CHEMSAIN KONSULTANT SDN BHD (130904-U)

sarawak energy

ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT (ESIA) REPORT

FOR THE PROPOSED TG. KIDURONG COMBINED CYCLE POWER PLANT PROJECT (UNIT 10 & 11 AND 12 & 13) BINTULU DIVISION, SARAWAK

VOLUME 2: APPENDICES

APRIL 2018

Appendix 1.2.1

DOE's PEIA Approval Letter and Approval Conditions for Existing Tg. Kidurong Power Station

TRANSLATED VERSION OF A LETTER FROM JABATAN ALAM SEKITAR (DOE), SARAWAK, KEMENTERIAN SUMBER ASLI DAN ALAM SEKITAR, TO MANAGING DIRECTOR SARAWAK POWER GENERATION SDN. BHD. REF.: AS(SWK)(B) 41/010/300/001 Jld 5 (16) DATED 14 JANUARY 2008

CONFIDENTIAL

Date: 14 January 2008

Managing Director
Sarawak Power Generation Sdn. Bhd.
4th Floor, Wisma SESCO
Petra Jaya
93673 KUCHING
(Attn.: Mr. Yong Kiong Choon)
Tel.: 082-441188
Fax: 082-448401

Sir,

ENVIRONMENTAL IMPACT ASSESSMENT REPORT (EIA) FOR THE PROPOSED COMBINED-CYCLE PROJECT STG UNIT NO. 9, TANJUNG KIDURONG, BINTULU, SARAWAK.

I refer to the EIA Report submitted by Sarawak Power Generation Sdn. Bhd. dated 2 November 2007 by your appointed EIA consultant, Sekitar Ceria Environmental Services Sdn. Bhd. and the Addendum, which was received on 7 December 2007 and 17 December 2007, respectively.

2. The EIA report was evaluated and discussed during the "One Stop Agency (OSA)" Committee Meeting held on 4 December 2007. After reviewing the EIA Report and the Addendum mentioned above, this Department concluded that the EIA Report submitted is in accordance to Section 34A, Environmental Quality Act, 1974. It is therefore concluded that the EIA Report is hereby **approved** subject to the Terms and Conditions of Approval of Department of Environment Sarawak (DOE) as listed in **Appendix A.**

3. We would also like to draw your attention to the following issues:

i. This project involves the expansion of energy production capacity of Bintulu Power Station. This expansion is done by converting two existing open-cycle gas turbine generating sets (GTG-7 and GTG-8) to one block of Combined-Cycle Power Generation Plant at Block 20, Kemena Land District, Tanjung Kidurong, Bintulu, with a new total capacity of 330 MW.

ii. According to ASEAN Marine Water Quality Criteria, increase in seawater temperature at cooling water discharge outlet must not exceed ±2°C above maximum ambient temperature. Continuous monitoring of temperature variation at the cooling water discharge outlet must first be carried out. Frequency of sampling must first be agreed by the Department of Environment, Sarawak.

4. For your information, the Environmental Management Plan (EMP) should emphasize on aspects of environmental management during site clearing, soil works and construction including management of surface water flow to reduce occurrence of siltation and pollution of water quality and solid waste and scheduled waste management and shall be prepared and submitted to this Department **before** commencement of construction works. The EMP must be revised from time to time in line with the project construction phase.

5. You are also reminded to pay attention to the following issues:

(i) The PPE1/97 form that is attached must be completed and submitted to this Department within **ninety (90) days** from the date of this letter.

(ii) The Monitoring Report and Compliance to Terms and Conditions of Approval Report using form PPE2 must be submitted to the Department of Environment once every three (3) months in accordance to section 34A (7), Environmental Quality Act, 1974.

6. This EIA approval conditions is only valid for two (2) years from the date of issuance of this letter. If the project is not carried out within the stipulated period, the approval of this EIA Report will be regarded as null and void. We would also like to remind you that this approval can be revoked at any time if it is found that any of the EIA approval conditions are not complied with and stop work order shall be issued immediately.

7. We appreciate your cooperation and support to care for our environment for sustainable development.

"BERKHIDMAT UNTUK NEGARA"

"INTEGRITI ASAS PENINGKATAN KUALITI"

Saya yang menurut perintah,

(HAJI ISMAIL BIN ITHNIN)
Pengarah
Jabatan Alam Sekitar Negeri Sarawak

b.p. Ketua Pengarah Kualiti Alam Sekeliling
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AS(SWK)(B):41/010/300/001 Jld 5 (16)

DEPARTMENT OF ENVIRONMENT SARAWAK

APPROVAL CONDITIONS OF ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

for

THE PROPOSED COMBINED-CYCLE PROJECT STG UNIT NO. 9, TANJUNG KIDURONG, BINTULU, SARAWAK

To be implemented by

SARAWAK POWER GENERATION SDN. BHD.
4TH FLOOR, WISMA SESCO
PETRA JAYA
93673 KUCHING

OBLIGATIONS

1. All prevention and control measures outlined in page C4-1 to C4-28, EIA Report entitled **Preliminary Environmental Impact Assessment For The Proposed Combined-Cycle Project STG Unit No.9, Tanjung Kidurong, Bintulu, Sarawak** dated 2 November 2007 and **Addendum** dated 7 December 2007 and 17 December 2007 prepared by consultant Sekitar Ceria Environmental Services Sdn. Bhd. must be fully complied and implemented. The Project Proponent, hereby, shall be fully responsible for the failure to carry out all the prevention and control measures.

PROJECT CONCEPT

2. This EIA Report approval is for the expansion of energy production capacity of the Bintulu Power Station. This expansion is done by converting two existing open-cycle gas turbine generating sets (GTG-7 and GTG-8) to one block of Combined-Cycle Power Generation Plant at Block 20, Kemena Land District, Tanjung Kidurong, Bintulu, with a new total capacity of 330 MW.

3. This project will apply the combined-cycle technology, which enables this new facility to generate 50% more electricity from 220 MW to 330 MW as compared to the open-cycle turbine power generation system.

4. Under this dual phase system, two combustion turbine-generators (GTG-7 & GTG-8) operate in conjunction with two Heat Recovery Steam Generators (HRSGs) and a steam turbine generator STG 9 (2:2:1 concept).

5. Combustion gases in the first cycle will power two turbine-generators (GTG-7 & GTG-8) to produce 2 x 110 MW of electricity. Hot exhaust from GTG-7 and GTG-8 is captured and routed through the two heat-recovery steam generators (HRSGs) whereby demineralised potable water is boiled to create steam.

6. Steam produced will spin an additional turbine-generator (STG-9) and produce an additional 110 MW of electricity. The steam is later channelled into a condenser where the steam returns to its liquid state for recycle. Seawater will be used to supply the necessary cooling for the condenser. Finally, the heated seawater will be discharged back to sea.

7. The project components are as follows:

i) Steam Turbine Generating Plant (STG-9)
- Unfired two-pressure heat recovery steam generators (HRSGs) boilers – including HRSG stacks, diverters, dampers and guillotines auxiliaries
- Condensing steam turbine generator set (without reheat) – including GCB and Auxiliaries

ii) Water System (including cooling water system and wastewater treatment plant)
- Cooling water system comprising seawater pump house, 2 x 50% intake pipes and 1 x 100% discharge
  - Intake chemical dosing system (seawater chlorination)
- Seawater cooled condenser complete with all accessories and auxiliaries
- Water treatment system
  - Potable water supply system including 2 x 50% storage tanks
  - Water treatment plant including 2 x 50% storage tanks
- Wastewater treatment system
  - Wastewater treatment plant
  - HRSGs Blowdown
  - Surface Water Drainage
  - Oil and Water from Transformer Compounds
  - Sewage/Sanitary Waste

iii) Mechanical and Electrical Auxiliary System
- Plant electrical distribution system – including auxiliary transformers, AC supply, DC supply and UPS systems
- 15/275 kV generator transformer, control panels, cabling and all necessary equipments to connect to the existing 275 kV switchgear

8. The design and layout of the Combined-Cycle Power Plant must be as shown in Figure 2.3 Detailed Project Layout in the EIA Report (Final Report with Addendum December 2007). Layout plan that has been approved by the Local Authority must be submitted to the Department of Environment Sarawak.

9. Any increase in processing capacity apart from that as mentioned here is not permitted without prior approval from the Director General of Environmental Quality.

10. This EIA Report approval is only valid for **two (2) years** from the date of issuance of the approval letter. Any project implementation after this two (2) years grace period must submit a new EIA Report, which needs to be approved by this Department.

CONTROL AND MONITORING OF WATER QUALITY

11. Effluent and sewage discharge must be treated to comply with **Standard B, Third Schedule, Environmental Quality (Sewage and Industrial Effluent) Regulations 1979,** before being discharged to the sea.

12. According to ASEAN Marine Water Quality Criteria, increase in water temperature at the cooling water discharge location must not exceed ±2°C above maximum ambient temperature. Continuous monitoring of temperature change at cooling water discharge point must be carried out. **Frequency of sampling must be approved by the Department of Environment Sarawak.**

13. Erosion and siltation control plan as well as drainage system for surface run-off water must be prepared **before** commencement of construction works.

CONTROL AND MONITORING OF AIR QUALITY

14. Installation of fuel combustion equipment must obtain Written Approval from the Director General of Environmental Quality in accordance to the Environmental Quality (Clean Air) Regulations, 1978.

15. Any release of gases and particulates to the air must be controlled in order to comply with the Recommended Malaysian Air Quality Guidelines (ambient standards) at 25°C. Detecting/control device to ensure that oxygen content and pressure is always below explosive level must be calibrated from time to time to ensure good function.

16. Report on emission samples to the air and ambient air quality monitoring for both construction and operation stage must be carried out every month, whereby the monitoring location and final emission standards must initially be approved by the Department of Environment Sarawak.

CONTROL AND MONITORING OF NOISE LEVEL

17. Noise from plant activity and operation must be controlled to ensure it does not exceed **74.9 dB(A) (baseline data)** at the premise boundary during daytime for day time operation (7.00 am – 10.00 pm) and **75.5 dB(A) (baseline data)** during night time (10.00 pm – 7.00 am).

18. Noise level monitoring must be carried out at the boundary of the premise during the construction and operation phase. Noise level monitoring must be carried out on monthly basis and submitted to the Department of Environment Sarawak once every three (3) months.

EMERGENCY RESPONSE PLAN

19. Emergency Response Plan (ERP) for the entire Bintulu Power Station Project must be revised by taking into consideration the control and safety aspects for the project operation and submitted to the Department of Environment Sarawak **one (1) month before the commencement of project operation.**

SCHEDULED WASTES HANDLING & CONTROL

20. All scheduled wastes produced from the construction and operation activities must be handled and disposed of according to the Environmental Quality (Scheduled Wastes) Regulations 2005. Scheduled wastes must only be disposed at disposal sites as approved by the Department of Environment Malaysia.

21. Effective solid waste management system must be implemented and the solid wastes must be disposed at disposal sites approved of by the Local Authority.

REPORTING TO DEPARTMENT OF ENVIRONMENT

22. The approved Environmental Management Plan – EMP for the entire Bintulu Power Station Project must be revised by taking into account safety and control aspects for the project operation and must be submitted to the Department of Environment Sarawak **two (2) months** before the project commences.

23. The following reports must also be submitted to the Department of Environment Sarawak:

    i) Report on compliance to approval conditions that have been set must be submitted to the Department of Environment once every three (3) months in accordance to Section 34A (7), Environmental Quality Act, 1974 using the **PPE2 form** attached;

    ii) Post-EIA Monitoring Report for condition no. 16 and 18 must follow the reporting format as attached and must be submitted to the Department of Environment **once every three (3) months** during the construction phase in accordance to Section 34A (7), Environmental Quality Act, 1974;

    iii) The abandonment plan must be prepared and submitted to the Department of Environment Sarawak **no later than six (6) months** before the completion of the Combined-Cycle Project.

24. **Environmental Audit Report** on the effectiveness of mitigating measures must be submitted to the Department of Environment Sarawak **once a year** effective from the date of project commencement and stating the progress of project development at that stage. The scope of this audit must be forwarded to the Department of Environment Sarawak for their consent before the auditing process. If the Director General of Environmental Quality is of the opinion that an independent auditor is required to determine the standard of compliance, then the cost of the audit process will be the responsibility of the project proponent.

25. The **PPE1/97** form attached with this approval conditions must be completed and submitted to the Department of Environment Sarawak within **90 days from the date of this letter.**

ADMINISTRATION

26. The project proponent must officially inform the Department of Environment Sarawak on the actual date of project commencement and the proposed date of completion **within 14 days** after project commencement. The project proponent must also notify the Department of Environment Sarawak on the actual date of project completion **not exceeding 14 days** after the project has been completed.

27. The officer-in-charge of matters related to environmental management including compliance to approval conditions of the EIA Report must be included in the organization structure. The names of the officers must be submitted to the Department of Environment Sarawak before project operation begins.

28. The project proponent must **immediately** inform the Department of Environment Sarawak if there are any changes of property ownership and management.

29. A copy of this approval conditions of this EIA report, with every copy of the documents that form part of the approval conditions and the EIA report must be displayed at a suitable location, which can be clearly seen on the project site.

(ISMAIL BIN ITHNIN)
Director,
Department of Environment Sarawak.

for Director General Environmental Quality
Malaysia.

Date: 14 January 2008

JABATAN ALAM SEKITAR
(NEGERI SARAWAK),
KEMENTERIAN SUMBER ASLI DAN ALAM SEKITAR,
TINGKAT 7, 8 DAN 9, WISMA STA,
26, JALAN DATUK ABANG ABDUL RAHIM,
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TERHAD

Ruj. Tuan:

Ruj. Kami: AS(SWK)(B) 41/010/300/001 Jld 5 (16)

Tarikh: 14 Januari 2008

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SARAWAK ENERGY BERHAD
RECEIVED
04 FEB 2008
ADMIN. DEPT

Tuan,

Laporan Penilaian Kesan Kepada Alam Sekeliling (*Environmental Impact Assessment* – EIA) Bagi Projek ` The Proposed Combined-Cycle Project STG Unit No.9, Tanjung Kidurong, Bintulu, Sarawak'

Saya merujuk kepada Laporan EIA yang dikemukakan oleh pihak tuan melalui surat bertarikh 2 November 2007 yang disediakan oleh perunding EIA, Sekitar Ceria Environmental Services Sdn. Bhd. serta maklumat tambahan yang telah yang telah diterima pada 7 Disember 2007 dan 17 Disember 2007.

2. Laporan EIA tersebut telah dikaji dan diteliti dan telah dibincangkan dalam mesyuarat Jawatankuasa mesyuarat "One Stop Agency (OSA)" yang telah diadakan pada 4 Disember 2007. Setelah mengkaji Laporan EIA dan maklumat tambahan tersebut Jabatan ini mendapati Laporan EIA yang dikemukakan menepati kehendak Seksyen 34A, Akta Kualiti Alam Sekeliling, 1974. Dengan ini, maka Laporan EIA tersebut <u>diluluskan</u> tertakluk kepada syarat-syarat dari Jabatan ini iaitu syor-syor kelulusan seperti di **Lampiran A.**

3. Jabatan ini juga ingin menarik perhatian pihak tuan kepada perkara-perkara seperti berikut:

i. Projek ini melibatkan penambahan kapasiti pengeluaran tenaga Stesen Janakuasa Bintulu. Penambahan ini adalah dengan menukarkan dua buah penjana turbin gas kitar terbuka (GTG-7 dan GTG-8) yang sedia ada kepada satu blok Loji Janakuasa Kitar Padu di Blok 20, Daerah Kemena, Tanjung Kidurong,Bintulu dengan kapasiti baru sebanyak 330 MW.

ii. Peningkatan suhu air laut di lokasi air pelepasan hendaklah tidak lebih daripada ±2°C di atas suhu ambient maksimum mengikut *ASEAN Marine Water Quality Criteria.* Pemantauan yang berterusan terhadap perubahan suhu di lokasi air pelepasan hendaklah terlebih dahulu dijalankan. Kekerapan persampelan hendaklah dipersetujui oleh Jabatan Alam Sekitar Negeri Sarawak terlebih dahulu.

4. Untuk perhatian tuan, Pelan Pengurusan Alam Sekitar (*Environmental Management Plan, EMP*) yang antara lain menekankan aspek-aspek pengurusan alam sekitar semasa kerja-kerja pembersihan tapak, kerja tanah dan pembinaan termasuk pengurusan aliran air permukaan untuk mengurangkan berlakunya kelodakan dan pencemaran kualiti air serta pengurusan sisa pepejal dan bahan buangan terjadual perlu disediakan dan dikemukakan kepada Jabatan ini sebelum kerja-kerja pembinaan dimulakan. EMP tersebut hendaklah dikemaskini dari semasa ke semasa mengikut fasa pembangunan projek.

5. Diperingatkan juga supaya perkara-perkara berikut diberi perhatian:

(i) Borang PPE1/97 yang disertakan hendaklah dilengkapkan dan dikemukakan kepada Jabatan ini dalam tempoh sembilan puluh (90) hari dari tarikh surat kelulusan ini dikeluarkan.

(ii) Laporan Pengawasan dan Laporan Pematuhan Syarat-Syarat Kelulusan menggunakan Borang PPE2 yang disertakan hendaklah dikemukakan ke Jabatan Alam Sekitar setiap tiga (3) bulan sekali sebagaimana yang dikehendaki di bawah Seksyen 34A (7), Akta Kualiti Alam Sekeliling, 1974.

6. Syarat-syarat kelulusan EIA ini hanya sah diterima pakai dalam tempoh dua (2) tahun dari tarikh surat kelulusan ini dkeluarkan. Sekiranya projek ini tidak dilaksanakan dalam tempoh tersebut, kelulusan Laporan EIA dengan sendirinya terbatal. Sukacita juga diingatkan bahawa kelulusan ini boleh ditarik balik bila-bila masa jika didapati perlanggaran mana-mana syarat kelulusan EIA dan arahan bagi memberhentikan kerja akan dikenakan serta-merta.

7. Di atas kerjasama dan sokongan pihak tuan dalam menjaga kualiti alam sekitar kita untuk pembangunan lestari amatlah dihargai.

Sekian.

"BERKHIDMAT UNTUK NEGARA"

"INTEGRITI ASAS PENINGKATAN KUALITI"

Saya yang menurut perintah,

(HAJI ISMAIL BIN ITHNIN)
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TERHAD

LAMPIRAN A
*The Proposed Combined-Cycle Project
STG Unit No.9,*
Sarawak Power Generation Sdn. Bhd

AS(SWK)(B):41/010/300/001 Jld 5 (15)

SYARAT-SYARAT KELULUSAN LAPORAN PENILAIAN KESAN KEPADA ALAM SEKELILING (EIA)

Bagi Projek

THE PROPOSED COMBINED-CYCLE PROJECT STG UNIT NO.9, TANJUNG KIDURONG, BINTULU, SARAWAK'

Untuk Dilaksanakan Oleh

**Sarawak Power Generation Sdn. Bhd
4th Floor, Wisma SESCO
Petra Jaya
93673 KUCHING**

PEMATUHAN AKTA KUALITI ALAM SEKELILING 1974

1. Semua langkah-langkah pencegahan dan kawalan yang digariskan di mukasurat C4-1 hingga C4-28, Laporan EIA bertajuk *Preliminary Environmental Impact Assessment For The Proposed Combined –Cycle Project STG Unit No.9, Tanjung Kidurong, Bintulu, Sarawak* bertarikh 2 November 2007 serta maklumat tambahan bertarikh 7 Disember 2007 dan 17 Disember 2007 telah disediakan oleh perunding Sekitar Ceria Environmental Services Sdn. Bhd. hendaklah dipatuhi dan dilaksanakan sepenuhnya. Kegagalan melaksanakan langkah-langkah kawalan yang telah digariskan adalah dipertanggungjawabkan sepenuhnya kepada Penggerak Projek.

AS(SWK)(B):41/010/300/001 Jld 5 (15)

KONSEP PROJEK

2. Kelulusan laporan EIA ini adalah untuk menambahkan kapasiti pengeluaran tenaga Stesen Janakuasa Bintulu. Penambahan ini adalah dengan menukarkan dua buah penjana turbin gas kitar terbuka (GTG-7 dan GTG-8) yang sedia ada kepada satu blok Loji Janakuasa Kitar Padu di Blok 20, Daerah Kemena, Tanjung Kidurong,Bintulu dengan kapasiti baru sebanyak 330 MW.

3. Projek ini akan mengaplikasikan teknologi kitar padu yang membolehkan fasiliti baru ini menjana elektrik sebanyak 50% dari 220 MW kepada 330 MW berbanding dengan sistem kuasa penjanaan turbin gas kitar terbuka.

4. Di bawah system dua fasa iaitu dua penjana turbin pembakaran api (GTG-7 dan GTG-8) akan beroperasi selari dengan dua unit *Heat Recovery Steam Generator (HRSGs)* dan satu penjana turbin stim STG 9 (konsep 2:2:1).

5. Pembakaran gas di dalam kitar yang terbuka akan menjana dua penjana turbin (GTG-7 dan GTG-8) bagi menghasilkan 2 x 110 MW elektrik. EKzos yang panas dari GTG-7 dan GTG-8 akan disalurkan melalui dua HRSGs di mana air dinyahmineralkan akan dididihkan untuk menghasilkan stim.

6. Stim yang terhasil akan memutarkan penjanaan turbin STG 9 dan menghasilkan lebihan elektrik sebanyak 110 MW. Stim tersebut kemudian akan disalurkan ke pemeluwapan di mana stim akan bertukar kembali kepada bentuk cecair untuk dikitar semula. Air laut akan digunakan untuk membekalkan penyejukan kepada pemeluwapan. Akhirnya, air laut akan disalurkan kembali ke laut.

7. Komponen-komponen Projek adalah seperti berikut:

   i) Loji Penjana Turbin Stim (STG-9)
      - Dua dandang tekanan tak berapi heat *recovery steam generators (HRSGs)* – termasuk cerobong *HRSG, diverters, damper*s and alat-alat bantuan *guillotines*
      - Penjana turbin pemeluwap (tanpa pemanasan semula) – termasuk GCB dan alat-alat bantuan

   ii) Sistem Air (termasuk sistem penyejukan air, sistem rawatan air dan sistem rawatan effluen)
      - Sistem penyejukan air termasuk rumah pam air laut, 2 x 50% paip masuk dan 1 x 100% paip keluar
      - sistem kemasukan dos kimia (pengklorinan air laut)

- Pemeluwap penyejuk air laut yang lengkap dengan semua aksesori dan auxiliaries
- Sistem rawatan air
- sistem pembekalan air minuman termasuk 2 x 50% tangki penyimpanan
- loji rawatan air termasuk 2 x 50% tangki penyimpan

- Sistem rawatan air effluen
- loji rawatan air effluen
- *HRSGs Blowdown*
- Saliran air permukaan
- Minyak dan air dari kawasan trasformer
- Sisa kumbahan/sanitari

iii) Sistem Bantuan Mekanikal dan Elektrik
- Sistem loji pengagihan elektrik – termasuk alat-alat bantuan untuk transformers, bekalan arus berulang, bekalan arus terus dan sistem UPS
- Transformer penjana15/275 kV, panel kawalan, kabel dan semua peralatan yang diperlukan untuk penyambungan ke *switchgear* 275kV yang sedia ada.

8. Rekabentuk dan susunatur *Combined Cycle Power Plant* hendaklah sepertimana yang digambarkan melalui *Figure 2.3 Detailed Project Layout* di dalam Laporan EIA berkenaan (*Final Report with Addendum December 2007*). Pelan susunatur yang telah mendapat kelulusan pihak Berkuasa Tempatan hendaklah dikemukakan kepada Jabatan Alam Sekitar Negeri Sarawak.

9. Sebarang peningkatan kapasiti pemprosesan selain daripada yang telah ditetapkan adalah tidak dibenarkan tanpa mendapat kelulusan Ketua Pengarah Kualiti Alam Sekeliling terlebih dahulu.

10. Tempoh sah bagi kelulusan Laporan EIA ini adalah **dua (2) tahun** sahaja dari tarikh surat kelulusan dikeluarkan. Pelaksanaan projek selepas tempoh dua (2) tahun tersebut memerlukan laporan EIA yang baru yang perlu diluluskan oleh Jabatan ini.

LAMPIRAN A
The Proposed Combined-Cycle Project
STG Unit No.9,
Sarawak Power Generation Sdn. Bhd

AS(SWK)(B):41/010/300/001 Jld 5 (15)

KAWALAN DAN PENGAWASAN KUALITI AIR

11. Pelepasan effluen dan kumbahan hendaklah diolah terlebih dahulu supaya mematuhi **Piawai B, Jadual Ketiga,, Peraturan-Peraturan Kualiti Alam Sekeliling (Kumbahan dan Effluen-Effluen Perindustrian) 1979**, sebelum dilepaskan ke laut.

12. Peningkatan suhu air laut di lokasi air pelepasan hendaklah tidak lebih daripada ±2°C di atas suhu ambient maksimum mengikut *ASEAN Marine Water Quality Criteria*. Pemantauan yang berterusan terhadap perubahan suhu di lokasi air pelepasan hendaklah terlebih dahulu dijalankan. Kekerapan persampelan hendaklah dipersetujui oleh Jabatan Alam Sekitar Negeri Sarawak terlebih dahulu.

13. Pelan dan system kawalan hakisan dan kelodakan serta sistem perparitan untuk air larian permukaan (*surface run-off*) yang bersesuaian hendaklah disediakan sebelum kerja-kerja pembinaan dijalankan.

KAWALAN DAN PENGAWASAN KUALITI UDARA

14. Pemasangan alat pembakaran bahanapi hendaklah mendapat Kelulusan Bertulis terlebih dahulu daripada Ketua Pengarah Kualiti Alam Sekeliling sepertimana yang ditetapkan Peraturan-Peraturan Kualiti Alam Sekliling(Udara Bersih), 1978.

15. Sebarang pelepasan gas dan bendasing ke udara hendaklah dikawal supaya mematuhi sekurang-kurangnya *Recommended Malaysian Air Quality Guideliness (ambient standards) at* 25 °C. Alat pengesan/ penggera untuk memastikan kandungan oksigen dan tekanan sentiasa berada di bawah paras letupan, hendaklah sentiasa dikawal selia dari masa ke semasa agar dapat berfungsi dengan baik.

16. Laporan percontohan pelepasan ke udara dan pengawasan kualiti udara ambient bagi kedua-dua peringkat pembinaan dan operasi hendaklah dijalankan setiap bulan di mana parameter, lokasi pengawasan dan takat pelepasan terakhir hendaklah dipersetujui oleh Jabatan Alam Sekitar Negeri Sarawak terlebih dahulu.

KAWALAN DAN PENGAWASAN BUNYI BISING

17. Bunyi bising dari aktiviti dan operasi loji hendaklah dikawal supaya tidak melebihi paras **74.9 dB(A) (iaitu data garis dasar)** di sempadan premis pada waktu siang semasa operasi pada waktu siang (7.00 am – 10.00 pm) dan **75.5 dB(A) (iaitu data garis dasar)** pada waktu malam (10.00 pm – 7.00 am).

18. Pengawasan paras bunyi bising hendaklah dijalankan di sempadan kawasan projek semasa fasa pembinaan dan operasi. Kekerapan pengawasan bunyi bising hendaklah dijalankan setiap bulan dan dikemukakan kepada Jabatan Alam Sekitar Negeri Sarawak setiap tiga (3) bulan.

KAWALAN KESELAMATAN DAN KECEMASAN

19. Emergency Response Plan (ERP) bagi keseluruhan Projek Stesen Janakuasa Bintulu ini perlu dikemaskini dengan mengambilkira aspek-aspek kawalan dan keselamatan bagi operasi projek ini dan dikemukakan kepada Jabatan Alam Sekitar Sarawak dalam tempoh satu (1) bulan sebelum projek ini mula beroperasi.

PENGENDALIAN BAHAN BUANGAN

20. Semua buangan terjadual yang dihasilkan dari aktiviti-aktiviti pembinaan dan operasi ini hendaklah dikendalikan dan dilupuskan mengikut Peraturan Peraturan Kualiti Alam Sekeliling (Buangan Terjadual) 2005. Semua pelupusan buangan terjadual hendaklah dilupuskan di tempat pelupusan yang telah dilesenkan oleh Jabatan Alam Sekitar Malaysia.

21. Sistem pengurusan sisa pepejal yang baik hendaklah disediakan dan sisa pepejal ini hendaklah dilupuskan di tapak pelupusan yang diluluskan oleh Pihak Berkuasa Tempatan.

LAMPIRAN A
The Proposed Combined-Cycle Project
STG Unit No.9,
Sarawak Power Generation Sdn. Bhd

AS(SWK)(B):41/010/300/001 Jld 5 (15)

PELAPORAN KEPADA JABATAN ALAM SEKITAR

22. Pelan Pengurusan Alam Sekitar (*Environmental Management Plan - EMP*) bagi keseluruhan Projek Stesen Janakuasa Bintulu ini yang telah diluluskan hendaklah dikemaskini dengan mengambilkira aspek-aspek kawalan dan keselamatan bagi operasi projek ini dan hendaklah dikemukakan ke Jabatan Alam Sekitar Negeri Sarawak, dua (2) bulan sebelum projek ini dimulakan.

23. Laporan-Laporan seperti berikut hendaklah juga dikemukakan kepada Jabatan Alam Sekitar Negeri Sarawak:

    i) Laporan pematuhan syarat-syarat kelulusan yang telah ditetapkan hendaklah dikemukakan ke Jabatan Alam Sekitar setiap tiga (3) bulan sekali seperti yang diperuntukkan di bawah Seksyen 34A (7), Akta Kualiti Alam Sekeliling, 1974 dengan mengemukakan **Borang PPE2** yang disertakan;

    ii) Laporan Pengawasan post-EIA untuk syarat no. 16 dan 18 perlu mengikut format pelaporan seperti yang dilampirkan hendaklah dikemukakan ke Jabatan Alam Sekitar setiap (3) bulan sekali semasa fasa pembinaan sebagaimana yang dikehendaki di bawah Seksyen 34A (7), Akta Kualiti Alam Sekeliling, 1974;

    iii) Pelan penutupan (abandonment plan) pelantar ini hendaklah disediakan dan dikemukakan kepada Jabatan Alam Sekitar Negeri Sarawak tidak lewat daripada enam (6) bulan sebelum pengooperasian kemudahan dihentikan.

24. **Laporan audit alam sekitar** terhadap keberkesanan langkah-langkah kawalan alam sekitar hendaklah dikemukakan ke Jabatan Alam Sekitar Negeri Sarawak setahun sekali mulai dari tarikh projek dimulakan dengan menyatakan peringkat pembangunan projek ketika itu. Bidang rujukan bagi audit ini hendaklah dikemukakan untuk persetujuan Jabatan Alam Sekitar Negeri Sarawak terlebih dahulu. Jika pada pandangan Ketua Pengarah Kualiti Alam Sekeliling audit bebas diperlukan bagi menentukan tahap pematuhan, kos audit tersebut hendaklah ditanggung oleh penggerak projek;

25. **Borang PPE1/97** yang disertakan dengan syarat kelulusan ini hendaklah dilengkapkan dan dikemukakan kepada Jabatan Alam Sekitar Negeri Sarawak dalam tempoh **90 hari dari tarikh surat kelulusan dikeluarkan.**

LAMPIRAN A
The Proposed Combined-Cycle Project
STG Unit No.9,
Sarawak Power Generation Sdn. Bhd

AS(SWK)(B):41/010/300/001 Jld 5 (15)

PENTADBIRAN

26. Pemaju hendaklah memaklumkan kepada Jabatan Alam Sekitar Negeri Sarawak secara bertulis, tarikh sebenar projek dijalankan tidak lewat daripada 14 hari selepas projek bermula, dan tarikh projek dijangka siap, termasuk tarikh sebenar projek disiapkan tidak lewat 14 hari selepas projek siap.

27. Jawatan pegawai yang bertanggungjawab ke atas hal-hal berkaitan pengurusan alam sekitar termasuk pematuhan syarat-syarat kelulusan Laporan EIA ini hendaklah diperuntukkan dalam struktur organisasi. Nama pegawai tersebut hendaklah dikemukakan ke Jabatan Alam Sekitar Sarawak sebelum projek mula beroperasi.

28. Pemaju hendaklah memaklumkan dengan segera kepada Jabatan Alam Sekitar Negeri Sarawak jika terdapat sebarang pertukaran atau pembahagian hak milik hartanah atau pengurusan projek ini.

29. Satu salinan syarat-syarat kelulusan laporan EIA ini, bersama-sama dengan setiap salinan dokumen yang menjadi sebahagian daripada syarat-syarat kelulusan dan laporan EIA hendaklah dipamerkan di suatu tempat yang sesuai dan boleh dilihat dengan jelas di tapak projek.

Sekian.

(ISMAIL BIN ITHNIN)
Pengarah,
Jabatan Alam Sekitar Negeri Sarawak.

b.p.: Ketua Pengarah Kualiti Alam Sekeliling
Malaysia.

Tarikh : 14 **Januari 2008**

Appendix 1.2.2

DOE's PEIA Approval Letter and Approval Conditions for Tg. Kidurong Combined Cycle Gas Turbine (CCGT) Block 1

COMPLIANCE

1. All the preventive and control measures stated in the Environmental Impact Assessment (EIA) Report and Additional Information Documents (hereafter will be referred as EIA Report), prepared by EIA consultant which is Chemsain Konsultant Sdn Bhd. shall be fully executed and complied:-

   1.1 Two Volume of EIA Report which were submitted through letter with reference, CK/EV103/618/0773/15 dated 16 November 2015 titled:
   (i) Volume 1 – "Environmental Impact Assessment (EIA) For The Proposed Tanjung Kidurong Combined-Cycle Power Plant, Bintulu, Sarawak and
   (ii) Volume 2 – "Environmental Impact Assessment (EIA) For The Proposed Tanjung Kiduring Combined-Cycle Power Plant, Bintulu, Sarawak (Appendices)

   1.2 Additional informations which has been submitted are as follows:-
   (i) Additional Information titled "Environmental Impact Assessment (EIA) For The Proposed Tanjung Kidurong Combined-Cycle Power Plant, Bintulu, Sarawak' which were submitted through letter with reference, CK/EV103/618/0855/15 dated 8 December 2015.

PROJECT CONCEPT

2. The EIA Report Approval is only for the construction of Gas Turbine Combined-Cycle Power Plant, Class F (GT Unit 10) and Steam Turbine (ST, Unit 11), indicated in Figure 2.2.1: Project Location, page C2-3 in the EIA Report and located at the following coordinates:-

Corner	Latitude (N)	Longitude(E)
1	03º 17' 8.05"	113º 5' 31.18"
2	03º 17' 16.95"	113º 5' 47.29"
3	03º 17' 19.24"	113º 5' 24.91"
4	03º 17' 25.08"	113º 5' 35.32"
5	03º 17' 44.19"	113º 5' 24.64"
6	03º 17' 47.20"	113º 5' 29.98"

3. Project development is limited to Gas Turbine Combined-Cycle Power Plant, Class F (GT Unit 10) and Steam Turbine (ST, Unit 11) using natural gas with a power capacity of 440 MW. The usage of Diesel as alternative fuel must be notified in writing to Department of Environment Sarawak (DOE) first.

4. The design basis and the layout plan of the proposed project shall be as specific as in Figure 2.4.1: Site Layout Plan, page C2-5 and Figure 2.4.2: Project Layout Plan page C2-6 in the EIA Report titled "Environmental Impact Assessment (EIA) For The Proposed Tanjung Kidurong Combined-

Cycle Power Plant, Bintulu, Sarawak". A copy of layout plan that has been approved by the Approving Authority shall be submitted to the Department of Environment Sarawak within two weeks, from the approval date.

5. Project components shall be as specified in Item 2.4: Project Component. Any changes or additional project components must be notified and obtain approval from the Director General of Environmental Quality.

6. Processes involved in the Combined-Cycle Power Plant shall be as specified in Figure: 2.4.3: Summary Process Flow Diagram For new CCGT Block, page C2-7 and Figure 2.4.4: Plant Process Flow Diagram, page C2-8 in the EIA Report titled "Environmental Impact Assessment (EIA) For The Proposed Tanjung Kidurong Combined-Cycle Power Plant, Bintulu, Sarawak.

7. Any construction of Industrial Effluent Treatment System must be notified in writing to Department of Environment Sarawak (DOE) using the form as stated in Second Schedule, Environmental Quality (Industrial Effluent) Regulations, 2009, P.U.(A) 434, within 30 days before the construction work commence.

8. The design, construction, specification compliances, industrial effluent discharge monitoring, handling and performance monitoring of industrial effluent treatment system must comply with Environmental Quality (Industrial Effluent) Regulations, 2009, P.U.(A) 434.

9. Any conceptual changes in process involved or upgrading of project capacity are not allowed without the approval from the Director General of Environmental Quality.

CONTROL OF DREDGING ACTIVITY AND DISPOSAL OF DREDGED/SPOIL MATERIAL

10. Silt curtain installation must be implemented prior to dredging activity which conducted at water intake and outflow area to reduce sediment dispersion impact/effect at that area.

11. Dredging activity for the construction of the water intake structure and outlet must be implemented using methods and dredging equipment that does not produce a significant impact towards the environment especially the dispersion impact by dredged/spoil material.

12. Dredging operation must be stop and mitigation measures must be implemented immediately if the Total Suspended Solids (TSS) exceed 100mg/l.

13. Dredged/Spoil material from the project site must be reused again for the purpose of trench backfilling after the completion of pipe laying works.

COASTAL CONTROL

14. *Coastal Hydraulic Study* must be approved by the Department of Irrigation and Drainage Sarawak (JPS) first before the project commencement. All the approval conditions issued by the JPS on the project implementation must be strictly adhered.

MARINE WATER CONTROL AND MONITORING

15. Any discharge of industrial effluent produced by this project including contaminated storm water, must be treated in the industrial effluent treatment system and comply with **Standard B** in **Fifth Schedule and Seventh Schedule** of the Environmental Quality (Industrial Effluent) Regulations, 2009, P.U.(A) 434. Sampling location and frequency of the monitoring must be approved by the Department of Environment Sarawak.

16. Marine water monitoring shall be carried out during the period of construction and operation of the project. Marine water quality shall be compared with "Malaysian Marine Water Quality Criteria and Standards" by Department of Environment (DOE). Marine water quality monitoring program, monitoring location and sampling frequency must be submitted to DOE Sarawak for approval before implementation.

17. The increment of sea water temperature at discharge location shall not more than ± 2ºC above maximum ambient temperature according to ASEAN Marine Water Quality Criteria. Continuous monitoring of the temperature changes at the discharge location must be conducted. Sampling frequency must first be approved by DOE Sarawak.

WATER QUALITY CONTROL AND MONITORING

18. Any runoff discharge from the project site to the outside boundaries of project site during earthwork and construction shall not contain following parameters:-

    (i) Turbidity exceeding 250 *Nephelometric Turbidity Unit* (NTU); and
    (ii) Total Suspended Solids (TSS) exceeding 50mg/L

19. Temporary toilet facilities that meet the specifications set by Ministry of Health or Department of Sewerage Services shall be provided in the workers camp throughout the construction period.

20. Domestic sewage from worker quarters or site office shall be treated to comply with the Standard B in Second Schedule (Regulation 7) of the Environmental Quality (Sewage) Regulations, 2009 P.U. (A) 432 before being discharged into inland water bodies.

21. All the components of effluent treatment system must be maintained throughout operation phase through performance monitoring procedure.

AIR QUALITY CONTROL AND MONITORING

22. Any installation of fuel burning equipment such as standby generator, Written Notification must be submitted first to DOE Sarawak as required in the Environmental Quality (Clean Air) Regulations 2014.

23. Gas and impurities emission into the air during operation phase must comply with limit values and technical standard as in **LAMPIRAN B.**

24. *Continuous Emission Monitoring Systems* (CEMs) must be installed to monitor **SOx, NOx, CO** parameters, from commencement of power plant operation throughout the operation phase, based on Volume I: Guideline for the Installation & Maintenance of Continuous Emission Monitoring Systems (CEMS) Version 6.0 of Nov 2009 and Volume II: Guideline for the Continuous Emission Monitoring Systems – Data Interface System (CEMS-DIS) Version 6.0 published by DOE. Location for CEMs installation must be approved by the DOE Sarawak. This continuous monitoring shall be linked directly (online) to DOE Sarawak.

25. Ambient air quality monitoring must be implemented during construction and operation phase for **TSP,PM10,SO2 and NO2** parameters and comply with limits stipulated in *Recommended Malaysian Air Quality Guidelines*, issued by DOE. Sampling locations and frequency must first obtain the approval from DOE Sarawak.

26. Open burning for solid waste, residual biomass and construction waste are prohibited. All the waste shall be disposed at landfill site which was approved by local authority.

NOISE CONTROL AND MONITORING

27. Noise level must be controlled not exceeding 70db (A) from 7.00 a.m. to 10.00 p.m. and 60db (A) from 10.00 p.m. to 7.00 a.m. at project area boundary, during construction and operational phase, based on "*Annex A Schedule of Permissible Sound Levels, Schedule 1: Maximum Permissible Sound Level (LAeq) by Receiving Land Use for Planning and New Development*" in guideline "*Planning Guidelines for Environmental Noise Limits and Control*" issued by DOE, 2004.

28. Noise measurement shall be carried out starting from the construction phase and throughout operation phase. Sampling frequency and location shall be referred to and approved by the DOE Sarawak.

MANAGEMENT OF RAW MATERIALS, CHEMICALS, PETROLEUM PRODUCTS AND WASTE MATERIAL

29. Handling and management of raw materials must be conducted in a goof condition.

30. Bund must be built surrounding any chemical storage tanks or petroleum tanks. The bund must be built to meet a minimum of 110% capacity of the largest tank in the bunded area. The base of the tank must be concreted and facilities to pump back any spillage in the bund must be provided.

31. All scheduled wastes as listed in the First Schedule (Regulation 2), Environmental Quality (Scheduled Wastes) Regulations, 2005 P.U. (A) 158 shall be properly managed in accordance with the rules stated in this Regulations. Scheduled wastes shall be disposed, treated or recovered in licensed premises approved by the Department of Environment.

32. Solid waste management system shall be provided and disposal to any waterways is strictly prohibited.

SECURITY AND EMERGENCY CONTROL

33. Emergency Response Plan (ERP) for ‘on-site’ and ‘off-site’ must be prepared to encounter any unforeseen accident and incident. ERP must be prepared after consulting the Fire and Rescue Department, Royal Malaysian Police, Department of Safety and Health and Local Authorities. Overall ERP to encounter any unforeseen incidents and Contingency Plan regarding closure and discontinuation of the project in an emergency situation must be submitted to DOE Sarawak and relevant involved parties within **one month** before the project start operation and updated from time to time as required.

34. Sea traffic safety control shall be ensured by installing adequate safety control devices within the project area, especially during dredging work is carried out. Any requirement and condition from related authorities such as Malaysian Marine Department must be complied.

CLOSURE AND REHABILITATION PROJECT PLAN

35. If the project could not be completed or terminated, Project Proponent or Contractors which involved in this project are responsible for the rehabilitation in term of public safety and environment (air impact, water impact, soil contamination etc,).

36. Project Proponent shall submit a notice in writing to the DOE Sarawak immediately after the project proponent decided to end/complete the project either in earthwork phase, construction or operation, which contained:-

(i) Closure/termination project's date
(ii) Commitment from Project Proponent or Responsible Party on rehabilitation of project site in term of public safety and environmental. Closure Plan shall be submitted to DOE Sarawak and fully executed before the project terminated.

37. Detailed closure plan including project site stabilization works, contaminated soil rehabilitation, equipment and machineries dismantling process, site clean-up work, environmental monitoring or any appropriate rehabilitation measures proposed shall be prepared and submitted for approval to DOE Sarawak before the project is fully terminated.

ENVIRONMENTAL MANAGEMENT PLAN (EMP)

38. Environmental Management Plan (EMP) outlining all of the actions taken in complying with the EIA Report approval conditions and the proposed mitigation measures in EIA Report shall be prepared and approved prior to construction phase and operational phase commencement. This EMP shall be prepared according to the format in **LAMPIRAN C** and submitted to DOE Sarawak for approval and shall be reviewed and updated from time to time as required.

ENVIRONMENTAL AUDIT

39. Environmental audit for the project as required under Seksyen 33A, Environmental Quality Act, 1974 shall be implemented accordance to *Environmental Audit Guidance Manual,* issued by DOE by a third party which is auditor registered with DOE as follows:-

    i. **Early phase before the earthworks and construction began.** Audit criteria shall include **documents such as EMP and other relevant approval, and installation of control measures such as silt curtain etc, shall first be** submitted for approval to DOE Sarawak;

    ii. Dredging and construction phase **once in every four (4) months or as instructed by DOE Sarawak**, starting from the date of commencement to the completion of construction. (Auditors must have CESSWI certificate – *Certified Erosion, Sediment and Storm Water Instructor* or equivalents); and

    iii. Operation phase **every once per year** throughout the operation phase.

40. All costs of environmental audit shall be borne by the Project Proponent.

REPORTING

41. The following reports shall be submitted to the Department of Environment Sarawak consisting of:

    i. Summary report of work progress for earth work and construction including photographs shall be submitted using EIA Form 1-08 as in **LAMPIRAN D,** within 90 days from the approval date of this EIA Report. This information must be submitted once in every three (3) months until the completion of the construction works
    ii. The report of EIA approval conditions compliance which shows all approval conditions have been complied with and the mitigation and control measures have been implemented as specified under Section 34A(7), Environmental Quality Act, 1974 using the EIA Form 2-08 as in **LAMPIRAN E.** This information must be submitted once in every three (3) months commencing from dredging, construction and operation phase.
    iii. Monitoring and evaluation of marine water quality, marine sediments and marine biology reports shall be submitted once in every three (3) months commencing from dredging, construction and operation phase.
    iv. Monitoring reports of air quality for emission of gas and air impurities from chimney once in every three (3) months.
    v. Monitoring and Evaluation report of ambient air quality once in every three (3) months.
    vi. Monitoring and Evaluation report of noise once in every three (3) months.
    vii. Monitoring and Evaluation report of industrial effluent quality once (1) per month.

ADMINISTRATION

42. The Project Proponent must include all the EIA report approval conditions and recommendations by EIA consultant as specified in the EIA report as part of the terms of agreement in the tender and contractual agreement to any contractor or sub-contractor who involved in the Project implementation.

43. A copy of the EIA report approval conditions report, together with any copies of documents that are part of the approval conditions shall be displayed and can be seen clearly in the management office.

44. A competent Environmental Officer (EO) who will be fully responsible on matters related to environmental management and implementation of all mitigation measures shall be elected. The name, title and contact details of the officer has to be submitted to the Department of Environment Sarawak, not later than fourteen (14) days before the earthworks and construction work

begin. Among the duties of EO is to ensure effective implementation of mitigation measures, good housekeeping and other matters related to environmental management. The responsibility of the EO are as below:-

i. <u>EARTHWORK AND CONSTRUCTION STAGES</u>

a) To supervise the erosion and sediment control work on site accordance to erosion and sediment control plan (ESCP) and environmental management plan (EMP);
b) To update daily site reports;
c) To update rainfall records;
d) To take and record Rain Gauge readings;
e) To carry out daily inspection on the pollution control measures including structures of Best Management Practices (BMPs) for erosion and sediment control (including perimeter drain, check dam, silt trap, wash trough, slope protection and others);
f) To conduct site meeting once every two (2) weeks with Project Proponent and contractors;
g) To conduct turbidity in-situ parameter measurement at the discharge point within 30 minutes after rain. If the rain continues for more than 24 hours, the measurement should be carried out once per day. (Failure to comply with these conditions should be recorded with strong and reasonable reason).

*Note: EO for erosion and sediment control must possess CESSWI certificate (*Certified Erosion, Sediment and Storm Water Instructor)* or equivalent qualifications. Equivalent qualifications should be consulted first to DOE Sarawak.

ii. <u>OPERATION STAGE</u>

To ensure all measures implemented effectively, ensuring the practice of good housekeeping and others related to environmental management

45. The project proponent shall comply with the instructions and additional conditions imposed from time to time by the Director General of Environmental Quality or his representative.

46. The Project Proponent shall notify in writing to the Department of Environment Sarawak shall there any changes or transfer of project ownership within 30 days from the changes or transfer of ownership's date. The requirement to comply with the EIA report approval conditions has to be included in the sales and purchase/ transfer of ownership agreement to the new owner.

47. Good housekeeping shall be practiced all the time within project site.

LAMPIRAN B

VALUES AND TECHNICAL STANDARD (ACCORDANCE TO ACTIVITY OR INDUSTRY)

A. HEAT AND POWER GENERATION

2. Combustion turbines

The O_2 reference content is 15%.

Fuel type	Pollutant	Capacity at ISO conditions	Limit value	Monitoring
Gaseous fuels	Sum of NO and NO_2 expressed as NO_2	> 10 MW_e	150mg/m^3	Continuous*
	Carbon monoxide (CO)	> 10 MW_e	100 mg/m^3	Continuous*
Liquid fuels	Sum of NO and NO_2 expressed as NO_2	> 10 MW_e	200 mg/m^3	Continuous*
	Carbon monoxide (CO)	> 10 MW_e	100 mg/m^3	Continuous*

*Averaging time for continuous monitoring is 30 minutes

3. Generator sets for combined heat and power production with a total thermal output ≥ 3 MW_e:

The O_2 reference content is 5%.

Fuel type	Pollutant	Capacity	Limit value	Monitoring
Liquid or gas fuels	Sum of NO and NO_2 expressed as NO_2	≥ 3 MW_e	600mg/m^3	Periodic
	Carbon monoxide (CO)	≥ 3 MW_e	650 mg/m^3	Periodic
	Total PM	≥ 3 MW_e	80 mg/m^3	Periodic

JABATAN ALAM SEKITAR
NEGERI SARAWAK
KEMENTERIAN SUMBER ASLI DAN ALAM SEKITAR,
TINGKAT 7, 8 DAN 9, WISMA STA,
26, JALAN DATUK ABANG ABDUL RAHIM,
93450 KUCHING,
SARAWAK.

Telefon : 082-482535/339535/342354
Faks : 082-480863

Ruj. Tuan:

Ruj. Kami: AS (SWK) (B):41/010/100/025 (20)

Tarikh: 18 Disember 2015

TERHAD

Pengurus Besar
Sarawak Energy Berhad
Menara Sarawak Energy
Level 3, South Wing, No 1, The Isthmus
93050 KUCHING
(u.p.: Tuan Hj. Johari Atok)

No. Faks: 082-484522

Tuan,

LAPORAN PENILAIAN KESAN KEPADA ALAM SEKELILING BAGI *"ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR THE PROPOSED TANJUNG KIDURONG COMBINED-CYCLE POWER PLANT, BINTULU, SARAWAK".*

Saya dengan hormatnya merujuk kepada perkara tersebut seperti di atas.

2. Jabatan Alam Sekitar (JAS) telah menerima Laporan EIA bertajuk *'Environmental Impact Assessment (EIA) For The Proposed Tanjung Kidurong Combined-Cycle Power Plant, Bintulu, Sarawak'* yang disediakan oleh jururunding EIA, Chemsain Konsultant Sdn. Bhd., melalui surat rujukan CK/EV103/618/0773/15 bertarikh 13 November 2015 yang diterima oleh Jabatan ini pada 16 November 2015.

3. Laporan EIA berkenaan telah dikaji dengan teliti dan dibincangkan di Mesyuarat Jawatankuasa Teknikal EIA pada 25 November 2015. Maklumat-maklumat tambahan kepada isu-isu yang telah dibangkitkan dalam mesyuarat tersebut telah diterima oleh Jabatan ini pada 8 Disember 2015 melalui surat jururunding Tuan, rujukan CK/EV103/618/0855/15 bertarikh 8 Disember 2015.

-2/...

... 4. Setelah mengkaji Laporan EIA dan Maklumat-Maklumat Tambahan yang dikemukakan, Jabatan ini mendapati bahawa Laporan EIA tersebut mematuhi Seksyen 34A(2), Akta Kualiti Alam Sekeliling 1974. Dengan itu, sukacita dimaklumkan bahawa Laporan EIA ini diluluskan dengan syarat-syarat kelulusan seperti di **LAMPIRAN A.** Selain dari syarat-syarat kelulusan seperti di LAMPIRAN A, suka diingatkan bahawa pihak Tuan hendaklah **sentiasa mematuhi peruntukan-peruntukan Akta Kualiti Alam Sekeliling, 1974 dan peraturan-peraturan di bawahnya.**

5. Sehubungan itu, Jabatan ini ingin menarik perhatian Tuan bahawa pihak Tuan juga perlu **mendapatkan kelulusan yang berkaitan daripada Kerajaan Negeri dan Jabatan-Jabatan Kerajaan lain yang berkaitan sebelum projek ini dilaksanakan.**

6. Kelulusan Laporan EIA ini hanya **sah diterima pakai dalam tempoh dua (2) tahun dari tarikh surat kelulusan ini dikeluarkan. Sekiranya projek ini tidak dilaksanakan dalam tempoh tersebut, kelulusan ke atas Laporan EIA dengan sendirinya terbatal.**

7. Kerjasama dan sokongan Tuan dalam memulihara kualiti alam sekitar ke arah pembangunan lestari amatlah dihargai.

Sekian, dimaklumkan.

"BERKHIDMAT UNTUK NEGARA"

Saya yang menurut perintah,

(HAJAH AZURI AZIZAH BINTI HJ. SAEDON)
Pengarah
Jabatan Alam Sekitar Negeri Sarawak
b.p. Ketua Pengarah Kualiti Alam Sekeliling Malaysia

<u>s.k.</u> :-

Ketua Pengarah
Jabatan Alam Sekitar Malaysia
Kementerian Sumber Asli dan Alam Sekitar
Aras 1- 4, Podium 2 & 3, Wisma Sumber Asli
No. 25, Persiaran Perdana, Presint 4
62574 W.P. PUTRAJAYA
(u.p.: Pengarah Bahagian Penilaian) **No. Faks : 03-88891045**

...3/-

Ketua Cawangan
Jabatan Alam Sekitar Cawangan Bintulu
Tingkat 2, Wisma Bintulu
No. 1, Jalan Tanjung Kidurong
97000 BINTULU **No. Faks : 086-312958**

Pengarah
Chemsain Konsultant Sdn. Bhd.
No. 47, Wisma Ko-Perkasa
Jalan SimpangTiga
93350 KUCHING
(u.p.: Ir. Brian Chong Sin Hian) **No. Faks : 082-415506**

Fail Punca

LAMPIRAN A

JABATAN ALAM SEKITAR
NEGERI SARAWAK

AKTA KUALITI ALAM SEKELILING 1974

PERINTAH KUALITI ALAM SEKELILING
(AKTIVITI YANG DITETAPKAN)
(PENILAIAN KESAN KEPADA ALAM SEKELILING) 2015

SYARAT–SYARAT KELULUSAN
LAPORAN PENILAIAN KESAN KEPADA ALAM SEKELILING
(EIA)

bagi :

ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR THE PROPOSED TANJUNG KIDURONG COMBINED-CYCLE POWER PLANT, BINTULU, SARAWAK

Untuk dilaksanakan sepenuhnya oleh :

SARAWAK ENERGY BERHAD
MENARA SARAWAK ENERGY
LEVEL 3, SOUTH WING, NO 1, THE ISTHMUS
93050 KUCHING

PEMATUHAN

1. Semua **langkah pencegahan dan kawalan** yang digariskan di dalam Laporan Penilaian Kesan Kepada Alam Sekeliling (EIA) dan Maklumat –maklumat Tambahan (yang mana selepas ini disebut sebagai Laporan EIA) yang telah disediakan oleh Jururunding EIA iaitu, Chemsain Konsultant Sdn. Bhd. **hendaklah dipatuhi sepenuhnya**:-

   1.1 Laporan EIA sebanyak dua *volume* yang telah dikemukakan melalui surat rujukan, CK/EV103/618/0773/15 bertarikh 16 November 2015 bertajuk
   (i) Volume 1 - "*Environmental Impact Assessment (EIA) For The Proposed Tanjung Kidurong Combined-Cycle Power Plant, Bintulu, Sarawak*"; dan

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(ii) Volume 2 - "*Environmental Impact Assessment (EIA) For The Proposed Tanjung Kidurong Combined-Cycle Power Plant, Bintulu, Sarawak* (Appendices)".

1.2 Maklumat-maklumat tambahan yang telah dikemukakan seperti berikut :-

(i) Maklumat Tambahan bertajuk "*Environmental Impact Assessment (EIA) For The Proposed Tanjung Kidurong Combined-Cycle Power Plant, Bintulu, Sarawak)*" yang telah dikemukakan melalui surat rujukan CK/EV103/618/0855/15 bertarikh 8 Disember 2015.

KONSEP PROJEK

2. Kelulusan laporan EIA ini **adalah hanya** bagi pembinaan Stesen Janakuasa Kitar Padu Turbin Gas Kelas F (GT Unit 10) dan Turbin Stim (ST, Unit 11) di lokasi seperti yang ditunjukkan dalam *Figure 2.2.1 : Project Location* dalam mukasurat C2-3 dalam Laporan EIA tersebut dan terletak di kedudukan koordinat – koordinat berikut:-

Sudut	Latitud (N)	Longitud(E)
1	03° 17' 8.05"	113° 5' 31.18"
2	03° 17' 16.95"	113° 5' 47.29"
3	03° 17' 19.24"	113° 5' 24.91"
4	03° 17' 25.08"	113° 5' 35.32"
5	03° 17' 44.19"	113° 5' 24.64"
6	03° 17' 47.20"	113° 5' 29.98"

3. Pembangunan projek adalah dihadkan kepada Stesen Janakuasa Kitar Padu Turbin Gas Kelas F (GT Unit 10) dan Turbin Stim (ST, Unit 11) menggunakan gas asli dengan kapasiti kuasa 440MW. Penggunaan diesel sebagai alternatif bahan bakar perlu dimaklumkan secara bertulis kepada Jabatan Alam Sekitar Negeri Sarawak terlebih dahulu.

4. Asas rekabentuk dan pelan susunatur cadangan projek hendaklah sebagaimana yang dinyatakan di dalam *Figure 2.4.1: Site Layout Plan* di mukasurat C2-5 dan *Figure 2.4.2: Project Layout Plan* di mukasurat C2-6 dalam Laporan EIA bertajuk "*Environmental Impact Assessment (EIA) For The Proposed Tanjung Kidurong Combined-Cycle Power Plant, Bintulu, Sarawak*". Sesalinan pelan susunatur yang diluluskan oleh Pihak Berkuasa yang meluluskan hendaklah dikemukakan kepada Jabatan Alam Sekitar Negeri Sarawak dalam tempoh dua (2) minggu dari tarikh ianya diluluskan.

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5. Komponen-komponen projek adalah sepertimana dinyatakan dalam Perkara 2.4: *Project Component.* Sebarang perubahan atau penambahan komponen-komponen projek hendaklah terlebih dahulu dimaklumkan dan mendapat kelulusan Ketua Pengarah Kualiti Alam Sekeliling.

6. Proses-proses yang terlibat dalam Stesen Janakuasa Kitar Padu ini adalah sebagaimana yang ditunjukkan di *Figure 2.4.3: Summary Process Flow Diagram For new CCGT Block* di mukasurat C2-7 dan *Figure 2.4.4: Plant Process Flow Diagram* di mukasurat C2-8 dalam Laporan EIA bertajuk "*Environmental Impact Assessment (EIA) For The Proposed Tanjung Kidurong Combined-Cycle Power Plant, Bintulu, Sarawak*".

7. Sebarang pembinaan sistem pengolahan efluen perindustrian hendaklah diberitahu secara bertulis kepada Jabatan Alam Sekitar Negeri Sarawak dalam bentuk sebagaimana yang dinyatakan dalam Jadual Kedua, Peraturan-Peraturan Kualiti Alam Sekeliling (Efluen Perindustrian), 2009, P.U.(A) 434, dalam masa tiga puluh (30) hari sebelum kerja pembinaan bermula.

8. Rekabentuk, pembinaan, pematuhan kepada spesifikasi, pemantauan pembuangan efluen perindustrian, pengendalian dan pemantauan prestasi sistem pengolahan efluen perindustrian hendaklah mematuhi Peraturan-Peraturan Kualiti Alam Sekeliling (Efluen Perindustrian), 2009, P.U.(A) 434.

9. Sebarang perubahan konsep kepada proses-proses yang terlibat atau peningkatan kapasiti projek adalah tidak dibenarkan tanpa kelulusan Ketua Pengarah Kualiti Alam Sekeliling terlebih dahulu.

KAWALAN AKTIVITI PENGERUKAN DAN PELUPUSAN SISA KERUKAN

10. Pemasangan *silt curtain* hendaklah dilaksanakan terlebih dahulu sebelum aktiviti pengerukan (*dredging*) dijalankan di kawasan pengambilan air dan alur keluar bagi mengurangkan kesan penyerakan sedimen ke kawasan berkenaan.

11. Aktiviti pengerukan (*dredging*) bagi pembinaan struktur pengambilan air dan alur keluar hendaklah dilaksanakan menggunakan kaedah dan peralatan pengerukan (*dredging*) yang tidak memberi impak ketara kepada alam sekitar terutamanya impak penyerakan sedimen sisa kerukan.

12. Operasi pengerukan (*dredging*) hendaklah diberhentikan dan langkah pemulihan hendaklah dilaksanakan serta-merta sekiranya Jumlah Pepejal Terampai (*Total Suspended Solids - TSS*) melebihi 100 mg/l.

LAMPIRAN A

13. Sisa pengerukan (*dredged/spoil material*) daripada tapak projek hendaklah digunakan semula bagi tujuan *trench backfilling* sebaik sahaja kerja-kerja *pipe laying* telah disiapkan.

KAWALAN PERSISIRAN PANTAI

14. *Coastal Hydraulic Study* perlu diluluskan oleh Jabatan Pengairan dan Saliran Negeri Sarawak (JPS) terlebih dahulu sebelum projek dimulakan. Semua syarat-syarat kelulusan yang dikeluarkan oleh JPS berkenaan perlaksanaan projek ini hendaklah dipatuhi sepenuhnya.

KAWALAN DAN PENGAWASAN AIR MARIN

15. Sebarang pelepasan efluen perindustrian yang terhasil dari projek ini termasuklah air ribut tercemar (*contaminated storm water*), hendaklah diolah terlebih dahulu di dalam sistem pengolahan efluen perindustrian dan hendaklah sentiasa mematuhi **Standard B** dalam **Jadual Kelima dan Jadual Ketujuh** di dalam Peraturan-Peraturan Kualiti Alam Sekeliling (Efluen Perindustrian), 2009, P.U.(A) 434. Lokasi percontohan dan frekuensi hendaklah mendapat kelulusan Jabatan Alam Sekitar Negeri Sarawak.

16. Pengawasan air marin hendaklah dijalankan di sepanjang tempoh pembinaan dan operasi projek ini. Kualiti air marin ini hendaklah dibandingkan dengan "*Malaysian Marine Water Quality Criteria and Standards*" oleh Jabatan Alam Sekitar. Program pengawasan kualiti air marin, lokasi pengawasan dan kekerapan percontohan hendaklah dikemukakan kepada Jabatan Alam Sekitar Negeri Sarawak untuk persetujuan sebelum dilaksanakan.

17. Peningkatan suhu air laut di lokasi pelepasan hendaklah tidak lebih daripada $\pm$ 2°C di atas suhu *ambient* maksimum mengikut *ASEAN Marine Water Quality Criteria.* Pemantauan yang beterusanterhadap perubahan suhu di lokasi air pelepasan hendaklah terlebih dahulu dijalankan. Kekerapan persampelan hendaklah dipersetujui oleh Jabatan Alam Sekitar Negeri Sarawak terlebih dahulu.

KAWALAN DAN PENGAWASAN KUALITI AIR

18. Sebarang pelepasan air larian permukaan dari tapak projek ke luar sempadan tapak projek semasa kerja-kerja tanah dan pembinaan hendaklah **tidak boleh mengandungi** parameter :

(i) Kekeruhan melebihi 250 *Nephelometric Turbidity Unit* (NTU); dan

(i) Jumlah pepejal terampai, *TSS* melebihi 50 mg/L.

19. Kemudahan tandas sementara yang memenuhi spesifikasi yang ditetapkan oleh Kementerian Kesihatan atau Jabatan Perkhidmatan Pembetungan hendaklah disediakan di kem pekerja di sepanjang tempoh pembinaan.

20. Kumbahan domestik dari kuarters pekerja atau pejabat hendaklah diolah terlebih dahulu dan mematuhi Standard B Jadual Kedua (Peraturan 7), di bawah Peraturan-Peraturan Kualiti Alam Sekeliling (Kumbahan) 2009, P.U.(A) 432 sebelum dilepaskan ke perairan pedalaman.

21. Semua komponen sistem pengolahan efluen hendaklah diselenggara dengan baik sepanjang tempoh operasi melalui prosedur pemantauan prestasi (*performance monitoring*).

KAWALAN DAN PENGAWASAN KUALITI UDARA

22. Sebarang pemasangan alat pembakaran bahan api seperti janakuasa tunggu sedia hendaklah mengemukakan Pemberitahuan Bertulis (Notifikasi) terlebih dahulu kepada Jabatan Alam Sekitar Negeri Sarawak seperti mana yang ditetapkan dalam Peraturan-Peraturan Kualiti Alam Sekeliling (Udara Bersih) 2014.

23. Pelepasan gas dan bendaasing ke udara semasa fasa operasi hendaklah mematuhi nilai-nilai batas dan standard teknikal seperti di **Lampiran B.**

24. Pemasangan alat *Continuous Emission Monitoring Systems (CEMs)* hendaklah dilakukan bagi pengawasan parameter-parameter SO_x, NO_x, ***CO***, bermula dari operasi kilang ini di sepanjang tempoh operasi, berpandukan kepada *Volume I: Guideline for the Installation & Maintenance of Continuous Emission Monitoring Systems (CEMS) Version 6.0 of Nov 2009* dan *Volume II: Guideline for the Continuous Emission Monitoring Systems – Data Interface System (CEMS-DIS) Version 6.0* terbitan Jabatan Alam Sekitar. Lokasi CEMs akan dipasang hendaklah mendapat kelulusan Jabatan Alam Sekitar Negeri Sarawak terlebih dahulu. Pengawasan berterusan ini hendaklah dihubungkan secara terus (*on-line*) kepada Jabatan Alam Sekitar Negeri Sarawak.

25. Pengawasan kualiti udara ambien ketika peringkat pembinaan dan operasi kilang ini hendaklah dilaksanakan bagi parameter-parameter ***TSP***, PM_{10}, SO_2 dan NO_2 serta mematuhi had-had yang ditetapkan dalam *Recommended Malaysian Air Quality Guidelines,* terbitan Jabatan Alam Sekitar. Lokasi-lokasi percontohan dan frekuensi hendaklah mendapat kelulusan terlebih dahulu daripada Jabatan Alam Sekitar Negeri Sarawak.

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26. Sebarang aktiviti pembakaran terbuka sisa pepejal, sisa *biomass* dan sisa pembinaan adalah dilarang sama sekali. Sisa-sisa ini hendaklah dilupuskan di tapak pelupusan yang diluluskan oleh Pihak Berkuasa Tempatan.

KAWALAN DAN PENGAWASAN BUNYI BISING

27. Bunyi bising hendaklah dikawal supaya tidak melebihi paras 70 dB(A) dari jam 7.00 am hingga 10:00 pm dan 60 dB(Adari jam 10.00 pm hingga 7.00 am di sempadan kawasan projek semasa peringkat pembinaan dan operasi, berpandukan kepada "*Annex A Schedule of Permissible Sound Levels, Schedule 1: Maximum Permissible Sound Level (LAeq) by Receiving Land Use for Planning and New Development*" di dalam garispanduan "*Planning Guidelines for Environmental Noise Limits and Control*" terbitan Jabatan Alam Sekitar, 2004.

28. Pengukuran bunyi bising hendaklah dijalankan bermula dari tarikh pembinaan dan operasi projek. Kekerapan dan lokasi percontohan hendaklah dirujuk dan mendapat persetujuan Jabatan Alam Sekitar Negeri Sarawak.

PENGURUSAN BAHAN MENTAH, BAHAN KIMIA, BAHAN PETROLEUM DAN BUANGAN

29. Pengendalian dan pengurusan bahan mentah hendaklah dilaksanakan dengan baik.

30. Benteng hendaklah dibina di sekeliling tangki simpanan bahan kimia dan bahan petroleum. Benteng yang dibina hendaklah berupaya menampung sekurang-kurangnya 110% kandungan tangki terbesar di dalam benteng berkenaan. Tapak tangki hendaklah diperbuat daripada konkrit dan kemudahan untuk mengepam semula bahan yang tumpah hendaklah disediakan.

31. Sebarang buangan terjadual sepertimana yang tersenarai di Jadual Pertama (Peraturan 2), Peraturan-Peraturan Kualiti Alam Sekeliling (Buangan Terjadual) 2005, P.U. (A) 158 hendaklah diurus dengan sempurna mengikut kaedah-kaedah yang ditetapkan di dalam Peraturan tersebut. Buangan-buangan terjadual hendaklah dilupuskan, diolah atau diperoleh kembali di premis yang dilesenkan oleh Jabatan Alam Sekitar.

32. Sistem pengurusan sisa pepejal yang baik hendaklah disediakan dan pelupusan ke dalam mana-mana alur air tidak dibenarkan.

KAWALAN KESELAMATAN DAN KECEMASAN

33. Pelan Tindakan Kecemasan atau *Emergency Response Plan* (ERP) bagi '*on-site*' dan '*off-site*' hendaklah disediakan bagi menghadapi sebarang kemalangan dan kejadian luar jangkaan. ERP ini hendaklah disediakan setelah membuat rundingan dengan Jabatan Bomba dan Penyelamat, Polis Diraja Malaysia, Jabatan Keselamatan dan Kesihatan Pekerjaan; dan Pihak Berkuasa Tempatan. Pelan Tindakan Kecemasan keseluruhan bagi menghadapi sebarang kejadian luar jangka dan Pelan Kontingensi berkaitan penutupan dan pemberhentian projek ini dalam keadaan kecemasan hendaklah dikemukakan kepada Jabatan Alam Sekitar Negeri Sarawak dan pihak-pihak terlibat **satu (1) bulan** sebelum projek mula beroperasi serta dikemas kini dari masa ke semasa mengikut keperluan.

34. Kawalan keselamatan trafik laut hendaklah dipastikan dengan memasang alat-alat kawalan keselamatan yang mencukupi di kawasan projek terutama semasa kerja-kerja pengerukan dijalankan. Sebarang keperluan dan syarat daripada agensi berkuasa berkaitan seperti Jabatan Laut Malaysia hendaklah sentiasa dipatuhi.

PELAN PENUTUPAN DAN PEMULIHAN PROJEK

35. Sekiranya projek ini gagal disiapkan atau projek ditamatkan, maka pemulihan dari segi keselamatan awam dan alam sekitar (impak udara, impak air, tanah tercemar dan sebagainya) adalah menjadi tanggungjawab Penggerak Projek atau kontraktor-kontraktor yang terlibat bagi projek berkenaan.

36. Penggerak projek hendaklah mengemukakan pemberitahuan secara bertulis kepada Jabatan Alam Sekitar Negeri Sarawak dengan serta merta sebaik sahaja pihak Pengurusan Penggerak Projek menetapkan untuk menamatkan projek ini samada di peringkat kerja tanah, pembinaan atau operasi, yang mengandungi:-

(i) Tarikh penutupan/penamatan projek; dan

(ii) Komitmen daripada Penggerak Projek atau pihak yang bertanggungjawab sepenuhnya ke atas pemulihan tapak projek dari segi keselamatan awam dan alam sekitar. Pelan Penutupan perlu dikemukakan kepada Jabatan Alam Sekitar Negeri Sarawak dan dilaksanakan sepenuhnya sebelum projek ditamatkan.

37. Pelan Penutupan yang terperinci termasuklah kerja-kerja penstabilan tapak projek, kerja-kerja pemulihan tanah tercemar, pembukaan peralatan-peralatan serta jentera-jentera proses, kerja-kerja pembersihan tapak, pengawasan alam sekitar atau apa-apa jua langkah pemulihan yang bersesuaian yang dicadangkan hendaklah disediakan dan dikemukakan untuk kelulusan kepada Jabatan Alam sekitar Negeri Sarawak sebelum projek tamat sepenuhnya.

PELAN PENGURUSAN ALAM SEKITAR (*ENVIRONMENTAL MANAGEMENT PLAN,* EMP)

38. "***Environmental Management Plan***" **(EMP)** yang menggariskan semua tindakan yang diambil bagi mematuhi syarat-syarat kelulusan Laporan EIA dan langkah-langkah kawalan yang dicadangkan di dalam Laporan EIA hendaklah disediakan dan **diluluskan** sebelum fasa pembinaan dan fasa operasi dijalankan. EMP ini hendaklah disediakan mengikut **format** di **LAMPIRAN C** dan dikemukakan kepada Jabatan Alam Sekitar Negeri Sarawak untuk kelulusan dan hendaklah dikaji semula dan diubahsuai dari semasa ke semasa mengikut keperluan.

AUDIT ALAM SEKELILING

39. Audit alam sekeliling terhadap projek sepertimana yang dikehendaki di bawah Seksyen 33A, Akta Kualiti Alam Sekeliling, 1974 hendaklah dilaksanakan berpandukan kepada *Environmental Audit Guidance Manual,* terbitan Jabatan Alam Sekitar oleh pihak ketiga iaitu Juru Audit yang berdaftar dengan Jabatan Alam Sekitar seperti berikut:-

i. Di **peringkat awal sebelum kerja tanah dan pembinaan bermula. Kriteria audit** hendaklah merangkumi antara lainnya **dokumen-dokumen seperti EMP dan kelulusan-kelulusan lain yang berkaitan, pemasangan langkah-langkah kawalan seperti *silt curtain*** dan sebagainya, yang perlu dikemukakan kepada Jabatan Alam Sekitar Negeri Sarawak terlebih dahulu untuk kelulusan;

ii. Di peringkat pengerukan dan pembinaan setiap empat (4) bulan sekali atau mengikut arahan Jabatan Alam Sekitar Negeri Sarawak, bermula dari tarikh mula sehingga selesai pembinaan. (Juruaudit hendaklah mempunyai sijil CESSWI -*Certified Erosion, Sediment and Storm Water Inspector* atau kelayakan yang setara); dan

iii. Di peringkat **operasi** setiap **satu (1) tahun sekali** sepanjang tempoh operasi.

40. Segala kos audit alam sekeliling hendaklah ditanggung oleh Penggerak Projek.

LAPORAN

41. Laporan-laporan berikut hendaklah dikemukakan kepada Jabatan Alam Sekitar Negeri Sarawak yang mengandungi:-

(i) Laporan ringkasan maklumat kemajuan kerja-kerja tanah dan pembinaan termasuklah laporan bergambar kemajuan kerja hendaklah dikemukakan dengan melengkapkan **BORANG EIA 1-08** seperti di **LAMPIRAN D**, dalam tempoh 90 hari dari tarikh surat kelulusan Laporan EIA ini. Maklumat ini hendaklah dikemukakan **setiap tiga (3) bulan sekali** sehingga kerja-kerja tanah dan pembinaan siap sepenuhnya.

(ii) Laporan pematuhan syarat-syarat kelulusan Laporan EIA ini yang menunjukkan bahawa semua syarat kelulusan dipatuhi dan langkah-langkah pencegahan dan kawalan dilaksanakan bagi semua aktiviti berkaitan seperti yang diperuntukkan di bawah Seksyen 34A(7), Akta Kualiti Alam Sekeliling, 1974, hendaklah dikemukakan dengan melengkapkan **BORANG EIA 2-08** seperti di **LAMPIRAN E.** Maklumat ini hendaklah dikemukakan **setiap tiga (3) bulan sekali** bermula dari peringkat kerja-kerja tanah, pembinaan dan operasi projek.

(iii) Laporan pengawasan dan penilaian kualiti air marin, sedimen marin dan biologi marin hendaklah dikemukakan **setiap tiga (3) bulan sekali** bermula dari peringkat pengerukan, pembinaan dan operasi.

(iv) Laporan pengawasan dan pemantauan kualiti udara bagi pelepasan gas dan bendasing udara dari cerobong setiap **setiap tiga (3) bulan sekali.**

(v) Laporan pengawasan dan penilaian kualiti udara ambien setiap **setiap tiga (3) bulan sekali**.

(vi) Laporan pengawasan dan penilaian bunyi bising setiap **setiap tiga (3) bulan sekali.**

(vii) Laporan pengawasan dan penilaian kualiti **efluen perindustrian setiap sebulan sekali.**

PENTADBIRAN

42. Penggerak Projek hendaklah menjadikan syarat-syarat kelulusan Laporan EIA ini dan syor-syor Jururunding EIA dalam Laporan EIA sebagai sebahagian daripada syarat perjanjian dalam tender dan perjanjian kontrak kepada mana-mana kontraktor/sub-kontraktor yang terlibat dalam pelaksanaan projek ini.

43. Satu salinan syarat kelulusan Laporan EIA ini, bersama setiap salinan dokumen yang menjadi sebahagian syarat-syarat kelulusan hendaklah dipamerkan di satu tempat yang sesuai dan boleh dilihat dengan jelas di pejabat pengurusan.

44. ***Environment Officer (EO)*** yang kompeten dan perlu bertanggungjawab sepenuhnya ke atas perkara – perkara berkaitan pengurusan alam sekitar dan pelaksanaan semua langkah kawalan hendaklah dilantik. Nama, jawatan dan maklumat perhubungan yang lengkap pegawai berkenaan hendaklah dikemukakan kepada Jabatan Alam Sekitar Negeri Sarawak tidak lewat daripada empat belas (14) hari sebelum projek ini beroperasi. Antara tugas – tugas pegawai ini adalah memastikan pelaksanaan semua langkah kawalan secara berkesan, memastikan amalan "*good housekeping*" dan sebagainya berkaitan pengurusan alam sekitar. Antara tugas ***EO*** adalah :-

(i) **<u>Di peringkat kerja tanah dan pembinaan</u>**:-

a) menyelia kerja-kerja kawalan hakisan dan sedimen di tapak seperti mana ditetapkan dalam *Erosion and Sediment Control Plan (ESCP)* dan Pengurusan Alam Sekitar projek;

b) mengemaskini Buku Harian Tapak;

c) mengemaskini Rekod Hujan;

d) mengambil dan merekod bacaan Rekod Tolok Hujan;

e) menjalankan pemeriksaan ke atas langkah-langkah kawalan pencemaran serta struktur *Best Management Practices* (BMPs) kawalan hakisan dan sedimen projek (termasuklah '*perimeter drain*', '*check dam*', '*silt trap*', '*wash trough*', '*slope protection*' dan lain-lain) setiap hari;

LAMPIRAN A

f) mengadakan mesyuarat tapak setiap dua (2) minggu bersama pemaju projek dan kontraktor; dan

g) menjalankan pengukuran in-situ parameter kekeruhan di takat pelepasan dalam tempoh tidak melebihi 30 minit selepas hujan. Sekiranya hujan berterusan melebihi 24 jam, pengukuran hendaklah dijalankan sekali setiap hari. (Kegagalan mematuhi syarat ini perlu dicatatkan dengan alasan yang kukuh dan munasabah).

