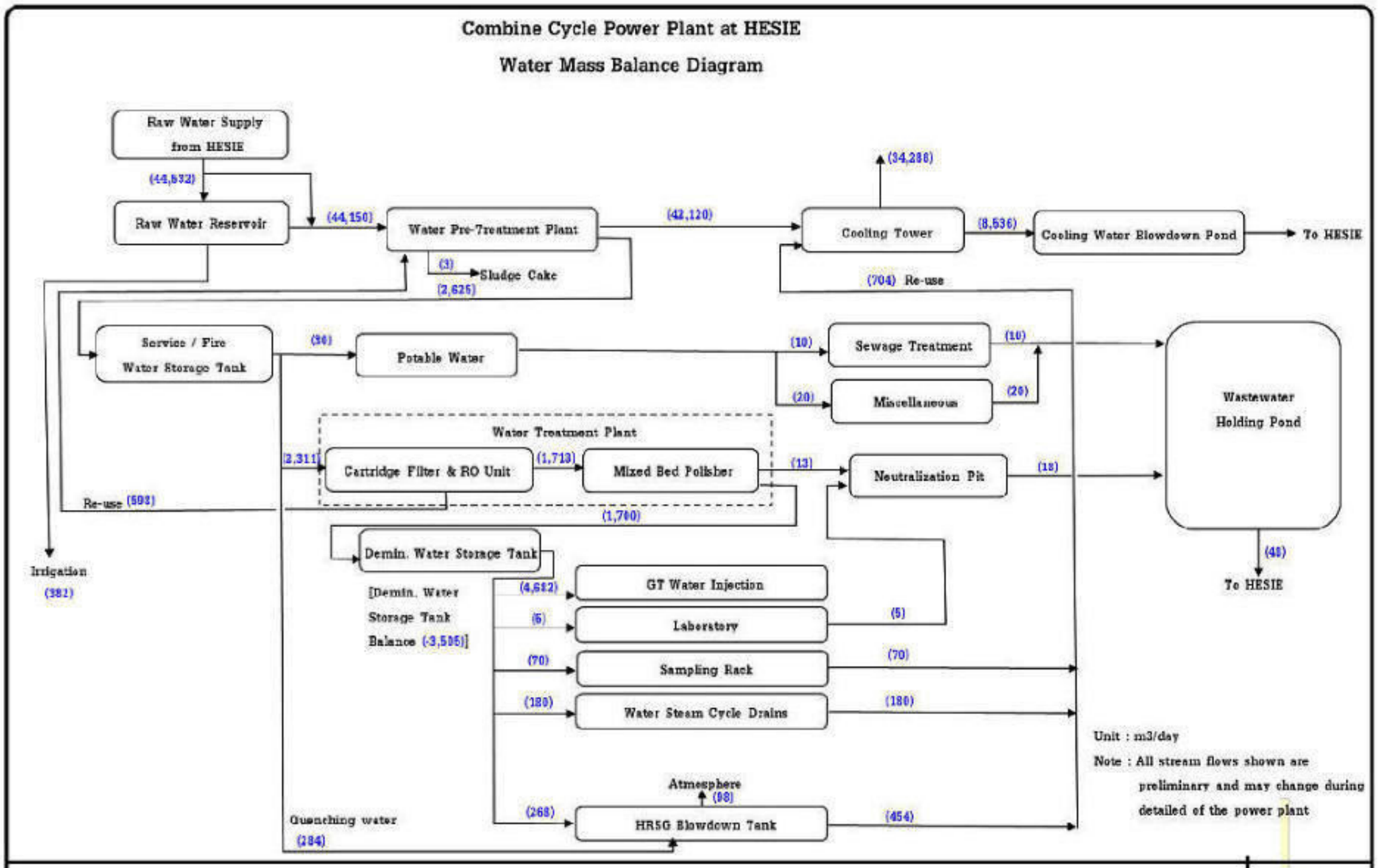


FIGURE 3.9-9: WATER MASS BALANCE OF THE SRIRACHA POWER PLANT WHEN USING DIESEL OIL AT INTERMEDIATE LOAD (415.1 MW)

TEAM

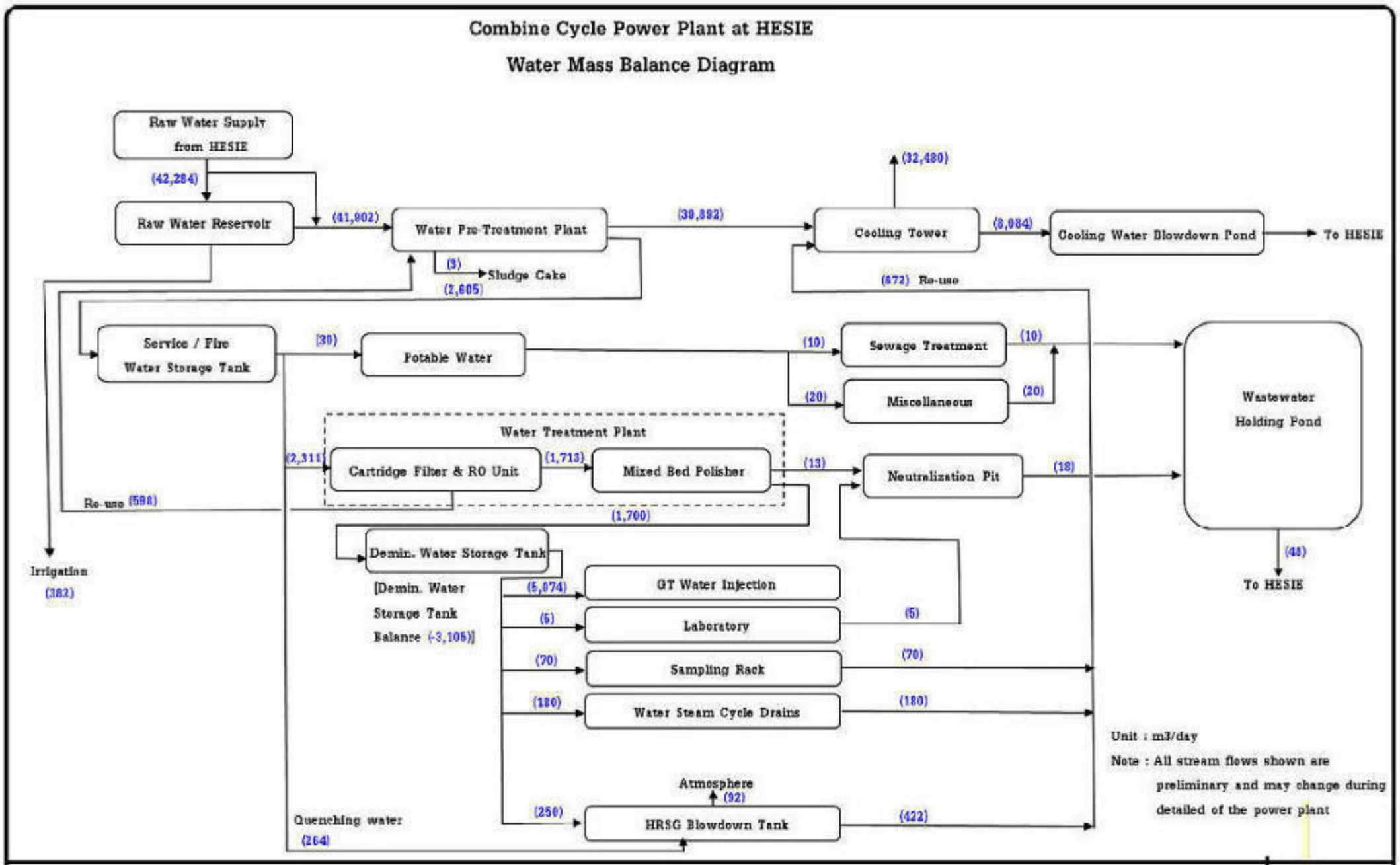


FIGURE 3.9-10: WATER MASS BALANCE OF THE SRIRACHA POWER PLANT WHEN USING DIESEL OIL AT MINIMUM LOAD (375 MW)

TEAM

3.9.3 DEMINERALIZED WATER

The project's water treatment plant has a maximum production capacity approximately 1,800 m^3/day. Demineralized water from the water treatment plant will be held in the demineralized water storage tank. Production of demineralized water will depend on which fuel is being run: natural gas or diesel. This is described in **Figure 3.9-5** through **Figure 3.9-7** and **Figure 3.9-8** through **Figure 3.9-10**. The production for each cycle are described as follows:

(1) In case of using natural gas as fuel – Approximately 1,700 m^3/day of demineralized water will be produced with approximately 599 (5+70+60+120+344) m^3/day of this used in various applications. Approximately 1,101 (1,700-599) m^3/day will be reserved in the demineralized water storage tank when the power plant is operated by using diesel oil as fuel. The water demineralization plant and the demineralized water storage tank are designed to produce and store sufficient demineralized water for 3 days of diesel cycle. When the power plant is able to completely fill up the demineralized water storage tank (takes approximately 12 days), production of demineralized water will be reduced to 599 m^3/day to meet daily demands without need to produce reserve water. The water mass balance figure for natural gas cycle describing this water reserve (considered maximum water use) is shown in **Figure 3.9-5.**

(2) In case of using diesel oil as fuel– Approximately 1,700 m^3/day of demineralized water will be produced with approximately 541 (5+70+60+120+286) m^3/day of this used in various applications. Approximately 1,159 (1,700-541) m^3/day will used for water injection. However, maximum amount of the water injection is 5,074 m^3/day. To make up the required amount of water 3,915 (5,074- 1,159) m^3/day of water from the demineralized water storage tank will be drawn as per **Figure 3.9-8**. However, the diesel cycle can continue until all the water in the demineralized water storage tank is depleted (which takes approximately 3 days) and be forced to go back to natural gas cycle and resume producing demineralized water reserve in contingency for the next diesel cycle run.

3.10 RAIN WATER MANAGEMENT IN THE POWER PLANT

The project's rain water drainage system is designed to utilize the Earth's gravity. Rain water in the drains will be directed to 3 rain water retention ponds with combined capacity of 89,468.6 m^3. This is capable of retaining rain water for 3 hours without exceeding the water drainage rate prior to project's existence (calculated from 100 mm of rainfall/h x 3 hours, with c value of pre-project is 0.3 and c value of post project is 0.7). Rain water in the rain water retention pond can be pumped for use as raw water in the power plant. The rain water can also be discharged into the rain drainage of Hemaraj

Eastern Seaboard Industrial Estate. Rain water drainage is detailed as shown in **Figure 3.10-1**. Note that the rain water drainage system is clearly separated from all other wastewater systems and the Hemaraj Eastern Seaboards Industrial Estate rain water drainage system is also separated from its wastewater system.

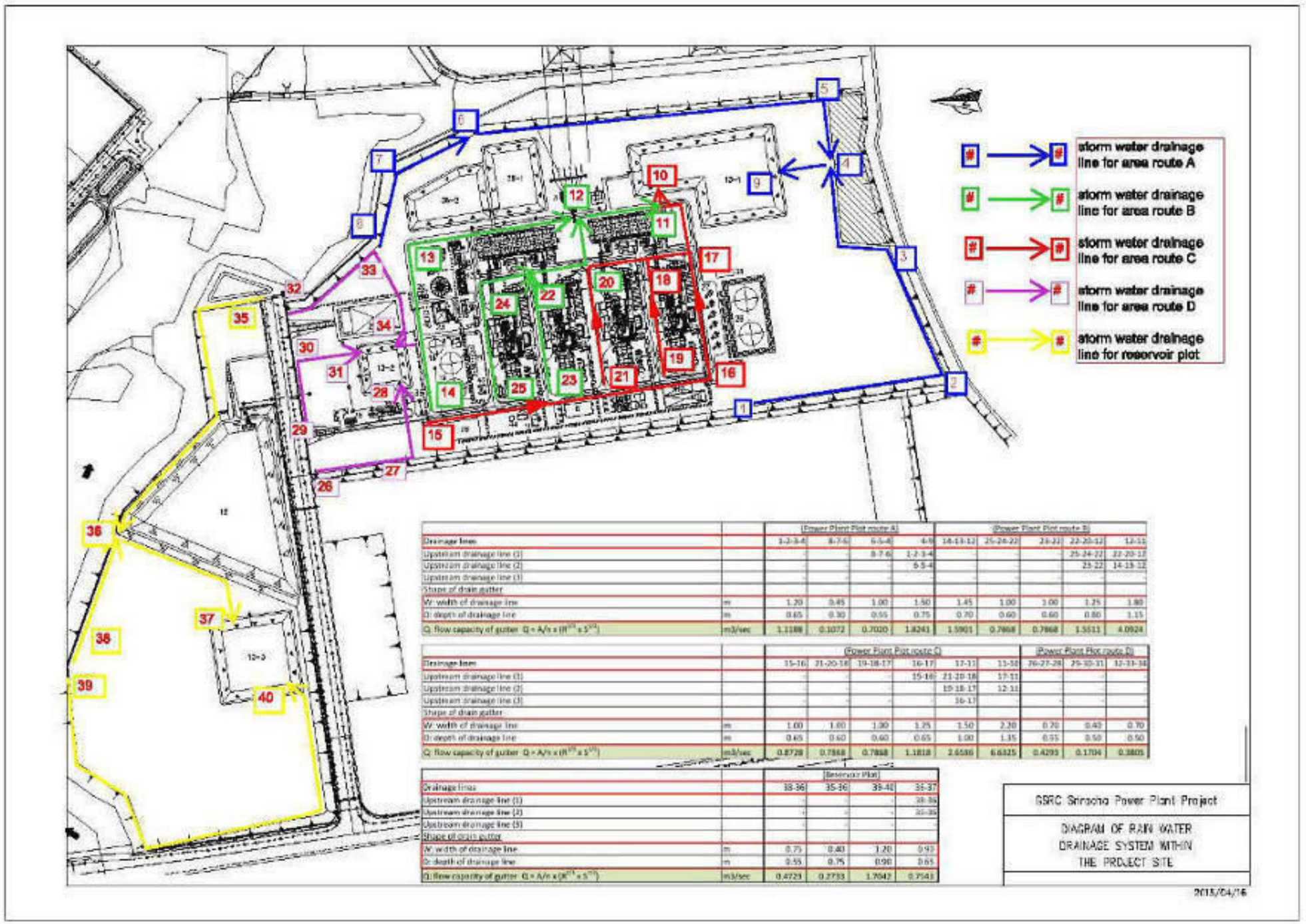
Calculations for the rain water drainage and rain water retention pond is detailed in **Appendix 2J**.

In case the rain water is not pumped back for reuse, it can be discharged into the industrial estate's rain water drainage system. The drainage rate is 2.01 m^3/s for the northern area where the raw water pond is located and upto 4.00 m^3/s for the southern area where the power plant is situated. Both drainage rates are similar to the rates prior to project to development. The industrial estate's rain water drainage has the capacity to drain at rates of 6.68 and 10.86 m^3/s respectively for the two discharge points.

Calculations for the rain water drainage and drainage capacity of the industrial estate's rain water drainage system are detailed as **Appendix 2K**.

Rainfall in the oil contaminated area, such as in the concrete dike surrounding the diesel oil storage tanks, will be collected for further separation process at the oil/water separator prior to discharge into the central wastewater system of the Hemaraj Eastern Seaboard Industrial Estate. Oily areas will be surrounded with a dike and an oil/water separator indicated in **Figure 3.10-2**. The dike surrounding the diesel tanks is compacted soil dike and a height of 2.85 m and a slope of 1:2. Inside the dike laid the soil foundation with HDPE sheet for sealant and on top of the plastic sheet is a 10 cm thick steel-reinforced concrete as shown in **Figure 3.10-3**. Rain water capacity of the concrete dike in oily area is calculated against 10 year peak rain intensity (116.22 mm/h) for 15 min and detailed in **Appendix 2L**.

The study on impact of flood water to water drainage system (specifically the wastewater from the cooling tower) of Sriracha Power Plant Project, 2015 as shown in **Appendix 2M** found the following: the Sriracha Power Plant site is located on a slope with Khlong Kram stream running through the middle of the Hemaraj ESIE and topographically splitting the industrial estate into two. Where the stream runs through the industrial estate it widens so much like a swamp so the locals call it "Map Kradon". The stream flows into Khlong Rawoeng stream which feeds into Nong Pla Lai reservoir. At the far end of the project area from the stream, the landscape is mainly a flat plain with some undulations. A weir at Ban Wang Ka Yang retards the water in the stream before flowing down stream into Nong Pla Lai reservoir. Therefore, the 2 factors influencing floods in the project area and impact assessment are from heavy rainfall in the flood plain and from overflow of Khlong Kram stream, Map Kradon reservoir and Khlong Rawoeng.



		(Power Plant Plot route A)				(Power Plant Plot route B)				
Drainage lines		1-2-3-4	8-7-6	6-5-4	4-9	16-13-12	25-24-22	24-22	22-20-12	12-11
Upstream drainage line (1)		-	-	8-7-6	1-2-3-4	-	-	-	25-24-22	22-20-12
Upstream drainage line (2)		-	-	-	6-5-4	-	-	-	25-22	14-13-12
Upstream drainage line (3)		-	-	-	-	-	-	-	-	-
Shape of drain gutter										
W: width of drainage line	m	1.20	0.45	1.00	1.50	1.45	1.00	1.00	1.25	1.80
D: depth of drainage line	m	0.65	0.30	0.55	0.75	0.70	0.60	0.60	0.80	1.15
Q: flow capacity of gutter $Q = A/n \times (R^{2/3} \times S^{1/2})$	m3/sec	1.1188	0.1072	0.7020	1.8241	1.5901	0.7868	0.7868	1.5513	4.0924

		(Power Plant Plot route C)						(Power Plant Plot route D)		
Drainage lines		15-16	21-20-18	19-18-17	16-17	17-11	13-11	26-27-28	29-30-31	32-33-34
Upstream drainage line (1)		-	-	-	15-16	21-20-18	17-11	-	-	-
Upstream drainage line (2)		-	-	-	-	19-18-17	12-11	-	-	-
Upstream drainage line (3)		-	-	-	-	16-17	-	-	-	-
Shape of drain gutter										
W: width of drainage line	m	1.00	1.00	1.30	1.75	1.50	2.20	0.70	0.40	0.70
D: depth of drainage line	m	0.65	0.60	0.60	0.65	1.00	1.35	0.55	0.50	0.50
Q: flow capacity of gutter $Q = A/n \times (R^{2/3} \times S^{1/2})$	m3/sec	0.8728	0.7868	0.7868	1.1818	2.6586	6.6325	0.4293	0.1704	0.3805

		(Reservoir Plot)			
Drainage lines		38-36	35-36	39-40	36-37
Upstream drainage line (1)		-	-	-	38-36
Upstream drainage line (2)		-	-	-	35-36
Upstream drainage line (3)		-	-	-	-
Shape of drain gutter					
W: width of drainage line	m	0.75	0.40	1.20	0.90
D: depth of drainage line	m	0.55	0.75	0.90	0.65
Q: flow capacity of gutter $Q = A/n \times (R^{2/3} \times S^{1/2})$	m3/sec	0.4729	0.2733	1.7642	0.7543

FIGURE 3.10-1 : RAIN WATER DRAINAGE WITHIN THE PROJECT AREA

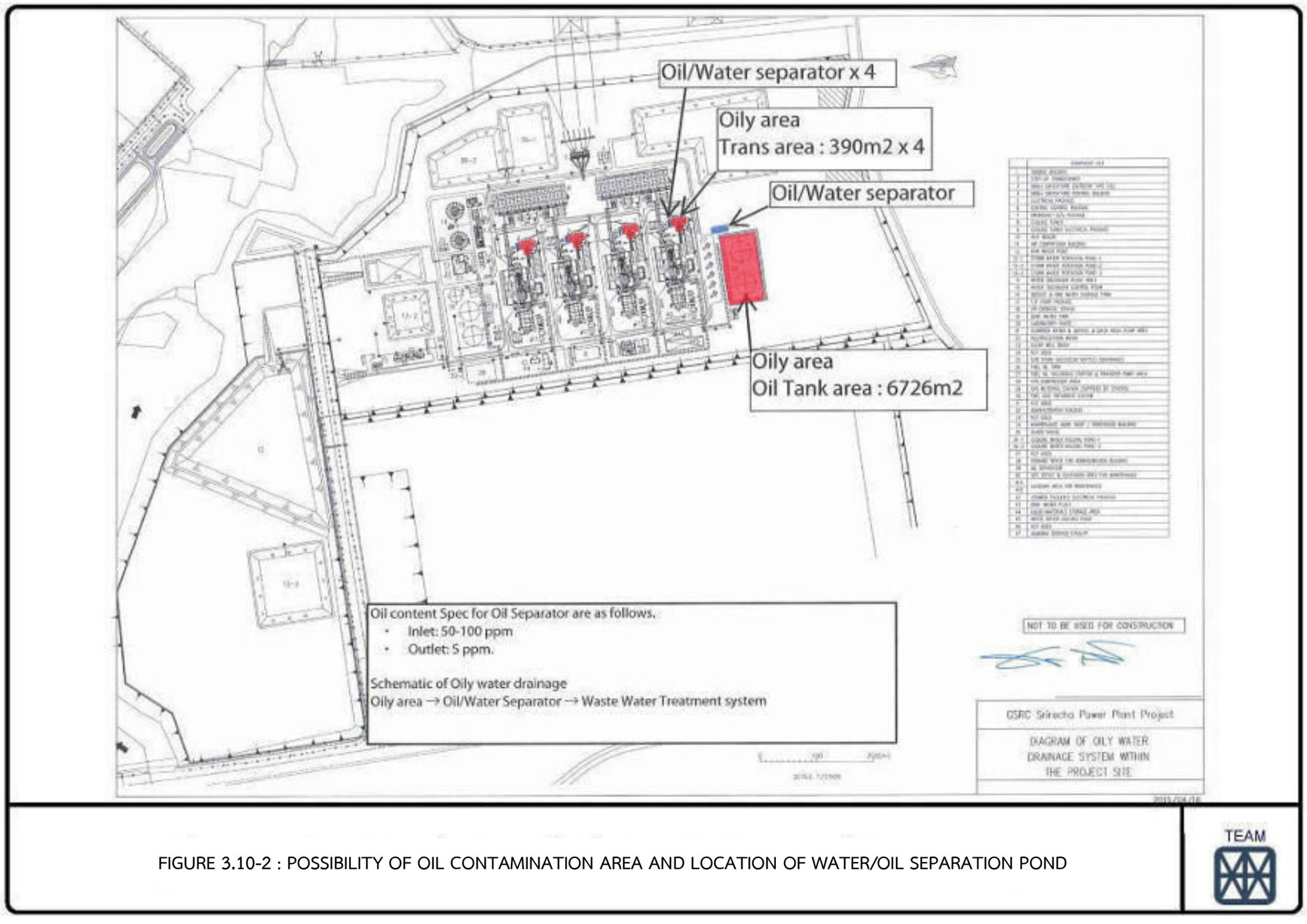


FIGURE 3.10-2 : POSSIBILITY OF OIL CONTAMINATION AREA AND LOCATION OF WATER/OIL SEPARATION POND

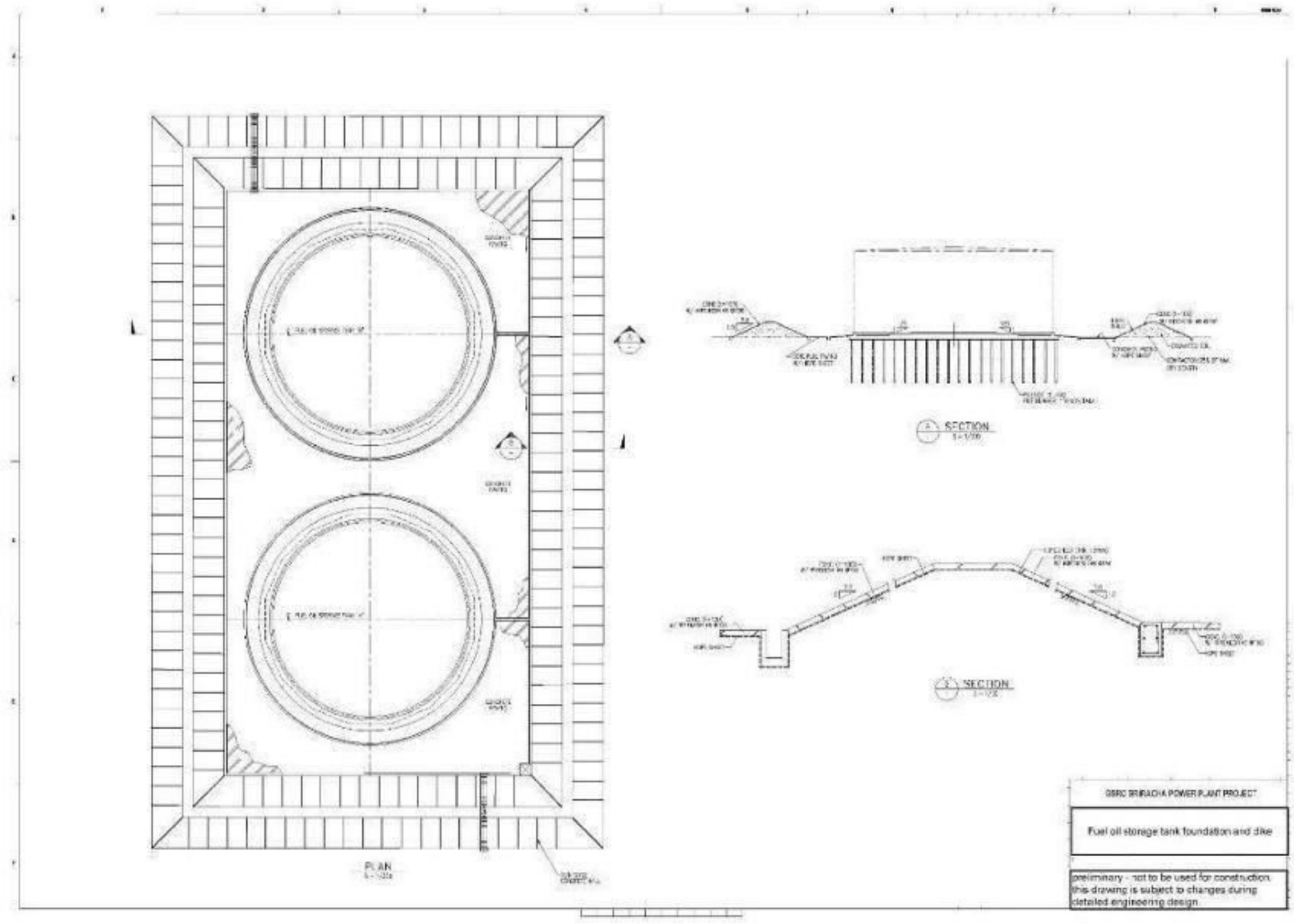


FIGURE 3.10-3 : CONCRETE DIKE SURROUND DIESEL TANK

A study on the impact of wastewater discharge from the power plant was made to analyze the flow of the streams using MIKE 11 HD software to create different models of floods both pre-project and post-project. The models ranged from recurring floods at 5 years interval from before the project commenced to 100 years after. The analyzes showed the effects to the flood levels when impacted by wastewater discharges from the 3 power plants – Sriracha Power Plant, Tasit 3 power plant and Tasit 4 power plant - in the Hemaraj ESIE as follows:

- The difference in the peak of wastewater discharge level between the scenario when only wastewater from Sriracha Power Plant is discharged and the scenario when all 3 power plants discharge wastewater at the same time is marginal (between only 0.002 to 0.004 m). This is due to very small water discharge into Khlong Kram at only 0.174 m^3/s maximum (all 3 power plants discharging). The peak water flow during floods that recur every 5 to 100 years are between 51.3-83.7 m^3/s. At maximum wastewater drainage from the all 3 power plants simultaneously, only 0.34 % and 0.21% is added on top of the maximum 5 and 100 year flood levels respectively.
- Analyses of floods recurring every 5 to 100 years found no risk of flood overflowing its banks and affecting communities due to a topography that can cope with 100 years recurring floods. This can be explained by the relatively steeply sloping flood plain and because the altitude difference between the weir at Ban Wang Kha Yang (+45.58 m.) is only marginally lower than the maximum water level at Nong Pla Lai reservoir (+45.65 m.) thus posing little impact.

The project area is located in the Khlong Yai river basin where the basin slopes downward from northwest to southeast. However, the Sriracha Power Plant Project site is 40 m higher in altitude than the inlet of the Nong Pla Lai. Also, the project area will raise the surface to 78 m above mean sea level to be on par with many other factories in the Hemaraj ESIE and certainly higher than the water level in Map Kradon reservoir. Thus, the possibility of the project area being inundated is very low.

3.11 POLLUTION AND CONTROL

3.11.1 AIR POLLUTION AND CONTROL

(1) Source of Air Pollution

During construction period, the activities creating impact are stripping topsoil, excavation for foundation works and building ponds. Air pollutants created by these activities are total suspended particulates (TSP). Mitigation measures are to spray water on the grounds of construction site at least twice per day and install 3 m high shading nets or solid fence on the perimeter of the project area.

Air pollutants during operational period of the power plant originate from the combustion of natural gas to power the combustion turbines. Under normal conditions, the exhaust gas will be emitted out through the stack of each Heat Recovery Steam Generator (HRSG). Key pollutants in the exhaust gas are nitrogen oxides (NO_x), sulfur dioxide (SO_2) and total suspended particulates (TSP) and are created during combustion. The details of air pollutants emit from the project's stacks during various case are shown in **Table 3.11-1**.

The power plant project considered designing Heat Recovery Steam Generator (HRSG) to reuse thermal energy for maximum efficiency. The technology will keep the exhaust stack temperature relatively low especially in natural gas cycle where the exhaust temperature at the HRSG stack is 75-80 °C. The principle of the HRSG is to reuse the heat of the exhaust from the gas turbine to generate steam. The HRSG does not combust any fuel and does not use air preheater tubes as in conventional steam generators that are powered by burning fuel such as coal fired boiler and biomass boiler. **The low pressure (LP) economizer tube is most susceptible to corrosion by acid rain inside the stacks.** To maximize resistant to acid rain corrosion, the LP economizer tube will be made with stainless steel tube (SA-268, Type TP-430).

Acid rain can occur in the HRSG stack when the exhaust temperature is lower than the dew point of the acid, transforming the said acid from gaseous state into liquid state and condensate on the heat exchanger tubes causing corrosion especially in areas of low temperature - in this case the last row of LP economizer tubes. Dew point for each exhaust gas varies according to the concentration of the gas such that the lower the concentration,

the lower the dew point for the gas. In the natural gas combustion, acid rain may occur due to presence of sulfur in natural gas.

Taking into consideration the specifications of the natural gas from vendor, the maximum sulfur content in the form of H_2S is equal to or less than 50 parts per million (H_2S =< 50 ppm), the acid dew point will be in between 55-75 ºC. Therefore, the project design has specified the exhaust stack temperature to be slightly higher than the acid dew point to minimize acid rain inside the stack.

The designed exhaust stack temperature is therefore suitable for the Heat Recovery Steam Generator (HRSG) to reuse thermal energy for maximum benefits.

The Sriracha Power Plant Project is certified by the Hemaraj ESIE that the designed emission levels are within their standards. The certification from Hemaraj ESIE is attached as **Appendix 2N**.

TABLE 3.11-1

DATA OF THE POWER PLANT OPERATION IN DIFFERENT CASES

Details	Type of Fuel	Unit	Normal Operating Case		
			Minimum Generation Load	Intermediate Load	100 % Load
Data of operation (Using Natural Gas as a Fuel)					
Net Output	Natural gas	MW/1 Unit	375	500	625
Low Heat Value (LHV)	Natural gas	kJ/kg	46,600	46,600	46,600
Use of fuel	Natural gas	MMscf/day/ 4 units	240	300	368
Data of operation (Using Diesel Oil as a Fuel)					
Net Output	Diesel oil	MW/1 unit	375	415.1	455.2
Low Heat Value (LHV)	Diesel oil	kJ/kg	43,148	43,148	43,148
Use of fuel	Diesel oil	liter/day/ 4 units	7,184,000	7,822,000	8,476,000
Data of stack					
Diameter of a stack	-	m	7.01	7.01	7.01
Number of stack	-	Stacks	4	4	4
Stack Height above ground level	-	m	60	60	60
Air Pollutant Emission (Using Natural Gas as a Fuel)					
Net Output	Natural gas	MW/1 unit	375	500	625
SO_2 (20)*/**		ppm	5.5	5.5	5.5
NO_2 (120)*/**		ppm	24.8	24.8	24.8
Particulates (60)*/*		mg/Nm^3	20	20	20
Velocity of air pollutant emission from a stack		m/s	16.2	19.5	23.5
Temperature of gas emission at the end of the stack		°C	75.3	78.0	82.4

TABLE 3.11-1 (Cont'd)

DATA OF THE POWER PLANT OPERATION IN DIFFERENT CASES

Details	Type of Fuel	Unit	Normal Operating Case		
			Minimum Generation Load	Intermediate Load	100 % Load
Air Pollutant Emission (Using Diesel Oil as Fuel)					
Net Output	Diesel oil	MW/1 unit	375	415.1	455.2
SO_2 (260*) (320**)		ppm	20	20	20
NO_2 (180)*/**		ppm	29.4	29.4	29.4
Particulates (120)*/**		mg/Nm^3	35	35	35
Velocity of air pollutant emission from a stack		m/s	22.9	25.2	27.5
Temperature of gas emission at the end of the stack		°C	143.7	146.1	148.0

Remark: (1) Number shown in the above table is calculated from cogeneration power plant 1 unit (Gas Turbine 1 set) at 32.5 °C, 1,000.9 mbar in pressure and 76 % relative humidity

(2) Concentration value of pollutant emission is measured at 25 °C, 760 mmHg in pressure, 7 % oxygen content in dry condition

(3) Oxide of sulfur are calculated from pollutant emission from a stack based on a assumption that hydrogen sulfide contamination in natural gas is 50 ppm and the quantity of sulfur contamination in diesel oil is lower than 0.005 %.

(4) Number in ( ) means standard index of air pollutant emission from an electric power plant in accordance with (*) the notification of the Ministry of Natural Resource and Environment for the controlling standard of air pollutant emission of new power plant dated 20 December B.E.2552 (2008) and (**) the Notification of the Ministry of Industry B.E.2547 (2004) for pollutant emission from power plant or electricity distribution.

Source: Gulf SRC Co., Ltd., 2015

(2) NO_x Emission Controlling Technology

The Hemaraj ESIE enforces emission standards for IPP as stipulated in the Environmental Impact Mitigation Plan included in the Project Description Modification Report under the Hemaraj ESIE Environment Impact Assessment Report No.2, 2015 as per **Table 3.11-2**. Therefore, to comply with the emission standards, the project has selected the following nitrogen oxide (NO_x) emission control technology: Dry Low NO_x (DLN) Combustion with Selective Catalytic Reduction in case of using natural gas as a fuel. In case of using diesel oil as a fuel, the project has chosen Water Injection technology with Selective Catalytic Reduction to keep the nitrogen oxide levels within the industrial estate's emission standards for IPP. This compliance also conforms to the new Notification of Ministry of Natural Resources and Environment re: Prescribing Power Plant Airborne Emissions Standard dated 20 December 2009 and the Notification of Ministry of Industrial Works 2004 re: Prescribing Airborne Emissions standards for power plants or power distributor. These standards stipulated that NO_x emissions for in case of using natural gas as a fuel shall not exceed 24.8 ppm at 7% O_2 which is lower than legal limit of 120 ppm at 7% O_2. For in case of using diesel oil as a fuel, the NO_x emission shall not exceed 29.4 ppm at 7% O_2 which is lower than the legal limit of 180 ppm at 7% O_2.

As a preventive measure, if the SCR malfunction, the power plant will immediately shut down, thus there is no air pollution emissions into the atmosphere. The working principle of this measure is explained in 3.2.2 (1) (B).

The differences in NO_x emission between Installation with and without Selective Catalytic Reduction (SCR) are as follows:

- **Without Selective Catalytic Reduction (SCR):**
  - For natural gas cycle at 100 % load, the NO_x emission is 70 ppm or 56.5 g/s.
  - For diesel cycle at 100 % load, the NO_x emission is 110 ppm or 75 g/s.
- **With Selective Catalytic Reduction (SCR):**
  - For natural gas cycle at 100 % load, the NO_x emission is 24.8 ppm or 20 g/s.
  - For diesel cycle at 100 % load, the NO_x emission is 29.4 ppm or 20 g/s.

TABLE 3.11-2

RATE OF POLLUTION EMISSION OF SRIRACHA POWER PLANT IN CASE OF INSTALLATION WITH AND WITHOUT SELECTIVE CATALYTIC REDUCTION (SCR) SYSTEM

Detail	Unit	Natural gas 100 % load	Diesel Oil 100 % load	Standard value[1],[2]		Regulation of industrial estate[3]	
				Natural gas	Diesel Oil	Natural gas	Diesel Oil
1. In case of without SCR together with other system							
Concentrations of air pollutants							
– NOx as NO_2 @ 7% O_2	ppmvd	70	110	120	180	25	30
– SOx as SO_2 @ 7% O_2	ppmvd	5.5	20	20	260	14	28
– TSP @ 7 % O_2	mg/m^3	20	35	60	120	32	44
Emission rate of air pollutions/ stack							
– NO_2	g/s	56.5	75			20	20
– SO_2	g/s	6.17	18.95			15.79	25.79
– TSP	g/s	7.86	11.60			12.35	14.22
2. In case of with Dry Low NO_x Combustion for natural gas and water injection system for diesel oil							
Concentrations of air pollutants							
– NO_x as NO_2 @ 7% O_2	ppmvd	24.8	29.4	120	180	25	30
– SO_x as SO_2 @ 7% O_2	ppmvd	5.5	20	20	260	14	28
– TSP @ 7% O_2	mg/m^3	20	35	60	120	32	44
Emission rate of air pollutions/ stack							
– NO_2	g/s	20.00	20.00			20	20
– SO_2	g/s	6.17	18.95			15.79	25.79
– TSP	g/s	7.86	11.60			12.35	14.22

Remark: (1) The standard of air pollution emission from power plant by the Ministry of Natural Resources and Environmental: Control Standards Emission Power Plant announced on December 20, 2009.

(2) The standard of air pollution emission from power plant by Ministry of Industry in 2004: Stipulate the contaminates in air pollution emission from production power plant or distribution of electricity

(3) Stipulate of air pollution emission from IPP power plant which is identified in Environmental Impact Prevention and Mitigation Plan and Monitoring Plan in Hemaraj Eastern Seaboard Industrial Estate Amended EIA Report No.2, 2015 (**Appendix 20**)

Source: Gulf SRC Co., Ltd., 2015

The ratio between emission rates (g/s) and concentration (ppm) for both installation with and without Selective Catalytic Reduction (SCR) are the same at 0.81 for in case of using natural gas as a fuel and 0.68 for in case of using diesel oil as a fuel (**Table 3.11-3**).

TABLE 3.11-3

THE RATIO OF NITROGEN OXIDES EMISSION RATE TO CONCENTRATION VALUE IN CASE OF INSTALLATION WITH AND WITHOUT SELECTIVE CATALYTIC REDUCTION (SCR)

Detail	Unit	With SCR		Without SCR	
		Natural Gas	Diesel Oil	Natural Gas	Diesel Oil
- NOx as NO_2 @ 7% O_2	ppm	24.8	29.4	70	110
- NOx as NO_2 @ 7% O_2	g/s	20	20	56.5	75
- Ratio between emission rates (g/s) and concentration (ppm)	-	0.81	0.68	0.81	0.68

The specifications of the Dry Low NO_x Combustion technology, Water Injection and Selective Catalytic Reduction systems are attached as per **Appendix 2P** and the certificate for pollution control system from the manufacture is attached as **Appendix 2Q**.

Moreover, the projects also monitor air quality, continuously, taking measurement of NO_2, SO_2 and TSP at the exhaust stack and controlling them to not exceed the emissions standards to prevent impact to public health and agricultural produce near the project area.

(3) An Installation of Continuous Emission Monitoring System (CEMs) of Air Pollutant

The power plant will be equipped with Continuous Emission Monitoring System (CEMs) for air pollutant. The system consists of measurement tool for performing concentration index of nitrogen oxides (NO_x), sulfur dioxide (SO_2), total suspended particulates (TSP) following either U.S. EPA standard or requirement of government agency on oxygen (O_2), flow rate and temperature of fuel gas. Continuous Emission Monitoring (CEMs) device will be equipped on the top of each HRSG's stack to measure the continuous emission performance data. The power plant is also provided with a channel for conducting manual sampling at the top of each HRSG's stack.

(4) Monitoring Program for Preventing NO_x Emission Exceeding Standards

The project has a monitoring plan to prevent NO_x emissions exceeding standards of 24.8 and 29.4 ppm (at dry air condition) for in case using natural gas as a fuel and in case using diesel oil as a fuel respectively at 100 % load and also to prevent more than 7 % excess oxygen. When the Continuous Emission Monitoring System (CEMs) detects an anomaly, a warning signal will go off in the control room to warn the control room operators of the situation to further analyze and take corrective action.

Apart from the continuous emission monitoring at top of stack, the gas turbine combustion control system operates on the fact that NO_x concentration in the exhaust from combined cycle power plant from minimum generation load to 100 % load would be below the emission standards. Inversely, if the combined cycle power plant operate below the minimum generation load, the NO_x concentration could exceed emission standards. Several parameters affect the combustion in the combustion chamber and any of these can be adjusted automatically by the control system. Should the control system malfunction, the protection function will prevent damage to the equipment and/or prevent emissions from exceeding standards.

Moreover, the project has a proactive preventive maintenance and monitoring plan to make certain that air pollution control system are functioning at full capacity all the time and contribute to prevention of system malfunction. Details of the preventive maintenance and monitoring plan will be in accordance with the manufacturer's product manual. Also, sufficient stock of spare parts will be kept for immediate use in emergencies.

3.11.2 NOISE POLLUTION AND CONTROL

(1) Construction period

(a) Noise source and levels

During construction period of the Sriracha Power Plant Project, the key sources of noise are from the machinery and equipment used in excavation for the construction of foundations and during finishing and testing and commissioning. The peak noise level from excavation work for foundation construction is 89 dB(A) at 15 m from noise source.

(b) Noise prevention and control

- Contractors are required to use properly maintained equipment and which produce low levels of noise.
- Noisy construction work are prohibited from 18:00 p.m. to 07:00 a.m. Any necessary work that are required to be undertaken during this period must be discussed with concerned agencies and communities in advance.

(2) Operation period

(a) Noise source and levels

It is required that equipment and machine in use must not generate noise level higher than 85 dB(A) at 1 m distance from the equipment. Equipment and machine engine to be used in the power plant are as follows:

- Combustion Turbine Gases (CTs)
- Heat Recovery Steam Generator (HRSG)
- Generators
- Cooling Towers
- Circulating Water Pumps
- Feed Water Pumps
- Electric Motors
- Air Compressors
- Control Valves and Associated Pipe Work
- Gas Compressors
- Cooling Fans for Transformers

Some equipment such as safety valve, start up vent valve, etc., may generate loud noise. Silencer will be installed to the equipment to decrease the noise. Therefore, the power plant could control noise level at perimeter fence of the power plant not to be higher than 70 dB(A).

However, in any irregular cases such as:

- Starting operation
- Stopping operation
- Irregularity equipment and machine during operation period.

The public relation unit will inform communities in vicinity of the site before carrying out such irregularly loud noise activities.

(b) Noise prevention and control

- Noisy machinery and equipment such as the gas turbine, steam turbine, HRSG, gas compressor etc. are specified to emit no more than 85 dB(A) at 1 m from noise source.
- Any noisy machinery in the Sriracha Power Plant must be equipped with exhaust silencers.
- Silencers must be regularly checked and tested for efficiency.
- Noise warning signs must be installed in areas where noise level is above 85 dB(A) such as the HRSG and gas turbine combustion chamber. All personnel working in these areas must wear personal protection equipment (PPE) such as ear plugs or ear muffs.