**Nota: EO bagi kawalan hakisan dan sedimen ini hendaklah mempunyai sijil CESSWI (Certified Erosion Sediment and Stormwater Inspector) atau kelayakan yang setara. Kelayakan setara yang lain perlu dirujuk kepada Jabatan Alam Sekitar Negeri Sarawak terlebih dahulu.*

(ii) **Di peringkat operasi** – memastikan pelaksanaan semua langkah kawalan secara berkesan, memastikan amalan "*good housekeeping*" dan sebagainya berkaitan pengurusan alam sekitar.

45. Penggerak projek hendaklah mematuhi arahan dan syarat-syarat tambahan yang dikenakan dari semasa ke semasa oleh Ketua Pengarah Kualiti Alam Sekeliling atau wakilnya.

46. Penggerak projek hendaklah memaklumkan secara bertulis kepada Jabatan Alam Sekitar Negeri Sarawak jika terdapat sebarang pertukaran hak milik atau pengurusan projek dalam tempoh 30 hari dari tarikh pertukaran hak milik atau pengurusan. Sebarang pertukaran hak milik atau pembahagian hak milik atau pengurusan hendaklah memasukkan kehendak mematuhi syarat-syarat kelulusan laporan EIA kepada pemilik baru dalam transaksi jual-beli/pertukaran hak milik tersebut.

47. *Good house-keeping rules* hendaklah diamalkan dalam kawasan projek pada setiap masa.

Sekian

(HAJAH AZURI AZIZAH BINTI HJ. SAEDON)
Pengarah Jabatan Alam Sekitar Negeri Sarawak
b.p. Ketua Pengarah Kualiti Alam Sekeliling Malaysia

Tarikh : **18 Disember 2015**

LAMPIRAN B

NILAI DAN STANDARD TEKNIKAL (MENGIKUT AKTIVITI ATAU INDUSTRI)

A. Penjanaan Haba Dan Kuasa

1. Turbin Pembakaran :

Kandungan rujukan O_2 ialah 15%

Jenis Bahanapi	Pencemar	Kapasiti pada kedaan ISO	Nilai Batas	Pemantauan
Bahan Api	Jumlah NO dan NO_2 dinyatakan sebagai NO_2	>10MW_e	150 mg/m^3	Berterusan*
	Karbon Monoksida (CO)	>10MW_e	100 mg/m^3	Berterusan*
Bahan Cecair	Jumlah NO dan NO_2 dinyatakan sebagai NO_2	>10MW_e	200 mg/m^3	Berterusan*
	Karbon Monoksida (CO)	>10MW_e	100 mg/m^3	Berterusan*

*Purata masa bagi pemantauan secara berterusan ialah 30 minit

2. Set Penjana untuk gabungan pengeluaran haba dan kuasa dengan jumlah keluaran terma $\geq$ 3MW_e :

Kandungan rujukan O_2 ialah 5%

Jenis Bahanapi	Pencemar	Kapasiti pada kedaan ISO	Nilai Batas	Pemantauan
Bahan Api Cecair atau gas	Jumlah NO dan NO_2 dinyatakan sebagai NO_2	>3MW_e	600 mg/m^3	Berkala
	Karbon Monoksida (CO)	>3MW_e	650 mg/m^3	Berkala
	Jumlah jirim zarahan (PM_{10})	>3MW_e	80 mg/m^3	Berkala

GUIDANCE DOCUMENT FOR PREPARATION AND SUBMISSION OF ENVIRONMENTAL MANAGEMENT PLAN (EMP)

A. THE GUIDANCE DOCUMENT

1.0 INTRODUCTION TO GUIDANCE DOCUMENT

Environmental Management Plan (EMP) translates the EIA approval conditions into action. The EMP is neither a report of another study nor a document which is descriptive in character. As a contrast, the EMP document states in explicit terms what actions will be taken, what measures will be instituted, what structures will be built, what will be installed, when the actions will be executed; etc. in order for the project activities to be compliant with the EIA approval conditions. The EMP is a concrete plan of action which is explicit, illustrative, action-oriented, time-bound and definitive. Even though the EMP exhibits all of the above characteristics, the EMP is by nature, a living document which needs to be revised and updated when there exists certain circumstances which demand changes to be made. These factors may include changes to project details and surrounding areas and inadequacy of the control measures to comply with regulatory standards.

2.0 OBJECTIVE OF GUIDANCE DOCUMENT

The objective of the Guidance Document is to:

Provide general guidance to consultants in the preparation of EMPs to be submitted to the DOE for approval. Pertinent aspects to be incorporated in the document are stipulated to ensure that the EIA approval conditions are translated into actionable items.

3.0 HOW TO GET STARTED

Firstly the project proponent and the consultant who has been tasked to prepare the EMP should study and understand each of the EIA approval conditions.

Secondly, for each of the approval conditions, whether they are administrative or physical in nature, identify actions required to be executed in order to comply with them.

Thirdly, compute an estimated cost to be incurred for each of the executable actions.

Fourthly, the project proponent needs to be thoroughly briefed on the executable actions to be undertaken and the cost implication. Later, the proponent also needs to make a declaration that all the actions stipulated in the EMP will be implemented (see paragraph C 1.0).

The logical steps to be followed in the EMP preparation as outlined above are depicted in Figure 1.

Step:		Action by:
1	Study EIA approval conditions	EMP preparer
2	Translate conditions into executable actions	EMP preparer
3	Prepare cost estimate	EMP preparer
4	Make declaration	Project proponent

Figure 1: Typical steps in EMP Preparation

B. THE ENVIRONMENTAL MANAGEMENT PLAN (EMP)

The EMP shall at a minimum, contain the following chapters: chapter 1 to chapter 5. However, the depth of treatment and details discussed in chapter 5 shall be tailored to suit the individual project and the EIA approval conditions.

1.0 INTRODUCTION

a. Project layout as approved in the Development Order by Local Authority.
b. Project implementation schedule.
c. Name of the EMP preparer and his consulting firm.

2.0 POLICY

a. Company's corporate policy statement on environmental management and protection.

3.0 ORGANIZATIONAL STRUCTURE

a. Organization chart of the company's top management with responsibilities on environmental management and protection (provide names, positions, mobile phone contact numbers and e-mail addresses).

b. Name, mobile phone contact number and e-mail address of environmental manager, engineering consultant, contractor, site supervisor and industrial effluent treatment system (IETS)/air pollution control (APC) competent person (wherever relevant and available).

c. Name of environmental consultant and accredited laboratory conducting environmental monitoring, analysis of environmental samples and submitting reports to DOE.

4.0 TRAINING REQUIREMENT

a. Plan for staff training in order to develop competency to discharge responsibilities on environmental requirements and compliance.

5.0 ENVIRONMENTAL REQUIREMENTS

a. EIA Approval Conditions.

b. Table of "Mitigating Measures to be Implemented" as in the **Appendix I**.

5.1 IMPLEMENTATION OF EROSION AND SEDIMENTCONTROL

a. Name and contact (mobile phone number, e-mail address) of professional who is CPESC certified,* preparing the ESCP that would comply with the Guidance Document on ESCP preparation issued by the DOE.

b. Schedule of project phasing and submission of ESCP.

Schedule of project phasing, ESCP preparation and submission and pre construction meeting to be attended by project proponent/management, ESCP design engineer, contractor and DOE officer.

(*Note: As an interim measure, an equivalent certification may be accepted. The non-CPESC certified professional must submit certified evidence to the DOE and obtain DOE's consent before undertaking any assignment on ESCP preparation).

c. **Method Statement**
Method statement and layout plan to be implemented for the major ctivitiesof the project that may cause erosion and sedimentation.

5.2 WATER POLLUTION CONTROL

a. Ambient monitoring
Detailed environmental monitoring program inclusive of map indicating location, longitude, latitude, frequency, parameters, equipment, personnel and schedule.

b. Effluent treatment
Proposed treatment technology; schedule for submission of Notification for new source of effluent discharge, design of IETS, recruitment of competent person and purchase of relevant equipment.

c. Temporary sullage and sewage treatment
Detailed proposal for management and treatment of sullage and provision of temporary sewage facilities for workers.

d. Permanent sullage and sewage treatment
Proposed treatment technology; schedule for submission of Notification for new source of sewage discharge, design of sewage treatment system (STS), recruitment of competent person and purchase of relevant equipment.

5.3 CONTROL OF AIR POLLUTION AND NOISE

a. Ambient monitoring
Detailed environmental monitoring program inclusive of map indicating location, longitude latitude, frequency, parameters, equipment, personnel and schedule.

b. Air pollution control
Proposed control technology; list of equipment requiring approval from DOE; schedule for submission of application for air pollution control system (APCS) Written Approvals, recruitment of competent person and purchase of relevant equipment.

5.4 MATERIALS AND WASTE MANAGEMENT

a. Raw materials and stockpiles.
Detailed proposal for management of raw materials, including chemicals, fuels, etc., and stockpiles.

b. Solid waste.
Detailed proposal for management of solid waste during earthwork and construction phase.

c. Scheduled waste.
Detailed proposal for management of scheduled waste to comply with Environmental Quality (Scheduled Waste) Regulations 2005.

d. Biomass.
Detailed proposal for management of biomass during land clearing and construction phase.

e. Spoils/dredge materials/construction waste.
Detailed proposal for management of spoils/ dredge materials/ construction waste during earthwork and construction phase.

f. Open burning.
Measures to prevent occurrence of open burning.

g. Housekeeping.
Proposal for implementing best practices in general housekeeping including housekeeping of the vehicles and machinery maintenance area.

5.5 EMERGENCY RESPONSE PLAN (ERP)

Name and contact (mobile phone number, e-mail address) of professional who will prepare the ERP and the schedule for its preparation and submission to the DOE.

C. DECLARATION AND CHECKLIST

1.0 DECLARATION

The project proponent is required to make a declaration that all the actions/measures/plans outlined in the EMP will be implemented by using the format in Appendix II.

2.0 CHECKLIST

To assist the consultant who has been assigned to prepare the EMP and submit it to the DOE, a checklist/form (Appendix III) has been prepared. The form is required to be filled out and submitted to the DOE together with the EMP document.

Department of Environment (Headquarters)
Putrajaya
December 28, 2010

LAMPIRAN C

Appendix I

ENVIRONMENTAL MANAGEMENT PLAN
MITIGATION MEASURES TO BE IMPLEMENTED

Table: Mitigation Measures to be Implemented

Project activities and environmental issues concerned	**Impacts**	**Mitigation measures recommended in EIA**	**Mitigation measures to be implemented**
*	*	*	

- Note: The contents of the above Table are to be derived from Table I: "Summary of Impacts and Mitigation Measures" presented in the EIA report and additional requirements stipulated in the EIA approval conditions.

Appendix II

ENVIRONMENTAL MANAGEMENT PLAN
DECLARATION BY PROJECT PROPONET/AUTHORIZED PERSON

I certify that the Environmental Management Plan has been prepared with my knowledge and I shall undertake the responsibility to ensure the actions/ measures/plans stated in the EMP will be implemented.

PROJECT TITLE: ....
....
....

PROJECT ADDRESS/LOCATION: ....
....
....

....
Name of project proponent/authorized person

Signature: (..............................)

Date: ....

LAMPIRAN C

Appendix III

ENVIRONMENTAL MANAGEMENT PLAN

EIA APPROVAL CONDITIONS COMPLIANCE CHECKLIST

PROJECT TITLE: ______________________________

NAME OF PROJECT PROPONENT: ______________________________

____

NAME OF CONSULTANT: ______________________________

EIA APPROVAL CONDITIONS COMPLIANCE CHECKLIST

EIA APPROVAL CONDITION, NUMBER....	ACTIONABLE ITEM IN EMP ON PAGE.....	NOTES

Name of project proponent/authorized person

....

Signature: (..............................)

Date: ....

LAMPIRAN D

BORANG EIA 1-08 **NO RUJUKAN SYARAT KELULUSAN:**

MAKLUMAT KEMAJUAN KERJA BAGI PROJEK-PROJEK YANG TERTAKLUK KEPADA EIA

Kepada : Tarikh:
Pengarah
Jabatan Alam Sekitar Negeri ____________________

Tuan,

Saya adalah dengan hormatnya merujuk kepada perkara yang tersebut di atas dan sukacita bersama ini dikembalikan maklumat kemajuan kerja bagi projek-projek yang tertakluk kepada EIA yang diminta untuk perhatian tuan selanjutnya:

1. Nama Projek :____________________

2. Alamat Tapak Projek :____________________

3. Nama & Alamat Pemaju :____________________
No. Telefon :____________________ No. Faks: ____________________

4. Pertukaran hakmilik pengurusan: Ya ☐ Tidak ☐

Jika ya, nyatakan butir-butir pemaju yang baru:

Alamat :____________________
No. Telefon:____________________ No. Faks: ____________________

5. Pelan Pengurusan Alam Sekitar (EMP) : Tarikh Kelululusan JAS:____________ rujukan ____________

6. Pelan Susunatur : ☐ Diluluskan oleh Pihak Berkuasa Tempatan.
Tarikh Kelulusan: ____________, Nombor Pelan: ____________________

☐ Tiada/Belum diluluskan oleh Pihak Berkuasa Tempatan.

7. Pelan Kerja Tanah : ☐ Diluluskan oleh Pihak Berkuasa Tempatan
Tarikh Kelulusan: ____________, Nombor Pelan: ____________________

☐ Tiada/Belum diluluskan oleh Pihak Berkuasa Tempatan

8. Pelan Kawalan Hakisan dan Kelodakan (ESCP) : ☐ Diluluskan oleh Jabatan Pengairan dan Saliran
Tarikh Kelulusan ____________, Nombor Pelan: ____________________

☐ Tiada/Belum diluluskan oleh Jabatan Pengairan dan Saliran.

9. Status Kemajuan Kerja Projek*:

Status	%Siap	Tarikh Mula	Tarikh Dijangka Siap
☐ Belum dimulakan			
☐ Pra-Pembinaan			
☐ Pembinaan			
☐ Operasi/siap			
☐ Tangguh/Terbengkalai			

10. Nyatakan peringkat fasa projek (jika berkenaan): ____________________

11. Sertakan gambarfoto-gambarfoto yang menunjukkan status kemajuan projek

PENGESAHAN : **Segala maklumat-maklumat yang dinyatakan di atas adalah benar:**
Tandatangan :

Nama Pegawai : Cop Rasmi:

Jawatan : :

☐ Tandakan '_/' pada tempat yang berkenaan

BORANG EIA 2-08
JADUAL PEMATUHAN SYARAT-SYARAT KELULUSAN EIA

Nama Projek :

Pemaju :

No. Fail JAS :

Tarikh Laporan EIA Diluluskan :

Jururunding Laporan EIA :

Tarikh Kelulusan EMP :

Jururunding Pengawasan Post EIA :

No. Syor (A)	[1]Syarat-syarat Kelulusan EIA (Nyatakan Dengan Lengkap) (B)	[2]Ulasan Pemaju (C)	Ulasan JAS (Kosongkan) (D)

No. Syor (A)	[1]Syarat-syarat Kelulusan EIA (Nyatakan Dengan Lengkap) (B)	[2]Ulasan Pemaju (C)	Ulasan JAS (Kosongkan) (D)

[1] *Sila nyatakan bilangan muka surat pada setiap helaian jadual.*

[2] *Ulasan pemaju hendaklah merangkumi perkara-perkara berikut:-*

- *(i)* *Ringkasan mengenai langkah kawalan yang dicadangkan di dalam laporan EIA;*
- *(ii)* *Langkah kawalan sebenar yang diambil di peringkat pelaksanaan projek. Justifikasi ke atas sebarang pindaan yang dibuat kepada cadangan asal di dalam laporan EIA dari sudut keberkesanan langkah kawalan;*
- *(iii)* *Gambar /bukti-bukti sokongan hendaklah juga dilampirkan; dan*
- *(iv)* *Perunding dan pemaju diminta membuat perbandingan ke atas ramalan impak/kesan ke atas Alam Sekitar yang dibuat di dalam laporan EIA dengan kesan sebenar pelaksanaan projek ke atas alam sekitar.*

Dengan ini saya mengaku dan mengesahkan semua kenyataan dan butir-butir yang dikemukakan di atas adalah benar.

Tanda Tangan :

Nama :

Jawatan :

Cop Rasmi :

Tarikh

Kepada : .... *(nama pelanggan)*

Jabatan Alam Sekitar memohon kerjasama daripada pihak tuan/puan untuk memberi maklumbalas mengenai perkhidmatan yang telah diberikan kepada tuan/puan. Maklumat ini akan digunakan untuk penambahbaikan perkhidmatan kami. Sila gunakan borang yang dikepilkan dan fakskan kepada Jabatan ini. Borang ini juga boleh dimuat turun dari laman web www.doe.gov.my dan kembalikan melalui email kepada shirley@doe.gov.my

Kerjasama pihak tuan/puan amatlah dihargai dan diucapkan ribuan terima kasih.

Sekian.

JABATAN ALAM SEKITAR, MALAYSIA

BORANG MAKLUMBALAS PELANGGAN

Ketua Pengarah (Ibu Pejabat)/ Pengarah JAS Negeri
Jabatan Alam Sekitar
(*alamat JAS berkenaan*) ....
....
(u/p: Pengarah Bahagian Penilaian (Ibu Pejabat) /Pengarah JAS Negeri)
Tel : ....
Faks : ....

Perkhidmatan yang telah diberikan kepada kami adalah dari Bahagian: Udara/Air&Marin/Bahan Berbahaya/Penguatkuasaan/Komunikasi Strategik/Penilaian/Pentadbiran & Kewangan/Teknologi Maklumat atau Jabatan Alam Sekitar Negeri/ Cawangan...*.

Jenis perkhidmatan/urusan yang telah diberikan adalah seperti berikut:-
Permohonan KB/ Lesen/ EIA/ .... ☐
Khidmat nasihat berkenaan .... ☐
Lain-lain (nyatakan) .... ☐

Soalan	Penilaian**				Ulasan / Cadangan Penambahbaikan ***
Adakah perkhidmatan yang telah diberikan mencapai matlamat yang dikehendaki oleh pihak tuan/puan?	Ya tercapai ☐	Sebahagian-nya tercapai ☐	Tidak tercapai ☐	Tidak pasti ☐	....
Adakah tuan/puan berpuas hati dengan tempoh masa yang diambil untuk menyampaikan perkhidmat-an ini?	Sangat memuaskan ☐	Memuaskan ☐	Kurang memuaskan ☐	Tidak memuaskan ☐	....
Adakah tuan/puan berpuas hati dengan perkhidmatan yang diberikan oleh pegawai semasa beliau mengendalikan perkhidmat-an ini?	Sangat memuaskan ☐	Memuaskan ☐	Kurang memuaskan ☐	Tidak memuaskan ☐	....

Yang benar,

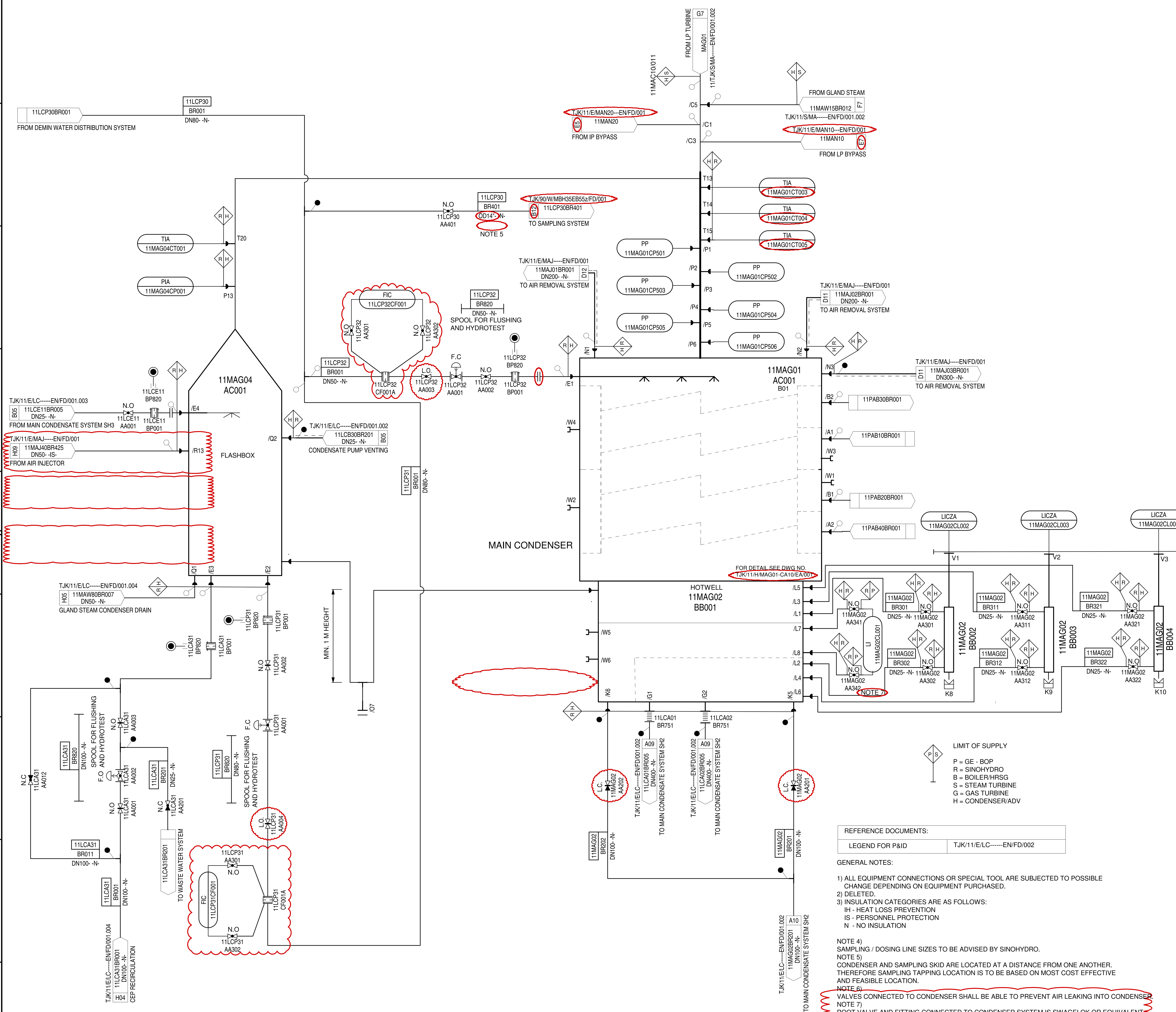
....

(...) (*Nama pelanggan*)

* Potong mana yang tidak berkenaan
** Tandakan (√) di mana bersesuaian.
*** Sekiranya perlu, lampiran boleh disertakan.

Appendix 3.3.1

Piping and Instrumentation Diagram (P&ID) for the Main Condensate System



LIMIT OF SUPPLY

P = GE - BOP
R = SINOHYDRO
B = BOILER/HRSG
S = STEAM TURBINE
G = GAS TURBINE
H = CONDENSER/ADV

REFERENCE DOCUMENTS:	
LEGEND FOR P&ID	TJK/11/E/LC------EN/FD/002

GENERAL NOTES:

1) ALL EQUIPMENT CONNECTIONS OR SPECIAL TOOL ARE SUBJECTED TO POSSIBLE CHANGE DEPENDING ON EQUIPMENT PURCHASED.
2) DELETED.
3) INSULATION CATEGORIES ARE AS FOLLOWS:
   IH - HEAT LOSS PREVENTION
   IS - PERSONNEL PROTECTION
   N - NO INSULATION

NOTE 4)
SAMPLING / DOSING LINE SIZES TO BE ADVISED BY SINOHYDRO.
NOTE 5)
CONDENSER AND SAMPLING SKID ARE LOCATED AT A DISTANCE FROM ONE ANOTHER. THEREFORE SAMPLING TAPPING LOCATION IS TO BE BASED ON MOST COST EFFECTIVE AND FEASIBLE LOCATION.
NOTE 6)
VALVES CONNECTED TO CONDENSER SHALL BE ABLE TO PREVENT AIR LEAKING INTO CONDENSER.
NOTE 7)
ROOT VALVE AND FITTING CONNECTED TO CONDENSER SYSTEM IS SWAGELOK OR EQUIVALENT QUALITY TO PREVENT AIR LEAKING TO THE CONDENSER AND LEVEL TRANSMITTER.

Revision History

Rev.	Revision Date	Created by	Checked by	Approved by	Description
C	08 Jun 2017	S.MURTHI	J. Tan	A. Abdullah	Second Issue
B	19 Apr 2017	S.MURTHI	T. ONG	L. TAN	Revision
A	27 Jan 2017	S.MURTHI	L. TAN	L. TAN	First Issue

D	Description Latest Revision : Revision

Project:

Bintulu Tanjung Kidurong Combined - Cycle Power Plant Project

DOCUMENT REVIEW STATUS

☐	STATUS 1:	WORK MAY PROCEED.
☐	STATUS 2:	REVISE AND RESUBMIT. WORK MAY PROCEED SUBJECTED TO INCORPORATION OF COMMENT INDICATED.
☐	STATUS 3:	REVISE AND RESUBMIT. WORK MAY NOT PROCEED.
☐	STATUS 4:	REVIEW NOT REQUIRED. WORK MAY PROCEED.
☐	STATUS 5:	REJECTED AND RESUBMIT. WORK MAY NOT PROCEED.

PERMISSION TO PROCEED SHALL NOT CONSTITUTE ACCEPTANCE OR APPROVAL OF DESIGN DETAILS, CALCULATION, ANALYSIS, TEST METHOD, OR MATERIALS DEVELOPED OR SELECTED BY CONTRACTOR AND SHALL NOT RELIEVE CONTRACTOR FROM FULL COMPLIANCE WITH CONTRACT TECHNICAL SPECIFICATIONS AND DRAWINGS.

SEB ____________ DATE ____________

GE/Subcontractor SINOHYDRO

Owner sarawak energy

SEB Document Numbering:	SBP160002-GE-M-S05-04-PD-504	Revision	V 0.4

Cross checked

Department	Name	Date	Signature

Main Contractor

Replaces		Scale	Document Code TJK/11/E/LC------EN/FD/001
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Originator: GE POWER

Document Type: Piping and instrument diagram

Document Status: Released

Document Title: P&ID Main Condensate System

Identification Number: TJK/11/E/LC------EN/FD/001

Rev.	Date	Lang.	Sheet
D	26-Dec-2017	EN	1 / 4

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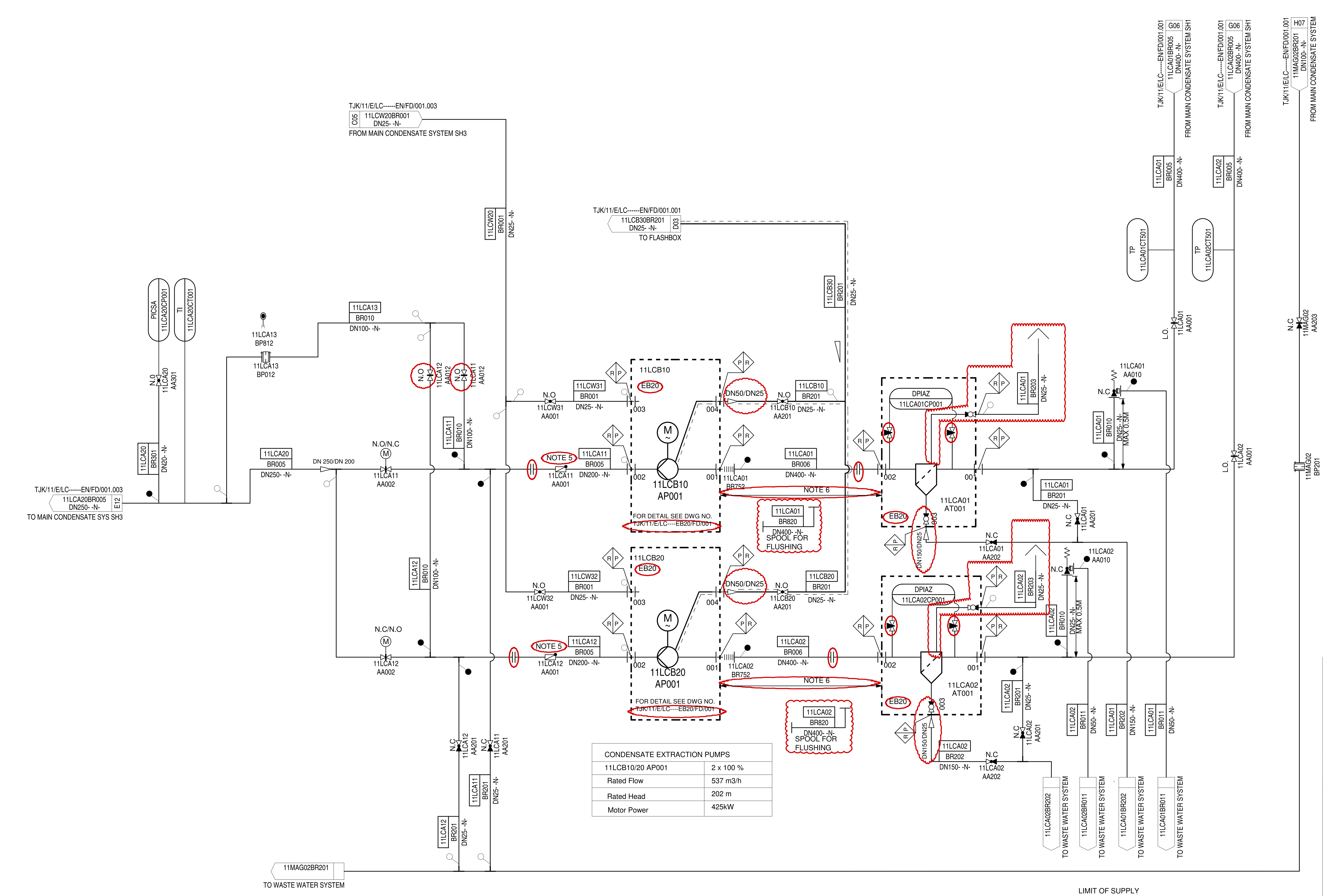

CONDENSATE EXTRACTION PUMPS	
11LCB10/20 AP001	2 x 100 %
Rated Flow	537 m3/h
Rated Head	202 m
Motor Power	425kW

LIMIT OF SUPPLY

P = GE - BOP
R = SINOHYDRO
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IH - HEAT LOSS PREVENTION
IS - PERSONNEL PROTECTION
N - NO INSULATION

NOTE 4)
VALVES CONNECTED TO CONDENSER SHALL BE ABLE TO PREVENT AIR LEAKING INTO CONDENSER.
NOTE 5)
NON-SLAMMING CHECK VALVE.
NOTE 6)
MIN. RECOMMENDED DISTANCE : 2 X D (32")

Revision History

Rev.	Revision Date	Created by	Checked by	Approved by	Description
C	08 Jun 2017	S.MURTHI	J. Tan	A. Abdullah	Second Issue
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SEB ____ DATE ____

GE/Subcontractor | Owner

SINOHYDRO | sarawak energy

SEB Document Numbering:	SBP160002-GE-M-S05-04-PD-504	Revision	V 0.4

Cross checked

Department	Name	Date	Signature

Main Contractor

Replaces		Scale	Document Code TJK/11/E/LC------EN/FD/001
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Originator	Document Type: Piping and instrument diagram		Document Status: Released
GE POWER	Document Title: P&ID Main Condensate System		Identification Number: TJK/11/E/LC------EN/FD/001
			Rev. D / Date 26-Dec-2017 / Lang. EN / Sheet 2 / 4

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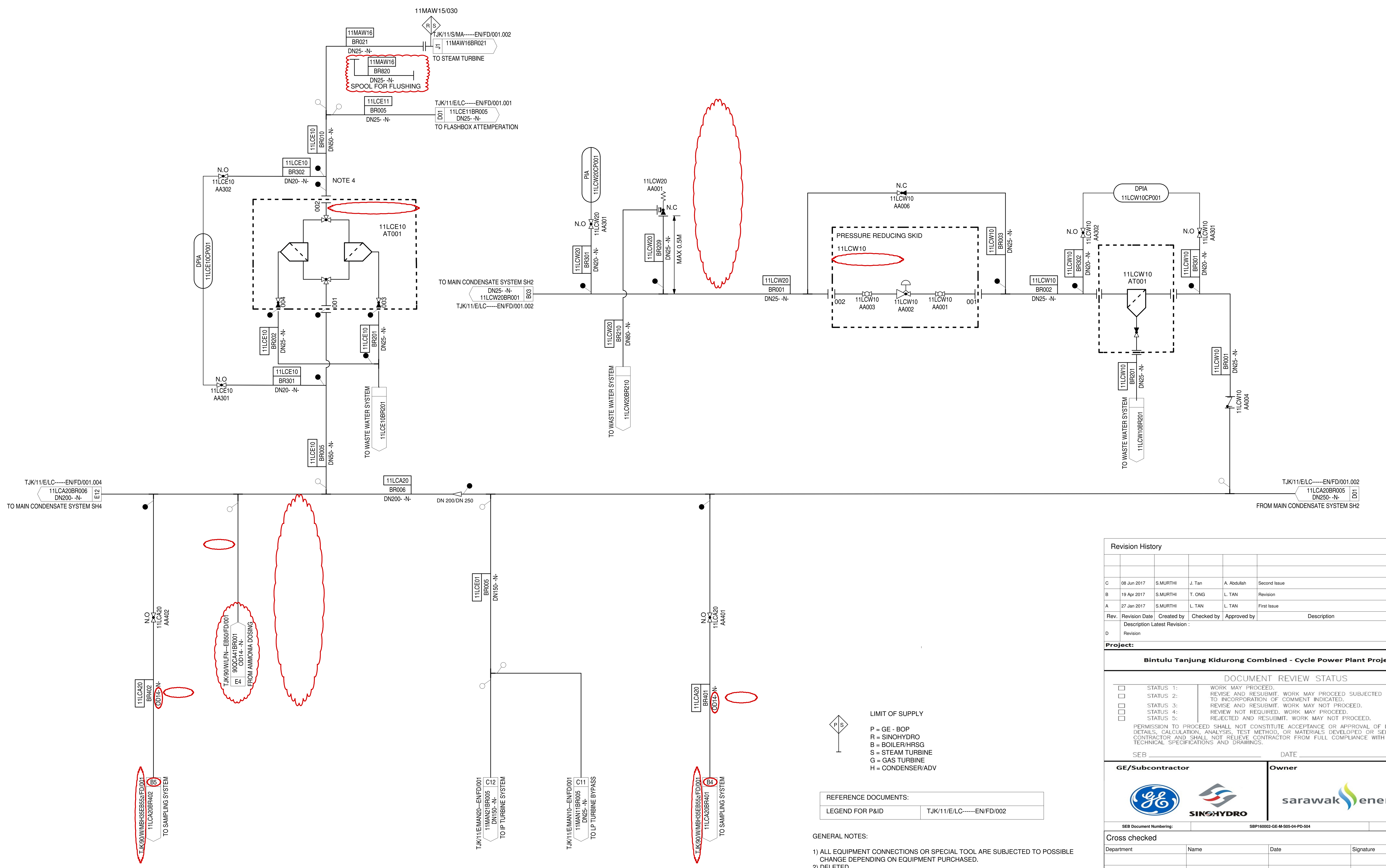

LIMIT OF SUPPLY

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2) DELETED.
3) INSULATION CATEGORIES ARE AS FOLLOWS:
IH - HEAT LOSS PREVENTION
IS - PERSONNEL PROTECTION
N - NO INSULATION

NOTE 4)
PIPING DOWNSTREAM OF DUPLEX FILTER SHALL BE STAINLESS STEEL.

Revision History

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STATUS 4: REVIEW NOT REQUIRED. WORK MAY PROCEED.
STATUS 5: REJECTED AND RESUBMIT. WORK MAY NOT PROCEED.

PERMISSION TO PROCEED DOES NOT CONSTITUTE ACCEPTANCE OR APPROVAL OF DESIGN DETAILS, CALCULATION, ANALYSIS, TEST METHOD, OR MATERIALS DEVELOPED OR SELECTED BY CONTRACTOR AND SHALL NOT RELIEVE CONTRACTOR FROM FULL COMPLIANCE WITH CONTRACT TECHNICAL SPECIFICATIONS AND DRAWINGS.

SEB ____ DATE ____

GE/Subcontractor — SINOHYDRO

Owner — sarawak energy

SEB Document Numbering: SBP160002-GE-M-S05-04-PD-504 Revision V 0.4

Cross checked

Department	Name	Date	Signature

Main Contractor

Replaces		Scale	Document Code TJK/11/E/LC------EN/FD/001
Responsible Dept. GSAEM	Created by 22 Dec 2017 S.MURTHI	Checked by A. Abdullah	Approved by A. Abdullah — Format A1

Originator — GE POWER

Document Type: Piping and instrument diagram
Document Status: Released
Document Title: P&ID Main Condensate System
Identification Number: TJK/11/E/LC------EN/FD/001

Rev.	Date	Lang.	Sheet
D	26-Dec-2017	EN	3 / 4

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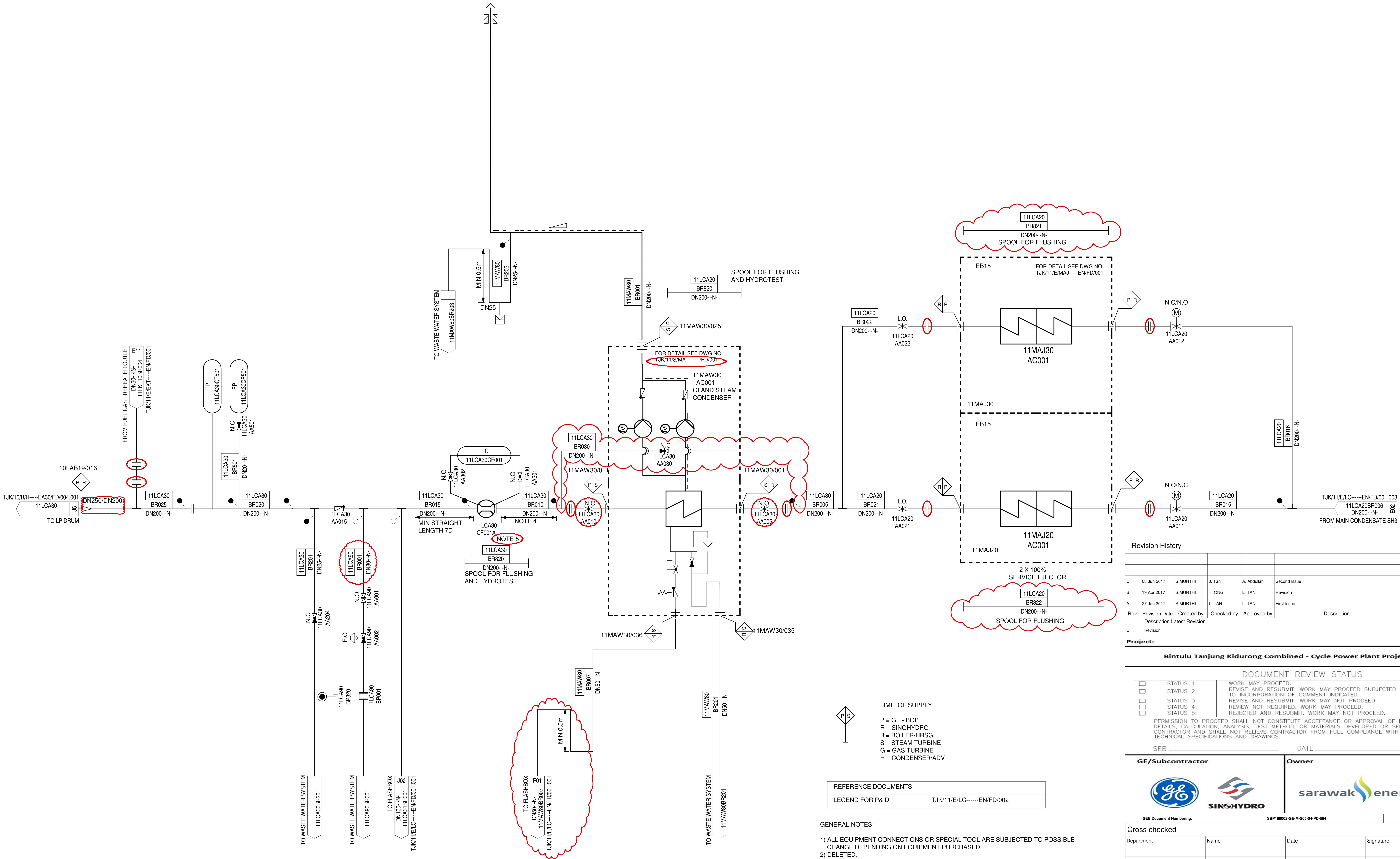

LIMIT OF SUPPLY

P = GE - BOP
R = SINOHYDRO
B = BOILER/HRSG
S = STEAM TURBINE
G = GAS TURBINE
H = CONDENSER/ADV

REFERENCE DOCUMENTS:	
LEGEND FOR P&ID	TJK/11/E/LC------EN/FD/002

GENERAL NOTES:

1) ALL EQUIPMENT CONNECTIONS OR SPECIAL TOOL ARE SUBJECTED TO POSSIBLE CHANGE DEPENDING ON EQUIPMENT PURCHASED.
2) DELETED.
3) INSULATION CATEGORIES ARE AS FOLLOWS:
   IH - HEAT LOSS PREVENTION
   IS - PERSONNEL PROTECTION
   N - NO INSULATION

NOTE 4

MIN STRAIGHT LENGTH 65D - TWO 90°C BENDS IN PERPENDICULAR PLANES (S<5D)
MIN STRAIGHT LENGTH 44D - TWO 90°C BENDS IN PERPENDICULAR PLANES (5D<S<35D)
MIN STRAIGHT LENGTH 42D - TWO 90°C BENDS IN PERPENDICULAR PLANES (10D<S<35D)
S - SEPARATION DISTANCE BETWEEN TWO BENDS

NOTE 5)
FLOW TRASMITTER SHALL HAVE 5-WAY MANIFOLD

Revision History

Rev.	Revision Date	Created by	Checked by	Approved by	Description
C	08 Jun 2017	S.MURTHI	J. Tan	A. Abdullah	Second Issue
B	19 Apr 2017	S.MURTHI	T. ONG	L. TAN	Revision
A	27 Jan 2017	S.MURTHI	L. TAN	L. TAN	First Issue

Description Latest Revision :
D Revision

Project:

Bintulu Tanjung Kidurong Combined - Cycle Power Plant Project

DOCUMENT REVIEW STATUS

- ☐ STATUS 1: WORK MAY PROCEED.
- ☐ STATUS 2: REVISE AND RESUBMIT. WORK MAY PROCEED SUBJECTED TO INCORPORATION OF COMMENT INDICATED.
- ☐ STATUS 3: REVISE AND RESUBMIT. WORK MAY NOT PROCEED.
- ☐ STATUS 4: REVIEW NOT REQUIRED. WORK MAY PROCEED.
- ☐ STATUS 5: REJECTED AND RESUBMIT. WORK MAY NOT PROCEED.

PERMISSION TO PROCEED SHALL NOT CONSTITUTE ACCEPTANCE OR APPROVAL OF DESIGN DETAILS, CALCULATION, ANALYSIS, TEST METHOD, OR MATERIALS DEVELOPED OR SELECTED BY CONTRACTOR AND SHALL NOT RELIEVE CONTRACTOR FROM FULL COMPLIANCE WITH CONTRACT TECHNICAL SPECIFICATIONS AND DRAWINGS.

SEB ____________ DATE ____________

GE/Subcontractor | **Owner**

SINOHYDRO | sarawak energy

SEB Document Numbering:	SBP160002-GE-M-S05-04-PD-504	Revision	V 0.4

Cross checked

Department	Name	Date	Signature

Main Contractor

Replaces		Scale	Document Code TJK/11/E/LC------EN/FD/001	
Responsible Dept. GSAEM	Created by 22 Dec 2017 S.MURTHI	Checked by A. Abdullah	Approved by A. Abdullah	Format A1

Originator

GE POWER

Document Type	Document Status
Piping and instrument diagram	Released
Document Title	Identification Number
P&ID Main Condensate System	TJK/11/E/LC------EN/FD/001

Rev.	Date	Lang.	Sheet
D	26-Dec-2017	EN	4 / 4

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Appendix 3.4.1

Approval of the Hydrological Study by DID

JABATAN PENGAIRAN DAN SALIRAN MALAYSIA
(Department of Irrigation and Drainage, Malaysia)
KEMENTERIAN SUMBER ASLI DAN ALAM SEKITAR
(Ministry of Natural Resources And Environment)
JALAN SULTAN SALAHUDDIN
50626 KUALA LUMPUR
MALAYSIA
htpp:// www.water.gov.my
Bahagian Pengurusan Zon Pantai
Tel: 03-2615 1601 Faks: 03-2697 3201

SEGERA DENGAN FAKS

Ruj. Kami : (27) dlm.PPS14/7/Q9

Tarikh: 5 April 2018

Ketua Pengarah
Jabatan Alam Sekitar
Kementerian Sumber Asli & Alam sekitar
Aras 1-4, Podium 2 & 3
Wisma Sumber Asli No.25
Persiaran Perdana, Presint 4
Pusat Pentadbiran Kerajaan Persekutuan
62574 PUTRAJAYA (Faks: 03-8889 9987)

Pengarah
Jabatan Pengairan dan Saliran Negeri Sarawak
Tingkat 9 & 10, Wisma Saberkas
Jalan Tun Abang Haji Openg
Peti Surat No. 1230
93626 KUCHING (Faks: 082 – 426 400)

Pengarah
Jabatan Alam Sekitar Negeri Sarawak
Tingkat 7-9, Bangunan Wisma STA
No. 26, Jalan Datuk Abang Abdul Rahim
93450 KUCHING (Faks: 082-480 863)

Tuan,

HYDRAULIC STUDY FOR THE PROPOSED BINTULU TANJUNG KIDURONG COMBINED CYCLE POWER PLANT PROJECT (UNIT 9,13), BINTULU DIVISION, SARAWAK
- Ulasan Akhir Laporan Kajian Hidraulik

Dengan segala hormatnya perkara di atas adalah dirujuk.

2. Adalah dimaklumkan bahawa berdasarkan laporan kajian hidraulik yang telah dikemukakan oleh pihak perunding Dr. Nik & Associates Sdn. Bhd. melalui surat ruj.: DNA/CH/15/057-006 bertarikh 26 Februari 2018 dan mesyuarat kajian hidraulik di Jabatan ini pada 16 Mac 2018, didapati pihak perunding telah melaksanakan kajian hidraulik bagi projek tersebut mengikut kehendak-kehendak garis panduan Jabatan ini.

3. Butir-butir berkenaan kajian hidraulik ini adalah seperti berikut:

i.	Penggerak Projek	: Sarawak Energy Bhd.
ii.	Perunding Kajian Hidraulik	: Dr. Nik & Associates Sdn. Bhd.

iii. Skop Kajian Hidraulik :a) Pembinaan loji janakuasa yang mengandungi *intake pipeline* dan *outfall pipeline* masing-masing sepanjang 1,450m dan 320m menganjur ke laut.

4. Jabatan ini pada dasarnya tiada halangan terhadap hasil kajian laporan tersebut bagi cadangan projek di atas, tertakluk kepada syarat-syarat seperti berikut:

i. Kelulusan kajian hidraulik ini adalah bagi kerja:

- Pengalihan paip *intake* sediada ke tengah laut dan pembinaan 2 paip intake yang baharu.
- Pembinaan paip *outfall* yang baharu sepanjang 320m
- Kaedah pembinaan menggunakan kaedah pipe jacking bagi *outfall*
- Kaedah kerja menggunakan kaedah *pipe jacking* bagi pembinaan intake sejauh 320m dan disambung dengan kaedah penggalian *trenching.*

Pelan lokasi dan susun atur kawasan projek serta maklumat pembangunan ini adalah seperti di **Lampiran 1**.

ii. Penggerak Projek tanpa gagal hendaklah memastikan bahawa cadangan kaedah pembinaan *outfall* dan *intake* sejauh 320m dengan menggunakan kaedah *pipe jacking* **TIDAK** akan memberikan impak negatif kepada kawasan sekitar projek. (**Lampiran 2**)

iii. Penggerak Projek hendaklah memastikan semasa kerja pengorekan bagi tujuan pembinaan intake dan outfall serta semasa kerja penimbusan semula struktur ini, ia tidak akan melibatkan sebarang *overdredge*.

iv. Langkah-langkah mitigasi yang disyorkan oleh Perunding dalam laporan kajian hidraulik seperti di **Lampiran 3** hendaklah dilaksanakan sepenuhnya oleh Penggerak Projek. Sebarang perubahan kerja-kerja mitigasi tersebut **TIDAK** dibenarkan tanpa terlebih dahulu mendapat **KEBENARAN BERTULIS** daripada Bahagian Pengurusan Zon Pantai, Jabatan Pengairan dan Saliran Malaysia dan Jabatan Alam Sekitar. Sekiranya berlaku pemendapan atau hakisan di sepanjang garis pantai di sekitar kawasan pemantauan dijalankan, kaedah mitigasi tambahan hendaklah dilaksanakan sepenuhnya oleh Pengerak Projek;

v. Penggerak Projek perlu menentukan semula lokasi stesen pemantauan kualiti air yang baharu berdasarkan kedudukan *intake chamber*. Lokasi tersebut perlu mendapat kelulusan daripada Jabatan Alam Sekitar Negeri Sarawak. Penggerak Projek hendaklah menjalankan kerja-kerja pemantauan kualiti air seperti yang dicadangkan di dalam laporan kajian hidraulik. (**Lampiran 4**)

vi. Sebarang perubahan konsep ataupun rekabentuk skop asal adalah **TIDAK DIBENARKAN** tanpa terlebih dahulu mendapat kelulusan dan kebenaran bertulis daripada Jabatan ini;

5. Tempoh sah kelulusan kajian hidraulik ini adalah dua (2) tahun dari tarikh surat ini. Penggerak Projek juga diingatkan bahawa kelulusan ini boleh ditarik bila-bila masa jika didapati pelanggaran mana-mana syarat kelulusan.

6. Kerjasama dari pihak Jabatan Alam Sekitar adalah dipohon agar dapat memasukkan syarat-syarat kelulusan dari Jabatan ini di dalam syarat-syarat kelulusan Laporan Kajian Penilian Kesan Kepada Alam Sekeliling (EIA) sekiranya diluluskan oleh pihak tuan kelak.

7. Sekiranya terdapat sebarang kemusykilan atau memerlukan keterangan yang lebih lanjut, pihak tuan boleh menghubungi pegawai Jabatan ini, Ir. Lokman Bin Amir Hamzah di talian 03-2615 1638 atau emel ke lokman@water.gov.my .

Sekian, terima kasih.

"BERKHIDMAT UNTUK NEGARA"
"Warga Berintegriti, Organisasi Berkualiti"

Saya yang menurut perintah,

(KAPT. (B) DATO' Ir. HAJI ANUAR BIN HAJI YAHYA)
Bahagian Pengurusan Zon Pantai
b.p. Ketua Pengarah
Jabatan Pengairan dan Saliran, Malaysia
Ak/lah

Salinan kepada:

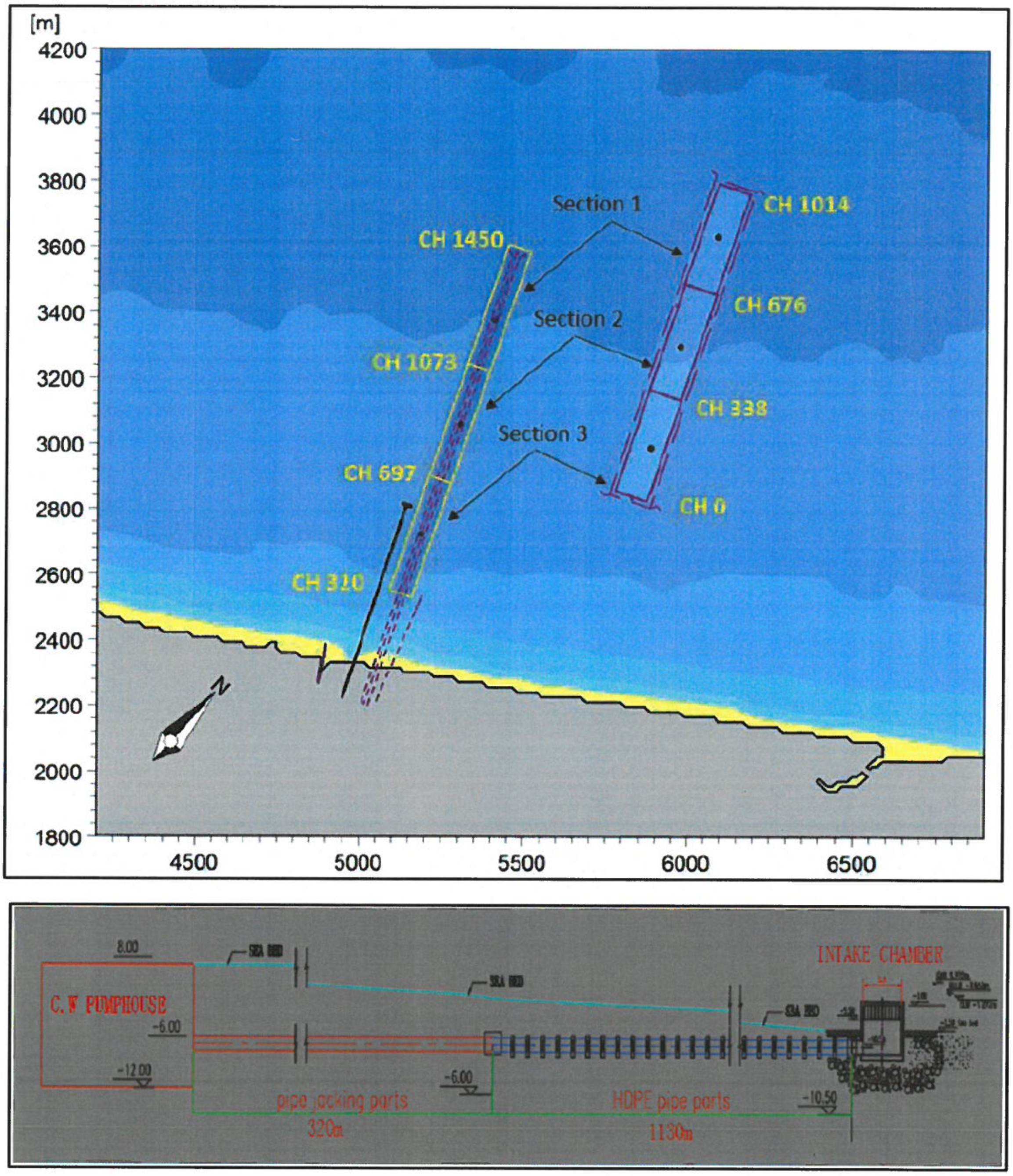
1. Pengarah Urusan
   Sarawak Energy Bhd.
   Level 4, South Wing,
   No. 1 The Isthmus
   93050 Kuching
   SARAWAK (Faks: 082-330708)

2. Pengarah Urusan
   Dr. Nik & Associates Sdn. Bhd.
   Kuala Lumpur Suburban Centre (KLSC)
   Section 5 Pusat bandar Wangsa Maju
   53300 KUALA LUMPUR (Faks: 03-4145 8877)

LAMPIRAN 1

Rajah1: Susun Atur Projek

LAMPIRAN 2



Rajah 2: Kaedah pembinaan Intake Pipeline dan tempat pelupusan sementara

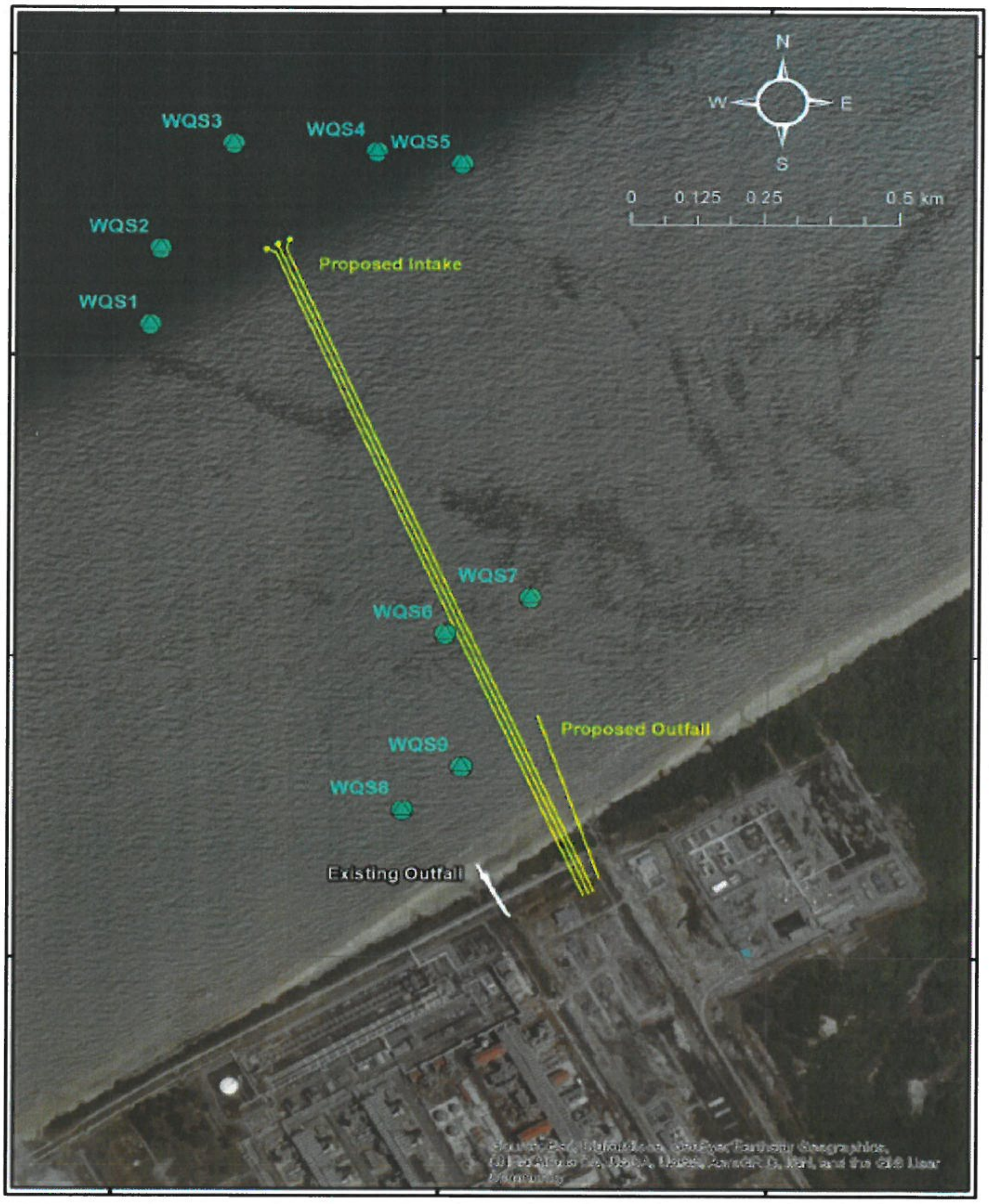
LAMPIRAN 3

LANGKAH-LANGKAH MITIGASI

Monitoring System during Construction	• Address uncertainties in hydraulic study & design • Install ADCP & online turbidity sensors near existing intake structure • Works to be temporarily stopped when trigger value reached
Temporary Offshore Disposal Area	• When backfilling, dredge only initially deposited material (no over-dredging)
Post Construction Survey	• To conduct pre-, post- & progress surveys at trenching location & temporary offshore disposal area • To monitor seabed levels before, during & after completion
Water Quality Monitoring	• To monitor on monthly basis near intake & outfall structures to monitor changes in seawater temperature & chlorine concentration • Measurements are taken at bottom, mid-depth & near surface of water column

LAMPIRAN 4

LOKASI PEMANTAUAN KUALITI AIR



Station	Longitude	Latitude
WQ1	113° 5' 02.2"	3° 18' 22.1"
WQ2	113° 5' 02.8"	3° 18' 27.1"
WQ3	113° 5' 07.2"	3° 18' 34.1"
WQ4	113° 5' 16.0"	3° 18' 33.6"
WQ5	113° 5' 21.2"	3° 18' 32.7"
WQ6	113° 5' 20.3"	3° 18' 01.5"
WQ7	113° 5' 25.5"	3° 18' 03.9"
WQ8	113° 5' 17.7"	3° 17' 49.8"
WQ9	113° 5' 21.3"	3° 17' 52.7"

Appendix 3.4.2

Agreement for the Crossing of Pipeline with Murphy

RESTRICTED

SEB Power Sdn Bhd (1154615-U)
A Subsidiary of Sarawak Energy Berhad

sarawak energy

SBP160002/C01WK01/2018-001/CKL/dnb
30th January 2018

Mr. Ananda Gnanasegran
Murphy Sarawak Oil Co., Ltd.
Level 27, Tower 2,
Petronas Twin Towers,
KLCC,
50088 Kuala Lumpur

Tel: 03-74907400
Email: Ananda_Gnanasegran@murphyoilcorp.com

Dear Sir,

BINTULU TANJUNG KIDURONG COMBINED-CYCLE POWER PLANT PROJECT (UNIT-10, UNIT-11)
- Agreement for the Crossing of Pipeline

Please find enclosed two (2) copies of duly signed "Agreement for the Crossing of Pipeline" for your further action. Kindly return us both copies of the signed agreement for us to proceed with document stamping.

Thank You.

Yours sincerely,

Chua Kim Leong
Project Director, Tg Kidurong
Combined Cycle Power Plant Project

Encl. *Agreement for the Crossing of Pipeline*

DATED DAY OF 2018

MURPHY SARAWAK OIL CO., LTD.
(Company No. 993918-P)

AND

SARAWAK ENERGY BERHAD
(Company No. 007199-D)

AGREEMENT FOR THE CROSSING OF PIPELINE

ARTICLE 3
AGREEMENT TO THE CROSSING

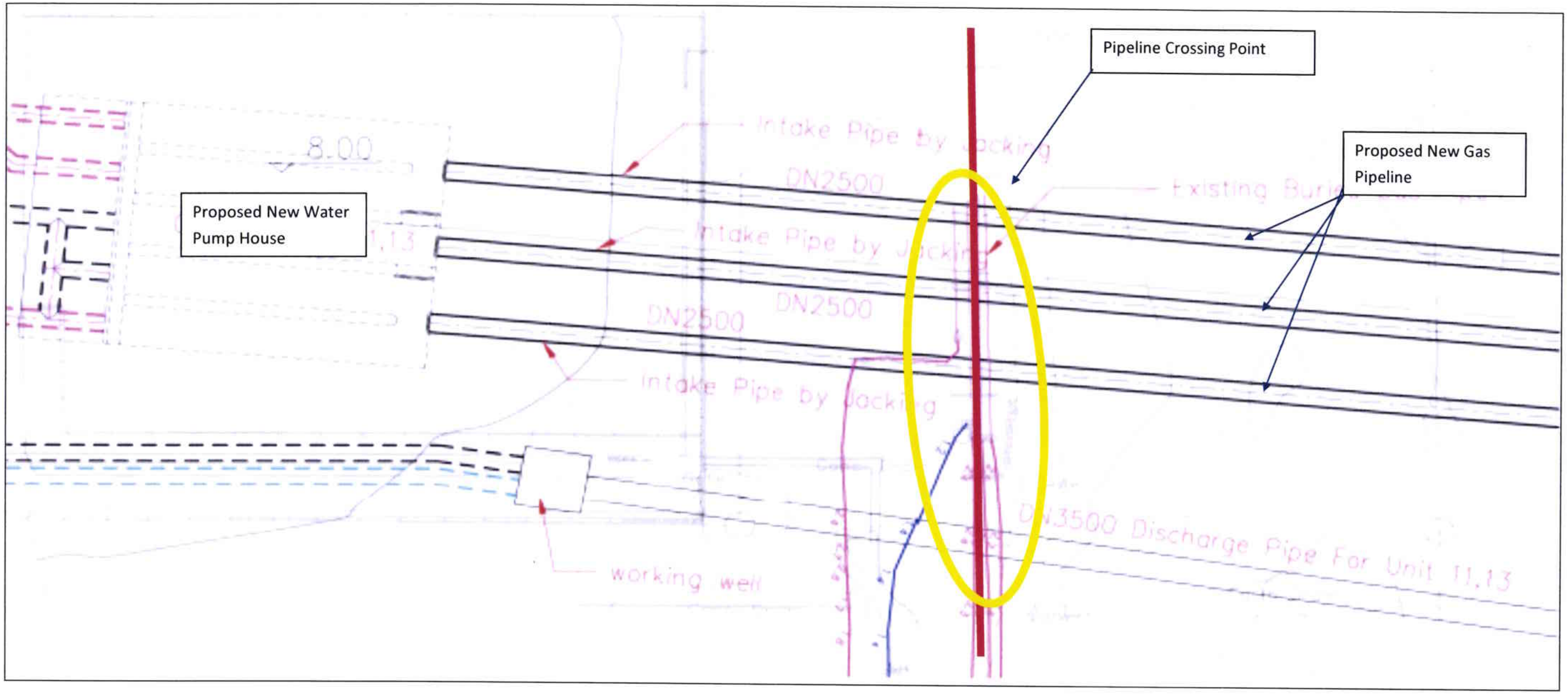
3.1 In consideration of the mutual exchange of promises, MURPHY hereby agrees to allow SEB to install SEB pipeline in close proximity to MURPHY pipeline in accordance with the provisions of this Agreement.

3.2 The Parties agree to exercise their respective rights and discharge their respective obligations under this Agreement in accordance with all applicable laws, rules and regulations and acceptable gas industry practice.

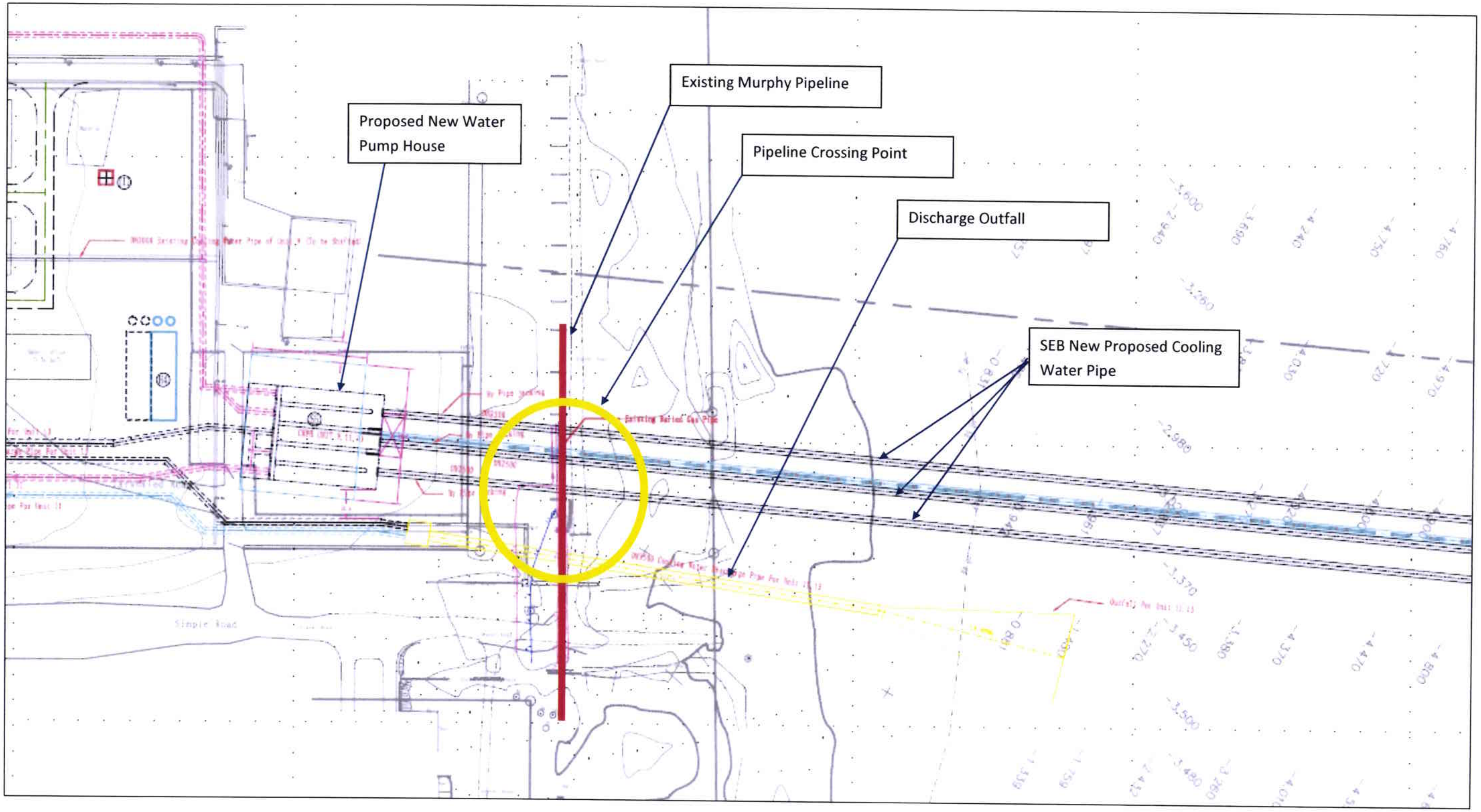
END OF ARTICLE 3

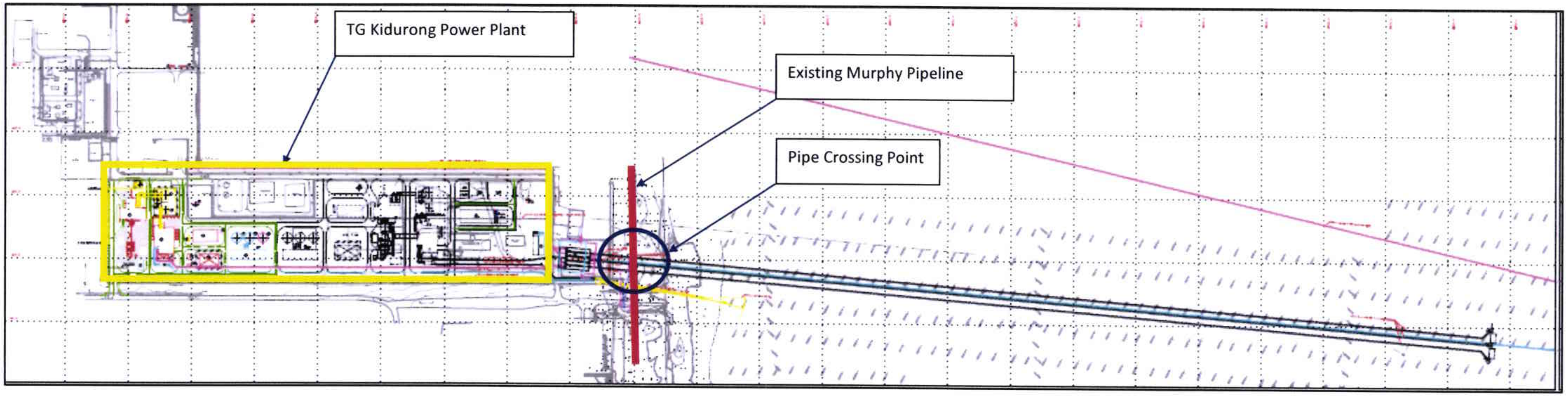
SCHEDULE A
ROUTE OF PIPELINES AND CROSSING POINT

(Refer layout as attached)



Pipeline Crossing Point
Proposed New Gas Pipeline
Proposed New Water Pump House
8.00
Intake Pipe by Jacking
DN2500
Existing Buried
Intake Pipe by Jacking
DN2500
DN2500
Intake Pipe by Jacking
DN3500 Discharge Pipe For Unit 11,13
working well


Existing Murphy Pipeline
Proposed New Water Pump House
Pipeline Crossing Point
Discharge Outfall
SEB New Proposed Cooling Water Pipe
Existing Refied Gas Pipe
Simple Road


TG Kidurong Power Plant
Existing Murphy Pipeline
Pipe Crossing Point

Appendix 3.4.3

Written Engagement with PETRONS for the Crossing of Pipeline

RESTRICTED

sarawak energy

Our Ref : PLS130157/PE/SC/MKN/013
Date : 5th October 2015

TELEFAX SENT
Date : 06.10.2015
Time : 3.00 pm

PETRONAS CARIGALI SDN BHD
Menara Petronas, No.2, Lrg. Belia,
88100 Kota Kinabalu, Sabah.

Tel: 03 - 2331 5000 Fax: 03 - 2331 3306

Attention: ***Head Of Sabah Sarawak Gas Pipeline (SSGP), En. Norrizam Bin Mohamad***

Dear Sir,

BINTULU TANJUNG KIDURONG COMBINED-CYCLE POWER PLANT PROJECT (UNIT 10, UNIT 11)
- Minutes of Meeting on Crossing of Existing Underground Gas Pipelines

We are pleased to forward herewith the updated minutes of meeting on pipe crossing agreement dated 14th September 2015 for your record and action. Kindly return the original copy to us after signing.

Thank you.

Yours faithfully,

Simon Chen
Project Director Bintulu Tg. Kidurong Combined-Cycle Power Plant Project

Tel: 082 - 388 388 Ext. 8592
Fax: 082 - 331 417

Encl.

Our Ref : PLS130157/PE/SC/MKN/013
Date : 5th October 2015

c.c. Murphy Oil Sarawak Company Limited,
(Attn.: Mr. Ananda Gnanasegran, Business Development and Commercial)
Email: ananda_gnanasegran@murphyoilcorp.com

Distribution List – Sarawak Energy Berhad

1. James Ung, Senior Vice President *[Thermal Power Generation]*
2. Einar Kilde, Senior Vice President *[Project Execution]*
3. Tan Ah Hock, Vice President *[Shared Services]*
4. Tan Hang Kiak, Project Director *[Transmission Substation Projects]*
5. Alfred Lai, Senior Manager *[Thermal Power Development]*
6. James Hannon, Senior Manager *[Contracts, Legal & Commercial]*
7. Tiew Hua Ming, Contracts Manager *[Thermal Projects]*
8. Haji Mostapha Lai, Project Manager *[Transmission Substation Projects]*
9. Phung Jee Kiong, Station Manager *[Tg. Kidurong Power Station]*

MINUTES OF MEETING TANJUNG KIDURONG COMBINED CYCLE POWER PLANT UNIT 10 & 11 PROJECT	Form Ref.:			
	Revision No.:	0	Date:	Oct 09
	SARAWAK ENERGY BERHAD 6th Floor, No.1 the Isthmus, 93050 Kuching, Sarawak.			

MEETING: **Meeting With PETRONAS Carigali Sdn. Bhd. (PCSB) On Crossing Of Pipeline**
DATE: 14th September 2015 TIME: 2:00 pm
VENUE: Conference Room, Tanjung Kidurong Power Station Bintulu
ATTENDANCE: SEB & PETRONAS CARIGALI S/B (Refer to attached attendance list)

ITEM	DESCRIPTION	ACTION
1.0	INTRODUCTION	
1.1	The Chairman welcomed all participants to the meeting.	**Info**
1.2	Safety briefing was conducted by SESCO Safety Officer before commencement of meeting.	**Info**
1.3	Project briefing was conducted by Mr. Mohamad Khalik Norjali from SEB Project Execution Team.	**Info**
2.0	Technical & Construction Requirements for Onshore and Offshore Structures	
	SEB informed that the technical features of the cooling water pipe and discharge outfall presented in the project brief are still at conceptual stage. Detail design by the contractor will carried out once the EPC contract is awarded.	**SEB**
	PCSB will inform both SEB and Murphy Sarawak Oil Company Limited the extent of their jurisdiction and construction requirements with regards to the crossing pipelines. Mr. Norrizam requested SEB to submit the scope of work, methodology and related documents for their review once the design is confirmed.	**SEB/PCSB**
	Regarding the proposed cooling water pipe and intake head located 1.6 km from shoreline. PCSB raised concern on the offshore component of this project in view of the existing pipeline which also located in the same area. SEB informed that the proposed cooling water pipe shall be designed to a safe distance from the existing offshore pipeline. PCSB recommended SEB to communicate with the existing pipeline owner of its plan. PCSB might be able to advise SEB the rightful owner of the offshore pipeline and SEB will coordinate accordingly with the relevant party/parties for further action.	**SEB**
2.0	Existing Pipeline Survey Verification	
2.1	PCSB) informed Sarawak Energy Berhad (SEB) that a Confidentiality Agreement (CA) must be signed before As-Built Drawings can be issued to SEB for tender and construction purposes. A draft of the CA will be submitted to SEB for review.	**PCSB**
2.2	Despite the issuance of the As-Built Drawings, SEB will engage a licensed third party surveyor to confirm the coordinates and depth of existing gas pipelines within the project boundary. This information is crucial to ascertain the as built depth and position of gas pipelines and other underground utilities if any.	**SEB**
2.3	SEB informed PCSB that excavation for survey verification for the existing pipelines will be done manually. PCSB has no objections with manual excavation but require that their site personnel to be notified during the execution of the works. A letter to notify PCSB for the survey verification shall be issued. As the site is under Murphy Oil jurisdiction, SEB to coordinate directly with Murphy Oil on the matter.	**SEB**
ITEM	**DESCRIPTION**	**ACTION**
3.0	Pipeline Crossing Agreement PCSB informed that they will share the draft pipeline crossing agreement to SEB for	**PCSB**

	review and further discussion if needed.	
4.0	Adjournment of Meeting	
4.1	The meeting was adjourned at 3:30 p.m.	**Info**

Minutes recorded by:

Awang Afizal Ikram Bin Awang Alias
Civil Engineer (Project Execution)

Minutes accepted by:

Sarawak Energy Berhad (SEB)

Simon Chen
Project Director(Tg. Kidurong CCPP Unit 10&11)

PETRONAS Carigali Sendirian Berhad (PCSB)

Norrizam Bin Mohamad
Head Of Sabah Sarawak Gas Pipeline(SSGP)

sarawak energy

BINTULU TANJUNG KIDURONG COMBINED CYCLE POWER PLANT UNIT-10 AND UNIT-11

ATTENDANCE LIST

PURPOSE	:	**Meeting with Petronas Carigali Sdn. Bhd. on Crossing of Pipeline**
DATE	:	**Monday, 14th September 2015**
TIME	:	**2:00pm**
VENUE	:	**Conference Room, Tg. Kidurong Power Station Bintulu**

No.	Name	Organization	Designation	Contact No.	Signature
1.	MOHAMAD JAIS BIN DAUD	PCSB	EXECUTIVE	011-26810926 jaisdaud@petronas.com.my	
2.	MAZLAN MOHTAR	PCSB	EXECUTIVE OPERATION	019-4515240 azlan.mohtar@petronas.com.my	
3.	FLORENCIA S. INANSUL	PCSB	EXEC, PLANNING DEPT	016-5884604 florencia.inansul@petronas.com.my	
4.	Peter Yong	PCSB	Finance	0168182832 peter_yong@petronas	
5.	Norrizam Mohamed	PCSB	Head, SSCP	013-3488819 norriz@petronas.com.my	
6.	MOHD AZLI BIN HUSIN	PGB	MANAGER BINTULU OPN CENTER	019-7299945 mazli_husin@petronas.com.my	
7.	MUHAMAD HAZULFADLI BIN HASAN	PETRONAS GAS BHD (PGB)	GAS PLANNER	019-2092702 hazulfadli_hasan@petronas.com.my	
8.	MOHD AZMAN FRORAN	PETRONAS GAS	TECH. ASSISTANCE	019-8347434 mazmanfroranmramlee@petronas.com	
9.	Thian Kah Kien	SEB	Mgr (Civil)	019-8597906	
10.	JACKLYN DOMINIC MERICKAN	SEB	SR. CIVIL ENGR.	019-8595849	
11.	Awang Afizal	SEB	CIVIL ENGINEER	012-8070093	
12.	Lee Tiong Ho	SEB	Mgr. (ERM)	0198897755	
13.	Chung King Long	SEB	Sr Mech. Eng	0168836757	
14.	Jason Yeo	SEB	Elec. Engr.	0149940687	
15.	ALFRED LAI	SEB	SR MANAGER	019 8895959	
16.	Mohamad Khalik Nanjali	SEB	Mech Eng.	016-5892710	
17.	ALEXANDER GUTTE	SEB	Mechanical Engineer	019-8582890	
18.					
19.					
20.					