- Personal protective equipment such ear plugs and ear muffs must be provided for all personnel who enter areas with noise level above 80 dB(A).

3.11.3 WASTEWATER AND CONTROL

(1) Construction Period

Wastewater sources from project construction activities are summarizes in **Table 3.11-4** includes the following:

Wastewater from workers' consumption is 179.2 m^3/day assuming 80 % of total potable water consumed by a maximum number of 3,200 workers and at a rate of 70 L/day/person (Kriangsak, 1996).

Approximately 55 m^3/day of wastewater from construction work is mainly used in cleaning construction equipment.

Approximately 250 m^3 of wastewater will be from the hydrostatic test of the natural gas and fuel oil pipelines. This test will be conducted once only. The enquiry letter on supply and discharge of water for the hydrostatic test is attached as **Appendix 2B**.

Wastewater not contaminated from construction activities will be sent to sedimentation pond before being discharged into to the wastewater drainage of Hemaraj ESIE.

TABLE 3.11-4

WASTEWATER SOURCES AND TREATMENT DURING CONSTRUCTION PERIOD

Activity	Volume m^3/day	Treatment
1. Wastewater from workers' consumption assuming 80 % of total potable water consumed by a maximum number of 3,200 workers and at a rate of 70 liters/day/person	179.2	- Wastewater treatment tank -> Hemaraj ESIE's central wastewater treatment system.
2. Wastewater from construction activities - Wastewater from construction work	55	- Wastewater not contaminated from construction activities will be sent to sedimentation pond before being discharged into to the water drainage of the estate.
- Wastewater from hydrostatic test of gas and diesel pipelines[1/]	250[1/]	- Discharged into to the Hemaraj ESIE's central wastewater treatment system.
Total	**234.2**	

Remarks : [1/]Water used for hydrostatic test occur only once, not daily.

Source : Gulf SRC, 2015.

(2) Operation Period

Wastewater sources from project operations are detailed in the water mass balance diagrams (**Figure 3.9-5** - **Figure 3.9-10**). Wastewater sources from construction activities are summarized in **Table 3.11-5**. Wastewater from project operations can be divided into two categories:

Wastewater from the project during operational period can be divided into 2 main categories:

(a) Blowdown cooling water - 12,232 m^3/day – is the cooling water held to cool down in the cooling tower basin which has a capacity of greater than 12,232 m^3 and thus able to receive 1 day's worth of used cooling water from the cooling tower. After this water is cooled, it is sent to one of two the cooling water holding pond with 19,000 m^3 capacity each. At any one time, only one pond is used while the other is reserved for emergencies. Afterwards, the water here will be discharged into the Hemaraj ESIE cooling water holding pond for 1 more day as per Hemaraj ESIE Amended EIA report No.2 (2015).

Moreover, the wastewater from the cooling water will meet applicable government standards such as the Notification of Ministry of Industry No. 2 (B.E. 2539) re: Prescribing Factory Wastewater Standards. Total Dissolved Solids (TDS) will meet the requirement of the Royal Irrigation Department of no more than 1,300 mg/l with temperature of no more than 34 °C.

Water Quality Index	Wastewater quality from cooling tower discharge to cooling water holding pond of Hemaraj Eastern Seaboard Industrial Estate	
	Sriracha Power Plant	Ministry of Industry[1/]
Temperature (°C)	34	40
pH	5.5 - 9.0	5.5 - 9.0
Total Dissolved Solid (TDS) (mg/l)	1,300 [2/]	3,000

Remarks : [1/] Notification of Ministry of Industry No.2 1996, Subject : stipulate of wastewater quality discharged from industries

[2/] Standard of water quality discharged in watercourse of Ministry of Irrigation

Table 3.11-5

SOURCE, RATE AND METHOD OF WASTEWATER TREATMENT OF THE PROJECT

Source of wastewater	Wastewater Rate (m^3/day) [1]	Wastewater Treatment Method	Occurrence of wastewater (continuous/ discontinuous)
a. Wastewater from Cooling System			
1. Wastewater from Cooling Water	12,232	- Cooling Water Holding Pond of power plant → Cooling Water Holding Pond of power plant of Hemaraj Eastern Seaboard Industrial Estate	continuous
Total	12,232		
b. Wastewater from Process			
1. Water Treatment System (demineralization system)– Wastewater from Mixed Ion Bed Regeneration	13	- Neutralization Pond → Wastewater Holding Pond → the Central Wastewater Treatment of Hemaraj Eastern Seaboard Industrial Estate	discontinuous
2. Wastewater from Laboratory	5	- Neutralization pond → Wastewater Holding Pond → the Central Wastewater Treatment of Hemaraj Eastern Seaboard Industrial Estate	discontinuous
3. Wastewater from the office building	30	- Septic Tank (10 m^3/day) → Wastewater Holding Pond → the Central Wastewater Treatment of Hemaraj Eastern Seaboard Industrial Estate	continuous
Total	48		
Total Wastewater from (a) and (b)	**12,280**	-	

Remark: [1/]volume of wastewater calculated from an operation of full Load 100 % and uses natural gas as fuel

Source: Gulf SRC Co., Ltd., 2015

The project is to implement an online water quality monitoring system to monitor the water in the cooling water holding pond these parameters: temperature, pH, Dissolved Oxygen (DO) and conductivity (to determine TDS). The wastewater from the cooling water will meet applicable government standards such as the Notification of Ministry of Industry No. 2 (B.E. 2539) re: Prescribing Factory Wastewater Standards. Total Dissolved Solids (TDS) will meet the requirement of the Royal Irrigation Department of no more than 1,300 mg/l as per **Figure 3. 11- 1**. Moreover, the wastewater management will comply with requirements as specified in Hemaraj ESIE Amended EIA report No. 2 approved by the Office of Natural Resources and Environmental Policy and Planning (ONEP), reference TorSor 1009. 3/ 10241 dated 26 August 2015. The Hemaraj ESIE Revised has established an environmental protection, mitigation and monitoring plan (for the operational period) for independent power producers (IPP) as detailed in the attached **Appendix 2O**.

(b) Wastewater from processes totaling 48 m^3/day as follows:

- Approximately 13 m^3/day wastewater from the water treatment plant (water demineralization) comes from wastewater in the process of mixed bed regeneration. This wastewater will be sent to the neutralization pond for treatment prior to being sent to the project's wastewater holding pond for further discharge into Hemaraj ESIE central wastewater treatment system as per **Figure 3.11-1**.
- Approximately 5 m^3/day of wastewater from the laboratory will be sent to the neutralization pond, then held in the project's wastewater holding pond prior to discharge into Hemaraj ESIE central wastewater treatment system.
- Wastewater from consumption:
  - Approximately 10 m^3/day of wastewater from bathrooms will be treated in septic or treatment tank before being sent to the project's wastewater holding pond prior to discharge into Hemaraj ESIE central wastewater treatment system.
  - Approximately 20 m^3/day of general consumption wastewater is sent to the project's wastewater holding pond prior to discharge into Hemaraj ESIE's central wastewater treatment system.

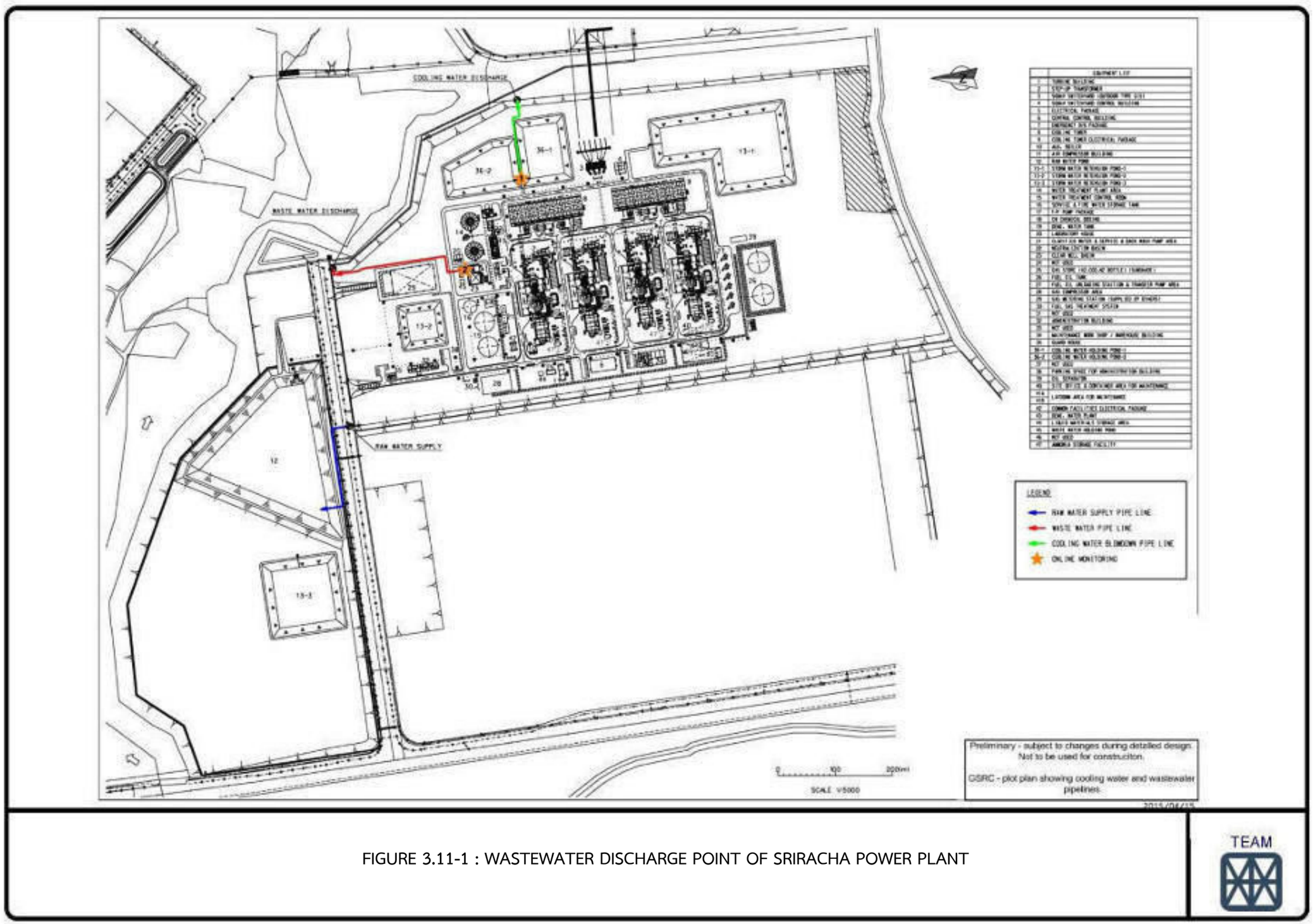


FIGURE 3.11-1 : WASTEWATER DISCHARGE POINT OF SRIRACHA POWER PLANT

Wastewater in (B) will be held in one of two wastewater holding ponds with a capacity of 75 m^3 each. Each pond can hold wastewater up to 1.5 days prior to discharge into Hemaraj ESIE central wastewater treatment system. The wastewater discharge will meet the requirements of Hemaraj ESIE as per **Table 3.11-6** using online water quality monitoring system to continuously monitor temperature, pH levels and conductivity prior to discharging from the project. The wastewater holding ponds will be designed to prevent their content leaking into the ground below using lining. They will be regularly monitored, maintained and any damaged will be fixed immediately. The calculations for the wastewater holding ponds are detailed as **Appendix 2R**.

(2) Wastewater from rain water drainage system of the project

Wastewater from the rain water drainage will collected and managed as follows:

(a) Uncontaminated rain water which is drained from uncontaminated areas will be held in the storm water retention pond designed to receive 100 mm/h. of rain for 3 hours period without spilling over at a rate of no more than it was before project development (C value or pre-development is 0.3 and post-development is 0.7). Rain water in the storm water pond can be reuse as raw water or it can be discharged out into the Hemaraj ESIE's storm drainage system.

The calculations for the storm water drainage system including the storm water ponds and the storm water drainage are detailed in **Appendix 2J**. The calculations for the rate of rain water drainage from the project and the retention capacity from the rain water drainage of the Hemaraj Eastern Seaboard Industrial Estate are detailed in **Appendix 2K.**

(b) Contaminated rain water washed from areas contaminated with oil will be collected into an oil separator to separate oil from water. Separated water will be sent to the storm water pond before being discharged into Hemaraj ESIE's central wastewater system as per **Table 3.11-6**.

Calculations for oil contaminated rain water are detailed in **Appendix 2L**.

TABLE 3.11-6

PROPERTY OF WASTEWATER FROM THE INDUSTRY ALLOWING TO DISCHARGE INTO CENTRAL WASTEWATER OF HEMARAJ EASTERN SEABOARD INDUSTRIAL ESTATE

No.	Water Quality Index	Unit	Standard Index
1	Biological Oxygen Demand (BOD_5 as 20 °C)	mg/l	≤500
2	Chemical Oxygen Demand (COD)	mg/l	≤1,250
3	pH		5.5-9.0
4	Total Dissolved Solid (TDS)	mg/l	≤3,000
5	Suspended Solid (SS)	mg/l	≤200
6	Total Kjeldahl Nitrogen: TKN	mg/l	≤100
7	Heavy Metals		
	7.1 Mercury (as Hg)	mg/l	≤0.005
	7.2 Selenium (as Se)	mg/l	≤0.02
	7.3 Cadmium (as Cd)	mg/l	≤0.03
	7.4 Lead (as Pb)	mg/l	≤0.20
	7.5 Arsenic (as As)	mg/l	≤0.25
	7.6 Trivalent Chromium (Cr^{3+})	mg/l	≤0.75
	7.7 Hexavalent Chromium (Cr^{6+})	mg/l	≤0.25
	7.8 Barium (as Ba)	mg/l	≤1
	7.9 Nickel (Ni)	mg/l	≤1
	7.10 Copper (as Cu)	mg/l	≤2
	7.11 Zinc (as Zn)	mg/l	≤5
	7.12 Manganese (Mn)	mg/l	≤5
	7.13 Silver (as Ag)	mg/l	≤1
	7.14 Total Iron (as Fe)	mg/l	≤10
8	Sulphide (as H_2S)	mg/l	≤1
9	Cyanide as HCN	mg/l	≤0.2
10	Formaldehyde	mg/l	≤1
11	Phenols Compound	mg/l	≤1
12	Free Chlorine	mg/l	≤1
13	Chloride as Chlorine	mg/l	≤2,000
14	Fluoride	mg/l	≤5
15	Pesticide	mg/l	None
16	Temperature	°C	≤45 °C
17	Colour		Color is an abomination
18	Odor		Color is an abomination
19	Oil & Grease	mg/l	≤10
20	Surfactants	mg/l	≤30

Source: Notification of Industrial Estate Authority of Thailand no.78 2011 Subject : Property of wastewater from the industry allowing to discharge into central wastewater of Industrial Estate, 2014

3.11.4 SOLID WASTE MANAGEMENT

The project shall comply with the Notification of Ministry of Industry re: Disposal of Waste or Discarded Materials B.E. 2548 as follows:

(1) Solid Waste/Trash Occurring during Construction Period

Solid waste is expected to occur during construction period as follows:

- Waste materials from various constructing activities such as a piece of structure or unused/waste materials.
- Hazardous wastes such as used battery, lubricant, oil, filter, mineral oil, cleaning solution or solvent and coating products or low quality color.
- 2,720 kg/day of trash calculated from maximum number of 3,200 workers (considering trash produced 0.85 kg/day/person, from Kriengsak Udomsipanarojana, 1994).

The project will provide exclusive areas for managing each type of solid waste. In addition, the project will prepare a proper container suitable to each type of waste in order to separate different waste and to dispose conveniently.

(2) Solid Waste/Trash Occurring during operational period

(a) Trash

Trash arising from office building is about 51 kg/day (calculated from 60 employees producing trash at 0.85 kg/person/day, from Kriengsak Udomsipanarojana, 1994) composed of foods, plastic bags and papers. The trashes will be gathered and disposed by the waste management unit of permission from the government or local waste management company.

(b) Air Filter

Air filter is a sheet of synthetic fabrics for filtering dust, materials coming with air before bring the filtered air into electric generating system of the power plant. A filter can be used only one time and cannot be reused as large quantity of damp dusts which are trapped in synthetic fabrics sheet of the filter can neither be washed nor blew. Filter has to be changed with new one after being used for a period of time. The filter consumption rate is 4,704 sheets/1.5 year. The used air filter sheet will be sent to a company who has official permission from the Department of Industrial Works for managing and disposing of industrial solid wastes.

(c) Used Lubricant and Oil from Oil Separator Pond

Used lubricant from deteriorated engine and oil from oil separator pond with an estimated volume of 800 L/month will be gathered into 200-liter tank in for picking up by the above-mentioned waste management company.

(d) Resin using in Demineralized Water System for a Power Plant

In each year, part of resin will be changed at an estimated amount of 1 m^3 annually. Resin seller will be requested to bring back the used resin otherwise the resin will be put into plastic bag and then contained in a 200-liter tank ready for picking up by the above-mentioned waste management company.

(e) Sludge from the water pre-treatment plant.

The water pre-treatment plant will produce a maximum of 5 tons/day of sludge as follows**:**

1. Using natural gas as a fuel

- Raw water entering the water pre-treatment plant total 62,618 m^3/day.
- Total Suspended Solids (TSS) in the raw water is 16 mg/l maximum (source: Eastern Water Resources Development and Management PCL).
- TSS in the raw water is therefore 16 mg/l x 62,618 m3/day x 1,000,000,000 mg/ton x 1,000 L/m3 = 1.00 ton/day.
- Up to 3.2 m3/day of ferric chloride and polymer are used as coagulants in the water pre-treatment plant are Ferric Chloride and Polymer.

Therefore, the sediment in the water pre-treatment plant and sludge is 4.2 tons/day or approximately 5 tons/day.

2. Using diesel oil as a fuel

- Raw water entering the water pre-treatment plant total 46,857 m3/day.
- Total Suspended Solids (TSS) in the raw water is 16 mg/l maximum (source: Eastern Water Resources Development and Management PCL).
- TSS in the raw water is therefore 16 mg/l x 46,857 m3/day x 1,000,000,000 mg/ton x 1,000 L/m3 = 0.75 ton/day.
- Up to 3.2 m3/day of ferric chloride and polymer are used as coagulants in the water pre-treatment plant are Ferric Chloride and Polymer.

Therefore, the sediment in the water pre-treatment plant and sludge is 3.95 tons/day or approximately 4 tons/day.

The sediment will be kept inside the water pre-treatment plant in tank with capacity 20 tons which is sufficient before disposing as in the notification of Ministry of Industry (B.E. 2548) re: Disposal of sewage or other material that are not used. Allowed company from Department of Industrial Works will manage and dispose of industrial solid wastes.

The 35 tons/week of sediment will be loaded in truck with capacity 15 ton. Thus, there will use 3 truck load/week to receive sediment from the project area. Type, amount, and waste disposal method are summarized in **Table 3.11-7**.

TABLE 3.11-7

GARBAGE AND SOLID WASTE TYPE, VOLUME, AND MANAGEMENT METHODS DURING THE OPERATION PERIOD

Waste type	Volume	Disposal method	Source/frequency/storage method
1. Office wastes	51 kg/day	Collect and outsource licensed garbage collector (private, government or local administration) to collect and dispose the wastes.	- Office wastes can be reduced by reusing paper and recycling them. - Collect and outsource licensed garbage collector (private, government or local administration) to collect and dispose the wastes every 2 days.
2. Air Filter	4,704 pieces/1.5 years	Send to industrial waste management company licensed by the Department of Industrial Works.	- Air filters are used to filter out dust from the air entering the gas turbines. Dirty filters reduce gas turbine efficiency. If unfiltered, dusts would end up in the exhaust. - Each air filter has service life of 1.5 years. Replaced filters will be gathered at the gas turbine building for further disposal.
3. Used engine oil and oil from the oil/water separator	800 liters/ month	Collected in 200 liters metal drums and send to industrial waste management company licensed by the Department of Industrial Works	Engine oil reaching the end of service will be changed. The used oil will be collected with oil from the oil/water separator and collected in 200 liters metal drums at the Maintenance Building awaiting disposal.
4. Used resin	1 m^3/year	Send back to vendor or collect in 200 liters metal drums or plastic bags and send to industrial waste management company licensed by the Department of Industrial Works	Resin used in the mixed bed of the water demineralization plant has a service life of approximately 1 year. Used resin to be bring back by the seller or put in plastic bag and contain in a 200 liters metal drums at the Maintenance Building for further disposal.
5. Sediment from the water pre-treatment plant	5 tons/day	Collect for disposal as per the Notification of Ministry of Industry re: Disposal of Waste or Discarded Materials B.E. 2548 or send to industrial waste management company licensed by the Department of Industrial Works.	The water pre-treatment plant separate sediments from raw water. The sediments will be collected in sludge hopper at the water pre-treatment plant for further disposal approximately 3 times a week.

Source: Gulf SRC Co., Ltd., 2015.

3.12 MANPOWER RATE OF THE POWER PLANT

(1) Construction Period

Construction period is approximately 48 months which expected to have maximum workers and employees approximate 3,200 persons. The amount of maximum worker (3,200 persons) will work for 6 months. Their accommodation will be outside project area and industrial estate area in 4 to 5 km radius of project area.

(2) Operational Period

The maximum number of worker in operation period is 60 person as shown in organization chart in **Figure 3.12-1**.

3.13 MATERIAL AND EQUIPMENT TRAQNSPORTATIONS

(1) Construction Period

Expectation of amount of vehicles use in project during construction period and worker transportation is approximately 3,200 persons. The detail shown in **Table 3.13-1**.

(2) Operational Period

During operational period, 60 personnel are expected to commute in and out of the power plant using only personal transport. The project is expected to produce approximately 5 tons of sludge per day from the water pre-treatment plant. The sludge will be held at the sludge holding tank at the water pre-treatment plant. Total sludge to be disposed of is approximately 35 tons/week. Using 10-wheeled trucks each with load capacity of 10 tons, then 3 truckloads per week should suffice. Moreover, there are expected to be 140 shipments of chemicals per year or 3 shipments per week. Thus, project requires 1 truck per day for chemical transportation.