RESTRICTED

SEB Power Sdn Bhd (1154615-U)
A Subsidiary of Sarawak Energy Berhad

sarawak energy

SBP160002/C01WK01/2017-005/CKL/dnb
1st November 2017

En. Norrizam bin Mohamad
PETRONAS CARIGALI SDN BHD
Menara Petronas,
No. 2, Lorong Belia,
88100 Kota Kinabalu,
Sabah

T: + 03 – 2331 5000
Email: norriz@petronas.com

Dear Sir,

BINTULU TANJUNG KIDURONG COMBINED-CYCLE POWER PLANT PROJECT (UNIT-10, UNIT-11)
CONTRACT NO: SBP160002-C01-WK01
- Additional Cooling Water Pipe Crossings Below Existing Petronas Carigali S/B ("PCSB") & Murphy Oil Gas Pipelines

Reference is made to the meeting held on Thursday, 12th October 2017 in Bintulu.

We would like to notify PCSB that due to developments in the Bintulu Tanjung Kidurong Combined Cycle Power Plant Project, Sarawak Energy intends to construct additional two (2) Cooling Water Pipes for its Cooling Water Pump House, which leads to an additional two (2) points of crossing at the existing gas pipeline along the shoreline. We attached herewith the revised pipe crossing layout for Schedule A of the agreement.

Thus, based on the existing Pipeline Crossing Agreement dated 17th May 2017 ("PLCA") between Sarawak Energy and Petronas Carigali Sdn. Bhd. ('PCSB'), the said two (2) additional pipes are construed as "Future Crossings" under Article 12 and is subject to a separate agreement.

We had during the said meeting indicated that we are amenable to either a separate agreement or a new agreement with similar terms for all four (4) crossings which will supersede the existing PLCA and with retrospective effect.

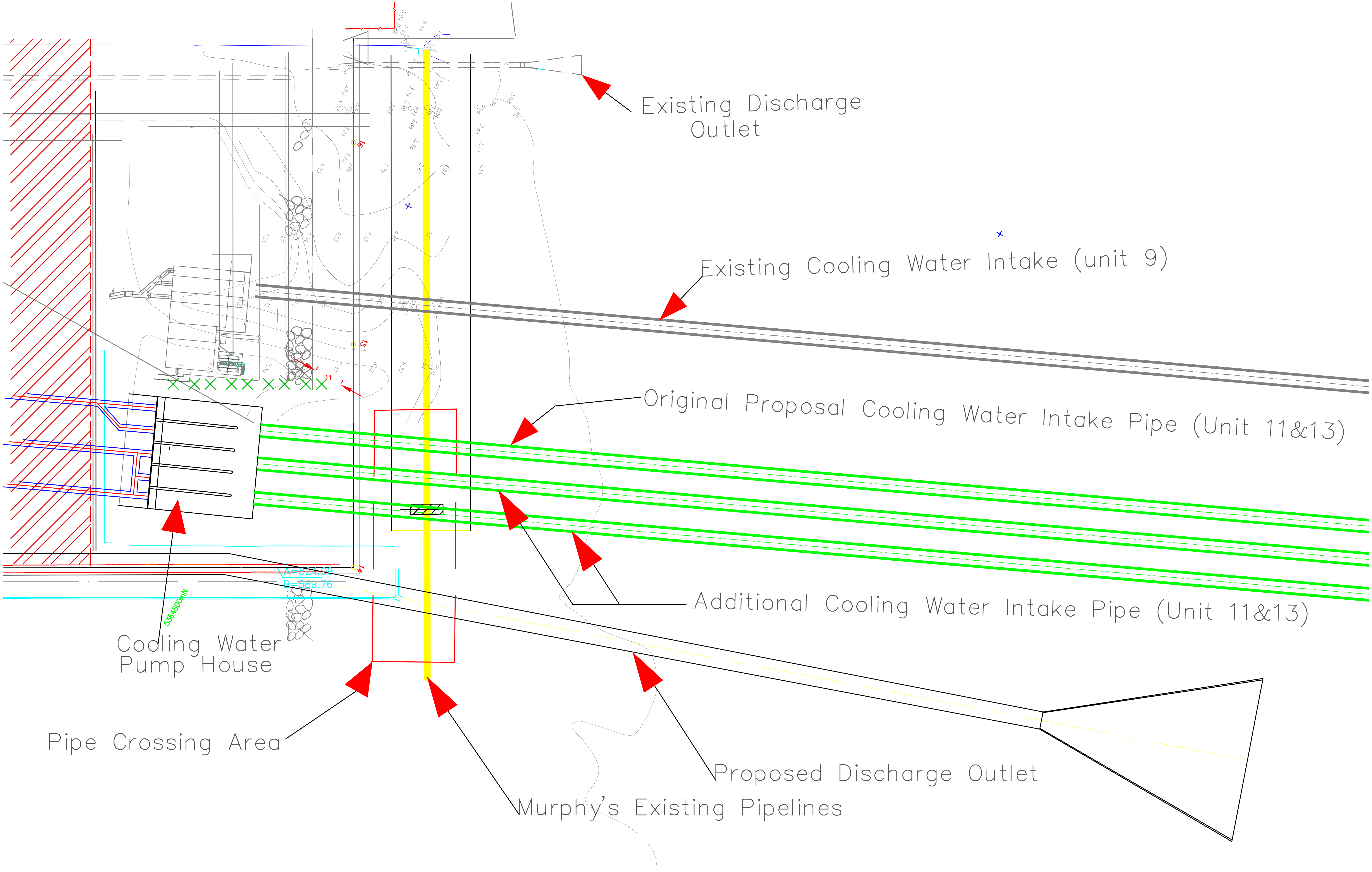
Please furnish us with the initial draft for our perusal and approval.

PCSB's support and cooperation on the matter is highly appreciated.

Thank you.

Yours sincerely,

Chua Kim Leong
Project Director, Tg Kidurong
Combined Cycle Power Plant Project


Existing Discharge Outlet
Existing Cooling Water Intake (unit 9)
Original Proposal Cooling Water Intake Pipe (Unit 11&13)
Additional Cooling Water Intake Pipe (Unit 11&13)
Cooling Water Pump House
Pipe Crossing Area
Murphy's Existing Pipelines
Proposed Discharge Outlet

ATTACHMENT E-16 PIPE CROSSING SPECIFICATION BY EXISTING GAS PIPE OWNER

ARTICLE 5
PROCEDURES FOR INSTALLATION OF THE CROSSING PIPELINE & STRUCTURES

5.1 PETRONAS Carigali agrees to SEB installing the Crossing Pipeline & Structures over and below the Crossed Pipeline in accordance with the procedures as provided in Schedule B to the extent necessary for SEB's installation activities in connection with the Crossing Pipeline & Structures.

5.2 Upon request from SEB, PETRONAS Carigali shall provide the latest available position of the Crossed Pipeline and SEB shall, at its own cost, carry out all surveys necessary to establish the actual position of the Crossed Pipeline at the Crossing Points to the reasonable satisfaction of PETRONAS Carigali. Such surveys to be carried out by SEB shall be carried out not less than three (3) months prior to the Commencement Date, unless otherwise agreed in writing by PETRONAS Carigali.

5.3 SEB shall give PETRONAS Carigali not less than thirty (30) days' written notice of its intention to start the installation activities with a further written notice to be given fourteen (14) days before the Commencement Date of such installation activities. SEB shall thereafter provide daily progress reports during the period of the installation activities.

5.4 PETRONAS Carigali shall use all reasonable efforts to ensure that any work to be carried out on the Crossed Pipeline prior or during the execution of the SEB Work, if any, shall be carried out in a manner that the installation activities in the Right of Way may be carried on without delay or interruption.

5.5 SEB shall provide PETRONAS Carigali with the route of the Crossing Pipeline & Structures in the vicinity of the Crossed Pipeline by providing:

(a) the coordinates/locations within forty-eight (48) hours after the installation of the Crossing Pipeline & Structures in the Right of Way; and

(b) the charted information as soon as practicable after the Completion Date.

5.6 As soon as reasonably practicable after the completion of the SEB Work, SEB shall at its own expense, carry out a post crossing survey of the Crossing Points and of the Crossed Pipeline and the Crossing Pipeline & Structures within two hundred (200) metres of the Crossing Points.

5.7 Following the completion of SEB Work, SEB shall submit to PETRONAS Carigali, at its own cost, detailed report of the design, construction and installation of the crossing, including a set of composite "as built' drawings showing the position and route of the Crossing Pipeline & Structures within two hundred (200) metres of the Crossing Points.

5.8 Pursuant to Article 5.7, SEB shall also provide PETRONAS Carigali with copies of information, material, data and documentation (including, but not limited to, reports, charts, drawings, photographs and records) connected with or arising out of the post crossing survey together with a written report of the condition of the Crossing Points which shall include full details on the condition and nature of the protection material separating the Crossed Pipeline from the Crossing Pipeline & Structures.

5.9 The composite "as built" drawings and the result of the survey carried out by SEB after the completion of SEB Work shall be reviewed for acceptance by PETRONAS Carigali. Upon acceptance by PETRONAS Carigali, the composite "as built" drawings and the result of the survey shall be the conclusive evidence of the condition of the Crossed Pipeline and the Crossing Pipeline & Structures at the Crossing Points, subject to Article 4.6.

5.10 SEB shall identify and record the final coordinates of the Crossing Points.

5.11 If damage is caused to the Crossed Pipeline within the Right of Way resulting from the SEB's installation of the Crossing Pipeline & Structures, PETRONAS Carigali shall as soon as practicable repair the damage to the Crossed Pipeline. The direct and actual total cost of such repair or work of the Crossed Pipeline Cable carried out by PETRONAS Carigali shall be solely borne by SEB.

5.12 If (a) SEB makes unapproved changes to the approved procedures or (b) the SEB deviates from the approved procedures when carrying out Work, or (c) if, in the reasonable opinion of PETRONAS Carigali there is a serious risk of damage to the Crossed Pipeline as a result of Work carried out by SEB in connection with the installation of the Crossing Pipeline & Structures, then in the case of (a) or (b) or (c), PETRONAS Carigali after in consultation with SEB shall take appropriate action to prevent such damage. Any such action after consultation with SEB, shall be carried out by PETRONAS Carigali after the completion of SEB Work. The cost shall be determined and mutually agreed by the Parties and shall be paid by SEB.

END OF ARTICLE 5

ARTICLE 6
SURVEYS

6.1 A Party intending to carry out a survey within the Right of Way shall give written notice to the other Party before the survey commences. The Parties may consider joint surveys and/or cost-sharing if practical. The Parties shall make freely available to each other the results of all surveys carried out for the purpose of this Agreement.

6.2 The "as found" condition of the Crossed Pipeline shall be the condition of the Crossed Pipeline prior to the commencement of the SEB Work. The "as found" condition of the Crossed Pipeline shall be determined by survey carried out by SEB prior to the commencement of the SEB Work. The results of the survey shall be reviewed by PETRONAS Carigali and in the absence of manifest error, accepted by both Parties to be the conclusive evidence of the "as found" condition of the Crossed Pipeline.

6.3 SEB shall ensure that standard onshore pipeline maintenance routines and inspections of the Crossing Points are performed as required. SEB shall notify PETRONAS Carigali of any anomaly detected during the said inspection as soon as reasonably practicable. In the event either Party requires maintenance or repair work to be carried out, the Parties shall meet to discuss and agree on the scope and methodology of such maintenance or repair work.

6.4 PETRONAS Carigali shall notify SEB of any anomaly detected during its pipeline inspection activities on the Crossed Pipeline and shall advise SEB of any major maintenance activity on the Crossed Pipeline which may affect the integrity of the Crossing Pipeline & Structures at the Crossing Points.

<u>END OF ARTICLE 6</u>

SCHEDULE B
TECHNICAL AND CONSTRUCTION SPECIFICATION FOR FOREIGN CROSSING

1.0 General

1.1 Applicant shall only construct its crossing at the identified location approved by SSGP.

1.2. Applicant shall submit detail crossing information and construction procedures to SSGP for review and/or approval. Information shall include:-

a. type of crossing;
b. intent or reason for crossing;
c. plan, profile and cross-section drawings of Applicant's crossing covering the entire SSGP ROW;
d. exact location of crossing with reference to SSGP pipeline chainage;
e. duration of crossing whether temporary or permanent;
f. soil investigation and soil settlement report (wherever and whenever relevant);
g. engineering study, risk analysis, or EIA (wherever and whenever relevant);
h. schedule of work;
i. any other relevant information.

1.3 Applicant shall bear all cost associated with upgrading SSGP pipeline and/or its related appurtenances or R.O.W. to allow the construction of the Applicant's crossing at the Crossing Area. This upgrading shall include, but not limited to, all costs for relocating, reconstruction, hot tapping, line stopping, gas release/blowdown, earthwork, structural protection, engineering consultation, supply of linepipe, labour and equipment.

1.4 Applicant shall probe and expose SSGP pipeline under SSGP supervision prior to commencement of work to confirm the pipeline location and elevation. Applicant shall take the actual coordinate of the Crossing Area and include it in Applicant's proposed construction drawing and also final as-built drawing.

1.5 Applicant shall not cut or remove earth/soil within SSGP R.O.W without SSGP written consent.

1.6 Applicant shall ensure that the proposed crossing and its related construction equipment / machinery and activities does not subject SSGP pipeline to excessive loading. In order to prove that, Applicant shall perform engineering calculation/analysis/study and submit to SSGP for review and approval.

1.7 Applicant, its client and representative shall be responsible for any damages that occur to SSGP pipeline arising out of the construction activities. SSGP reserves the right to stop the work until the pipeline has been repaired satisfactorily at Applicant's own cost. In critical situations where Applicant does not react immediately to repair the pipeline, SSGP may decide to repair the pipeline on its own and then bill Applicant at actual cost of replacement items, manpower, equipment plus 25% management cost. Pipeline repair shall include but not limited to coating repair, clamp, epoxy sleeve, clock spring reinforcement, pipe spool replacement and hot tap and line stopping operation.

1.8 The construction of Applicant's crossing shall not in any way block the access into the SSGP R.O.W. Proper access shall be provided across Applicant's crossing for SSGP vehicle movement along the R.O.W.

1.9 The construction of Applicant's crossing shall not block or stop natural water which may cause flooding of the R.O.W or the adjacent lands. Applicant shall provide solution to overcome these problems through proper engineering assessment/study/analysis.

1.10 Applicant shall apply for "Work Permit" to be issued by SSGP at least 48 hours prior to work commencing. All safety requirements and regulations imposed by SSGP shall be strictly adhered to while working inside SSGP R.O.W. Applicant shall attend a pre-job meeting to be held prior to start work.

1.11 Applicant shall only work within the SSGP R.O.W under the supervision of SSGP and during the identified working hours only.

1.12 Applicant shall reinstate and re-turf SSGP R.O.W affected by the construction of Applicant's crossing to the satisfaction of SSGP.

1.13 Applicant shall install :-

a. Standard SSGP warning marker at both sides of the crossing.

b. Cathodic Protection Test Posts for road, railroad, steel pipes, and High Voltage Transmission lines.

1.14 Applicant shall perform joint final inspection with SSGP upon completion of the construction activity.

1.15 Applicant shall submit as-built drawing/s of the crossing covering the whole SSGP R.O.W within 30 days after completion of the work.

1.16 SSGP shall not be liable and shall be indemnified against any damages or losses whether to property or life occurring as a result of Applicant's crossing.

1.17 Applicant, its client and representative shall be responsible for any damage that occur to SSGP pipeline arising out of the operation of Applicant's crossing and shall bear all costs incurred to repair such damage.

1.18 SSGP in the course of maintaining its pipeline integrity may have to excavate and perform inspection, repair or other works on its pipeline within the Crossing Area. SSGP will do its best to inform Applicant prior to such work. In executing the work, SSGP will exercise extreme care to avoid damages to Applicant's crossing. SSGP, however, shall not be liable for any damage that may occur to Applicant's crossing arising out of the work.

1.19 Applicant shall not construct any new crossing, widening, and modification across SSGP R.O.W without prior approval of SSGP, which consent shall not be unreasonably withheld.

1.20 Applicant shall allow and provide access for SSGP, SSGP contractors and adjacent landowners to enter and perform work on the R.O.W which is within the crossing area or blocked by the crossing area. Applicant shall not impose any access charges, toll, or performance bond to any of these parties.

1.21 Applicant shall allow:

a. PETRONAS, its subsidiaries and associate companies,

b. Other Applicants constructing new foreign crossings, and any private companies or Government bodies which have permits from SSGP to access, enter and perform work in the R.O.W areas which are within the Crossing Area or blocked by the crossing area. Any type of guarantee, performance bond or compensation for damages to Applicant's structure shall be discussed and agreed between Applicant and the respective parties without the need of SSGP intervention.

2.0 Drain Crossing

2.1 The clear distance between SSGP pipeline and Applicant's drain shall be determined as follows and shall extend the full width of SSGP R.O.W:-

a. For earth drain of width not exceeding 1000mm and depth not exceeding 1000mm, clearance shall be 900mm.

b. For earth drain of width exceeding 1000mm or depth exceeding 1000mm, clearance shall be 1200mm.

c. For concrete drain of width not exceeding 1000mm or depth not exceeding 1000mm, clearance shall be 300mm.

d. For concrete drain of width exceeding 1000m or depth exceeding 1000 mm, clearance shall be 600mm.

e. For culvert crossing over SSGP pipeline, the condition stated for concrete drain crossing shall be used:

i. For culvert crossing under SSGP pipeline, clearance shall be 300mm.

2.2 SSGP pipeline shall be reasonably protected from future dredging or settlement of the drain structure. *Applicant shall propose and design a proper protection for* SSGP *pipeline and submit to* SSGP *for review and approval.*

2.3 SSGP pipeline must be reasonably protected from possible movement of pipeline in soft soil area. Due to this, SSGP may require a rubber padding material be installed between the pipeline and the drain or culvert. This case is normally encountered whenever a culvert crosses under SSGP pipeline.

2.4 In cases where it is justified by Applicant and accepted by SSGP that the clearance stated in Item 6.1 cannot be met, SSGP will consider reducing the clearance provided the Applicant considers installing a reinforced concrete slab or rubber padding or a combination of both between SSGP pipeline and Applicant's drain.

2.5 If the construction of Applicant's drains crossing results in blocking future access to SSGP ROW, Applicant shall construct an access bridge (for a standard 4WD vehicle) or provide a reasonable alternative for SSGP.

3.0 <u>Pipeline Crossing</u>

3.1 Applicant's pipeline shall cross SSGP pipeline with minimum clearance of 600 mm.

3.2 Applicant shall cross under SSGP pipeline only.

3.3 Applicant may cross over and above SSGP pipeline provided the following conditions:

a. difficult soil condition,

b. very large diameter (>36 inch),

c. not enough existing pipe cover,

d. product is water or any non-toxic and nonflammable gas or liquid,

e. Applicant willingness to protect aboveground items against vehicle damage and install access bridge for SSGP vehicle (standard 4 wheel drive).

3.4 Applicant's pipeline shall be able to withstand the load of vehicle normally used for SSGP pipeline maintenance. SSGP shall not be responsible for any damage that may occur to Applicant's pipe due to vehicles crossing over the pipe.

3.5 All working pits constructed for pipeline crossings installed using Horizontal Directional Drilling, Pipe Jacking, Boring, Microtunnelling or similar methods, shall be installed outside SSGP ROW.

4.0 Blasting Near PGB-TOD Pipeline

4.1. The intensity of the ground vibrations emanating from the blasting point measured at the nearest point on the ground above SSGP pipeline shall be limited to the following:

a. Energy ratio of 1.0, or

b. Resultant single amplitude of 0.0152mm and resultant particle velocity of 50mm per second.

4.2 Applicant shall perform trial blasting at a safe distance away from the pipeline or at other places to confirm that the explosive design and arrangement will not exceed the limits stated in item 9.1.

4.3 If the limits in item 9.1 are exceeded during actual blasting, then Applicant shall, together with SSGP, perform inspection on the pipeline within 50m distance from where the limits were breached. The inspection shall include as a minimum, complete excavation and exposure of the pipeline, visual inspection for gouges, dents, buckles or ovalities, and NDT on welds for cracks. If the results of the inspection indicate any damages that exceed the requirement of the codes and standards, refer to item 1.7 for further details.

5.0 Piling Near PGB-TOD Pipeline

5.1 As much as possible, piling should be avoided inside SSGP R.O.W, however if further engineering calculations/assessment/study prevails that piling is required, Applicant shall follow the conditions stated below:-

a. The intensity of the ground vibrations emanating from the piling point measured at the nearest point on the ground above SSGP pipeline shall be limited to the following:-

Energy ratio of 1.0, or

Resultant single amplitude of 0.0152mm and resultant particle velocity of ground at 50mm per second.

b. Piling method, configuration and distance from SSGP pipeline shall be adjusted to suit the above requirement.

5.2 The arrangement of piling shall be confirmed to be safe from possible danger of piling hitting the pipe, and not affecting SSGP pipeline cathodic protection system and future pipe laying activities. In addition, Applicant shall perform cathodic protection mitigation study or such study for SSGP pipeline as a result Applicant's piling. Applicant shall perform all mitigation measures recommended by the mitigation study.

In general, the arrangement shall use the following rules:

Clear distance between Applicant's piles and edge of SSGP pipeline	1 m minimum
Gap between piles along the pipeline	1 m minimum
Gap provided for future pipeline to pass through	3 m minimum

Applicant shall seek SSGP advice and concurrence prior to designing its piling.

5.3. No permanent steel piling is allowed within 20m away from SSGP pipeline to ensure SSGP cathodic protection system is not disturbed.

5.4 Permanent markers shall be installed at nearest point to SSGP pipeline indicating distance from the piles.

5.5 If the piling is in row configuration, Applicant shall provide marker at every 10 meter distance. The design of the marker shall be submitted to SSGP for review and approval.

6.0 Material Specifications

6.1 Test Post

6.1.1 The test posts used shall be of such a design that there will be no exposed metallic surfaces such as Zap Gard Cathodic Protection test station or equivalent.

6.1.2 The test facility shall be provided with terminals such that up to five separate cables can be terminated and up to four of these may be electrically bonded together.

6.1.3 The test station shall be fitted with a lockable cap coloured orange.

6.1.4 The test post support body shall be made of PVC with thickness of minimum 10 mm.

6.2 Cables and Warning Marker

6.2.1 All DC cables shall be single core multiple stranded copper 300/500 volt grade to BS 6004:1984

6.2.2 Monitoring cables shall be 16 mm^2 PVC/PVC black.

6.3 Permanent Reference Cell

6.3.1 The permanent reference cell shall be Stelth2 Model SRE-007-CUY.

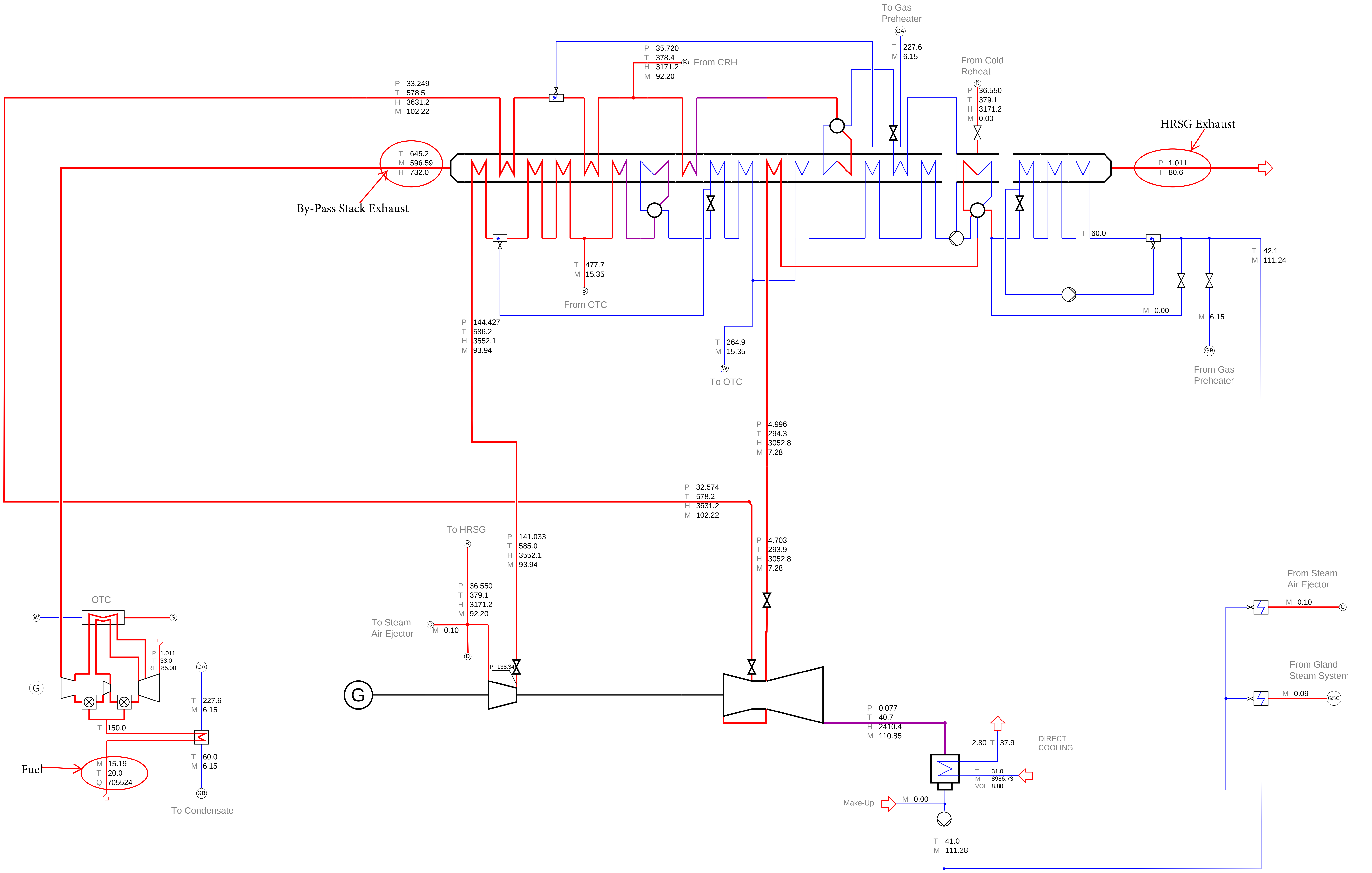
6.4 Other Materials

6.4.1 CONTRACTOR shall responsible to prepare all necessarily items needed to complete the installation of CADWELD and test post installation.

END OF SCHEDULE B

Appendix 3.4.4

Heat Balance Diagram



FUEL: Natural Gas

LHV 46457 kJ/kg

PF 0.85 [-]

P	Pressure	bar
M	Mass flow	kg/s
T	Temperature	°C
H	Enthalpy	kJ/kg

COMBINED CYCLE PERFORMANCES

GT_Output	257908	kW Elec.
ST_Output	163707	kW Elec.
Gross_Output	421615	kW Elec.
Gross_Heat_Rate	6024	kJ/kWh
Gross_Efficiency	59.76	%

Drawn: G. Moore

Revision:

Checked: H. Ahlmann

Approved: T. Maniyan

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For information only!

HEAT BALANCE DIAGRAM

Tanjung Kidurong CCPP

100% CCPP Load - MCL - Design Ambient Conditions

Fuel: Natural Gas

P_AMB 1.011 [bar] T_AMB 33.0 [°C] RH 85.00 [%]

GT Data: TJK-11-G-MB------EN-CA-001-en / Case 1 / Col D

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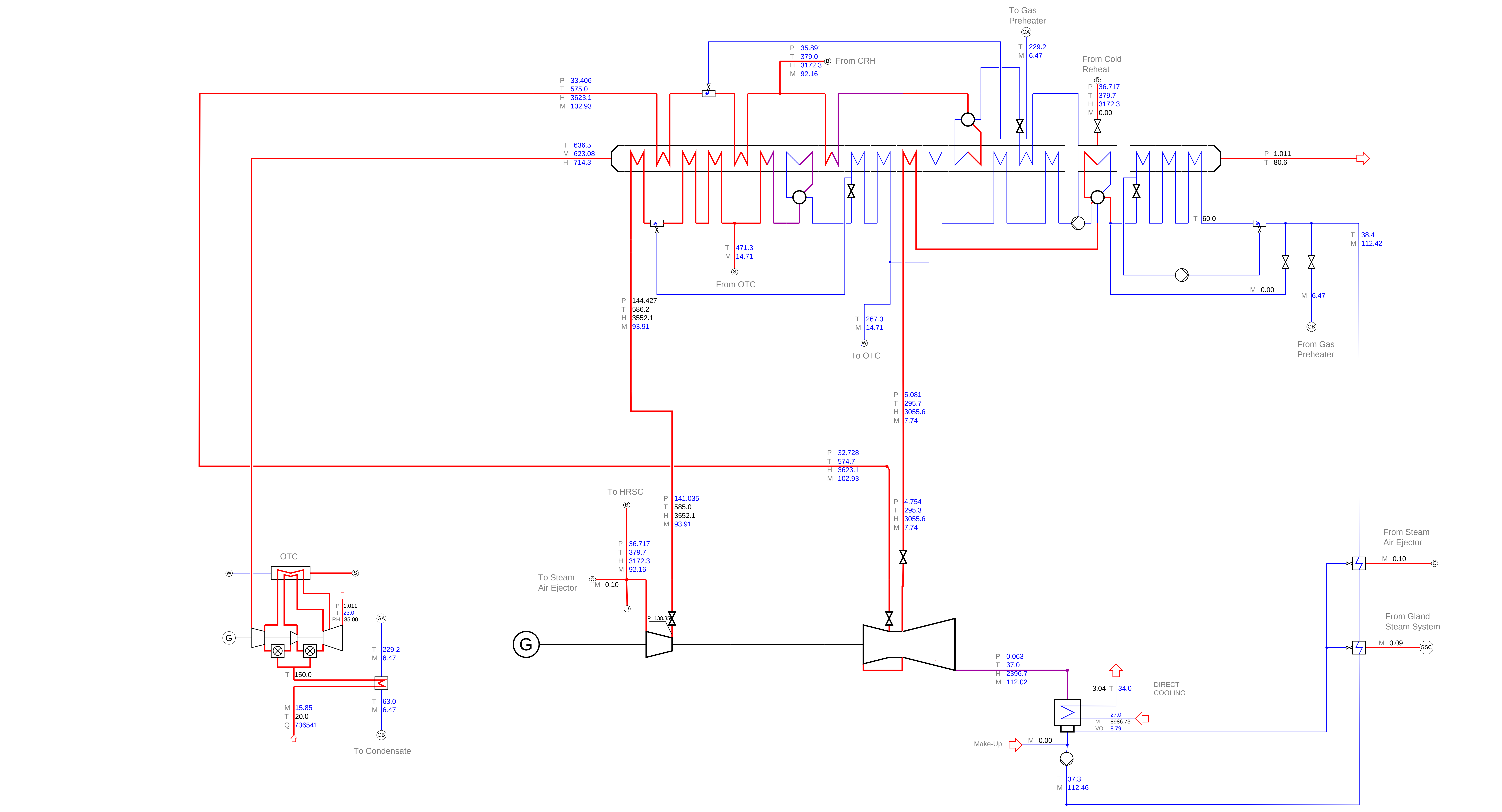

FUEL: Natural Gas

LHV 46457 kJ/kg
PF 0.85 [-]

P	Pressure	bar
M	Mass flow	kg/s
T	Temperature	°C
H	Enthalpy	kJ/kg

COMBINED CYCLE PERFORMANCES

GT_Output	276950	kW Elec.
ST_Output	165470	kW Elec.
Gross_Output	442421	kW Elec.
Gross_Heat_Rate	5993	kJ/kWh
Gross_Efficiency	60.07	%

Drawn: G. Moore
Revision:
Checked: H. Ahlmann
Approved: T. Maniyan
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HEAT BALANCE DIAGRAM

Tanjung Kidurong CCPP
100% CCPP Load - MCL - Min Ambient Conditions
Fuel: Natural Gas
P_AMB 1.011 [bar] T_AMB 23.0 [°C] RH 85.00 [%]
GT Data: TJK-11-G-MB------EN-CA-001-en / Case 24 / Col AA

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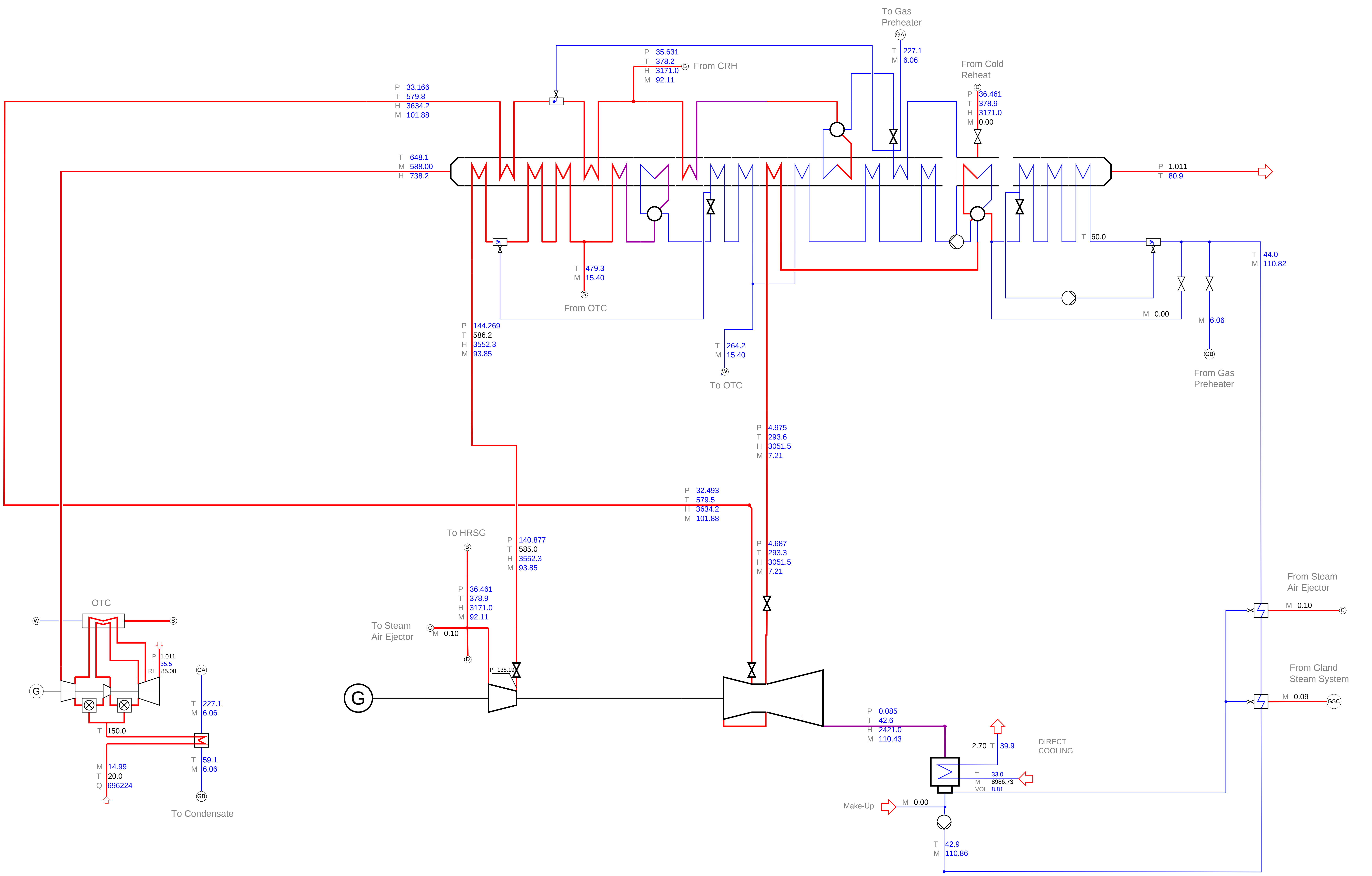

FUEL: Natural Gas

LHV 46457 kJ/kg

PF 0.85 [-]

P	Pressure	bar
M	Mass flow	kg/s
T	Temperature	°C
H	Enthalpy	kJ/kg

COMBINED CYCLE PERFORMANCES

GT_Output	252249	kW Elec.
ST_Output	162370	kW Elec.
Gross_Output	414618	kW Elec.
Gross_Heat_Rate	6045	kJ/kWh
Gross_Efficiency	59.55	%

Drawn: G. Moore

Revision:

Checked: H. Ahlmann

Approved: T. Maniyan

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HEAT BALANCE DIAGRAM

Tanjung Kidurong CCPP

100% CCPP Load - MCL - Max Ambient Conditions

Fuel: Natural Gas

P_AMB 1.011 [bar] T_AMB 35.5 [°C] RH 85.00 [%]

GT Data: TJK-11-G-MB------EN-CA-001-en / Case 36 / Col AM

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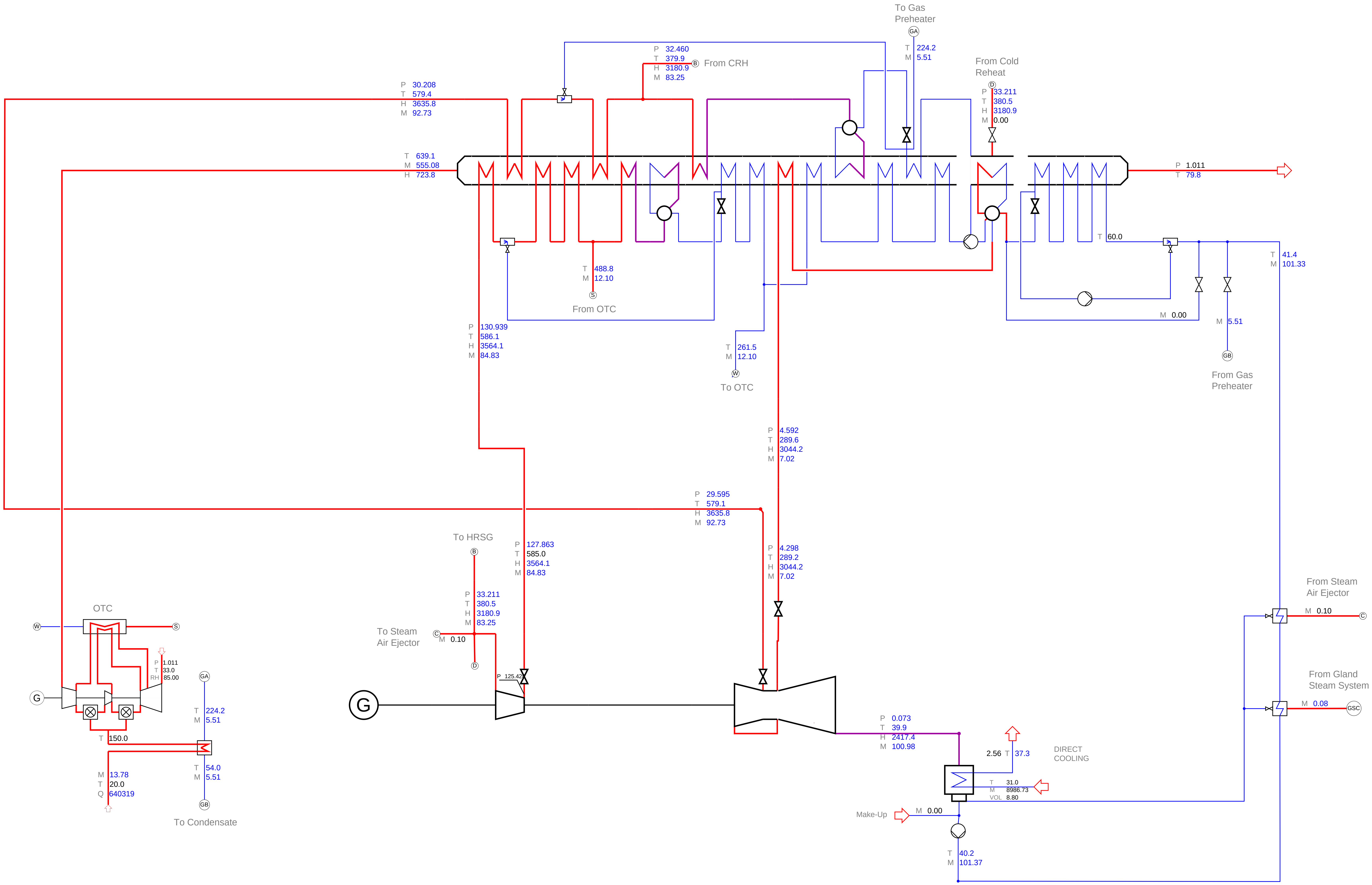

FUEL: Natural Gas

LHV	46457	kJ/kg
PF	0.85	[-]

P	Pressure	bar
M	Mass flow	kg/s
T	Temperature	°C
H	Enthalpy	kJ/kg

COMBINED CYCLE PERFORMANCES

GT_Output	231710	kW Elec.
ST_Output	148377	kW Elec.
Gross_Output	380087	kW Elec.
Gross_Heat_Rate	6065	kJ/kWh
Gross_Efficiency	59.36	%

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Approved: T. Maniyan
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HEAT BALANCE DIAGRAM

Tanjung Kidurong CCPP

90% CCPP Load - Design Conditions

Fuel: Natural Gas

P_AMB 1.011 [bar] T_AMB 33.0 [°C] RH 85.00 [%]

GT Data: TJK-11-G-MB------EN-CA-001-en / Case 6 / Col I

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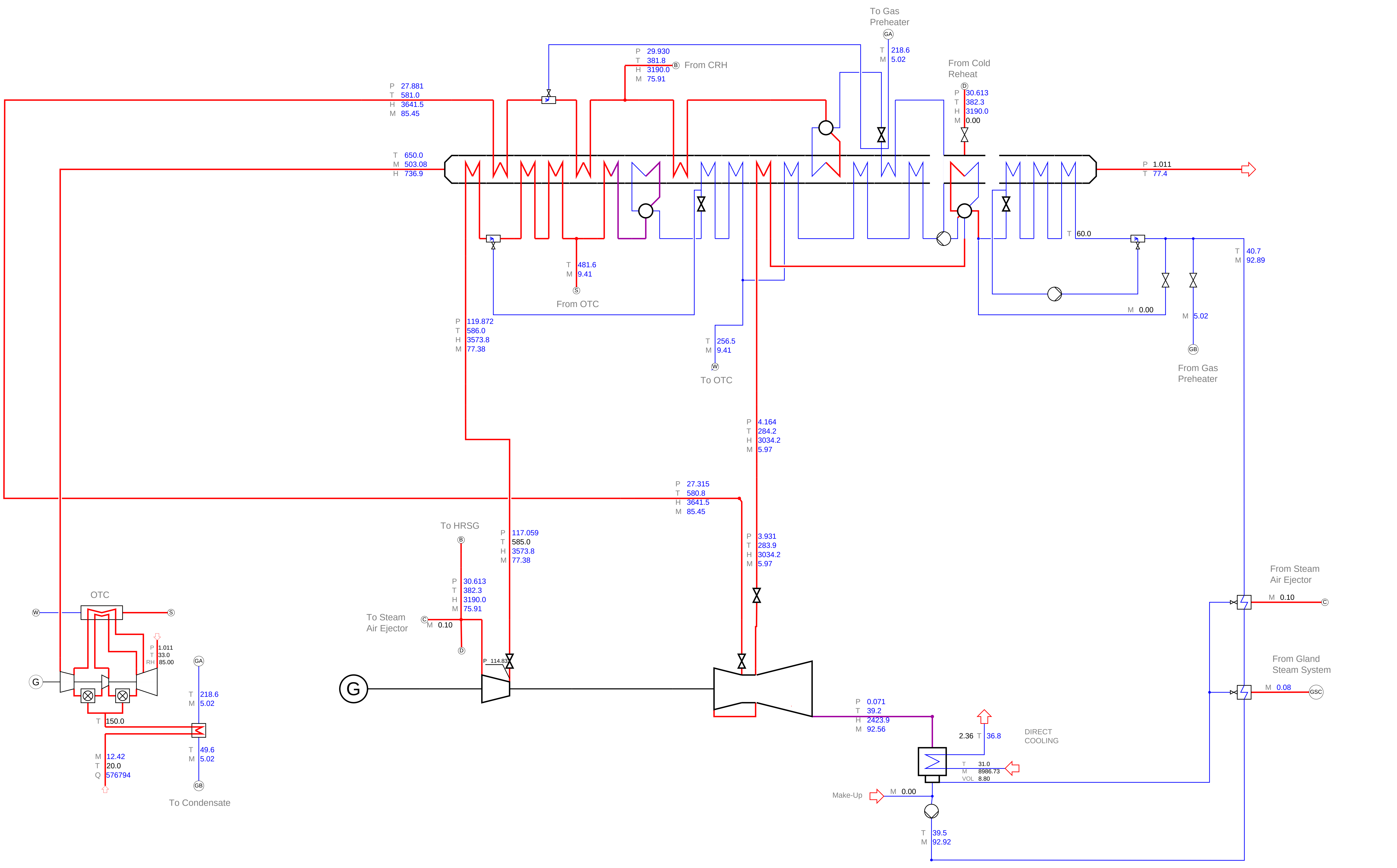

FUEL: Natural Gas

LHV 46457 kJ/kg
PF 0.85 [-]

P	Pressure	bar
M	Mass flow	kg/s
T	Temperature	°C
H	Enthalpy	kJ/kg

COMBINED CYCLE PERFORMANCES

GT_Output	202778	kW Elec.
ST_Output	135886	kW Elec.
Gross_Output	338664	kW Elec.
Gross_Heat_Rate	6131	kJ/kWh
Gross_Efficiency	58.71	%

Drawn: G. Moore
Revision:
Checked: H. Ahlmann
Approved: T. Maniyan
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HEAT BALANCE DIAGRAM

Tanjung Kidurong CCPP

80% CCPP Load - Design Ambient Conditions

Fuel: Natural Gas

P_AMB 1.011 [bar] T_AMB 33.0 [°C] RH 85.00 [%]

GT Data: TJK-11-G-MB------EN-CA-001-en / Case 9 / Col L

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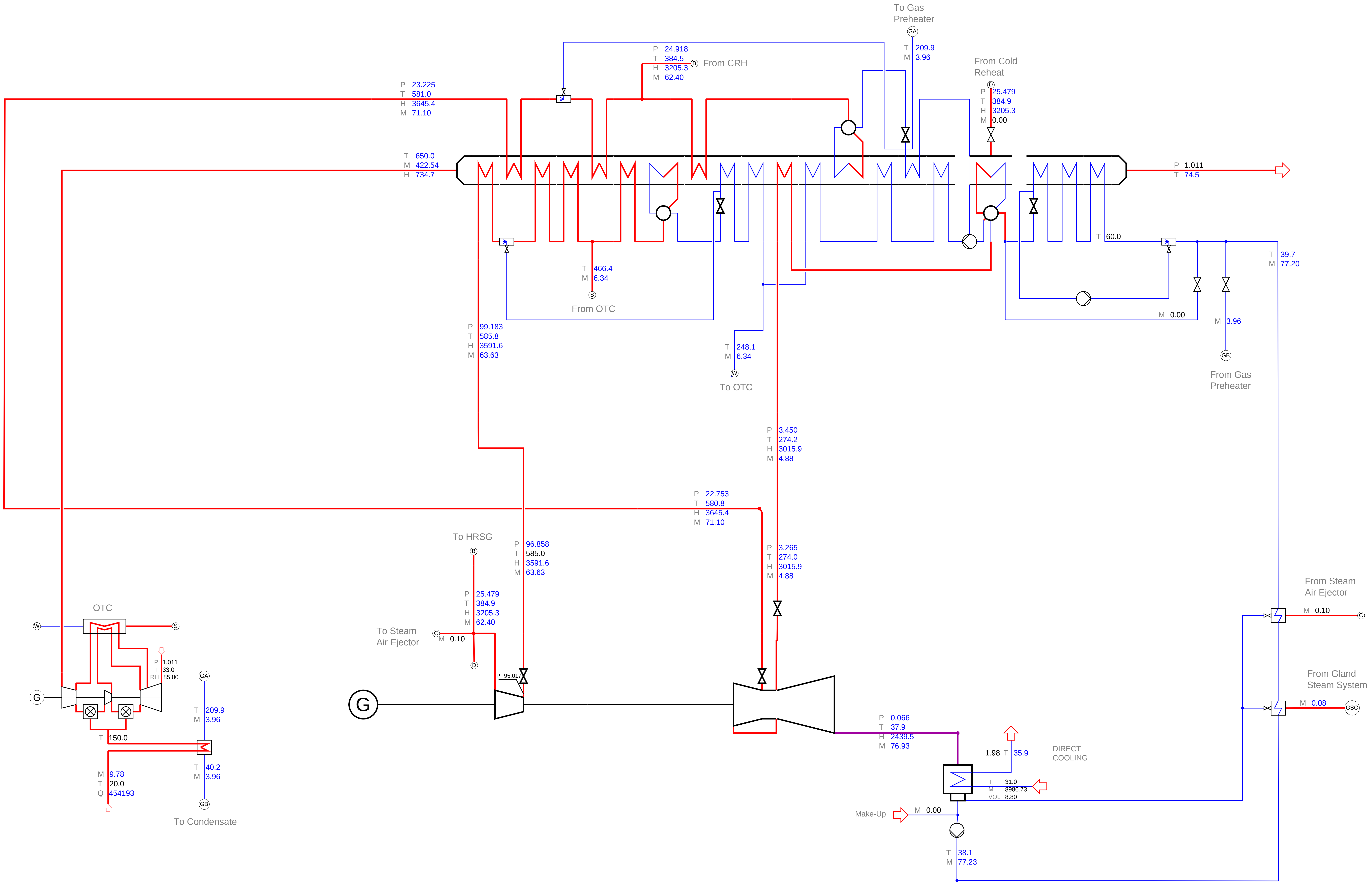

FUEL: Natural Gas

LHV 46457 kJ/kg

PF 0.85 [-]

P	Pressure	bar
M	Mass flow	kg/s
T	Temperature	°C
H	Enthalpy	kJ/kg

COMBINED CYCLE PERFORMANCES

GT_Output	143404	kW Elec.
ST_Output	111648	kW Elec.
Gross_Output	255052	kW Elec.
Gross_Heat_Rate	6411	kJ/kWh
Gross_Efficiency	56.16	%

Drawn: G. Moore

Revision:

Checked: H. Ahlmann

Approved: T. Maniyan

For information only!

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HEAT BALANCE DIAGRAM

Tanjung Kidurong CCPP

60% CCPP Load - Design Ambient Conditions

Fuel: Natural Gas

P_AMB 1.011 [bar] T_AMB 33.0 [°C] RH 85.00 [%]

GT Data: TJK-11-G-MB------EN-CA-001-en / Case 12 / Col O

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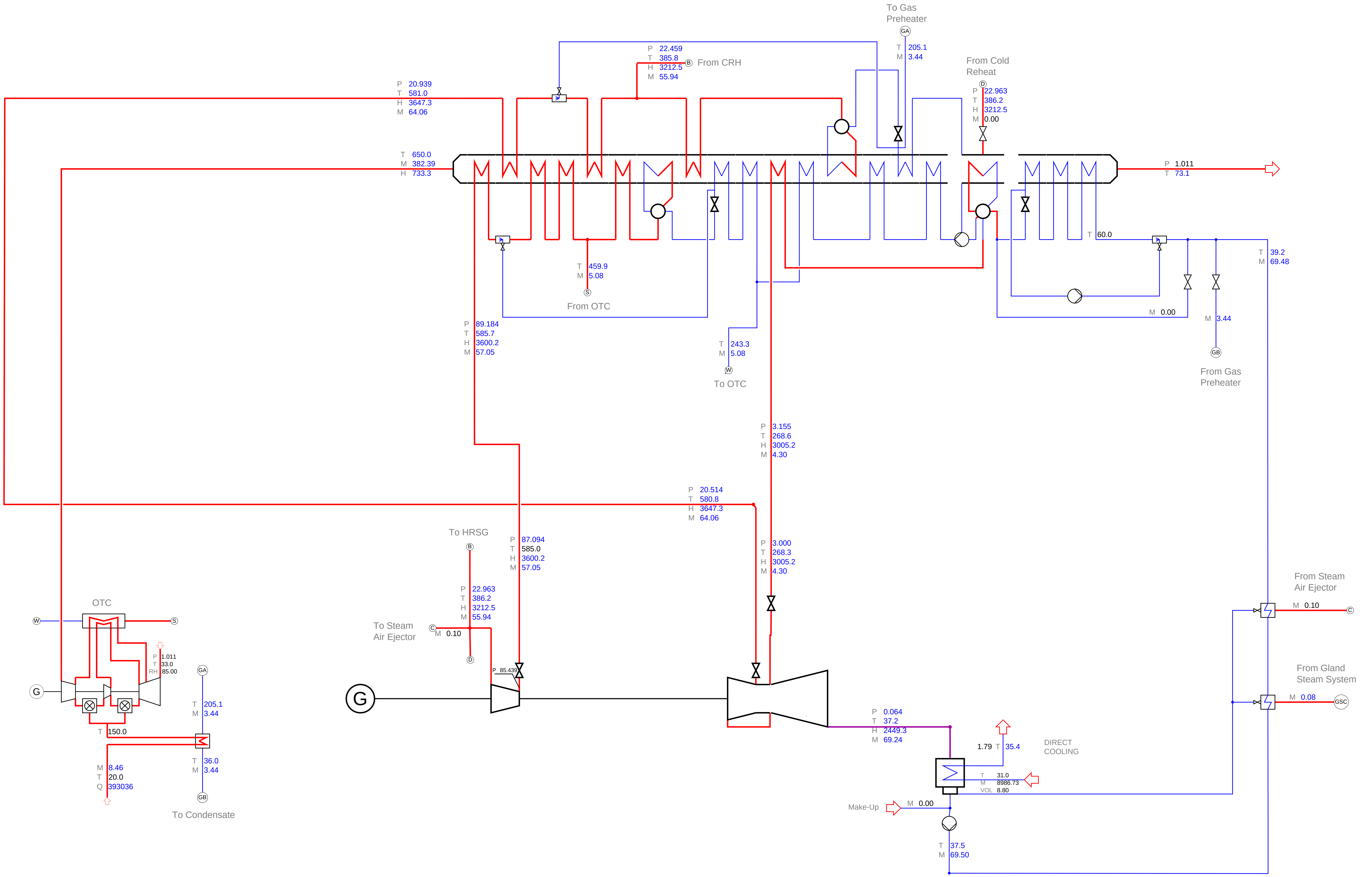

FUEL: Natural Gas

LHV 46457 kJ/kg
PF 0.85 [-]

P	Pressure	bar
M	Mass flow	kg/s
T	Temperature	°C
H	Enthalpy	kJ/kg

COMBINED CYCLE PERFORMANCES

GT_Output	113213	kW Elec.
ST_Output	99771	kW Elec.
Gross_Output	212984	kW Elec.
Gross_Heat_Rate	6643	kJ/kWh
Gross_Efficiency	54.19	%

Drawn: G. Moore
Revision:
Checked: H. Ahlmann
Approved: T. Maniyan
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For information only!

HEAT BALANCE DIAGRAM

Tanjung Kidurong CCPP

45% GT Load - MECL - Design Ambient Conditions

Fuel: Natural Gas

P_AMB 1.011 [bar] T_AMB 33.0 [°C] RH 85.00 [%]

GT Data: TJK-11-G-MB------EN-CA-001-en / Case 70 / Col BU

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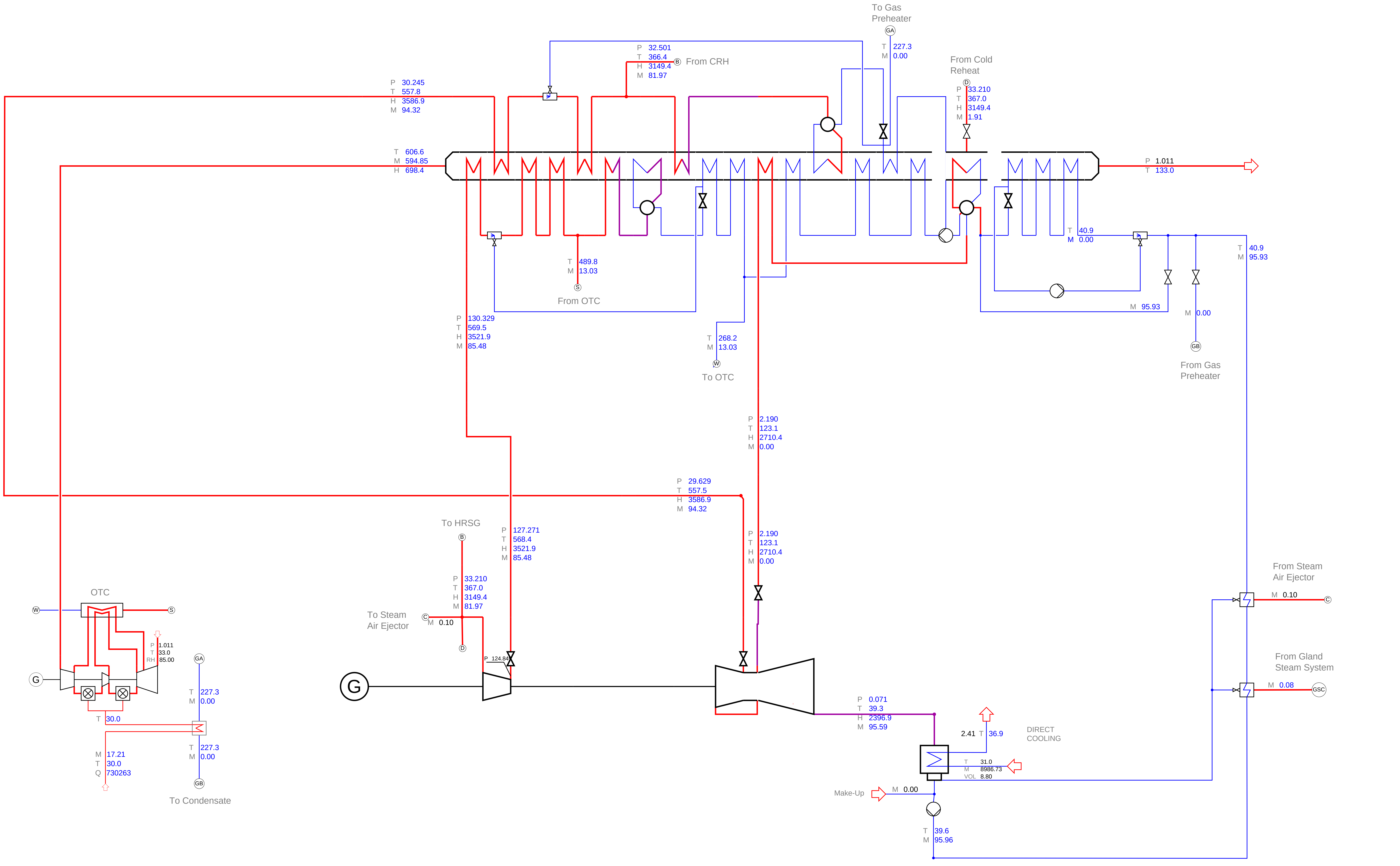

FUEL: Fuel Oil

LHV	42434	kJ/kg
PF	0.85	[-]

P	Pressure	bar
M	Mass flow	kg/s
T	Temperature	°C
H	Enthalpy	kJ/kg

COMBINED CYCLE PERFORMANCES

GT_Output	247588	kW Elec.
ST_Output	142630	kW Elec.
Gross_Output	390218	kW Elec.
Gross_Heat_Rate	6737	kJ/kWh
Gross_Efficiency	53.44	%

Drawn: G. Moore
Revision:
Checked: H. Ahlmann
Approved: T. Maniyan
Doc: Format: Lang: E Sheet: No of Sh:

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HEAT BALANCE DIAGRAM

Tanjung Kidurong CCPP

100% CCPP Load - FO - Design Ambient Conditions

Fuel: Fuel Oil

P_AMB 1.011 [bar] T_AMB 33.0 [°C] RH 85.00 [%]

GT Data: TJK-11-G-MB------EN-CA-001-en / Case 183 / Col GD

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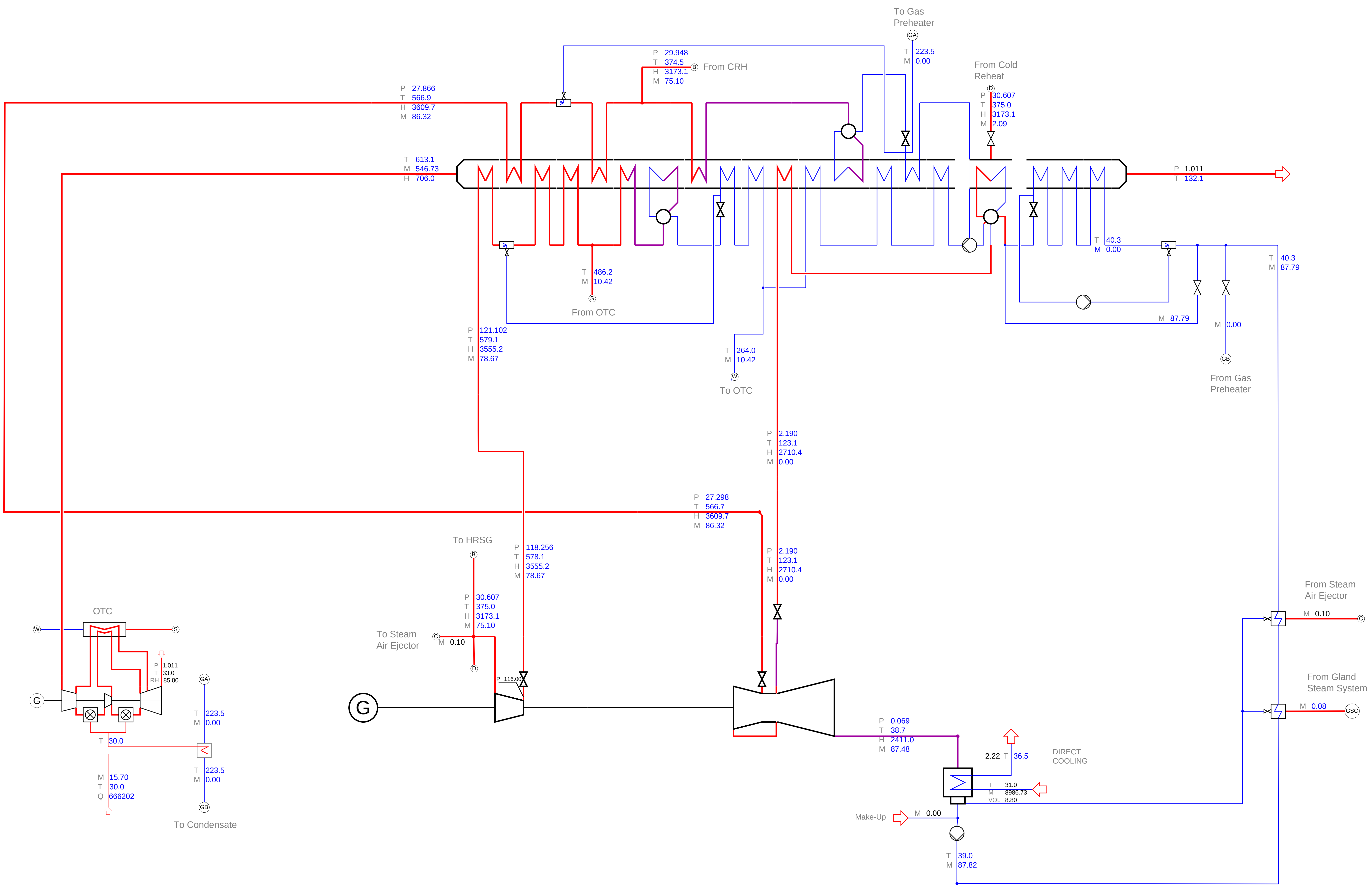

FUEL: Fuel Oil

LHV 42434 kJ/kg

PF 0.85 [-]

P	Pressure	bar
M	Mass flow	kg/s
T	Temperature	°C
H	Enthalpy	kJ/kg

COMBINED CYCLE PERFORMANCES

GT_Output	221591	kW Elec.
ST_Output	132083	kW Elec.
Gross_Output	353675	kW Elec.
Gross_Heat_Rate	6781	kJ/kWh
Gross_Efficiency	53.09	%

Drawn: G. Moore

Revision:

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Approved: T. Maniyan

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HEAT BALANCE DIAGRAM

Tanjung Kidurong CCPP

90% CCPP Load - FO - Design Ambient Conditions

Fuel: Fuel Oil

P_AMB 1.011 [bar] T_AMB 33.0 [°C] RH 85.00 [%]

GT Data: TJK-11-G-MB------EN-CA-001-en / Case 184 / Col GE

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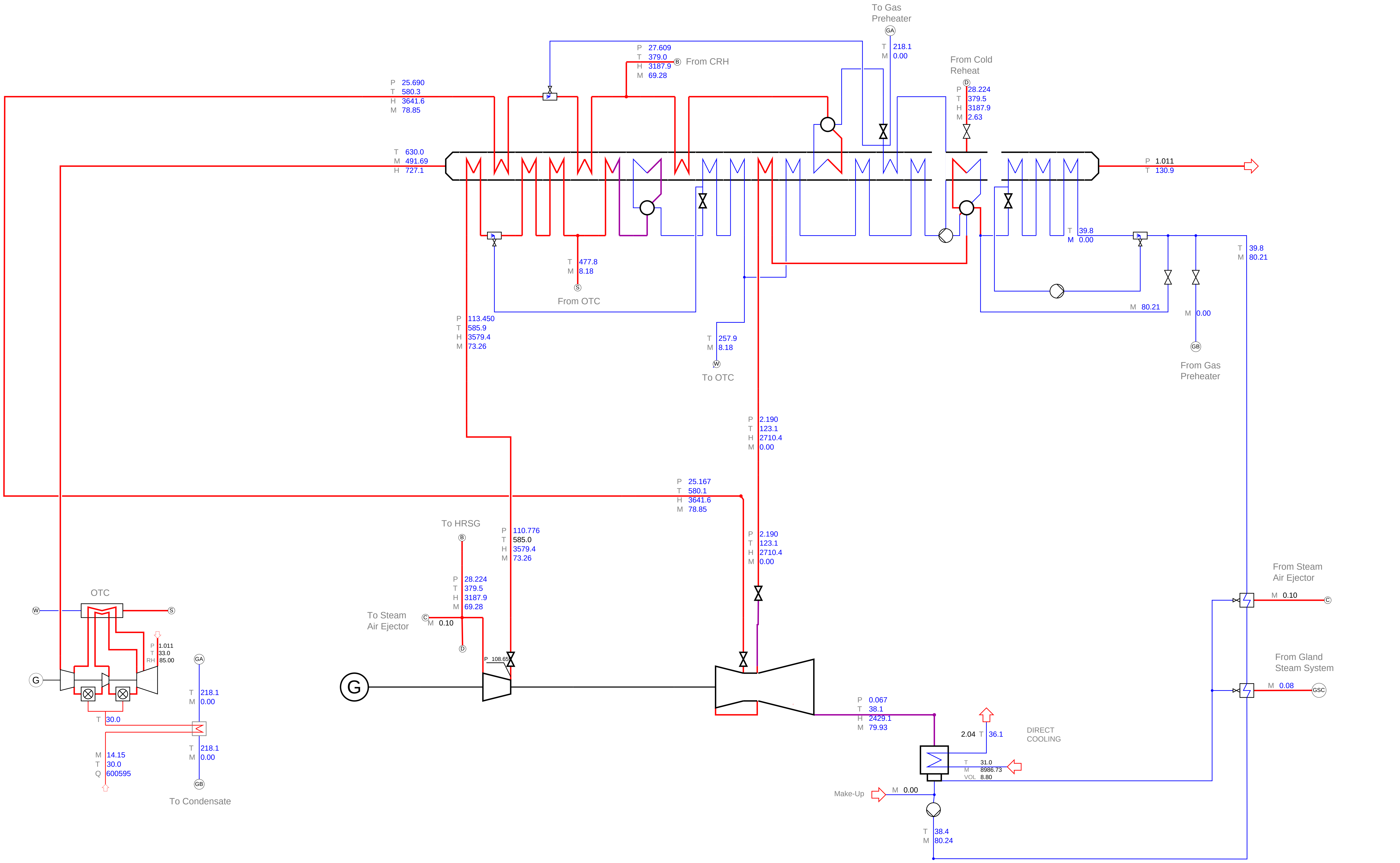

FUEL: Fuel Oil

LHV	42434	kJ/kg
PF	0.85	[-]

P	Pressure	bar
M	Mass flow	kg/s
T	Temperature	°C
H	Enthalpy	kJ/kg

COMBINED CYCLE PERFORMANCES

GT_Output	192376	kW Elec.
ST_Output	122824	kW Elec.
Gross_Output	315200	kW Elec.
Gross_Heat_Rate	6860	kJ/kWh
Gross_Efficiency	52.48	%

Drawn: G. Moore
Revision:
Checked: H. Ahlmann
Approved: T. Maniyan
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HEAT BALANCE DIAGRAM

Tanjung Kidurong CCPP

80% CCPP Load - FO - Design Ambient Conditions

Fuel: Fuel Oil

P_AMB 1.011 [bar] T_AMB 33.0 [°C] RH 85.00 [%]

GT Data: TJK-11-G-MB------EN-CA-001-en / Case 185 / Col GF

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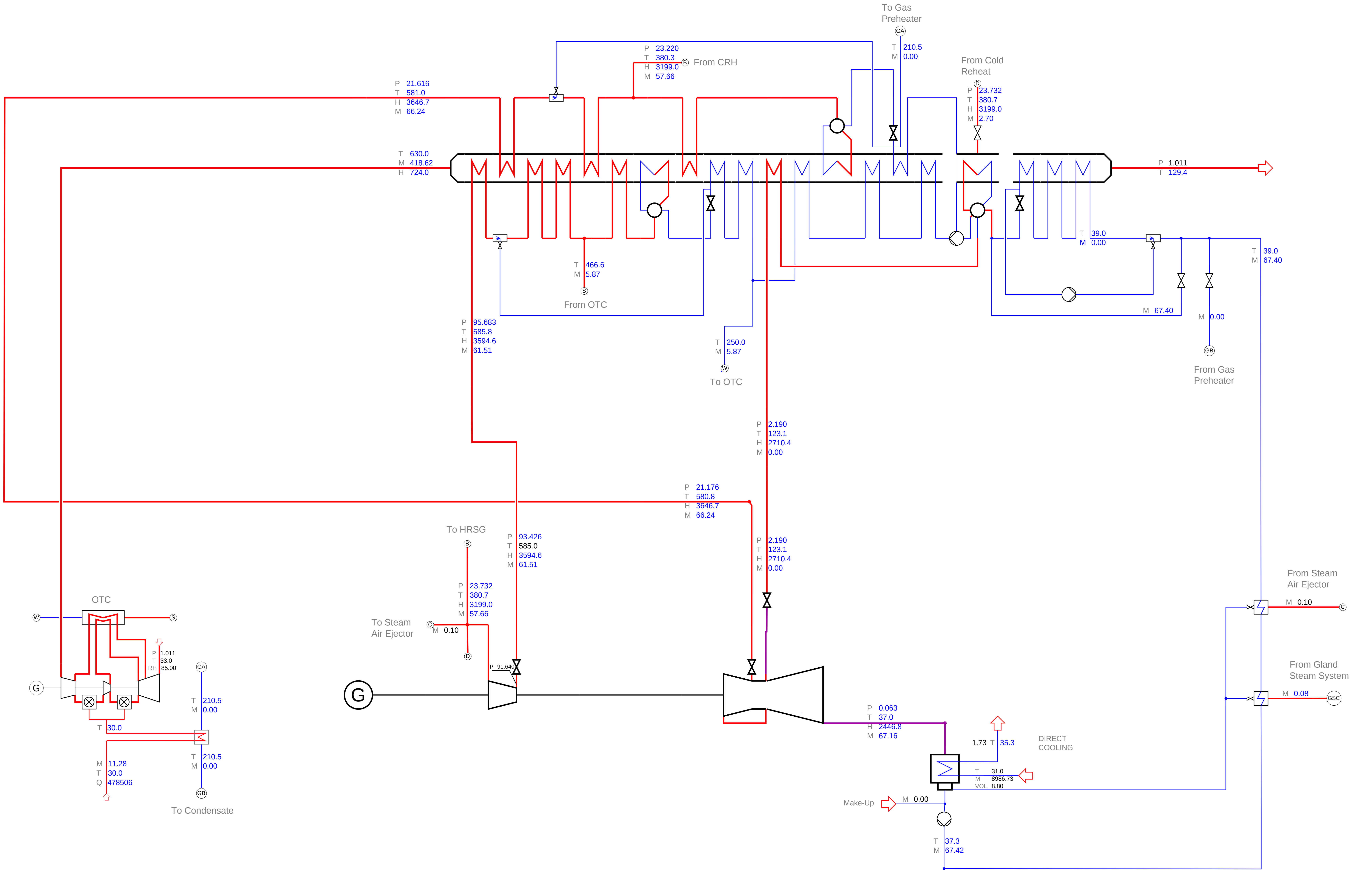

FUEL: Fuel Oil

LHV	42434	kJ/kg
PF	0.85	[-]

P	Pressure	bar
M	Mass flow	kg/s
T	Temperature	°C
H	Enthalpy	kJ/kg

COMBINED CYCLE PERFORMANCES

GT_Output	136421	kW Elec.
ST_Output	102353	kW Elec.
Gross_Output	238774	kW Elec.
Gross_Heat_Rate	7214	kJ/kWh
Gross_Efficiency	49.90	%

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Approved: T. Maniyan
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HEAT BALANCE DIAGRAM

Tanjung Kidurong CCPP

60% CCPP Load - FO - Design Ambient Conditions

Fuel: Fuel Oil

P_AMB 1.011 [bar] T_AMB 33.0 [°C] RH 85.00 [%]

GT Data: TJK-11-G-MB------EN-CA-001-en / Case 186 / Col GG

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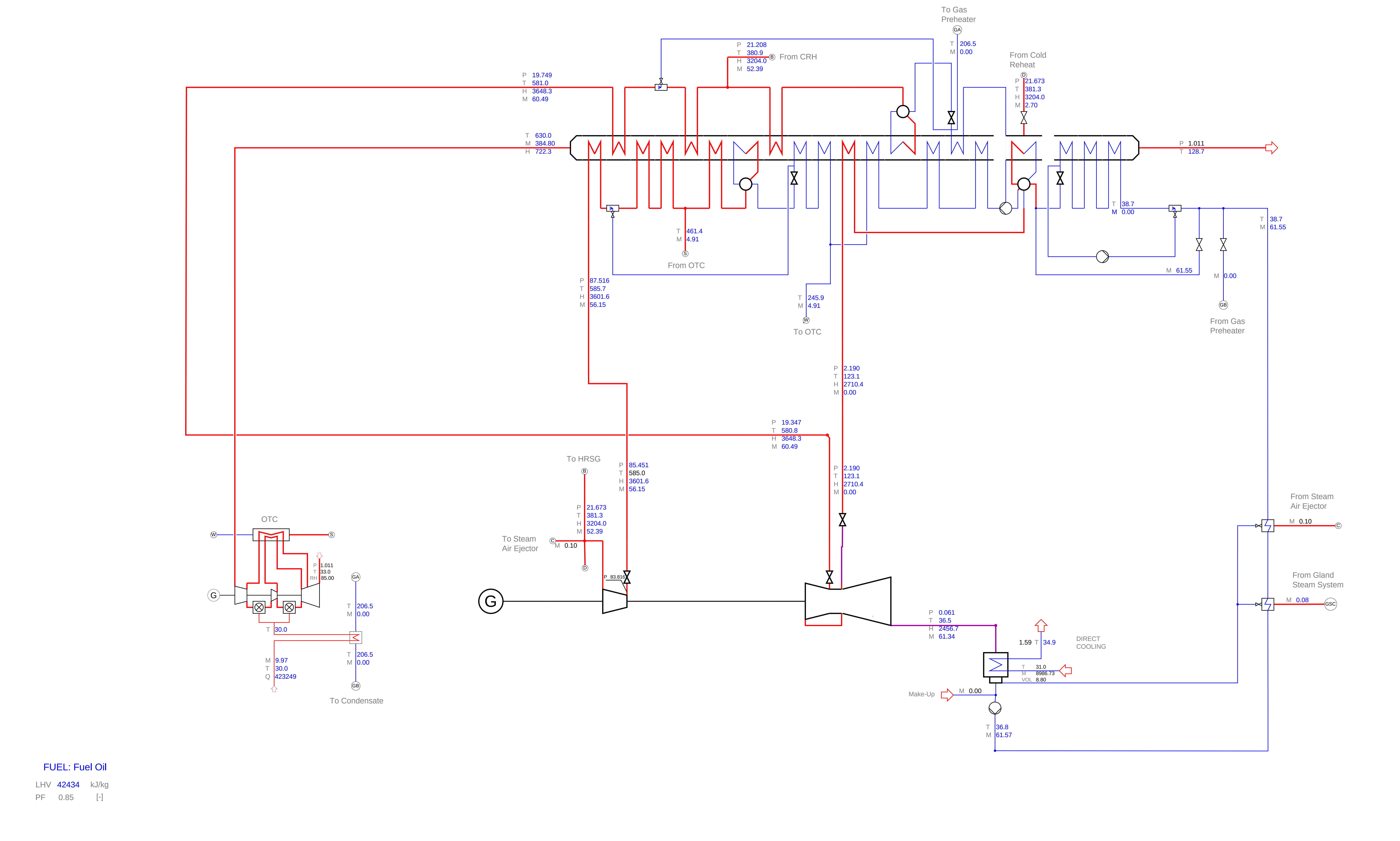

P	Pressure	bar
M	Mass flow	kg/s
T	Temperature	°C
H	Enthalpy	kJ/kg

COMBINED CYCLE PERFORMANCES

GT_Output	111415	kW Elec.
ST_Output	92924	kW Elec.
Gross_Output	204338	kW Elec.
Gross_Heat_Rate	7457	kJ/kWh
Gross_Efficiency	48.28	%

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Revision:
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Approved: T. Maniyan
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HEAT BALANCE DIAGRAM

Tanjung Kidurong CCPP

45% GT Load - MECL - FO - Design Ambient Conditions

Fuel: Fuel Oil

P_AMB 1.011 [bar] T_AMB 33.0 [°C] RH 85.00 [%]

GT Data: TJK-11-G-MB------EN-CA-001-en / Case 211 / Col HF

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Appendix 3.5.1

Specification for Natural Gas

ATTACHMENT E-2 NATURAL GAS SPECIFICATION

Natural Gas supplied to Tanjung Kidurong Power Station is from three (3) gas fields of specifications as tabulated below. The overall fuel gas composition received at the Power Station will depend on the production attributed by each field at the time.

Properties		**Measured Units**	**Specification**		
			E11	**F6**	**F23**
Methane	CH_4	%-mol	86.75	88.86	89.93
Ethane	C_2H_6	%-mol	2.4	3.99	3.33
Propane	C_3H_8	%-mol	1.27	2.8	2.34
i-BUTANE	$C_4H_{10}i$	%-mol	0.27	0.74	0.6
n-BUTANE	$C_4H_{10}n$	%-mol	0.28	0.76	0.52
i-PENTANE	$C_5H_{12}i$	%-mol	0.12	0.31	0.21
n-PENTANE	$C_5H_{12}n$	%-mol	0.08	0.19	0.11
Hexane+	$C_6H_{14}+$	%-mol	0.23	0.33	0.24
Carbon dioxide	CO_2	%-mol	7.34	1.51	2.16
Nitrogen	N_2	%-mol	1.26	0.51	0.56
Water (overall moisture content)	H_2O	vppm	80 to 90	80 to 90	80 to 90
Dew point		°C	-5 to -10	-5 to -10	-5 to -10
Lower Heating Value (LHV) at 20°C		kJ/kg	40,459	47,154	46,464
Higher Heating Value (HHV) at 25°C		kJ/kg	44,798	52,110	51,390
Wobbe Index (WI = HHV/sqrt(SG)) at 25°C		kJ/m3	44,191	50,832	49,656
Specific gravity relative to air (SG) at 20°C			0.67	0.66	0.64

Note:
1. Sulphur content in the Natural Gas is negligible.

2. Further to the Natural Gas specifications of the three (3) gas fields, the following values are to be used for design and performance guarantees.

Design Fuel Gas			
Properties		**Measured Units**	**Value**
Methane	CH4	%-mol	89.93
Ethane	C2H6	%-mol	3.33
Propane	C3H8	%-mol	2.34
i-BUTANE	C4H10i	%-mol	0.60
n-BUTANE	C4H10n	%-mol	0.52
i-PENTANE	C5H12i	%-mol	0.21
n-PENTANE	C5H12n	%-mol	0.11
Hexane+	C6H14+	%-mol	0.24
Carbon dioxide	C02	%-mol	2.16
Nitrogen	N2	%-mol	0.56
Particulate size		11m	max 10
Particulate quantity		ppm	max 3
Oil mist/vapour			Negligible
Hydrocarbon dewpoint		·C	max 12.78
Hydrocarbon dewpoint		bar	49.3
Trace Metals:			
Sodium and Potassium	Na + K	ppm	max 0.5
Lead	Pb	ppm	max 1
Magnesium	Mig	ppm	max 2
Calcium	Ca	ppm	max 2
Lower Heating Value @2o·c		kJ/kg	46,464
Fuel Gas Pressure		barg	56
Fuel Gas Temperature		·C	20

Appendix 3.5.2

Specification for Diesel Oil

ATTACHMENT E-3 DIESEL OIL SPECIFICATION

Diesel Oil from local fuel suppliers supplied to Tanjung Kidurong Power Station is as tabulated below.

Properties	Test Method	Measured Units	Specification	Typical Value
Trade Name	-	-	Shell Diesoline	
Density @ 15°C	ASTM D4052	kg/l	max. 0.81 max. 0.87	0.84
Cetane Number	ASTM D613		min. 49	52
Kinematic Viscosity @ 40°C	ASTM D445	cSt	min. 1.5 max. 5.8	3.0
Sulphur	ASTM D4294	%wt	0.05	<0.05
Water	ASTM D95	% v	0.05	<0.05
Sediment	ASTM D473	%wt	0.01	<0.01
Carbon Residue, Conradson (on 10% bottom)	ASTM D4530	%wt	max. 0.2	<0.2
Ash	ASTM D482	%wt	0.01	<0.01
Flash Point, PMCC	ASTM D93	°C	min. 60	74
Pour Point	ASTM D97	°C	Max. 15	0
Copper Corrosion (3hr/100°C)	ASTM D130	°C	max. 1	--
Distillation @95%v recovery	ASTM D86	°C	Max.370	--
Distillation:				
Recovered at 300°C		%v	min. 40	
Recovered at 357°C		%v	min. 85	
Gross Calorific Value	ASTM D4868	MJ/kg	To be calculated for each batch	45
Sodium + Potassium (Na + K)	IP288	ppm	Shell does nots limit specific metal contents, however, typical values are as stated.	<0.4
Lead (Pb)	IP288	ppm		<0.01
Vanadium (V)	IP288	ppm		<0.09
Calcium (Ca)	IP288	ppm		<0.1

Note: 1. Shell Diesoline exceeds MS123:2005 (Euro IIM) standards 2. Only Shell specification limit values are guaranteed. Typical values are obtained from result of sample testing. Typical values are for information only and may change if Shell Diesoline product conditions differ.		
Further to the Diesel oil specification as provided by the local fuel supplier the following values are to be used for design and performance guarantees.		
Design Fuel Oil		
Properties	**Measured Units**	**Value**
Carbon	%wt	86
Hydrogen	%wt	13.94
Sulphur	%wt	0.05
Ash	%wt	0.01
Lower Heating Value @30°C	MJ/kg	42.434
Fuel Oil Temperature	°C	30

Appendix 3.6.1

Overall Noise Protection Method

4. NOISE CONTROL REQUIREMENTS

4.1. Gas Turbine Building

4.1.1. Cladding

The gas turbine building walls and roof must provide a minimum sound reduction index Rw = 26 dB, with the following sound transmission loss spectrum:

Frequency/oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
TL / dB	4	8	15	18	23	25	30	35	38

Furthermore, the cladding of gas turbine building has to be designed with a sound absorbing inner liner (minimum 50 mm mineral wool or 50 mm Heraklith or adequate products) in order to obtain a sufficient absorption area inside the building and to limit the noise level build-up due to reflecting sound. At least 70% of the total wall area shall be absorbent.

4.1.2. Ventilation Equipment

- Roof Fans

The total sound power level of all roof fans including noise emitted by the Gas turbine unit shall not exceed:

Sound Power Level Pref. = 10^{-12}W

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	115	117	113	113	110	103	98	95	91	111

In addition, the surface sound pressure level (free field conditions) inside the gas turbine building will not exceed 82 dB(A) at a distance of 1 m from each indoor fan sleeve.

- Air Intake Louvers

No acoustical measures are necessary, standard weather protection only.

4.1.3. Gas Turbine Unit

The combustion turbine, the exhaust diffuse including manhole to bearing No 1 and the air intake manifold shall be equipped with an acoustical enclosure.

The unattenuated sound power level of the gas turbine including diffuser and air intake manifold is:

Sound Power Level Pref. = 10^{-12}W

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	106	108	110	112	112	122	121	119	113	127

The surface sound pressure level at a distance of 1 m from the enclosure of the gas turbine unit (free field conditions) will not exceed:

Surface Sound Pressure Level (free field conditions) pref. = $2x10^{-5}$Pa

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	98	97	96	80	72	70	67	62	58	82

4.1.4. Gas Turbine Generator

The generator of the gas turbine unit (type TOP AIR) located indoor, shall be equipped with an acoustical enclosure in order to maintain the noise limits.

The unattenuated sound power level of one generator is:

Sound Power Level Pref. = 10^{-12}W

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	104	116	121	114	113	113	110	107	101	118

The sound power level of the generator enclosure including ventilation shall not exceed:

Sound Power Level Pref. = 10^{-12}W

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	112	114	113	99	93	88	88	84	80	100

The maximum surface sound pressure level (free field conditions) at a distance of 1m from the generator and 1.5m above ground or personnel platform will not exceed 85 dB(A). To reach this level and to avoid stationary wave a complete sound enclosure shall be provided.

4.1.5. Gas Turbine Auxiliaries – Fuel Gas Control Block

For the fuel gas control valve block, sound absorbing walls have to be used on both accessible sides (long sides in direction of combustion turbine and in direction of lube oil system). Furthermore, the double floor between fuel gas block and combustion turbine enclosure has to be lined with a sound absorbing material (see also HZX-VB 8307).

Alternatively, to the fuel gas control valve block sound absorbing walls, the entire auxiliary system (auxiliary block and control valve block) may be enclosed.

4.1.6. Gas Turbine Air Inlet Duct (indoor part)

The maximum surface sound pressure level (free field conditions) of the air inlet duct (indoor part) at a distance of 1 m will be limited to 85 dB(A).

4.1.7. Other Gas Turbine building indoor equipment

The maximum surface sound pressure level (free field conditions) at a distance of 1m from all equipment other than mentioned above located inside the Turbine building, will be limited to 85 dB(A).

Low noise type control valves and acoustic insulation on blowdown tank and related downstream pipes should be necessary to achieve this requirement.

4.2. Steam Turbine Building

4.2.1. <u>Cladding</u>

The steam turbine building walls and roof must provide a minimum sound reduction index Rw = 26 dB, with the following sound transmission loss spectrum:

Frequency/oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
TL / dB	4	8	15	18	23	25	30	35	38

Furthermore, the cladding of steam turbine building has to be designed with a sound absorbing inner liner (minimum 50 mm mineral wool or 50 mm Heraklith or adequate products) in order to obtain a sufficient absorption area inside the building and to limit the noise level build-up due to reflecting sound. At least 70% of the total wall area shall be absorbent.

4.2.2. <u>Ventilation Equipment</u>

- Roof Fans

The total sound power level of all roof fans including noise emitted by the Steam turbine unit (Average sound pressure level of 101 dB(A) inside the Steam turbine building during steam turbine bypass operation) shall not exceed:

Sound Power Level Pref. = 10^{-12}W

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	115	117	113	113	110	103	98	95	91	111

In addition, the surface sound pressure level (free field conditions) inside the steam turbine building will not exceed 82 dB(A) at a distance of 1 m from each indoor fan sleeve.

- Air Intake Louvers

No acoustical measures are necessary, standard weather protection only.

4.2.3. <u>Steam Turbine Unit</u>

The steam turbine, have to fulfil the requirement of a surface sound pressure level of 85 dB(A) at 1 m distance during the continuous base load operation, Therefore, no additional measures are necessary.

4.2.4. <u>Main Condenser</u>

The maximum sound power level emitted by each condenser set shall be limited to:

Sound Power Level Pref. = 10^{-12}W

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	113	113	121	108	107	105	104	102	99	112

The condenser walls thickness must be designed in order that the emitted sound pressure level (free field conditions) at any point 1 m distance from the equipment will not exceed 85 dB(A) during normal operation.

4.2.5. Steam Turbine Generator

The generator of the Steam turbine unit which is located indoor shall be equipped with an acoustical enclosure in order to maintain the noise limits.

The unattenuated sound power level of the generator is:

Sound Power Level Pref. = 10^{-12}W

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	104	116	121	114	113	113	110	107	101	118

The sound power level of the steam turbine generator enclosure including ventilation shall not exceed:

Sound Power Level Pref. = 10^{-12}W

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	114	117	112	100	94	89	88	83	79	100

The maximum surface sound pressure level (free field conditions) at a distance of 1m from the generator and 1.5m above ground or personnel platform will not exceed 85 dB(A). To reach this level and to avoid stationary wave a complete sound enclosure shall be provided.

4.2.6. Condensate Pumps

The total sound power level of each vertical Condensate extraction pump set (2 x 100%) shall be limited to:

Sound Power Level Pref. = 10^{-12}W

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	93	93	98	101	99	98	96	88	79	103

In addition, the surface sound pressure level at 1 m distance (free field conditions) will not exceed 85 dB(A).

4.2.7. Service ejector

The sound power level of the insulated service ejector (2x100%) shall be limited to :

Sound Power Level Pref. = 10^{-12}W

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	107	102	100	96	85	83	89	93	93	98

In addition, the surface sound pressure level (free field conditions) at 1 m distance will not exceed 85 dB(A).

4.2.8. Other Steam Turbine building indoor equipment

The maximum surface sound pressure level (free field conditions) at a distance of 1m from all equipment other than mentioned above located inside the Turbine building, will be not exceed to 85 dB(A).

In particular, low noise type control valves and acoustic insulation on blowdown tank and related downstream pipes should be necessary to achieve this requirement.

4.3. Flue Gas System

4.3.1. Basic Data

The sound power level at the gas turbine exhaust amounts to:

Sound Power Level Pref. = 10^{-12}W

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	135	133	133	134	137	142	140	147	122	150

Due to high frequency attenuation mechanism in the turbulent flow, the sound power downstream the exhaust diffuser will be reduced.

For the design of the GT exhaust duct, diverter damper and the transition duct to the HRSG, the following sound power level shall be considered:

Sound Power Level Pref. = 10^{-12}W

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	135	133	133	134	137	142	136	139	106	145

4.3.2. General Requirement for the Exhaust System

Pure tones (as per ISO-1996-2) generated by the exhaust system itself are not permitted. The requirements below includes the noise generated by steam blow down as well as noise generated by the steam flow for the relevant part of the piping (pipes close to the HRSG inlet duct are part of the HRSG inlet duct,…)

4.3.3. Outdoor Spool Section & Diverter valve

The sound power level of outdoor spool section and diverter valve between the turbine building and the bypass stack shall not exceed.

Sound Power Level Pref. = 10^{-12}W

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	114	113	109	110	104	105	96	97	73	109

In addition, the surface sound pressure level in free field conditions at a distance of 1 m will not exceed 85 dB(A). at any point at a height of 1.5 m above the ground level or personnel platforms.

4.3.4. GT Bypass System (Simple Cycle Operation)

During operation in simple Cycle, the maximum sound power level emitted into the Bypass Stack, upstream to the silencer, by gas turbine exhaust amounts to:

Sound Power Level Pref. = 10^{-12}W

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	151	145	142	140	142	152	146	144	143	155

4.3.4.1. Bypass Stack Body

The sound power level of the gas turbine bypass stack body shall not exceed.

Sound Power Level Pref. = 10^{-12}W

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	95	93	99	105	98	91	73	65	64	100

4.3.4.2. Bypass Stack mouth

The sound power level at the gas turbine bypass stack mouth, including self-induced noise caused by the flow, shall not exceed:

Sound Power Level Pref. = 10^{-12}W

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	122	120	113	109	101	101	97	93	88	107

The height of the bypass stack is presumed with 40 m for this specification.

4.3.5. HRSG transition duct

The sound power level of the transition duct between the outlet flange of the Diverter damper and inlet of boiler body shall not exceed:

Sound Power Level Pref. = 10^{-12}W

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	121	113	106	99	96	97	90	93	63	101

In addition, the surface sound pressure level in free field conditions at a distance of 1 m will not exceed 85 dB(A). at any point at a height of 1.5 m above the ground level or personnel platforms.

4.3.6. Heat Recovery Steam Generator (HRSG)

The sound power level of the boiler between the outlet flange of the HRSG transition duct and stack, shall not exceed :

Sound Power Level Pref. = 10^{-12}W

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	116	109	102	96	93	92	83	84	66	96

In addition, the sound pressure level in free field conditions will not exceed 85 dB(A) at a distance of 1 m from the outline of the whole HRSG equipment set (including the blow down tank).

Steam flow generated noise radiated from pipes, valves, cleaning process, blow down tank (continuous operation), etc. is included in the sound power level given above.

4.3.7. Stack Body

The sound power level of the HRSG stack body including self-induced noise caused by the flow shall not exceed:

Sound Power Level Pref. = 10^{-12}W

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	101	101	104	106	96	94	84	84	82	101

In addition, the sound pressure level in free field conditions at a distance of 1 m from the HRSG stack will not exceed 85 dB(A) max. at any point at a height of 1.5 m above the ground level or personnel platforms.

4.3.8. Stack mouth

The sound power level at the HRSG stack mouth, including self-induced noise caused by the flow, shall not exceed.

Sound Power Level Pref. = 10^{-12}W

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	125	125	122	119	115	110	90	87	85	116

The height of the stack is presumed with 60 m for this specification. In case of the stack height will be below 60 m, this specification would be invalid.

4.4. Air Inlet System

4.4.1. Basic Data

The sound power level at the GT compressor inlet with an air intake manifold equipped with an absorbing inner liner, amounts to:

Sound Power Level Pref. = 10^{-12}W

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	114	117	120	122	126	143	140	139	137	147

4.4.2. Air Inlet Cross Section

The sound power level at the air inlet cross section including self-induced noise caused by the flow through silencer, filter and weather protection, shall not exceed the following spectrum:

Sound Power Level Pref. = 10^{-12}W

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	107	114	113	106	97	103	94	99	105	109

4.4.3. Gas Turbine Air Intake Duct (outdoor part)

To achieve the far field noise requirements and to prevent a pure tone generation, the air intake silencer has to be located inside the Gas Turbine Hall. In this case, the sound emissions of the air intake duct outdoor section and filter house walls should not exceed the following spectrum:

Sound Power Level Pref. = 10^{-12}W

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	90	87	80	81	81	103	93	83	72	104

4.5. Transformers

4.5.1. Main Transformers

The sound power level of each step-up transformer unit must be below:

Sound Power Level Pref. = 10^{-12}W

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	105	107	107	104	104	98	93	88	81	104

In addition to the requirement given above, the surface sound pressure level (free field conditions) at a distance of 1 m from the duct, will not exceed 85 dB(A).

4.5.2. Unit / Service / Auxiliary Transformers

The sound power level emitted by each station service transformer shall be limited to:

Sound Power Level Pref. = 10^{-12}W

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	95	88	93	92	88	81	81	76	73	90

4.6. Feedwater Pump

The feedwater pumps will be located outdoor.

The sound power level of each feedwater pump set (2X100%) shall not exceed:

Sound Power Level Pref. = 10^{-12}W

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	104	102	107	110	109	106	108	102	96	113

In addition to the requirement given above the surface sound pressure level at a distance of 1 m to the equipment will not exceed 85 dB(A). To achieve this level, an acoustic enclosure has to be foreseen on the pumps and coupling parts.

The surface sound pressure level at 1m from feedwater recirculation pumps will not exceed 85dB(A)

4.7. OTC

The sound power level emitted by one OTC shall be limited to:

Sound Power Level Pref. = 10^{-12}W

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	91	86	90	95	92	88	87	88	88	96

In addition, the surface sound pressure level (free field conditions) at a distance of 1 m will not exceed 85 dB(A).

4.8. GT Fin fan coolers

The total sound power level of the GT fin fan cooler shall not exceed:

Sound Power Level Pref. = 10^{-12}W

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	121	119	116	112	111	106	102	96	93	112

In addition, the average sound pressure at a distance of 1 m from equipment will not exceed 85 dB(A) in free field conditions.

4.9. Dump condensing Module

4.9.1. Feedwater pump (1*100%, 3000 rpm, 200 kW)

The total sound power level emitted by the feedwater pump set (motor+coupling+pump) shall not exceed the following:

Sound Power Level Pref. = 10^{-12}W

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	85	84	89	91	92	92	89	84	79	96

In addition, the surface sound pressure level (free field conditions) at 1 m distance from the equipment will not exceed 85 dB(A).

These noise limits can be achieved without acoustic protection (to be confirmed by supplier).

4.9.2. Air Cooled Condenser (3 fans of 55 kW)

The fans deck is supposed to be located at 8m above ground. Nearest personal access is supposed to be at a platform situated at least 4m below the nearest fan sleeve.

4.9.2.1. Air Inlet

The total (i.e. the 3 fans as a sum) sound power level emitted by the air-cooled condenser at the air inlet should not exceed:

Sound Power Level Pref. = 10^{-12}W

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	109	107	105	100	95	92	89	84	80	99

In addition, the surface sound pressure level (free field conditions) at 3 m distance from the air inlets will not exceed 85 dB(A).

4.9.2.2. Air outlet

The total (i.e. the 3 fans as a sum) sound power level emitted by the air-cooled condenser at the air outlet should not exceed:

Sound Power Level Pref. = 10^{-12}W

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	105	103	101	96	92	89	86	81	77	95

These noise limits can be achieved with low noise fans.

4.10. Cooling water pumps

The total sound power level of one cooling water pump shall not exceed each:

Sound Power Level Pref. = 10^{-12}W

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	83	84	91	94	97	100	99	93	84	104

In addition, the surface sound pressure level at a distance of 1 m to the pump will be below 85 dB(A).

4.11. Demineralization plant.

The equipment of the demineralised water production plant will be housed inside a building, which will limit the noise emissions towards the outdoor environment.

The sound transmission losses for the wall and roof cladding of this building shall not be less than:

Frequency/oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
TL / dB	1	4	10	15	19	24	25	30	30

A standard 0.7 mm thick steel sheet cladding shall be sufficient to achieve these attenuations.

For all the equipment located inside the building (pumps, blowers, filter units, cells…), the surface sound pressure level (free field conditions) at a distance of 1 m from each equipment will not exceed 85 dB(A).

No acoustical measures but standard weather protection only are necessary for the air intake louvers.

4.12. Other miscellaneous pumps

The total sound power level of Service water pump (2x100%) and Potable water pump (2x100%) and pumps in Storm water basin (2x100%) area shall not exceed each:

Sound Power Level Pref. = 10^{-12}W

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	87	89	91	91	89	87	85	77	75	92

In addition, the surface sound pressure level at a distance of 1 m to the coolers will be below 85 dB(A).

4.13. Ventilation in other buildings

For all the buildings other than mentioned above, as well as for the gas turbine electrical modules, the sound power level emitted by each ventilation unit towards the outdoor environment, shall not exceed

Sound Power Level Pref. = 10^{-12}W

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	84	86	85	90	88	86	81	71	69	90

In addition, the surface sound pressure level (free field conditions) will not exceed 85 dB(A) at 1 m distance from each ventilation fan.

No acoustical measures but standard weather protection only is necessary for the air intake louvers.

4.14. ELECTROCHLORINATION PLANT

The equipment of the electro chlorination plant will be housed inside a building, which will limit the noise emissions towards the outdoor environment.

The sound transmission losses for the wall and roof cladding of this building shall not be less than:

Frequency/oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
TL / dB	1	4	10	15	19	24	25	30	30

A standard 0.7 mm thick steel sheet cladding shall be sufficient to achieve these attenuations.

For all the equipment located inside the building (pumps, blowers, filter units, cells…), the surface sound pressure level (free field conditions) at a distance of 1 m from each equipment shall not exceed 82 dB(A).

In addition, the surface sound pressure level (free field conditions) will not exceed 85 dB(A) at a distance of 1 m to each ventilation unit.

No acoustical measures but standard weather protection only is necessary for the air intake louvers.

4.15. Doors & Gates

The doors and gates of all buildings shall be provided with a minimum sound reduction index Rw = 18dB.

4.16. Other Outdoor Equipment

All other equipment will be equipped with acoustical measures in order to maintain a surface sound pressure level of 85 dB(A) (ref $2.x10^{-5}$.Pa) at a distance of 1 m from the equipment /equipment enclosure and 1.5m above ground level.

5. TRANSIENT AND EXCEPTIONAL NOISE SOURCES

5.1. Atmospheric drain silencer

The max sound power level at the vent opening of the Atmospheric drain silencer, shall not exceed 106 dB(A) (ref 1 pW).

In addition, the Atmospheric drain silencer line and its connected pipe must be equipped with acoustic insulation, in order that the surface sound pressure level (free field conditions) at a distance of 1 m, will not exceed 95 dB(A).

5.2. Start Up Ejector

The total sound power level of the start-up ejector including blow out opening shall not exceed:

Sound Power Level Pref. = 10^{-12}W

f / oct	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Σ A
dB	92	92	96	106	103	97	98	97	90	106

In addition, the start-up ejector line and its connected pipe must be equipped with acoustic insulation, in order that the surface sound pressure level (free field conditions) at a distance of 1 m, will not exceed 95 dB(A).

5.3. Safety Valves and Power Operated Relief Valves

Noise emitted by each Pressure Safety Valve and its entire exhaust system (piping, silencer, and other components) shall not exceed the following levels, when measured at any point at 1m distance from the equipment :

- Maximum sound pressure level (free field condition) : 115 dB(A)
- Maximum instantaneous noise pressure level : 140 dB(C)

5.4. Steam Turbine bypass system

The surface sound pressure level (free field conditions) emitted by the components of the steam turbine bypass system, including the dump tubes, shall not exceed 105 dB(A) at a minimum distance of 1 m from the equipment, or at the nearest normally accessible platform.

This value will be achieved by suitable acoustic insulation on the valve bodies and connected downstream pipes up to the condenser, including the water spray manifold.

5.5. Fuel Gas blow out after GT shutdown

The noise emission of the fuel gas blow out after shut GT shutdown shall be reduced by orifices to a maximum sound power level of 105 dB(A) (ref 1 pW).

5.6. Other Vent Systems & Plant Intermittent Operation

Any other atmospheric vent system, including drains and other systems operating during Plant start-up and intermittent operations (e.g. steam blow down vents, vacuum breaker valve vents, …), shall be fitted with suitable silencer, if necessary, in order to limit the surface sound pressure level (free field conditions) emitted during transient operations to 95 dB(A) at a minimum distance of 1 m from each vent outlet.

In addition, the blowdown tanks and their connected pipes must be equipped with acoustic insulation, in order that their surface sound pressure level (free field conditions) at a distance of 1 m, does not exceed 95 dB(A).

5.7. Transient operations and intermittent noise

The recommendations from international specialist organizations, i.e. Occupational Safety and Health Association (OSHA for short term exposure, noise levels shall not exceed the limit as stipulated in the Occupational Safety & Health Administration (OSHA) standard.

Maximum equivalent continuous noise level dB(A)	Unprotected exposure period per day for 8 hrs/day and 5 days/ week
90	8
95	4
100	2
105	1
110	1/2
115	1/4
120	No exposure permitted at or above this level

Referring to our above table, the expected noise level for Transient operations and intermittent noise are as per below table.

Transient operations and intermittent noise	Expected Sound Pressure Level
Atmospheric drain silencer vent opening	Surface sound pressure level (free field conditions) of 95 dB(A) at 1meter distance
Start-up ejector including blow out opening	Surface sound pressure level (free field conditions) of 95 dB(A) at 1meter distance.
Each Pressure Safety Valve and its entire exhaust system (piping, silencer, and other components)	Maximum sound pressure level (free field condition) of 115dB(A) at 1m distance from the equipment
Steam turbine bypass system, including the dump tubes	Surface sound pressure level (free field conditions) of 105 dB(A) at a minimum distance of 1 m from the equipment
Fuel gas blow out after shut GT shutdown	Surface sound pressure level (free field conditions) of 95 dB(A) at 1meter distance.
Any other atmospheric vent system, including drains and other systems operating during Plant start-up and intermittent operations (e.g. steam blow down vents, vacuum breaker valve vents, …)	Surface sound pressure level (free field conditions) of 95 dB(A) at 1meter distance

Appendix 3.8.1

SPA Application Letter for CCGT Block 1

JC - Combined Cycle Plant

LEMBAGA
KEMAJUAN
BINTULU

Our Ref: (16) LKB/ST/B-11/15

Date: 30 SEP 2016

CORPORATE SHARED SERVICES DEPARTMENT

Date Recd:	12 OCT 2016
VP (CSS):	
To:	Remarks:

Vice President
Corporate Shared Services,
Sarawak Energy Berhad,
No.1 Isthmus,
93050 Kuching,
Sarawak.

Dear Sir,

SESCO Combined Cycle Power Plant Project at Tanjung Kidurong, Bintulu.

I am pleased to inform that the above quoted application has been considered and approved by the State Planning Authority, subject to the following terms and conditions:-

(i) The development of the land should be in accordance with the plan duly endorsed on the **"Approved Plan"** plan No. **SPA/11-16/9D(ST/B-11/15)(1/6 to 6/6),**one set of which is attached herewith;

(ii) the accuracy of the perimeter boundary of the land as shown in the plan as submitted by you;

(iii) the detailed building plan for the proposed development are to be submitted for consideration;

(iv) you must ensure that there is satisfactory drainage and discharge outlet for the scheme;

2. This approval is registered as **SPA approval No.G/9D/17-16**. This approval number must be quoted by you if you advertise your approved development either on the site by way of billboard or through the mass media or through other forms of advertisement.

3. This approval is valid for a period of 24 months from the date as shown in "Approved Plan". If, within that time,the works covered by the building plans have not been commenced, then the approval granted shall lapse.

5. If the terms and conditions and the approved plan are acceptable to you, kindly acknowledge us within three (3) weeks from the date of this letter.

Thank you.

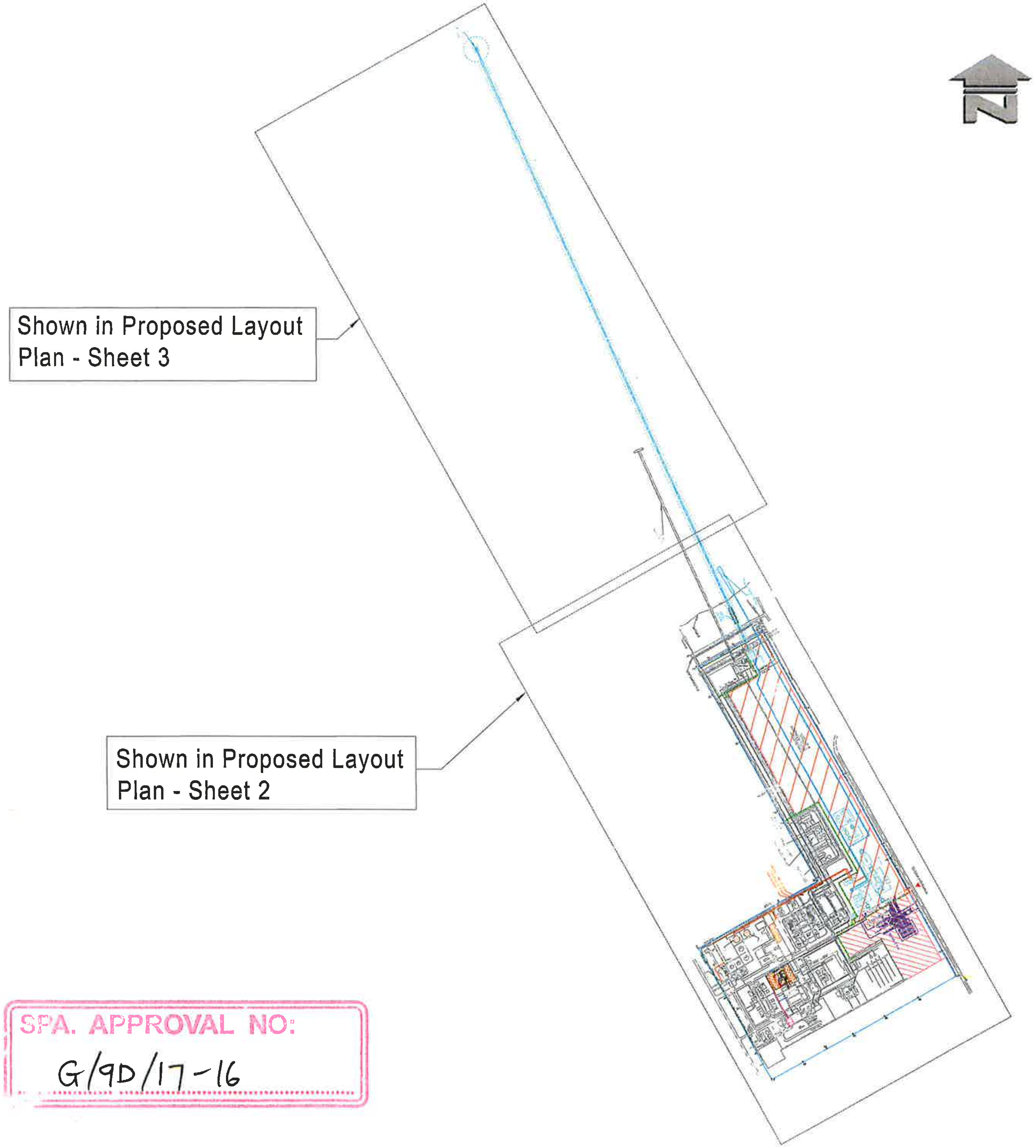
"BERSATU BERUSAHA BERBAKTI"

"AN HONOUR TO SERVE"

Yours faithfully

(RODZIAH BINTI HJ. MORSHIDI]
General Manager

PS/



SPA. APPROVAL NO:

G/9D/17-16

SUBMITTED BY :

LEMBAGA KEMAJUAN BINTULU
NO. 1, JLN. TG. KIDURONG
PETI SURAT 55
BINTULU, SARAWAK

PROJECT TITLE :

BINTULU TANJUNG KIDURONG COMBINED CYCLE POWER PLANT PROJECT (UNIT-10, UNIT-11)

DATE :	SCALE : 1 : 6,000 (A1 SIZE)
FILE REF. :	DRAWING NO. :

PROPOSAL DESCRIPTION / LEGEND

PROPOSED LAYOUT PLAN - SHEET 1

Legend :

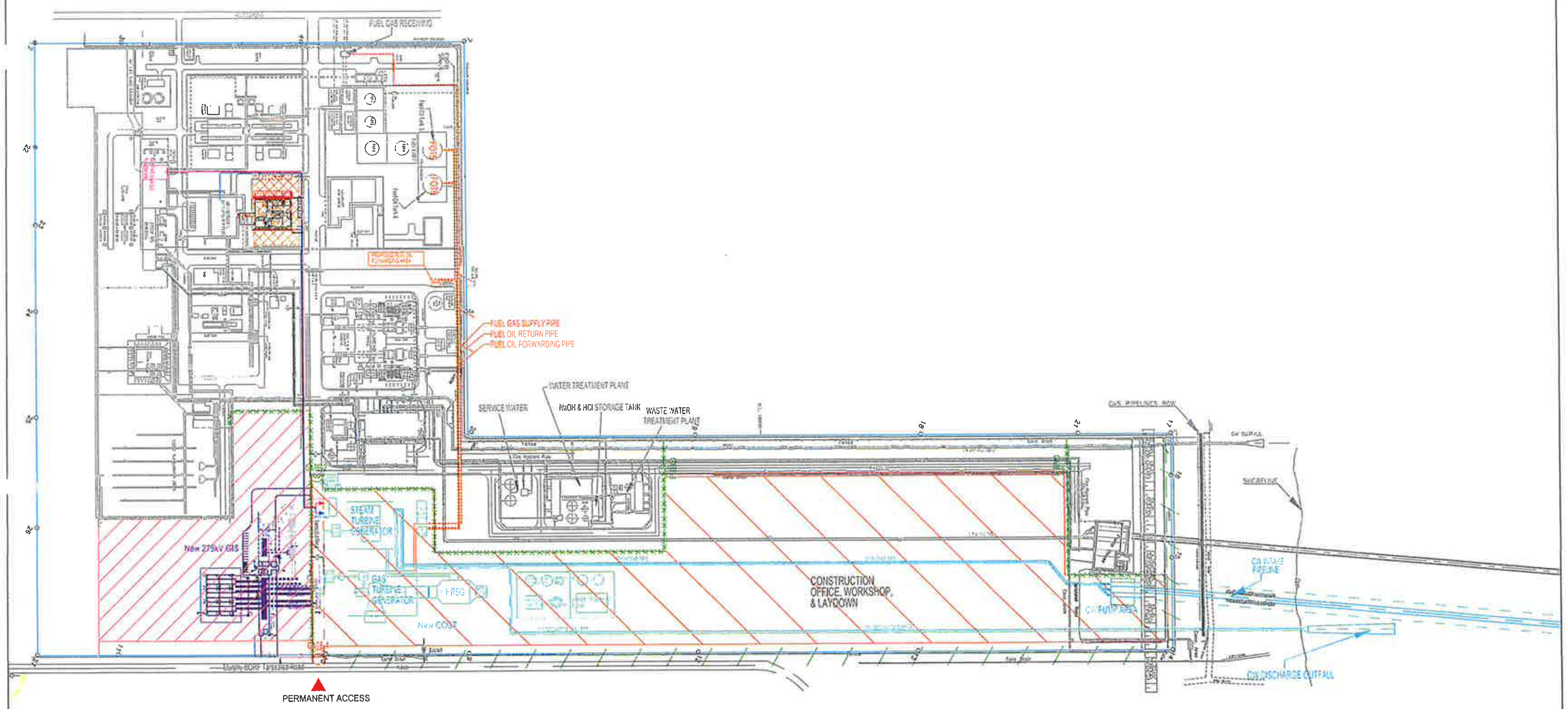
- New 275 kV GIS Area
- New Combined Cycle Gas Turbine Plant Area (Unit 10, Unit 11)
- New Administration Building

THIS PLAN IS APPROVED BY THE STATE PLANNING AUTHORITY (SPA) IN ACCORDANCE WITH SECTION 232 OF THE LAND CODE. THIS PLAN SHALL HEREINAFTER BE REFERRED AS "THE APPROVED PLAN"

PLAN NO. SPA/11-16/9D(ST/B-11/15) 1/6

25/8/16

(DATU SUDARSONO OSMAN) DATE:
SECRETARY SPA



SUBMITTED BY :

LEMBAGA KEMAJUAN BINTULU
NO. 1, JLN. TG. KIDURONG
PETI SURAT 55
BINTULU, SARAWAK

PROJECT TITLE :

BINTULU TANJUNG KIDURONG COMBINED CYCLE POWER PLANT PROJECT (UNIT-10, UNIT-11)

DATE :	SCALE : 1 : 2,500 (A1 SIZE)
FILE REF. :	DRAWING NO. :

PROPOSAL DESCRIPTION / LEGEND

PROPOSED LAYOUT PLAN - SHEET 2

Legend :

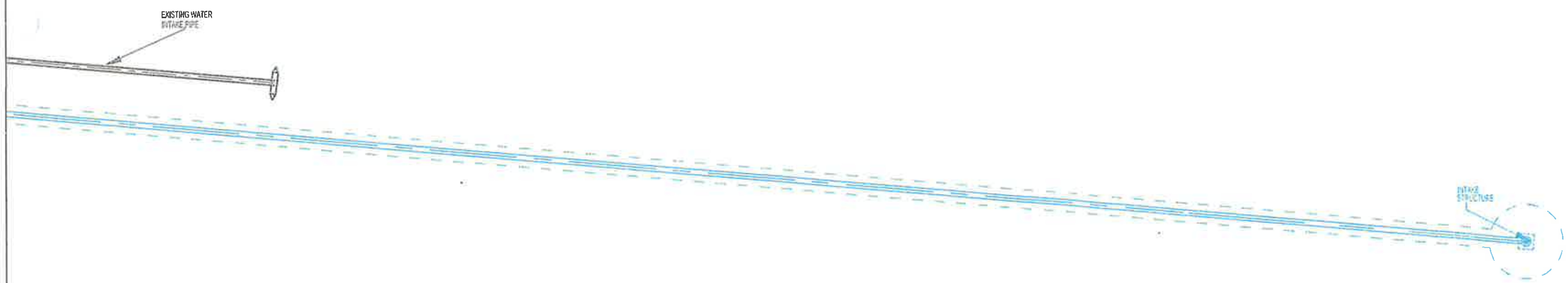
- New 275 kV GIS Area
- New Combined Cycle Gas Turbine Plant Area (Unit 10, Unit 11)
- New Administration Building

THIS PLAN IS APPROVED BY THE STATE PLANNING AUTHORITY ... IN ACCORDANCE WITH SECTION ... PLAN SHALL HERE... REFERRED AS "THE APPROVED PLAN"

PLAN NO. SPA/11-16/9D (ST/B-11/5) 2/6

(DATU SUDARSONO OSMAN)
SECRETARY SPA

DATE: 25/8/16



SUBMITTED BY :

LEMBAGA KEMAJUAN BINTULU
NO. 1, JLN. TG. KIDURONG
PETI SURAT 55
BINTULU, SARAWAK

PROJECT TITLE :

BINTULU TANJUNG KIDURONG COMBINED CYCLE POWER PLANT PROJECT (UNIT-10, UNIT-11)

DATE :	SCALE : 1 : 2,500 (A1 SIZE)
FILE REF. :	DRAWING NO. :

PROPOSAL DESCRIPTION / LEGEND

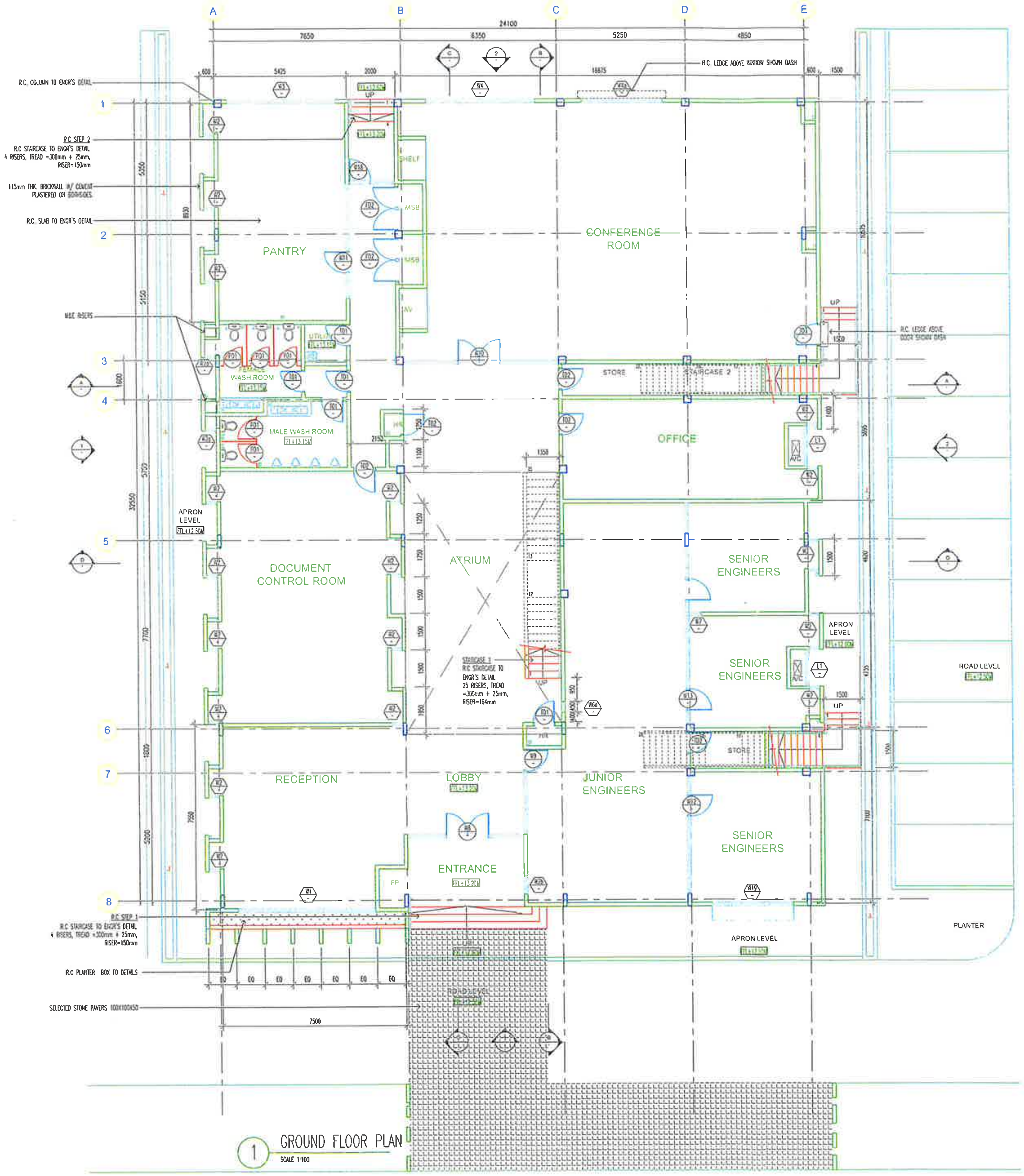
PROPOSED LAYOUT PLAN - SHEET 3
NEW COOLING WATER INTAKE PIPELINE AND INTAKE HEAD

THIS PLAN IS APPROVED BY THE STATE PLANNING AUTHORITY [illegible] IN ACCORDANCE WITH SECTION [illegible] LAND CODE. THIS PLAN SHALL HEREINAFTER BE REFERRED AS "THE APPROVED PLAN"

PLAN NO.: SPA/11-16/9D(ST/B-11/15)3/6

(DATU SUDARSONO OSMAN)
SECRETARY SPA

DATE: 25/8/16



SUBMITTED BY :

LEMBAGA KEMAJUAN BINTULU
NO. 1, JLN. TG. KIDURONG
PETI SURAT 55
BINTULU, SARAWAK

PROJECT TITLE :

BINTULU TANJUNG KIDURONG COMBINED CYCLE POWER PLANT PROJECT (UNIT-10, UNIT-11)

DATE :	SCALE : AS SHOWN
FILE REF. :	DRAWING NO. :

PROPOSAL DESCRIPTION / LEGEND

FLOOR PLANS

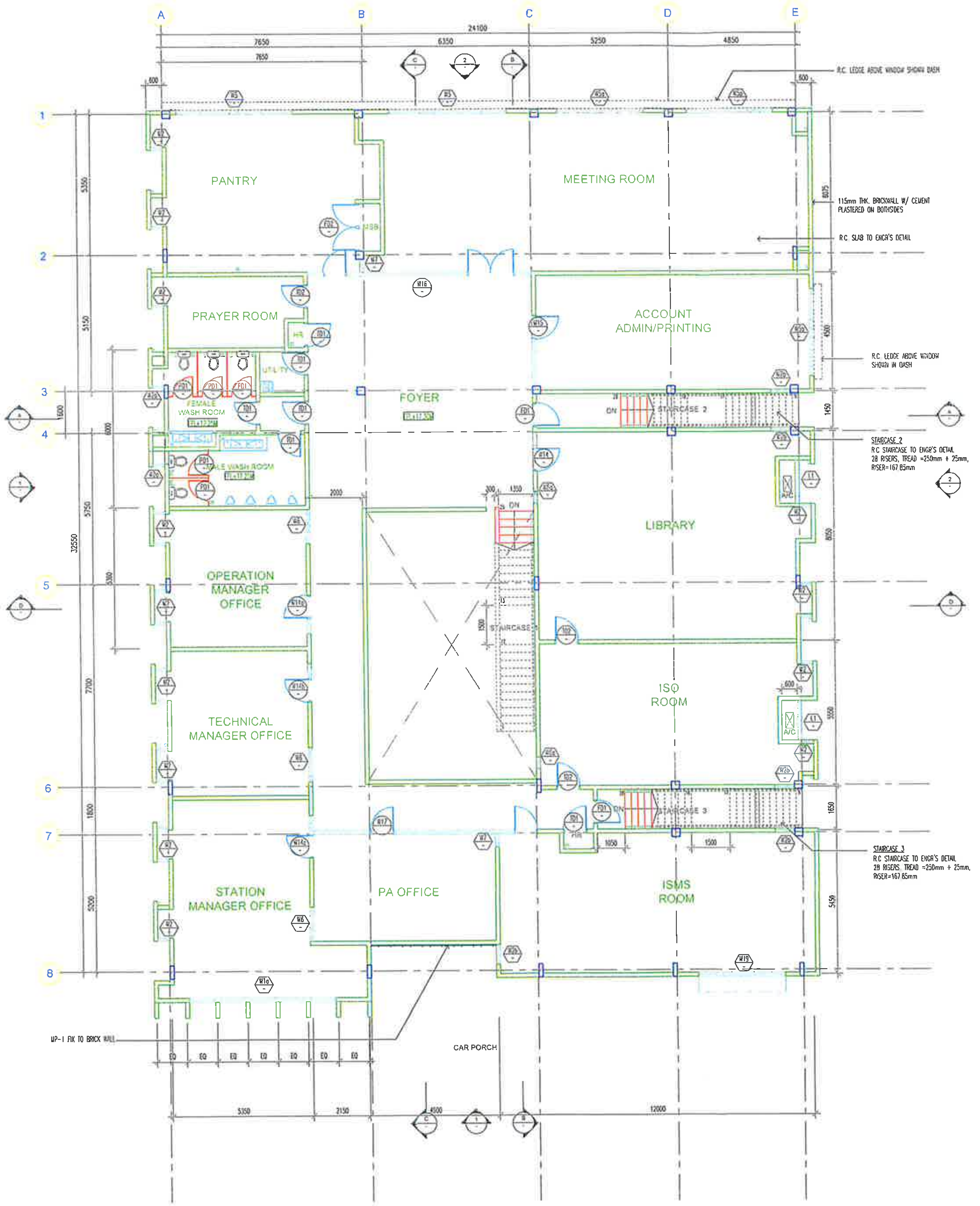
THIS PLAN IS APPROVED BY THE STATE PLANNING AUTHORITY (SPA) IN ACCORDANCE WITH SECTION 2?? OF THE LAND CODE. THIS PLAN SHALL HEREINAFTER BE REFERRED AS "THE APPROVED PLAN"

PLAN NO. SPA/11-16/90(ST/B-11/15)4/6

25/8/16

(DATU SUDARSONO OSMAN)
SECRETARY SPA

DATE:



2 FIRST FLOOR PLAN
SCALE 1:100

SUBMITTED BY :

LEMBAGA KEMAJUAN BINTULU
NO. 1, JLN. TG. KIDURONG
PETI SURAT 55
BINTULU, SARAWAK

PROJECT TITLE :

BINTULU TANJUNG KIDURONG COMBINED CYCLE POWER PLANT PROJECT (UNIT-10, UNIT-11)

DATE :	SCALE : AS SHOWN
FILE REF. :	DRAWING NO. :

PROPOSAL DESCRIPTION / LEGEND

FLOOR PLANS

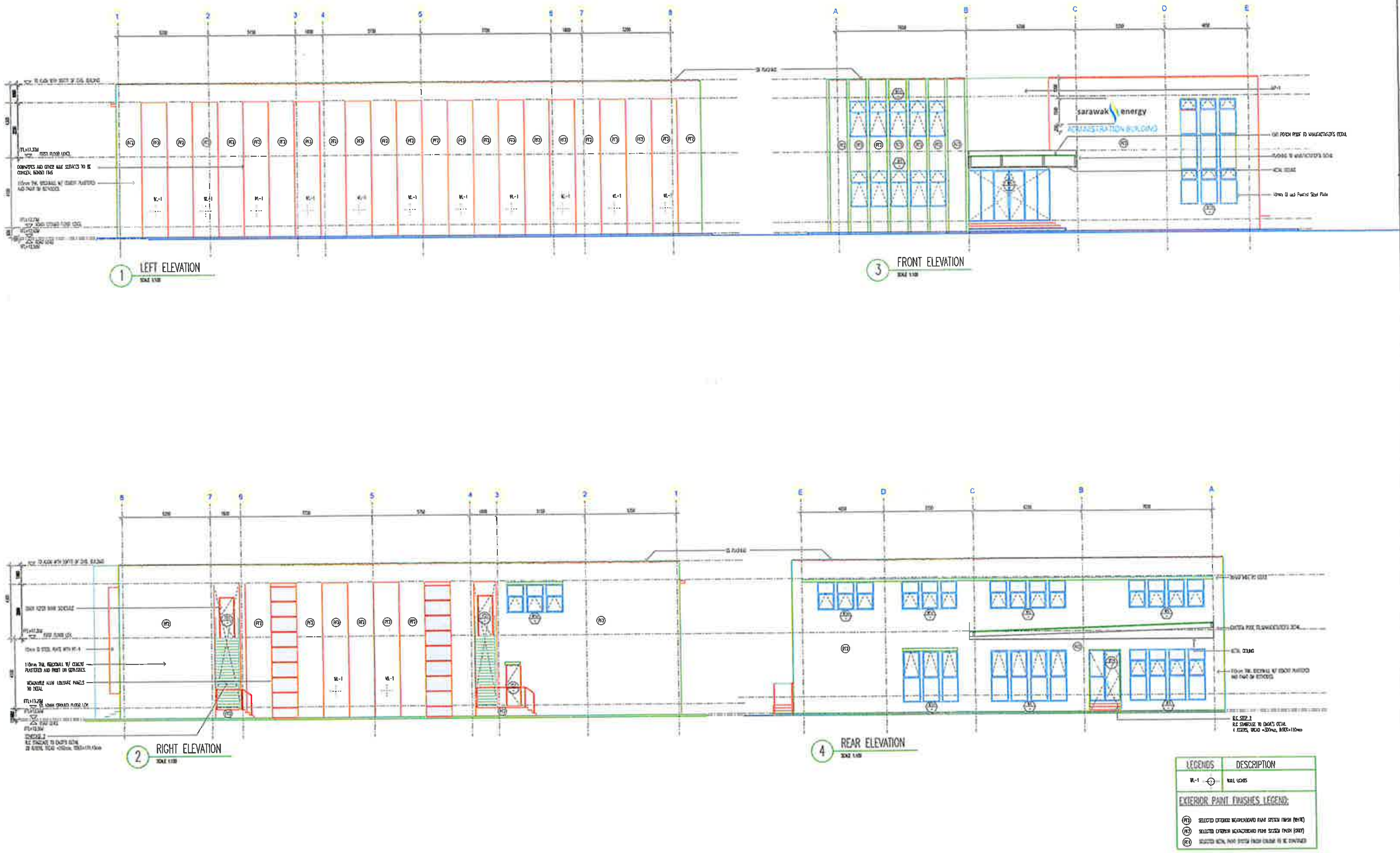
THIS PLAN IS APPROVED BY THE STATE PLANNING AUTHORITY (SPA) IN ACCORDANCE WITH SECTION 2[illegible] THE LAND CODE. THIS PLAN SHALL HEREINAFTER BE REFERRED AS "THE APPROVED PLAN"

PLAN NO. SPA/11-16/90(ST/B-11/15) 5/6

20/8/16

(DATU SUDA[illegible])
SECRETARY SPA

DATE:



SUBMITTED BY :

LEMBAGA KEMAJUAN BINTULU
NO. 1, JLN. TG. KIDURONG
PETI SURAT 55
BINTULU, SARAWAK

PROJECT TITLE :

BINTULU TANJUNG KIDURONG COMBINED CYCLE POWER PLANT PROJECT (UNIT-10, UNIT-11)

DATE :	SCALE : AS SHOWN
FILE REF. :	DRAWING NO. :

PROPOSAL DESCRIPTION / LEGEND

ELEVATIONS

THIS PLAN IS APPROVED BY THE STATE PLANNING AUTHORITY (SPA) IN ACCORDANCE WITH SECTION 202 OF THE LAND CODE. THIS PLAN SHALL HEREAFTER BE REFERRED AS "THE APPROVED PLAN"

PLAN NO. SPA/11-16/9D(ST/B-11/15) 8/6

(DATU SUDARSONO OSMAN)
SECRETARY SPA

DATE: 25/8/16

Appendix 3.8.2

SPA Approval Letter for CCGT Block 2

sarawak energy

Our ref: SBP-170001/LAND/AL/hk

27 NOV 2017

General Manager
BINTULU DEVELOPMENT AUTHORITY
Wisma Bintulu
No.1 Jalan Tanjung Kidurong
97000 Bintulu

Dear Sir

TG. KIDURONG COMBINED-CYCLE POWER PLANT PROJECT (UNIT 12 & 13) at Lot 76 Block 20 Kemana Land District, Bintulu.

Due to the rapid development of energy-intensive industries under Sarawak Corridor of Renewal Energy (SCORE), Sarawak Energy Berhad is building additional power plants to meet the power demand and to enhance the reliability and security of power supply in the State of Sarawak.

With this planning in view, Sarawak Energy Berhad is currently looking into the construction of an additional block of Combined-cycle Gas Turbine Power Plant with a capacity of 400MW. The site for this additional capacity is being proposed within the boundary of the existing Tg. Kidurong Power Station at Lot 76 Block 20 Kemena Land District, Bintulu.

The construction of the proposed project is expected to commence as early as 2nd Quarter 2018 with the intention of having the plant to be fully operational in 4th Quarter 2020.

Appended, please find the Siting Application Form with the following necessary documents for your kind attention -

Appendix A. Project Brief of the Proposed Power Plant
Appendix B. Land Title of the existing Tg. Kidurong Power Plant
Appendix C. Proposed layout plan of the Proposed Power Plant
Appendix D. Cadastral Plan

Your favourable consideration would be greatly appreciated.

Thank you.

Yours sincerely
for **SARAWAK ENERGY BERHAD**

James Ung
Chief Executive Officer
SEB Power Sdn Bhd

Sarawak Energy Berhad (007199-D)
Menara Sarawak Energy,
No. 1, The Isthmus, 93050 Kuching,
Sarawak, Malaysia

T +6082 388 388
F +6082 344 433
www.sarawakenergy.com.my

SITING APPLICATION FORM

1.	**Name of Project**	:	Proposed Bintulu Tanjung Kidurong Combined-Cycle Power Plant Project (Unit 12, Unit 13)
2.	**Applicant**	:	Sarawak Energy Berhad
3.	**Contact Person**	:	Chua Yaw Chiang **Tel No.:** 082-388388/ 019-8197997
4.	**Area Required**	:	11.25 ha (approximate)
5.	**Total Scheme Value**	:	RM1.5 billion

6. **Amount of fund approved in the** N/A **Malaysia Plan**

7. **Amount of Fund Available Now** : RM1.5 billion

8. **Project Justification and description of Project Components**

The construction of the new Bintulu Tanjung Kidurong Combined-Cycle Power Plant (Unit 12 & Unit 13) is to meet the growing power requirements of the energy-intensive industries under Sarawak Corridor of Renewable Energy (SCORE) and to enhance the reliability and security of power supply in the State of Sarawak in Malaysia. The project is scheduled to commence in 1st Quarter of 2018 and targeted to complete by 4th Quarter of 2020.

Attachments: Appendix A : Project Brief

9. **Reason for selecting the site**

The ideal power plant location is situated within the existing compounds of the Bintulu Tanjung Kidurong Power Plant where all the necessary infrastructures are readily available including the gas supply receiving station. The proposed power plant is to be built on the land registered under Syarikat SESCo Bhd for the same purpose.

Attachment: Appendix B : Land Title

Signature :		Designation :	Chief Executive Officer (SEB Power Sdn Bhd)
Name Of Officer :	James Ung	Date :	6/11/17

Proposed Second Combined-Cycle Gas Turbine Block for Tanjung Kidurong

Brief Summary of Project

1. EXECUTIVE SUMMARY

Bintulu Tanjung Kidurong Power Station currently has eight generating units of which seven of them utilize natural gas as the fuel resource. Units 1 to 5 are GE F6 gas turbines that operate as open-cycle gas turbines (OCGT). Units 7 to 9 constitute a combined-cycle gas turbine (CCGT) power block operating at a higher efficiency than Units 1 to 5. Units 7 and 8 are gas turbines and Unit 9 is a steam turbine.

The current gas supply agreement with Petronas allocates 100mmscfd (average daily quantity) of natural gas to the power station. Units 7 and 8 currently consume 50mmscfd and the balance is consumed by Units 1 to 5.

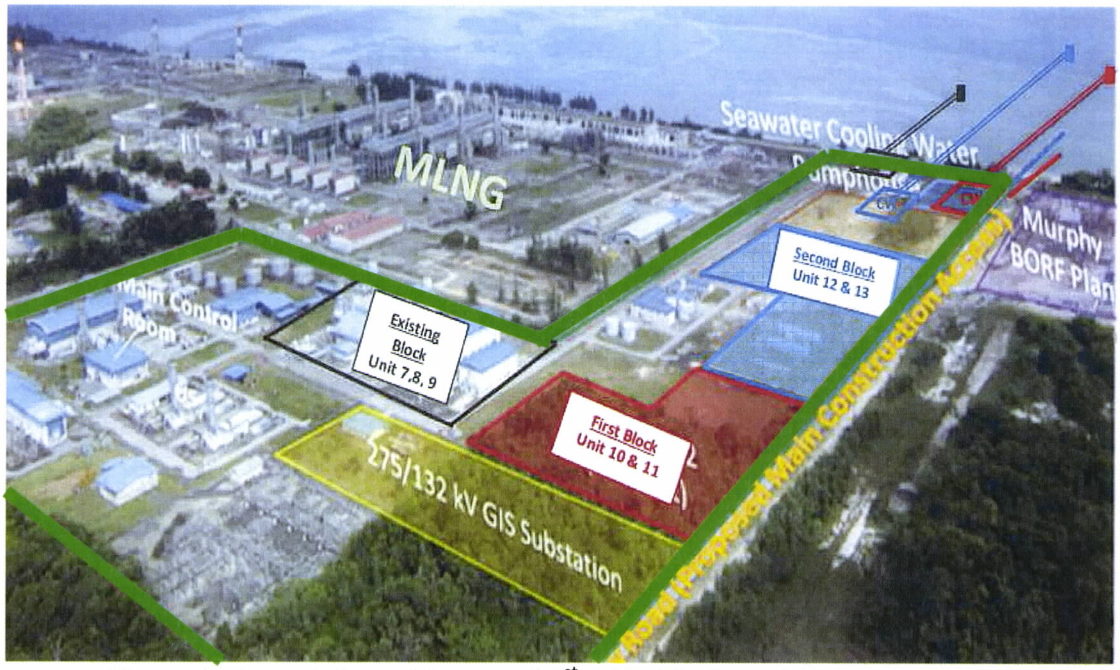


Figure 1: Overall view of Proposed 1st CCGT Block (Units 10 and 11) and 2nd CCGT Block (Units 12 and 13)

The first CCGT Block (Units 10 and 11) is currently at the early stage of implementation with a Commercial Operation Date (COD) in Q3 2020. And, the second CCGT Block (Units 12 and 13) is expected to be in operation in Q4 2020. The features for these two CCGT Blocks shall be similar.

2. CONCEPT ENGINEERING

The 2nd CCGT Block shall be located between the existing cooling water supply pipeline (for Unit 9) and the cooling water lines for the 1st CCGT Block with the GTG, HRSG and STG to be arranged in parallel with the need for diversion of the existing cooling water supply pipeline (for Unit 9) as shown in Figure 2.

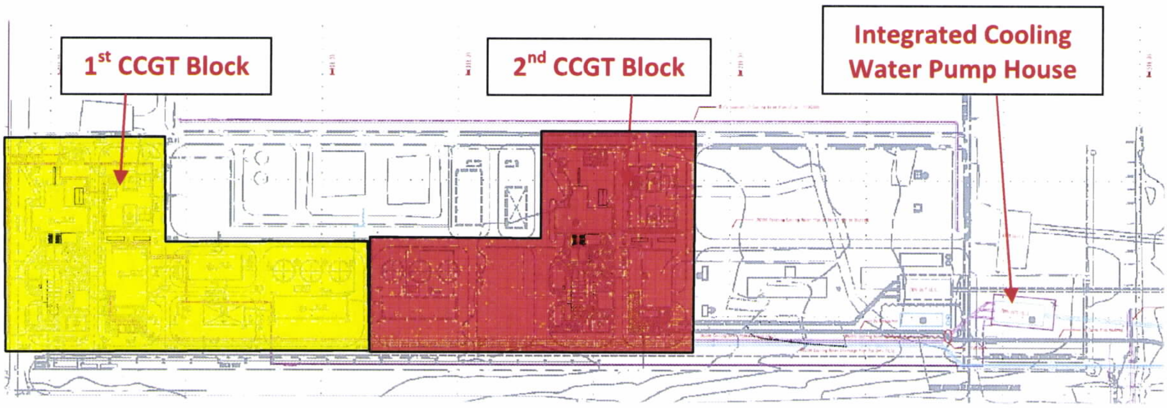
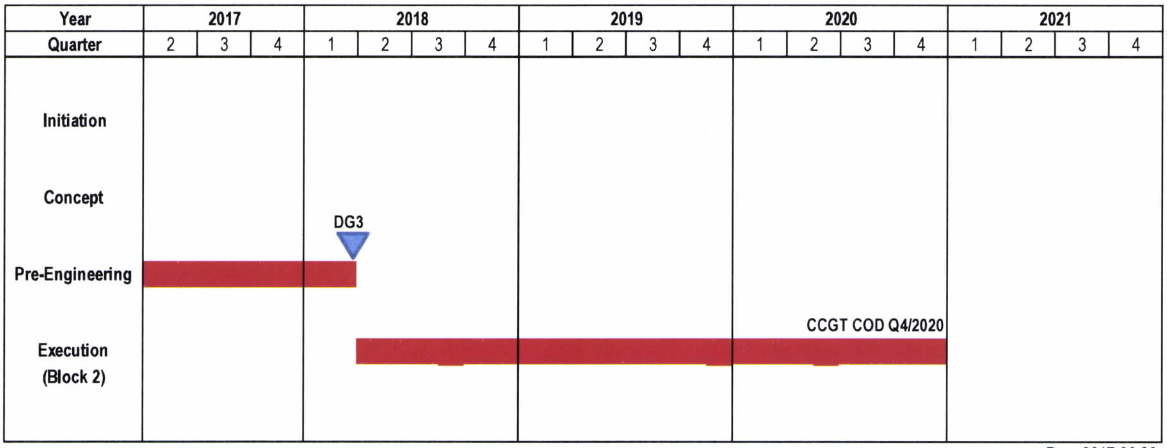


Figure 2: Layout for the 2nd CCGT Block

3. PROJECT TIMELINE

Proposed 2nd Block Bintulu Tg. Kidurong Combined-Cycle Power Plant Project



Rev. 2017.06.28

Appendix B

SESCO LAND REGISTER NO
402 / KLD / 020

Code Number: 321/20/76

Locality: Tanjong Kidurong,
Bintulu.

L.&S. 9
Section 20
(Rev. 2/83)

LEASE OF STATE LAND

KNOW ALL MEN BY THESE PRESENTS that I, KENNETH ONG SOO KAN Superintendent of Lands and Surveys, Bintulu Division, in consideration of the payment of a premium of dollars seven million thirty-three thousand six hundred and thirty-two only ($7,033,632.00) ~~(payable by instalments as follows:—~~

~~(a) The first instalment of $ .... to be paid on the registration of this lease; and~~

~~(b) .... subsequent equal instalments of $ .... to be paid annually thereafter on the 1st day of January of each succeeding year.)~~

and of the rent hereinafter reserved and of the restrictions and conditions hereinafter imposed do hereby under and by virtue of the powers conferred on me by the Land Code, lease unto Sarawak Electricity Supply Corporation all that land situate in the Kemena Land District and known as Lot Number 76 in Block/~~Section~~ Number 20 containing 35.580 hectares more or less, and which is more precisely delineated on Survey Plan Number G14-31-1 (8.3) BP 9/15 deposited in the office of the said Superintendent to hold from the 30th day of December, 1993 for the term expiring on the 29th day of December, 2053 subject to the payment of an annual rent of dollars sixty thousand four hundred and eighty-six only ($60,486.00) or to the payment of such revised rent as may hereafter be determined under section 30 of the Land Code and subject also to the implied conditions and restrictions contained in the said Land Code and the express conditions hereunder written.

RESTRICTIONS AND SPECIAL CONDITIONS

(including any modification of implied conditions and restrictions)

(i) This land is to be used only for the erection, installation and operation of a plant for generating electrical energy for providing light and power in accordance with the provision of the Electricity Ordinance;

(ii) The erection of a building or buildings in accordance with plans and specifications approved by the Chief Electrical Inspector and the Bintulu Development Authority shall be completed within eighteen (18) months from the date of registration of this lease; and

(iii) No dealing affecting this land may be effected without the consent in writing of the Director of Lands and Surveys.

RESTRICTIONS AND SPECIAL CONDITIONS (CONTD.)

In witness whereof I the said Superintendent have hereunto set my hand and seal of office this thirtieth day of December, One thousand nine hundred and ninety-three.

SUPERINTENDENT OF LANDS & SURVEYS
BINTULU DIVISION
SARAWAK

Superintendent of Lands and Surveys,
Bintulu.

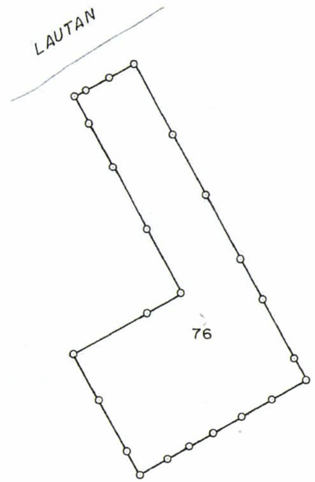
REGISTERED at the .... Land Registry Office this 30th day of December, 19 93

REGISTRAR
BINTULU
SARAWAK
LANDS & SURVEYS

Asst. Registrar

Category : Mixed Zone Land; Town Land vide Gazette Notification No. Swk. L.N. 95 (iv) dated 26.6.1993.

DIAGRAM



Scale: 1 : 15,000

CONTINUED ON CONTIN[UA]TION SHEET NO. 1

DATE: 03 OCT 2006 Asst. Registrar

SUBMITTED BY :

Appendix C

LEMBAGA KEMAJUAN BINTULU
NO. 1, JLN. TG. KIDURONG
PETI SURAT 55
BINTULU, SARAWAK

PROJECT TITLE :

BINTULU TANJUNG KIDURONG COMBINED CYCLE POWER PLANT PROJECT (UNIT-12, UNIT-13)

DATE :	SCALE :
FILE REF. :	DRAWING NO. :

PROPOSAL DESCRIPTION / LEGEND

PROPOSED LAYOUT PLAN

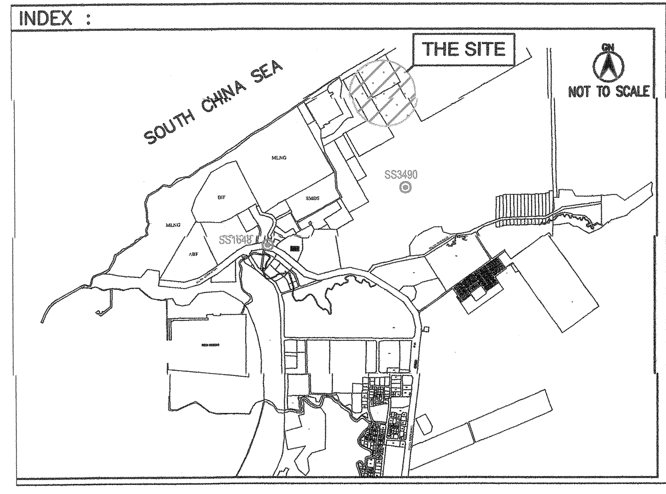
Legend :

- New Combined Cycle Gas Turbine Plant Area (Unit 10, Unit 11) - approved via Plan No. SPA/11-16/9D (ST/B-11/15) on 25 Aug 2016
- New Combined Cycle Gas Turbine Plant Area (Unit 12, Unit 13)

Appendix 4.2.1

Topographical Survey Plan of Project Site (Onshore)

INDEX :



GEODETIC PARAMETERS :

Name	: BRSO
Projection Name	: Oblique Marcator Angle (RSO)
Units of Coordinates	: Meters
Latitude of Origin	: 04° 00' 00.000" N
Longitide of Origin	: 115° 00' 00.000" E
False Easting at Origin	: 2000000 m
False Northing at Origin	: 5000000 m
Scale Factor at Origin	: 0.99984
Datum	: Local/Reference Datum
Name	: TIMBALAI 1948
Semi Major Axis	: 6377298.562 m
Semi Minor Axis	: 6356097.556 m
Plattening (1/f)	: 300.8017
Eccentricity	: 0.081472981521583

DATUM: SS1648
E=2377058.483
N=5362187.415
ELEVATION =16.025m

REV. NO.	DATE	DESCRIPTION	PREPARED	CHECKED / DRAWING	APPROVED

SCALE :
20 15 10 5 0 10 20 30 40 50 meter
SCALE 1 : 1 000

DRAWING TITLE :

TOPOGRAPHIC SURVEY FOR 400MW COMBINED CYCLE GENERATING PROJECT AT BINTULU TANJUNG KIDURONG COMBINED CYCLE POWER PLANT PROJECT (Unit 10, Unit 11)

I Saimi Bin Mahmud *of Asia Survey Consultants, a land surveyor licensed under the Land Surveyor's* Ordinance 2001, do hereby certify that this plan has been prepared from the survey undertaken by me / done under my supervision and that both survey and plan are correct.

Date : ....

ASIA SURVEY CONSULTANT

....
Saimi Bin Mahmud
Licensed Land Surveyor, Sarawak

ASIA SURVEY CONSULTANTS

Yoshi Square B12-2 [1st Floor]
Block B, Lot 67, Section 66, Jalan Pelabuhan
93450, Kuching, Sarawak.
TEL. : 082-334236
FAX. : 082-334235

FILE : D:/DESKTOP FILE/ACADFILE IN DESKTOP	
SCALE : 1 : 1000	CADASTRAL SHEET REF :
SURVEYED BY : LI	DRAWN BY : DNA
DATE : JANUARY 2017	CHECKED BY : WEE
DRAWING NO.	ASC/17/01

Appendix 4.2.2

Topographical and Bathymetry Survey Plan of Project Site (Offshore)

TOPOGRAHY AND BATHYMETRY SURVEY FOR KIDURONG COMBINED CYCLE PROJECT. BINTULU

GEODETIC PARAMETERS :

Name	: BRSO
Projection Name	: Oblique Marcator Angle (RSO)
Units of Coordinates	: Meters
Latitude of Origin	: 04° 00' 00.000" N
Longitide of Origin	: 115° 00' 00.000" E
False Easting at Origin	: 2000000 m
False Northing at Origin	: 5000000 m
Scale Factor at Origin	: 0.99984
Datum	: Local/Reference Datum
Name	: TIMBALAI 1948
Semi Major Axis	: 6377298.562 m
Semi Minor Axis	: 6356097.556 m
Plattening (1/f)	: 300.8017
Eccentricity	: 0.081472981521583

SURVEYED BY : LING SIAW HUI/TINI SUDOM
: MOHAMMAD FIQRIE/RAMLI HIJAD ALI
DATED : 8TH DECEMBER 2016
DRAWN BY: TINI SUDOM/NASARUDIN
SCALE : 1: 4000(A1)
DATUM: SS1648
E=2377058.483
N=5362187.415
ELEVATION =16.025m

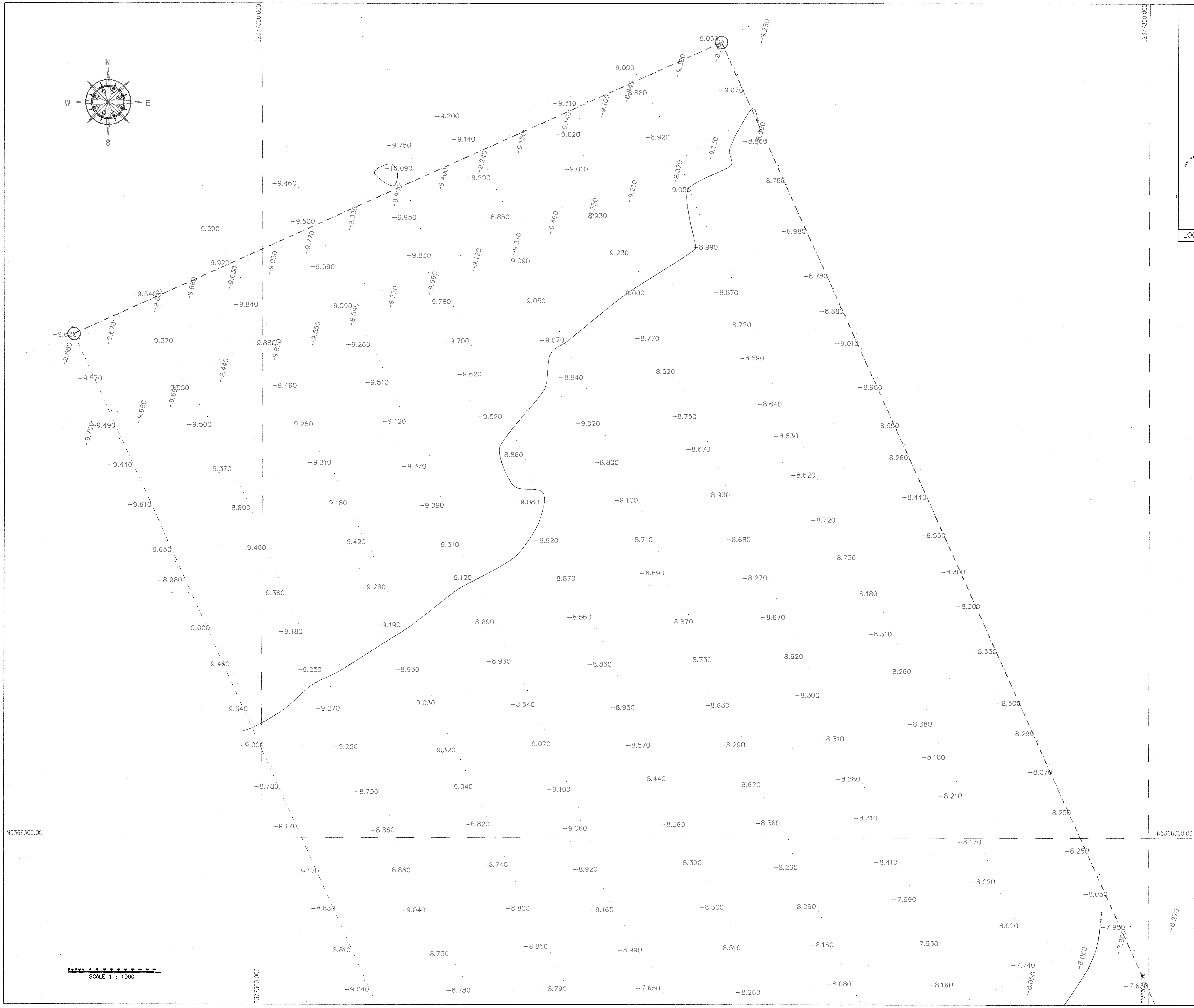
I, ..HUSAINI BIN SUHAILI.......of Putra Geomatics Survey do hereby certify that this plan has been prepared from the survey executed by me/done under my supervision and that both the plan and survey are correct.