From above, it can be summarized that when the power plant is operational, there will be increased traffic from commuting power plant personnel, sludge disposal trucks and chemical shipments. Details of traffic during operational period are described as per **Table 3.13-2**.

Form of transportation in the project area and a transport route map including traffic direction and parking space in the project are detailed in **Figure 3.13-1**.

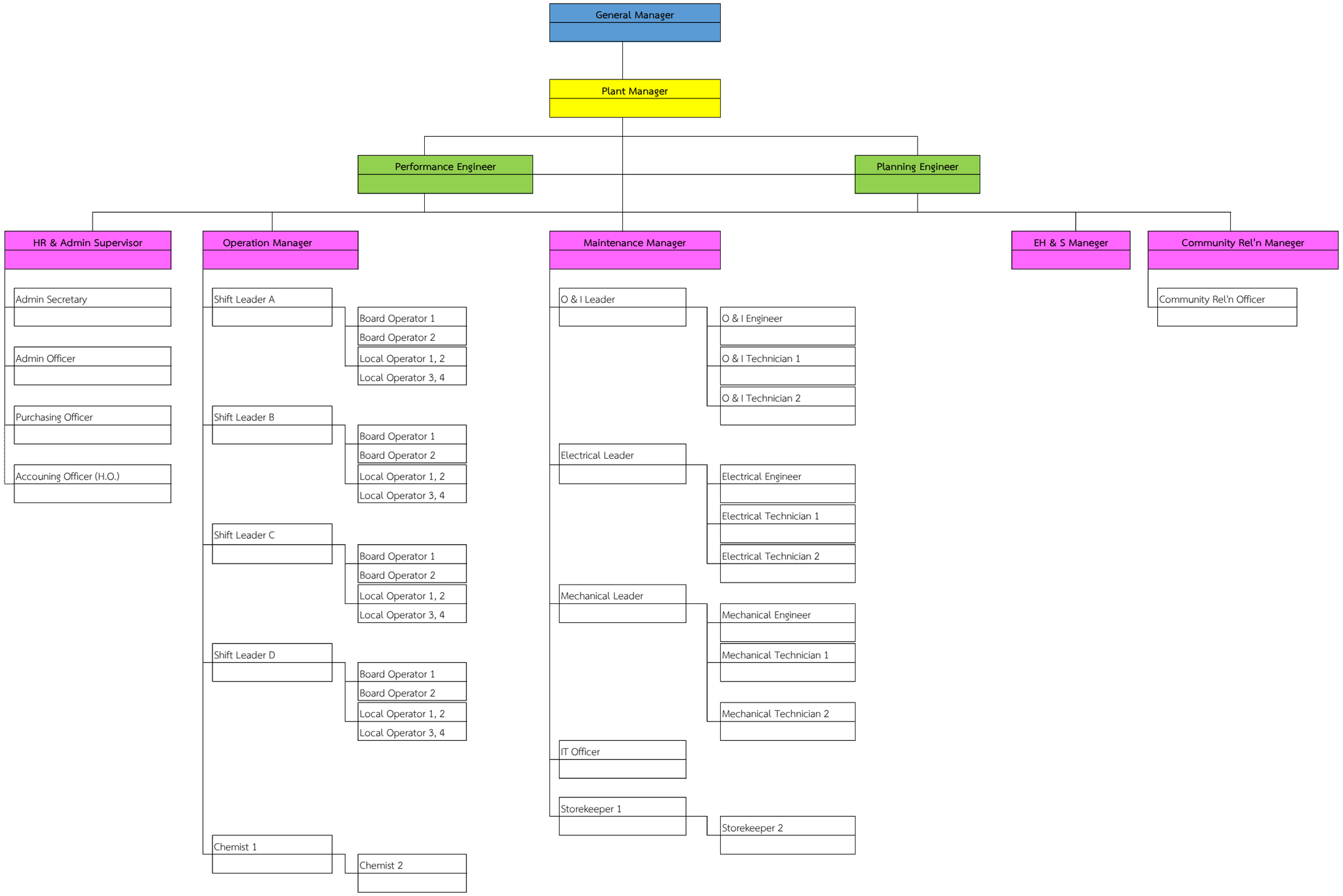


FIGURE 3.12-1 : ORGANIZATION CHART

TABLE 3.13-1

MAXIMUM EXPECTATION OF AMOUNT OF VEHICLE USE IN CONSTRUCTION PERIOD

Transportation activities	Type of vehicle	Amount of vehicle (car/day)	Shipment (shipment/day)
Engine	Trailer	10	20
Worker	Small Truck	48	96
Equipment	Trailer	30	60
Total		**88**	**176**

Source: Gulf SRC Co., Ltd., 2015.

TABLE 3.13-2

MAXIMUM EXPECTATION OF AMOUNT OF VEHICLE USE IN OPERATIONAL PERIOD

Transportation activities	Type of vehicle	Amount of vehicle (car/day)	Shipment (shipment/day)
Commuting power plant personnel	Personal car	60	120
Transportation of sediment form water pre-treatment plant	10-wheeled trucks	1	2
Transportation of chemical	Trailer	1	2
Total		**62**	**124**

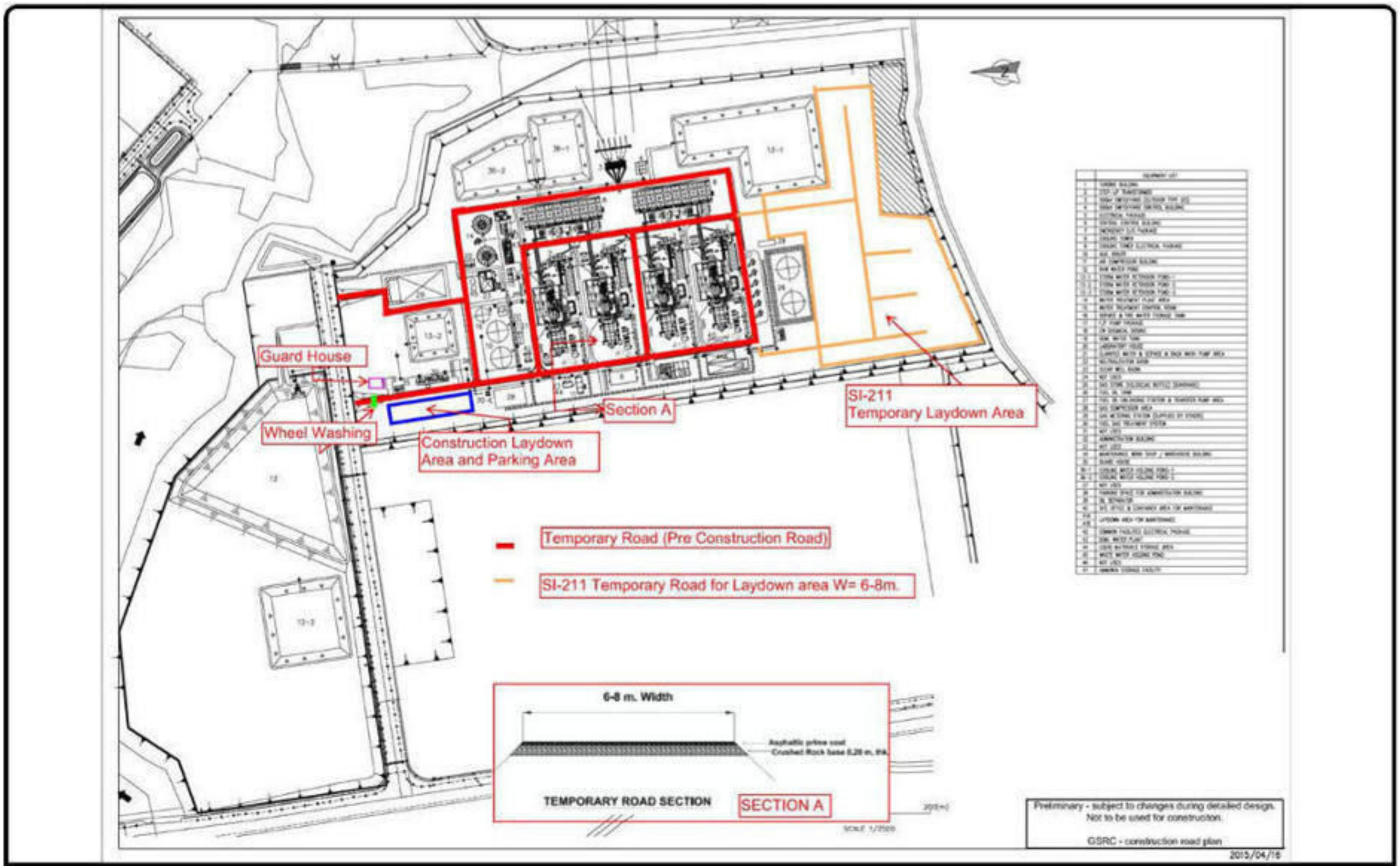


FIGURE 3.13-1 : TRANSPORTATION TYPES, ROUTES, TRAFFIC DIRECTIONS AND PARKING ON THE PROJECT SITE

TEAM

3.14 OCCUPATIONAL HEALTH AND SAFETY

The project place great emphasis on safety and has devised an occupational health and safety in conformity with applicable standards and laws such as:

(1) Ministerial Regulation re: Prescribing Standards for Management, Administration and Implementation of Occupational Health, Safety and Working Environment in working conditions with hazardous chemicals B.E. 2556;

(2) Department of Labour Welfare & Protection's Notification re: Prescribing Personal Protective Equipment Standards B.E. 2554;

(3) Guideline of hazardous material transportation of Pollution Control Depart, September 2011.

(4) Hazardous Chemicals Management and Administration in Work Places Manual, April 2011;

(5) Department of Industrial Works' Notification re: Hazardous Chemicals and Storage Manual B.E.2550.

(6) Department of Industrial Works' Notification re: Manual on Storage of Hazardous Chemicals and Substances B.E. 2550;

(7) Ministerial Regulation re: Prescribing Standards on Management, Administration and Implementation of Occupational Health and Safety in Workplaces B.E. 2549;

(8) Ministerial Regulations No. 33 B.E. 2535 issued by virtue of the Building Control Act B.E. 2522 on high rise buildings.

(9) Ministry of Interior's Notification re: Fire Prevention and Suppression in Work Places for the Safety of Employees B.E. 2539.

(10) Department of Industrial Works' Notification re: Fire Prevention and Suppression in Factory B.E. 2552.

3.14.1 CONTROL OF OCCUPATIONAL HEALTH AND SAFETY DURING CONSTRUCTION PERIOD

The project has established an operation and monitoring plan on occupational health, safety and working environment to conform with project general safety codes as follows:

(1) All contracts must explicitly require contractors to operate in compliance with the occupational health and safety code as follows:

- The project requires that all contractors, subcontractors and employees entering to work in the power plant area under the contract implement measures on occupational health, safety and working environment throughout the design, construction and operation period to ensure compliance with the occupational health and safety rules.
- Designate a qualified personnel as safety officer.
- The project and main contractors shall establish an Occupational health, Safety and Working Environment committee, members of which must include supervisors of subcontractors in the project. The Occupational Health, Safety and Environment Manager reports directly to the Project Manager.
- First aid and basic medical kit, including emergency transport must be available in accordance with the regulation of Ministry of Labour re: Provision of Welfare in Work Places B.E. 2548.
- Sufficient utilities must be available to workers such as clean drinking water, washrooms and toilets, in accordance with the sanitary principle.
- Warning signage must be installed to signify the construction area, the hazardous area, and the area requiring personnel to wear appropriate personal protective equipment.
- Main contractors must prepare a coordination plan with local fire fighters as a contingency plan.
- Establish a work permit system in certain areas as required by law.
- Personal Protective Equipment must be regularly inspected for integrity and proper functionality.
- The occupation, health, safety and environment committee shall convene at least once per month to evaluate progress and proposal solutions to any issues.

Moreover, the project requires that all construction contractors take out third party liability insurance to insure against bodily harm or loss of asset due to work on the project area.

(2) Construction safety code shall cover all aspects of construction work such as:

- Fire prevention and suppression.
  - Construction contractors must provide sufficient fire extinguishing equipment for the number of personnel working in any hazard areas or in work areas in which high temperature is involved such as welding. Each welding area must be equipped

with a chemical fire extinguisher. Welding in high areas must be protected with fire resistant flooring/partition to protect sparks from harming others working below.

- Contractors must devise a coordination plan with local fire fighters as a contingency plan.
- Hazard areas must be strictly controlled for entering and exiting personnel and vehicles. Warning signs must be located in visible areas. These are supervised by foremen or safety officer.
- Construction equipment and construction environment must be inspected for safety especially in hazard areas or fire hazard areas.
- Fire extinguishers must be regularly inspected as stipulated in the project safety procedure.

3.14.2 CONTROL OF OCCUPATIONAL HEALTH AND SAFETY DURING OPERATIONAL PERIOD

(1) Management of Occupational Health, Safety and Environment

The company shall establish an Occupational Health, Safety and Environment Policy and a project safety procedure as a guideline on administration and implementation of occupational health, safety and environment in conformity with applicable laws and regulations for the health and safety of every employee.

(a) Summary of Implementation Plan according to the Policy

The company is to establish an annual work plan on Occupational Health, Safety and Working Environment for optimal performance on the following:

- Training plan for the safe working procedures, use of personal protective equipment and safety code for hazardous work.
- Fire prevention and suppression training for employees.
- Employee health check.
- Safety promotion activities.
- Fire extinguisher and fire alarm inspection plan.
- Safety compliance inspection such as:
  - Electrical system inspection 1 time per year.
  - Occupational Health, Safety and Working Environment committee report every month.

- Employee health check as per Labour Protection Act once a year.
- Machinery (cranes) registration audit once a year.
- Fire prevention and suppression training report once a year.
- Fire evacuation drill report once per year.

(b) Occupational Health, Safety and Working Environment Committee

The project is to establish an Occupational Health, Safety and Working Environment Committee as required by the Ministerial Regulations re: Prescribing Standards for Management, Administration and Implementation of Occupational Health, Safety and Working Environments B.E 2549 dated 16 May 2549. Its section 23 stipulates that a workplace must establish an Occupational Health, Safety and Working Environment Committee comprising the employer or the employer's representative of executive level as the committee chairperson, an employer's supervisory officer as a member, at least 2 representatives who are employees at operational level, and 1 secretary. The committee organization structure is detailed as per **Figure 3.14-1** or as prescribed in the Safety Procedure. The committee has role and responsibility as follows:

- Discuss the policy and work plan on work place safety and safety outside of workplace to prevent and reduce the number of incidents, injuries or disputes caused by project work or lack of safety. These are reported to the project management.
- Report and propose any measures or guidelines for improvement to the project management in order to comply with applicable laws and regulations on occupational safety and working conditions for contractor employees and outside personnel who enter the project area.
- Promote and support company activities on occupational Health, Safety and working environment.
- Discuss the rules and manual in the ministerial regulations re: Prescribing Standards for Management, Administration and Implementation of Occupational Health, Safety and Working Environment B.E. 2549 and also the project safety procedure and report to the management.
- Audit work place safety operations and accident statistics at least once a month.
- Design a project or training plan on Occupational Health, Safety and Working Environment and a training on safety roles and responsibilities of work supervisors and all workers for proposal to management.
- Design an unsafe report system and make clear that it is all employees' duty to comply.

- Follow up on proposals to management.
- Report annual performance result detailing issues and suggestions and propose to management.
- Evaluate company safety performance.

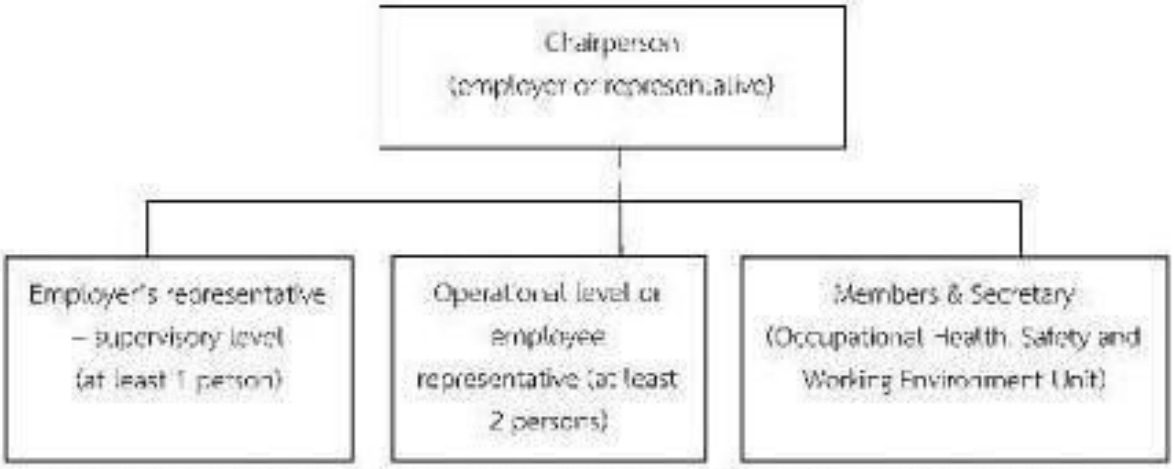


FIGURE 3.14-1: OCCUPATIONAL HEALTH, SAFETY AND WORKING ENVIRONMENT COMMITTEE ORGANIZATIONAL STRUCTURE

(2) Occupation health management

Occupation health management shall be in accordance with the project safety procedure to ensure employee health, hygiene, suitable and safe working environment as follows:

(a) Industrial hygiene survey: The safety officer shall survey work areas in regards to decide if there are any areas that may have impact on occupational safety and health of working personnel.

(b) Industrial hygiene check: The safety officer shall use the data from the work area survey to assess against applicable law, EIA report or other regulations. The industrial hygiene check is conducted annually by the safety officer using the project procedure as guideline on topics like heat, light, noise and dust etc.

(c) Analysis and follow-up: The safety officer shall analyze the audit report by comparing to Thai or international standards and submit the analysis report to persons responsible in those work areas for acknowledgment. In case of failing to comply with standards, request for correction action.

(d) Identify risk group for health check up accordance to risk factors: Results from industrial hygiene, laws, and related regulations will be together considered by safety officers in order to identify risk groups of employees which may impact from work and work and working environment.

(e) Make a Plan for annual health check for risk groups: The safety officer, in collaboration with registered nurses, design an annual health check for different risk groups.

(f) Conduct annual health check up accordance to risk factors: Nurses, in collaboration with public health centers, conduct annual health check according to risk groups as planned. Should an employee be given a health check prior to work or on work transfer, they shall be reported to safety officer for a risk-based health check and prepare a baseline data before sending to human resources for further processing.

(g) Follow up on health check: The health check reports that have been verified against baseline data and/or database will be sent to the employees' division with a summary to the safety officer. Any employees who fail the health criteria will be contacted for immediate follow-up by the nurse and concerned division and safety officer notified. If the follow-up finds that the employee's abnormality is due to his or her work, then a solution will need to be devised and closely monitored.

(h) Occupational health performance report: the occupational health performance report will be reviewed by the management for approval and/or request for feedback in case of failure to meet standards and require policy adjustment. The occupational health works also involve proactive work on industrial hygiene – promoting awareness on health and hygiene in the Working Environment and identifying source of hazard for prevention and rectification.

(3) Occupational health & safety evaluation, assessment and monitoring

(a) Safety Audit

The project requires the following responsibility on safety:

- Work supervisor/ shift leader in each division are responsible for the safety in their area of responsibility, conducting safety audit daily or according to the safety procedure.

- The safety officer is to routinely audit safety on all factory areas according to the Safety Procedure.

The project will also conduct a survey to identify danger work area during which any employees may report on any work area they find dangerous which will contribute to risk mitigation.

(b) Working Environment monitoring and assessment

Continuous monitoring and assessment of the working environment both in dangerous and general areas will be conducted to measure heat, light, noise and dust levels. This is protect employees from harm and also in compliance with the law, including the Notification of Ministry of Industry re: Measures for Safety in Factories and Working Environment B.E. 2546 and the ministerial regulations re: Provision of Welfare in Work Place B.E. 2548.

(c) Employee health check

The project provides all employees a health check performed by first class physician licensed to practice occupational medicine. Each employee will receive a health check prior to work commencement and then annually.

(4) Personal Protective Equipment

The project requires all personnel entering health hazard areas to wear appropriate personal protective equipment according to their type of work and its impact as detailed in **Table 3.14-1**. The project will also conduct regular inspection of the personal protective equipment or according to the project Safety Procedure.

TABLE 3.14-1

PERSONAL PROTECTIVE EQUIPMENT REQUIREMENT IN EACH AREA

Work area	Personal protective equipment
1. Boilers & Turbine	- Safety helmet, safety shoes, ear plugs, ear muffs, safety goggles.
2. Maintenance work	- Safety helmet, safety shoes, safety goggles, safety gloves, ear plugs or ear muffs.
3. Chemical handling	- Chemistry lab safety goggles, chemistry lab coat/apron, safety face shield, chemical resistant gloves, chemical resistant boots and chemical respirators.

Remarks : Basic Personal Protective Equipment provided to each employee: Safety helmet and safety shoes. Work area-specific personal protective equipment are provided according to the nature of the work in the area.

Source : Gulf SRC Co., Ltd., 2015

(5) Working Environment preventive safety plan

The project has established a working environment preventive safety plan cover impact from noise, heat, chemicals, and hazardous work. To prevent harm to the employees and complying with applicable laws, the plan covers the following:

(a) Noise

The designed maximum noise level of Sriracha Power Plant is at 85 dB(A) which meets safety standards prescribed in the Notification of Ministry of Industry re: Measures for Safety in Factories and Working Environment B.E. 2546. However, there are factors to consider for impact reduction in the long term, such as mechanical wear of the generators which may increase noise to the extent that it exceeds limit if proper maintenance is lacking. Therefore, the Sriracha Power Plant Project has established environmental impact mitigation and preventive measures relating to noise in the working environment as follow:

- Perform preventive maintenance of equipment in the power generation process routinely.
- Provide sufficient noise protection equipment such as ear plugs and ear muffs to employees.
- Install marker post in areas of high noise levels in order to warn employees to use ear plugs and ear muff. Provide training to employees on safe work procedure and how to use ear plugs and ear muffs properly.
- Install silencers on the exhaust pipes and cover noisy machinery.