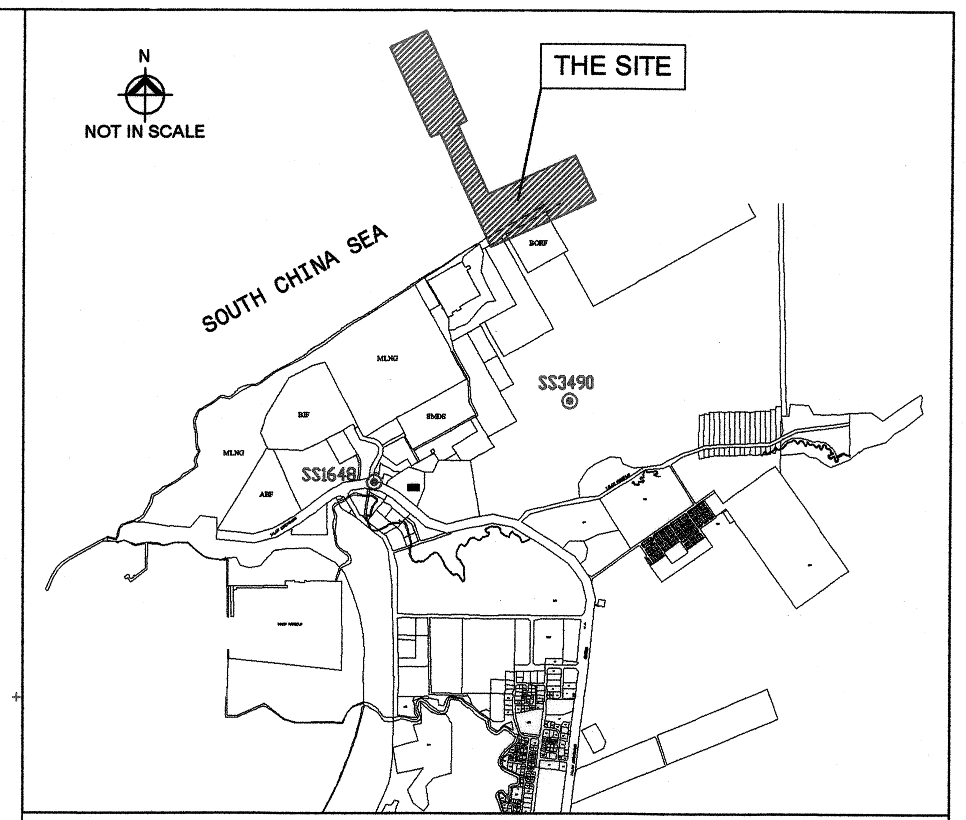
Date : ..3RD JANUARY 2017..... Signature : ....
Registration No: ....055........

PUTRA GEOMATICS SURVEY

Consultants in cadastral(Subdivision), Engineering, Topographical, Strata Title, Perimeter, Hydrographical Survey, Land Devt. and GIS

Lot 642, 2nd Floor, Jalan North Yu Seng MIRI
Tel: 019-8565771





LOCALITY PLAN SCALE: N.T.S

LEGEND :

LP	LAMP POST
CP	CATHODIC PROTECTION
SB	SIGN BOARD
PM	PIPE MARKER
CM	CABLE MARKER
TOP	TOP OF PLATE
IL	INVERT LEVEL
TL	TOP LEVEL

TOPOGRAHY AND BATHYMETRY SURVEY FOR KIDURONG COMBINED CYCLE PROJECT. BINTULU

GEODETIC PARAMETERS :

Name	: BRSO
Projection Name	: Oblique Marcator Angle (RSO)
Units of Coordinates	: Meters
Latitude of Origin	: 04° 00' 00.000" N
Longitide of Origin	: 115° 00' 00.000" E
False Easting at Origin	: 2000000 m
False Northing at Origin	: 5000000 m
Scale Factor at Origin	: 0.99984
Datum	: Local/Reference Datum
Name	: TIMBALAI 1948
Semi Major Axis	: 6377298.562 m
Semi Minor Axis	: 6356097.556 m
Plattening (1/f)	: 300.8017
Eccentricity	: 0.081472981521583

SURVEYED BY : LING SIAW HUI/TINI SUDOM
: MOHAMMAD FIQRIE/RAMLI HIJAD ALI
DATED : 8TH DECEMBER 2016
DRAWN BY: TINI SUDOM/NASARUDIN
SCALE : 1:1000(A1)1:2000(A3)
DATUM: SS1648
E=2377058.483
N=5362187.415
ELEVATION =16.025m

I, ..HUSAINI BIN SUHAILI.......of Putra Geomatics Survey do hereby certify that this plan has been prepared from the survey executed by me/done under my supervision and that both the plan and survey are correct.

Date : 30TH DECEMBER 2016 Signature: ....

Registration No: ...035...........

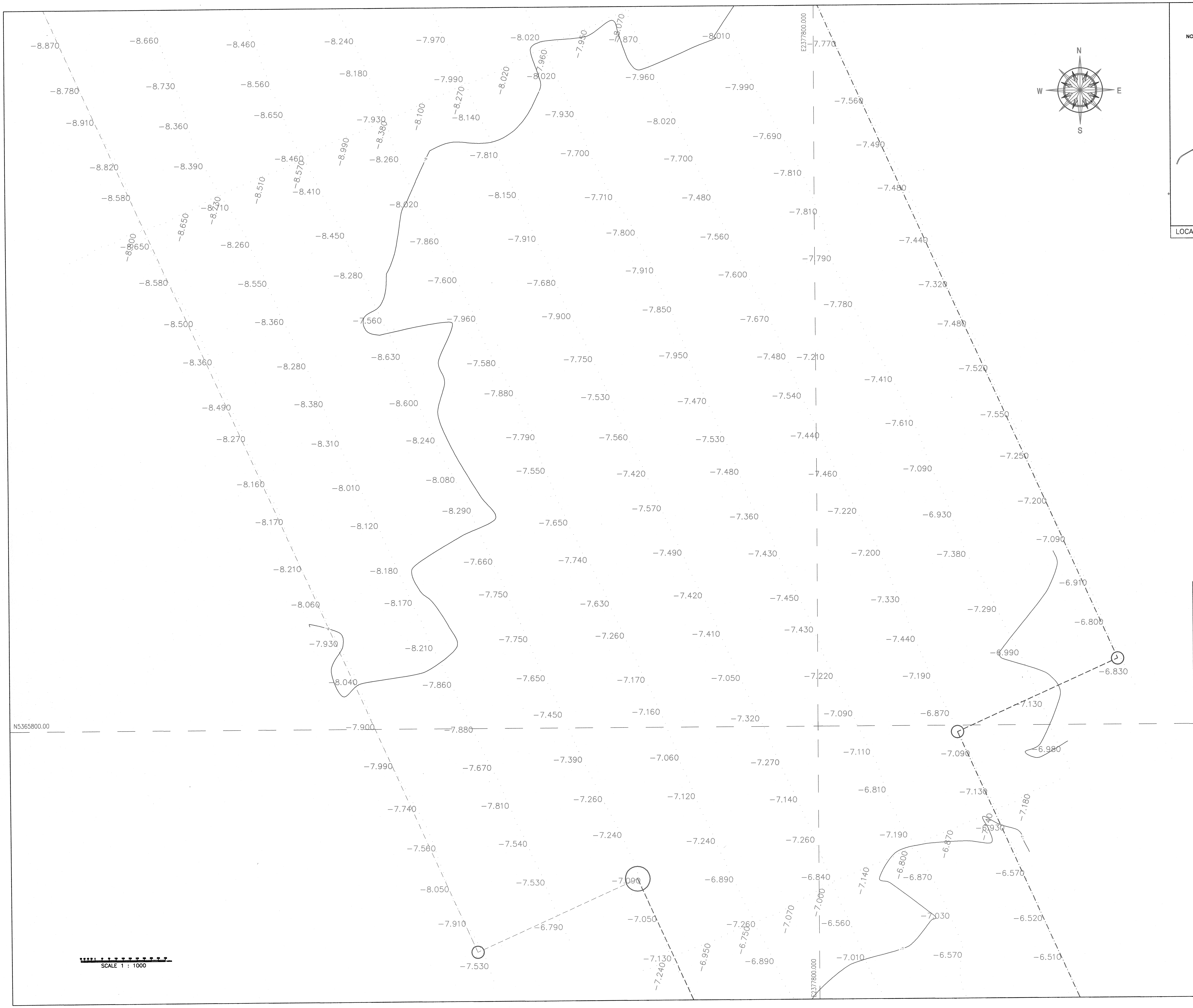
PUTRA GEOMATICS SURVEY

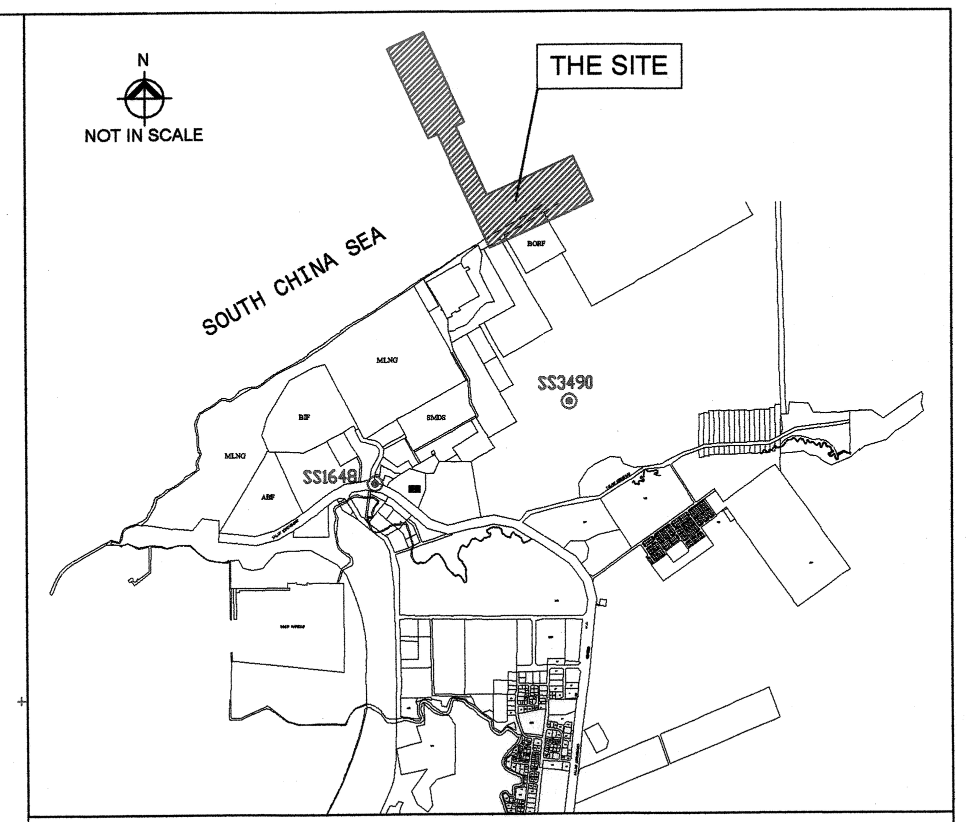
Consultants in cadastral(Subdivision), Engineering,Topographical,Strata Title, Perimeter,Hydrographical Survey,Land Devt.and GIS

Lot 642,2nd Floor,Jalan North Yu Seng MIRI

Tel: 019-8565771

DWG. NO-1





LOCALITY PLAN SCALE: N.T.S

LEGEND :

LP	LAMP POST
CP	CATHODIC PROTECTION
SB	SIGN BOARD
PM	PIPE MARKER
CM	CABLE MARKER
TOP	TOP OF PLATE
IL	INVERT LEVEL
TL	TOP LEVEL

TOPOGRAHY AND BATHYMETRY SURVEY FOR KIDURONG COMBINED CYCLE PROJECT. BINTULU

GEODETIC PARAMETERS :

Name	: BRSO
Projection Name	: Oblique Marcator Angle (RSO)
Units of Coordinates	: Meters
Latitude of Origin	: 04° 00' 00.000" N
Longitide of Origin	: 115° 00' 00.000" E
False Easting at Origin	: 2000000 m
False Northing at Origin	: 5000000 m
Scale Factor at Origin	: 0.99984
Datum	: Local/Reference Datum
Name	: TIMBALAI 1948
Semi Major Axis	: 6377298.562 m
Semi Minor Axis	: 6356097.556 m
Plattening (1/f)	: 300.8017
Eccentricity	: 0.081472981521583

SURVEYED BY : LING SIAW HUI/TINI SUDOM
: MOHAMMAD FIQRIE/RAMLI HIJAD ALI
DATED : 8TH DECEMBER 2016
DRAWN BY: TINI SUDOM/NASARUDIN
SCALE : 1:1000(A1)1:2000(A3)
DATUM: SS1648
E=2377058.483
N=5362187.415
ELEVATION =16.025m

I, HUSAINI BIN SUHAILI ......of Putra Geomatics Survey do hereby certify that this plan has been prepared from the survey executed by me/done under my supervision and that both the plan and survey are correct.

Date : 30TH DECEMBER 2016 Signature : ....
Registration No: 085.........

PUTRA GEOMATICS MIRI SURVEY

PUTRA GEOMATICS
SURVEY
Consultants in cadastral(Subdivision), Engineering, Topographical, Strata Title, Perimeter, Hydrographical Survey, Land Devt.and GIS
Lot 642,2nd Floor,Jalan North Yu Seng MIRI
Tel: 019-8565771 DWG. NO-2

LEGEND :

LP	LAMP POST
CP	CATHODIC PROTECTION
SB	SIGN BOARD
PM	PIPE MARKER
CM	CABLE MARKER
TOP	TOP OF PLATE
IL	INVERT LEVEL
TL	TOP LEVEL

TOPOGRAHY AND BATHYMETRY SURVEY FOR KIDURONG COMBINED CYCLE PROJECT. BINTULU

GEODETIC PARAMETERS :

Name	: BRSO
Projection Name	: Oblique Marcator Angle (RSO)
Units of Coordinates	: Meters
Latitude of Origin	: 04° 00' 00.000" N
Longitude of Origin	: 115° 00' 00.000" E
False Easting at Origin	: 2000000 m
False Northing at Origin	: 5000000 m
Scale Factor at Origin	: 0.99984
Datum	: Local/Reference Datum
Name	: TIMBALAI 1948
Semi Major Axis	: 6377298.562 m
Semi Minor Axis	: 6356097.556 m
Plattening (1/f)	: 300.8017
Eccentricity	: 0.081472981521583

SURVEYED BY : LING SIAW HUI/TINI SUDOM
: MOHAMMAD FIQRIE/RAMLI HIJAD ALI
DATED : 8TH DECEMBER 2016
DRAWN BY: TINI SUDOM/NASARUDIN
SCALE : 1:1000(A1)1:2000(A3)
DATUM: SS1648
E=2377058.483
N=5362187.415
ELEVATION =16.025m

I, HUSAINI BIN SUHAILI of Putra Geomatics Survey do hereby certify that this plan has been prepared from a survey executed by me/done under my supervision and that both this plan and survey are correct.

Date : 30TH DECEMBER 2016 Signature : ....

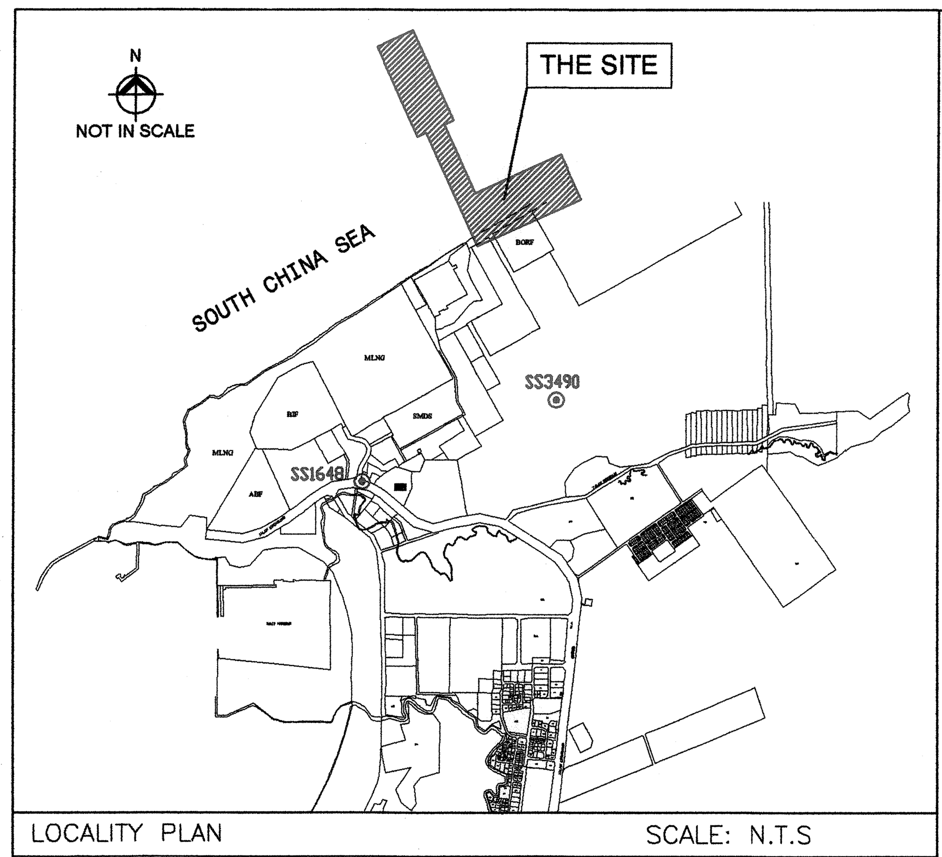
Registration No: ....

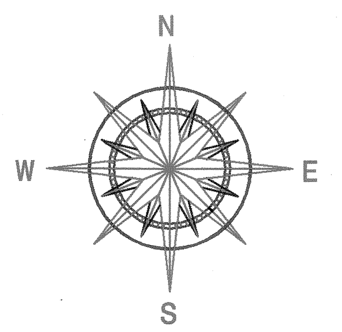
PUTRA GEOMATICS SURVEY

MIRI

PUTRA GEOMATICS SURVEY
Consultants in cadastral(Subdivision), Engineering,Topographical,Strata Title, Perimeter,Hydrographical Survey,Land Devt.and GIS
Lot 642,2nd Floor,Jalan North Yu Seng MIRI
Tel: 019-8565771

DWG. NO-3





LEGEND :

LP	LAMP POST
CP	CATHODIC PROTECTION
SB	SIGN BOARD
PM	PIPE MARKER
CM	CABLE MARKER
TOP	TOP OF PLATE
IL	INVERT LEVEL
TL	TOP LEVEL

TOPOGRAHY AND BATHYMETRY SURVEY FOR KIDURONG COMBINED CYCLE PROJECT. BINTULU

GEODETIC PARAMETERS :

Name	: BRSO
Projection Name	: Oblique Marcator Angle (RSO)
Units of Coordinates	: Meters
Latitude of Origin	: 04° 00' 00.000" N
Longitide of Origin	: 115° 00' 00.000" E
False Easting at Origin	: 2000000 m
False Northing at Origin	: 5000000 m
Scale Factor at Origin	: 0.99984
Datum	: Local/Reference Datum
Name	: TIMBALAI 1948
Semi Major Axis	: 6377298.562 m
Semi Minor Axis	: 6356097.556 m
Plattening (1/f)	: 300.8017
Eccentricity	: 0.081472981521583

SURVEYED BY : LING SIAW HUI/TINI SUDOM
: MOHAMMAD FIQRIE/RAMLI HIJAD ALI
DATED : 8TH DECEMBER 2016
DRAWN BY: TINI SUDOM/NASARUDIN
SCALE : 1:1000(A1)1:2000(A3)
DATUM: SS1648
E=2377058.483
N=5362187.415
ELEVATION =16.025m

I, ...HUSAINI BIN SUHAILI......of Putra Geomatics Survey do hereby certify that this plan has been prepared from the survey executed by me/done under my supervision and that both the plan and survey are correct.

Date : 30TH DECEMBER 2016 Signature : ....

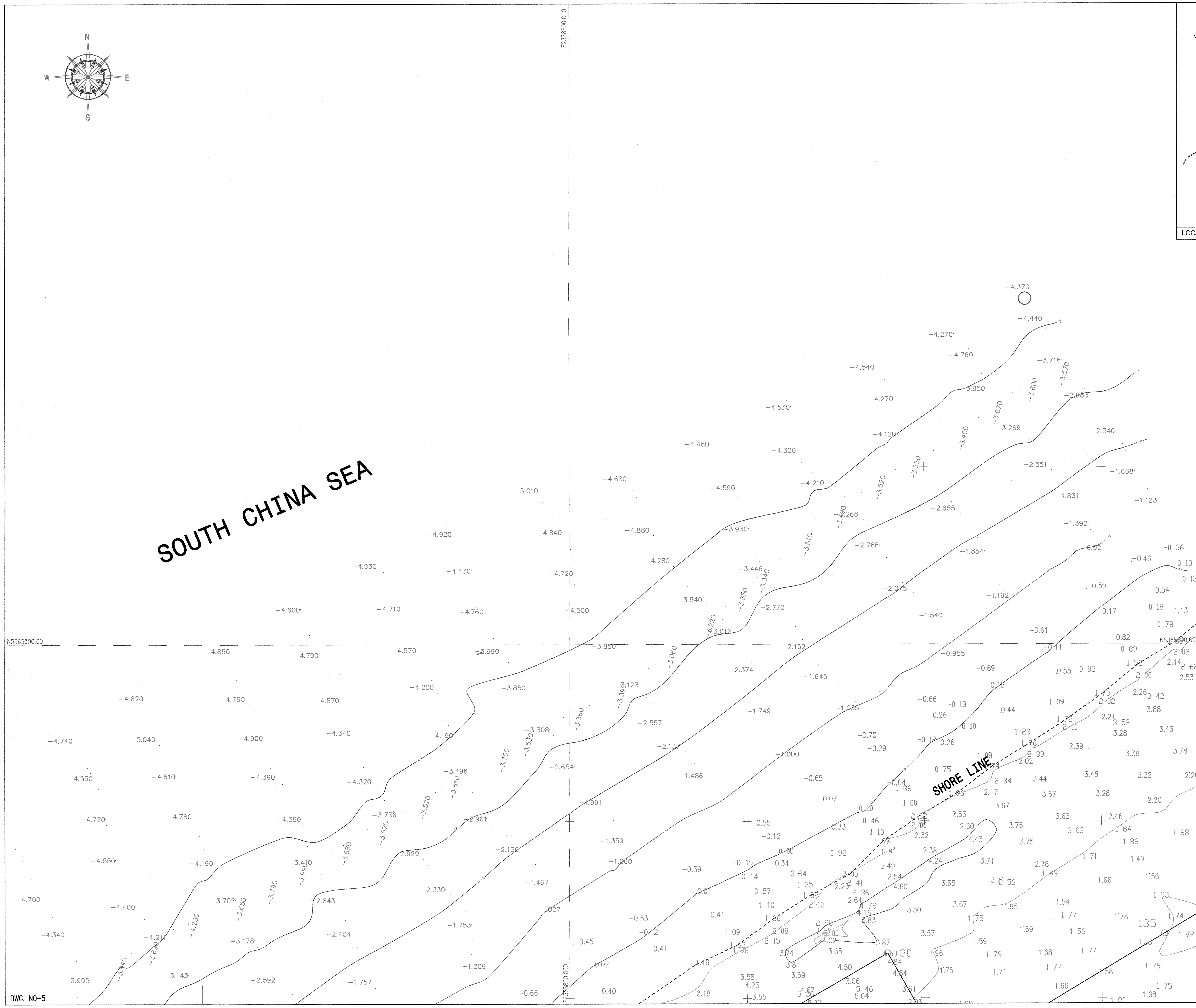
Registration No: ....

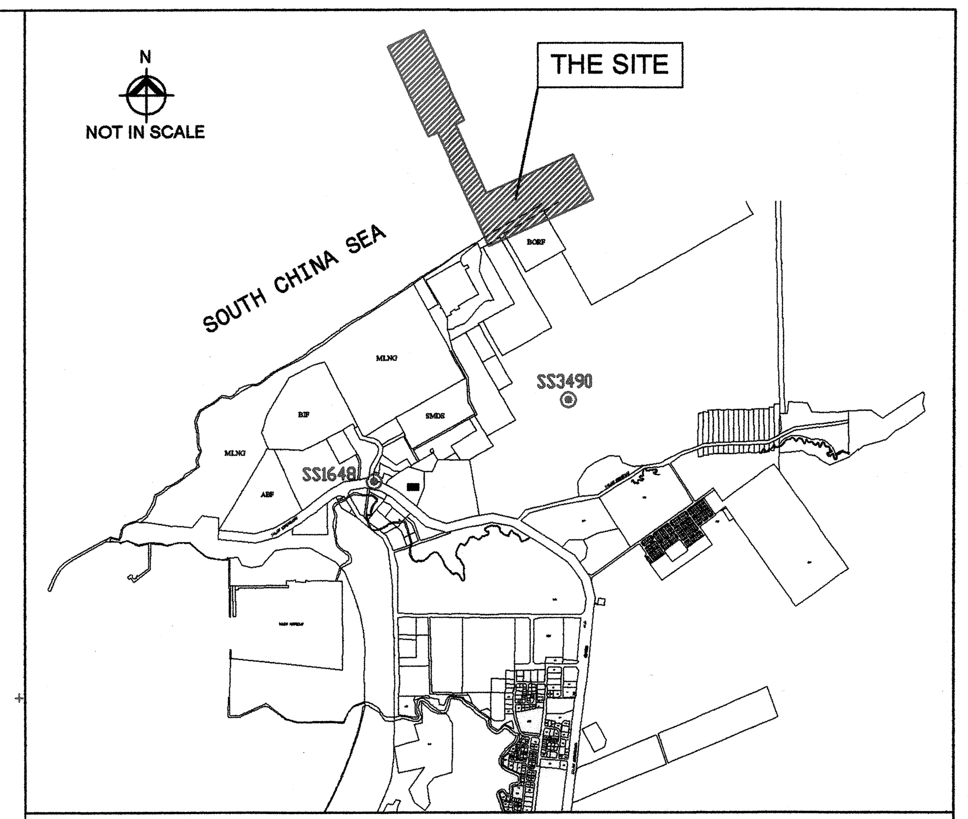
PUTRA GEOMATICS SURVEY

Consultants in cadastral(Subdivision), Engineering,Topographical,Strata Title, Perimeter,Hydrographical Survey,Land Devt.and GIS

Lot 642,2nd Floor,Jalan North Yu Seng MIRI
Tel: 019-8565771

DWG. NO-4





LOCALITY PLAN SCALE: N.T.S

LEGEND :

LP	LAMP POST
CP	CATHODIC PROTECTION
SB	SIGN BOARD
PM	PIPE MARKER
CM	CABLE MARKER
TOP	TOP OF PLATE
IL	INVERT LEVEL
TL	TOP LEVEL

TOPOGRAHY AND BATHYMETRY SURVEY FOR KIDURONG COMBINED CYCLE PROJECT. BINTULU

GEODETIC PARAMETERS :

Name	: BRSO
Projection Name	: Oblique Marcator Angle (RSO)
Units of Coordinates	: Meters
Latitude of Origin	: 04° 00' 00.000" N
Longitide of Origin	: 115° 00' 00.000" E
False Easting at Origin	: 2000000 m
False Northing at Origin	: 5000000 m
Scale Factor at Origin	: 0.99984
Datum	: Local/Reference Datum
Name	: TIMBALAI 1948
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Semi Minor Axis	: 6356097.556 m
Plattening (1/f)	: 300.8017
Eccentricity	: 0.081472981521583

SURVEYED BY : LING SIAW HUI/TINI SUDOM
: MOHAMMAD FIQRIE/RAMLI HIJAD ALI
DATED : 8TH DECEMBER 2016
DRAWN BY: TINI SUDOM/NASARUDIN
SCALE : 1:1000(A1)1:2000(A3)
DATUM: SS1648
E=2377058.483
N=5362187.415
ELEVATION =16.025m

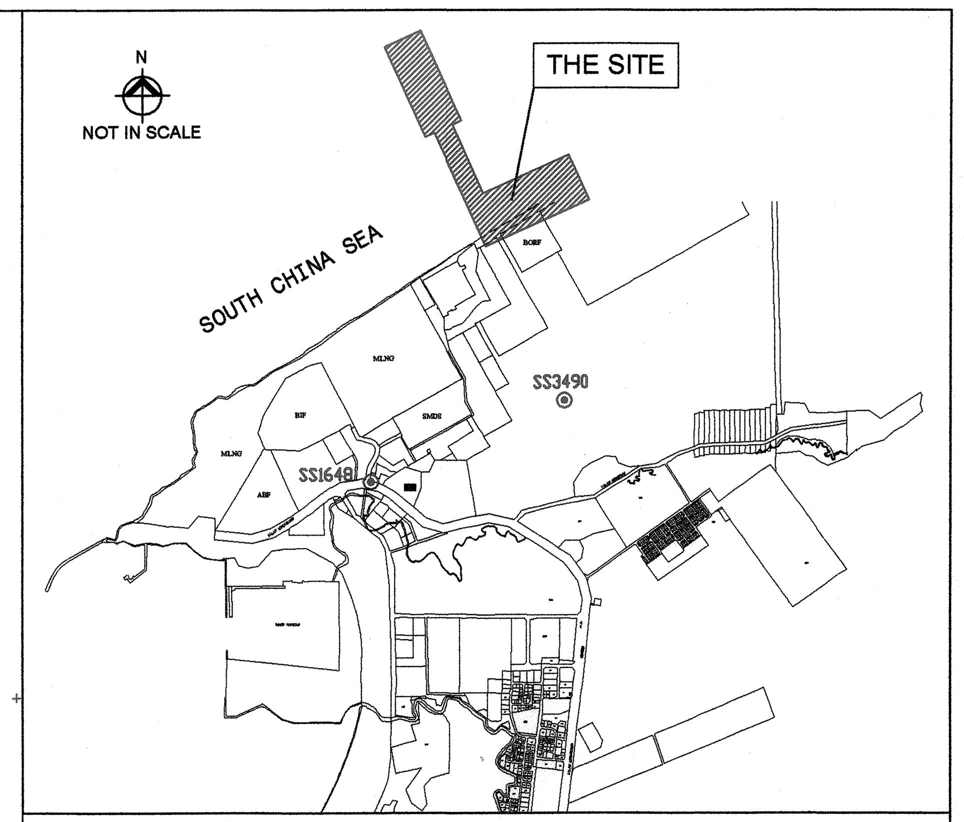
I, HUSAINI BIN SUHAILI of Putra Geomatics Survey do hereby certify that this plan has been prepared from the survey executed by me/done under my supervision and that both the plan and survey are correct.

Date : 30TH DECEMBER 2016 Signature : ....
Registration No: 055

PUTRA GEOMATICS MIRI
PUTRA GEOMATICS SURVEY

Consultants in cadastral(Subdivision), Engineering, Topographical, Strata Title, Perimeter, Hydrographical Survey, Land Devt.and GIS
Lot 642,2nd Floor,Jalan North Yu Seng MIRI
Tel: 019-8565771

DWG. NO-5



LOCALITY PLAN — SCALE: N.T.S

SCALE 1 : 1000

LEGEND :

LP	LAMP POST
CP	CATHODIC PROTECTION
SB	SIGN BOARD
PM	PIPE MARKER
CM	CABLE MARKER
TOP	TOP OF PLATE
IL	INVERT LEVEL
TL	TOP LEVEL

TOPOGRAHY AND BATHYMETRY SURVEY FOR KIDURONG COMBINED CYCLE PROJECT. BINTULU

GEODETIC PARAMETERS :

Name	: BRSO
Projection Name	: Oblique Marcator Angle (RSO)
Units of Coordinates	: Meters
Latitude of Origin	: 04° 00' 00.000" N
Longitide of Origin	: 115° 00' 00.000" E
False Easting at Origin	: 2000000 m
False Northing at Origin	: 5000000 m
Scale Factor at Origin	: 0.99984
Datum	: Local/Reference Datum
Name	: TIMBALAI 1948
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Semi Minor Axis	: 6356097.556 m
Plattening (1/f)	: 300.8017
Eccentricity	: 0.081472981521583

SURVEYED BY : LING SIAW HUI/TINI SUDOM
: MOHAMMAD FIQRIE/RAMLI HIJAD ALI
DATED : 8TH DECEMBER 2016
DRAWN BY: TINI SUDOM/NASARUDIN
SCALE :1:1000(A1)1:2000(A3)
DATUM: SS1648
E=2377058.483
N=5362187.415
ELEVATION =16.025m

I, HUSAINI BIN SUHAILI ......of Putra Geomatics Survey do hereby certify that this plan has been prepared from the survey executed by me/done under my supervision and that both the plan and survey are correct.

Date : 30TH DECEMBER 2016 Signature : ....

Registration No: 655

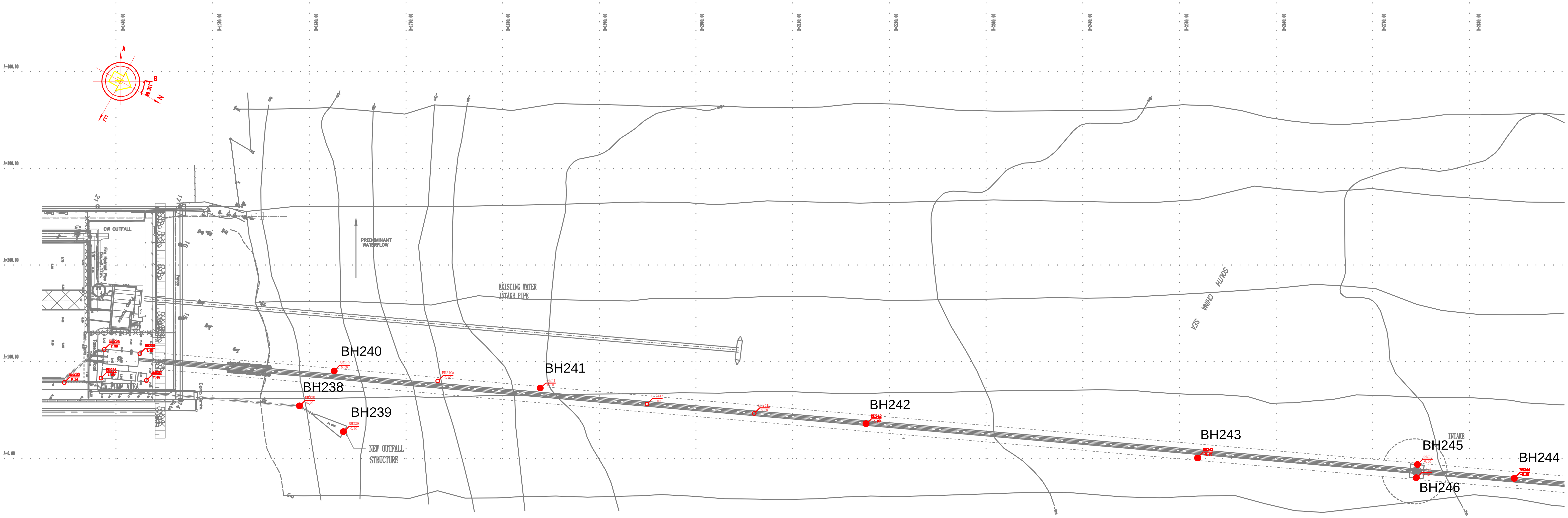
PUTRA GEOMATICS SURVEY

Consultants in cadastral(Subdivision), Engineering,Topographical,Strata Title, Perimeter,Hydrographical Survey,Land Devt.and GIS

Lot 642,2nd Floor,Jalan North Yu Seng MIRI
Tel: 019-8565771

Appendix 4.2.3

Borehole Log Results


CW OUTFALL
PREDOMINANT
WATERFLOW
EXISTING WATER
INTAKE PIPE
SOUTH
CHINA
SEA
BH240
BH241
BH238
BH239
NEW OUTFALL
STRUCTURE
BH242
BH243
INTAKE
BH245
BH244
BH246

GEOSPEC SDN. BHD.	LOG OF BORING Sheet 1 of 2 JOB No.: GSI/2016/2636	BOREHOLE No.: BH238 E. 2378274.285 N. 5364759.855 Date Started: 5/1/2017

PROJECT: SOIL INVESTIGATION WORKS FOR BINTULU TANJUNG KIDURONG COMBINED CYCLE POWER PLANT PROJECT (UNIT 10, UNIT 11)	**Date Completed:** 6/1/2017 **Boring Dia.:** 76mm **Coring Dia.:** 52mm
CLIENT: Sinohydro Corporation (M) Sdn. Bhd.	**Rotary Boring Rig:** YWE-D45
CONSULTING ENGINEER:	**Ground Level:** 0mCD

Date & Time	Depth (m)	Casing (m)	Depth (m)	Sample Type	SPT Test	N Value /mm	R Ratio	Depth (m)	Description/ Classification	Log
5/1 09:30	0		0.00-0.20	D1				0.20	Light brown SAND	
10:42	1		1.00-1.45	P1/D2	4,4,5,6,6,8	25	10/45	1.50	Medium dense light brown slightly clayey/silty SAND	S
11:10	2		2.00-2.45	P2/D3	11,8,8,9,10,10	37	16/45	2.50	Dense brownish grey SAND	
11:20	3	3.00	3.00-3.45	P3/D4	7,9,9,10,10,11	40	12/45		Dense grey clayey/silty SAND	
11:38	4		4.00-4.45	P4/D5	8,9,10,10,11,10	41	10/45	4.50		S-F
11:48	5		5.00-5.385	P5/D6	9,10,12,14,16,8/10	50/235	NIL	5.50	Very dense medium grey SAND	
12:06	6	6.00	6.00-6.424	P6/D7	8,9,10,12,15,13/49	50/274	7/42.4	6.50	Very dense medium grey SAND with traces of gravel	
13:33	7		7.00-7.387	P7/D8	4,7,12,14,17,7/12	50/237	12/38.7	7.50	Very dense medium grey SAND with traces of rock fragments	
14:03	8		8.00-8.353	P8/D9	4,9,13,16,21/53	50/203	17/35.3		Very dense grey slightly clayey/silty fine SAND	S
14:26	9	9.00	9.00-9.399	P9/D10	5,8,10,13,16,11/24	50/249	15/39.9			
	10							10.00		
15:18	11		10.50-10.898	P10/D11	5,9,10,14,16,10/23	50/248	16/39.8	11.50	Very dense greyish brown SAND with traces of shell fragments	
15:53	12	12.00	12.00-12.45	P11/D12	3,3,6,8,8,10	32	14/45		Dense medium grey SAND with traces of shell fragments	
	13							13.00		
16:19	14		13.50-13.95	P12/D13	4,4,5,7,9,14	35	18/45	14.50	Dense greyish brown clayey/silty fine SAND	S-F
16:39	15	15.00	15.00-15.45	P13/D14	2,2,3,3,5,7	18	17/45		Medium dense grey slightly clayey/silty SAND	
16:53	16 17		16.50-16.95	P14/D15	3,3,4,4,7,9	24	15/45			S
17:46	18	18.00	18.00-18.45	P15/D16	3,3,4,4,5,6	19	NIL			
	19							19.00		
6/1 10:20	20		19.50-19.95	P16/D17	1,2,2,3,2,3	10	45/45		Stiff grey CLAY	

SAMPLE/ TEST KEY

- D Disturbed Sample
- U Undisturbed Sample
- C Cored Sample
- P Standard Penetration Test
- V Vane Shear Test
- R Sample Recovery

WATER LEVEL MONITORING, depth (m)

Date	Time	Hole	Casing	Water

Remarks:

Scale: 1: 100 | Driller: M. Azhar | Logged by: Asala | Checked by Geologist: Wong Sing Wei

GEOSPEC SDN. BHD.	LOG OF BORING Sheet 2 of 2	BOREHOLE No.: BH238 E. 2378274.285 N. 5364759.855
	JOB No.: GSI/2016/2636	Date Started: 5/1/2017
PROJECT: SOIL INVESTIGATION WORKS FOR BINTULU TANJUNG KIDURONG COMBINED CYCLE POWER PLANT PROJECT (UNIT 10, UNIT 11)		Date Completed: 6/1/2017
		Boring Dia.: 76mm / Coring Dia.: 52mm
CLIENT: Sinohydro Corporation (M) Sdn. Bhd.		Rotary Boring Rig: YWE-D45
CONSULTING ENGINEER:		Ground Level: 0mCD

Date & Time	Depth (m)	Casing (m)	Depth (m)	Sample Type	SPT Test	N Value /mm	R Ratio	Depth (m)	Description/ Classification	Log
	20									
10:48	21		21.00-21.50	U1			100%		Stiff grey CLAY	CV
	22									
11:15	23		22.50-22.95	P17/D18	1,2,2,2,3,2	9	45/45	23.50		
11:57	24		24.00-24.50	U2			100%		Firm grey SILT	MV
	25									
14:08	26		25.50-25.95	P18/D19	1,1,2,1,2,2	7	45/45			
14:39	27		27.00-27.50	U3			100%			MV
	28									
15:01	29		28.50-28.95	P19/D20	1,2,2,1,2,3	8	45/45	29.50		
15:38	30		30.00-30.50	U4			100%		Firm grey CLAY	CV
	31									
	32							32.50		
16:19	33		33.00-33.45	P20/D21	2,3,3,4,4,5	16	16/45	33.45	Very stiff medium grey CLAY with traces of decayed wood	
	34								BH238 terminated at 33.45m below ground level	
	35									
	36									
	37									
	38									
	39									
	40									

SAMPLE/ TEST KEY
D Disturbed Sample
U Undisturbed Sample
C Cored Sample
P Standard Penetration Test
V Vane Shear Test
R Sample Recovery

WATER LEVEL MONITORING, depth (m)

Date	Time	Hole	Casing	Water

Remarks:

Scale: 1: 100 | Driller: M. Azhar | Logged by: Asala | Checked by Geologist: Wong Sing Wei

GEOSPEC SDN. BHD.	LOG OF BORING Sheet 1 of 2	BOREHOLE No.: BH239 E. 2378280 N. 5364792
	JOB No.: GSI/2016/2636	Date Started: 12/4/2017
PROJECT: SOIL INVESTIGATION WORKS FOR BINTULU TANJUNG KIDURONG COMBINED CYCLE POWER PLANT PROJECT (UNIT 10, UNIT 11)		Date Completed: 13/4/2017
		Boring Dia.: 76mm / Coring Dia.: 52mm
CLIENT: Sinohydro Corporation (M) Sdn. Bhd.		Rotary Boring Rig: YWE-D45
CONSULTING ENGINEER:		Ground Level: -0.30mCD

Date & Time	Depth (m)	Casing (m)	Depth (m)	Sample Type	SPT Test	N Value /mm	R Ratio	Depth (m)	Description/ Classification	Log
12/4 09:02	1	3.00	1.00-1.45	P1/D1	2,3,3,4,4,6	17	10/45		Medium dense medium brown SAND with traces of organic matter	
10:11	2		2.00-2.45	P2/D2	1,3,4,3,6,6	19	10/45	2.50		
11:02	3		3.00-3.45	P3/D3	2,2,3,3,5,6	17	11/45		Medium dense brown slightly clayey/silty fine SAND	S
11:40	4	6.00	4.00-4.45	P4/D4	2,3,4,5,6,8	23	10/45			
11:55	5		5.00-5.45	P5/D5	3,3,4,5,7,8	24	15/45			
13:14	6		6.00-6.45	P6/D6	2,3,3,6,10,11	30	10/45	7.00		
14:03	7	9.00	7.00-7.41	P7/D7	3,8,13,16,10,11/35	50/260	15/41		Very dense brownish grey slightly clayey/silty fine SAND	S
14:50	8		8.00-8.415	P8/D8	3,6,9,10,11,20/40	50/265	18/41.5			
15:11	9	12.00	9.00-9.405	P9/D9	3,6,8,15,17,10/30	50/255	20/40.5	10.00		
15:30	10		10.50-10.815	P10/D10	13,10,14,15,21/15	50/165	20/31.5	11.50	Very dense brownish gey clayey/silty fine SAND	S-F
16:33	12		12.00-12.45	P11/D11	3,4,4,6,7,9	26	25/45	13.00	Medium dense medium grey fine SAND	
13/4 11:41	13	15.00	13.50-13.845	P12/D12	3,4,10,16,24/45	50/145	25/34.5	15.00	Very dense medium grey fine SAND	
13:02	15		15.00-15.45	P13/D13	3,3,4,4,6,8	22	20/45		Medium dense grey clayey/silty fine SAND	S-F
13:22	16		16.50-16.95	P14/D14	4,4,4,6,6,6	22	25/45			
14:17	18		18.00-18.45	P15/D15	5,3,4,6,7,6	23	30/45	19.50		
14:55	20		19.50-19.95	P16/D16	2,2,2,2,2,3	9	40/45		Stiff medium grey CLAY	

SAMPLE/ TEST KEY
- D Disturbed Sample
- U Undisturbed Sample
- C Cored Sample
- P Standard Penetration Test
- V Vane Shear Test
- R Sample Recovery

WATER LEVEL MONITORING, depth (m)

Date	Time	Hole	Casing	Water
12/4	17:00	12.00	15.00	3.00
13/4	08:00	12.00	15.00	2.50

Remarks: Platform to ground level=2.00m

Scale: 1: 100 | Driller: Wasli | Logged by: Zulqarnain | Checked by Geologist: Wong Sing Wei

GEOSPEC SDN. BHD.	LOG OF BORING Sheet 2 of 2	BOREHOLE No.: BH239 E. 2378280 N. 5364792
	JOB No.: GSI/2016/2636	Date Started: 12/4/2017
PROJECT: SOIL INVESTIGATION WORKS FOR BINTULU TANJUNG KIDURONG COMBINED CYCLE POWER PLANT PROJECT (UNIT 10, UNIT 11)		Date Completed: 13/4/2017
		Boring Dia.: 76mm / Coring Dia.: 52mm
CLIENT: Sinohydro Corporation (M) Sdn. Bhd.		Rotary Boring Rig: YWE-D45
CONSULTING ENGINEER:		Ground Level: -0.30mCD

Date & Time	Depth (m)	Casing (m)	Depth (m)	Sample Type	SPT Test	N Value /mm	R Ratio	Depth (m)	Description/ Classification	Log
	20							21.00	Stiff medium grey CLAY	
15:11	21		21.00-21.50	U1			100%			MH
	22							22.50	Soft grey SILT	
15:42	23		22.50-22.95	P17/D17	2,2,1,1,2,2	6	45/45	24.00	Firm medium grey CLAY	
15:59	24		24.00-24.50	U2			100%			MV
	25							25.50	Soft grey SILT	
16:20	26		24.50-25.95	P18/D18	2,1,2,2,2,2	8	45/45			
16:34	27		27.00-27.45	P19/D19	2,2,1,1,2,2	6	40/45			
	28								Stiff grey SILT	
17:02	29		28.50-28.95	P20/D20	3,3,3,2,3,2	10	40/45			MV
17:15	30		30.00-30.45	P21/D21	2,2,1,2,3,3	9	40/45	30.45		
	31								BH239 terminated at 30.45m below ground level	
	32									
	33									
	34									
	35									
	36									
	37									
	38									
	39									
	40									

SAMPLE/ TEST KEY
- D Disturbed Sample
- U Undisturbed Sample
- C Cored Sample
- P Standard Penetration Test
- V Vane Shear Test
- R Sample Recovery

WATER LEVEL MONITORING, depth (m)

Date	Time	Hole	Casing	Water

Remarks:

Scale: 1: 100 | Driller: Wasli | Logged by: Zulqarnain | Checked by Geologist: Wong Sing Wei

GEOSPEC SDN. BHD.	LOG OF BORING Sheet 1 of 2 JOB No.: GSI/2016/2636	BOREHOLE No.: BH240 E. 2378233 N. 5364750 Date Started: 15/4/2017
PROJECT: SOIL INVESTIGATION WORKS FOR BINTULU TANJUNG KIDURONG COMBINED CYCLE POWER PLANT PROJECT (UNIT 10, UNIT 11)		**Date Completed:** 15/4/2017 **Boring Dia.:** 76mm **Coring Dia.:** 52mm
CLIENT: Sinohydro Corporation (M) Sdn. Bhd.		**Rotary Boring Rig:** YWE-D45
CONSULTING ENGINEER:		**Ground Level:** -0.30mCD

Date & Time	Depth (m)	Casing (m)	Depth (m)	Sample Type	SPT Test	N Value /mm	R Ratio	Depth (m)	Description/ Classification	Log
	0									
15/4 07:35	1	3.00	1.00-1.45	P1/D1	1,1,1,1,1,0	3	30/45	2.00	Very loose light brown SAND	
07:49	2		2.00-2.45	P2/D2	1,2,1,2,2,1	6	30/45	3.00	Loose medium brown SAND	
08:10	3		3.00-3.45	P3/D3	1,1,1,1,1,1	4	20/45			
08:30	4	6.00	4.00-4.45	P4/D4	1,1,1,1,1,2	5	30/45	5.00	Loose dark brown SAND	
08:42	5		5.00-5.45	P5/D5	1,2,2,2,2,3	9	NIL	6.00	Loose light brown SAND	
08:51	6		6.00-6.45	P6/D6	2,2,4,4,4,5	17	NIL	7.00	Medium dense dark grey SAND	
09:02	7	9.00	7.00-7.45	P7/D7	2,2,4,8,12,15	39	30/45			
09:11	8		8.00-8.45	P8/D8	3,3,4,11,13,17	45	25/45	9.00	Dense brownish grey slightly clayey/silty fine SAND	S
09:30	9	12.00	9.00-9.34	P9/D9	7,10,12,14,24/40	50/190	24/34			
	10									
09:45	11		10.50-10.815	P10/D10	10,10,19,21,10/15	50/165	20/31.5		Very dense grey clayey/silty fine SAND	
09:59	12		12.00-12.31	P11/D11	11,12,20,26,4/10	50/160	20/31	13.50		S-F
	13									
10:15	14	15.00	13.50-13.95	P12/D12	5,6,7,6,6,6	25	30/45	15.00	Medium dense medium grey SAND	
10:32	15		15.00-15.27	P13/D13	10,11,20,30/45	50/120	15/27	16.50	Very dense medium grey SAND	
	16									
10:51	17	18.00	16.50-16.95	P14/D14	5,4,5,5,6,7	23	30/45			
11:20	18		18.00-18.45	P15/D15	4,4,6,6,6,6	24	35/45	19.50	Medium dense grey clayey/silty fine SAND with some wood	S-F
	19									
11:51	20		19.50-19.95	P16/D16	4,6,6,4,7,6	23	35/45		Refer to next page	

SAMPLE/ TEST KEY
D Disturbed Sample
U Undisturbed Sample
C Cored Sample
P Standard Penetration Test
V Vane Shear Test
R Sample Recovery

WATER LEVEL MONITORING, depth (m)

Date	Time	Hole	Casing	Water

Remarks: Platform to ground level=2.00m

Scale: 1: 100 | Driller: Wasli | Logged by: Zulqarnain | Checked by Geologist: Wong Sing Wei

GEOSPEC SDN. BHD.	LOG OF BORING Sheet 2 of 2 JOB No.: GSI/2016/2636	BOREHOLE No.: BH240 E. 2378233 N. 5364750 Date Started: 15/4/2017

PROJECT: SOIL INVESTIGATION WORKS FOR BINTULU TANJUNG KIDURONG COMBINED CYCLE POWER PLANT PROJECT (UNIT 10, UNIT 11)	**Date Completed:** 15/4/2017 **Boring Dia.:** 76mm **Coring Dia.:** 52mm
CLIENT: Sinohydro Corporation (M) Sdn. Bhd.	**Rotary Boring Rig:** YWE-D45
CONSULTING ENGINEER:	**Ground Level:** -0.30mCD

Date & Time	Depth (m)	Casing (m)	Depth (m)	Sample Type	SPT Test	N Value /mm	R Ratio	Depth (m)	Description/ Classification	Log
	20							21.00	Medium dense medium grey clayey fine SAND	
12:10	21		21.00-21.45	P17/D17	4,3,2,2,2,3	9	40/45		Stiff grey SILT	
	22									
12:49	23		22.50-22.95	P18/D18	3,3,4,3,2,2	11	40/45			
13:11	24		24.00-24.45	P19/D19	2,3,4,3,1,2	10	40/45			MV
	25									
13:41	26		24.50-25.95	P20/D20	2,2,2,2,2,3	9	40/45			
13:58	27		27.00-27.45	P21/D21	2,1,2,2,2,2	8	40/45			
	28									
14:20	29		28.50-28.95	P22/D22	1,1,1,2,3,3	9	40/45			MV
14:43	30		30.00-30.45	P23/D23	1,2,2,2,2,2	8	40/45	30.45		
	31								BH240 terminated at 30.45m below ground level	
	32									
	33									
	34									
	35									
	36									
	37									
	38									
	39									
	40									

SAMPLE/ TEST KEY
D Disturbed Sample
U Undisturbed Sample
C Cored Sample
P Standard Penetration Test
V Vane Shear Test
R Sample Recovery

WATER LEVEL MONITORING, depth (m)

Date	Time	Hole	Casing	Water

Remarks:

Scale: 1: 100 | Driller: Wasli | Logged by: Zulqarnain | Checked by Geologist: Wong Sing Wei

GEOSPEC SDN. BHD.	LOG OF BORING Sheet 1 of 2	BOREHOLE No.: BH241 E. 2378136 N. 5364964
	JOB No.: GSI/2016/2636	Date Started: 26/3/2017
PROJECT: SOIL INVESTIGATION WORKS FOR BINTULU TANJUNG KIDURONG COMBINED CYCLE POWER PLANT PROJECT (UNIT 10, UNIT 11)		Date Completed: 27/3/2017
		Boring Dia.: 76mm / Coring Dia.: 52mm
CLIENT: Sinohydro Corporation (M) Sdn. Bhd.		Rotary Boring Rig: YWE-D90
CONSULTING ENGINEER:		Ground Level: -4.20mCD

Date & Time	Depth (m)	Casing (m)	Depth (m)	Sample Type	SPT Test	N Value /mm	R Ratio	Depth (m)	Description/ Classification	Log
	0									
26/3 14:20	1		1.00-1.45	P1/D1	1,0,0,1,0,0	1	26/45			
15:00	2		2.00-2.45	P2/D2	Weight of hammer	0	20/45		Very soft grey CLAY	
15:20	3	12.00	3.00-3.45	P3/D3	Weight of hammer	0	20/45			CH
								4.00		
15:50	4		4.00-4.45	P4/D4	1,0,1,1,0,1	3	25/45			
16:30	5		5.00-5.45	P5/D5	1,0,1,0,1,1	3	25/45		Very loose light grey slightly clayey/silty SAND	S
								6.00		
27/3 06:15	6	15.00	6.00-6.445	P6/D6	9,12,14,15,17,4/70	50/295	15/44.5			
06:30	7		7.00-7.445	P7/D7	9,11,13,16,18,3/70	50/295	15/44.5		Very dense light grey clayey/silty SAND	S-F
								8.00		
07:00	8		8.00-8.45	P8/D8	1,0,0,0,1,0	1	15/45		Very soft dark grey sandy CLAY	
								9.00		
07:20	9	18.00	9.00-9.50	U1			100%			CL
	10									
07:50	11		10.50-10.95	P9/D9	1,0,1,0,1,0	2	40/45		Very soft grey CLAY	
08:20	12	21.00	12.00-12.50	U2			100%			CV
	13							13.50		
09:00	14		13.50-13.95	P10/D10	1,0,1,1,1,1	4	40/45		Firm grey SILT	MV
								15.00		
09:20	15	24.00	15.00-15.50	U3			100%		Very soft grey CLAY	CV
	16							16.00		
09:55	17		16.50-16.95	P11/D11	1,0,0,0,1,0	1	30/45		Very soft dark grey CLAY	CH
								17.50		
10:30	18		18.00-18.45	P12/D12	1,0,1,0,0,1	2	30/45		Very soft medium grey CLAY with decayed wood	
	19							19.50		
11:00	20		19.50-19.95	P13/D13	1,0,1,1,2,2	6	20/45		Stiff light brown CLAY	

SAMPLE/ TEST KEY
D Disturbed Sample
U Undisturbed Sample
C Cored Sample
P Standard Penetration Test
V Vane Shear Test
R Sample Recovery

WATER LEVEL MONITORING, depth (m)

Date	Time	Hole	Casing	Water
26/3	17:00	5.45	12.00	3.90
27/3	07:00	5.45	12.00	4.10

Remarks: Platform to ground level=9.00m
Final water level= 4.00m on 27/3/2017

Scale: 1: 100 | Driller: Wasli | Logged by: Hafizuddin | Checked by Geologist: Wong Sing Wei

GEOSPEC SDN. BHD.	LOG OF BORING Sheet 2 of 2 JOB No.: GSI/2016/2636	BOREHOLE No.: BH241 E. 2378136 N. 5364964 Date Started: 26/3/2017

PROJECT: SOIL INVESTIGATION WORKS FOR BINTULU TANJUNG KIDURONG COMBINED CYCLE POWER PLANT PROJECT (UNIT 10, UNIT 11)

Date Completed: 27/3/2017

Boring Dia.: 76mm | **Coring Dia.:** 52mm

CLIENT: Sinohydro Corporation (M) Sdn. Bhd.

Rotary Boring Rig: YWE-D90

CONSULTING ENGINEER:

Ground Level: -4.20mCD

Date & Time	Depth (m)	Casing (m)	Depth (m)	Sample Type	SPT Test	N Value /mm	R Ratio	Depth (m)	Description/ Classification	Log
	20									
11:30	21		21.00-21.45	P14/D14	1,2,2,2,2,2	8	30/45		Stiff light brown CLAY	CH
	22							22.50		
12:00	23		22.50-22.95	P15/D15	2,3,4,6,9,9	28	30/45		Very stiff medium grey sandy CLAY	
12:30	24		24.00-24.435	P16/D16	3,2,7,13,18,12/60	50/285	30/43.5	24.00	Hard medium grey sandy CLAY	
	25							25.50		
13:00	26		25.50-25.95	P17/D17	2,3,4,5,5,6	20	30/45		Very stiff grey CLAY	
13:45	27		27.00-27.45	P18/D18	2,4,5,6,5,6	22	30/45			CV
15:20	28–29		28.50-28.95	P19/D19	2,5,5,6,6,6	23	30/45			
16:00	30		30.00-30.45	P20/D20	3,6,6,6,6,8	26	30/45			CV
	31									
	32							33.00		
16:30	33		33.00-33.45	P21/D21	3,5,6,7,7,7	27	30/45		Very stiff grey SILT	
	34–35									
17:00	36		36.00-36.45	P22/D22	3,6,6,7,8,8	29	30/45	36.45		MV
	37								BH241 terminated at 36.45m below ground level	
	38									
	39									
	40									

SAMPLE/ TEST KEY
D Disturbed Sample
U Undisturbed Sample
C Cored Sample
P Standard Penetration Test
V Vane Shear Test
R Sample Recovery

WATER LEVEL MONITORING, depth (m)

Date	Time	Hole	Casing	Water

Remarks:

Scale: 1: 100 | Driller: Wasli | Logged by: Hafizuddin | Checked by Geologist: Wong Sing Wei

GEOSPEC SDN. BHD.	LOG OF BORING Sheet 1 of 2 JOB No.: GSI/2016/2636	BOREHOLE No.: BH242 E. 2378004 N. 5365280 Date Started: 16/3/2017

PROJECT: SOIL INVESTIGATION WORKS FOR BINTULU TANJUNG KIDURONG COMBINED CYCLE POWER PLANT PROJECT (UNIT 10, UNIT 11)

Date Completed: 19/3/2017

Boring Dia.: 76mm **Coring Dia.:** 52mm

CLIENT: Sinohydro Corporation (M) Sdn. Bhd.

Rotary Boring Rig: YWE-D90

CONSULTING ENGINEER:

Ground Level: -5.00mCD

Date & Time	Depth (m)	Casing (m)	Depth (m)	Sample Type	SPT Test	N Value /mm	R Ratio	Depth (m)	Description/ Classification	Log
	0									
16/3 12:20	1		1.00-1.45	P1/D1	1,0,0,0,0,0	0	15/45	2.00	Decayed WOOD	
13:00	2		2.00-2.45	P2/D2	1,0,1,0,0,1	2	10/45	2.50	Very soft light grey sandy SILT	MS
13:20	3	12.00	3.00-3.45	P3/D3	1,0,0,1,0,0	1	35/45			
13:50	4		4.00-4.45	P4/D4	1,0,0,1,0,0	1	30/45		Very loose medium grey SAND	
14:20	5		5.00-5.45	P5/D5	1,0,0,1,0,0	1	10/45	5.50		
15:00	6	15.00	6.00-6.45	P6/D6	1,0,0,0,1,0	1	25/45	6.50	Very soft grey sandy SILT with seashell fragment	MS
15:30	7		7.00-7.45	P7/D7	1,0,0,0,0,0	0	25/45			
16:00	8		8.00-8.45	P8/D8	1,0,0,0,1,0	1	25/45	9.00	Very loose medium grey SAND	
16:30	9	18.00	9.00-9.50	U1			100%			CV
	10								Very soft grey CLAY	
18/3 12:00	11		10.50-10.95	P9/D9	1,0,0,0,1,0	1		11.50		
13:00	12	21.00	12.00-12.50	U2			100%			MV
	13								Very soft grey SILT	
19/3 06:30	14		13.50-13.95	P10/D10	Weight of hammer	0	30/45	14.50		
06:50	15	24.00	15.00-15.45	P11/D11	Weight of hammer	0	30/45		Very soft dark grey CLAY	CV
	16							16.50		
07:15	17		16.50-16.95	P12/D12	1,0,0,0,1,0	1	NIL			
07:50	18		18.00-18.45	P13/D13	1,0,0,0,0,1	1	25/45	19.00	Very soft medium grey sandy CLAY	
08:30	19 20		19.50-19.95	P14/D14	1,0,1,0,0,0	1	25/45	20.00	Very soft medium grey CLAY laminated with fine sand	

SAMPLE/ TEST KEY
- D Disturbed Sample
- U Undisturbed Sample
- C Cored Sample
- P Standard Penetration Test
- V Vane Shear Test
- R Sample Recovery

WATER LEVEL MONITORING, depth (m)

Date	Time	Hole	Casing	Water
16/3	17:15	9.50	18.00	2.70
18/3	13:20	12.50	21.00	2.50

Remarks: Platform to ground level=9.00m
Final water level= 2.30m on 15/3/2017

Scale: 1: 100 | Driller: Wasli | Logged by: Hafizuddin | Checked by Geologist: Wong Sing Wei

GEOSPEC SDN. BHD.

LOG OF BORING

JOB No.: GSI/2016/2636

BOREHOLE No.: BH242

E. 2378004 **N.** 5365280

Date Started: 16/3/2017

PROJECT: SOIL INVESTIGATION WORKS FOR BINTULU TANJUNG KIDURONG COMBINED CYCLE POWER PLANT PROJECT (UNIT 10, UNIT 11)

Date Completed: 19/3/2017

Boring Dia.: 76mm **Coring Dia.:** 52mm

CLIENT: Sinohydro Corporation (M) Sdn. Bhd.

Rotary Boring Rig: YWE-D90

CONSULTING ENGINEER:

Ground Level: -5.00mCD

Date & Time	Depth (m)	Casing (m)	Depth (m)	Sample Type	SPT Test	N Value /mm	R Ratio	Depth (m)	Description/ Classification	Log
09:20	21		21.00-21.45	P15/D15	1,0,0,1,0,0	1	25/45	22.00	Very soft dark grey CLAY laminated with fine sand	CI
10:15	22		22.50-22.95	P16/D16	1,0,1,1,1,1	4	30/45		Soft grey slightly sandy SILT	M
11:00	24		24.00-24.45	P17/D17	1,1,1,1,1,1	4	30/45	25.50		
12:00	25		25.50-25.95	P18/D18	2,3,4,4,5,7	20	30/45	27.00	Very stiff medium grey CLAY with sand	
12:50	27		27.00-27.45	P19/D19	4,4,6,8,9,10	33	20/45	28.50	Hard medium grey CLAY with sand	
14:00	28		28.50-28.855	P20/D20	5,11,14,19,17/55	50/205	10/35.5		Hard grey slightly sandy SILT	M
14:50	30		30.00-30.265	P21/D21	13,12/55,24,26/60	50/135	10/26.5	33.00		
15:40	33		33.00-33.45	P22/D22	3,4,5,7,7,7	26	30/45		Very stiff dark grey CLAY	CH
16:15	36		36.00-36.45	P23/D23	3,4,6,7,7,7	27	30/45	36.45		
									BH242 terminated at 36.45m below ground level	

SAMPLE/ TEST KEY
D Disturbed Sample
U Undisturbed Sample
C Cored Sample
P Standard Penetration Test
V Vane Shear Test
R Sample Recovery

WATER LEVEL MONITORING, depth (m)

Date	Time	Hole	Casing	Water

Remarks:

Scale: 1: 100 | Driller: Wasli | Logged by: Hafizuddin | Checked by Geologist: Wong Sing Wei

GEOSPEC SDN. BHD.	LOG OF BORING Sheet 1 of 2 **JOB No.:** GSI/2016/2636	**BOREHOLE No.:** BH243 **E.** 2377866 **N.** 5365596 **Date Started:** 14/3/2017
PROJECT: SOIL INVESTIGATION WORKS FOR BINTULU TANJUNG KIDURONG COMBINED CYCLE POWER PLANT PROJECT (UNIT 10, UNIT 11)		**Date Completed:** 15/3/2017 **Boring Dia.:** 76mm **Coring Dia.:** 52mm
CLIENT: Sinohydro Corporation (M) Sdn. Bhd.		**Rotary Boring Rig:** YWE-D90
CONSULTING ENGINEER:		**Ground Level:** -6.70mCD

Date & Time	Depth (m)	Casing (m)	Depth (m)	Sample Type	SPT Test	N Value /mm	R Ratio	Depth (m)	Description/ Classification	Log
	0									
14/3 13:10	1	12.00	1.00-1.45	P1/D1	Weight of hammer	0	30/45		Very soft grey CLAY	CV
13:20	2		2.00-2.45	P2/D2	Weight of hammer	0	30/45	2.50		
14:00	3		3.00-3.50	U1			100%		Very soft grey SILT	MV
14:20	4	15.00	4.00-4.45	P3/D3	1,0,0,0,1,0	1	30/45	4.50		
14:50	5		5.00-5.45	P4/D4	1,0,0,0,0,0	0	30/45			CV
15:30	6		6.00-6.50	U2			100%		Very soft grey CLAY	CV
15/3 07:00	7	18.00	7.00-7.45	P5/D5	1,0,0,0,0,0	0		7.50		
07:30	8		8.00-8.45	P6/D6	1,0,0,0,0,0	0		8.50	Very soft grey SILT	MV
07:50	9		9.00-9.50	U3			90%			CV
	10								Very soft grey CLAY	
08:30	11	21.00	10.50-10.95	P7/D7	1,0,0,1,0,0	1		11.50		
09:00	12		12.00-12.50	U4			100%			MV
09:30	13 / 14	24.00	13.50-13.95	P8/D8	1,0,0,0,1,0	1	40/45		Very soft grey SILT	
10:00	15		15.00-15.45	P9/D9	1,0,0,1,0,0	1	20/45	16.00		
10:30	16 / 17	27.00	16.50-16.95	P10/D10	1,0,0,0,1,0	1	30/45			CV
11:00	18 / 19		18.00-18.45	P11/D11	1,0,0,1,0,0	1	30/45		Very soft grey CLAY	
11:30	20	30.00	19.50-19.95	P12/D12	1,0,1,0,0,1	2	30/45			

SAMPLE/ TEST KEY

- D Disturbed Sample
- U Undisturbed Sample
- C Cored Sample
- P Standard Penetration Test
- V Vane Shear Test
- R Sample Recovery

WATER LEVEL MONITORING, depth (m)

Date	Time	Hole	Casing	Water
14/3	16:50	6.50	15.00	2.40
15/3	07:10	6.50	15.00	2.20

Remarks: Platform to ground level=10.50m
Final water level= 2.30m on 15/3/2017

Scale: 1: 100 | Driller: Wasli | Logged by: Hafizuddin | Checked by Geologist: Wong Sing Wei

GEOSPEC SDN. BHD.	LOG OF BORING Sheet 2 of 2	BOREHOLE No.: BH243 E. 2377866 N. 5365596
	JOB No.: GSI/2016/2636	Date Started: 14/3/2017
PROJECT: SOIL INVESTIGATION WORKS FOR BINTULU TANJUNG KIDURONG COMBINED CYCLE POWER PLANT PROJECT (UNIT 10, UNIT 11)		Date Completed: 15/3/2017
		Boring Dia.: 76mm / Coring Dia.: 52mm
CLIENT: Sinohydro Corporation (M) Sdn. Bhd.		Rotary Boring Rig: YWE-D90
CONSULTING ENGINEER:		Ground Level: -6.70mCD

Date & Time	Depth (m)	Casing (m)	Depth (m)	Sample Type	SPT Test	N Value /mm	R Ratio	Depth (m)	Description/ Classification	Log
	20							21.00	Very soft grey CLAY	
12:30	21		21.00-21.45	P13/D13	1,0,1,0,1,1	3	30/45	22.50	Soft light grey CLAY	
13:30	22	33.00	22.50-22.95	P14/D14	1,0,1,0,1,1	3	30/45	24.00	Soft grey CLAY	CH
14:30	24		24.00-24.45	P15/D15	1,0,1,1,1,1	4	30/45			
15:15	25	36.00	25.50-25.95	P16/D16	1,1,1,1,1,2	5	30/45	27.00	Firm grey SILT	MV
16:00	27		27.00-27.45	P17/D17	2,3,6,7,9,9	31	30/45	28.50	Hard medium grey sandy CLAY with traces of gravel	
16:30	28		28.50-28.945	P18/D18	2,3,11,13,13,13/70	50/295	15/44.5	30.00	Very dense medium grey clayey SAND	
17:00	30		30.00-30.45	P19/D19	4,9,9,10,11,13	43	20/45	33.00	Hard grey sandy SILT	MS
17:30	33		33.00-33.445	P20/D20	5,7,11,12,14,13/70	50/295	20/44.5	36.00	Hard grey slightly sandy SILT	M
18:00	36		36.00-36.45	P21/D21	5,5,6,7,9,12	34	30/45	36.45	Hard grey CLAY	CV
	37–40								BH243 terminated at 36.45m below ground level	

SAMPLE/ TEST KEY
- D Disturbed Sample
- U Undisturbed Sample
- C Cored Sample
- P Standard Penetration Test
- V Vane Shear Test
- R Sample Recovery

WATER LEVEL MONITORING, depth (m)

Date	Time	Hole	Casing	Water

Remarks:

Scale: 1: 100 | Driller: Wasli | Logged by: Hafizuddin | Checked by Geologist: Wong Sing Wei

GEOSPEC SDN. BHD.	LOG OF BORING Sheet 1 of 3 JOB No.: GSI/2016/2636	BOREHOLE No.: BH244 E. 2377724 N. 5365892 Date Started: 23/3/2017

PROJECT: SOIL INVESTIGATION WORKS FOR BINTULU TANJUNG KIDURONG COMBINED CYCLE POWER PLANT PROJECT (UNIT 10, UNIT 11)

Date Completed: 24/3/2017

Boring Dia.: 76mm | **Coring Dia.:** 52mm

CLIENT: Sinohydro Corporation (M) Sdn. Bhd.

Rotary Boring Rig: YWE-D90

CONSULTING ENGINEER:

Ground Level: -6.80mCD

Date & Time	Depth (m)	Casing (m)	Depth (m)	Sample Type	SPT Test	N Value /mm	R Ratio	Depth (m)	Description/ Classification	Log
	0									
23/3 14:30	1		1.00-1.45	P1/D1	Weight of hammer	0	20/45		Very soft dark brown SILT with traces of seashell fragment	
14:50	2		2.00-2.45	P2/D2	Weight of hammer	0	30/45	2.00	Very soft grey SILT with decayed wood	ME
15:15	3	15.00	3.00-3.50	U1			100%	3.00		CI
15:50	4		4.00-4.45	P3/D3	Weight of hammer	0	20/45		Very soft grey CLAY	CV
16:30	5		5.00-5.45	P4/D4	Weight of hammer	0	30/45	5.50		
17:15	6	18.00	6.00-6.50	U2			100%			CV
17:50	7		7.00-7.45	P5/D5	Weight of hammer	0	30/45		Very soft dark grey CLAY	
18:20	8		8.00-8.45	P6/D6	1,0,0,0,1,0	1	30/45	8.50		
24/3 07:30	9	21.00	9.00-9.50	U3			100%			MV
	10								Very soft dark grey SILT	
07:50	11		10.50-10.95	P7/D7	1,0,0,0,1,0	1		11.50		
08:20	12	24.00	12.00-12.50	U4			100%			
	13								Very soft grey SILT	
08:50	14		13.50-13.95	P8/D8	1,0,0,1,0,1	2	20/45	14.50		
09:30	15		15.00-15.45	P9/D9	1,0,0,0,0,0	0	30/45			CV
	16									
10:00	17		16.50-16.95	P10/D10	1,0,0,0,0,0	0	30/45		Very soft grey CLAY	
10:30	18		18.00-18.45	P11/D11	1,0,0,0,1,0	1	30/45			
	19							19.00		
11:00	20		19.50-19.95	P12/D12	1,0,0,1,0,0	1	30/45	20.00	Very soft dark grey CLAY	

SAMPLE/ TEST KEY
- D Disturbed Sample
- U Undisturbed Sample
- C Cored Sample
- P Standard Penetration Test
- V Vane Shear Test
- R Sample Recovery

WATER LEVEL MONITORING, depth (m)

Date	Time	Hole	Casing	Water
23/3	18:20	8.00	18.00	3.30
24/3	07:30	8.00	18.00	4.40

Remarks: Platform to ground level=12.00m
Final water level= 4.40m on 24/3/2017

Scale: 1: 100 | Driller: Wasli | Logged by: Hafizuddin | Checked by Geologist: Wong Sing Wei

GEOSPEC SDN. BHD.

LOG OF BORING

JOB No.: GSI/2016/2636

BOREHOLE No.: BH244

E. 2377724 N. 5365892

Date Started: 23/3/2017

Date Completed: 24/3/2017

Boring Dia.: 76mm **Coring Dia.:** 52mm

Rotary Boring Rig: YWE-D90

Ground Level: -6.80mCD

PROJECT: SOIL INVESTIGATION WORKS FOR BINTULU TANJUNG KIDURONG COMBINED CYCLE POWER PLANT PROJECT (UNIT 10, UNIT 11)

CLIENT: Sinohydro Corporation (M) Sdn. Bhd.

CONSULTING ENGINEER:

Date & Time	Depth (m)	Casing (m)	Depth (m)	Sample Type	SPT Test	N Value /mm	R Ratio	Depth (m)	Description/ Classification	Log
11:40	21		21.00-21.45	P13/D13	1,0,0,0,0,0	0	30/45		Very soft grey CLAY	CH
12:30	22		22.50-22.95	P14/D14	1,0,0,0,0,0	0	30/45			
14:00	24		24.00-24.45	P15/D15	1,0,0,0,0,0	0	30/45			
	25		25.50-25.95	P16/D16	1,0,1,0,1,0	2	30/45	26.50		
	27		27.00-27.45	P17/D17	1,0,0,1,0,1	2	30/45		Very soft grey SILT	
	28		28.50-28.95	P18/D18	1,0,0,1,0,0	1	30/45			
	30		30.00-30.45	P19/D19	1,0,0,1,0,1	2	30/45	32.50		
	33		33.00-33.45	P20/D20	1,0,1,0,1,0	2	40/45	36.00	Very soft dark grey SILT	ME
	36		36.00-36.45	P21/D21	3,4,7,7,9,9	32	30/45	38.50	Hard grey slightly sandy SILT	M
	39		39.00-39.45	P22/D22	4,6,7,9,11,12	39	30/45	40.00	Hard medium grey sandy CLAY	

SAMPLE/ TEST KEY
- D Disturbed Sample
- U Undisturbed Sample
- C Cored Sample
- P Standard Penetration Test
- V Vane Shear Test
- R Sample Recovery

WATER LEVEL MONITORING, depth (m)

Date	Time	Hole	Casing	Water

Remarks:

Scale: 1: 100 | Driller: Wasli | Logged by: Hafizuddin | Checked by Geologist: Wong Sing Wei

GEOSPEC SDN. BHD.	LOG OF BORING Sheet 3 of 3	BOREHOLE No.: BH244 E. 2377724 N. 5365892
	JOB No.: GSI/2016/2636	Date Started: 23/3/2017
PROJECT: SOIL INVESTIGATION WORKS FOR BINTULU TANJUNG KIDURONG COMBINED CYCLE POWER PLANT PROJECT (UNIT 10, UNIT 11)		Date Completed: 24/3/2017
		Boring Dia.: 76mm / Coring Dia.: 52mm
CLIENT: Sinohydro Corporation (M) Sdn. Bhd.		Rotary Boring Rig: YWE-D90
CONSULTING ENGINEER:		Ground Level: -6.80mCD

Date & Time	Depth (m)	Casing (m)	Depth (m)	Sample Type	SPT Test	N Value /mm	R Ratio	Depth (m)	Description/ Classification	Log
	40									
	41								Hard dark grey sandy CLAY	
	42		42.00-42.45	P23/D23	4,7,8,8,11,13	40	30/45	42.45		CH
	43								BH244 terminated at 42.45m below ground level	
	44									
	45									
	46									
	47									
	48									
	49									
	50									
	51									
	52									
	53									
	54									
	55									
	56									
	57									
	58									
	59									
	60									

SAMPLE/ TEST KEY
- D Disturbed Sample
- U Undisturbed Sample
- C Cored Sample
- P Standard Penetration Test
- V Vane Shear Test
- R Sample Recovery

WATER LEVEL MONITORING, depth (m)

Date	Time	Hole	Casing	Water

Remarks:

Scale: 1: 100 | Driller: Wasli | Logged by: Hafizuddin | Checked by Geologist: Wong Sing Wei

GEOSPEC SDN. BHD.	LOG OF BORING Sheet 1 of 2	BOREHOLE No.: BH245 E. 2377761.167 N. 5365797.650
	JOB No.: GSI/2016/2636	Date Started: 6/4/2017
PROJECT: SOIL INVESTIGATION WORKS FOR BINTULU TANJUNG KIDURONG COMBINED CYCLE POWER PLANT PROJECT (UNIT 10, UNIT 11)		Date Completed: 7/4/2017
		Boring Dia.: 76mm Coring Dia.: 52mm
CLIENT: Sinohydro Corporation (M) Sdn. Bhd.		Rotary Boring Rig: YWE-D90
CONSULTING ENGINEER:		Ground Level: -7.20mCD

Date & Time	Depth (m)	Casing (m)	Depth (m)	Sample Type	SPT Test	N Value /mm	R Ratio	Depth (m)	Description/ Classification	Log
	0									
6/4 14:30	1		1.00-1.45	P1/D1	1,0,1,0,1,0	2	25/45		Very soft dark grey sandy CLAY	
14:50	2		2.00-2.45	P2/D2	1,0,0,1,1,0	2	25/45	3.00		
15:20	3	15.00	3.00-3.45	P3/D3	1,1,1,1,1,1	4	30/45	3.50	Very loose medium grey clayey SAND	
15:50	4		4.00-4.45	P4/D4	2,3,3,4,5,6	18	NIL	5.00	Medium dense grey SAND	
16:15	5		5.00-5.45	P5/D5	Weight of hammer	0	30/45			
16:30	6	18.00	6.00-6.45	P6/D6	Weight of hammer	0	30/45		Very soft dark grey CLAY	
16:50	7		7.00-7.45	P7/D7	Weight of hammer	0	30/45			CV
17:20	8		8.00-8.45	P8/D8	Weight of hammer	0	30/45	8.50		
17:50	9	21.00	9.00-9.50	U1			NIL			
7/4 06:00	10		9.50-9.95	P9/D9	Weight of hammer	0	30/45		Very soft grey CLAY	CV
06:30	11		10.50-10.95	P10/D10	Weight of hammer	0	30/45	11.50		
06:50	12	24.00	12.00-12.50	U2			100%			MV
07:20	13-14		13.50-13.95	P11/D11	Weight of hammer	0	35/45	14.50	Very soft grey SILT	
07:50	15	27.00	15.00-15.50	U3			100%			CV
08:15	16-17		16.50-16.95	P12/D12	Weight of hammer	0	30/45	17.50	Very soft grey CLAY	
09:00	18		18.00-18.45	P13/D13	1,0,0,0,1,0	1	30/45		Very soft dark grey SILT	MV
09:30	19-20		19.50-19.95	P14/D14	1,0,1,0,1,0	2	30/45	20.00		

SAMPLE/ TEST KEY
D Disturbed Sample
U Undisturbed Sample
C Cored Sample
P Standard Penetration Test
V Vane Shear Test
R Sample Recovery

WATER LEVEL MONITORING, depth (m)

Date	Time	Hole	Casing	Water
6/4	18:00	9.00	21.00	3.30
7/4	07:30	9.00	21.00	4.20

Remarks: Platform to ground level=12.00m
Final water level= 4.20m on 7/4/2017
Water sample taken on 7/4/2017

Scale: 1: 100 | Driller: Wasli | Logged by: Hafizuddin | Checked by Geologist: Wong Sing Wei

GEOSPEC SDN. BHD.	LOG OF BORING Sheet 2 of 2 JOB No.: GSI/2016/2636	BOREHOLE No.: BH245 E. 2377761.167 N. 5365797.650 Date Started: 6/4/2017

PROJECT: SOIL INVESTIGATION WORKS FOR BINTULU TANJUNG KIDURONG COMBINED CYCLE POWER PLANT PROJECT (UNIT 10, UNIT 11)

Date Completed: 7/4/2017

Boring Dia.: 76mm | **Coring Dia.:** 52mm

CLIENT: Sinohydro Corporation (M) Sdn. Bhd.