(b) Heat

Even though the nature of work and the duration of exposure to heat may not impact employee health, the Sriracha Power Plant Project has in place several safety measures during operational period such as heat insulation and enclosures of heat sources based on the nature of the production unit.

(c) Chemicals

(C.1) Chemical transportation safety measures

Transportation of hazardous chemicals must be operated with utmost emphasis on the safety of communities, assets and environment. Operators of hazardous chemical transportation must fully comply with the project safety procedure, applicable laws and regulations such as Department of Pollution Control Hazardous Materials Transportation Manual of September 2011, Manual on Hazardous Chemicals Management in Workplace, July 2013, and the Notification of Department of Industrial Work re: Hazardous Chemicals and Storage Manual B.E.2550 such as:

- Chemical transportation operation permit
- Correctly marked chemical transporters as per Department of Land Transport regulations.
- Proper and safe sorting and transportation of chemicals.
- Shipping paper administration
- Material Safety Data Sheet (MSDS) is to be made available for all chemicals being shipped in both Thai and English languages.
- Personal Protective Equipment equipped on board each chemical transport.
- Provide training for drivers of chemical transports, making sure that the drivers understand the hazards of chemicals being shipped. Drivers must also be trained for safe driving skills and emergency mitigation procedures.

(c.2) Chemical storage safety measures

The Sriracha Power Plant chemical storage safety measures will comply with the Notification of Department of Industrial Works re: Hazardous Chemicals and Storage Manual B.E.2550 and the Hazardous Chemicals Management and Administration in Work Places Manual, April 2011 such as:

- Material Safety Data Sheet (MSDS) is to be made available for all chemicals being stored in both Thai and English languages.
- Hazardous substances must be stored and handled as appropriate to the 4 types according to the degree of hazard as follows: type 1 – business operator to comply with specified criteria and procedures, type 2 – as with type 1 and must obtain registration certificate from the authority, type 3 – as with type 2 and obtain permit, and type 4 – prohibited from production, distribution or possession.
- Hazardous chemical storage must be of in a safe condition or suitable to hazardous chemicals being stored.

(c.3) Safety Measures for Use of Chemicals

The project will devise chemicals safety measures as per US Occupational Safety and Health Agency (OSHA) and Ministerial Regulations re: Management, Administration, and Implementation of Occupational Health and Safety in Hazardous Chemicals Working Environment B.E. 2556. Details of the safety measures will also be included in the project safety procedure.

- Prepare Material Safety Data Sheet (MSDS) about the hazard characteristics of the substance's property in Thai and English and place it at the point of work.
- Install warning/ instructional/ caution signs for hazardous chemicals work in clear view at the work area.
- Allocate area and equipment for safety protection in the area of work concerning hazardous substances, such as, the place for eye wash, hand and face wash, and the shower for washing off hazardous substances from body.
- Provide appropriate Personal Protective Equipment to employees working with hazardous chemicals suitable to the nature of the hazard and hazard level to protect employees from possible harm.
- Establish preventive measures for protection against hazardous chemicals at the hazardous chemical storage areas. Preliminary mitigation measures include proper ventilation system, fire prevention system, spill retention

dike to prevent chemical leaking out of the hazardous substance storage area and dedicated spill drainages unconnected to water drainage system.

- Provide a hazardous chemical detection equipment to monitor traces of chemicals in the atmosphere of work places and chemical storage areas. An alarm would go off when these chemical traces exceed safe limit.
- Conduct regular monitoring and analyses of chemicals in the atmosphere of work places and hazardous chemical storage areas.
- Provide appropriate fire extinguishers and emergency medical supplies.
- Assign responsibility for chemists to improve chemical administration safety plan.
- Chemists and safety officer shall audit and devise hazardous chemical audit system in each work area requiring use of chemicals with annual review and revision.
- Provide training for all employees who work with chemicals on safe handling of chemicals, preventive measures and leak detection.

(c.4) Risks

Natural gas

Measures for safety, control and mitigation of use of natural gas are as follows:

- Establish perimeter of danger areas and implement strict control and safety measures such as no smoking area, Hot Work and authorized personnel only areas etc.
- Equip and use gas monitoring system to detect natural gas leakage.
- Regularly test the thickness and corrosion of natural gas pipelines.
- Install warning signs for underground natural gas lines to warn that any action to the ground above the line may impact the gas line and provide contact information if any abnormalities are found by passerby.
- Develop and implement work safety procedures for natural gas pipeline work.
- Install shutdown control and relief valve to quickly and accurately check for pipeline pressure anomalies.

Diesel oil

The power plant also uses diesel oil as backup fuel, therefore the storage of diesel oil will be in compliance with applicable laws:

- Ministry of Energy regulations on Fuel Storage re: Fuel Depot B.E. 2556.
- Fuel tanks of API 650 standard.
- Fuel pipeline designed to ASME B31.1 standard.
- Hazardous area classification to API RP 500 standard.
- Fire prevention and protection to NFPA 850 and NFPA 11 standards.

(6) Safety monitoring systems

The project will be equipped with various safety monitoring systems to warn personnel of danger such as fire, gas leak, explosion and other emergencies. These safety monitoring systems operate automatically, sending warning signals to relevant work areas. Four types of safety monitoring systems will be deployed:

(a) Fixed Gas Detection System: the project will be equipped with Flammable Gas Detectors with 2 levels of alarm – one at 20 % LEL and another at 40% LEL. The gas detectors will be installed in high gas leak risk areas such as Metering & Regulating Station.

(b) Smoke Detectors: the project will install smoke detectors in the control room along with Automatic Fire Suppression Systems of NFPA72 standard.

(c) Fire Suppression: the project will install fire suppression systems in the control room, office and work areas. They include handheld fire extinguishers, Deluge Water Spray and fire hydrants in all work areas of NFPA72 standard.

(7) Fire prevention and suppression

(a) Firefighting equipment

The project is to install sufficient number of fire prevention and suppression equipment and to the US National Fire Protection Association (NFPA) standards and applicable laws, standards and regulations as follows:

- Ministerial Regulations No. 33 B.E. 2535 issued by virtue of the Building Control Act B.E. 2522 on high rise buildings.
- Ministry of Interior's Notification re: Work Place Fire Prevention and Suppression for the Safety of Employees, published in the Royal Gazette dated 21 May 1996.

- Ministry of Industry's Notification re: Fire Prevention and Suppression in Factories B.E. 2552.

Details of fire protection system installed in the power plant comprising turbine buildings, maintenance buildings, administration buildings and other areas are shown in **Figure 3.14-2** and **3.14-3**. Details of quantity and size of fire prevention and protection equipment, including their standards, are shown on **Table 3.14-2** and **3.14-3**.

The project fire prevention and protection system design will undergo modification and finalization prior to construction and the design will comply with applicable standards. In essence, the format of fire prevention and protection systems are of the same standards as other power plants built by the company including those already in operation and those under construction. Moreover, the project is serious about fire prevention and protection and the systems will be tested by the insurance companies every year.

(b) Fire water system

(b.1) Fire water reserve

The project has designed a fire water tank on site. The fire water reserve is the water produced by the water pre-treatment plant and stored in the 4,200 m^3 Service/Fire Water Tank. Service water is pumped out from the top of this tank while fire water is pumped out from the bottom of the tank. Water reserve for firefighting will be more than 1,500 m^3 which is sufficient for 2 hours of firefighting (diesel fuel tank fire requires 1,364 m^3 of water to suppress) as per NFPA 850 standard - Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations.

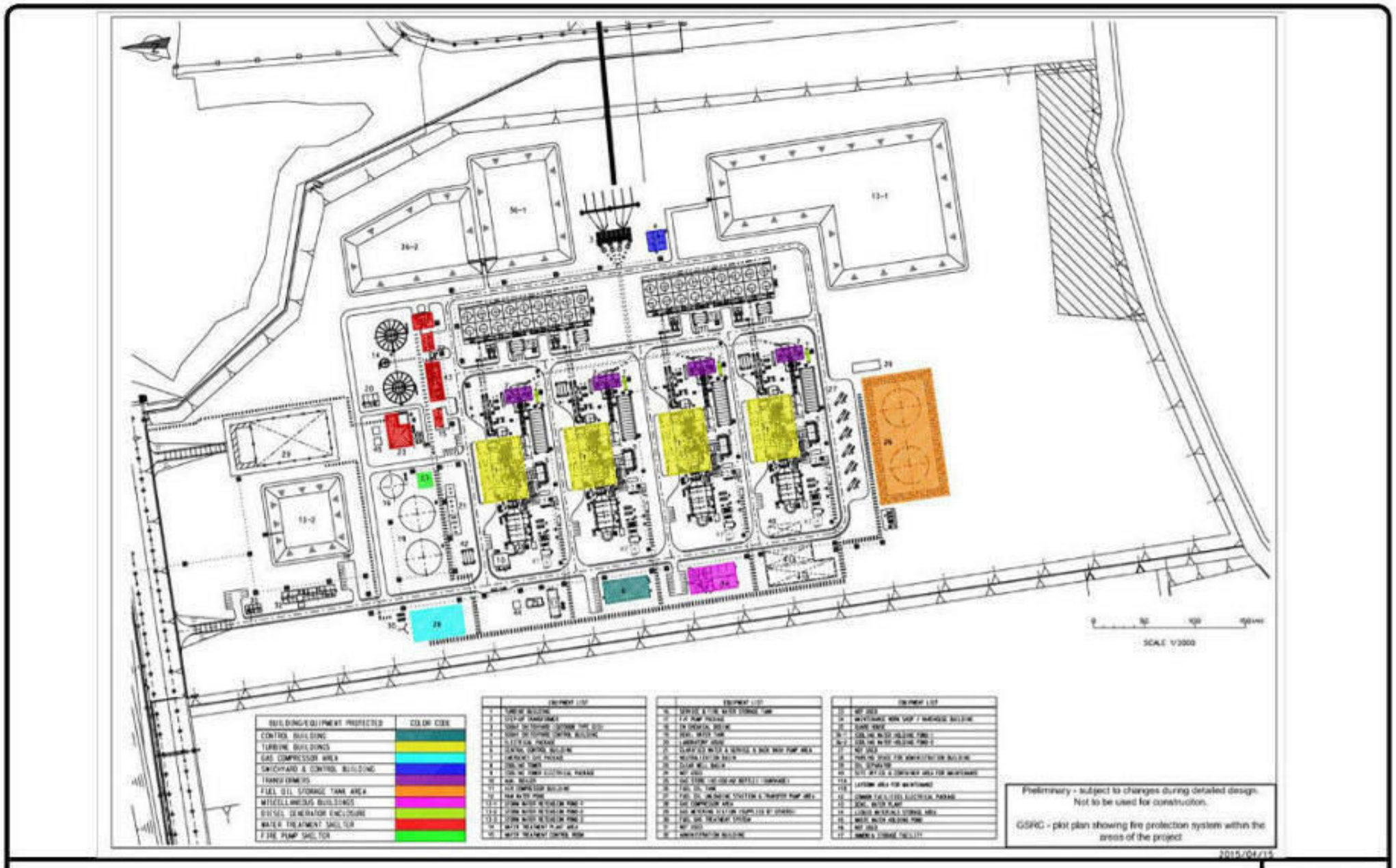


FIGURE 3.14-2 : FIRE PREVENTION AND PROTECTION SYSTEM IN THE PROJECT

TEAM

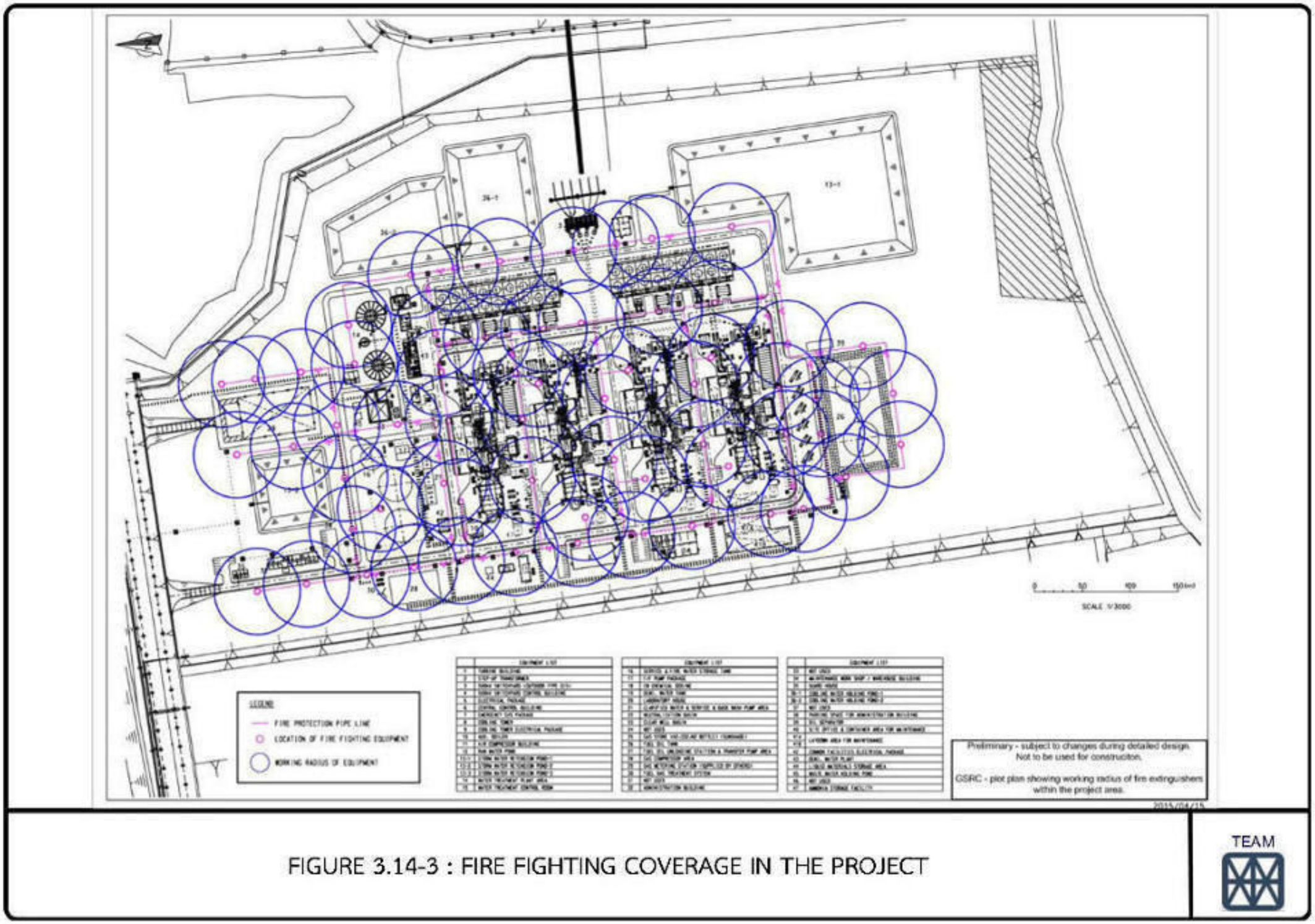


FIGURE 3.14-3 : FIRE FIGHTING COVERAGE IN THE PROJECT

TEAM

TABLE 3.14-2

FIRE PROTECTION EQUIPMENT AND STANDARD OF FIRE PROTECTION SYSTEM FOR POWER PLANT BUILDING OF PROJECT

Area	Fire protection system	Working system	Amount(1)	Standard of design / equipment	Area (m^2) / Volume (m^3)
Control Buildings					
Control Building Office Areas	• Pre-Action Sprinkler	Automatic	60	- NFPA 13 - NFPA 850	556 / 1,668
	• Smoke Detection	Automatic	20	- NFPA 72 - NFPA 850	-
	• Portable Extinguishers	Manual	10	- NFPA 10	-
Toilet	• Smoke Detection	Automatic	2	- NFPA 72 - NFPA 850	22.5/67.5
Computer sever room	• Smoke Detection	Automatic	1	- NFPA 72 - NFPA 850	30/90
Electrical Package Area					
Electrical control building	• Smoke Detection	Automatic	2 set/Unit	- NFPA 72 - NFPA 850	504/1,612
Turbine Buildings					
Gas turbine and steam turbine room	• Portable Extinguishers	Manual	10 set/Unit	- NFPA 10	10,080 / 282,240
Turbine Lube Oil Unit	• Deluge Water Spray with Wet-Pilot Sprinkler Head	Automatic	4 set/Unit	- NFPA 15 - NFPA 850	-
Turbine Lube Oil Piping and Grade Level under Pedestal	• Wet-pipe Sprinkler	Automatic	50 set/Unit	- NFPA 13 - NFPA 850	-
Generator Bearings	• Heat Detection	Automatic	2 set/Unit	- NFPA 72 - NFPA 850	-
	• Pre-Action Close-head Sprinkler)	Automatic	4 set/Unit	- NFPA 13 - NFPA 850	-
Hydrogen Seal Oil of Generator Hydrogen Seal Oil Units	• Deluge Water Spray with Wet-Pilot Sprinkler Head	Automatic	2 set/Unit	- NFPA 15 - NFPA 850	-
Combustion Turbine Enclosures including Combustion Turbine Exhaust End Bearing Tunnel	• Heat Detection	Automatic	8 set/Unit	- NFPA 72	-
	• Carbon Dioxide Fire Protection	Automatic	1 set/Unit	- NFPA 72	-

TABLE 3.14-2 (Cont'd)

FIRE PROTECTION EQUIPMENT AND STANDARD OF FIRE PROTECTION SYSTEM FOR POWER PLANT BUILDING OF PROJECT

Area	Fire protection system	Working system	Amount(1)	Standard of design / equipment	Area (m^2) / Volume (m^3)
Fuel Gas Compressor Area					
Gas Compressor	• Heat Detection	Automatic	4 sets	- NFPA 72 - NFPA 850	-
Electrical control building	• Smoke Detection	Automatic	6 sets	- NFPA 72 - NFPA 850	108/345
Diesel Generator					
Inside of Eenclosure of Diesel Generator Enclosure	• Wet-pipe Sprinkler or Pre-Action Close-head Sprinkler	Automatic	8 set/Unit	- NFPA 13 - NFPA 850	-
Water Treatment Control House					
Control room	• Smoke Detection	Automatic	4 sets	- NFPA 72 - NFPA 850	128/448
	• Portable Extinguishers	Manual	2 sets	- NFPA 10	-
Fire Pump Package					
Fire pump unit	• Wet-pipe Sprinkler	Automatic	8 sets	- NFPA 13 - NFPA 850	-
	• Heat Detection	Automatic	4 sets	- NFPA 72 - NFPA 850	-
500 kV Switchyard Control Building					
Electrical control room	• Smoke Detection	Automatic	4 sets	- NFPA 72 - NFPA 850	209/836
Transformers					
Step-up Transformers	• Deluge Water Spray with Wet-Pilot Sprinkler Head	Automatic	60 set/Unit	- NFPA 15 - NFPA 850	1,200 ตร.ม.
Unit Transformers	• Deluge Water Spray with Wet-Pilot Sprinkler Head	Automatic	20 set/Unit	- NFPA 15 - NFPA 850	360 ตร.ม.
Fuel Oil Storage Tank Area					
Fuel Oil Storage Tank	• Foam hydrant	Manual	6 sets	- NFPA 11	6,726

Remark : (1) Number of fire protection equipment will be rechecked during detail design of each building as NFPA standard

Source : Gulf SRC Co., Ltd., 2015

TABLE 3.14-3

FIRE PROTECTION EQUIPMENT AND STANDARD OF FIRE PROTECTION SYSTEM OF ADMINISTRATIVE OFFICES /LABORATORY AND WAREHOUSE OF PROJECT

Area	Fire protection system	Working system	Amount[(1)]	Standard of design / equipment	Area (m^2) / Volume (m^3)
Administrative Offices and Common Areas	• Wet-pipe Sprinkler	Automatic	30 sets	- NFPA 13	572/1,716
Workshop and Warehouse	• Wet-pipe Sprinkler	Automatic	40 sets	- NFPA 13	1,104/8,016
Guard House	• Portable Extinguishers	Manual	3 sets	- NFPA 11	124/298

Remark : [(1)] Number of fire protection equipment will be rechecked during detail design of each building as NFPA standard

Source : Gulf SRC Co., Ltd., 2015

(b) Pumps for fire protection

Fire pumps in the project include:

- 1 set of Electric motor pump with 3,000 gallons per minute (gal/min) capacity with the pressure of 90 m and 250 KW output as per NFPA 20 Standard for the Installation of Stationary Pumps for Fire Protection.
- 1 set of Engine-powered pump with 3,000 gal/min capacity with the pressure of 90 m and 250 KW output as per NFPA 20 Standard for the Installation of Stationary Pumps for Fire Protection.
- 1 set of Jockey pump with 50 gal/min with the pressure of 90 m and 5 KW output as per NFPA 20 Standard for the Installation of Stationary Pumps for Fire Protection.

Location of fire pumps and fire water tank are shown in **Figure 3.14-4** and calculations for fire water tank and fire pump capacity are attached as **Appendix 2S**.

60 sets of fire hoses are installed throughout the project and designed in compliance with NFPA 24 Standard for the Installation of Private Fire Service Mains and Their Appurtenances and NFPA 850 - Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations.

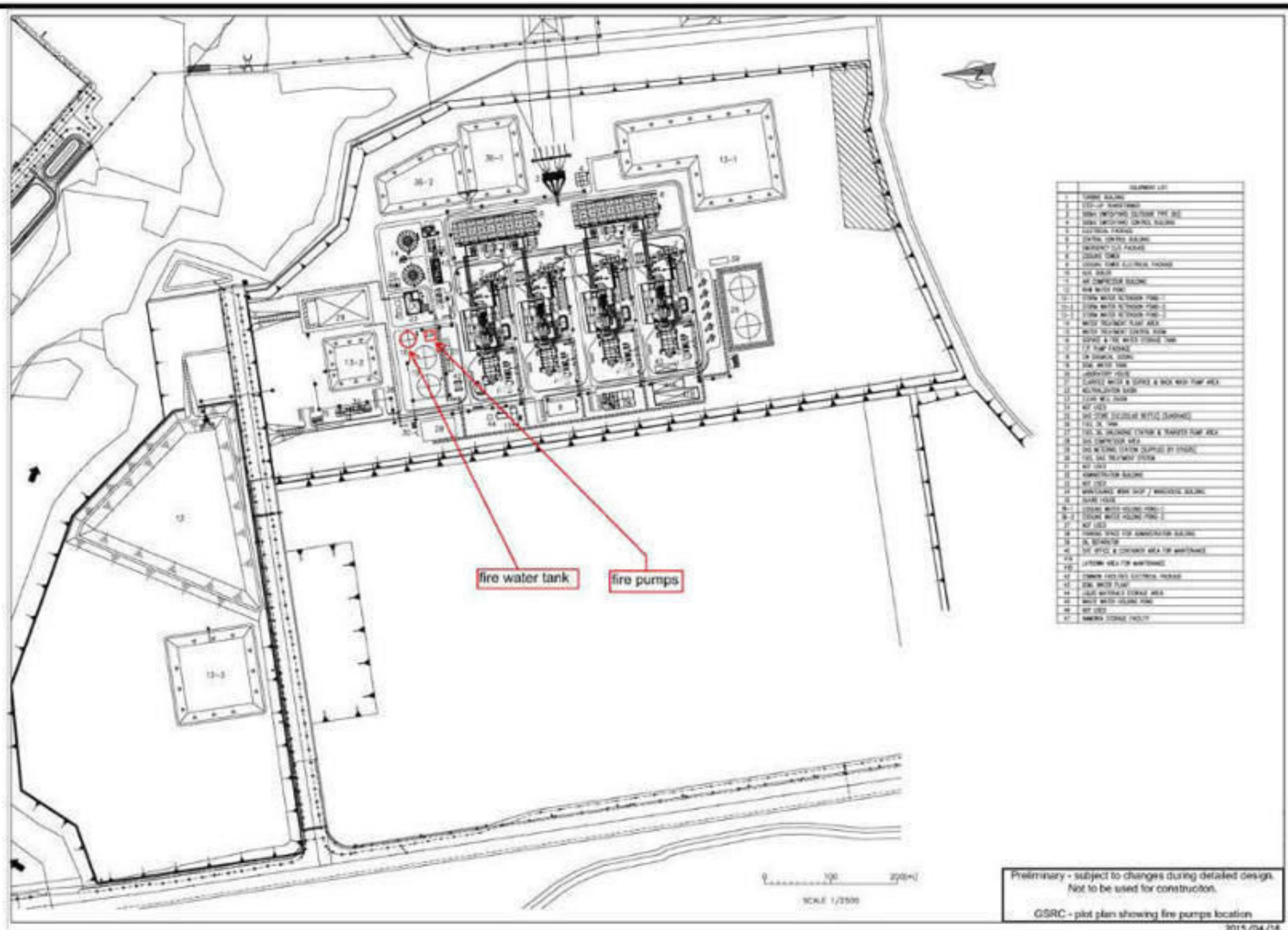


FIGURE 3.14-4 : LOCATION OF FIRE PUMPS

(c) Safety Shower and Eye Washer

Chemicals used in the project are described in **3.5** and each chemical are stored in appropriate containers as per **Table 3.5-1**. The chemicals containers are also surrounded by concrete dikes or trays for retention in case of leaks and spillages. Moreover, the dikes and trays are protected from rain water by a roof designed to keep out the rain.

The safety procedure also includes Spill Prevention and Control Plan as per **Appendix 2T**.

In an area where chemicals are stored, a Safety Shower and Eye Washer will be installed for emergency wash of body and eyes in case of accidental contact with hazardous chemicals. Their locations are shown in **Figure 3.14-5**.

(8) Emergency operation plan

The project has developed a contingency plan for various scenarios that might occur. The aim is to mitigate the impact the incident may pose on personnel working on site and minimize damage to machinery and equipment. The contingency plan includes:

(a) Building locality plan indicating all exits

(b) Evacuation routes and rally points.

(c) Firefighting equipment layout plan indicating location of fire nozzle, fire hose and fire extinguishers in each building.

(d) Emergency operation plans for various emergencies such as fire, electrical leakage, storm, flood, accident, chemical leakage, riot etc.

(e) Evacuation plan

(f) First-aid

(g) Fire suppression training

During normal operation hours, the power plant manager is the designated emergency director while outside of the normal operation hours, the shift manager will be designated emergency director. The emergency director will be responsible for controlling and directing all actions during an emergency to evacuate all personnel into a safe place. The emergency director is knowledgeable in all contingency plans, able to assess situations, able to decide whether to evacuate all or certain group of personnel and which area to be blocked to contain a situation. When the situation returns to normal, the emergency director can order all or only specific group of personnel back to work. He or she will also be responsible to report on the incident in detail, specifying date, time, location, cause, severity, any casualties, damages or losses to machinery and working hours lost. The report will detail orders made, rehabilitation plan, machinery repair plan, expected time of repair, personnel involved in repair and rehabilitation and cost estimate for repairs and parts to be replaced etc.

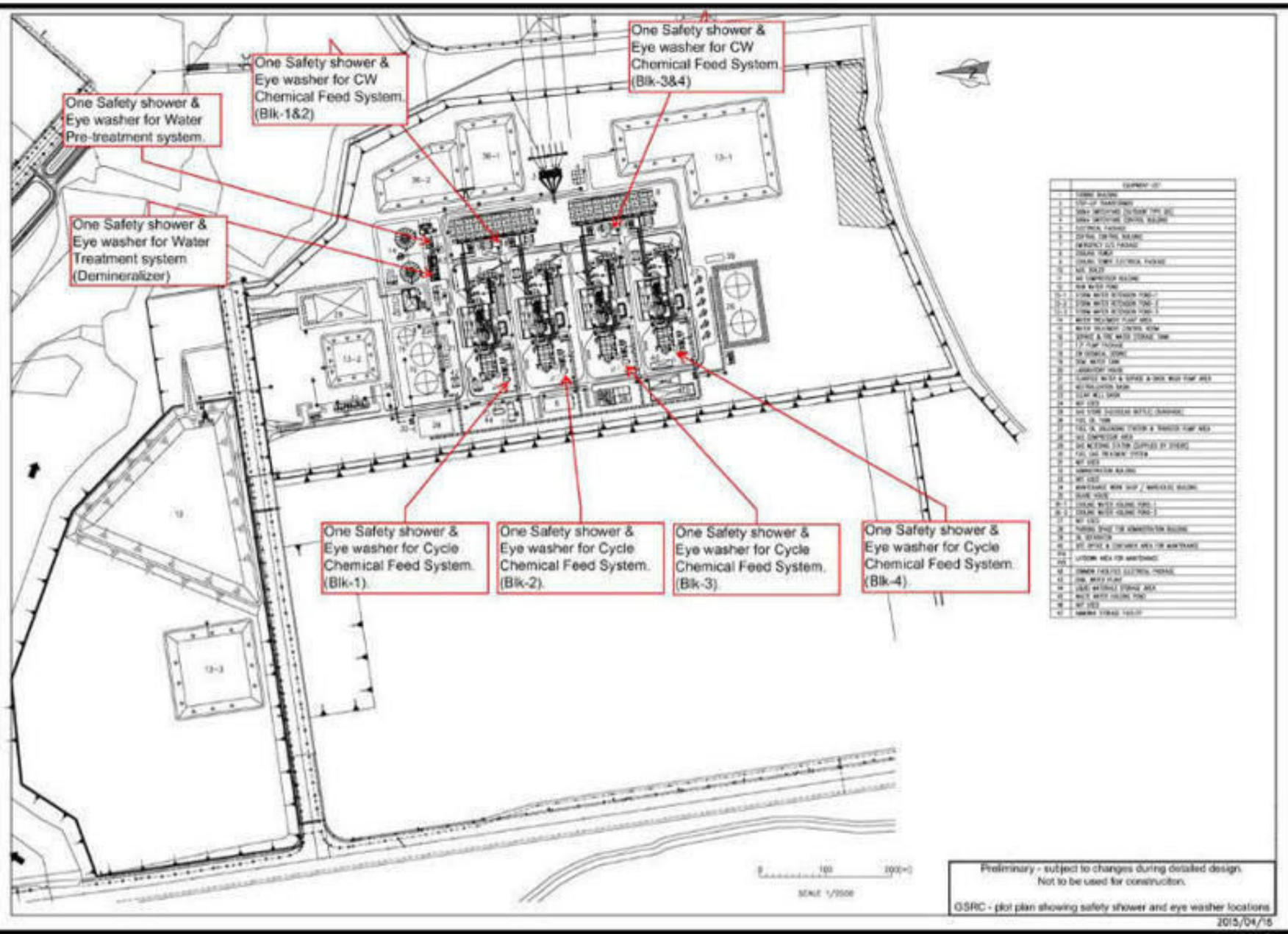


FIGURE 3.14-5 : LOCATION OF SAFETY SHOWER AND EYE WASHERS

The project is to conduct an emergency drill once per year which will include employee training for emergency response and also conduct audit and inspection of all fire suppression equipment once per week or as specified in the project Safety Procedure.

The project has developed project emergency preparedness measures into 3 phases as follows:

Phase 1: Emergency preparedness measure comprising:

(1) Preparation, inspection and preventive maintenance of fire prevention and protection equipment to ensure full working order at all times. The maintenance of each work area are responsible for the maintenance of the fire alarm, communication and suppression systems. The safety department shall provide consultation on best practices. All fire suppression equipment must have designated personnel responsible for their maintenance to ensure that they are in working order at all times.

(2) Agencies or organizations with expertise in occupational safety, health and environment shall be consulted for the organization of emergency training and fire suppression training.

(3) Designated personnel responsible for the project contingency plan shall strictly fulfil his duties.

Phase 2: Emergency counteraction measures

Emergencies can occur due to one of 2 key causes: natural gas emergencies and other emergencies. Therefore, the project has developed contingency plan to cover both types of emergencies:

Natural Gas Emergency and Fire Prevention and Suppression Plan.

(1) Objectives

- To prevent fire caused by natural gas.
- To effectively prepare for fire suppression.

(2) Background information

To promote safe working with natural gas, we need to understand its characteristics, the many hazards involving natural gas and safety procedures.

(a) Characteristics of natural gas and causes of natural gas incidents

- Natural gas used for generating electricity is made up mainly of Methane, a dry gas.
- Natural gas has a vapor density of 0.6 by mass compared to air (air is 1.0).

- At normal temperature and atmospheric pressure, it is present in the form of gas vapor.
- Methane can expand several times more the other gases.
- The suitable range of ratios of methane and air mixture that allows it to ignite is called flammable and explosive limit is at 5.0-14.0 % (Low to High Limit)

(b) Natural gas hazards

- Leakage into the atmosphere (methane is dangerous when mixed with air at certain ratios).
- Natural gas is colorless and not harmful to human body, but inhaling it can cause unconsciousness due to lack of oxygen.

(c) Danger area – personnel entering a danger area must strictly abide by the safety rules such as:

- No smoking
- Lighters, matches or anything that may cause sparks are prohibited.
- Materials that support fire are prohibited.
- Combustible materials such as yellow or white phosphorus and magnesium alloys are prohibited.
- Hot Work such as welding and cutting requires authorization prior to start of work.
- Safety measures must be implemented prior to operation.
- Unauthorized personnel are prohibited from entering hazard zones.

(d) Pipeline monitoring measures

Safety monitoring and mitigation of natural gas pipeline within the project is the responsibility of the power plant. The safety measures to be implemented at the project gas metering station is as follows:

- Conduct regular inspection of natural gas pipeline for possible leak at welded joints above ground at the gas metering station and gas compressors as per requirement of the project safety procedure.
- Install warnings signs indicating gas pipe line underground.

Gas leakage procedure

- Approach the fire or leakage from upwind.
- Evacuate everyone from gas leakage and remove any flammable materials out of the way immediately.
- Man a perimeter of no less than 200 feet from the gas leakage to prohibit people entering the area except those authorized to work on the leak incident.
- Gas leakage with no fire
    - Shut the gas valve to block the flow of gas.
    - Douche the gas leakage with water spray by cutting the gas leak direction or in the manner that changes direction of the gas leak.
    - If gas leakage cannot be stopped, then control ignition by hosing water at hot metal parts such as pipeline.
    - Prevent spark and ignition.

Gas leak with fire

- Shut the gas valve to block flow of the gas.
- Do not use fire extinguishers until gas flow can be blocked successfully.
- Douche hot objects such as concrete, pipes, and metallic surfaces. Allow for fire to burn away where it leaks.
- If the fire occurs at the block valve, douche the valve with water spray and send in a person armed with firefighting suit to shut the valve.
- Dry chemical fire extinguishers are effective in suppressing relatively small fire – direct the extinguisher nozzle at the leak. For very low pressure gas pressure leak, CO2 extinguisher should be used instead.
- If gas leak cannot be stopped, then control the gas vapor by douching equipment around it.

Gas leak protective measures

- When a gas leak is known, shut down all electric equipment that are not explosion proof type in the gas leak area.
- Shut down the valve to block flow of gas to the leakage.
- Control fire sources such as flames, hot surfaces and sparks.
- Check for gas to air mixture ratio in the gas leak area to identify danger area and ventilate accordingly.
- Personnel who were not wearing firefighting suits must check possible gas trapped inside their own clothes which can cause danger.

(e) Identifying gas leakage

- Identify the location of possible gas leakage.
- Assign the order of valve and flange numbers for gas leak identification test.
- Devise test schedule and test duration.
- Conduct the test using gas leak detector.

(f) Repair or maintenance of gas equipment or pipeline

- Block a valves before performing any repair or maintenance.
- Ensure adequate ventilation in the repair or maintenance area.
- Test for gas-air ratio before performing repair or maintenance, and periodically test it during the operation.
- Tools and equipment used in repair or maintenance should be non-sparking type.
- Gas facilities must be well maintained to prevent gas leakages with regular inspection such as pipeline thickness tests.

Detail of protection and prevention of emergency and fire from diesel oil

(1) Diesel oil Storage

Diesel oil will be stored in two storage tanks, each with capacity of 14,300 m^3 and it will be stored not exceed 90 % of diesel storage tank or not exceed 13,000 m^3 per tank in accordance with the regulation of the Ministry of Energy B.E.2556 (2013) for Tank farm. The storage tanks are sufficient as backup fuel for 3 days. The storage tanks are located in the area with concrete dike surrounding the tanks, which can withhold 100 % of the capacity of the largest storage tank in case of leakage in accordance with the regulation of the Ministry of Energy B.E.2551 (2008) for fuel oil storage place.

(2) Diesel Oil Unloading

The diesel oil unloading is surrounded by concrete dike. Rainwater will be contaminated with diesel oil by washing away from unloading area. It will be collected in pipe and sent to Oil Separator of the Project. The Emergency Plan for fuel leakage is as follows:

Emergency Plan for Diesel oil leakage

(1) Emergency Plan Training Program

Environment Health & Safety (EH&S) is responsible for training the personnel on emergency procedures and the associate document related to emergency plan. EH&S must inform personnel in case of any change and implementation of the documents.

(2) Diesel Oil Leakage Prevention Plan

- All departments associated with diesel must act according to Fuel Oil Unloading Procedure.
- Any personnel working with diesel must be caution to prevent leakage, and must act according to Fuel Oil Unloading Procedure and associated MSDS.

(3) Preparation/Inspection of Equipment for Emergency Action Plan

The equipment must be ready for use in case of emergency; the equipment are as follows;

- Absorption materials such as sand, saw dust, fabric etc.
- Appropriate Personal Protective Equipment such as rubber gloves, face mask, face shield etc.
- Receptor for storage of the contaminated material
- The storage tank, gate value, and safety value must be inspected every month.

(4) Actions during Diesel Oil Leakage

- **Minor leakage**
  - In case of minor leakage, encountered person can take action immediately.
  - Use saw dust or other absorption materials to cover the spill or leak, to prevent further contamination.
  - Report the incident to Chief or responsible authority immediately.
  - Use fabric or other absorption materials to clean the contaminated area.
  - Remove all absorption material and fabric used to clean the spill and dispose them at the designated area.
  - Clean the contaminated area to prevent the effect on the environment.
  - Chief or responsible authorities to organize meeting to implement protective measures.
- **Major leakage**
  - Report the incident to Chief or responsible authority immediately.

- Seal the area, to prevent further contamination and facilitate the emergency procedures.

- When proceed with the emergency plan, the Emergency Response Team; (ERT) should be upwind to avoid the fuel vapor. The emergency team must also wear appropriate PPE.

- Emergency response for oil leakage according to oil leakage mitigation plan.

(5) Procedures after Fuel Leakage

- After the incident, the Emergency Response Team; (ERT) announce the end of evacuation plan/emergency plan and inform all personnel to go back to work, and coordinate with Operation or Maintenance to restore the area back to normal condition.
- Damage Survey by Head Department
- Restoring the area

- Emergency Response Team; (ERT) is responsible area restoration and must wear appropriate PPE

- Emergency Response Team; (ERT) must seal the area and install warning signs

- Emergency Response Team; (ERT) must clean the area. All waste must be disposed according to Hazardous waste Procedure.

- Seal the waterway to prevent the contaminated water from emergency procedure to the environment. The water from emergency activities must be collected and treated properly.

- EH&S prepare the report and present to the Manager or Safety Committee to implement the emergency plan.

In case of emergency occurrence, EH&S is responsible for assessment on efficiency emergency procedures and improve response plan for after Fuel Leakage.

Emergency Plan for fire and others

(1) Fire around the Power Plant

Fire may be expanded if strong wind is blown in period of dry climate condition, near to flammable substance and flammable origin. In addition, control of fire incident will be more difficult if fire occurs from flammable and explosive materials such as oil. However, trained employee's skill and quick response to fire is important factor to

control fire. In addition, readiness of fire extinguisher devices, their positions, sufficiency of water pressure, readiness of fire pump having weekly examination for ready use are also important. These preparations, examination and emergency plan verification must be done regularly. In addition, the emergency plan of power plant will often be reviewed.

(2) Factory Fire in Vicinity Areas

Communication between the project, RIP and factories in vicinity areas is necessary during factory fires. This communication is to exchange information of risk and emergency probability. Consequently, details of fire extinguisher system of project and each factory, name list of safety officer and mutual aid coordinate, communicative signal channel, telephone numbers or walky-talky channels of persons in charge for communication in emergency must be arranged. For example, fire extinguisher devices and safety officer will be sent to help resolving and controlling fire when there is a request from other factory in vicinity areas.

(3) Chemical Leakage around the Power Plant Areas

Chemicals use in the project may leak during process of adding, transporting, lifting up and down from a truck or loading from tank to chemical pumping machine. When chemical liquid leaks, mutual aid coordinate will determine the situation by surveying chemical contamination in soil or groundwater and providing proper management methods.

(4) Electric Leakage

Electric leakage will rarely happen because the power plant is designed with underground connective system which is better than other factories. However, if electric leakage happens, a mutual aid coordinate must be able to inform everyone to understand rescue practice to correctly save life of electric shock victim to safety.

(5) Accident

Accident such as falling from height, heavy weight falling during lifting, lost consciousness in confined space or traffic accident is sometimes considered just small things. If accident occurs to employees, who are not relevant, will affect in unable to work consequently, solving the situation would become more difficult.

(6) Storm

A mutual aid coordinate must listen to news and climate forecast announcement from the Meteorological Department for possible storm occurrence. Then, he will determine and instruct or prepare readiness in advance such as fixing protection to equipment, lifting up stuffs to high and safe place, warn worker or employees to stop working outdoor around the building, etc.

Emergency Control

In regular working hour, a power plant manager will be responsible for controlling safety of workers and handling other emergencies.

In period of irregular working hour, periodic chief will be responsible for controlling emergency until the emergency is resolved or the power plant manager arrives at accident area and assumes the responsibility in place of the periodic chief. Emergency cause is classified into two levels as follows:

(1) Emergency Level 1

Emergency level 1 is a case occurs in the areas of the factory that mutual aid coordinate can control the situation and limit the damage with support of employees and workers, available fire extinguisher devices until the situation turns to normal stage.

(2) Emergency Level 2

Emergency level 2 is a case occurs both inside and outside factory. The mutual aid coordinate determines the case and, if it is found that supporting plan of emergency level 1 cannot be used, accordingly, he must request support both manpower and equipment from Hemaraj ESIE to control the situation as shown in **Appendix 2U** (**Source:** Hemaraj Eastern Seaboards Industrial Estate, 2015).

Emergency operational procedures for the power plant

(1) Operational procedures during normal working hours

Employees who encounter an incident should decide whether they can control the situation on their own or not. If not, they call the central control for help and notify the Emergency Director. During an emergency situation, the power plant manager is the designated Emergency Director who is in charge of assessing the situation – whether the emergency can be contained using available resources or not. He will be giving orders to control and rectify the situation, ensuring safety of all plant employees and power plant asset. He can call for support from the industrial estate's firefighting unit, or ambulance from nearby hospitals to take care of any casualties. He is tasked with ordering the power plant firefighting unit to deploy and evacuate employees to a safe rally point, close down relevant roads and entry/exit points on site etc.

(2) Operational procedures outside normal working hours

Employees who encounter an incident should decide whether they can control the situation on their own or not. If not, they call the central control for help and notify the Emergency Director. Due to smaller number of employees working during these hours, the Shift Leader will be designated Emergency Director in emergency situations. If the fire situation is classified as emergency class 2, he must call for the industrial estate firefighting unit as soon as possible and call upon all on-call employees to report to work. He is also tasked with ordering the firefighting and safety teams to proceed as per training and call for local ambulance for backup medical assistance. He also orders shutting down the power in relevant areas to allow for firefighting and report the situation to the power plant manager.