Rotary Boring Rig: YWE-D90

CONSULTING ENGINEER:

Ground Level: -7.20mCD

Date & Time	Depth (m)	Casing (m)	Depth (m)	Sample Type	SPT Test	N Value /mm	R Ratio	Depth (m)	Description/ Classification	Log
	20									
13:00	21		21.00-21.45	P15/D15	1,0,1,0,1,0	2	30/45	22.50	Very soft medium grey CLAY	
11:00	22		22.50-22.95	P16/D16	1,1,1,1,1,2	5	30/45	24.00	Firm grey CLAY	CV
12:00	24		24.00-24.45	P17/D17	3,4,4,3,3,3	13	20/45	25.50	Stiff medium grey CLAY with decayed wood	
12:30	25		25.50-25.95	P18/D18	1,0,1,0,1,1	3	20/45	27.00	Soft grey CLAY	CH
13:00	27		27.00-27.45	P19/D19	1,0,0,1,1,1	3	30/45	28.50	Soft light grey sandy CLAY	
13:30	28		28.50-28.95	P20/D20	1,1,1,1,1,2	5	30/45			
14:20	30		30.00-30.45	P21/D21	1,1,1,2,2,2	7	30/45	33.00	Firm light grey CLAY	CH
15:00	33		33.00-33.45	P22/D22	3,4,5,6,6,7	24	30/45			
15:50	36		36.00-36.45	P23/D23	3,4,5,6,7,7	25	30/45		Very stiff grey slightly sandy CLAY	CV
17:00	39		39.00-39.45	P24/D24	4,4,5,6,8,8	27	30/45	39.45		
	40								BH245 terminated at 39.45m b.g.l	

SAMPLE/ TEST KEY
- D Disturbed Sample
- U Undisturbed Sample
- C Cored Sample
- P Standard Penetration Test
- V Vane Shear Test
- R Sample Recovery

WATER LEVEL MONITORING, depth (m)

Date	Time	Hole	Casing	Water

Remarks:

Scale: 1: 100 | Driller: Wasli | Logged by: Hafizuddin | Checked by Geologist: Wong Sing Wei

GEOSPEC SDN. BHD.	LOG OF BORING Sheet 1 of 2 JOB No.: GSI/2016/2636	BOREHOLE No.: BH246 E. 2377773.913 N. 5365803.419 Date Started: 2/4/2017

PROJECT: SOIL INVESTIGATION WORKS FOR BINTULU TANJUNG KIDURONG COMBINED CYCLE POWER PLANT PROJECT (UNIT 10, UNIT 11)

Date Completed: 3/4/2017

Boring Dia.: 76mm | **Coring Dia.:** 52mm

CLIENT: Sinohydro Corporation (M) Sdn. Bhd.

Rotary Boring Rig: YWE-D90

CONSULTING ENGINEER:

Ground Level: -7.40mCD

Date & Time	Depth (m)	Casing (m)	Depth (m)	Sample Type	SPT Test	N Value /mm	R Ratio	Depth (m)	Description/ Classification	Log
	0									
2/4 06:30	1		1.00-1.45	P1/D1	Weight of hammer	0	15/45		Very soft dark grey CLAY with decayed wood	
06:50	2		2.00-2.45	P2/D2	Weight of hammer	0	20/45	2.50		
07:30	3	15.00	3.00-3.50	U1			NIL			
08:00	4		4.00-4.45	P3/D3	Weight of hammer	0	30/45		Very soft grey CLAY	
08:30	5		5.00-5.45	P4/D4	Weight of hammer	0	30/45	5.50		CV
09:00	6	18.00	6.00-6.50	U2			60%			MV
09:30	7		7.00-7.45	P5/D5	Weight of hammer	0	30/45			
10:00	8		8.00-8.45	P6/D6	Weight of hammer	0	30/45			
10:20	9	21.00	9.00-9.50	U3			80%			MV
	10								Very soft grey SILT	
10:50	11		10.50-10.95	P7/D7	Weight of hammer	0	30/45			
11:15	12	24.00	12.00-12.45	P8/D8	Weight of hammer	0	30/45			
	13									MV
11:50	14		13.50-13.95	P9/D9	0,0,1,0,0,0	1	30/45	14.50		
12:30	15	27.00	15.00-15.45	P10/D10	1,0,0,1,0,0	1	30/45			
	16									
12:50	17		16.50-16.95	P11/D11	1,0,0,0,1,0	1	30/45		Very soft grey CLAY	CV
13:30	18	30.00	18.00-18.45	P12/D12	1,0,0,0,1,0	1	30/45			
	19									
14:00	20		19.50-19.95	P13/D13	1,0,1,0,0,1	2	30/45			

SAMPLE/ TEST KEY
- D Disturbed Sample
- U Undisturbed Sample
- C Cored Sample
- P Standard Penetration Test
- V Vane Shear Test
- R Sample Recovery

WATER LEVEL MONITORING, depth (m)

Date	Time	Hole	Casing	Water
2/4	-	20.45	20.00	3.10
3/4	06:30	20.45	20.00	3.10

Remarks: Platform to ground level=12.00m
Final water level= 3.10m on 3/4/2017
Water sample taken on 3/4/2017

Scale: 1: 100 | Driller: Wasli | Logged by: Hafizuddin | Checked by Geologist: Wong Sing Wei

GEOSPEC SDN. BHD.	LOG OF BORING Sheet 2 of 2	BOREHOLE No.: BH246 E. 2377773.913 N. 5365803.419
	JOB No.: GSI/2016/2636	Date Started: 2/4/2017
PROJECT: SOIL INVESTIGATION WORKS FOR BINTULU TANJUNG KIDURONG COMBINED CYCLE POWER PLANT PROJECT (UNIT 10, UNIT 11)		Date Completed: 3/4/2017
		Boring Dia.: 76mm Coring Dia.: 52mm
CLIENT: Sinohydro Corporation (M) Sdn. Bhd.		Rotary Boring Rig: YWE-D90
CONSULTING ENGINEER:		Ground Level: -7.40mCD

Date & Time	Depth (m)	Casing (m)	Depth (m)	Sample Type	SPT Test	N Value /mm	R Ratio	Depth (m)	Description/ Classification	Log
	20								Very soft grey CLAY	
14:40	21		21.00-21.45	P14/D14	1,0,1,0,1,0	2	30/45	21.50		CV
	22								Soft grey SILT	
15:30	23		22.50-22.95	P15/D15	1,0,1,1,0,1	3	30/45			
16:10	24		24.00-24.45	P16/D16	1,0,1,1,0,1	3	30/45			
	25									
16:30	26		25.50-25.95	P17/D17	1,1,0,1,1,1	3	30/45			MV
17:00	27		27.00-27.45	P18/D18	1,1,1,1,1,1	4	30/45			
	28									
17:30	29		28.50-28.95	P19/D19	1,0,1,1,1,1	4	30/45	30.00		
18:00	30		30.00-30.45	P20/D20	1,1,1,1,2,2	6	30/45		Firm grey CLAY	CV
	31									
	32							33.00		
3/4 06:30	33		33.00-33.45	P21/D21	2,2,2,3,3,3	11	30/45		Stiff light grey sandy CLAY	
	34									
	35							36.00		
07:00	36		36.00-36.45	P22/D22	2,3,5,5,8,9	27	30/45	37.00	Very stiff medium grey sandy CLAY	
	37								Very stiff medium grey sandy CLAY	
	38									
08:30	39		39.00-39.45	P23/D23	3,3,4,7,8,9	28	25/45	39.45		
	40								BH246 terminated at 39.45m b.g.l	

SAMPLE/ TEST KEY
D Disturbed Sample
U Undisturbed Sample
C Cored Sample
P Standard Penetration Test
V Vane Shear Test
R Sample Recovery

WATER LEVEL MONITORING, depth (m)

Date	Time	Hole	Casing	Water

Remarks:

Scale: 1: 100 | Driller: Wasli | Logged by: Hafizuddin | Checked by Geologist: Wong Sing Wei

Appendix 4.2.4

Surface Water Test Report

CHEMSAIN KONSULTANT SDN BHD *(130904-U)*
172, Rock Road, 93200 Kuching Sarawak.
Tel: +06-82-548366 **Fax:** +06-82-548388 / 548399
Email: laboratory@chemsain.com

MS ISO/IEC 17025
TESTING
SAMM NO. 057

TEST REPORT

* NOT FOR ADVERTISEMENT PURPOSES *

Customer : Sarawak Energy Berhad
No. 1, The Isthmus
93050 Kuching, Sarawak

Lab No.	:	CK/CL105/108687/17
Type (No.) of Sample	:	Surface Water (2)
Date Received	:	19th November 2017
Date of Report	:	7th December 2017
Project Code	:	CK/EV103/708/17

Lab No.	108687-1	108687-2	*Method*
Parameter (s)	W1 Date : 18/11/17 Time : 8.40 am	W2 Date : 18/11/17 Time : 9.05 am	
Temperature, °C *(in-situ / 18/11/17)*	28.2	30.6	*APHA 2550 B, 2012*
pH Value *(in-situ / 18/11/17)*	7.9	8.4	*APHA 4500-H^+ B, 2012*
Dissolved Oxygen, mg/L *(in-situ / 18/11/17)*	6.5	6.2	*APHA 4500-O G, 2012*
Turbidity (NTU)	7.2	1.6	*APHA 2130 B, 2012*
Conductivity @ 25°C, µmhos/cm	42,600	42,900	*APHA 2510 B, 2012*
Biochemical Oxygen Demand in 5 days @ 20°C, mg/L	<1.0	<1.0	*APHA 5210 B & 4500-O G, 2012*
Chemical Oxygen Demand, mg/L	54	49	*In House Method 0560 based on APHA 5220 C, 2012 & USGS*
Total Suspended Solids, mg/L	<5.0	<5.0	*APHA 2540 D, 2012*
Ammoniacal-Nitrogen (as N), mg/L	0.73	0.91	*APHA 4500-NH_3 F, 2012*
Oil & Grease, mg/L	1.1	1.1	*APHA 5520 B, 2012*

Date of commencement of BOD_5 analysis: 19th November 2017

Remark : The above pH readings are taken based on respective temperature reported

TANG JOCK KIE
B. Sc. (Hons), M.Env.Sc,
MMIC (2747/5242/08/08)
SENIOR CHEMIST

CHEMSAIN KONSULTANT SDN. BHD.
Laboratory
Kuching
(130904-U)

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Email: laboratory@chemsain.com

MS ISO/IEC 17025 TESTING SAMM NO. 057

TEST REPORT

* NOT FOR ADVERTISEMENT PURPOSES *

Customer	:	Sarawak Energy Bhd Level 3, EIA Division Menara Sarawak Energy No. 1, The Isthmus 93050 Kuching, Sarawak.	Lab No. Type (No.) of Sample Date Received Date of Report Project Code	: : : : :	CK/ML105/108688/17 Surface Water (2) 19th November 2017 23rd November 2017 CK/EV103-708/17

Lab No	108688-1	108688-2	*Test Method*
Parameter	W1 Date : 18/11/17 Time : 8.40 am	W2 Date : 18/11/17 Time : 9.05 am	
Total Coliform Count MPN/100 mL, 35±0.5°C/48h	4.9×10^2	$>1.6 \times 10^4$	*APHA 9221 B, 2012*
Fecal Coliform Count MPN/100 mL, 44.5±0.2°C/24 h	3.3×10^2	3.5×10^3	*APHA 9221 E, 2005*

GOH CHIA MEY
B. Sc. (Hons)
MJMM0118
MICROBIOLOGIST

CHEMSAIN KONSULTANT SDN. BHD.
Laboratory
Kuching
(130904-U)

Appendix 4.2.5

National Water Quality Standards for Malaysia (NWQSM)

NATIONAL WATER QUALITY STANDARDS (NWQS) FOR MALAYSIA

Parameters	Classes						
	Units	I	IIA	IIB	III	IV	V
Ammoniacal-N.	mg/l	0.1	0.3	0.3	0.9	2.7	>2.7
BOD	mg/l	1	3	3	6	12	>12
COD	mg/l	10	25	25	50	100	>100
DO	mg/l	7	5-7	5-7	3-5	3	<1
pH		6.5-8.5	6-9	6-9	5-9	5-9	-
Colour	TCU	15	150	150	-	-	-
Elec. Cond	μmhos/ cm	1000	1000	-	-	6000	-
Floatables		N	N	N	-	-	-
Odour		N	N	N	-	-	-
Salinity*	%	0.5	1	-	-	2	-
Taste		N	N	N	-	-	-
Tot. Diss. Sol.*	mg/l	500	1000	-	-	4000	-
Tot. Susp. Sol.	mg/l	25	50	50	150	300	>300
Temperature	°C	-	Normal ±2	-	Normal ±2	-	-
Turbidity	NTU	5	50	50	-	-	-
F. Coliform**	counts/ 100ml	10	100	400	5000 (20000)ε$^{\varepsilon}$	5000 (20000)ε	
Total Coliform	counts/ 100ml	100	5000	5000	5000	5000	5000
Al	mg/l	ENL	-	-	(0.06)	0.5	-
As	mg/l	ENL	0.05	0.4	(0.05)	0.1	>IV
Ba	mg/l	ENL	1	-	-	-	>IV
Cd	mg/l	ENL	0.01	0.01*	(0.001)	0.01	>IV
Cr(IV)	mg/l	ENL	0.05	1.4	(0.05)	0.1	>IV
Cr(III)	mg/l	ENL	-	2.5	-	-	>IV
Cu	mg/l	ENL	1	-	-	0.2	>IV
Hardness	mg/l	ENL	250	-	-	-	>IV
Ca	mg/l	ENL	-	-	-	-	>IV
Mg	mg/l	ENL	-	-	-	-	>IV
Na	mg/l	ENL	-	-	-	3 SAR	>IV
K	mg/l	ENL	-	-	-	-	>IV
Fe	mg/l	ENL	0.3	1	-	1(leaf) 5(others)	>IV
Pb	mg/l	ENL	0.05	0.02*	(0.01)	5	>IV
Mn	mg/l	ENL	0.1	0.1	-	0.2	>IV
Hg	mg/l	ENL	0.001	0.004	(0.0001)	0.002	>IV
Ni	mg/l	ENL	0.05	0.9*	-	0.2	>IV
Se	mg/l	ENL	0.01	0.25	(0.04)	0.02	>IV
Ag	mg/l	ENL	0.05	0.0002	-	-	>IV
Sn	mg/l	ENL	NR	0.004	-	-	>IV
U	mg/l	ENL	NR	-	-	-	>IV
Zn	mg/l	ENL	5	0.4*	-	2	>IV
B	mg/l	ENL	1	-	(3.4)	0.8	>IV
Cl	mg/l	ENL	200	-	-	80	>IV
Cl_2	mg/l	ENL	-	-	(0.02)	-	>IV
CN	mg/l	ENL	0.02	0.06	(0.02)	-	>IV
F	mg/l	ENL	1.5	10	-	1	>IV
NO_2	mg/l	ENL	0.4	0.4	(0.03)	5	>IV
NO_3	mg/l	ENL	7	-	-	-	
P	mg/l	ENL	0.2	0.1	-	-	>IV
Silica	mg/l	ENL	50	-	-	-	>IV
SO_4	mg/l	ENL	250	-	-	-	>IV
S	mg/l	ENL	0.05	-	(0.001)	-	>IV
CO_2	mg/l	ENL	-	-	-	-	>IV
Gross-α	Bq/l	ENL	0.1	-	-	-	>IV
Gross-β	Bq/l	ENL	1	-	-	-	>IV
Ra-226	Bq/l	ENL	<0.1	-	-	-	>IV

Parameters	Classes						
	Units	I	IIA	IIB	III	IV	V
Sr-90	Bq/l	ENL	<0.1	-	-	-	>IV
CCE	μg/l	ENL	500	-	-	-	>IV
MBAS/BAS	μg/l	ENL	500	5000	(200)	-	-
O & G (mineral)	μg/l	ENL	40;NF	N	-	-	-
O & G (emulsified edible)	μg/l	ENL	7000;N	N	-	-	-
PCB	mg/l	ENL	0.1	6	(0.05)	-	-
Phenol	μg/l	AB	10	-	-	-	-
Aldrin / Dieldrin	μg/l	AB	0.2	0.2	(0.01)	-	-
BHC	μg/l	AB	2	9	(0.1)	-	-
Chlordane	μg/l	AB	0.08	2	(0.02)	-	-
t-DDT	μg/l	AB	0.1	1	(0.01)	-	-
Endosulfan	μg/l	AB	10	-	-	-	-
Heptachlor / Epoxide	μg/l	AB	0.05	0.9	(0.06)	-	-
Lindane	μg/l	AB	2	3	(0.04)	-	-
2,4-D	μg/l	AB	70	450	-	-	-
2,4,5-T	μg/l	AB	10	160	-	-	-
2,4,5-TP	μg/l	AB	4	850	-	-	-
Paraquat	μg/l	AB	10	1800	-	-	-

N = Free from floatable materials/debris or No objectionable odour, or No objectionable taste.

* = Related parameters, only one recommended for use

** = Geometric mean

ε = Maximum not to be exceeded

AB = Absent

ENL = Expected Natural Level

@ = Maximum (unbracketed) and 24-hr average (bracketed) concentrations

CLASS	USES
I	Represents water body of excellent quality. Standards are set for the conservation of natural environment in its undisturbed state. Water bodies such as those in the national park areas, fountainheads, and in high land and undisturbed areas come under this category where strictly no discharge of any kind is permitted. Water bodies in this category meets the most stringent requirements for human health and aquatic life protection.
IIA/IIB	Represents water bodies of good quality. Most existing raw water supply sources come under this category. In practice, no body contact activity is allowed in this water for prevention of portable human pathogens. There is a need to introduce another class for water bodies not used for water supply but of similar quality which may be referred as **Class IIB**. The determination of **Class IIB** standard is based on criteria for recreational use and protection of sensitive aquatic species.
III	Is defined with the primary objective of protecting common and moderately tolerant aquatic species of economic value. Water under this classification may be used for water supply with extensive/advance treatment. This class of water is also defined to suit livestock drinking needs.
IV	Defines water quality required for major agricultural irrigation activities which may not cover minor applications to sensitive crops.
V	Represents other water which do not meet any of the above uses.

Appendix 4.2.6

Marine Water Test Report

CHEMSAIN KONSULTANT SDN BHD *(130904-U)*
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Tel: +06-82-548366 **Fax:** +06-82-548388 / 548399
Email: laboratory@chemsain.com

MS ISO/IEC 17025 TESTING SAMM NO. 057

TEST REPORT

* NOT FOR ADVERTISEMENT PURPOSES *

Customer	:	Sarawak Energy Berhad No. 1, Wisma SEB, The Isthmus 93050 Kuching, Sarawak	Lab No.	:	CK/CL105/108701/17
			Type (No.) of Sample	:	Marine Water (6)
			Date Received	:	20th November 2017
			Date of Report	:	8th December 2017
			Reference No.	:	CK/CL505/7818/17
			Project Code	:	CK/EV103/708/17

Lab No.	108701-1	108701-2	108701-3	*Method*
Parameter (s)	MW1 Date : 19/11/17 Time : 9.20 am	MW2 Date : 19/11/17 Time : 9.35 am	MW3 Date : 19/11/17 Time : 8.48 am	
Temperature, °C *(in-situ / 19/11/17)*	33.3	32.8	32.6	*APHA 2550 B, 2012*
Dissolved Oxygen, mg/L *(in-situ / 19/11/17)*	6.3	6.1	6.3	*APHA 4500-O G, 2012*
Turbidity (NTU)	1.9	6.5	2.6	*APHA 2130 B, 2012*
Total Chlorine (Cl_2), mg/L	<0.1	<0.1	<0.1	*In House Method 0501 Based on Palintest Comparator*
Total Suspended Solids, mg/L	<5.0	<5.0	<5.0	*APHA 2540 D, 2012*
Ammonia (as NH_3), mg/L	0.40	0.36	0.28	*APHA 4500-NH_3 F, 2012*
Nitrite (as NO_2), mg/L	<0.05	<0.05	<0.05	*APHA 4500-NO_2^- B, 2012*
Nitrate (as NO_3), mg/L	2.26	1.03	0.83	*APHA 4500-NO_3^- E, 2012*
Phosphorus (as PO_4), mg/L	0.09	0.07	0.06	*APHA 4500-P D, 2012*
Oil & Grease, mg/L	1.1	1.2	1.2	*APHA 5520 B, 2012*
**Lead (as Pb), mg/L	<0.01	<0.01	<0.01	*APHA 3125 B, 2012*
**Copper (as Cu), mg/L	<0.02	<0.02	0.33	
**Zinc (as Zn), mg/L	<0.02	<0.02	<0.02	
**Cadmium (as Cd), mg/L	<0.002	<0.002	<0.002	
**Total Chromium (as Cr), mg/L	<0.02	<0.02	<0.02	
**Arsenic (as As), mg/L	<0.006	<0.006	<0.006	
**Mercury (as Hg), mg/L	<0.001	<0.001	<0.001	
Phenol, mg/L	<0.01	<0.01	<0.01	*APHA 5530 C, 2012*
Cyanide (as CN), mg/L	<0.01	<0.01	<0.01	*APHA 4500-CN^- C & F, 2012*

CHEMSAIN KONSULTANT SDN BHD *(130904-U)*

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MS ISO/IEC 17025 TESTING SAMM NO. 057

TEST REPORT

* NOT FOR ADVERTISEMENT PURPOSES *

Lab No.: CK/CL105/108701/17

Lab No.	108701-4	108701-4	108701-5	*Method*
Parameter (s)	MW4 Date : 19/11/17 Time : 8.55 am	MW5 Date : 19/11/17 Time : 9.05 am	MW6 Date : 19/11/17 Time : 8.35 am	
Temperature, °C *(in-situ / 19/11/17)*	32.3	32.3	30.3	*APHA 2550 B, 2012*
Dissolved Oxygen, mg/L *(in-situ / 19/11/17)*	6.3	6.4	7.0	*APHA 4500-O G, 2012*
Turbidity (NTU)	1.9	1.7	0.25	*APHA 2130 B, 2012*
Total Chlorine (Cl_2), mg/L	<0.1	<0.1	<0.1	*In House Method 0501 Based on Palintest Comparator*
Total Suspended Solids, mg/L	<5.0	<5.0	<5.0	*APHA 2540 D, 2012*
Ammonia (as NH_3), mg/L	0.26	0.41	0.42	*APHA 4500-NH_3 F, 2012*
Nitrite (as NO_2), mg/L	<0.05	<0.05	<0.05	*APHA 4500-NO_2^- B, 2012*
Nitrate (as NO_3), mg/L	1.71	2.05	1.18	*APHA 4500-NO_3^- E, 2012*
Phosphorus (as PO_4), mg/L	0.08	<0.06	0.08	*APHA 4500-P D, 2012*
Oil & Grease, mg/L	1.2	1.1	1.2	*APHA 5520 B, 2012*
**Lead (as Pb), mg/L	<0.01	<0.01	<0.01	*APHA 3125 B, 2012*
**Copper (as Cu), mg/L	<0.02	<0.02	<0.02	
**Zinc (as Zn), mg/L	<0.02	<0.02	<0.02	
**Cadmium (as Cd), mg/L	<0.002	<0.002	<0.002	
**Total Chromium (as Cr), mg/L	<0.02	<0.02	<0.02	
**Arsenic (as As), mg/L	<0.006	<0.006	<0.006	
**Mercury (as Hg), mg/L	<0.001	<0.001	<0.001	
Phenol, mg/L	<0.01	<0.01	<0.01	*APHA 5530 C, 2012*
Cyanide (as CN), mg/L	<0.01	<0.01	<0.01	*APHA 4500-CN^- C & F, 2012*

*Not SAMM Accredited

**Sub-contracted and Not SAMM Accredited (The sub-contracted lab is SAMM Accredited)

TANG JOCK KIE
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SENIOR CHEMIST

CHEMSAIN KONSULTANT SDN. BHD.
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Kuching
(130904-U)

NOTE: 1) This Test Report Shall Not be reproduced except in full without the written approval of the laboratory.
2) The above result(s) are based on sample(s) as received.
3) The result(s) relates to the sample(s) tested.

CHEMSAIN KONSULTANT SDN BHD *(130904-U)*
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Email: laboratory@chemsain.com

MS ISO/IEC 17025
TESTING
SAMM NO. 057

TEST REPORT

* NOT FOR ADVERTISEMENT PURPOSES *

Customer	:	Sarawak Energy Bhd Level 3, EIA Division Menara Sarawak Energy No. 1, The Isthmus 93050 Kuching, Sarawak.		
Lab No.	:	CK/ML105/108702/17		
Type (No.) of Sample	:	Marine Water (6)		
Date Received	:	20th November 2017		
Date of Report	:	23rd November 2017		
Project Code	:	CK/EV103-708/17		

Lab No	Identification of Sample(s)	Fecal Coliform Count MPN/100 mL, 44.5±0.2°C/24 h *(Method : APHA 9221 E, 2005)*
108702-1	MW1 Date : 19/11/17 Time : 9.20 am	<1.1
108702-2	MW2 Date : 19/11/17 Time : 9.35 am	<1.1
108702-3	MW3 Date : 19/11/17 Time : 8.48 am	<1.1
108702-4	MW4 Date : 19/11/17 Time : 8.55 am	<1.1
108702-5	MW5 Date : 19/11/17 Time : 9.05 am	<1.1
108702-6	MW6 Date : 19/11/17 Time : 8.35 am	<1.1

GOH CHIA MEY
B. Sc. (Hons)
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MICROBIOLOGIST

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Kuching
(130904-U)

Appendix 4.2.7

Malaysia Marine Water Quality Criteria and Standard (MWQCS)

Malaysia Marine Water Quality Criteria and Standard

Parameter	CLASS 1	CLASS 2	CLASS 3	CLASS E
BENEFICAL USES	Preservation, Marine Protected areas, Marine Parks	Marine Life, Fisheries, Coral Reefs, Recreational and Mariculture	Ports, Oil & Gas Fields	Mangroves Estuarine & River-mouth Water
Temperature (℃)	≤ 2℃ increase over maximum ambient	≤ 2℃ increase over maximum ambient	≤ 2℃ increase over maximum ambient	≤ 2℃ increase over maximum ambient
Dissolved oxygen (mg/L)	>80% saturation	5	3	4
Total suspended solid (mg/L)	25 mg/L or ≤ 10% increase in seasonal average, whichever is lower	50mg/L (25 mg/L) or ≤ 10% increase in seasonal average, whichever is lower	100 mg/L or ≤ 10% increase in seasonal average, whichever is lower	100 mg/L or ≤ 30 % increase in seasonal average, whichever is lower
Oil and grease (mg/L)	0.01	0.14	5	0.14
Mercury* (µg/L)	0.04	0.16 (0.04)	50	0.5
Cadmium (µg/L)	0.5	2 (3)	10	2
Chromium (VI) (µg/L)	5	10	48	10
Copper (µg/L)	1.3	2.9	10	2.9
Arsenic (III)* (µg/L)	3	20(3)	50	20 (3)
Lead (µg/L)	4.4	8.5	50	8.5
Zinc (µg/L)	15	50	100	50
Cyanide (µg/L)	2	7	20	7
Ammonia (unionized) (µg/L)	35	70	320	70
Nitrite (NO2) (µg/L)	10	55	1,000	55
Nitrate (NO3) (µg/L)	10	60	1,000	60
Phosphate (µg/L)	5	75	670	75
Phenol (µg/L)	1	10	100	10
Tributyltin (TBT) (µg/L)	0.001	0.01	0.05	0.01
Faecal coliform (Human health protection for seafood consumption) - most Probable Number (MPN)	70 faecal coliform 100mL-1	100 faecal coliform 100mL-1 & (70 faecal coliform 100mL-1)	200 faecal coliform 100mL-1	100 faecal coliform 100mL-1 & (70 faecal coliform 100mL-1)
Polycyclic Aromatic Hydrocarbon (PAHs) ng/g	100	200	1000	1000

*IMWQS in parentheses are for coastal and marine water areas where seafood for human consumption is applicable.

Appendix 4.2.8

Seabed Sediment Test Report

CHEMSAIN KONSULTANT SDN BHD *(130904-U)*
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Tel: +06-82-548366 **Fax:** +06-82-548388 / 548399
Email: laboratory@chemsain.com

MS ISO/IEC 17025
TESTING
SAMM NO. 057

TEST REPORT

* NOT FOR ADVERTISEMENT PURPOSES *

Customer	:	Sarawak Energy Berhad	Lab No.	:	CK/CL105/108703/17
		Level 3, EIA Division	Type (No.) of Sample	:	Sediment (4)
		Menara Sarawak Energy	Date Received	:	20th November 2017
		No. 1, The Isthmus	Date of Report	:	13th December 2017
		93050 Kuching, Sarawak	Project Code	:	CK/EV103/708/17
Attn	:	En. Julaidi Rasidi			

Lab No.	108703-1	108703-2	108703-3	108703-4
Parameter (s)	SS1 Date : 19/11/17 Time : 9.38 am	SS2 Date : 19/11/17 Time : 9.45 am	SS3 Date : 19/11/17 Time : 9.55 am	SS4 Date : 19/11/17 Time : 9.00 am
As Received				
Cyanide (as CN), mg/kg *(Method: In House Method 0562 based on USEPA 9010 C & USEPA 9213)*	Not Detected (<1.0)	Not Detected (<1.0)	Not Detected (<1.0)	Not Detected (<1.0)
As Dry Basis				
Lead (as Pb), mg/kg *(Method: USEPA 200.2, Revision 2.8, EMMC V & USEPA 7000 B, Feb 2007)*	Not Detected (<1.5)	Not Detected (<1.5)	Not Detected (<1.5)	Not Detected (<1.5)
Copper (as Cu), mg/kg *(Method: USEPA 200.2, Revision 2.8, EMMC V & USEPA 7000 B, Feb 2007)*	Not Detected (<1.5)	Not Detected (<1.5)	Not Detected (<1.5)	Not Detected (<1.5)
*Nickel (as Ni), mg/kg *(Method: USEPA 200.2, Revision 2.8, EMMC V & USEPA 7000 B, Feb 2007)*	1.9	4.5	7.2	4.4
Cadmium (as Cd), mg/kg *(Method: USEPA 200.2, Revision 2.8, EMMC V & USEPA 7000 B, Feb 2007)*	Not Detected (<1.5)	Not Detected (<1.5)	Not Detected (<1.5)	Not Detected (<1.5)
Chromium (as Cr), mg/kg *(Method: USEPA 200.2, Revision 2.8, EMMC V & USEPA 7000 B, Feb 2007)*	6.5	10.5	14.2	10.2
Iron (as Fe), mg/kg *(Method: USEPA 200.2, Revision 2.8, EMMC V & USEPA 7000 B, Feb 2007)*	14,400	18,600	25,300	19,400

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TEST REPORT

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Lab No.: CK/CL105/108703/17

Lab No.	108703-1	108703-2	108703-3	108703-4
Parameter (s)	SS1 Date : 19/11/17 Time : 9.38 am	SS2 Date : 19/11/17 Time : 9.45 am	SS3 Date : 19/11/17 Time : 9.55 am	SS4 Date : 19/11/17 Time : 9.00 am
As Dry Basis				
*Manganese (as Mn), mg/kg *(Method: USEPA 200.2, Revision 2.8, EMMC V & USEPA 7000 B, Feb 2007)*	365	465	466	350
*Mercury (as Hg), mg/kg *(Method: In House Method 0583 based on USEPA 200.2 & USEPA 245.5)*	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)
Arsenic (as As), mg/kg *(Method: USEPA 200.2, Revision2.8, EMMC V & USEPA 206.3)*	1.9	2.4	1.9	1.7

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ilac-MRA STANDARDS MALAYSIA ACCREDITED LABORATORY
MS ISO/IEC 17025 TESTING SAMM NO. 057

TEST REPORT

* NOT FOR ADVERTISEMENT PURPOSES *

Customer	:	Sarawak Energy Berhad Level 3, EIA Division Menara Sarawak Energy No. 1, The Isthmus 93050 Kuching, Sarawak		
Attn	:	En. Julaidi Rasidi		

Lab No.	:	CK/CL105/108703A/17
Type (No.) of Sample	:	Sediment (4)
Date Received	:	20th November 2017
Date of Report	:	27th February 2018
Project Code	:	CK/EV103/708/17

Lab No.	108703A-1	108703A-2	108703A-3	108703A-4
Parameter (s)	SS1 Date : 19/11/17 Time : 9.38 am	SS2 Date : 19/11/17 Time : 9.45 am	SS3 Date : 19/11/17 Time : 9.55 am	SS4 Date : 19/11/17 Time : 9.00 am
As Dry Basis				
Zinc (as Zn), mg/kg *(Method: USEPA 3050 B, December 1996 & USEPA 7000 B, Feb 2007)*	30.6	38.2	38.1	34.1
As Received				
*Tributlytin, mg/kg *(Method: In House Method 0516)*	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)
*PCB's, mg/kg *(Method: In House Method 0519)*	Not Detected (<0.6)	Not Detected (<0.6)	Not Detected (<0.6)	Not Detected (<0.6)
Total Petroleum Hydrocarbon *(Method: In House Method 0539 based on TNRCC Method 1005, rev 03, 1st June 2001)*				
nC6-nC12, mg/kg	Not Detected (<20)	Not Detected (<20)	Not Detected (<20)	Not Detected (<20)
>nC12-nC28, mg/kg	Not Detected (<20)	Not Detected (<20)	Not Detected (<20)	Not Detected (<20)
>nC28-nC35, mg/kg	Not Detected (<20)	Not Detected (<20)	Not Detected (<20)	Not Detected (<20)
Polycyclic Aromatic Hydrocarbon (PAH) *(Method: In House Method 0537 based on USEPA 3540C in combination with In House Method 0534 based on USEPA 8270C)*				
Acenaphthene, mg/kg	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)
Acenaphthylene, mg/kg	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)
Anthracene, mg/kg	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)
Acenaphthene, mg/kg	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)
Acenaphthylene, mg/kg	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)

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TEST REPORT

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Lab No.: CK/CL105/108703A/17

Lab No.	108703A-1	108703A-2	108703A-3	108703A-4
Parameter (s)	SS1 Date : 19/11/17 Time : 9.38 am	SS2 Date : 19/11/17 Time : 9.45 am	SS3 Date : 19/11/17 Time : 9.55 am	SS4 Date : 19/11/17 Time : 9.00 am
As Received				
Polycyclic Aromatic Hydrocarbon (PAH) *(Method: In House Method 0537 based on USEPA 3540C in combination with In House Method 0534 based on USEPA 8270C)*				
Anthracene, mg/kg	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)
Benz (a) anthracene, mg/kg	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)
Benzo (a) pyrene, mg/kg	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)
Benzo (b) fluoranthene, mg/kg	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)
Benzo (g,h,i) perylene, mg/kg	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)
Benzo (k) fluoranthene, mg/kg	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)
Chrysene, mg/kg	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)
Dibenz (a,h) anthracene, mg/kg	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)
Fluoranthene, mg/kg	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)
Fluorene, mg/kg	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)
Indeno (1,2,3-cd) pyrene, mg/kg	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)
Naphthalene, mg/kg	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)
Phenanthrene, mg/kg	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)
Pyrene, mg/kg	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)	Not Detected (<0.1)

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Appendix 4.2.9

The National Oceanic and Atmospheric Administration (NOAA) Sediment Quality Guidelines

National Oceanic and Atmospheric and Administration (NOAA) Guideline

Contaminant	NOAA Guidelines	
	ERL	ERM
Metals (mg/kg dry wt.)		
Cadmium	1.2	9.6
Chromium	81	370
Copper	34	270
Lead	46.7	218
Mercury	0.15	0.71
Nickel	20.9	51.6
Silver	1.0	3.7
Zinc	150	410
Metalloids (mg/kg dry wt.)		
Arsenic	8.2	70
Organics (µg/kg dry wt.) [a]		
Acenapthene	16	500
Anthracene	85	1100
Fluorene	19	540
Naphthalene	160	2100
Phenanthrene	240	1500
Low Molecular Weight PAHs	552	3160
Benzo(a)anthracene	261	1600
Benzo(a)pyrene	430	1600
Dibenzo(a,h)anthracene	63.4	260
Chrysene	384	2800
Fluoranthene	600	5100
Pyrene	665	2600
High Molecular Weight PAHs	1700	9600
Total PAHs	4022	44792
Total DDT	1.58	46.1
Dieldrin	0.02	8
Chlordane	0.5	6
Total PCBs	22.7	180

a Normalised to 1% organic carbon

Table 1. ERL and ERM guideline values for trace metals (ppm, dry wt.) and percent incidence of biological effects in concentration ranges defined by the two values (from Long et al., 1995). ERL= Effects Range-Low; ERM= Effects Range-Median.

	Guidelines		Percent incidence of effects*		
Chemical	ERL	ERM	<ERL	ERL - ERM	>ERM
Arsenic	8.2	70	5.0	11.1	63.0
Cadmium	1.2	9.6	6.6	36.6	65.7
Chromium	81	370	2.9	21.1	95.0
Copper	34	270	9.4	29.1	83.7
Lead	46.7	218	8.0	35.8	90.2
Mercury	0.15	0.71	8.3	23.5	42.3
Nickel	20.9	51.6	1.9	16.7	16.9
Silver	1.0	3.7	2.6	32.3	92.8
Zinc	150	410	6.1	47.0	69.8

*Number of data entries within each concentration range in which biological effects were observed divided by the total number of entries within each range.

The incidence of effects increased to 20% to 30% for most trace metals and 40% to 60% for most organics when concentrations exceeded ERL values but were lower than the ERM values. When concentrations exceeded the ERM values, the incidence of adverse effects increased to 60% to 90% for most trace metals and 80% to 100% for most organics. However, the reliabilities of the ERMs for nickel, mercury, DDE, total DDTs, and total PCBs were much lower than those for other substances. Therefore, the probabilities that the ERM values for these substances would accurately predict adverse effects are much lower than those for most chemicals.

Appendix 4.2.10

Ambient Air Test Report

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TEST REPORT

* NOT FOR ADVERTISEMENT PURPOSES *

Customer	:	Sarawak Energy Berhad	Lab No.	:	CK/CL105/108881/17
		Level 3, EIA Division	Type (No.) of Sample	:	Filter Paper (4)
		Menara Sarawak Energy	Date Received	:	27th November 2017
		No.1, The Isthmus	Date of Report	:	29th November 2017
		93050 Kuching, Sarawak	Project Code	:	CK/EV103/708/17
Attn	:	En. Julaidi Rasidi			

Lab. No.	Identification of Sample (s)	Total Particulate Matter Retained (PM_{10}), $\mu g/m^3$ *(Method: AS/NZS 3580.9.6:2003)*
108881-1	Location : A1 Date of Sampling : 09/11/17 – 10/11/17 Time of Sampling : 8.30 am – 8.30 am	14.0
108881-2	Location : A2 Date of Sampling : 12/11/17 – 13/11/17 Time of Sampling : 10.00 am – 10.00 am	<10.0
108881-3	Location : A3 Date of Sampling : 11/11/17 – 12/11/17 Time of Sampling : 9.30 am – 9.30 am	20.8
108881-4	Location : A4 Date of Sampling : 10/11/17 – 11/11/17 Time of Sampling : 9.00 am – 9.00 am	<10.0

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TEST REPORT

* NOT FOR ADVERTISEMENT PURPOSES *

Customer	:	Sarawak Energy Berhad	Lab No.	:	CK/CL105/110533/18
		Level 3, EIA Division	Type (No.) of Sample	:	Filter Paper (2)
		Menara Sarawak Energy	Date Received	:	9th February 2018
		No. 1, The Isthmus	Date of Report	:	9th February 2018
		93050 Kuching, Sarawak	Project Code	:	CK/EV103/708/18
Attn	:	En. Julaidi Rasidi			

Lab No.	Identification of Sample (s)	Total Particulate Matter Retained (PM_{10}), $\mu g/m^3$ *(Method: AS/NZS 3580.9.6:2003)*
110533-1	Location : A5 Date of Sampling : 31/01/18 – 01/02/18 Time of Sampling : 2.50 pm – 2.50 pm	11.4
110533-2	Location : A6 Date of Sampling : 03/02/18 – 04/02/18 Time of Sampling : 3.40 pm – 3.40 pm	22.9

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TEST REPORT

* NOT FOR ADVERTISEMENT PURPOSES *

Customer	Sarawak Energy Berhad Level 3, EIA Division Menara Sarawak Energy No.1, The Isthmus 93050 Kuching, Sarawak	Lab No. Type (No.) of Sample Date Received Date of Report Project Code	: : : : :	CK/CL105/108882/17 Filter Paper (4) 27th November 2017 29th November 2017 CK/EV103/708/17
Attn	En. Julaidi Rasidi			

Lab No.	Identification of Sample (s)	Total Particulate Matter Retained ($PM_{2.5}$), $\mu g/m^3$ *(Method: AS/NZS 3580.9.14:2013)*
108882-1	Location : A1 Date of Sampling : 14/11/17 – 15/11/17 Time of Sampling : 11.00 am – 11.00 am	<10.0
108882-2	Location : A2 Date of Sampling : 13/11/17 – 14/11/17 Time of Sampling : 10.20 am – 10.20 am	<10.0
108882-3	Location : A3 Date of Sampling : 16/11/17 – 17/11/17 Time of Sampling : 12.25 pm – 12.25 pm	<10.0
108882-4	Location : A4 Date of Sampling : 15/11/17 – 16/11/17 Time of Sampling : 11.40 am – 11.40 am	<10.0

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TEST REPORT

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Customer	:	Sarawak Energy Berhad Level 3, EIA Division Menara Sarawak Energy No. 1, The Isthmus 93050 Kuching, Sarawak	Lab No.	:	CK/CL105/110534/18
			Type (No.) of Sample	:	Filter Paper (2)
			Date Received	:	9th February 2018
			Date of Report	:	9th February 2018
			Project Code	:	CK/EV103/708/18
Attn	:	En. Julaidi Rasidi			

Lab No.	Identification of Sample (s)	Total Particulate Matter Retained ($PM_{2.5}$), $\mu g/m^3$ *(Method: AS/NZS 3580.9.14:2013)*
110534-1	Location : A5 Date of Sampling : 01/02/18 – 02/02/18 Time of Sampling : 3.00 pm – 3.00 pm	10.4
110534-2	Location : A6 Date of Sampling : 02/02/18 – 03/02/18 Time of Sampling : 3.30 pm – 3.30 pm	<10.0

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TEST REPORT

* NOT FOR ADVERTISEMENT PURPOSES *

Customer	:	Sarawak Energy Berhad	Lab No.	:	CK/CL105/108672B/17
		Level 3, EIA Division	Type (No.) of Sample	:	Absorbing Solution (4)
		Menara Sarawak Energy	Date Received	:	18th November 2017
		No. 1, The Isthmus	Date of Report	:	30th November 2017
		93050 Kuching, Sarawak	Project Code	:	CK/EV103/708/17
Attn	:	En. Julaidi Rasidi			

Lab No.	Identification of Sample (s)	Sulphur Dioxide (as SO_2), $\mu g/m^3$ *(Method: In House Method based on Methods of air sampling and analysis, 3rd Edition, Method 704A (sampling excluded))*
108672B-1	Location : A1 Date of Sampling : 16/11/17 Time of Sampling : 8.50 am – 9.50 am	33
108672B-2	Location : A2 Date of Sampling : 17/11/17 Time of Sampling : 8.30 am – 9.30 am	35
108672B-3	Location : A3 Date of Sampling : 16/11/17 Time of Sampling : 1.40 pm – 2.40 pm	38
108672B-4	Location : A4 Date of Sampling : 15/11/17 Time of Sampling : 11.30 am – 12.30 pm	44

....
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TEST REPORT

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Customer	:	Sarawak Energy Berhad Level 3, EIA Division Menara Sarawak Energy No. 1, The Isthmus 93050 Kuching, Sarawak	Lab No.	:	CK/CL105/110450B/18
			Type (No.) of Sample	:	Absorbing Solution (2)
			Date Received	:	6th February 2018
			Date of Report	:	8th February 2018
			Project Code	:	CK/EV103/708/18
Attn	:	En. Julaidi Rasidi			

Lab No.	Identification of Sample (s)	Sulphur Dioxide (as SO_2), µg/m^3 *(Method: In House Method based on Methods of air sampling and analysis, 3rd Edition, Method 704A (sampling excluded))*
110450B-1	Location : A5 Date of Sampling : 01/02/18 Time of Sampling : 10.00 am – 11.00 am	<20
110450B-2	Location : A6 Date of Sampling : 03/02/18 Time of Sampling : 10.00 am – 11.00 am	<20

....
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TEST REPORT

* NOT FOR ADVERTISEMENT PURPOSES *

Customer :	Sarawak Energy Berhad	Lab No. :	CK/CL105/108671/17
	Level 3, EIA Division	Type (No.) of Sample :	Solid Sorbent Tube (4)
	Menara Sarawak Energy	Date Received :	18th November 2017
	No. 1, The Isthmus	Date of Report :	28th November 2017
	93050 Kuching, Sarawak	Project Code :	CK/EV103/708/17
Attn :	En. Julaidi Rasidi		

Lab No.	Identification of Sample (s)	Nitrogen Dioxide (as NO_2), µg/m^3 *(Method: In House Method based on Methods of air sampling and analysis, 3rd Edition, Method 818 (sampling excluded))*
108671-1	Location : A1 Date of Sampling : 16/11/17 Time of Sampling : 8.30 am – 9.30 am	<6.0
108671-2	Location : A2 Date of Sampling : 17/11/17 Time of Sampling : 8.13 am – 9.13 am	7.4
108671-3	Location : A3 Date of Sampling : 16/11/17 Time of Sampling : 1.20 pm – 2.20 pm	10.7
108671-4	Location : A4 Date of Sampling : 15/11/17 Time of Sampling : 12.50 pm – 1.50 pm	14.0

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NOTE: 1) This Test Report Shall Not be reproduced except in full without the written approval of the laboratory.
2) The above result(s) are based on sample(s) as received.
3) The result(s) relates to the sample(s) tested.

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TEST REPORT

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Customer	:	Sarawak Energy Berhad	Lab No.	:	CK/CL105/110449/18
		Level 3, EIA Division	Type (No.) of Sample	:	Solid Sorbent Tube (2)
		Menara Sarawak Energy	Date Received	:	6th February 2018
		No. 1, The Isthmus	Date of Report	:	7th February 2018
		93050 Kuching, Sarawak	Project Code	:	CK/EV103/708/18
Attn	:	En. Julaidi Rasidi			

Lab No.	Identification of Sample (s)	Nitrogen Dioxide (as NO_2), $\mu g/m^3$ *(Method: In House Method based on Methods of air sampling and analysis, 3rd Edition, Method 818 (sampling excluded))*
110449-1	Location : A5 Date of Sampling : 01/02/18 Time of Sampling : 10.00 am – 11.00 am	<6.0
110449-2	Location : A6 Date of Sampling : 03/02/18 Time of Sampling : 10.00 am – 11.00 am	8.1

....
TANG JOCK KIE
B. Sc. (Hons), M.Env.Sc.
MMIC (2747/5242/08/08)
SENIOR CHEMIST

CHEMSAIN KONSULTANT SDN. BHD.
Laboratory
Kuching
(130904-U)

Appendix 4.2.11

Malaysia Ambient Air Quality Standard (MAAQS), 2013

MALAYSIAN AMBIENT AIR QUALITY STANDARDS, 2013

i) Particulate matter with size less than 10 micron (PM_{10})

Average Time	Unit	Existing Guidelines	Interim Target (IT)-2 (2015)	Interim Target (IT) - 2 (2018)	Standard (2020)
1 Year	$\mu g/m^3$	50	50	45	40
24 Hours	$\mu g/m^3$	150	150	120	100

ii) Particulate matter with size less than 2.5 micron ($PM_{2.5}$)

Average Time	Unit	Existing Guidelines	Interim Target (IT)-2 (2015)	Interim Target (IT) - 2 (2018)	Standard (2020)
1 Year	$\mu g/m^3$	-	35	25	15
24 Hours	$\mu g/m^3$	-	75	50	35

iii) Sulfur Dioxide (SO_2)

Average Time	Unit	Existing Guidelines	Interim Target (IT)-2 (2015)	Interim Target (IT) - 2 (2018)	Standard (2020)
1 Hour	$\mu g/m^3$	350	350	300	250
24 Hours	$\mu g/m^3$	105	105	90	80

iv) Carbon Monoxide (CO)

Average Time	Unit	Existing Guidelines	Interim Target (IT)-2 (2015)	Interim Target (IT) - 2 (2018)	Standard (2020)
1 Hour	$\mu g/m^3$	35	35	35	30
24 Hours	$\mu g/m^3$	10	10	10	10

v) Nitrogen Dioxide (NO_2)

Average Time	Unit	Existing Guidelines	Interim Target (IT)-2 (2015)	Interim Target (IT) - 2 (2018)	Standard (2020)
1 Hour	$\mu g/m^3$	320	320	300	280
24 Hours	$\mu g/m^3$	75	75	75	70

vi) Ground-level Ozone (O_3)

Average Time	Unit	Existing Guidelines	Interim Target (IT)-2 (2015)	Interim Target (IT) - 2 (2018)	Standard (2020)
1 Year	$\mu g/m^3$	200	200	200	180
8 Hours	$\mu g/m^3$	120	120	120	100

Appendix 4.2.12

World Health Organization (WHO) Ambient Air Quality Guidelines

Ambient Air Quality

General Approach

Projects with significant[5,6] sources of air emissions, and potential for significant impacts to ambient air quality, should prevent or minimize impacts by ensuring that:

- Emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards[9] by applying national legislated standards, or in their absence, the current WHO Air Quality Guidelines[10] (see Table 1.1.1), or other internationally recognized sources[11];
- Emissions do not contribute a significant portion to the attainment of relevant ambient air quality guidelines or standards. As a general rule, this Guideline suggests 25 percent of the applicable air quality standards to allow additional, future sustainable development in the same airshed.[12]

At facility level, impacts should be estimated through qualitative or quantitative assessments by the use of baseline air quality assessments and atmospheric dispersion models to assess potential ground level concentrations. Local atmospheric, climatic, and air quality data should be applied when modeling dispersion, protection against atmospheric downwash, wakes, or eddy effects of the source, nearby[13] structures, and terrain features. The dispersion model applied should be internationally recognized, or comparable. Examples of acceptable emission estimation and dispersion modeling approaches for point and fugitive sources are

Table 1.1.1: WHO Ambient Air Quality Guidelines[7,8]

	Averaging Period	Guideline value in mg/m³
Sulfur dioxide (SO_2)	24-hour 10 minute	125 (Interim target-1) 50 (Interim target-2) 20 (guideline) 500 (guideline)
Nitrogen dioxide (NO_2)	1-year 1-hour	40 (guideline) 200 (guideline)
Particulate Matter PM_{10}	1-year 24-hour	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (guideline) 150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50 (guideline)
Particulate Matter $PM_{2.5}$	1-year 24-hour	35 (Interim target-1) 25 (Interim target-2) 15 (Interim target-3) 10 (guideline) 75 (Interim target-1) 50 (Interim target-2) 37.5 (Interim target-3) 25 (guideline)
Ozone	8-hour daily maximum	160 (Interim target-1) 100 (guideline)

5 Significant sources of point and fugitive emissions are considered to be general sources which, for example, can contribute a net emissions increase of one or more of the following pollutants within a given airshed: PM10: 50 tons per year (tpy); NOx: 500 tpy; SO2: 500 tpy; or as established through national legislation; and combustion sources with an equivalent heat input of 50 MWth or greater. The significance of emissions of inorganic and organic pollutants should be established on a project-specific basis taking into account toxic and other properties of the pollutant.

6 United States Environmental Protection Agency, Prevention of Significant Deterioration of Air Quality, 40 CFR Ch. 1 Part 52.21. Other references for establishing significant emissions include the European Commission. 2000. "Guidance Document for EPER implementation." http://ec.europa.eu/environment/ippc/eper/index.htm ; and Australian Government. 2004. "National Pollutant Inventory Guide." http://www.npi.gov.au/handbooks/pubs/npiguide.pdf

7 World Health Organization (WHO). Air Quality Guidelines Global Update, 2005. PM 24-hour value is the 99th percentile.

8 Interim targets are provided in recognition of the need for a staged approach to achieving the recommended guidelines.

9 Ambient air quality standards are ambient air quality levels established and published through national legislative and regulatory processes, and ambient quality guidelines refer to ambient quality levels primarily developed through clinical, toxicological, and epidemiological evidence (such as those published by the World Health Organization).

10 Available at World Health Organization (WHO). http://www.who.int/en

11 For example the United States National Ambient Air Quality Standards (NAAQS) (http://www.epa.gov/air/criteria.html) and the relevant European Council Directives (Council Directive 1999/30/EC of 22 April 1999 / Council Directive 2002/3/EC of February 12 2002).

12 US EPA Prevention of Significant Deterioration Increments Limits applicable to non-degraded airsheds.

Appendix 4.2.13

Ambient Noise Result

Session Report

17-Nov-17

Information Panel

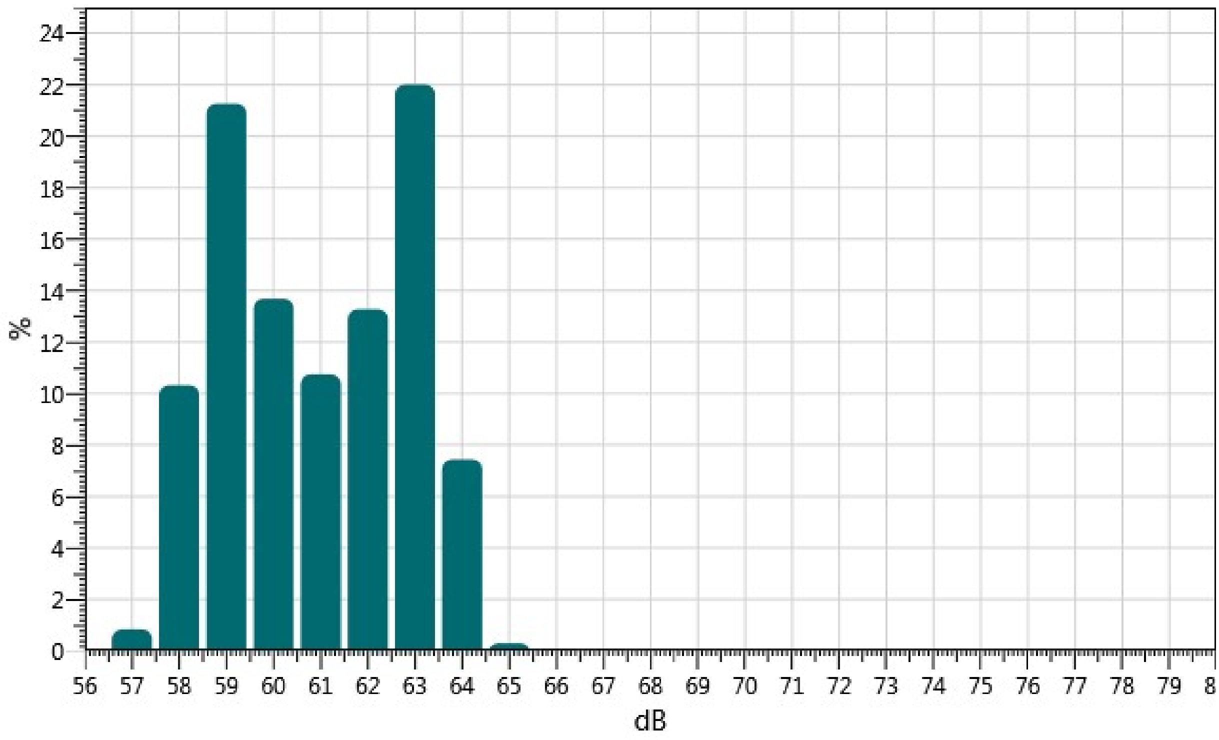
Company Name	Sarawak Energy Berhad
Description	CK/EV103-708/17
Location	N1 (Day Time)
Start Time	17-Nov-17 7:00:00 AM
Stop Time	17-Nov-17 10:00:00 PM
Run Time	15:00:00
Model Type	SoundPro DL
Comments	Nearby plant operation, insects, etc.

Summary Data Panel

Description	Meter	Value	Description	Meter	Value
Leq	1	61.7 dB	Lpk	1	84.1 dB
Lmax	1	75.4 dB	Lmin	1	56.5 dB
L10	1	63.7 dB	L90	1	58.8 dB
Mntime	1	17-Nov-17 12:24:58 PM	Mxtime	1	17-Nov-17 10:17:47 AM
Rtime	1	15:00:00	Dose	1	0.3 %
Exchange Rate	1	3 dB	Weighting	1	A
Response	1	FAST	Bandwidth	1	OFF

Statistics Chart

N1D - 24hrs: Statistics Chart



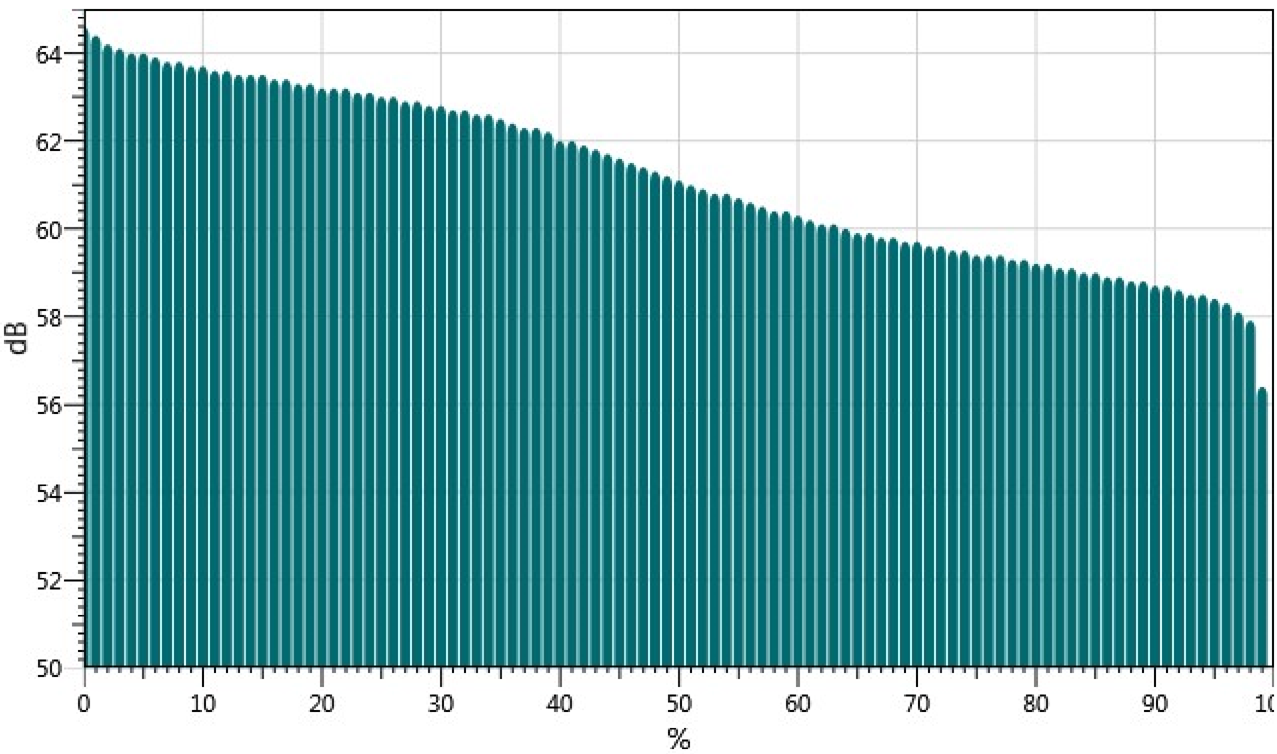
Statistics Table

dB:	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	%
56:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
57:	0.01	0.01	0.02	0.03	0.04	0.06	0.09	0.13	0.18	0.24	0.83
58:	0.34	0.44	0.58	0.72	0.90	1.06	1.26	1.47	1.66	1.89	10.32
59:	2.13	2.38	1.63	2.28	2.31	2.29	2.24	2.14	2.02	1.84	21.26
60:	1.70	1.58	1.48	1.41	1.36	1.30	1.25	1.23	1.20	1.17	13.68
61:	1.16	1.15	1.14	1.11	1.08	1.04	1.02	1.01	1.01	1.02	10.74
62:	1.06	1.14	0.80	1.13	1.21	1.31	1.43	1.55	1.74	1.91	13.28
63:	2.06	2.22	2.32	2.38	2.40	2.39	2.31	2.16	1.98	1.79	22.00
64:	1.57	1.34	1.13	0.93	0.74	0.57	0.43	0.32	0.24	0.16	7.44
65:	0.11	0.07	0.03	0.03	0.02	0.01	0.01	0.00	0.00	0.00	0.30
66:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
67:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
68:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
69:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
70:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
71:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
72:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01

dB:	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	%
73:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
74:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
75:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Exceedance Chart

N1D - 24hrs: Exceedance Chart

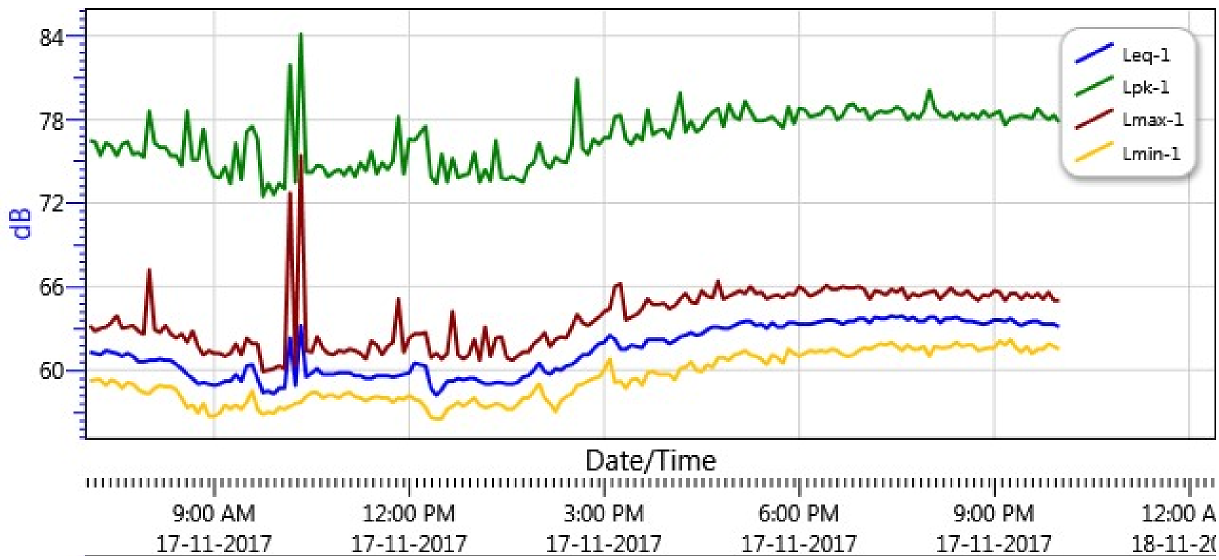


Exceedance Table

.	0%	1%	2%	3%	4%	5%	6%	%7	%8	%9
0%:		64.6	64.4	64.2	64.1	64.0	64.0	63.9	63.8	63.8
10%:	63.7	63.7	63.6	63.6	63.5	63.5	63.5	63.4	63.4	63.3
20%:	63.3	63.2	63.2	63.2	63.1	63.1	63.0	63.0	62.9	62.9
30%:	62.8	62.8	62.7	62.7	62.6	62.6	62.5	62.4	62.3	62.3
40%:	62.2	62.0	62.0	61.9	61.8	61.7	61.6	61.5	61.4	61.3
50%:	61.2	61.1	61.0	60.9	60.8	60.8	60.7	60.6	60.5	60.4
60%:	60.4	60.3	60.2	60.1	60.1	60.0	59.9	59.9	59.8	59.8
70%:	59.7	59.7	59.6	59.6	59.5	59.5	59.4	59.4	59.4	59.3
80%:	59.3	59.2	59.2	59.1	59.1	59.0	59.0	58.9	58.9	58.8
90%:	58.8	58.7	58.7	58.6	58.5	58.5	58.4	58.3	58.1	57.9
100%:	56.4									

Logged Data Chart

N1D - 24hrs: Logged Data Chart



Logged Data Table

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
17-Nov-17 7:05:00 AM	61.3	63.2	59.2	76.5
7:10:00 AM	61.2	62.8	59.3	76.4
7:15:00 AM	61.1	63	59.3	75.4
7:20:00 AM	61.4	63.1	58.9	76.3
7:25:00 AM	61.3	63.4	59.3	76.1
7:30:00 AM	61.2	63.9	59.1	75.4
7:35:00 AM	61	63	58.7	76.2
7:40:00 AM	61.2	63.1	59.1	76.4
7:45:00 AM	61	63.2	59	75.5
7:50:00 AM	60.6	62.8	58.6	75.6
7:55:00 AM	60.6	62.6	58.4	75.3
8:00:00 AM	60.7	67.2	58.3	78.6
8:05:00 AM	60.7	62.9	58.7	76.3
8:10:00 AM	60.8	62.7	58.9	76
8:15:00 AM	60.7	63.2	58.8	76
8:20:00 AM	60.7	62.6	58.8	75.4
8:25:00 AM	60.4	62.3	58.6	75.4
8:30:00 AM	60.1	62.6	58	74.7
8:35:00 AM	59.7	62	57.3	78.6
8:40:00 AM	59.4	62.8	57.5	75.1
8:45:00 AM	59	61.7	56.9	75.1

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
8:50:00 AM	59.1	61.1	57.6	77.3
8:55:00 AM	59	61.4	56.7	74.8
9:00:00 AM	58.9	61.2	56.7	73.9
9:05:00 AM	59	61.2	56.9	73.8
9:10:00 AM	59.2	61	57.5	74.6
9:15:00 AM	59.2	61.2	57.2	73.4
9:20:00 AM	59.7	61.9	57.5	76.3
9:25:00 AM	59.2	61.1	57.2	73.7
9:30:00 AM	60.3	62.3	57.7	77.1
9:35:00 AM	60.4	61.9	58.5	77.5
9:40:00 AM	59.4	61.9	57.2	76.6
9:45:00 AM	58.4	59.9	56.8	72.5
9:50:00 AM	58.5	60	57	73.4
9:55:00 AM	58.3	60.1	56.9	72.6
10:00:00 AM	58.7	60.3	57.3	73.4
10:05:00 AM	58.7	60.1	57.2	73
10:10:00 AM	62.3	72.7	57.4	81.9
10:15:00 AM	58.9	60.3	57.6	73.5
10:20:00 AM	63.2	75.4	57.7	84.1
10:25:00 AM	59.5	61.4	58.1	74.2
10:30:00 AM	59.8	61.3	58.4	74.2
10:35:00 AM	60.1	62.4	58.4	74.7
10:40:00 AM	59.7	61.6	58	74.6
10:45:00 AM	59.7	61.2	58.2	73.9
10:50:00 AM	59.7	61.1	58.2	74.2
10:55:00 AM	59.8	61.4	58	74.4
11:00:00 AM	59.8	61.3	58.3	74
11:05:00 AM	59.8	61.5	58.4	74.6
11:10:00 AM	59.6	61.4	58.1	73.9
11:15:00 AM	59.6	61.2	58	74.9
11:20:00 AM	59.4	60.8	57.8	74.3
11:25:00 AM	59.4	62.1	58	75.7
11:30:00 AM	59.6	61.8	58.1	74.1
11:35:00 AM	59.6	61.1	58	74.9
11:40:00 AM	59.6	61.7	58	74.4
11:45:00 AM	59.5	62	57.7	75
11:50:00 AM	59.6	65.1	58	78.2
11:55:00 AM	59.7	61.3	57.9	74.1
12:00:00 PM	59.8	62.3	58.2	76.6

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
12:05:00 PM	60.5	62.6	57.9	76.5
12:10:00 PM	60.4	62.6	57.8	77
12:15:00 PM	60.3	62.7	57.3	77.5
12:20:00 PM	58.7	60.9	56.6	73.9
12:25:00 PM	58.2	61.2	56.5	73.4
12:30:00 PM	58.6	60.8	56.5	75.5
12:35:00 PM	59.2	61.2	57.2	73.5
12:40:00 PM	59.2	64.2	57.4	75.2
12:45:00 PM	59.4	61.1	57.7	73.8
12:50:00 PM	59.3	60.8	57.4	74
12:55:00 PM	59.4	61.1	57.7	74.1
1:00:00 PM	59.4	62.2	58	75.6
1:05:00 PM	59.2	60.7	57.5	73.5
1:10:00 PM	59	63.1	57.3	74.4
1:15:00 PM	59	61	57.4	73.6
1:20:00 PM	59.1	62.3	57.6	76.5
1:25:00 PM	59.1	62.4	57.5	73.8
1:30:00 PM	59	60.9	57.2	73.7
1:35:00 PM	59	60.7	57.2	73.9
1:40:00 PM	59.1	61	57.5	73.7
1:45:00 PM	59.5	61.3	58	73.5
1:50:00 PM	59.6	61.3	58	74.6
1:55:00 PM	60	61.9	58.5	74.9
2:00:00 PM	60.5	62.2	59	76.3
2:05:00 PM	59.9	62.7	58	74.9
2:10:00 PM	59.7	61.7	57.6	74.5
2:15:00 PM	60.1	62.2	57	75.3
2:20:00 PM	60	62.4	57.8	75
2:25:00 PM	60.3	62.3	58.1	74.9
2:30:00 PM	60.4	63.1	58.3	76.2
2:35:00 PM	60.7	64	58.9	80.9
2:40:00 PM	61.1	63.4	59	75.9
2:45:00 PM	61.1	63.2	59.2	75.5
2:50:00 PM	61.5	63.5	59.4	76.6
2:55:00 PM	61.9	63.8	59.5	76.2
3:00:00 PM	62	64.2	60	76.7
3:05:00 PM	62.5	64.4	60.8	76.7
3:10:00 PM	62.2	66	59.1	78.2
3:15:00 PM	61.5	66.2	59.2	78.3

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
3:20:00 PM	61.5	63.6	58.7	76.6
3:25:00 PM	61.8	63.8	59.3	76.2
3:30:00 PM	61.7	64	59.4	76.9
3:35:00 PM	61.6	64.4	58.9	76.5
3:40:00 PM	62.2	65.1	59.8	78.7
3:45:00 PM	62.2	64.7	59.9	76.9
3:50:00 PM	62.2	64.7	59.7	77.2
3:55:00 PM	62.2	64.8	59.7	77.3
4:00:00 PM	61.9	64.4	59.7	76.7
4:05:00 PM	62.1	64.6	59.3	78.1
4:10:00 PM	62.4	65.1	60.1	79.9
4:15:00 PM	62.5	65.5	60.2	77.1
4:20:00 PM	62.7	64.9	60.6	77.9
4:25:00 PM	62.5	64.8	60	77.1
4:30:00 PM	62.6	65.7	59.9	77.4
4:35:00 PM	62.9	65.3	60.4	78.1
4:40:00 PM	63.1	65.2	60.2	78.5
4:45:00 PM	63.1	66.4	60.9	78.8
4:50:00 PM	63	65.1	60.9	77.5
4:55:00 PM	63	65.3	60.7	79.1
5:00:00 PM	63.2	65.5	61.1	78.2
5:05:00 PM	63.4	65.7	61.2	78
5:10:00 PM	63.5	65.5	61.4	79.3
5:15:00 PM	63.5	66	61.1	78.6
5:20:00 PM	63.2	65.5	61	77.9
5:25:00 PM	63.3	65.6	60.8	77.9
5:30:00 PM	63	65.1	60.4	78
5:35:00 PM	63.4	65.3	61.1	78.2
5:40:00 PM	63.1	65.4	60.9	77.8
5:45:00 PM	63.1	65.2	60.5	77.4
5:50:00 PM	63.4	65.5	61.5	78.9
5:55:00 PM	63.4	65.4	61.2	77.7
6:00:00 PM	63.3	66	61	78.8
6:05:00 PM	63.3	65.7	61.2	78.7
6:10:00 PM	63.3	65.3	61.4	78.2
6:15:00 PM	63.4	65.5	61.3	78.3
6:20:00 PM	63.5	65.7	61.4	78.4
6:25:00 PM	63.6	66.1	61.3	78.9
6:30:00 PM	63.6	65.8	61.5	78.8

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
6:35:00 PM	63.5	65.8	61.4	78
6:40:00 PM	63.3	66	61.1	78.3
6:45:00 PM	63.5	65.9	61	79
6:50:00 PM	63.5	65.9	61.1	79.1
6:55:00 PM	63.7	66	61.4	78.6
7:00:00 PM	63.7	65.8	61.6	78.8
7:05:00 PM	63.4	65.1	61.5	78
7:10:00 PM	63.8	65.7	61.7	78.4
7:15:00 PM	63.7	65.6	61.9	78.6
7:20:00 PM	63.7	65.4	61.8	78.5
7:25:00 PM	63.9	65.8	62	78.6
7:30:00 PM	63.8	65.6	61.7	78.9
7:35:00 PM	63.9	65.9	61.4	78.7
7:40:00 PM	63.6	65.1	61.8	78
7:45:00 PM	63.8	65.5	61.5	78.4
7:50:00 PM	63.5	65.3	61.5	78.1
7:55:00 PM	63.5	65.5	61.7	78.6
8:00:00 PM	63.8	65.6	61	80.1
8:05:00 PM	63.8	65.7	61.7	78.8
8:10:00 PM	63.4	65.1	61.6	78.3
8:15:00 PM	63.7	65.5	61.6	78.2
8:20:00 PM	63.7	65.9	61.7	78.5
8:25:00 PM	63.8	65.5	62	78
8:30:00 PM	63.6	65.4	61.7	78.4
8:35:00 PM	63.5	65.7	61.8	78.1
8:40:00 PM	63.5	65.3	61.8	78.4
8:45:00 PM	63.4	65	61.4	78.1
8:50:00 PM	63.3	65.4	61.5	78.6
8:55:00 PM	63.4	65.3	61.6	78.2
9:00:00 PM	63.6	65.7	61.6	78.4
9:05:00 PM	63.6	65.6	62.1	78.6
9:10:00 PM	63.5	65	61.8	77.6
9:15:00 PM	63.7	65.5	62.2	78.1
9:20:00 PM	63.4	65.5	61.6	78.2
9:25:00 PM	63.2	65.1	61.3	78.3
9:30:00 PM	63.4	65.5	61.7	78.2
9:35:00 PM	63.5	65.2	61.2	78.1
9:40:00 PM	63.5	65.5	61.5	78.8
9:45:00 PM	63.3	65.1	61.5	78.3

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
9:50:00 PM	63.3	65.6	61.9	78
9:55:00 PM	63.3	65	61.7	78.3
10:00:00 PM	63.1	65	61.5	77.8

Session Report

18-Nov-17

Information Panel

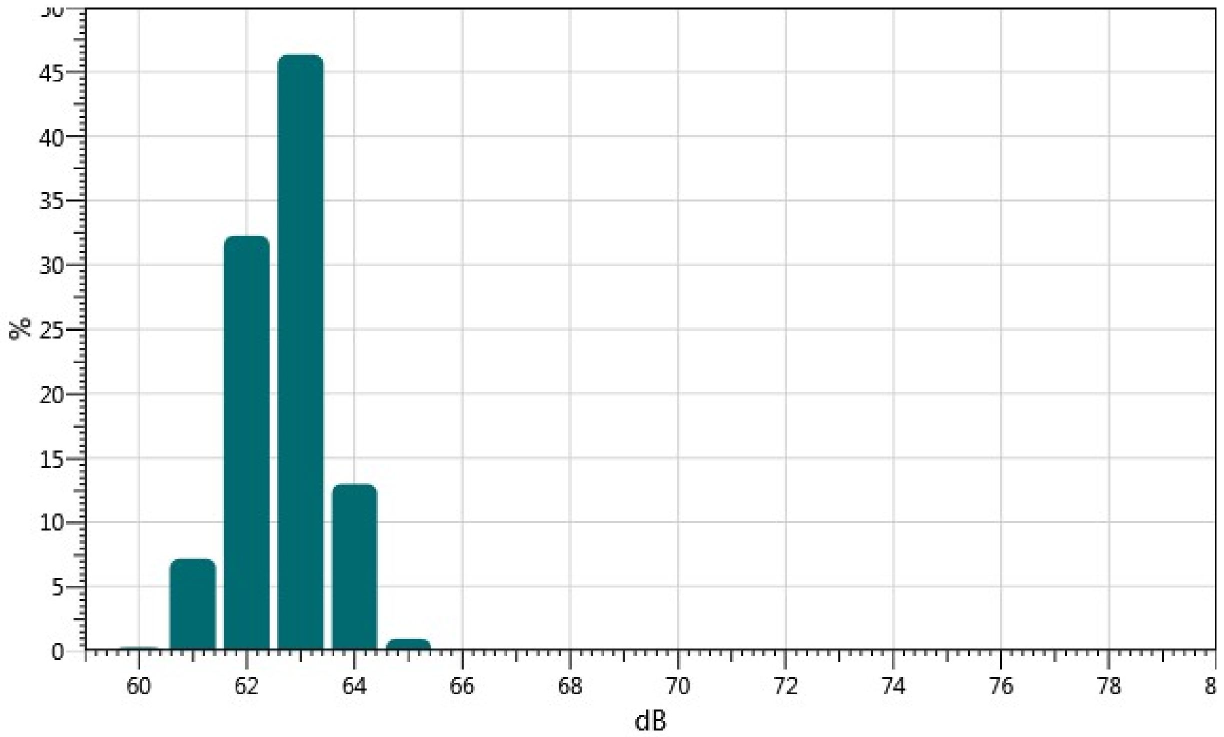
Company Name	Sarawak Energy Berhad
Description	CK/EV103-708/17
Location	N1 (Night Time)
Start Time	17-Nov-17 10:05:01 PM
Stop Time	18-Nov-17 7:05:01 AM
Run Time	09:00:00
Model Type	SoundPro DL
Comments	Nearby plant operation, insects, etc.