The emergency situation organization chart is shown in **Figure 3.14-6** and the emergency situation flowchart is shown on **Figure 3.14-7**.

Communication

To establish efficient communication during emergency situation, the emergency communication chart is to be used as per **Figure 3.14-8**.

Communications with external organizations and communities are shown on **Table 3.14-4**. The relevant local agencies are detailed below.

(1) Hemaraj Eastern Seaboard Industrial Estate

The Hemaraj ESIE fire-fighting unit comprises:

- 1 Fire truck with water pump and 6,000 liters water tank.
- 1 Rescue vehicle with equipment
- Wet Barrels no more than 150 m apart, 1.5-6.0 Bar pressure fire water pipeline, and 313,252 m^3 fire water reserve.
- Firefighters on duty 24 hour a day.

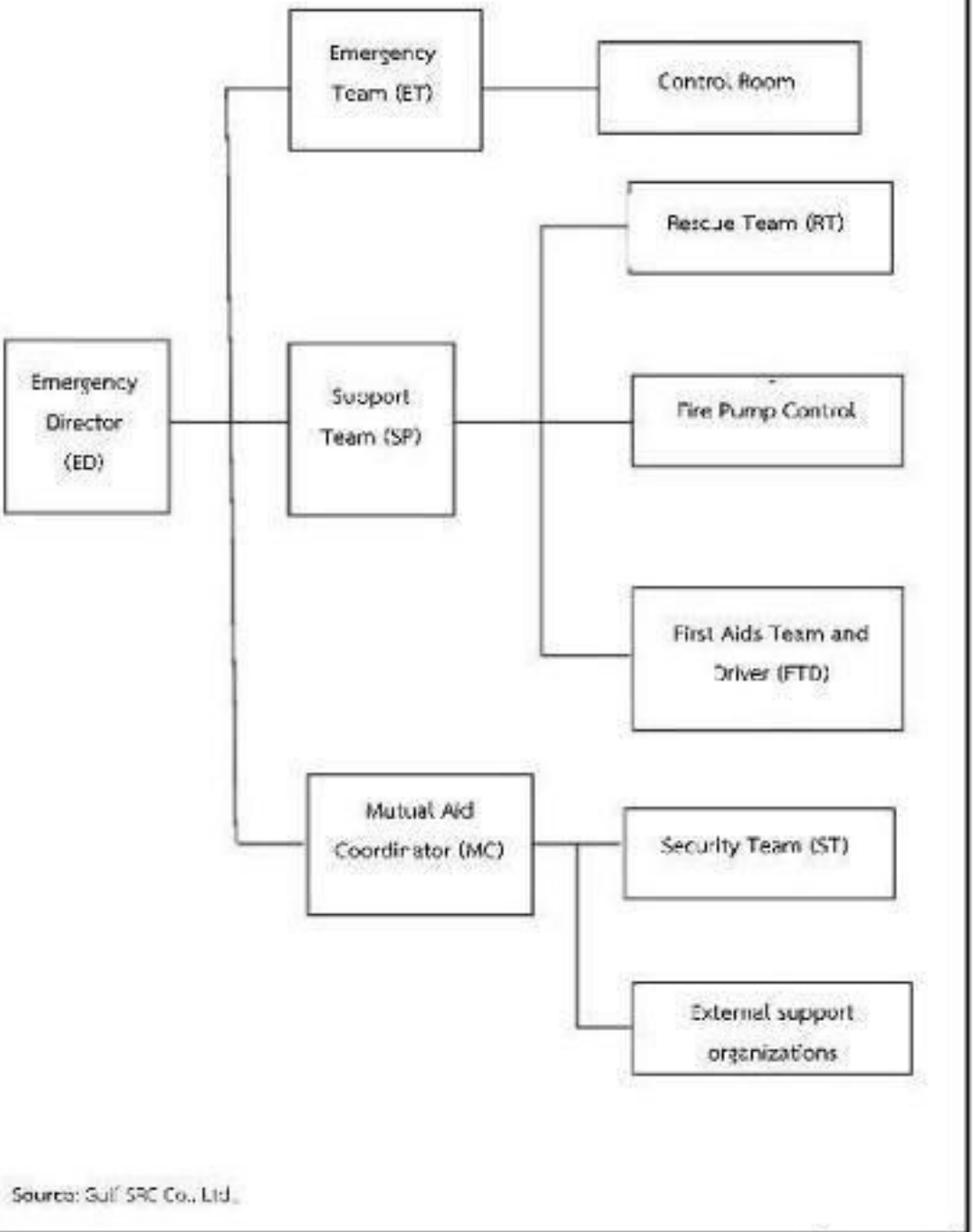
Distance from the power plant is 8.6 km, travel time between 10-15 min.

(2) Chomphon Chao Phraya Sub-district Municipality

The firefighting unit at Chomphon Chao Phraya Sub-district Municipality comprises:

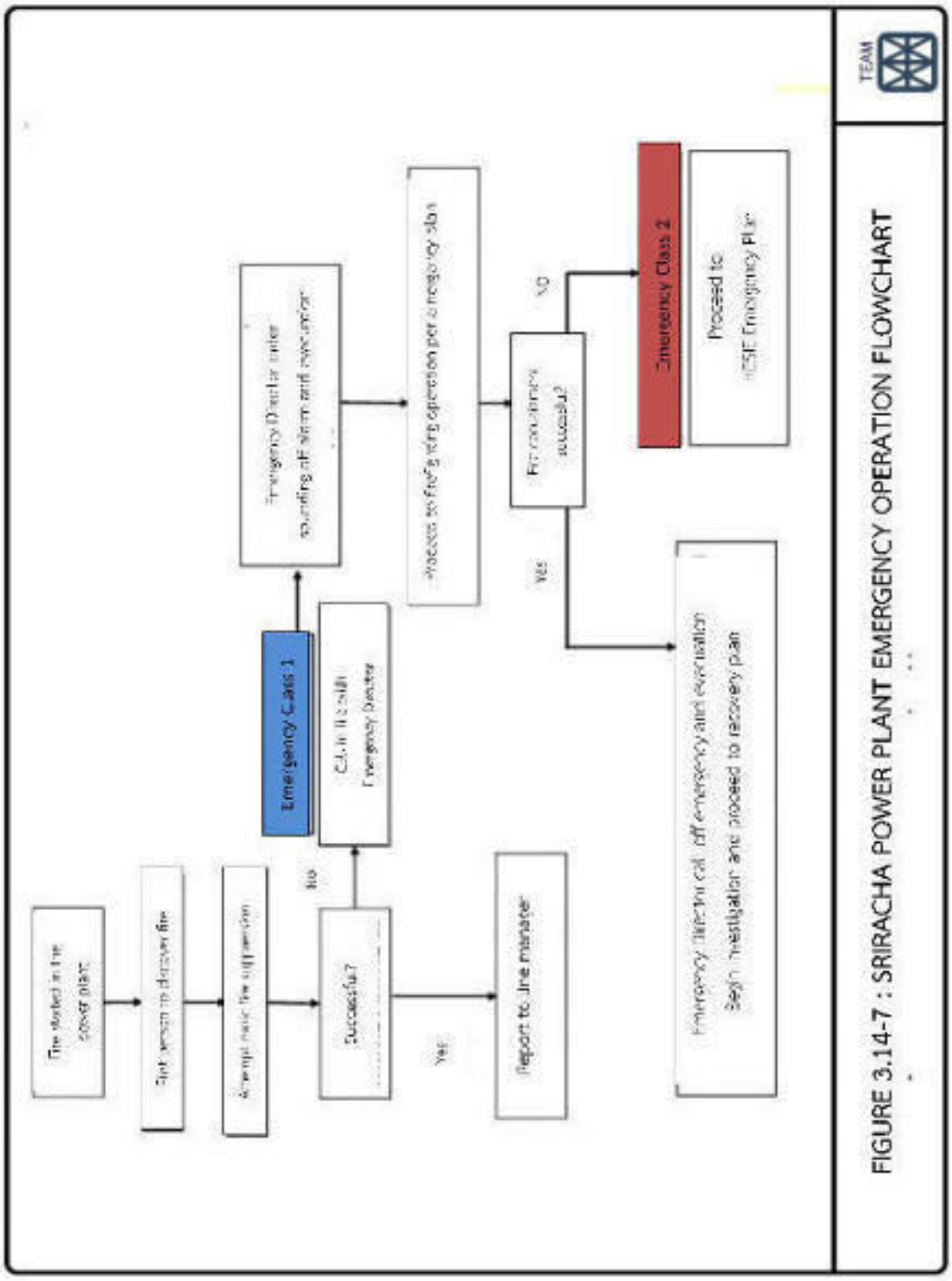
- 4 Fire trucks and service vehicles:
  - 2 Multipurpose water trucks with 12,000 liters water tank each.
  - 2 Fire trucks with 6,000 liters water tank each.
- 1 Portable firefighting unit.
- 3 Fire fighters' suits with firefighter masks.
- 6 Firefighters.
- 50 Civil defense volunteers.

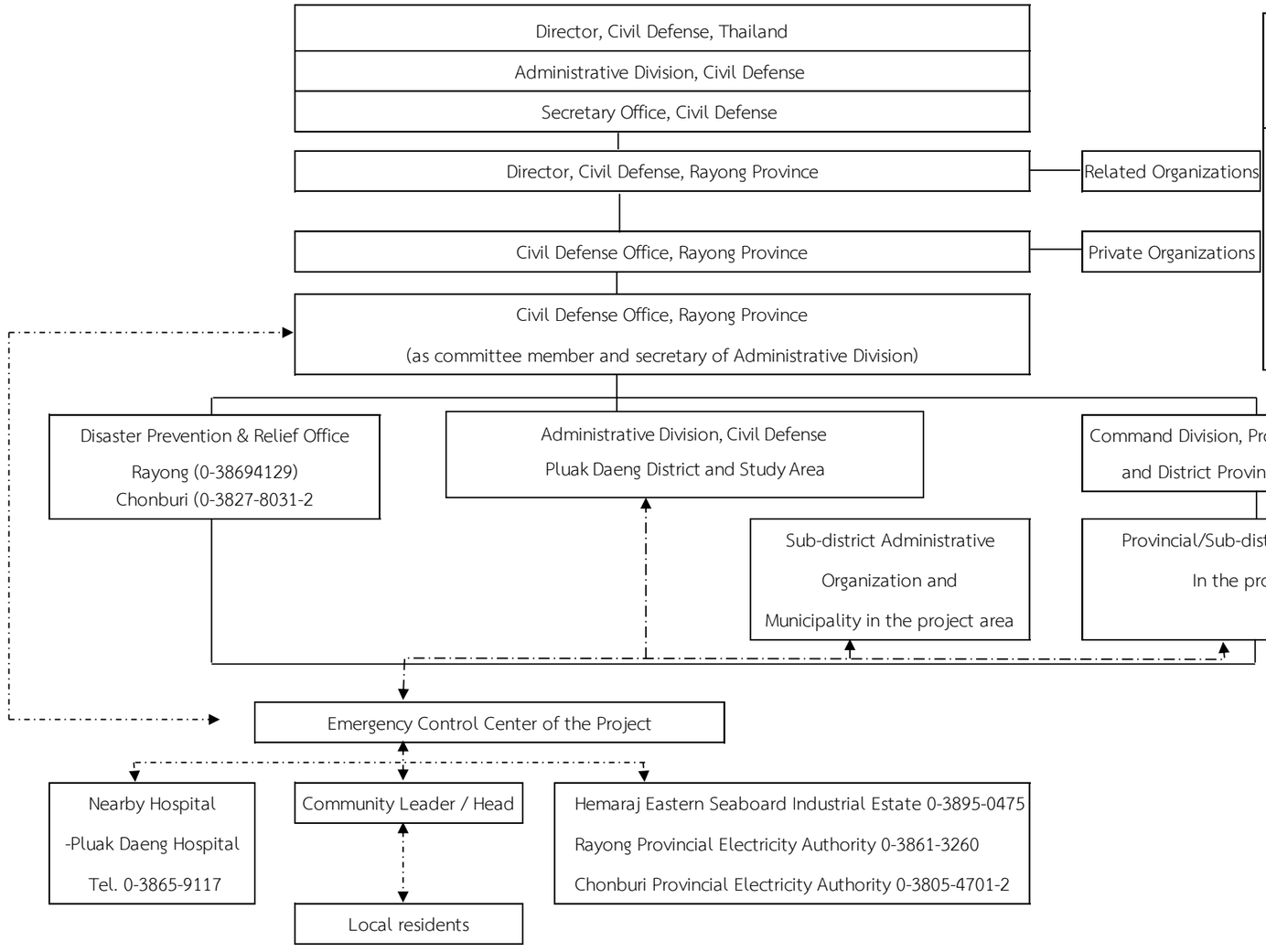
The unit is located 3.5 km from the power plant and travel time is between 5-10 min.



Source: Gulf SRC Co., Ltd.

FIGURE 3.14-6 : EMERGENCY SITUATION ORGANIZATION CHART


TEAM
FIGURE 3.14-7 : SRIRACHA POWER PLANT EMERGENCY OPERATION FLOWCHART
Emergency Class 2
Proceed to
ERP Emergency Plan
No
Yes
Yes
No



Rayong Province	Disaster Prevention & Relief Office, Rayong	0-3869-4129
	Provincial Electricity Authority, Rayong	0-3861-3260
	Command Division, Provincial Police, Rayong	0-3861-3340
Pluak Daeng District	Pluak Daeng District Office	0-3865-9002
	Provincial Police Station, Pluak Daeng	0-3865-9101
	Chomphon Chao Phraya Sub-district Municipality	0-3896-4176
	Ta Sit Sub-district Administrative Organization	0-3896-4221
	Pluak Daeng SAO	0-3865-9886
	Pluak Daeng Sub-district Municipality	0-3865-9003
	Pluak Daeng Hospital	0-3865-9117

Chonburi Province	Disaster Prevention & Relief Office, Chonburi	0-3827-8031-2
	Provincial Electricity Authority, Chonburi	0-3805-4701-2
	Command Division, Provincial Police, Chonburi	0-3826-0990
Si Racha District	Si Racha District Office	0-3831-1020
	Khao Khan Song SAO	0-3829-0225
	Bo Win SAO	0-3834-5949
	Provincial Police Station, Bo Win	0-3806-7313
	Laem Cha Bang Hospital	0-3835-1010-2
Ban Bueng District	Ban Bueng District Office	0-3844-3020
	Khlong Kiew SAO	0-3844-6358-60
	Provincial Police Station, Khlong Kiew	0-3820-1390
	Ban Bueng Hospital	0-3844-3560
Nog Yai District	Nong Yai District Office	0-3821-9383
	Nong Suea Chang SAO	0-3821-8801-2
	Provincial Police Station, Nong Yai District	0-3821-9999
	Nong Yai Hospital	0-3821-9145
Gas Pipeline System Operation Center, Area 3 of PTT PLC		0-3868-5009

FIGURE 3.14-8 : EXTERNAL PARTIES EMERGENCY COORDINATION CHART

TABLE 3.14-4

EMERGENCY CONTACT PHONE NUMBER WITH EXTERNAL AGENCY OF POWER PLANT

Area	Agency	Tel.
Rayong Province	Department of Disaster Prevention and Mitigation, Rayong Province	0-3869-4129
	Provincial Electricity Authority, Rayong Province	0-3861-3260
	Rayong Province Police	0-3861-3340
Pluak Daeng District	Pluak Daeng District Office	0-3865-9002
	Pluak Daeng District Police Station	0-3865-9101
	Chom Phon Chao Phra Ya Sub District Municipal Office	0-3896-4176
	Tasit Sub District Administration Organization	0-3896-4221
	Pluak Daeng Sub District Administration Organization	0-3865-9886
	Pluak Daeng Sub District Municipal Office	0-3865-9003
	Pluak Daeng Hospital	0-3865-9117
Chon Buri Province	Department of Disaster Prevention and Mitigation, Chonburi Province	0-3827-8031-2
	Provincial Electricity Authority, Chonburi Province	0-3805-4701-2
	Chonburi Province Police	0-3826-0990
Si Racha District	Si Racha District Office	0-3831-1020
	Khao Khansong Sub District Administration Organization	0-3829-0225
	Bo Win Sub District Administration Organization	0-3834-5949
	Bo Win Police Station	0-3806-7313
	Laem Chabang Hospital	0-3835-1010-2
Ban Bueng District	Ban Bueng District Office	0-3844-3020
	Klong Kiew Sub District Administration Organization	0-3844-6358-60
	Klong Kiew Police Station	0-3820-1390
	Ban Bueng Hospital	0-3844-3560
Nong Yai District	Nong Yai District Office	0-3821-9383
	Nong Sua Chang Sub District Administration Organization	0-3821-8801-2
	Nong Yai District Police Station	0-3821-9999
	Nong Yai Hospital	0-3821-9145

(3) Khao Khan Song Sub-district Administrative Organization

The fire-fighting unit at Khao Khan Song Sub-district Administrative Organization comprises:

- 1 Multipurpose water truck with 5,000 liters capacity.
- 1 Fire platform truck
- 1 Fire tiller truck is being budgeted for 2017 financial year.
- 33 Civil defense volunteers.

The unit is located 8.4 km from the power plant with a travel approximately 10-15 min.

(4) Ta Sit Sub-district Administrative Organization

The fire-fighting unit at Ta Sit Sub-district Administrative Organization comprises:

- 1 Fire truck with 12,000 liters water tank.
- 1 Sport Utility Vehicle Petrol
- 4 Firefighters.

The units is located 5.8 km from the power plant with a travel time of approximately 5-10 min.

(5) Pluak Daeng Sub-district Administrative Organization

The fire-fighting unit at Pluak Daeng Sub-distirct Administrative Organization comprises:

- 1 Multi-purpose fire truck with 12,000 liters water tank.
- 1 Fire truck with water cannon and 5,000 liters water tank.
- 1 Rapid response multi-purpose vehicle.
- 1 Fire platform truck.
- 1 Sport Utility Vehicle Petrol.
- 2 Public disaster workers.
- 1 Permanent staff.
- 2 Temporary staffs.
- 3 Clerks.
- 195 Civil defense volunteers.

The unit is 13.4 km from the power plant and estimated travel time of 15-20 min.

Evacuation plan

Sriracha Power Plant Project has designed rally points and evacuation routes for several contingencies. It is upto the Emergency Director to decide which rally point and route is the most appropriate to take taking in consideration safety and capability in evacuating personnel from the rally point. The fire evacuation plan for Sriracha Power Plant (as shown on **Figure 3.14-9**, takes into consideration from class 1 emergencies upwards. Details of the rally points of Sriracha Power Plant are described in **3.14.2.9 Assembly Points**.

FIGURE 3.14-9 : SRIRACHA POWER PLANT FIRE EVACUATION PLAN

Emergency relief and recovery plan

The emergency relief and recovery plan comprises:

- Coordination with government agencies.
- Damage assessment.
- Set up a committee comprising one person from each section and designation of rally point and awaiting orders.
- Survivors rescue and bodies recovery.
- Movement of casualties and properties of the deceased.
- Risk and operational assessment. Fire report.

Phase 3: Recovery measures after emergency

Recovery plans after fire are such as improvement of evaluating report in all occurrence aspects to proceed on remedy especially on fire protection, action plan for fire, relief plan (action immediately after fire has calmed down) including assist employees who have been accidents to the disabled workers.

(1) Improvement on fire protection and extinguishing plan

- Changing on regulations and measures
- Evaluation on practice of fire protection and extinguishing plan shows inefficient of original map and diagram.
- Increase equipment in system may cause abnormal occur
- Change director for firefighters
- Change of protection equipment and extinguishing location such as hoer, fire extinguisher etc.

(2) After the abnormal situation, observer has to advise for conclusion as follows;

- Achieve the objectives and practice method or not
- Have to adjust the plan or not
- Succeed on action plan or not
- Efficiency on communication with other organizations

(3) Improvement on project recovery

- Give information to public about cause of fire and guideline protection
- Support to victims from accidents of fire
- Renovation and restoration project

(9) Assembly Points

An assembly point is a safe area for personnel not required for in the emergency plan operation to gather for head count after the shift leader has ordered evacuation. If it also a prep area for evacuation out of the power plant site (project emergency plan class 1) There are 2 available rally points as shown in **Figure 3.14-10**, either of which have the capacity for all personnel.

(10) Emergency Drill

An emergency drill is to build preparedness for both personnel and equipment and is conducted at least once a year. After each drill, an assessment is made to further improve the plan for optimal efficiency. An emergency drill assessment requires the following:

(a) Occupational Health, Safety & Environment officer is responsible to assemble all emergency drill plans and propose to the power plant manager for approval of an annual emergency drill by the end of December each year.

(b) Occupational Health, Safety & Environment officer gives consultation on technicalities of an emergency drill and attend every emergency drill planning meeting.

(c) Occupational Health, Safety & Environment officer is to observe the drill at the following locations:

- Scene of Incident
- Traffic management
- Communications and coordination
- Emergency management and efficiency

(d) Occupational Health, Safety & Environment officer is to observe in the emergency drill, attend the drill assessment meetings of all departments and input his assessment of the drill. He then submits the report to the project manager for approval and offer recommendation for improvements (if any).

(e) Occupational Health, Safety & Environment officer present to the Occupational Health, Safety & Environment committee follow-up meeting the progress on recommended improvement on the emergency plan.

(11) Employee health check

In accordance with the Ministry of Labor's regulations re: Provision of Welfare in Workplace B.E 2548, the project organizes an annual employee health check by the first class physician licensed to practice occupational medicine and also for new employees being inducted into the work place as detailed in **Table 3.14-5**.