Summary Data Panel

Description	Meter	Value	Description	Meter	Value
Leq	1	63.1 dB	Lpk	1	87.5 dB
Lmax	1	72 dB	Lmin	1	59.4 dB
L10	1	64 dB	L90	1	62 dB
Mntime	1	18-Nov-17 3:49:08 AM	Mxtime	1	18-Nov-17 5:39:47 AM
Rtime	1	09:00:00	Dose	1	0.2 %
Exchange Rate	1	3 dB	Weighting	1	A
Response	1	FAST	Bandwidth	1	OFF

Statistics Chart

N1N - 24hrs: Statistics Chart

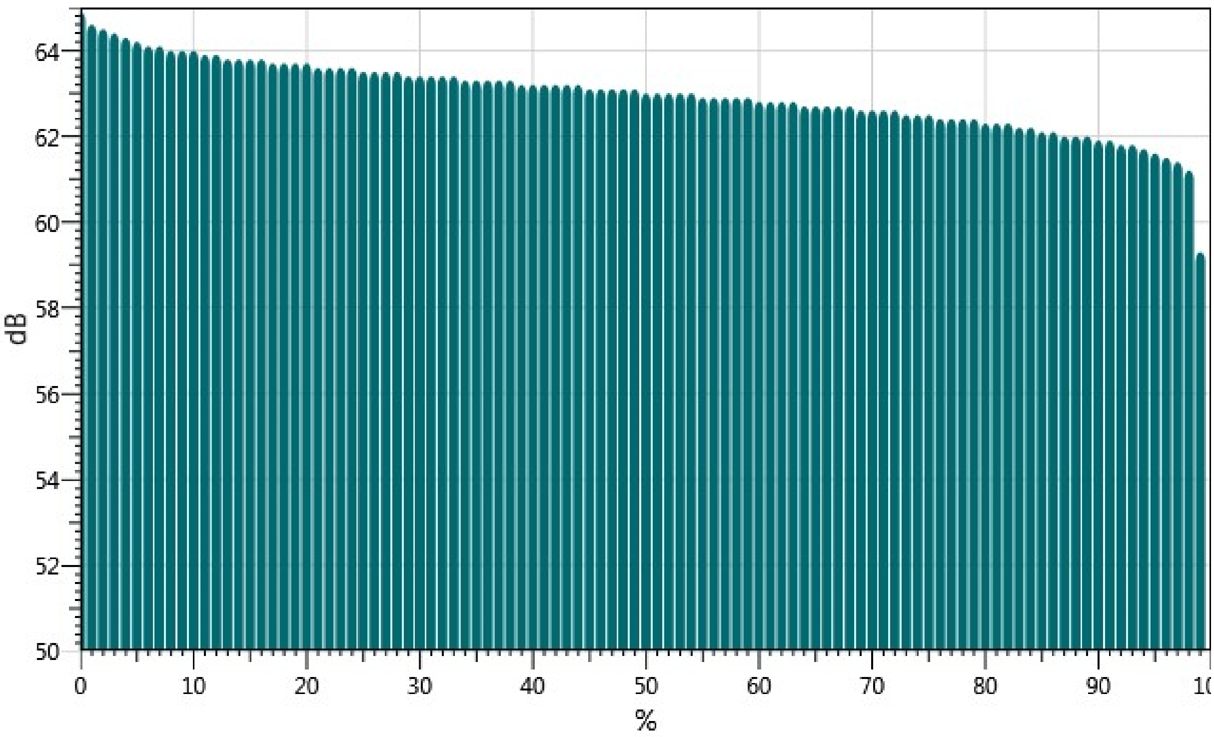


Statistics Table

dB:	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	%
59:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
60:	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.04	0.06	0.09	0.26
61:	0.13	0.18	0.26	0.34	0.49	0.66	0.84	1.11	1.41	1.73	7.16
62:	2.10	2.56	1.95	2.78	3.07	3.34	3.65	3.95	4.28	4.59	32.27
63:	4.87	5.10	5.20	5.22	5.13	4.91	4.59	4.22	3.78	3.32	46.35
64:	2.83	2.37	1.93	1.57	1.23	0.94	0.74	0.58	0.44	0.34	12.96
65:	0.26	0.19	0.10	0.10	0.08	0.06	0.04	0.03	0.03	0.02	0.92
66:	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.07
67:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
68:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
69:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
70:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
71:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
72:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Exceedance Chart

N1N - 24hrs: Exceedance Chart

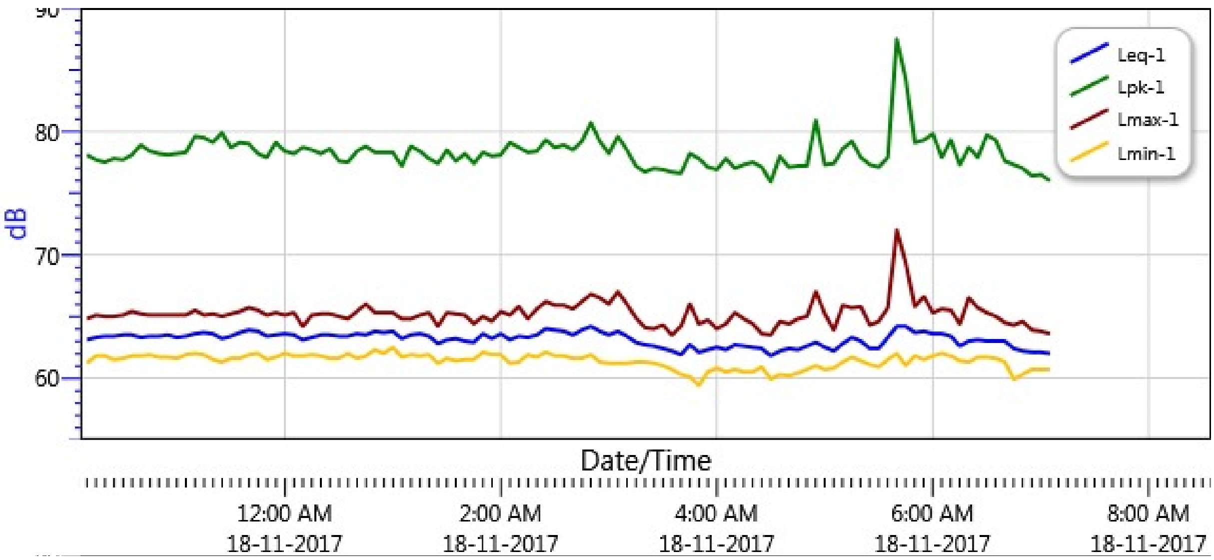


Exceedance Table

.	0%	1%	2%	3%	4%	5%	6%	%7	%8	%9
0%:		64.9	64.6	64.5	64.4	64.3	64.2	64.1	64.1	64.0
10%:	64.0	64.0	63.9	63.9	63.8	63.8	63.8	63.8	63.7	63.7
20%:	63.7	63.7	63.6	63.6	63.6	63.6	63.5	63.5	63.5	63.5
30%:	63.4	63.4	63.4	63.4	63.4	63.3	63.3	63.3	63.3	63.3
40%:	63.2	63.2	63.2	63.2	63.2	63.2	63.1	63.1	63.1	63.1
50%:	63.1	63.0	63.0	63.0	63.0	63.0	62.9	62.9	62.9	62.9
60%:	62.9	62.8	62.8	62.8	62.8	62.7	62.7	62.7	62.7	62.7
70%:	62.6	62.6	62.6	62.6	62.5	62.5	62.5	62.4	62.4	62.4
80%:	62.4	62.3	62.3	62.3	62.2	62.2	62.1	62.1	62.0	62.0
90%:	62.0	61.9	61.9	61.8	61.8	61.7	61.6	61.5	61.4	61.2
100%:	59.3									

Logged Data Chart

N1N - 24hrs: Logged Data Chart



Logged Data Table

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
17-Nov-17 10:10:01 PM	63.1	64.8	61.2	78.1
10:15:01 PM	63.3	65.1	61.8	77.7
10:20:01 PM	63.4	65	61.8	77.5
10:25:01 PM	63.4	65	61.5	77.8
10:30:01 PM	63.5	65.1	61.6	77.7
10:35:01 PM	63.5	65.4	61.8	78.1
10:40:01 PM	63.3	65.2	61.8	78.9
10:45:01 PM	63.4	65.1	61.9	78.4
10:50:01 PM	63.4	65.1	61.7	78.2
10:55:01 PM	63.5	65.1	61.7	78.1
11:00:01 PM	63.3	65.1	61.6	78.2
11:05:01 PM	63.4	65.1	61.9	78.3
11:10:01 PM	63.6	65.5	62	79.6
11:15:01 PM	63.7	65.1	61.9	79.5
11:20:01 PM	63.6	65.2	61.5	79.1
11:25:01 PM	63.2	65	61.3	79.9
11:30:01 PM	63.4	65.2	61.6	78.7
11:35:01 PM	63.7	65.4	61.6	79.1
11:40:01 PM	63.9	65.7	61.9	79
11:45:01 PM	63.8	65.5	62	78.2
11:50:01 PM	63.4	65.1	61.5	77.9

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
11:55:01 PM	63.5	65.3	61.7	79.1
18-Nov-17 12:00:01 AM	63.6	65.1	62	78.4
12:05:01 AM	63.5	65.3	61.8	78.2
12:10:01 AM	63.1	64.2	61.8	78.7
12:15:01 AM	63.3	65.1	61.9	78.5
12:20:01 AM	63.5	65.2	61.8	78.2
12:25:01 AM	63.5	65.2	61.6	78.6
12:30:01 AM	63.4	65	61.6	77.6
12:35:01 AM	63.4	64.8	62	77.5
12:40:01 AM	63.6	65.4	61.6	78.4
12:45:01 AM	63.5	66	61.8	78.8
12:50:01 AM	63.8	65.3	62.3	78.3
12:55:01 AM	63.7	65.3	62	78.3
1:00:01 AM	63.8	65.3	62.5	78.3
1:05:01 AM	63.2	64.8	61.7	77.2
1:10:01 AM	63.5	64.8	61.9	78.8
1:15:01 AM	63.6	65.1	61.8	78.4
1:20:01 AM	63.4	65.3	61.9	77.8
1:25:01 AM	62.8	64.2	61.2	77.4
1:30:01 AM	63.1	65.3	61.6	78.5
1:35:01 AM	63.2	65.2	61.4	77.6
1:40:01 AM	63	65.1	61.5	78.2
1:45:01 AM	62.9	64.4	61.5	77.4
1:50:01 AM	63.6	65	62.1	78.3
1:55:01 AM	63.2	64.6	61.9	78
2:00:01 AM	63.6	65.4	61.9	78.1
2:05:01 AM	63.1	65.1	61.2	79.1
2:10:01 AM	63.4	65.8	61.3	78.7
2:15:01 AM	63.3	64.8	61.9	78.3
2:20:01 AM	63.5	65.6	61.7	78.4
2:25:01 AM	64	66.2	62.1	79.3
2:30:01 AM	63.9	65.9	61.8	78.7
2:35:01 AM	63.8	65.9	61.8	78.9
2:40:01 AM	63.5	65.6	61.6	78.5
2:45:01 AM	63.9	66.2	61.6	79.2
2:50:01 AM	64.2	66.8	61.9	80.7
2:55:01 AM	63.8	66.5	61.3	79.2
3:00:01 AM	63.5	66	61.2	78.2
3:05:01 AM	63.8	67	61.2	79.6

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
3:10:01 AM	63.4	66	61.2	78.5
3:15:01 AM	62.9	64.9	61.3	77.2
3:20:01 AM	62.7	64.1	61.3	76.7
3:25:01 AM	62.6	64	61.2	77
3:30:01 AM	62.4	64.3	61	76.9
3:35:01 AM	62.2	63.5	60.7	76.7
3:40:01 AM	61.9	64.2	60.3	76.6
3:45:01 AM	62.7	66	60.1	78.2
3:50:01 AM	62.1	64.4	59.4	77.8
3:55:01 AM	62.3	64.7	60.5	77.1
4:00:01 AM	62.5	64	60.8	76.9
4:05:01 AM	62.3	64.4	60.5	77.8
4:10:01 AM	62.7	65.3	60.7	77
4:15:01 AM	62.6	64.8	60.5	77.3
4:20:01 AM	62.5	64.4	60.5	77.5
4:25:01 AM	62.4	63.6	60.9	77.1
4:30:01 AM	61.8	63.5	59.9	75.9
4:35:01 AM	62.2	64.6	60.3	78
4:40:01 AM	62.4	64.4	60.2	77.1
4:45:01 AM	62.3	64.8	60.4	77.2
4:50:01 AM	62.6	65	60.7	77.2
4:55:01 AM	62.9	67	61	80.9
5:00:01 AM	62.5	65.2	60.7	77.3
5:05:01 AM	62.2	63.9	60.8	77.4
5:10:01 AM	62.8	65.9	61.3	78.6
5:15:01 AM	63.3	65.7	61.7	79.2
5:20:01 AM	63	65.8	61.4	77.9
5:25:01 AM	62.4	64.3	61.1	77.3
5:30:01 AM	62.4	64.6	60.9	77.1
5:35:01 AM	63.3	65.7	61.5	77.9
5:40:01 AM	64.2	72	62	87.5
5:45:01 AM	64.2	69.3	61	84.2
5:50:01 AM	63.7	65.8	61.8	79.1
5:55:01 AM	63.8	66.6	61.5	79.3
6:00:01 AM	63.6	65.3	61.8	79.8
6:05:01 AM	63.6	65.6	62	77.9
6:10:01 AM	63.4	65.5	61.8	79.3
6:15:01 AM	62.6	64.4	61.4	77.3
6:20:01 AM	63	66.5	61.3	78.7

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
6:25:01 AM	63.1	65.7	61.7	77.9
6:30:01 AM	63	65.3	61.7	79.7
6:35:01 AM	63	65	61.6	79.3
6:40:01 AM	63	64.5	61.3	77.6
6:45:01 AM	62.4	64.3	59.9	77.3
6:50:01 AM	62.2	64.6	60.3	77
6:55:01 AM	62.1	63.9	60.7	76.4
7:00:01 AM	62.1	63.8	60.7	76.5
7:05:01 AM	62	63.6	60.7	76

Session Report

15-Nov-17

Information Panel

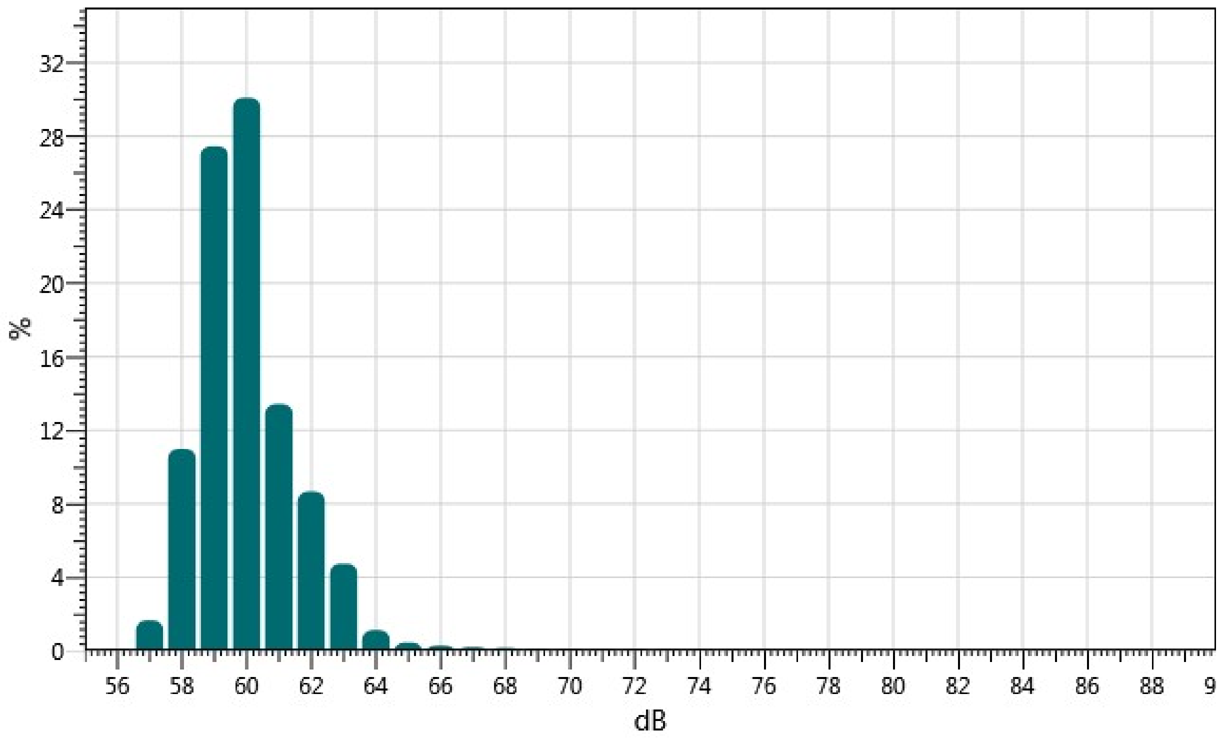
Company Name	Sarawak Energy Berhad
Description	CK/EV103-708/17
Location	N2 (Day Time)
Start Time	15-Nov-17 7:05:00 AM
Stop Time	15-Nov-17 10:05:00 PM
Run Time	15:00:00
Model Type	SoundPro DL
Comments	Nearby plant operation, workers activities, vehicles movement, construction activities, etc.

Summary Data Panel

Description	Meter	Value	Description	Meter	Value
Leq	1	61.3 dB	Lpk	1	95.7 dB
Lmax	1	86.6 dB	Lmin	1	55.8 dB
L10	1	62.6 dB	L90	1	58.7 dB
Mntime	1	15-Nov-17 4:08:38 PM	Mxtime	1	15-Nov-17 10:57:02 AM
Rtime	1	15:00:00	Dose	1	0.3 %
Exchange Rate	1	3 dB	Weighting	1	A
Response	1	FAST	Bandwidth	1	OFF

Statistics Chart

N2D - 24hrs: Statistics Chart



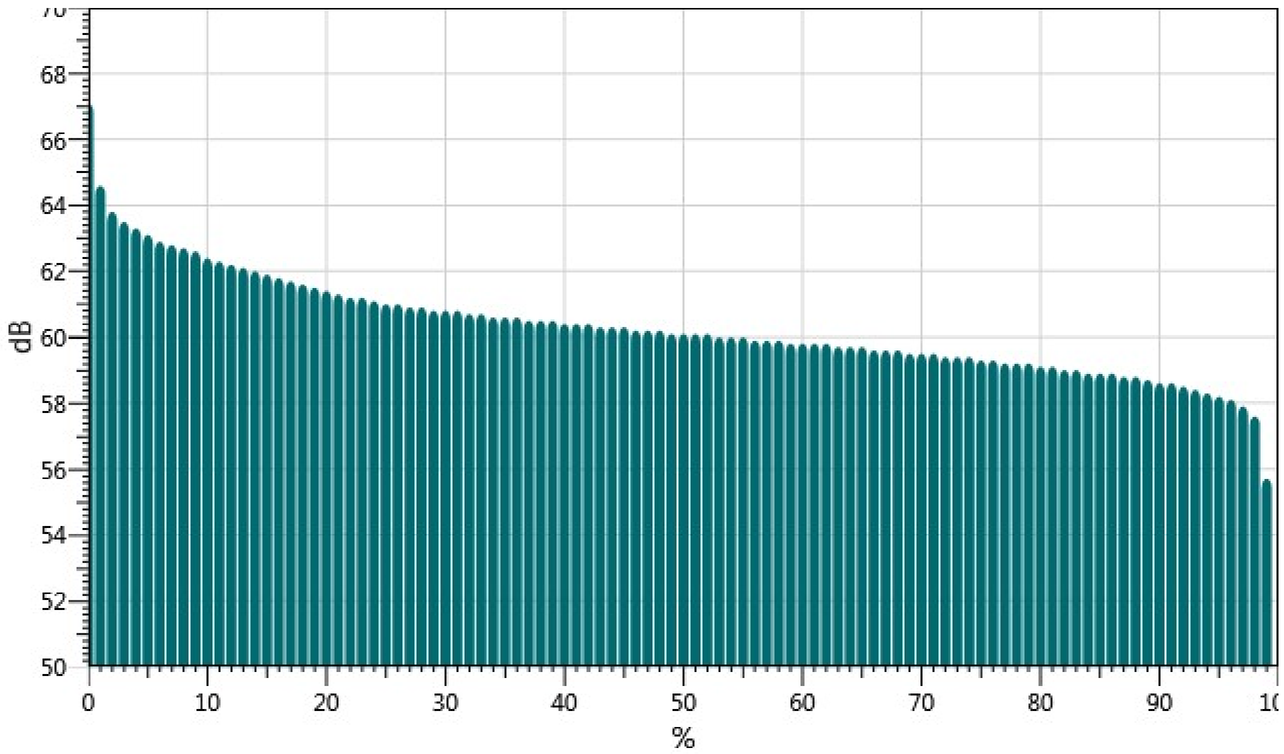
Statistics Table

dB:	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	%
55:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
56:	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.07
57:	0.04	0.05	0.06	0.09	0.12	0.16	0.20	0.24	0.31	0.39	1.65
58:	0.46	0.58	0.69	0.80	0.93	1.08	1.28	1.48	1.71	1.98	10.98
59:	2.29	2.62	1.83	2.60	2.74	2.88	2.99	3.10	3.17	3.24	27.47
60:	3.29	3.32	3.34	3.28	3.22	3.08	2.96	2.76	2.55	2.30	30.10
61:	2.07	1.84	1.64	1.44	1.28	1.17	1.07	0.99	0.95	0.96	13.42
62:	0.99	0.99	0.67	0.89	0.89	0.89	0.88	0.85	0.82	0.78	8.66
63:	0.74	0.69	0.62	0.55	0.50	0.45	0.38	0.32	0.26	0.22	4.74
64:	0.19	0.17	0.15	0.12	0.10	0.09	0.09	0.08	0.07	0.07	1.12
65:	0.06	0.06	0.04	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.46
66:	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.03	0.02	0.28
67:	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.20
68:	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.16
69:	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.10
70:	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.10
71:	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.08

dB:	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	%
72:	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.07
73:	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.07
74:	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.07
75:	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.00	0.06
76:	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.05
77:	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
78:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
79:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
80:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
81:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
82:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
83:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
84:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
85:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
86:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Exceedance Chart

N2D - 24hrs: Exceedance Chart



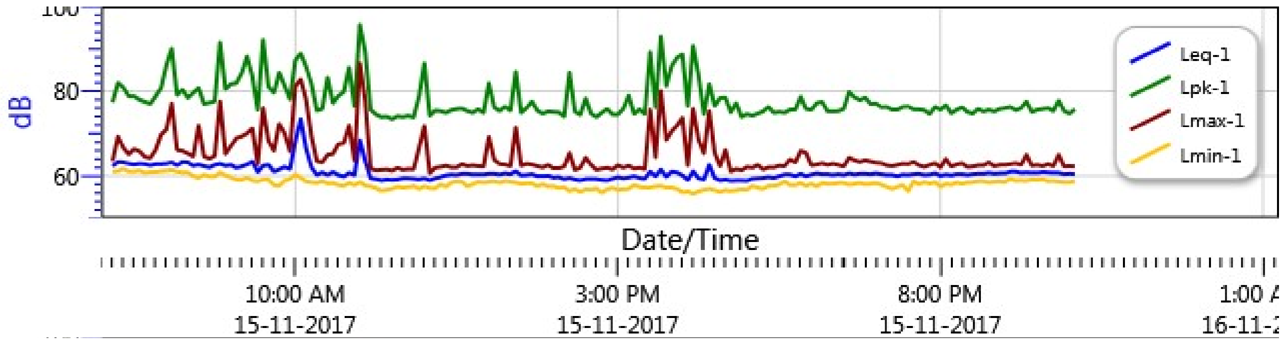
Exceedance Table

.	0%	1%	2%	3%	4%	5%	6%	%7	%8	%9
0%:		67.1	64.6	63.8	63.5	63.3	63.1	62.9	62.8	62.7

.	0%	1%	2%	3%	4%	5%	6%	%7	%8	%9
10%:	62.6	62.4	62.3	62.2	62.1	62.0	61.9	61.8	61.7	61.6
20%:	61.5	61.4	61.3	61.2	61.2	61.1	61.0	61.0	60.9	60.9
30%:	60.8	60.8	60.8	60.7	60.7	60.6	60.6	60.6	60.5	60.5
40%:	60.5	60.4	60.4	60.4	60.3	60.3	60.3	60.2	60.2	60.2
50%:	60.1	60.1	60.1	60.1	60.0	60.0	60.0	59.9	59.9	59.9
60%:	59.8	59.8	59.8	59.8	59.7	59.7	59.7	59.6	59.6	59.6
70%:	59.5	59.5	59.5	59.4	59.4	59.4	59.3	59.3	59.2	59.2
80%:	59.2	59.1	59.1	59.0	59.0	58.9	58.9	58.9	58.8	58.8
90%:	58.7	58.6	58.6	58.5	58.4	58.3	58.2	58.1	57.9	57.6
100%:	55.7									

Logged Data Chart

N2D - 24hrs: Logged Data Chart



Logged Data Table

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
15-Nov-17 7:10:00 AM	62.3	63.5	61	77.4
7:15:00 AM	63.3	69.3	61.1	82
7:20:00 AM	63.2	66.6	61.7	80.9
7:25:00 AM	62.9	65.1	61	78.8
7:30:00 AM	62.7	66.3	61	78.8
7:35:00 AM	62.9	65.8	61.3	78
7:40:00 AM	62.8	64.5	60.7	77.5
7:45:00 AM	62.5	64.2	60.9	77
7:50:00 AM	62.8	66.1	60.9	78.8
7:55:00 AM	62.8	69.7	61.1	80.7
8:00:00 AM	62.9	70.9	61.2	86.1
8:05:00 AM	63.2	77.1	61.4	90.1
8:10:00 AM	62.5	66.1	61	79.1
8:15:00 AM	63.3	65.9	60.8	80.4
8:20:00 AM	63.2	65.3	60.8	78.4

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
8:25:00 AM	62.4	64.6	59.9	79.6
8:30:00 AM	62.7	71.9	59.5	80.8
8:35:00 AM	62.3	64.6	60.3	77
8:40:00 AM	62	64.1	59.8	77.3
8:45:00 AM	62.6	64.7	59.8	77.6
8:50:00 AM	62.9	77.6	60.8	91.5
8:55:00 AM	62.4	65.2	60.1	80.5
9:00:00 AM	62.6	67	59.6	81.7
9:05:00 AM	61.9	68.9	59.1	81.9
9:10:00 AM	62.2	69.3	59	84.2
9:15:00 AM	62.7	70	59.6	88.2
9:20:00 AM	63.4	71.2	58.9	83.5
9:25:00 AM	60.9	62.8	58.7	75.6
9:30:00 AM	62.4	76	59.1	92.1
9:35:00 AM	62.6	68.3	59.1	81.1
9:40:00 AM	61	65.9	57.8	79.6
9:45:00 AM	61.5	72.3	57.6	84.4
9:50:00 AM	62.1	70	58.9	81.3
9:55:00 AM	61.6	65.8	59.2	78.1
10:00:00 AM	68.2	81.2	60.3	87.3
10:05:00 AM	73.4	82.8	59.5	88.9
10:10:00 AM	66.4	77.9	58.6	85.8
10:15:00 AM	62	69.3	58.5	81.7
10:20:00 AM	60.2	63.5	58.3	75.4
10:25:00 AM	60.8	63.2	58.8	75.8
10:30:00 AM	60.2	65	58.2	83.2
10:35:00 AM	60.9	65.2	58.3	77.2
10:40:00 AM	60.2	67.5	57.8	78.9
10:45:00 AM	59.8	67.7	57.6	79.8
10:50:00 AM	60.7	71.9	58.3	85.6
10:55:00 AM	60.2	63.7	57.8	76.4
11:00:00 AM	68.4	86.6	58.5	95.7
11:05:00 AM	63.5	77.6	57.7	89.2
11:10:00 AM	59.4	61.7	57.5	75.6
11:15:00 AM	59.2	61.3	57.1	74.5
11:20:00 AM	58.9	61.4	56.5	73.9
11:25:00 AM	59.1	61.5	56.7	74
11:30:00 AM	59	61.2	56.9	73.4
11:35:00 AM	59.1	61.9	57.4	74.1

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
11:40:00 AM	59.4	61.4	57.2	73.9
11:45:00 AM	59.4	61.6	57.3	74.2
11:50:00 AM	59.3	61.5	57.6	73.8
11:55:00 AM	59.1	66.5	56.9	78.7
12:00:00 PM	59.4	71.8	57.5	86.6
12:05:00 PM	58.9	60.6	57.1	74.2
12:10:00 PM	59.4	61.9	57	75.4
12:15:00 PM	59.7	62.1	58	75.3
12:20:00 PM	60.1	62.4	57.4	74.9
12:25:00 PM	60.3	62	58.4	75.5
12:30:00 PM	60.2	62	58.7	75.8
12:35:00 PM	60.5	62.8	58.6	75.9
12:40:00 PM	60.5	62.3	57.5	75.3
12:45:00 PM	60.3	62.5	58	74.9
12:50:00 PM	60.3	62.3	58.6	75.7
12:55:00 PM	60.3	62.2	58.4	74.9
1:00:00 PM	60.5	69.2	58.6	81.9
1:05:00 PM	60.5	63.8	58.7	76.2
1:10:00 PM	60.3	62.8	58.4	75.3
1:15:00 PM	60.6	62.7	58.8	76.4
1:20:00 PM	60.4	62.3	58.6	75.4
1:25:00 PM	61.1	71.4	58.4	84.6
1:30:00 PM	60.1	62.4	58.1	74.9
1:35:00 PM	60.2	62.9	58.2	76
1:40:00 PM	60.4	62.7	58.2	77.6
1:45:00 PM	59.9	62.3	57.5	75.4
1:50:00 PM	59.9	62	58	74.7
1:55:00 PM	60	62.6	57.5	75.2
2:00:00 PM	59.6	61.8	57.5	75.1
2:05:00 PM	59.7	61.8	57.1	75
2:10:00 PM	59.2	62.2	57.3	74
2:15:00 PM	59.5	65.4	56.4	84.4
2:20:00 PM	59.1	61.4	56.9	75.2
2:25:00 PM	58.9	61.9	56.2	74.4
2:30:00 PM	59.2	64.3	56.8	78.3
2:35:00 PM	59.2	62.6	56.7	74.7
2:40:00 PM	59.2	61.4	57	73.9
2:45:00 PM	59	61.7	56	74.9
2:50:00 PM	58.9	61.9	56.8	75.8

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
2:55:00 PM	59.3	61.5	57.1	74.5
3:00:00 PM	59.7	62.5	56.7	74.5
3:05:00 PM	59.4	61.9	56.8	75.8
3:10:00 PM	59.6	62.4	56.9	79
3:15:00 PM	59.9	61.7	57.8	74.6
3:20:00 PM	59.5	61.9	57.4	75.7
3:25:00 PM	59.3	61.6	57.2	74.6
3:30:00 PM	61	75.6	57.2	89.3
3:35:00 PM	59.9	64.4	57.5	76.2
3:40:00 PM	61.5	80	57.6	92.9
3:45:00 PM	59.8	68.5	57.2	81.3
3:50:00 PM	61	70.5	57.2	86
3:55:00 PM	60.8	71.9	56.9	87.9
4:00:00 PM	60.1	73.7	56.1	88.7
4:05:00 PM	59	62.5	56.3	76.5
4:10:00 PM	61.1	75.8	55.8	90.7
4:15:00 PM	59.4	68.6	56.3	83.7
4:20:00 PM	59.1	65.3	56.7	74.6
4:25:00 PM	62.6	75.3	56.9	81.7
4:30:00 PM	59.5	65.5	56.6	76.5
4:35:00 PM	58.9	62.3	56.2	78.4
4:40:00 PM	59.1	66.1	56.6	78.5
4:45:00 PM	58.8	61	56.4	75
4:50:00 PM	58.9	61.6	56.6	77.2
4:55:00 PM	58.9	61.3	56.8	73.9
5:00:00 PM	58.8	62.1	56.7	74.6
5:05:00 PM	59.3	61.9	57.6	74.2
5:10:00 PM	59.4	62.6	57.2	74.7
5:15:00 PM	59.5	61.5	56.9	75.2
5:20:00 PM	59.7	62	57.6	76.3
5:25:00 PM	59.5	62	57.6	74.9
5:30:00 PM	59.9	62.4	57.9	75.1
5:35:00 PM	60.3	62.3	58.7	74.9
5:40:00 PM	60.3	63.9	57.8	75.6
5:45:00 PM	59.9	63.2	57.8	75.6
5:50:00 PM	60.5	65.9	58.3	78.7
5:55:00 PM	59.9	65.4	57.6	75.8
6:00:00 PM	60.3	62.5	58.1	75.6
6:05:00 PM	60.6	62.7	57.5	77.2

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
6:10:00 PM	60.4	63	58.3	77.5
6:15:00 PM	60.4	62.6	58.1	75.2
6:20:00 PM	60.2	62.9	58.1	75.2
6:25:00 PM	60.4	62.6	58.3	75.3
6:30:00 PM	60.2	62.2	58.3	75.8
6:35:00 PM	60.6	64.3	57.9	79.8
6:40:00 PM	60.3	63.7	58.1	78.6
6:45:00 PM	60.5	63.3	58.3	77.9
6:50:00 PM	60.5	63.7	58	78.5
6:55:00 PM	60.4	63.4	58.1	77
7:00:00 PM	60.6	63.1	58.3	77.1
7:05:00 PM	60.4	63	57.9	76.2
7:10:00 PM	60.2	62.5	57.4	76.3
7:15:00 PM	60.2	62.3	56.9	75.6
7:20:00 PM	59.9	62.6	57.4	75.6
7:25:00 PM	60.3	62.9	57.8	76.3
7:30:00 PM	60.2	62.8	56.4	76.4
7:35:00 PM	60.4	63.3	58.7	75.7
7:40:00 PM	60.5	62.5	58	75.7
7:45:00 PM	60.2	62.1	58.5	75.5
7:50:00 PM	60.3	62.6	58.1	74.6
7:55:00 PM	60.6	63	58.5	76.3
8:00:00 PM	60	62	57.4	75.6
8:05:00 PM	60.3	64	58.1	76.7
8:10:00 PM	60.1	62.2	57.9	74.8
8:15:00 PM	60.4	62.7	58.4	75.6
8:20:00 PM	60.4	63	58.1	76.2
8:25:00 PM	60.2	62.1	58.4	75.1
8:30:00 PM	60.4	62.2	58.5	74.7
8:35:00 PM	60.5	62.5	58.7	75.8
8:40:00 PM	60.5	62.5	58.7	75.2
8:45:00 PM	60.7	63.2	58.4	75.6
8:50:00 PM	60.5	62.3	58.6	75.2
8:55:00 PM	60.6	62.6	58.7	75.8
9:00:00 PM	60.6	62.6	58.5	76
9:05:00 PM	61	62.8	59.3	76.3
9:10:00 PM	61	63	58.8	75.5
9:15:00 PM	60.7	62.6	58.9	76
9:20:00 PM	60.8	65	58.8	77.6

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
9:25:00 PM	60.7	62.4	59.1	75.1
9:30:00 PM	60.7	62.6	59	75.6
9:35:00 PM	60.9	62.3	59.2	75.8
9:40:00 PM	60.8	62.8	58.7	76
9:45:00 PM	60.7	62.3	58.8	75.3
9:50:00 PM	60.7	65	58.6	77.8
9:55:00 PM	60.4	62.2	58.5	75.3
10:00:00 PM	60.5	62.3	58.5	74.7
10:05:00 PM	60.4	62.2	58.7	75.7

Session Report

15-Nov-17

Information Panel

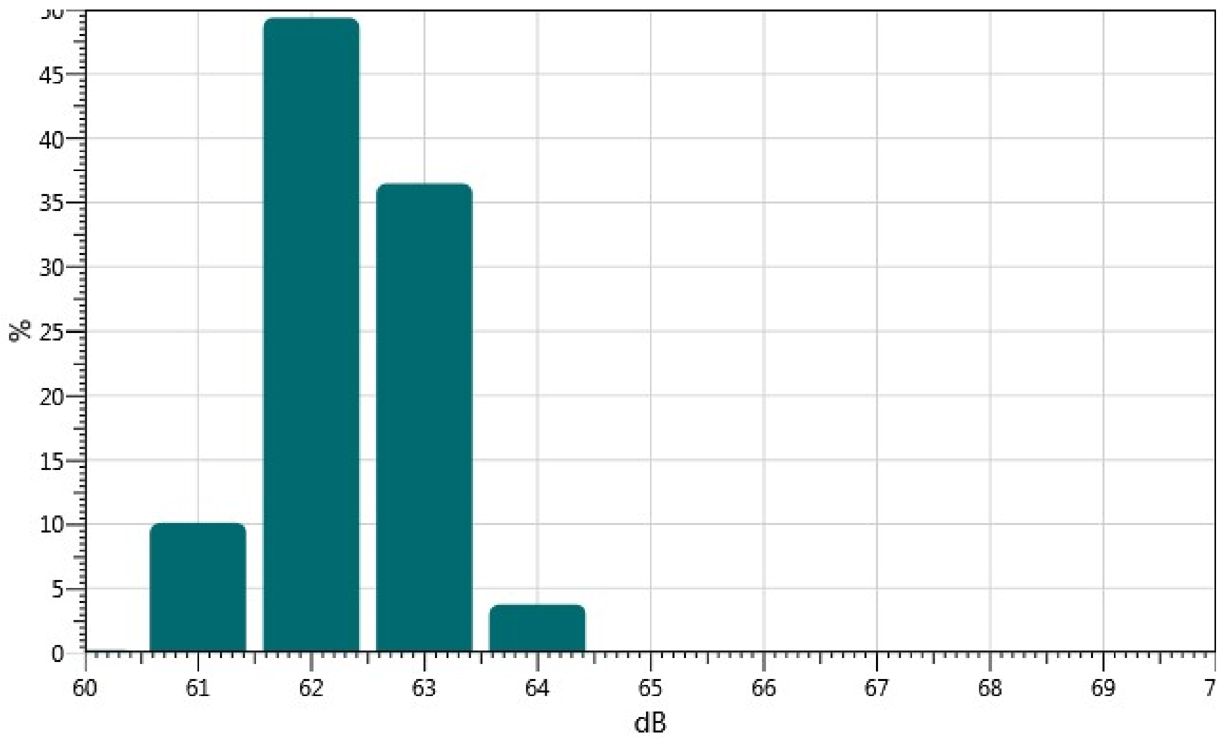
Company Name	Sarawak Energy Berhad
Description	CK/EV103-708/17
Location	N2 (Night Time)
Start Time	14-Nov-17 10:00:00 PM
Stop Time	15-Nov-17 7:00:00 AM
Run Time	09:00:00
Model Type	SoundPro DL
Comments	Nearby plant operation, insects, etc.

Summary Data Panel

Description	Meter	Value	Description	Meter	Value
Leq	1	62.8 dB	Lpk	1	83 dB
Lmax	1	69 dB	Lmin	1	60.2 dB
L10	1	63.5 dB	L90	1	61.8 dB
Mntime	1	15-Nov-17 1:18:44 AM	Mxtime	1	15-Nov-17 6:24:29 AM
Rtime	1	09:00:00	Dose	1	0.2 %
Exchange Rate	1	3 dB	Weighting	1	A
Response	1	FAST	Bandwidth	1	OFF

Statistics Chart

N2N - 24hrs: Statistics Chart

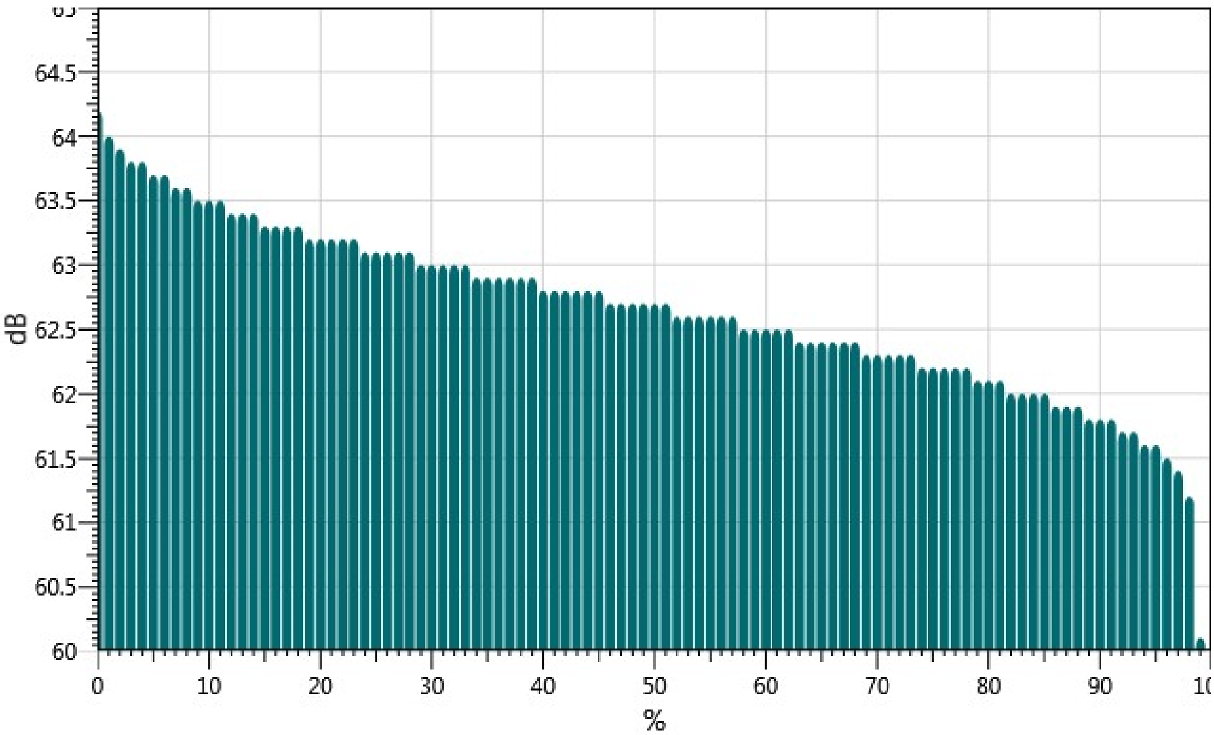


Statistics Table

dB:	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	%
60:	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.03	0.06	0.09	0.20
61:	0.13	0.20	0.29	0.42	0.61	0.86	1.20	1.61	2.09	2.68	10.09
62:	3.34	4.13	3.19	4.65	5.04	5.42	5.73	5.90	6.01	5.95	49.36
63:	5.77	5.40	4.95	4.47	3.95	3.42	2.88	2.34	1.86	1.43	36.47
64:	1.08	0.81	0.59	0.43	0.30	0.21	0.14	0.09	0.06	0.04	3.75
65:	0.02	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.08
66:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
67:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
68:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
69:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Exceedance Chart

N2N - 24hrs: Exceedance Chart

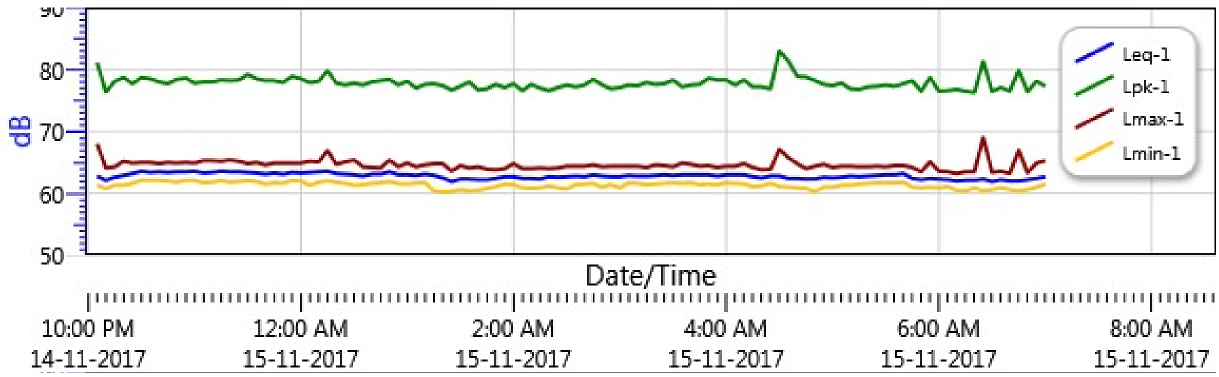


Exceedance Table

.	0%	1%	2%	3%	4%	5%	6%	%7	%8	%9
0%:		64.2	64.0	63.9	63.8	63.8	63.7	63.7	63.6	63.6
10%:	63.5	63.5	63.5	63.4	63.4	63.4	63.3	63.3	63.3	63.3
20%:	63.2	63.2	63.2	63.2	63.2	63.1	63.1	63.1	63.1	63.1
30%:	63.0	63.0	63.0	63.0	63.0	62.9	62.9	62.9	62.9	62.9
40%:	62.9	62.8	62.8	62.8	62.8	62.8	62.8	62.7	62.7	62.7
50%:	62.7	62.7	62.7	62.6	62.6	62.6	62.6	62.6	62.6	62.5
60%:	62.5	62.5	62.5	62.5	62.4	62.4	62.4	62.4	62.4	62.4
70%:	62.3	62.3	62.3	62.3	62.3	62.2	62.2	62.2	62.2	62.2
80%:	62.1	62.1	62.1	62.0	62.0	62.0	62.0	61.9	61.9	61.9
90%:	61.8	61.8	61.8	61.7	61.7	61.6	61.6	61.5	61.4	61.2
100%:	60.1									

Logged Data Chart

N2N - 24hrs: Logged Data Chart



Logged Data Table

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
14-Nov-17 10:05:00 PM	62.8	68	61.3	81.1
10:10:00 PM	62.1	64.1	60.8	76.4
10:15:00 PM	62.6	64.3	61.3	78.1
10:20:00 PM	62.9	65.2	61.3	78.7
10:25:00 PM	63.2	64.9	61.6	77.7
10:30:00 PM	63.6	65	62.1	78.7
10:35:00 PM	63.4	65	62.1	78.5
10:40:00 PM	63.5	64.8	62.1	78
10:45:00 PM	63.4	65	62	77.7
10:50:00 PM	63.5	64.9	61.8	78.4
10:55:00 PM	63.5	65	62.1	78.6
11:00:00 PM	63.6	64.9	62.1	77.8
11:05:00 PM	63.3	65.3	61.7	78
11:10:00 PM	63.4	65.3	61.8	78
11:15:00 PM	63.6	65.2	62.1	78.3
11:20:00 PM	63.5	65.4	61.8	78.2
11:25:00 PM	63.5	65.2	61.9	78.3
11:30:00 PM	63.4	64.8	62.1	79.2
11:35:00 PM	63.3	65	61.9	78.5
11:40:00 PM	63.1	64.6	61.5	78.2
11:45:00 PM	63.3	64.9	61.7	78.2
11:50:00 PM	63.1	64.9	61.6	77.9
11:55:00 PM	63.4	64.9	62.1	78.9
15-Nov-17 12:00:00 AM	63.3	64.9	62	78.5
12:05:00 AM	63.4	65.2	61.3	77.9

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
12:10:00 AM	63.5	65.1	61.8	78.1
12:15:00 AM	63.6	66.9	62	79.8
12:20:00 AM	63.2	64.7	61.8	77.8
12:25:00 AM	63.1	65.1	61.6	77.5
12:30:00 AM	63	65.4	61.3	77.8
12:35:00 AM	62.8	64.3	61.4	77.5
12:40:00 AM	63.1	64.2	61.6	78
12:45:00 AM	63.1	64.1	61.7	78.2
12:50:00 AM	63.5	65.4	61.9	78.4
12:55:00 AM	63	64.3	61.6	77.5
1:00:00 AM	63	64.9	61.5	78.1
1:05:00 AM	62.9	64.3	61.7	77
1:10:00 AM	63.1	64.6	61.7	77.6
1:15:00 AM	62.9	64.8	60.4	77.7
1:20:00 AM	62.5	64.8	60.2	77.4
1:25:00 AM	61.9	63.6	60.3	76.7
1:30:00 AM	62.3	64.5	60.6	77.3
1:35:00 AM	62.3	64.1	60.4	78
1:40:00 AM	62.2	64.3	60.5	76.7
1:45:00 AM	62.2	63.9	60.8	76.9
1:50:00 AM	62.4	63.8	61.1	77.6
1:55:00 AM	62.7	64	61.5	77.1
2:00:00 AM	62.7	64.8	61.4	77.7
2:05:00 AM	62.4	64	60.9	76.6
2:10:00 AM	62.4	64	60.8	77.6
2:15:00 AM	62.3	64.1	60.9	77
2:20:00 AM	62.7	64	61.2	76.6
2:25:00 AM	62.6	64.1	60.9	77.1
2:30:00 AM	62.7	64.4	60.7	77.5
2:35:00 AM	62.8	64.4	61.4	77.2
2:40:00 AM	62.7	64.4	61.5	77.5
2:45:00 AM	63	64.6	61.6	78.4
2:50:00 AM	62.8	64.3	61	77.5
2:55:00 AM	62.7	64.4	61.4	76.9
3:00:00 AM	62.7	64.4	60.9	77.1
3:05:00 AM	62.9	64.4	61.7	77.5
3:10:00 AM	62.8	64.4	61.6	77.4
3:15:00 AM	62.8	64.2	61.4	77.9
3:20:00 AM	62.9	64.6	61.5	77.6

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
3:25:00 AM	63	64.5	61.6	77.7
3:30:00 AM	62.9	64.3	61.7	78.3
3:35:00 AM	63	64.9	61.6	77.2
3:40:00 AM	63	64.7	61.7	77.5
3:45:00 AM	63	64.4	61.4	77.6
3:50:00 AM	63	64.5	61.5	78.6
3:55:00 AM	62.8	64.2	61.4	78.3
4:00:00 AM	63	64.4	61.7	78.3
4:05:00 AM	63	64.4	61.6	77.5
4:10:00 AM	63	64.8	61.5	78.3
4:15:00 AM	62.7	64.2	61.1	77.2
4:20:00 AM	62.5	63.8	61.2	77.2
4:25:00 AM	62.8	63.9	61.6	76.9
4:30:00 AM	62.8	67.1	61.1	83
4:35:00 AM	62.4	65.8	61	81.4
4:40:00 AM	62.4	64.8	60.9	78.9
4:45:00 AM	62.3	64	60.8	78.8
4:50:00 AM	62.3	64.4	60.3	78.2
4:55:00 AM	62.6	64.7	61	77.6
5:00:00 AM	62.5	64.2	61	77.4
5:05:00 AM	62.6	64.4	61.3	77.8
5:10:00 AM	62.8	64.4	61.3	76.9
5:15:00 AM	62.7	64.3	61.5	76.8
5:20:00 AM	62.8	64.3	61.6	77.2
5:25:00 AM	62.9	64.4	61.7	77.3
5:30:00 AM	63	64.3	61.7	77.5
5:35:00 AM	63	64.5	61.7	77.3
5:40:00 AM	63.2	64.5	61.8	77.7
5:45:00 AM	62.4	64.2	61	78.2
5:50:00 AM	62.2	63.5	60.9	76.5
5:55:00 AM	62.4	65.1	61	78.7
6:00:00 AM	62.3	63.6	60.9	76.5
6:05:00 AM	62.2	63.5	61.1	76.6
6:10:00 AM	62	63.2	60.5	76.8
6:15:00 AM	62.1	63.5	60.4	76.5
6:20:00 AM	62.1	63.5	60.9	76.3
6:25:00 AM	62.3	69	60.4	81.3
6:30:00 AM	61.9	63.4	60.6	76.5
6:35:00 AM	62.2	63.6	60.9	77.1

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
6:40:00 AM	62	63.2	60.6	76.5
6:45:00 AM	62	67	60.4	79.9
6:50:00 AM	62.2	63.3	60.6	76.4
6:55:00 AM	62.4	64.9	61	78.1
7:00:00 AM	62.7	65.3	61.5	77.3

Session Report

22-Nov-17

Information Panel

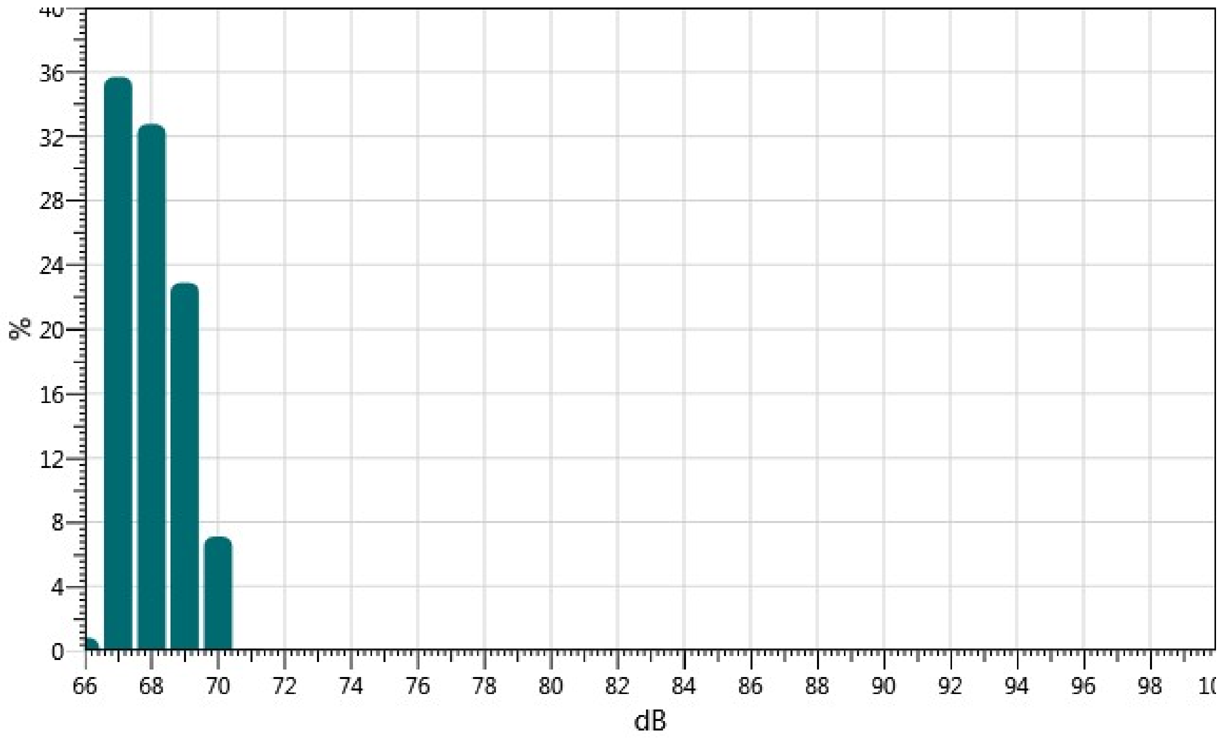
Company Name	Sarawak Energy Berhad
Description	CK/EV103-708/17
Location	N3 (Day Time)
Start Time	22-Nov-17 7:00:00 AM
Stop Time	22-Nov-17 10:00:00 PM
Run Time	15:00:00
Model Type	SoundPro DL
Comments	Nearby plant operation, human activities, vehicles movement, etc.

Summary Data Panel

Description	Meter	Value	Description	Meter	Value
Leq	1	69.2 dB	Lpk	1	101.3 dB
Lmax	1	94.9 dB	Lmin	1	66.1 dB
L10	1	69.8 dB	L90	1	67.3 dB
Mntime	1	22-Nov-17 4:55:46 PM	Mxtime	1	22-Nov-17 8:14:18 AM
Rtime	1	15:00:00	Dose	1	1.6 %
Exchange Rate	1	3 dB	Weighting	1	A
Response	1	FAST	Bandwidth	1	OFF

Statistics Chart

N3D - 24hrs: Statistics Chart



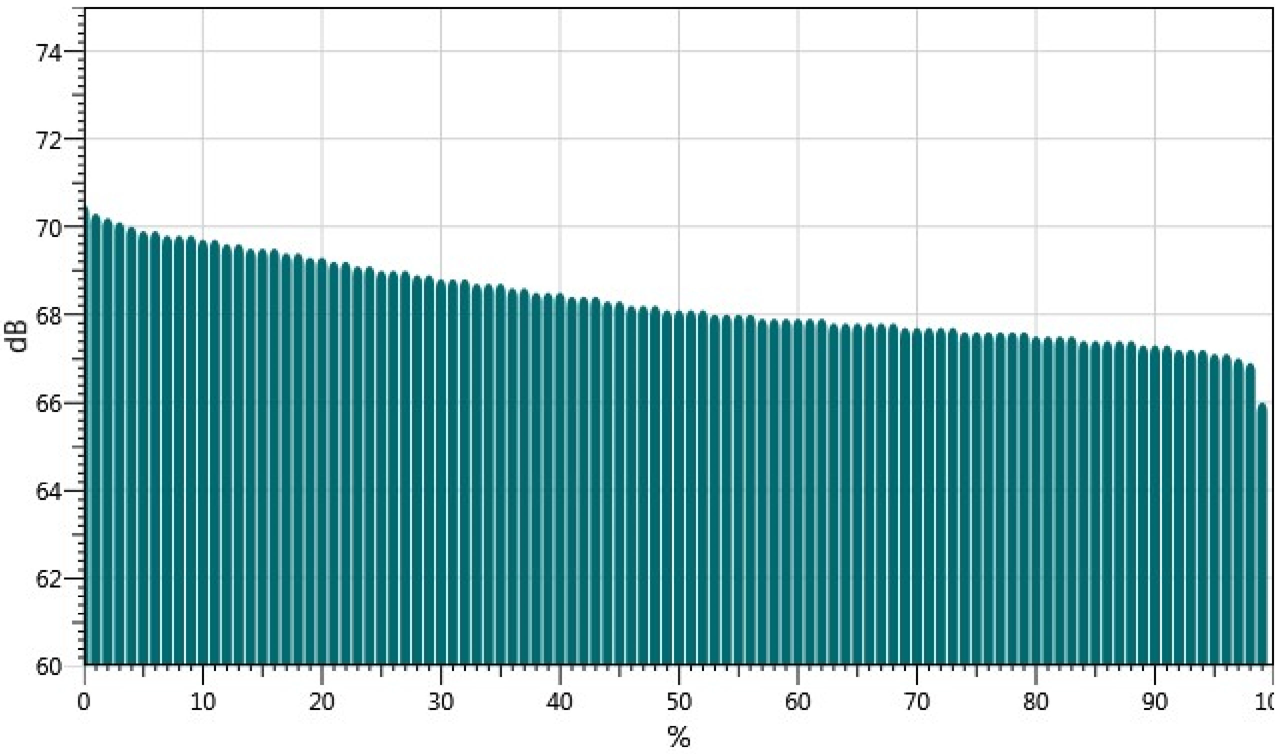
Statistics Table

dB:	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	%
66:	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.09	0.21	0.43	0.80
67:	0.78	1.29	1.94	2.68	3.44	4.15	4.77	5.27	5.62	5.74	35.69
68:	5.52	4.99	3.22	3.01	2.76	2.58	2.61	2.66	2.73	2.67	32.75
69:	2.53	2.35	2.23	2.16	2.19	2.26	2.32	2.37	2.31	2.19	22.89
70:	1.94	1.61	1.25	0.90	0.61	0.37	0.22	0.12	0.06	0.04	7.11
71:	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.11
72:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
73:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
74:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
75:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
76:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
77:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
78:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
79:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03
80:	0.00	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.06
81:	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.06
82:	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.07

dB:	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	%
83:	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.08
84:	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.06
85:	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
86:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
87:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
88:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
89:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
90:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
91:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
92:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
93:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
94:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Exceedance Chart

N3D - 24hrs: Exceedance Chart



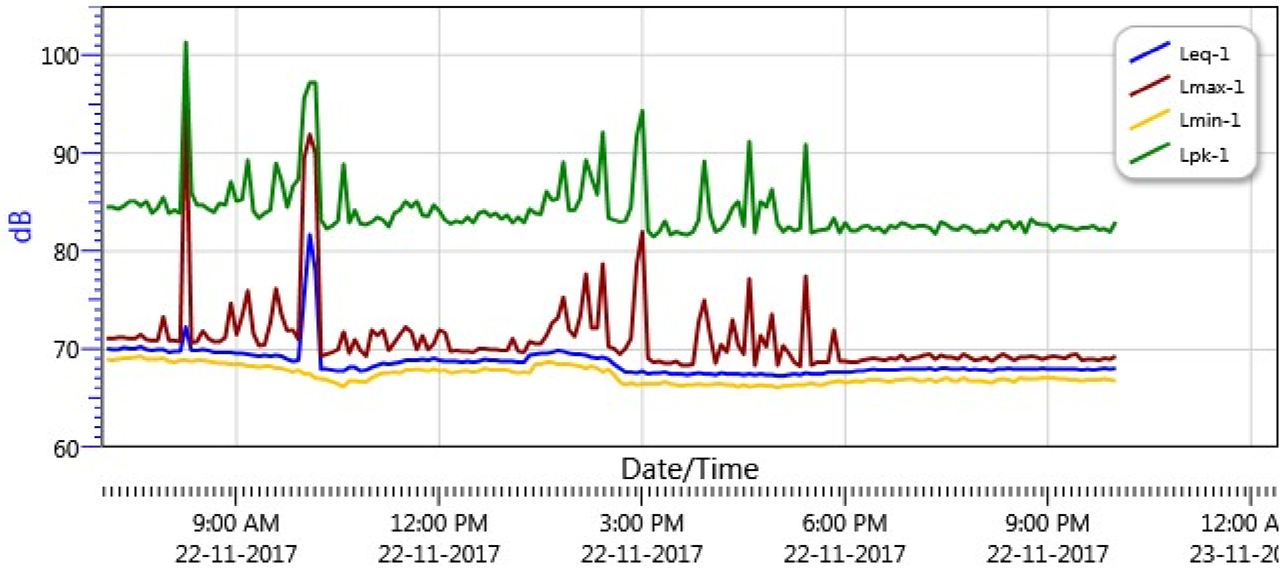
Exceedance Table

.	0%	1%	2%	3%	4%	5%	6%	%7	%8	%9
0%:		70.5	70.3	70.2	70.1	70.0	69.9	69.9	69.8	69.8
10%:	69.8	69.7	69.7	69.6	69.6	69.5	69.5	69.5	69.4	69.4
20%:	69.3	69.3	69.2	69.2	69.1	69.1	69.0	69.0	69.0	68.9
30%:	68.9	68.8	68.8	68.8	68.7	68.7	68.7	68.6	68.6	68.5

.	0%	1%	2%	3%	4%	5%	6%	%7	%8	%9
40%:	68.5	68.5	68.4	68.4	68.4	68.3	68.3	68.2	68.2	68.2
50%:	68.1	68.1	68.1	68.1	68.0	68.0	68.0	68.0	67.9	67.9
60%:	67.9	67.9	67.9	67.9	67.8	67.8	67.8	67.8	67.8	67.8
70%:	67.7	67.7	67.7	67.7	67.7	67.6	67.6	67.6	67.6	67.6
80%:	67.6	67.5	67.5	67.5	67.5	67.4	67.4	67.4	67.4	67.4
90%:	67.3	67.3	67.3	67.2	67.2	67.2	67.1	67.1	67.0	66.9
100%:	66.0									

Logged Data Chart

N3D - 24hrs: Logged Data Chart



Logged Data Table

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
22-Nov-17 7:05:00 AM	70.1	71.1	69	84.5
7:10:00 AM	70	71.1	68.9	84.5
7:15:00 AM	70	71.2	69	84.3
7:20:00 AM	70.2	71.2	69.1	84.6
7:25:00 AM	70.1	71.1	69.1	85.1
7:30:00 AM	70.1	71.1	69.2	85.1
7:35:00 AM	70.3	71.5	69.3	84.6
7:40:00 AM	70	71	69	85.1
7:45:00 AM	69.9	70.9	69	83.9
7:50:00 AM	70	70.9	69	84.4
7:55:00 AM	70	73.3	69.1	85.5
8:00:00 AM	69.7	70.9	68.8	83.9
8:05:00 AM	69.8	70.9	68.7	84.2

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
8:10:00 AM	69.8	70.8	68.9	83.9
8:15:00 AM	72.3	94.9	68.9	101.3
8:20:00 AM	69.9	70.7	68.8	86
8:25:00 AM	69.9	70.8	68.9	84.7
8:30:00 AM	70	71.9	68.9	84.7
8:35:00 AM	69.9	71.1	68.8	84.3
8:40:00 AM	69.7	70.8	68.7	84
8:45:00 AM	69.7	70.8	68.6	84.9
8:50:00 AM	69.7	71.2	68.6	84.7
8:55:00 AM	69.7	74.7	68.5	87.1
9:00:00 AM	69.6	71.5	68.5	85.1
9:05:00 AM	69.6	73.4	68.5	85.3
9:10:00 AM	69.5	76	68.3	89.3
9:15:00 AM	69.4	71.6	68.3	84.1
9:20:00 AM	69.3	70.4	68.2	83.4
9:25:00 AM	69.4	70.5	68.3	83.9
9:30:00 AM	69.3	72.7	68.3	84.2
9:35:00 AM	69.4	76.2	68.1	89
9:40:00 AM	69.3	73.5	68.1	87.2
9:45:00 AM	69	71.9	67.9	84.5
9:50:00 AM	68.8	72	67.7	86.6
9:55:00 AM	68.9	71	67.9	87.4
10:00:00 AM	75.5	89.5	67.5	95.6
10:05:00 AM	81.7	91.9	67.5	97.2
10:10:00 AM	78	90	67.1	97.2
10:15:00 AM	68	69.3	67	83.2
10:20:00 AM	68	69.5	66.9	82.3
10:25:00 AM	67.9	69.7	66.7	82.6
10:30:00 AM	67.8	70	66.5	83.1
10:35:00 AM	67.8	71.8	66.2	88.9
10:40:00 AM	68.2	69.6	66.8	82.9
10:45:00 AM	68.2	71	66.8	84.2
10:50:00 AM	67.8	69.9	66.7	82.8
10:55:00 AM	67.9	69.3	66.7	82.7
11:00:00 AM	68.2	72	67.1	83
11:05:00 AM	68.4	71.4	67.4	83.5
11:10:00 AM	68.6	72	67.6	83.2
11:15:00 AM	68.5	69.9	67.6	82.5
11:20:00 AM	68.6	70.7	67.7	83.9

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
11:25:00 AM	68.7	71.5	67.6	84.2
11:30:00 AM	68.9	72.3	67.9	85.1
11:35:00 AM	68.9	71.8	67.9	84.5
11:40:00 AM	68.9	70	68	85.1
11:45:00 AM	69	71.4	67.9	83.7
11:50:00 AM	68.9	70	67.8	83.6
11:55:00 AM	69.1	70.6	68	84.7
12:00:00 PM	68.9	72	67.8	84.1
12:05:00 PM	68.8	71.7	67.9	83.2
12:10:00 PM	68.8	69.8	67.6	82.8
12:15:00 PM	68.8	69.9	67.7	83.1
12:20:00 PM	68.7	69.8	67.8	82.9
12:25:00 PM	68.8	69.8	67.8	83.5
12:30:00 PM	68.7	69.7	67.7	82.9
12:35:00 PM	68.8	70.1	67.8	83.9
12:40:00 PM	69	70.1	68.1	84.1
12:45:00 PM	68.9	70	67.9	83.6
12:50:00 PM	68.9	70	67.9	83.9
12:55:00 PM	68.8	69.9	67.9	83.3
1:00:00 PM	68.8	69.9	67.9	83.7
1:05:00 PM	68.8	71.1	67.7	82.9
1:10:00 PM	68.7	69.8	67.6	83.5
1:15:00 PM	68.7	69.7	67.7	82.9
1:20:00 PM	69.4	70.8	67.6	84.3
1:25:00 PM	69.5	70.6	68.5	83.9
1:30:00 PM	69.6	70.6	68.5	83.8
1:35:00 PM	69.6	71.4	68.7	86.1
1:40:00 PM	69.7	72.7	68.7	85.2
1:45:00 PM	69.9	73.2	68.5	85.4
1:50:00 PM	69.8	75.3	68.5	89.1
1:55:00 PM	69.6	72	68.5	84.2
2:00:00 PM	69.5	71.3	68.4	84.2
2:05:00 PM	69.5	73.4	68.3	85.4
2:10:00 PM	69.4	77.7	68.1	89.3
2:15:00 PM	69.2	72.2	68.3	87.5
2:20:00 PM	69.1	72.2	68.1	85.8
2:25:00 PM	69.2	78.7	67.7	92.1
2:30:00 PM	69	70.3	68	83.4
2:35:00 PM	68.5	70.1	67.4	83.2

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
2:40:00 PM	68.1	69.5	66.7	83
2:45:00 PM	67.7	70.1	66.4	83.1
2:50:00 PM	67.7	71.1	66.6	84.5
2:55:00 PM	67.6	78.6	66.4	91.7
3:00:00 PM	67.8	82	66.5	94.3
3:05:00 PM	67.5	69.1	66.5	82.1
3:10:00 PM	67.6	68.7	66.5	81.5
3:15:00 PM	67.6	68.8	66.5	82
3:20:00 PM	67.7	68.6	66.7	83.1
3:25:00 PM	67.5	68.6	66.5	81.7
3:30:00 PM	67.5	68.8	66.4	82
3:35:00 PM	67.5	68.4	66.3	81.8
3:40:00 PM	67.4	68.4	66.4	81.7
3:45:00 PM	67.5	68.5	66.4	82
3:50:00 PM	67.6	72.8	66.5	83.2
3:55:00 PM	67.5	75	66.4	89.2
4:00:00 PM	67.5	71.6	66.4	83.8
4:05:00 PM	67.4	68.6	66.5	82
4:10:00 PM	67.6	70.5	66.5	82.3
4:15:00 PM	67.5	69.7	66.4	83.1
4:20:00 PM	67.5	73	66.4	84.4
4:25:00 PM	67.5	70.5	66.2	85.1
4:30:00 PM	67.4	69.5	66.4	82.6
4:35:00 PM	67.5	77.2	66.2	91.2
4:40:00 PM	67.4	68.4	66.3	81.9
4:45:00 PM	67.5	71.4	66.4	85.1
4:50:00 PM	67.4	70.3	66.3	84.5
4:55:00 PM	67.4	73.6	66.3	86.3
5:00:00 PM	67.3	68.4	66.1	82.8
5:05:00 PM	67.3	70.4	66.3	82
5:10:00 PM	67.4	69.6	66.3	82.5
5:15:00 PM	67.5	68.7	66.4	82.1
5:20:00 PM	67.4	68.3	66.4	82.3
5:25:00 PM	67.6	77.5	66.4	90.9
5:30:00 PM	67.5	68.4	66.6	81.9
5:35:00 PM	67.5	68.7	66.4	82.1
5:40:00 PM	67.5	68.7	66.4	82.2
5:45:00 PM	67.7	68.7	66.6	82.3
5:50:00 PM	67.7	72	66.7	83.4

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
5:55:00 PM	67.7	68.8	66.8	81.9
6:00:00 PM	67.7	68.8	66.6	82.9
6:05:00 PM	67.7	68.7	66.7	82.1
6:10:00 PM	67.8	68.7	66.8	82.1
6:15:00 PM	67.8	68.9	66.7	82.5
6:20:00 PM	67.9	69	66.9	82.6
6:25:00 PM	68	69.1	66.9	82.2
6:30:00 PM	67.9	69	66.9	82.4
6:35:00 PM	67.9	68.9	66.8	81.9
6:40:00 PM	67.9	69.1	66.7	82.6
6:45:00 PM	67.9	69	66.9	82.4
6:50:00 PM	68	69.4	66.9	82.9
6:55:00 PM	68	68.9	67	82.7
7:00:00 PM	68	69.1	67	82.4
7:05:00 PM	68	69.2	66.8	82.6
7:10:00 PM	68	69.4	66.8	82.6
7:15:00 PM	68.1	69.5	67	82.4
7:20:00 PM	67.9	69	66.7	81.8
7:25:00 PM	68.1	69.4	66.9	83
7:30:00 PM	68.1	69.2	67.1	82.7
7:35:00 PM	68	69.2	66.8	82.3
7:40:00 PM	68	69	66.8	82.2
7:45:00 PM	68.1	69.5	67.1	82.6
7:50:00 PM	67.9	69.2	66.8	82.4
7:55:00 PM	68	68.9	66.8	81.9
8:00:00 PM	67.9	69	66.8	82.1
8:05:00 PM	67.9	69.2	66.7	82
8:10:00 PM	67.8	68.8	66.6	82.7
8:15:00 PM	68	69.2	66.9	82.2
8:20:00 PM	68	69.5	67	83
8:25:00 PM	68.1	69.2	66.9	83.1
8:30:00 PM	68	68.9	66.7	82.3
8:35:00 PM	68	69.2	67.1	83
8:40:00 PM	68	69.2	67	81.9
8:45:00 PM	68	69.3	67	83.3
8:50:00 PM	68	69.2	67	82.8
8:55:00 PM	68.1	69	67.1	82.7
9:00:00 PM	68	69.2	67.1	82.7
9:05:00 PM	68	69.3	67.1	82.1

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
9:10:00 PM	68	69.2	67	82.6
9:15:00 PM	68	69.1	67	82.5
9:20:00 PM	68	69.4	66.9	82.4
9:25:00 PM	68	69.5	66.9	82.2
9:30:00 PM	67.9	68.9	66.8	82.4
9:35:00 PM	68	69	66.9	82.4
9:40:00 PM	67.9	69	66.9	82.6
9:45:00 PM	68	68.9	66.9	82.2
9:50:00 PM	68.1	69.1	67	82.3
9:55:00 PM	68	69	66.9	82
10:00:00 PM	68.1	69.3	66.8	83

Session Report

23-Nov-17

Information Panel

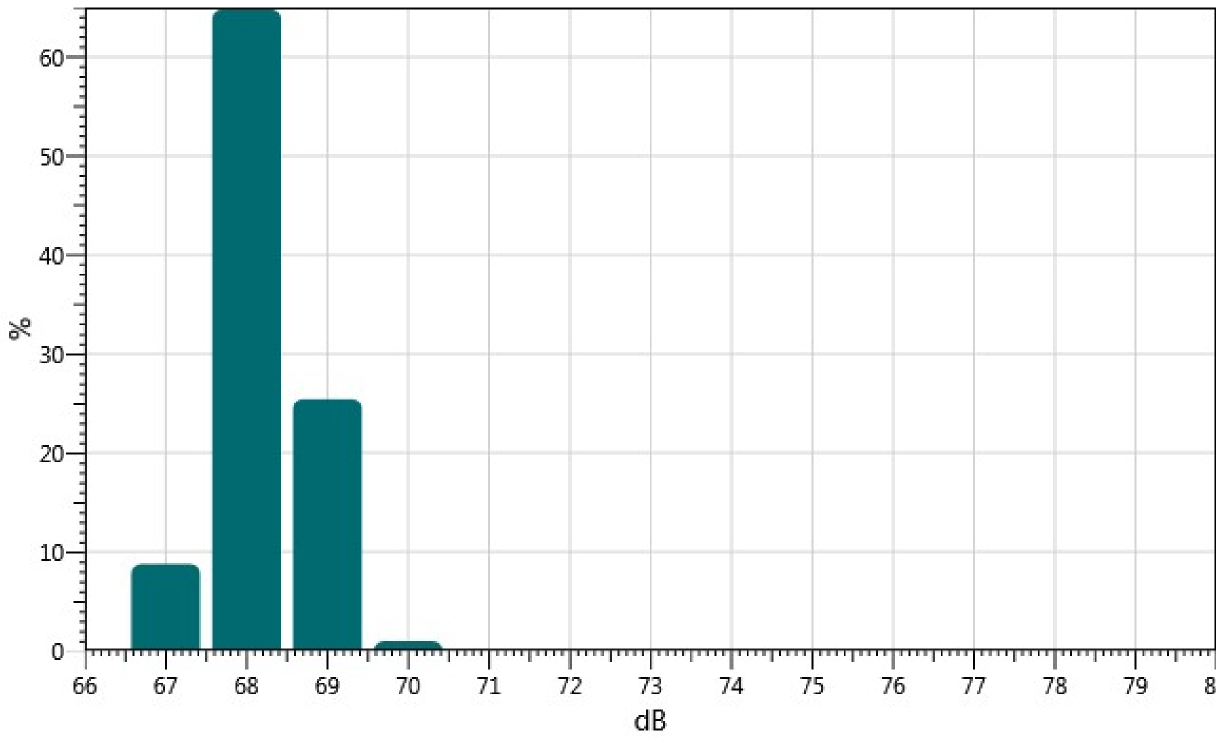
Company Name	Sarawak Energy Berhad
Description	CK/EV103-708/17
Location	N3 (Night Time)
Start Time	22-Nov-17 10:05:01 PM
Stop Time	23-Nov-17 7:05:01 AM
Run Time	09:00:00
Model Type	SoundPro DL
Comments	Nearby plant operation, human activities, vehicles movement, etc.