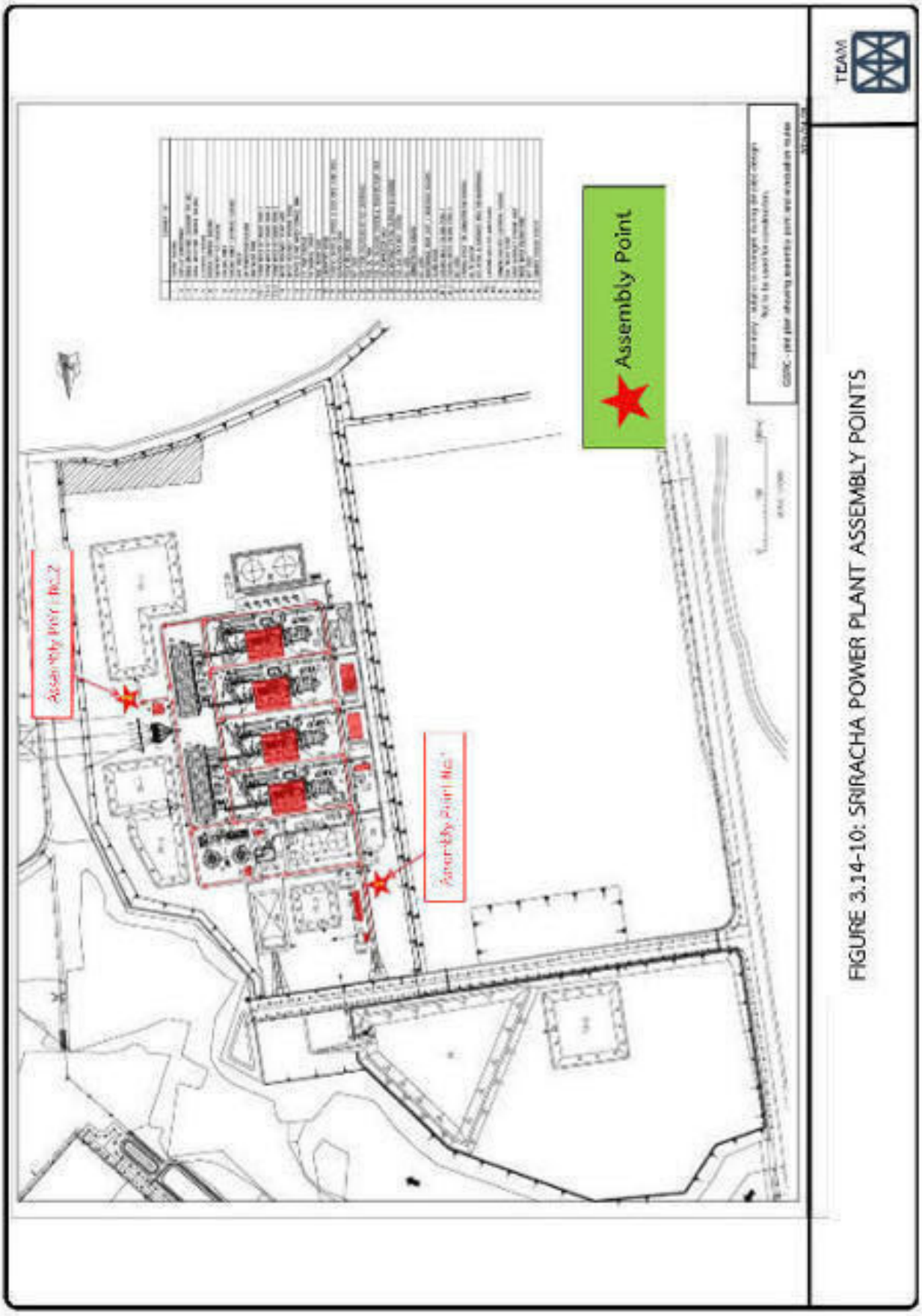


FIGURE 3.14-10: SRIRACHA POWER PLANT ASSEMBLY POINTS

TABLE 3.14-5

HEALTH CHECK UP PLAN OF EMPLOYEES IN SRIRACHA POWER PLANT PROJECT

Group of employees	Measurement Indices	Duration and frequency
New employees	- Physical Examination - Chest X-ray - Blood Test: complete blood count, blood group and immune hepatitis B	pre-employment
All employees	- Physical Examination - Chest X-ray - Blood Test: complete blood count, blood group and immune hepatitis B - Vision Test - Audiometric Test	Once per year

Source : Gulf SRC Co., Ltd., 2015

Each employee will be issued with a personal health record as part of the company employee health database to monitor health impact especially employees on hazardous work duty. The database is also used for the project occupational health management system. A designated personnel will be responsible for safe record keeping of employee health record throughout the duration of his or her employment.

3.14.3 WORKPLACE WELFARE

The project provides for all the welfare as required by the ministerial regulations re: Provision of Welfare in Work Place B.E. 2548 issued by virtue of the Labor Protection Act B.E. 2541 such as:

(1) Drinking water, wash rooms, toilets

The project will provide clean drinking water and adequately maintained wash rooms and toilets for project employees.

(2) First aid and healthcare

The project will provide healthcare for all employees at designated hospital or clinic as detailed on the employee healthcare card. For first aid and primary treatment for minor injuries or illness during working hours, the project has installed a first aid kit as required by the Ministry of Labor's Regulations re: Welfare in Workplace B.E 2548. For injuries requiring treatment, the project is to make an agreement with all employees that they be moved to a 24 hours hospital instead of providing for an in-house doctor on the premises.

3.15 COMMUNITY RELATIONS AND COMPLAINT PROCEDURE

3.15.1 COMMUNITY RELATIONS

The project operations might impact the livelihood and the environment of nearby communities both directly and indirectly. To ensure sustainable development, the project is to implement a public relations plan on a regular basis as per Gulf company group policy to increase understanding about the project. This is to help boost confidence in the project development and give back to the community benefits of sponsoring various activities in the community. The company has established a public relations plan for each period of the project as follows:

(1) Pre-construction Period

The objective is to create outreach to the public on the project development. A community relations team will meet up with local government organizations, local leaders and the public to share information pertaining to the project.

(2) Construction Period

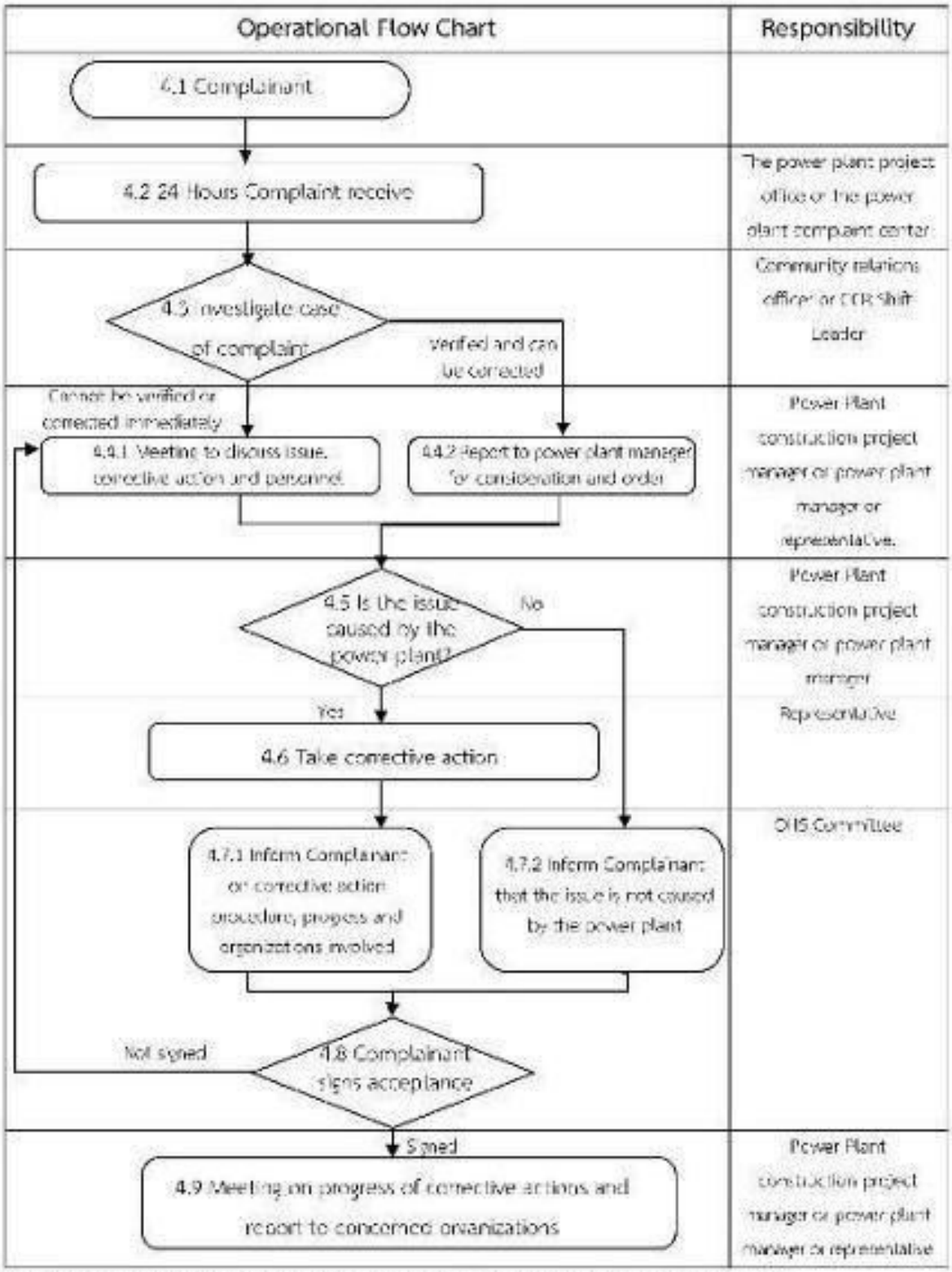
The project will continue to conduct outreach and publicize project progress and assimilate from the public suggestions and comments on the construction project, social and environmental matters. The feedback will form basis for improvements and changes to the project and serve as guideline to improve upon publicity approach.

(3) Operation Period

During the operation period, the project will continue to proceed on community relations, supporting community activities and engagement in community development by providing aid and support, as well partake in community activities as appropriate to build good community relations and give back to the community.

3.15.2 COMPLAINT PROCEDURE

The project is to set up a complaint center and assign a personnel responsible to processing complaints, implement outreach, assimilate suggestions, opinions and requests. The public can use any of the available complaint mechanisms such by words, telephone, fax, note, letter, email or inform another project employee. The complaint procedure is detailed as per **Figure 3.15-1**. For emergencies, this can be done as per **Figure 3.15-2** as follows:



Remarks: Notify the Complainant of the progress every 7 days or as mutually agreed upon period.

FIGURE 3.15-1: SRIRACHA POWER PLANT PROJECT COMPLAINT PROCEDURE

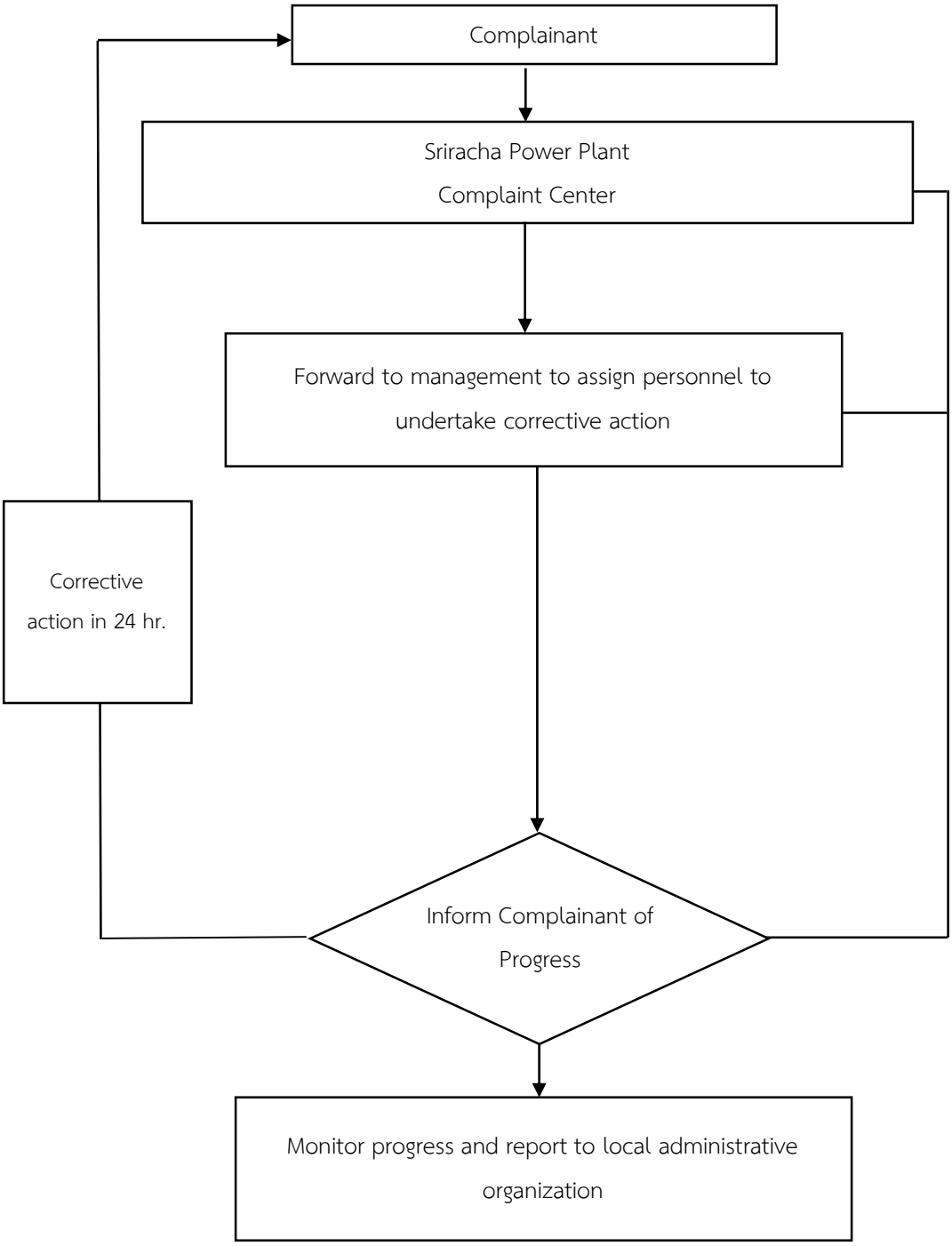


FIGURE 3.15-2: EMERGENCY COMPLAINT PROCEDURE

(1) After the complainant made a complaint via one of the channels to the complaint center or to the power plant, the responsible personnel will investigate the cause. If the issue did not originate from the project, then complainant must be informed within 24 hours.

(2) If the issue is indeed from the project, the complaint officer will forward the complaint to the site manager if it is during construction period or to the power plant manager if it is during operation period. A meeting to rectify the issue will be held and personnel assigned to rectify the issue. Progress must be informed to the complainant every 2 days or as agreed upon with the complainant.

(3) Site manager or the power plant manager is responsible for ordering corrective actions to being taken and report on the progress to the complainant every week or as agree upon period. The Occupational Health, Safety & Environment Committee must also be informed. The complaint officer and the complainant shall also inspect the rectification together.

3.16 PROJECT OPERATION & MANAGEMENT

Construction of the Sriracha Power Plant Project by Gulf SRC Co., Ltd. is expected to span 51 months commencing in 2018 and be generating power to the grid by 2021 and 2022. The various period of the project are shown on **Figure 3.16-1**.

3.17 GREEN AREA

The Sriracha Power Plant Project will set aside 35,300 m^2 or 5 % of the project total land as green area as shown on **Figure 3.17-1**. Perennials, shrubs and grasses will be planted in 3 zigzag rows between perennials and tall shrubs as per **Figure 3 .17-1**. Perennials to be planted are Asoke, Yellow Poinciana, Hummingbird Tree, Yellow Cotton Tree or other suitable perennials with trunk diameter of no less than 5 inches. Suitable gap between the perennials and the shrubs will be allowed for them to grow together. The minimum number of perennials in the green area must be no less than 450 and stand no shorter than 1.50-meter-tall to comply with the Industrial Estate Authority of Thailand Notification No. 103/ 2556 re: Work Place Land Development in Industrial Estates (**Appendix 2V**). The soil for the green area will be conditioned to make suitable for planting and up keep. To irrigate the green area, the project will draw approximately 382 m^3/day of raw water or water from the cooling water holding pond. Any tree that fell or damaged trees will have to be replaced within 1 month to maintain the required green area.

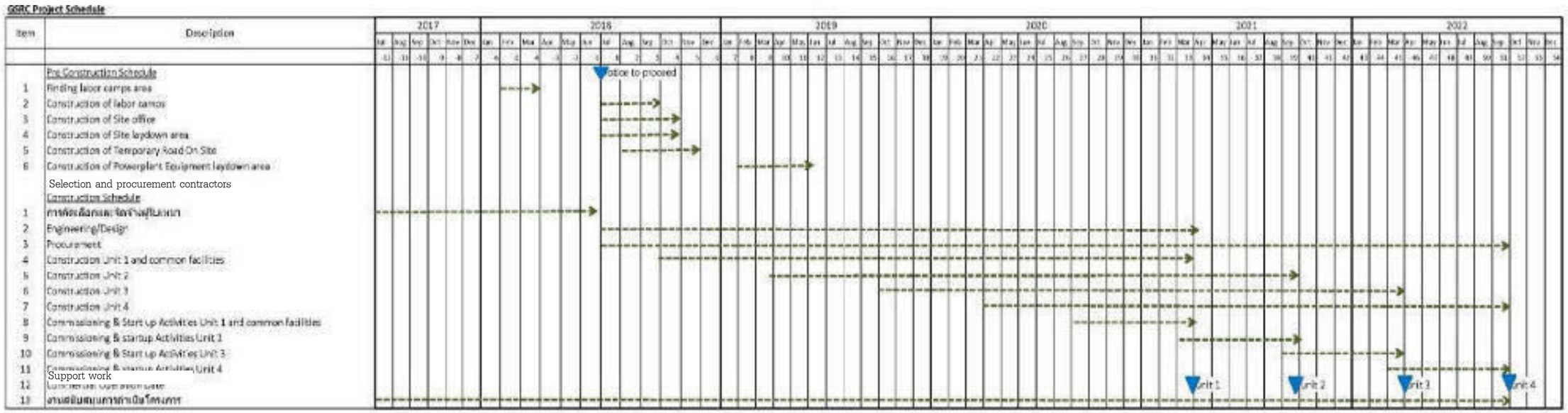


FIGURE 3.16-1 : PROJECT SCHEDULE

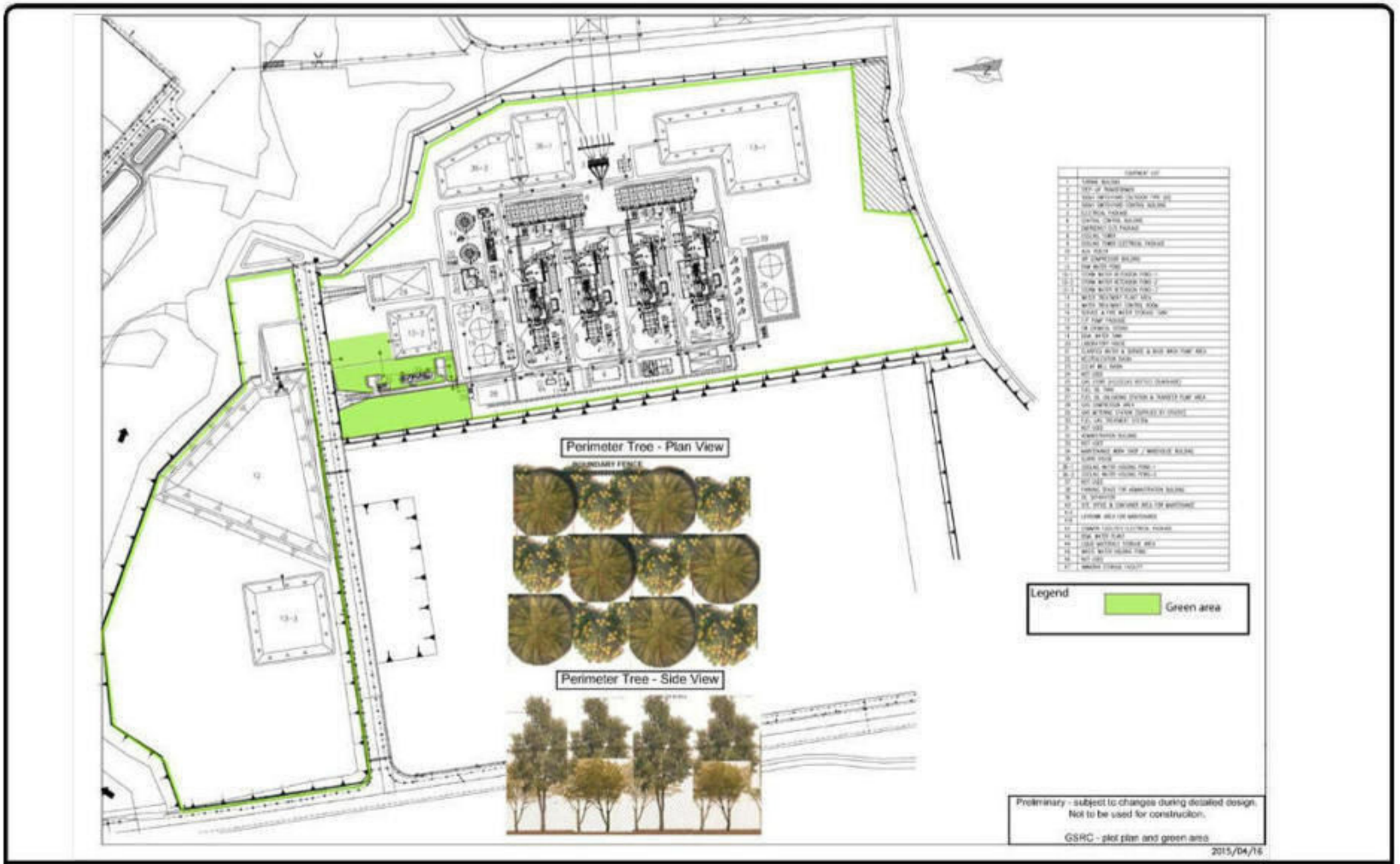


FIGURE 3.17-1: GREEN AREA