Summary Data Panel

Description	Meter	Value	Description	Meter	Value
Leq	1	68.6 dB	Lpk	1	88.3 dB
Lmax	1	73.7 dB	Lmin	1	66.6 dB
L10	1	69.2 dB	L90	1	67.9 dB
Mntime	1	23-Nov-17 5:42:18 AM	Mxtime	1	23-Nov-17 2:04:39 AM
Rtime	1	09:00:00	Dose	1	0.8 %
Exchange Rate	1	3 dB	Weighting	1	A
Response	1	FAST	Bandwidth	1	OFF

Statistics Chart

N3N - 24hrs: Statistics Chart

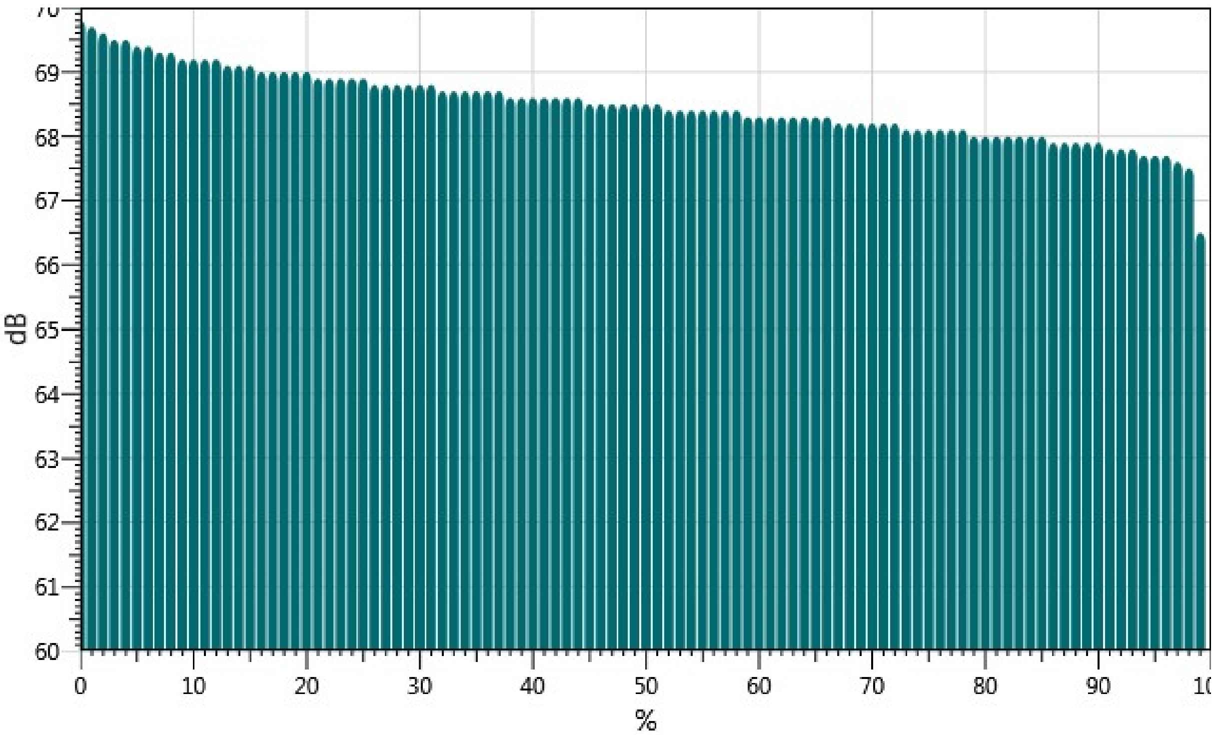


Statistics Table

dB:	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	%
66:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
67:	0.00	0.01	0.02	0.05	0.14	0.33	0.72	1.40	2.40	3.70	8.76
68:	5.17	6.59	5.58	6.63	7.34	7.36	7.26	6.89	6.31	5.69	64.82
69:	5.04	4.40	3.82	3.24	2.63	2.11	1.62	1.19	0.83	0.55	25.43
70:	0.37	0.23	0.15	0.09	0.06	0.03	0.02	0.01	0.01	0.01	0.97
71:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
72:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
73:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Exceedance Chart

N3N - 24hrs: Exceedance Chart

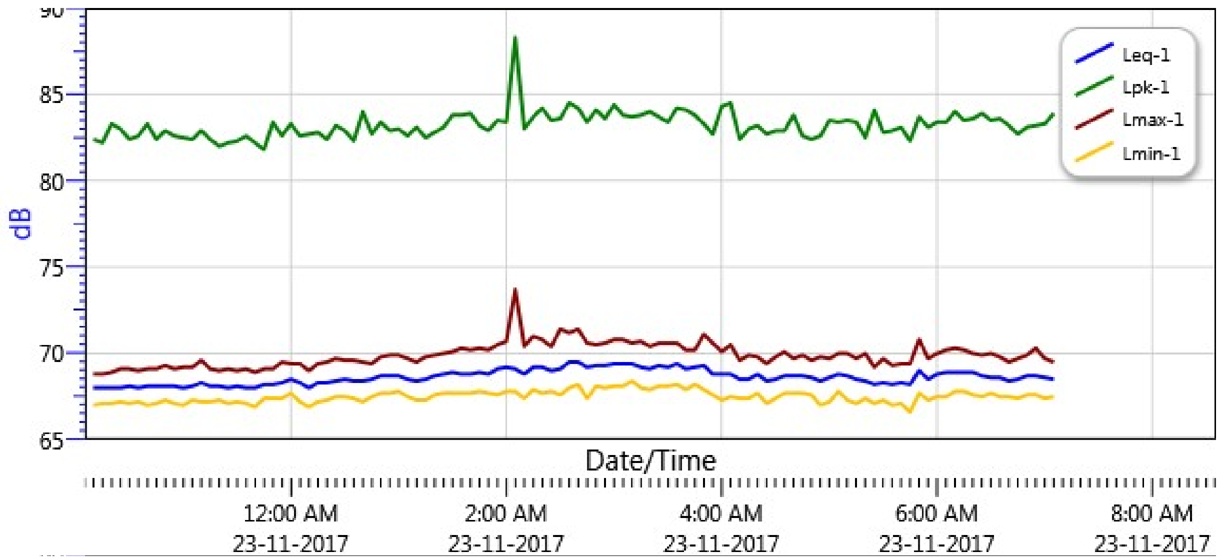


Exceedance Table

.	0%	1%	2%	3%	4%	5%	6%	%7	%8	%9
0%:		69.8	69.7	69.6	69.5	69.5	69.4	69.4	69.3	69.3
10%:	69.2	69.2	69.2	69.2	69.1	69.1	69.1	69.0	69.0	69.0
20%:	69.0	69.0	68.9	68.9	68.9	68.9	68.9	68.8	68.8	68.8
30%:	68.8	68.8	68.8	68.7	68.7	68.7	68.7	68.7	68.7	68.6
40%:	68.6	68.6	68.6	68.6	68.6	68.6	68.5	68.5	68.5	68.5
50%:	68.5	68.5	68.5	68.4	68.4	68.4	68.4	68.4	68.4	68.4
60%:	68.3	68.3	68.3	68.3	68.3	68.3	68.3	68.3	68.2	68.2
70%:	68.2	68.2	68.2	68.2	68.1	68.1	68.1	68.1	68.1	68.1
80%:	68.0	68.0	68.0	68.0	68.0	68.0	68.0	67.9	67.9	67.9
90%:	67.9	67.9	67.8	67.8	67.8	67.7	67.7	67.7	67.6	67.5
100%:	66.5									

Logged Data Chart

N3N - 24hrs: Logged Data Chart



Logged Data Table

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
22-Nov-17 10:10:01 PM	68	68.8	67	82.4
10:15:01 PM	68	68.8	67.1	82.2
10:20:01 PM	68	68.9	67.1	83.3
10:25:01 PM	68	69.1	67.2	83
10:30:01 PM	68.1	69.1	67.1	82.4
10:35:01 PM	68	69	67.2	82.6
10:40:01 PM	68.1	69.1	67	83.3
10:45:01 PM	68.1	69.1	67.1	82.4
10:50:01 PM	68.1	69.3	67.3	82.9
10:55:01 PM	68.1	69.1	67.1	82.6
11:00:01 PM	68	69.2	67	82.5
11:05:01 PM	68.1	69.2	67.3	82.4
11:10:01 PM	68.3	69.6	67.2	82.9
11:15:01 PM	68.1	69.1	67.2	82.4
11:20:01 PM	68.1	69	67.3	82
11:25:01 PM	68	69.1	67.1	82.2
11:30:01 PM	68.1	69	67.2	82.3
11:35:01 PM	68	69.1	67.1	82.6
11:40:01 PM	68	68.9	66.9	82.2
11:45:01 PM	68.2	69.1	67.4	81.8
11:50:01 PM	68.2	69.1	67.4	83.4

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
11:55:01 PM	68.3	69.5	67.4	82.6
23-Nov-17 12:00:01 AM	68.5	69.4	67.7	83.3
12:05:01 AM	68.3	69.4	67.2	82.6
12:10:01 AM	68	69	66.9	82.7
12:15:01 AM	68.3	69.4	67.2	82.8
12:20:01 AM	68.3	69.5	67.3	82.4
12:25:01 AM	68.4	69.7	67.5	83.2
12:30:01 AM	68.5	69.6	67.5	82.9
12:35:01 AM	68.4	69.6	67.4	82.3
12:40:01 AM	68.4	69.5	67.2	84
12:45:01 AM	68.5	69.4	67.5	82.7
12:50:01 AM	68.7	69.8	67.7	83.4
12:55:01 AM	68.7	69.9	67.7	82.9
1:00:01 AM	68.7	69.9	67.8	83
1:05:01 AM	68.5	69.7	67.5	82.6
1:10:01 AM	68.4	69.5	67.3	83.1
1:15:01 AM	68.5	69.8	67.3	82.5
1:20:01 AM	68.7	69.9	67.6	82.8
1:25:01 AM	68.8	70	67.7	83.1
1:30:01 AM	68.9	70.1	67.7	83.8
1:35:01 AM	68.8	70.3	67.7	83.8
1:40:01 AM	68.8	70.2	67.7	83.9
1:45:01 AM	68.9	70.3	67.8	83.2
1:50:01 AM	68.8	70.2	67.7	82.9
1:55:01 AM	69.1	70.5	67.6	83.5
2:00:01 AM	69.2	70.7	67.8	83.4
2:05:01 AM	69.1	73.7	67.8	88.3
2:10:01 AM	68.8	70.4	67.4	83
2:15:01 AM	69.2	71	67.9	83.7
2:20:01 AM	69.2	70.8	67.7	84.2
2:25:01 AM	69	70.4	67.8	83.5
2:30:01 AM	69.1	71.4	67.6	83.6
2:35:01 AM	69.5	71.2	68	84.5
2:40:01 AM	69.5	71.4	68.2	84.2
2:45:01 AM	69.2	70.6	67.4	83.4
2:50:01 AM	69.3	70.5	68.1	84.1
2:55:01 AM	69.3	70.6	68	83.6
3:00:01 AM	69.4	70.8	68.1	84.4
3:05:01 AM	69.4	70.8	68.1	83.8

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
3:10:01 AM	69.4	70.6	68.4	83.7
3:15:01 AM	69.2	70.7	68	83.8
3:20:01 AM	69.1	70.4	67.9	84
3:25:01 AM	69.3	70.6	68.1	83.7
3:30:01 AM	69.2	70.6	68.1	83.4
3:35:01 AM	69.4	70.6	68.2	84.2
3:40:01 AM	69.1	70.2	67.9	84.1
3:45:01 AM	69.2	70.2	68.2	83.8
3:50:01 AM	69.3	71.1	67.9	83.3
3:55:01 AM	68.8	70.6	67.6	82.7
4:00:01 AM	68.8	70.1	67.3	84.3
4:05:01 AM	68.8	70.5	67.5	84.5
4:10:01 AM	68.5	69.6	67.4	82.4
4:15:01 AM	68.5	69.9	67.4	83
4:20:01 AM	68.8	69.8	67.7	83.2
4:25:01 AM	68.4	69.4	67.1	82.7
4:30:01 AM	68.5	69.8	67.4	82.9
4:35:01 AM	68.7	70.1	67.7	82.9
4:40:01 AM	68.7	69.7	67.7	83.8
4:45:01 AM	68.7	69.9	67.7	82.6
4:50:01 AM	68.6	69.6	67.6	82.4
4:55:01 AM	68.4	69.8	67	82.6
5:00:01 AM	68.6	69.7	67.2	83.5
5:05:01 AM	68.8	70	67.8	83.4
5:10:01 AM	68.7	70	67.3	83.5
5:15:01 AM	68.5	69.7	67.1	83.4
5:20:01 AM	68.4	70	67.4	82.5
5:25:01 AM	68.2	69.2	67.1	84.1
5:30:01 AM	68.3	69.7	67.3	82.8
5:35:01 AM	68.2	69.3	67	82.9
5:40:01 AM	68.3	69.4	67.1	83.1
5:45:01 AM	68.2	69.4	66.6	82.3
5:50:01 AM	69	70.8	67.7	83.7
5:55:01 AM	68.5	69.7	67.3	83.1
6:00:01 AM	68.8	70	67.5	83.4
6:05:01 AM	68.9	70.2	67.5	83.4
6:10:01 AM	68.9	70.3	67.8	84
6:15:01 AM	68.9	70.2	67.8	83.5
6:20:01 AM	68.9	70	67.6	83.6

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
6:25:01 AM	68.7	69.9	67.5	83.9
6:30:01 AM	68.6	70	67.7	83.5
6:35:01 AM	68.6	69.8	67.5	83.6
6:40:01 AM	68.4	69.5	67.5	83.2
6:45:01 AM	68.5	69.7	67.4	82.7
6:50:01 AM	68.7	69.9	67.6	83.1
6:55:01 AM	68.7	70.3	67.6	83.2
7:00:01 AM	68.6	69.7	67.4	83.3
7:05:01 AM	68.5	69.5	67.5	83.9

Session Report

21-Nov-17

Information Panel

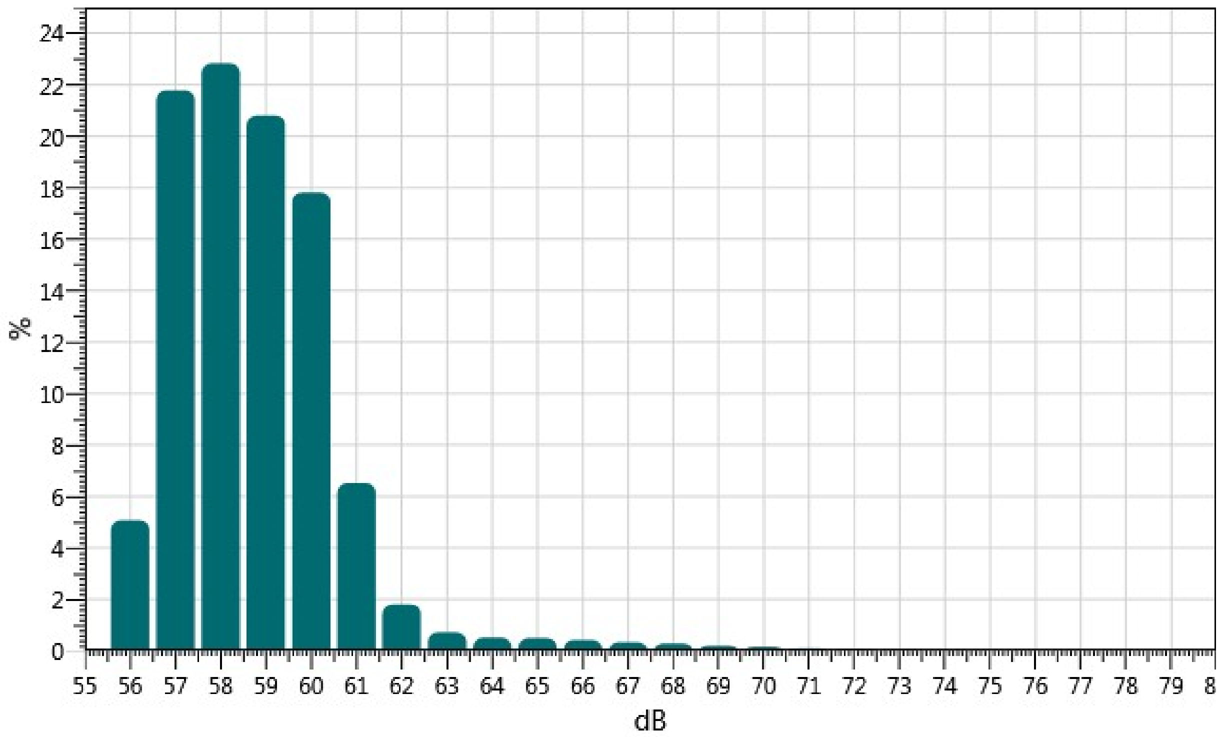
Company Name	Sarawak Energy Berhad
Description	CK/EV103-708/17
Location	N4 (Day Time)
Start Time	21-Nov-17 7:05:01 AM
Stop Time	21-Nov-17 10:05:01 PM
Run Time	15:00:00
Model Type	SoundPro DL
Comments	Nearby plant operation, workers activities, construction activities, insects, etc.

Summary Data Panel

Description	Meter	Value	Description	Meter	Value
Leq	1	59.9 dB	Lpk	1	98.2 dB
Lmax	1	79.8 dB	Lmin	1	55 dB
L10	1	61 dB	L90	1	57.2 dB
Mntime	1	21-Nov-17 12:05:33 PM	Mxtime	1	21-Nov-17 4:41:47 PM
Rtime	1	15:00:00	Dose	1	0.2 %
Exchange Rate	1	3 dB	Weighting	1	A
Response	1	FAST	Bandwidth	1	OFF

Statistics Chart

N4D - 24hrs: Statistics Chart



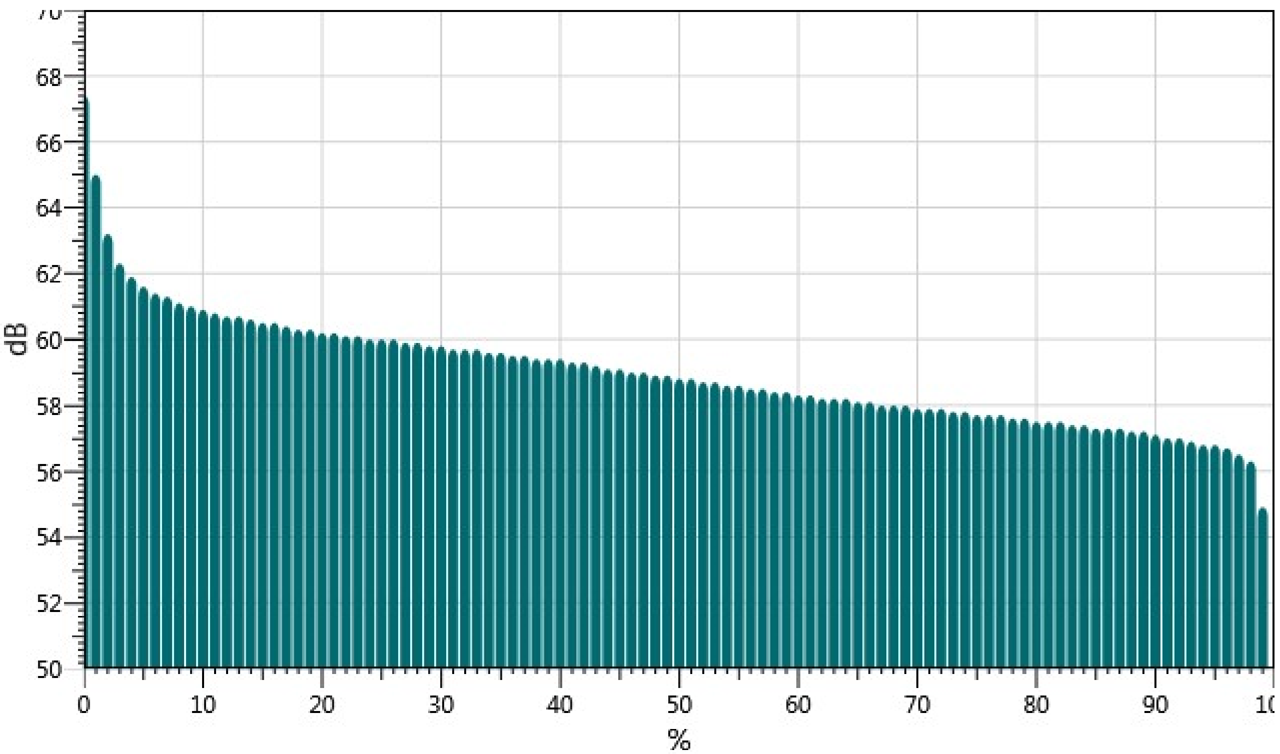
Statistics Table

dB:	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	%
55:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.04	0.08
56:	0.07	0.13	0.13	0.25	0.36	0.49	0.64	0.81	1.00	1.18	5.07
57:	1.40	1.61	1.82	2.01	2.20	2.37	2.48	2.58	2.63	2.68	21.78
58:	2.66	2.61	2.53	2.46	2.35	2.24	2.13	2.03	1.93	1.88	22.83
59:	1.91	2.00	1.36	1.93	2.05	2.17	2.26	2.34	2.41	2.37	20.80
60:	2.35	2.27	2.16	2.01	1.88	1.72	1.58	1.43	1.27	1.14	17.81
61:	1.01	0.90	0.82	0.74	0.67	0.60	0.53	0.47	0.41	0.37	6.52
62:	0.33	0.30	0.17	0.20	0.18	0.15	0.13	0.12	0.11	0.10	1.80
63:	0.09	0.09	0.08	0.08	0.07	0.07	0.06	0.06	0.06	0.06	0.72
64:	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.51
65:	0.05	0.06	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.49
66:	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.42
67:	0.04	0.03	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.33
68:	0.03	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.29
69:	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.20
70:	0.02	0.01	0.02	0.02	0.01	0.02	0.02	0.01	0.01	0.01	0.15
71:	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.10

dB:	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	%
72:	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.05
73:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
74:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
75:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
76:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
77:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
78:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
79:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Exceedance Chart

N4D - 24hrs: Exceedance Chart



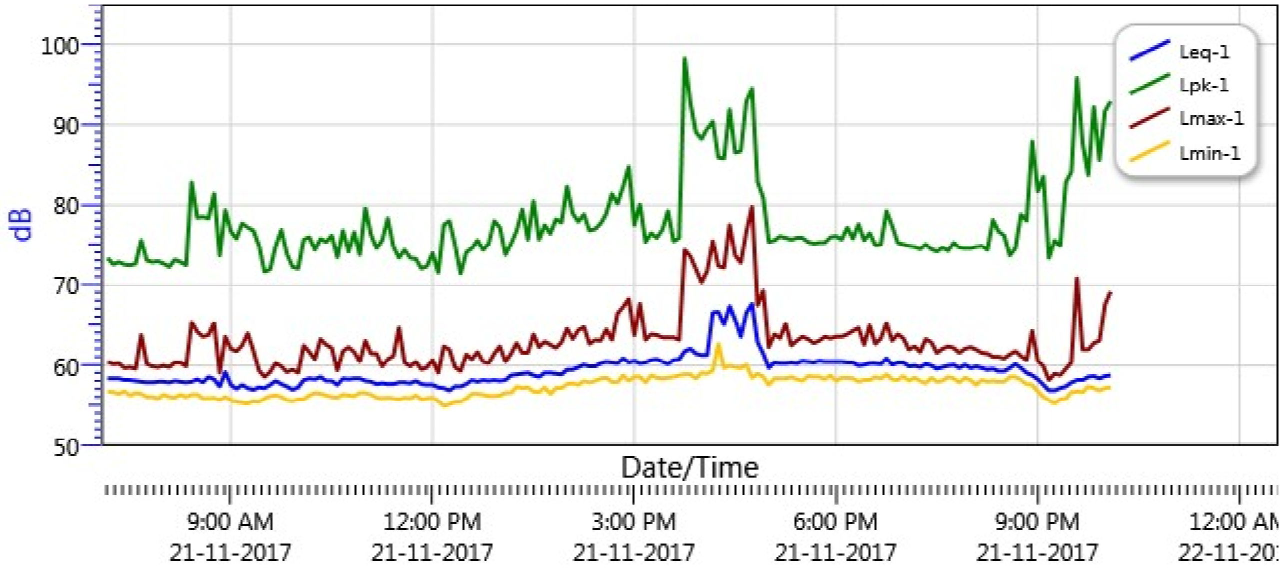
Exceedance Table

.	0%	1%	2%	3%	4%	5%	6%	%7	%8	%9
0%:		67.4	65.0	63.2	62.3	61.9	61.6	61.4	61.3	61.1
10%:	61.0	60.9	60.8	60.7	60.7	60.6	60.5	60.5	60.4	60.3
20%:	60.3	60.2	60.2	60.1	60.1	60.0	60.0	60.0	59.9	59.9
30%:	59.8	59.8	59.7	59.7	59.7	59.6	59.6	59.5	59.5	59.4
40%:	59.4	59.4	59.3	59.3	59.2	59.1	59.1	59.0	59.0	58.9
50%:	58.9	58.8	58.8	58.7	58.7	58.6	58.6	58.5	58.5	58.4
60%:	58.4	58.3	58.3	58.2	58.2	58.2	58.1	58.1	58.0	58.0
70%:	58.0	57.9	57.9	57.9	57.8	57.8	57.7	57.7	57.7	57.6

.	0%	1%	2%	3%	4%	5%	6%	%7	%8	%9
80%:	57.6	57.5	57.5	57.5	57.4	57.4	57.3	57.3	57.3	57.2
90%:	57.2	57.1	57.0	57.0	56.9	56.8	56.8	56.7	56.5	56.3
100%:	54.9									

Logged Data Chart

N4D - 24hrs: Logged Data Chart



Logged Data Table

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
21-Nov-17 7:10:01 AM	58.4	60.5	56.8	73.4
7:15:01 AM	58.4	60.2	56.7	72.6
7:20:01 AM	58.4	60.3	56.5	72.9
7:25:01 AM	58.2	59.7	56.8	72.6
7:30:01 AM	58.2	59.8	56.3	72.5
7:35:01 AM	58.1	59.6	56.6	72.7
7:40:01 AM	58	63.8	56.5	75.6
7:45:01 AM	57.9	60.2	56.1	73.1
7:50:01 AM	57.9	59.9	56.1	72.9
7:55:01 AM	58	59.8	55.9	73
8:00:01 AM	58	60	56.4	72.7
8:05:01 AM	57.9	59.8	56.1	72.3
8:10:01 AM	58.1	60.4	56	73.2
8:15:01 AM	58	60.4	56.4	72.9
8:20:01 AM	57.9	59.9	56.1	72.5
8:25:01 AM	58	65.4	56.4	82.8
8:30:01 AM	58.3	64.2	56.4	78.4

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
8:35:01 AM	57.9	63.6	55.9	78.5
8:40:01 AM	58.6	63.8	55.9	78.3
8:45:01 AM	58.3	65.3	56	81.4
8:50:01 AM	57.4	59.1	55.7	73.7
8:55:01 AM	59.2	63.6	56.1	79.3
9:00:01 AM	57.6	62.1	55.7	76.7
9:05:01 AM	57.1	61.8	55.5	75.8
9:10:01 AM	57.6	62.5	55.4	77.7
9:15:01 AM	57.2	64	55.3	77.2
9:20:01 AM	57	61.9	55.6	76.8
9:25:01 AM	57.3	59.4	55.5	75
9:30:01 AM	57.2	58.6	55.9	71.7
9:35:01 AM	57.6	59.2	56.2	72
9:40:01 AM	58.1	60.3	56.3	74.9
9:45:01 AM	57.7	59.9	56.1	76.9
9:50:01 AM	57.4	59.2	55.7	73.9
9:55:01 AM	57	59.5	55.6	72.3
10:00:01 AM	57.3	59.1	55.8	72.1
10:05:01 AM	58.2	62.5	55.8	75.7
10:10:01 AM	58.4	61.7	56.3	76
10:15:01 AM	58.3	60.8	56.6	74.4
10:20:01 AM	58.6	63.3	56.5	75.8
10:25:01 AM	58.1	62.6	56.3	75.4
10:30:01 AM	58.1	62.2	56.1	76.2
10:35:01 AM	57.6	59.4	56	73.5
10:40:01 AM	58.4	61.8	56.4	76.8
10:45:01 AM	58.3	62.3	56.3	74.2
10:50:01 AM	58.4	61.7	56.2	76.6
10:55:01 AM	58.4	60.5	56.6	73.8
11:00:01 AM	58.1	63.1	56.6	79.6
11:05:01 AM	58	61.5	56.4	76.3
11:10:01 AM	57.7	61.5	56	74.6
11:15:01 AM	57.8	59.9	55.9	75.6
11:20:01 AM	57.7	60.8	56	78.3
11:25:01 AM	57.7	61.2	55.9	74.8
11:30:01 AM	57.9	64.7	55.8	73.4
11:35:01 AM	57.9	60.4	56	74.4
11:40:01 AM	57.8	59.9	55.9	73.4
11:45:01 AM	58.1	60.5	56.3	73.3

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
11:50:01 AM	57.7	59.5	55.8	72.1
11:55:01 AM	57.6	59.8	55.9	72.4
12:00:01 PM	57.6	60.7	56	74
12:05:01 PM	57.3	59.1	55.6	71.6
12:10:01 PM	57.2	62.4	55	77.5
12:15:01 PM	56.9	62	55.2	78
12:20:01 PM	57.4	59.8	55.5	75
12:25:01 PM	57.4	59.3	55.5	71.5
12:30:01 PM	57.7	61.4	55.9	74.1
12:35:01 PM	58.2	60.8	56.5	74.6
12:40:01 PM	58	61.7	56.5	75.6
12:45:01 PM	58.2	60.5	56.4	74.4
12:50:01 PM	58.1	60.3	56.2	75.2
12:55:01 PM	58.2	61.5	56.2	78
1:00:01 PM	58.1	62.4	56.3	77.2
1:05:01 PM	58.2	60.5	56.6	73.8
1:10:01 PM	58.8	61.5	56.6	75.2
1:15:01 PM	58.9	62.8	57.4	76.8
1:20:01 PM	59	61.6	57.2	79.4
1:25:01 PM	59.1	61.6	57.3	75.7
1:30:01 PM	58.8	63.9	56.8	80.5
1:35:01 PM	58.6	62.3	56.7	75.7
1:40:01 PM	59.1	63	57.3	77.5
1:45:01 PM	59.1	62.6	56.5	76.4
1:50:01 PM	59	62.2	57.2	78.2
1:55:01 PM	58.9	62.9	57.2	77.8
2:00:01 PM	59.5	64.6	57.7	82.3
2:05:01 PM	59.5	63.3	57.8	78.9
2:10:01 PM	59.8	64.4	57.6	77.9
2:15:01 PM	60.1	64.8	58.1	78.8
2:20:01 PM	59.9	62.7	57.9	76.8
2:25:01 PM	59.9	63.2	58.1	77
2:30:01 PM	60.3	63.1	58.4	77.7
2:35:01 PM	60.5	64.5	58.5	78.9
2:40:01 PM	60.4	63.2	58	81.4
2:45:01 PM	60.3	66.5	57.9	80.2
2:50:01 PM	60.9	67.3	58.8	82.3
2:55:01 PM	60.4	68.3	58.1	84.8
3:00:01 PM	60.6	63.8	58.6	77.5

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
3:05:01 PM	60.3	67.7	58.6	80.1
3:10:01 PM	60.4	63.2	57.9	75.4
3:15:01 PM	60.7	63.9	58.8	76.5
3:20:01 PM	60.8	63.8	58.5	75.9
3:25:01 PM	60.5	63.5	58.4	76.9
3:30:01 PM	60.2	63.5	58.5	79.2
3:35:01 PM	60.7	63.5	58.6	75.5
3:40:01 PM	60.8	63.2	58.8	75.9
3:45:01 PM	61.8	74.4	58.9	98.2
3:50:01 PM	62.1	73.6	58.9	92.7
3:55:01 PM	61.5	72	58.4	89
4:00:01 PM	61.3	70.4	59.1	88.2
4:05:01 PM	61.3	71.8	59	89.5
4:10:01 PM	66.6	75.5	59.4	90.4
4:15:01 PM	66.7	72.4	62.7	85.9
4:20:01 PM	65.1	72.2	59.7	85.8
4:25:01 PM	67.4	77.5	60	91.9
4:30:01 PM	65.7	73.7	59.8	86.5
4:35:01 PM	63.6	72.8	59.7	86.7
4:40:01 PM	66.6	76.7	60.1	92.9
4:45:01 PM	67.7	79.8	58.5	94.5
4:50:01 PM	62.9	67.5	59	82.9
4:55:01 PM	61.5	69.3	58.6	80.9
5:00:01 PM	59.7	62.3	57.6	75.4
5:05:01 PM	60.4	63.9	58.4	75.6
5:10:01 PM	60.3	63.4	58.4	76.1
5:15:01 PM	60.3	65.2	58.4	75.9
5:20:01 PM	60.4	62.5	58.6	75.7
5:25:01 PM	60.3	63.1	58.3	75.9
5:30:01 PM	60.6	63.6	58.1	75.9
5:35:01 PM	60.5	63.3	58.7	75.4
5:40:01 PM	60.4	62.8	58.6	75.2
5:45:01 PM	60.6	63.1	58.6	75.3
5:50:01 PM	60.5	63.6	58.3	75.3
5:55:01 PM	60.5	63.4	58.8	76
6:00:01 PM	60.5	63.6	58.1	76.1
6:05:01 PM	60.5	63.6	58.5	75.7
6:10:01 PM	60.4	63.9	58.5	77.2
6:15:01 PM	60.4	64.3	58.4	75.8

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
6:20:01 PM	60	64.7	58	77.6
6:25:01 PM	60.1	62.6	58.2	75.6
6:30:01 PM	60.3	65	58.2	76.5
6:35:01 PM	60.3	62.7	58.6	75
6:40:01 PM	60.2	63.4	58.4	75.1
6:45:01 PM	60.9	65.3	58.9	79.2
6:50:01 PM	60.1	63.1	58.3	77.4
6:55:01 PM	60.4	63.9	58.2	75.3
7:00:01 PM	60.4	63.4	58.7	75.1
7:05:01 PM	59.9	62	58.1	74.9
7:10:01 PM	60	62.4	58.5	74.8
7:15:01 PM	59.8	61.7	58.1	74.5
7:20:01 PM	60.2	63.3	57.8	75.1
7:25:01 PM	60	62.9	58.5	74.5
7:30:01 PM	59.6	61.6	58	74.2
7:35:01 PM	59.8	62.1	58.1	74.7
7:40:01 PM	60	62.4	58.6	74.3
7:45:01 PM	60.1	62.2	58.4	75.3
7:50:01 PM	59.7	61.6	57.9	74.7
7:55:01 PM	60.1	62.1	58.5	74.6
8:00:01 PM	59.7	62.3	58.2	74.6
8:05:01 PM	59.9	62	57.6	74.8
8:10:01 PM	59.7	61.6	58.2	74.9
8:15:01 PM	59.5	61.5	58	74.4
8:20:01 PM	59.6	61.1	58.1	78.1
8:25:01 PM	59.3	61.1	58	76.7
8:30:01 PM	59.3	60.9	58	76.2
8:35:01 PM	59.7	61.4	58.6	73.7
8:40:01 PM	60.2	61.8	58.6	74.6
8:45:01 PM	59.7	61.2	58.2	78.8
8:50:01 PM	59.1	60.7	57.7	78
8:55:01 PM	58.8	64.3	57.6	87.9
9:00:01 PM	58.3	60.6	56.8	81.7
9:05:01 PM	57.6	59.9	56.1	83.5
9:10:01 PM	56.9	58.2	55.7	73.4
9:15:01 PM	56.9	59	55.3	75.6
9:20:01 PM	57.2	58.8	55.8	74.9
9:25:01 PM	57.4	59.6	55.9	82.8
9:30:01 PM	57.9	60.4	56.7	84.1

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
9:35:01 PM	58.2	70.9	56.8	95.8
9:40:01 PM	58.2	62	56.7	87.7
9:45:01 PM	58.6	62	57.4	83.7
9:50:01 PM	58.7	62.8	57.2	92.2
9:55:01 PM	58.4	63.1	56.9	85.6
10:00:01 PM	58.7	67.6	57.2	91.7
10:05:01 PM	58.8	69.2	57.3	92.9

Session Report

21-Nov-17

Information Panel

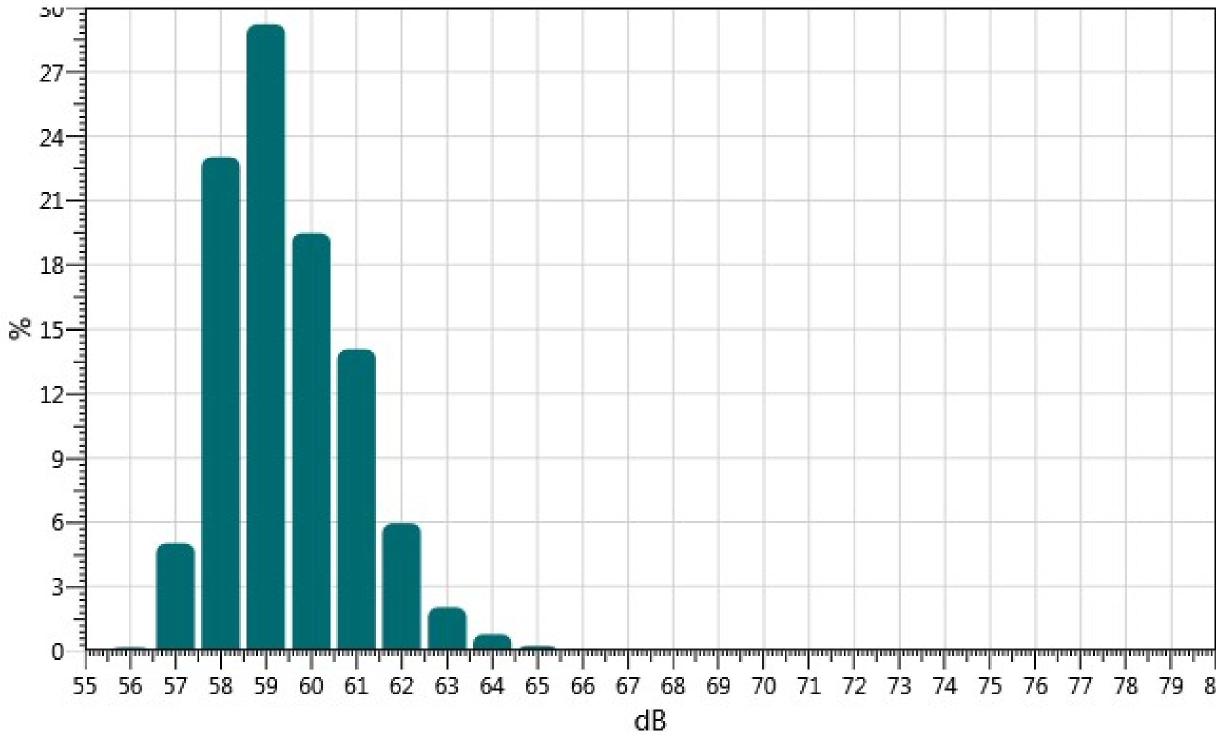
Company Name	Sarawak Energy Berhad
Description	CK/EV103-708/17
Location	N4 (Night Time)
Start Time	20-Nov-17 10:00:00 PM
Stop Time	21-Nov-17 7:00:00 AM
Run Time	09:00:00
Model Type	SoundPro DL
Comments	Nearby plant operation, workers activities, construction activities, insects, etc.

Summary Data Panel

Description	Meter	Value	Description	Meter	Value
Leq	1	60.1 dB	Lpk	1	101.9 dB
Lmax	1	75.2 dB	Lmin	1	55.9 dB
L10	1	61.8 dB	L90	1	58.1 dB
Mntime	1	20-Nov-17 11:43:57 PM	Mxtime	1	21-Nov-17 1:09:40 AM
Rtime	1	09:00:00	Dose	1	0.1 %
Exchange Rate	1	3 dB	Weighting	1	A
Response	1	FAST	Bandwidth	1	OFF

Statistics Chart

N4N - 24hrs: Statistics Chart



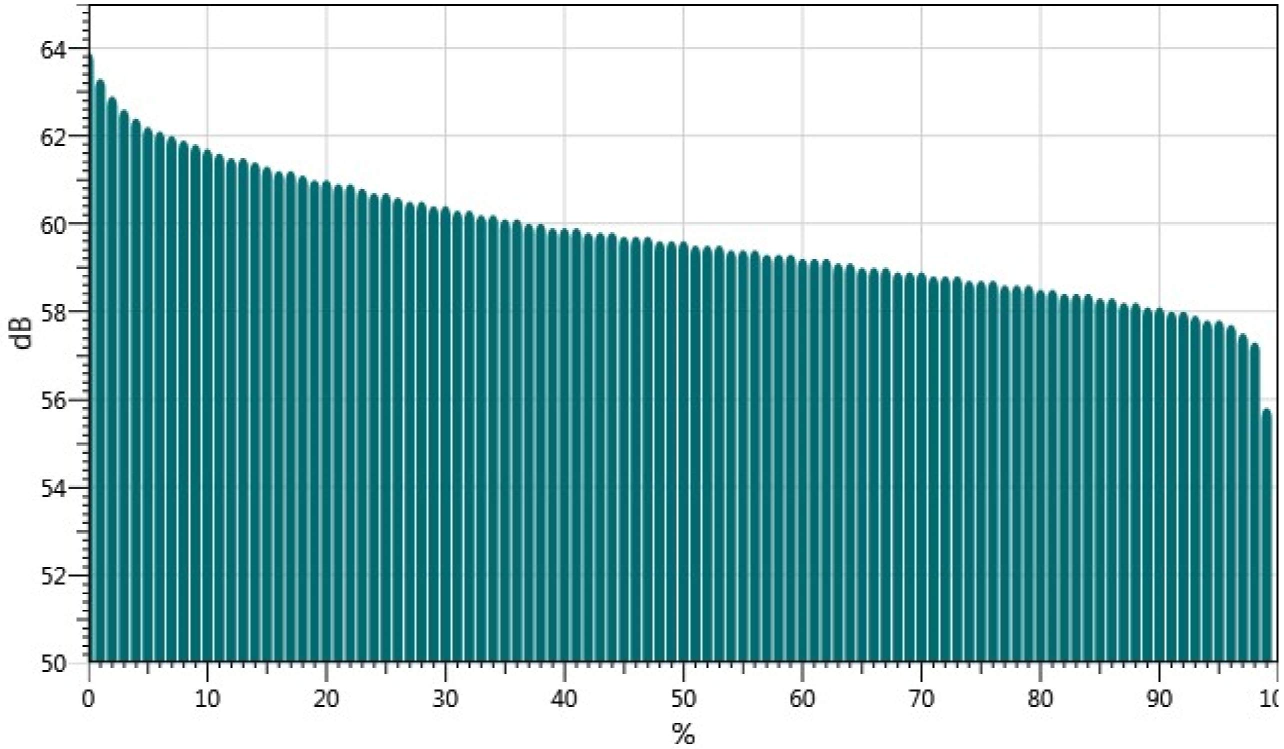
Statistics Table

dB:	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	%
55:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
56:	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.04	0.05	0.15
57:	0.08	0.11	0.16	0.23	0.33	0.45	0.60	0.79	1.01	1.24	5.01
58:	1.48	1.74	1.97	2.17	2.36	2.49	2.58	2.67	2.75	2.82	23.02
59:	2.99	3.21	2.17	2.97	3.05	3.07	3.04	2.99	2.92	2.81	29.21
60:	2.63	2.45	2.25	2.05	1.89	1.76	1.66	1.62	1.58	1.58	19.48
61:	1.57	1.56	1.56	1.51	1.46	1.43	1.36	1.28	1.22	1.11	14.06
62:	1.02	0.92	0.57	0.67	0.60	0.53	0.48	0.42	0.39	0.35	5.94
63:	0.31	0.27	0.25	0.22	0.20	0.18	0.17	0.15	0.14	0.12	2.01
64:	0.11	0.11	0.10	0.08	0.08	0.07	0.06	0.06	0.06	0.04	0.78
65:	0.04	0.03	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.23
66:	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.07
67:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
68:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
69:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
70:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
71:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

dB:	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	%
72:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
73:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
74:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
75:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Exceedance Chart

N4N - 24hrs: Exceedance Chart

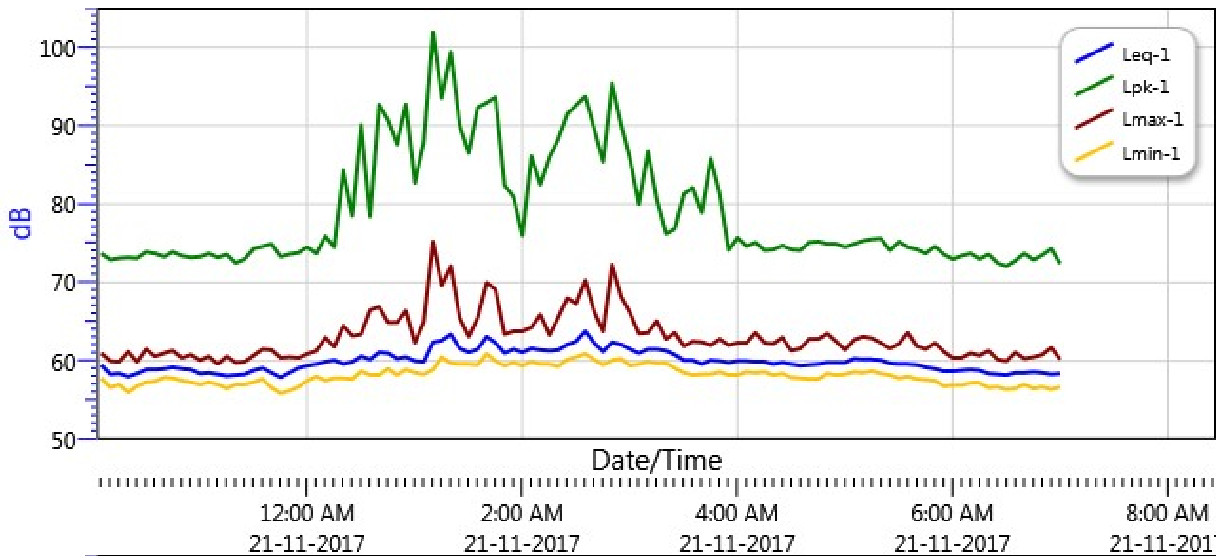


Exceedance Table

.	0%	1%	2%	3%	4%	5%	6%	%7	%8	%9
0%:		63.9	63.3	62.9	62.6	62.4	62.2	62.1	62.0	61.9
10%:	61.8	61.7	61.6	61.5	61.5	61.4	61.3	61.2	61.2	61.1
20%:	61.0	61.0	60.9	60.9	60.8	60.7	60.7	60.6	60.5	60.5
30%:	60.4	60.4	60.3	60.3	60.2	60.2	60.1	60.1	60.0	60.0
40%:	59.9	59.9	59.9	59.8	59.8	59.8	59.7	59.7	59.7	59.6
50%:	59.6	59.6	59.5	59.5	59.5	59.4	59.4	59.4	59.3	59.3
60%:	59.3	59.2	59.2	59.2	59.1	59.1	59.0	59.0	59.0	58.9
70%:	58.9	58.9	58.8	58.8	58.8	58.7	58.7	58.7	58.6	58.6
80%:	58.6	58.5	58.5	58.4	58.4	58.4	58.3	58.3	58.2	58.2
90%:	58.1	58.1	58.0	58.0	57.9	57.8	57.8	57.7	57.5	57.3
100%:	55.8									

Logged Data Chart

N4N - 24hrs: Logged Data Chart



Logged Data Table

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
20-Nov-17 10:05:00 PM	59.5	61	57.8	73.7
10:10:00 PM	58.3	60	56.6	72.9
10:15:00 PM	58.4	59.9	57	73.1
10:20:00 PM	58	61.2	56	73.2
10:25:00 PM	58.4	59.9	56.8	73.1
10:30:00 PM	58.9	61.5	57.3	73.9
10:35:00 PM	58.9	60.6	57.4	73.7
10:40:00 PM	59	61	57.9	73.3
10:45:00 PM	59.2	61.3	57.8	73.9
10:50:00 PM	59	60.4	57.5	73.4
10:55:00 PM	58.9	60.8	57.3	73.2
11:00:00 PM	58.4	60.1	57	73.3
11:05:00 PM	58.5	60.6	57.3	73.7
11:10:00 PM	58.3	59.6	57	73.2
11:15:00 PM	58.1	60.6	56.5	73.6
11:20:00 PM	58.2	59.8	57	72.5
11:25:00 PM	58.3	59.9	57	73
11:30:00 PM	58.8	60.7	57.3	74.3
11:35:00 PM	59.1	61.5	57.7	74.6
11:40:00 PM	58.5	61.4	56.6	74.9
11:45:00 PM	57.9	60.4	55.9	73.3

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
11:50:00 PM	58.5	60.5	56.2	73.6
11:55:00 PM	59.1	60.4	56.7	73.8
21-Nov-17 12:00:00 AM	59.4	60.9	57.5	74.5
12:05:00 AM	59.6	61.3	58	73.7
12:10:00 AM	59.9	63	57.5	75.9
12:15:00 AM	60.1	61.8	57.8	74.5
12:20:00 AM	59.6	64.5	57.8	84.3
12:25:00 AM	59.9	63.2	57.7	78.5
12:30:00 AM	60.6	63.4	58.7	90.1
12:35:00 AM	60.2	66.5	58.2	78.4
12:40:00 AM	61.1	66.9	58.2	92.7
12:45:00 AM	61	64.9	59	90.7
12:50:00 AM	60.3	64.9	58.2	87.6
12:55:00 AM	60.5	66.4	58.9	92.7
1:00:00 AM	60	62.3	58.5	82.7
1:05:00 AM	59.9	65	58.3	87.9
1:10:00 AM	62.4	75.2	58.9	101.9
1:15:00 AM	62.6	69.6	60.5	93.5
1:20:00 AM	63.4	72.1	59.7	99.4
1:25:00 AM	61.6	65.5	59.6	90
1:30:00 AM	61.1	63.1	59.6	86.5
1:35:00 AM	61.5	65.5	59.5	92.3
1:40:00 AM	63.1	70	60.9	92.9
1:45:00 AM	62.3	69.1	60	93.6
1:50:00 AM	61	63.4	59.4	82.4
1:55:00 AM	61.5	63.8	59.8	80.9
2:00:00 AM	61.1	63.8	59.4	76
2:05:00 AM	61.6	64.3	59.9	86.1
2:10:00 AM	61.4	65.9	59.6	82.5
2:15:00 AM	61.3	63.3	59.6	86
2:20:00 AM	61.4	65.6	59.3	88.3
2:25:00 AM	62.1	68	60.2	91.5
2:30:00 AM	62.5	67.3	60.5	92.6
2:35:00 AM	63.8	70.3	60.9	93.7
2:40:00 AM	62.3	66.3	60.2	89.6
2:45:00 AM	61.2	63.8	59.5	85.4
2:50:00 AM	62.4	72.3	60.1	95.4
2:55:00 AM	62.1	68.2	60.3	90.1
3:00:00 AM	61.5	66.1	59.4	85.7

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
3:05:00 AM	61	63.5	59.6	80
3:10:00 AM	61.5	63.6	59.9	86.7
3:15:00 AM	61.5	65.1	59.7	80.6
3:20:00 AM	61.3	62.8	59.7	76.2
3:25:00 AM	60.8	63.6	59.1	76.8
3:30:00 AM	60.1	61.9	58.5	81.3
3:35:00 AM	60.1	62.5	58.2	82.1
3:40:00 AM	59.6	62.4	58.3	78.9
3:45:00 AM	60.1	62	58.3	85.8
3:50:00 AM	60	62.8	58.6	81.3
3:55:00 AM	59.8	62	58.2	74.1
4:00:00 AM	60	62.3	58.2	75.7
4:05:00 AM	60	62.3	58.6	74.6
4:10:00 AM	59.9	63.6	58.5	75.1
4:15:00 AM	59.9	62.3	58.6	74.1
4:20:00 AM	59.6	62.2	58.2	74.2
4:25:00 AM	59.8	63	58.4	74.7
4:30:00 AM	59.6	61.3	57.9	74.2
4:35:00 AM	59.4	61.6	57.8	74.1
4:40:00 AM	59.5	62.8	57.7	75.1
4:45:00 AM	59.6	62.8	57.7	75.2
4:50:00 AM	59.8	63.5	58.4	74.9
4:55:00 AM	59.8	62.5	58.2	74.9
5:00:00 AM	59.8	61.4	58.3	74.5
5:05:00 AM	60.3	62.7	58.6	74.9
5:10:00 AM	60.2	63.1	58.5	75.3
5:15:00 AM	60.2	62.9	58.7	75.5
5:20:00 AM	60.1	62.3	58.4	75.6
5:25:00 AM	59.7	61.6	58.2	74.1
5:30:00 AM	59.6	62.2	57.8	75.2
5:35:00 AM	59.6	63.6	58	74.5
5:40:00 AM	59.5	61.9	57.7	74.2
5:45:00 AM	59.2	61.5	57.6	73.7
5:50:00 AM	59	62.3	57.5	74.6
5:55:00 AM	58.7	61.2	56.8	73.6
6:00:00 AM	58.7	60.4	56.9	73
6:05:00 AM	58.8	60.4	56.9	73.4
6:10:00 AM	58.9	61	57.2	73.7
6:15:00 AM	58.8	60.7	57.2	73

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
6:20:00 AM	58.4	61.3	56.6	73.6
6:25:00 AM	58.3	60.2	56.7	72.5
6:30:00 AM	58.2	60	56.4	72.1
6:35:00 AM	58.5	61.1	56.5	72.8
6:40:00 AM	58.5	60.3	57	73.7
6:45:00 AM	58.6	60.5	56.5	72.9
6:50:00 AM	58.5	60.8	56.7	73.5
6:55:00 AM	58.3	61.7	56.4	74.3
7:00:00 AM	58.4	60.2	56.7	72.4

Session Report

Information Panel

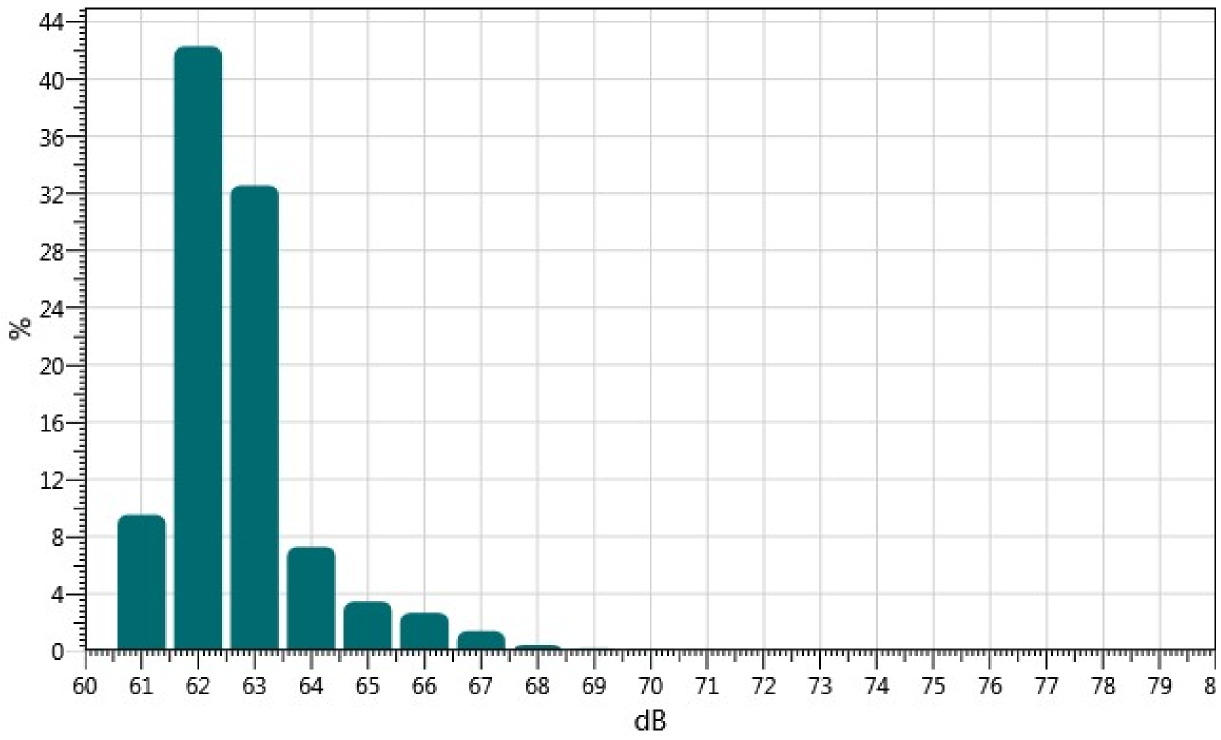
Company Name	Sarawak Energy Berhad
Description	CK/EV103-708/17
Location	N5 (Day Time)
Start Time	01-Feb-18 7:00:00 AM
Stop Time	01-Feb-18 10:00:00 PM
Run Time	15:00:00
Model Type	SoundPro DL
Comments	Site activities, vehicular movement, human activities

Summary Data Panel

Description	Meter	Value	Description	Meter	Value
Leq	1	63.3 dB	Lmax	1	78.1 dB
Lmin	1	60.1 dB	Lpk	1	101.8 dB
L10	1	64.5 dB	L90	1	61.9 dB
Mntime	1	01-Feb-18 9:02:34 AM	Mxtime	1	01-Feb-18 7:01:31 AM
Rtime	1	15:00:00	Dose	1	0.4 %
Exchange Rate	1	3 dB	Weighting	1	A
Response	1	FAST	Bandwidth	1	OFF

Statistics Chart

N5D - 24hrs: Statistics Chart



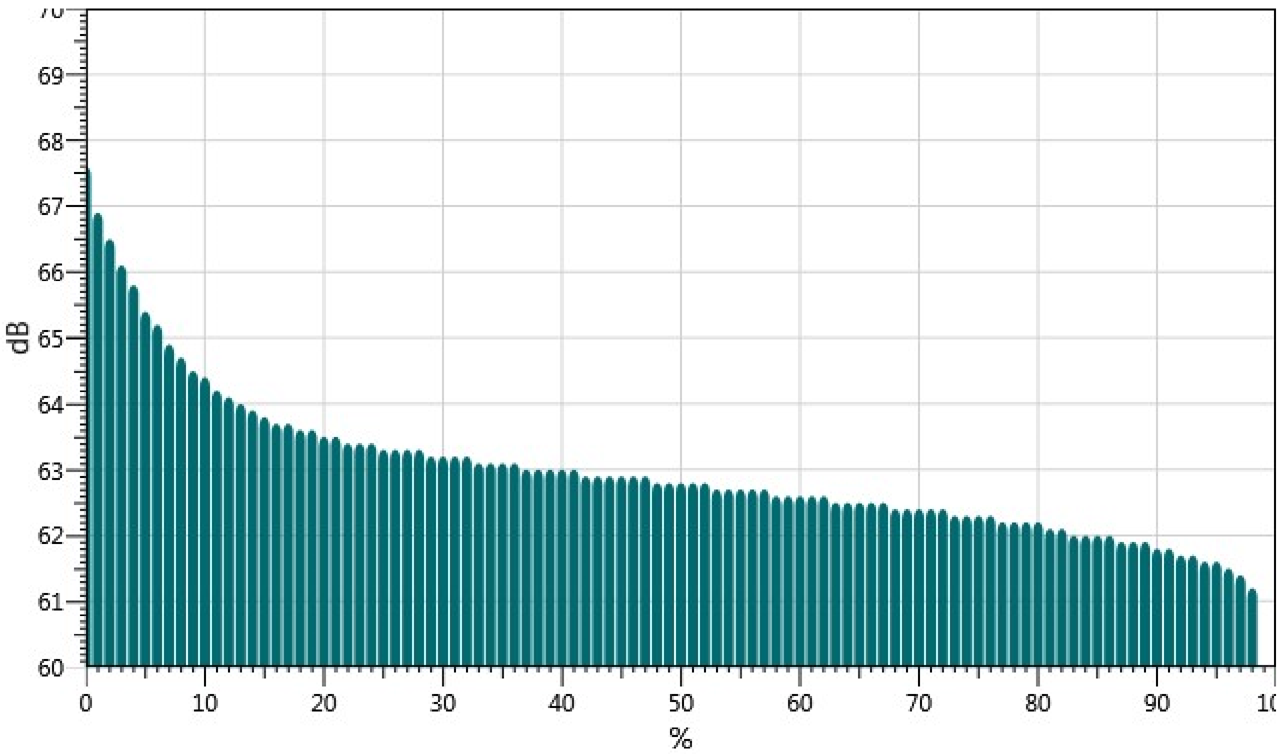
Statistics Table

dB:	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	%
60:	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.04	0.06	0.13
61:	0.10	0.17	0.28	0.42	0.62	0.87	1.18	1.53	1.95	2.41	9.52
62:	2.89	3.47	2.63	3.83	4.21	4.58	4.89	5.13	5.32	5.34	42.28
63:	5.21	4.94	4.55	4.06	3.50	2.95	2.44	2.00	1.60	1.31	32.55
64:	1.09	0.93	0.82	0.74	0.70	0.66	0.63	0.60	0.57	0.53	7.27
65:	0.49	0.46	0.29	0.36	0.34	0.32	0.31	0.30	0.29	0.29	3.44
66:	0.28	0.28	0.28	0.28	0.27	0.26	0.26	0.26	0.24	0.23	2.65
67:	0.21	0.19	0.17	0.16	0.13	0.12	0.11	0.10	0.09	0.09	1.38
68:	0.07	0.06	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.41
69:	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.16
70:	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.10
71:	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.05
72:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
73:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
74:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
75:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
76:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

dB:	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	%
77:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
78:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Exceedance Chart

N5D - 24hrs: Exceedance Chart

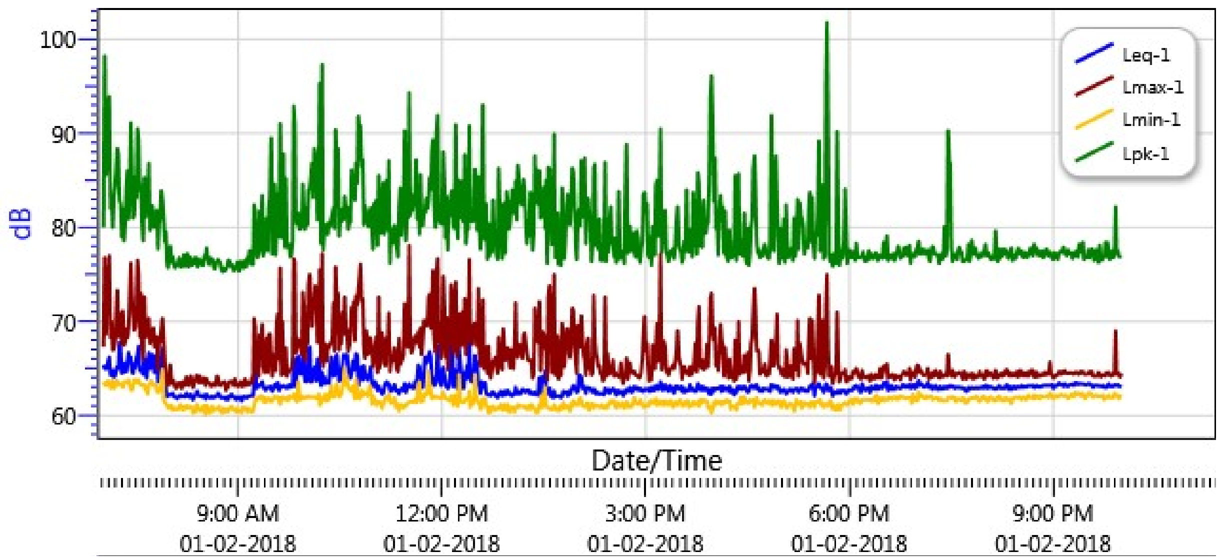


Exceedance Table

.	0%	1%	2%	3%	4%	5%	6%	%7	%8	%9
0%:		67.6	66.9	66.5	66.1	65.8	65.4	65.2	64.9	64.7
10%:	64.5	64.4	64.2	64.1	64.0	63.9	63.8	63.7	63.7	63.6
20%:	63.6	63.5	63.5	63.4	63.4	63.4	63.3	63.3	63.3	63.3
30%:	63.2	63.2	63.2	63.2	63.1	63.1	63.1	63.1	63.0	63.0
40%:	63.0	63.0	63.0	62.9	62.9	62.9	62.9	62.9	62.9	62.8
50%:	62.8	62.8	62.8	62.8	62.7	62.7	62.7	62.7	62.7	62.6
60%:	62.6	62.6	62.6	62.6	62.5	62.5	62.5	62.5	62.5	62.4
70%:	62.4	62.4	62.4	62.4	62.3	62.3	62.3	62.3	62.2	62.2
80%:	62.2	62.2	62.1	62.1	62.0	62.0	62.0	62.0	61.9	61.9
90%:	61.9	61.8	61.8	61.7	61.7	61.6	61.6	61.5	61.4	61.2
100%:	60.0									

Logged Data Chart

N5D - 24hrs: Logged Data Chart



Logged Data Table

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
01-Feb-18 7:01:00 AM	65.4	67.3	63.6	80
7:02:00 AM	65	76.8	63.3	98.2
7:03:00 AM	65	68.7	63.2	85.6
7:04:00 AM	65	73.5	63.6	87.4
7:05:00 AM	65.8	74.2	63.7	92
7:06:00 AM	66.2	77	63.6	93.9
7:07:00 AM	64.3	68.3	62.9	82
7:08:00 AM	64.8	70	63.2	83.4
7:09:00 AM	64.8	67	63.7	80
7:10:00 AM	64.1	67	62.9	83.2
7:11:00 AM	64.2	67.8	63	84.3
7:12:00 AM	64.9	70.4	63.7	85.9
7:13:00 AM	65.2	73.3	63.7	88.4
7:14:00 AM	65	68.4	63.3	87.7
7:15:00 AM	67.8	70.9	63.3	82.9
7:16:00 AM	67.3	70.5	63.4	82.5
7:17:00 AM	64.5	67.6	63.3	79
7:18:00 AM	64.6	71.1	63	82
7:19:00 AM	64.7	67.5	63.6	78.6
7:20:00 AM	65.6	67.9	63.5	80.5
7:21:00 AM	64.7	69.2	63.6	84.1

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
7:22:00 AM	65.5	68.3	63.5	86
7:23:00 AM	66.7	69.3	63.8	80.9
7:24:00 AM	65.8	72.6	63.2	85
7:25:00 AM	66.2	76.2	62.8	91.1
7:26:00 AM	64.8	73.2	62.7	87.3
7:27:00 AM	64.5	71	63.2	81
7:28:00 AM	65.5	69.1	63.8	81.3
7:29:00 AM	65.1	69.4	63.8	85.4
7:30:00 AM	66.1	71.7	63.5	83.2
7:31:00 AM	66.5	76.5	63.5	90.5
7:32:00 AM	67.4	75	63.8	89.3
7:33:00 AM	64.8	68.4	63.3	83.9
7:34:00 AM	64.8	73	63.4	84.5
7:35:00 AM	64.9	67.2	63.2	80.7
7:36:00 AM	64.4	66	63.3	78.6
7:37:00 AM	66	72.6	63.3	85.3
7:38:00 AM	65.2	68.3	62.7	81.1
7:39:00 AM	64	69.1	62.7	82.3
7:40:00 AM	65.7	70	62.3	84
7:41:00 AM	66.7	70.3	63.3	86.8
7:42:00 AM	65	67.7	63.3	79.7
7:43:00 AM	66.1	68.5	63.7	80.1
7:44:00 AM	66.5	68.9	63.5	82.3
7:45:00 AM	65.4	69.3	63.2	81.2
7:46:00 AM	64.6	67.3	63.2	80
7:47:00 AM	66.3	68.4	63.3	80.7
7:48:00 AM	66.5	68.4	62.6	81.8
7:49:00 AM	63.6	64.9	62.5	77.7
7:50:00 AM	64.7	67.9	62.5	80.4
7:51:00 AM	66.2	67.9	63	81.2
7:52:00 AM	66.1	69	62.9	83.9
7:53:00 AM	67.1	70.3	64.9	82.8
7:54:00 AM	64.3	67.9	61.8	81
7:55:00 AM	62.7	65.6	61.4	78.5
7:56:00 AM	63	64.6	61.3	79.5
7:57:00 AM	62	63.4	61.1	76.1
7:58:00 AM	62.1	63.2	60.8	75.7
7:59:00 AM	62.2	63.5	60.8	77
8:00:00 AM	62.3	65.4	61.1	78

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
8:01:00 AM	62.2	63.4	61.1	76.3
8:02:00 AM	62.4	63.8	60.6	76.9
8:03:00 AM	62	63.6	60.7	76.3
8:04:00 AM	62	63.1	60.8	75.7
8:05:00 AM	62	62.9	60.7	76.1
8:06:00 AM	61.8	63	60.6	76
8:07:00 AM	62	63.5	60.7	76.2
8:08:00 AM	62.1	63.4	60.9	76.8
8:09:00 AM	62.2	63.5	61.2	75.8
8:10:00 AM	62	62.9	60.8	75.8
8:11:00 AM	62.1	63.6	60.6	76
8:12:00 AM	62.1	63.3	60.9	77.1
8:13:00 AM	62	63.2	60.7	75.9
8:14:00 AM	62.4	64.1	61.1	76.4
8:15:00 AM	62.2	63.7	60.9	77.2
8:16:00 AM	62	63.2	60.8	75.8
8:17:00 AM	62	63.5	61	76.9
8:18:00 AM	62.3	64.2	60.9	76.3
8:19:00 AM	62	63.7	60.9	76
8:20:00 AM	61.7	63	60.3	76.1
8:21:00 AM	62.1	63.5	60.4	76.8
8:22:00 AM	62.1	63.8	60.4	76.2
8:23:00 AM	62.5	64.3	61.2	76.8
8:24:00 AM	62.6	64.2	61.1	75.8
8:25:00 AM	62.1	63.5	60.8	76.3
8:26:00 AM	62.1	64.2	60.5	76.6
8:27:00 AM	62.1	63.5	60.7	76.2
8:28:00 AM	62	63.5	60.5	76
8:29:00 AM	62.2	63.8	61	76
8:30:00 AM	62.2	64	61.1	77
8:31:00 AM	61.8	63.2	60.1	76.9
8:32:00 AM	62.3	63.9	61.1	77.8
8:33:00 AM	62.1	63.5	60.7	76.6
8:34:00 AM	62	63.5	60.4	76.1
8:35:00 AM	61.9	63.4	60.3	76.8
8:36:00 AM	61.9	63.1	60.8	76.7
8:37:00 AM	62.1	63.4	61	76.6
8:38:00 AM	61.9	63.2	60.5	75.9
8:39:00 AM	62	63.5	60.7	75.6

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
8:40:00 AM	62	63.2	60.7	76.1
8:41:00 AM	62.2	64.2	60.8	76.4
8:42:00 AM	62.4	64.1	60.7	76.6
8:43:00 AM	62.3	63.4	61	76.4
8:44:00 AM	62	63.2	60.6	76.2
8:45:00 AM	61.9	63.3	60.4	75.6
8:46:00 AM	61.9	63.5	60.3	75.3
8:47:00 AM	62	63.5	60.8	75.7
8:48:00 AM	61.9	63.6	60.4	75.4
8:49:00 AM	61.7	62.7	60.6	75.5
8:50:00 AM	62	63.1	60.7	75.8
8:51:00 AM	61.7	63	60.4	76.5
8:52:00 AM	62.1	63.6	60.8	76.5
8:53:00 AM	62.1	63.6	60.7	75.9
8:54:00 AM	62.3	63.6	61	76.1
8:55:00 AM	62	63.6	60.8	75.7
8:56:00 AM	62	63.2	60.6	75.4
8:57:00 AM	61.9	63.9	60.6	75.8
8:58:00 AM	61.7	63.2	60.4	75.9
8:59:00 AM	62	63.4	60.8	76.3
9:00:00 AM	61.9	63.1	60.6	75.4
9:01:00 AM	61.8	63.3	60.5	75.4
9:02:00 AM	62	63.6	60.5	76.4
9:03:00 AM	61.6	63.1	60.3	76.3
9:04:00 AM	62	63.1	60.9	75.7
9:05:00 AM	62.1	63.6	60.7	75.7
9:06:00 AM	62	63.9	60.8	76.5
9:07:00 AM	61.9	63.2	60.8	75.8
9:08:00 AM	61.9	63.6	60.4	76.8
9:09:00 AM	62.1	63.3	60.8	76.5
9:10:00 AM	62.1	63.3	60.6	77.5
9:11:00 AM	62.1	63.4	60.6	76.1
9:12:00 AM	62.2	64	60.4	77.5
9:13:00 AM	62.1	63.7	60.5	76.1
9:14:00 AM	63.5	70.3	61	82.4
9:15:00 AM	66.3	69.5	61.8	81.8
9:16:00 AM	62.9	66.3	61.6	78
9:17:00 AM	63	64.7	61.8	76.8
9:18:00 AM	63.2	64.2	62	77.3

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
9:19:00 AM	63.3	68.6	61.8	81.7
9:20:00 AM	63.2	66	62.1	77.6
9:21:00 AM	63.6	69.7	62.1	83.4
9:22:00 AM	63	65.2	61.5	77
9:23:00 AM	62.9	64.6	61.9	77.7
9:24:00 AM	62.7	65.9	61.4	77.9
9:25:00 AM	63	68.2	61.7	81
9:26:00 AM	62.9	64.6	61.9	77.5
9:27:00 AM	63	68.6	61.6	82.1
9:28:00 AM	63.1	68.7	61.8	83.3
9:29:00 AM	62.9	66.3	61.5	89.5
9:30:00 AM	62.6	64.2	61.6	77.2
9:31:00 AM	62.9	66.5	61.8	82.4
9:32:00 AM	63.3	66.1	62.1	84.6
9:33:00 AM	63	64.8	61.9	77.1
9:34:00 AM	63.4	69.8	61.9	80.8
9:35:00 AM	63.5	70.8	62	83.6
9:36:00 AM	62.7	66	61.6	79
9:37:00 AM	63.1	75.7	61.2	91
9:38:00 AM	63	64.3	62	78.9
9:39:00 AM	63.1	70	61.8	84.8
9:40:00 AM	63.2	65.6	62	87.8
9:41:00 AM	63.1	64.4	61.7	77.9
9:42:00 AM	63	67.2	61.8	85.2
9:43:00 AM	62.9	64.2	61.9	77.9
9:44:00 AM	63	64.7	61.6	77.9
9:45:00 AM	63.3	64.7	62.1	78.2
9:46:00 AM	63	64.9	61.9	76.9
9:47:00 AM	63.3	65	62	77.2
9:48:00 AM	63.1	66	61.9	78.5
9:49:00 AM	66.1	76.7	62.3	92.9
9:50:00 AM	65	76.3	61.7	91
9:51:00 AM	63.1	66.7	61.7	80.9
9:52:00 AM	65.6	68.1	61.5	80.4
9:53:00 AM	66.3	68.1	63.6	81.5
9:54:00 AM	64.5	67.3	61.9	79.8
9:55:00 AM	64.5	67.3	61.7	79.8
9:56:00 AM	64.4	66.5	62.1	80.2
9:57:00 AM	66.6	73.1	61.9	84.6

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
9:58:00 AM	66.2	71.6	61.8	81.4
9:59:00 AM	63.7	65.8	62	79.8
10:00:00 AM	63.6	68.3	62	82.1
10:01:00 AM	63.7	67.7	61.9	80.3
10:02:00 AM	66.1	73.8	62.1	84
10:03:00 AM	67.3	75	62	84.1
10:04:00 AM	63.6	72.6	61.9	85.2
10:05:00 AM	63.6	69.5	62	86.8
10:06:00 AM	64.5	71.4	62	83.2
10:07:00 AM	65	71.7	62	88.4
10:08:00 AM	65.2	73.8	61.9	87.7
10:09:00 AM	63.7	73.3	61.8	87.2
10:10:00 AM	66	67.8	61.9	80.8
10:11:00 AM	66	69.5	62.3	85.4
10:12:00 AM	64	75.5	61.1	95.3
10:13:00 AM	63.2	65.8	61.4	78.3
10:14:00 AM	64.6	77.2	61.8	97.3
10:15:00 AM	63.4	65.2	61.9	77.6
10:16:00 AM	64.1	67.7	62.2	79.5
10:17:00 AM	63.4	67.4	61.6	79.8
10:18:00 AM	63.6	65.8	62.3	80.3
10:19:00 AM	63.8	67.5	61.6	79.3
10:20:00 AM	63.4	67.2	61.9	80.5
10:21:00 AM	64.9	67.6	62.3	80.1
10:22:00 AM	66.2	67.8	63.2	80.9
10:23:00 AM	64.9	68.1	62	81.5
10:24:00 AM	64.2	72	62	82.1
10:25:00 AM	64.3	66.9	62	79.9
10:26:00 AM	66.1	75.8	62.6	90.4
10:27:00 AM	66.5	71.1	63.4	85.5
10:28:00 AM	65	73	62.5	88.4
10:29:00 AM	63.7	67	62	79.1
10:30:00 AM	63.8	68.5	62.1	81.6
10:31:00 AM	64.8	67.7	62.3	80.6
10:32:00 AM	65.3	71	63.1	82
10:33:00 AM	66.5	68.8	63.6	80.8
10:34:00 AM	66.4	72.6	65.1	83.3
10:35:00 AM	66.1	68.6	63.3	81.7
10:36:00 AM	66.5	69.1	63.8	82.2

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
10:37:00 AM	64.7	66.9	63	79.8
10:38:00 AM	64.8	67.5	62.9	80.6
10:39:00 AM	64	68.9	62.7	80.6
10:40:00 AM	64.4	71.5	62.6	86.1
10:41:00 AM	65.8	69.8	63.1	84.6
10:42:00 AM	65.1	72.1	62.5	85.1
10:43:00 AM	64.9	68	61.8	82.9
10:44:00 AM	66.6	72.7	63.9	86.8
10:45:00 AM	66.4	71.8	62.7	84.7
10:46:00 AM	63.2	73.2	61.9	91.8
10:47:00 AM	64.8	74.6	61.8	89.7
10:48:00 AM	64.6	76.1	62	90.8
10:49:00 AM	65.2	72.2	62.7	86.5
10:50:00 AM	63.8	72.4	62.1	87.2
10:51:00 AM	65.3	67.5	62.5	80.3
10:52:00 AM	64.1	66.1	62.3	82.3
10:53:00 AM	64.3	69	62.4	81.7
10:54:00 AM	63.8	66.5	62.1	81
10:55:00 AM	64.2	66.6	62.4	80.1
10:56:00 AM	64.7	68.3	63.2	81.2
10:57:00 AM	65.2	68.2	62.8	82.1
10:58:00 AM	63.3	67.3	61.2	79.7
10:59:00 AM	63.2	65.2	62.1	77.7
11:00:00 AM	63.1	67.2	61.8	82.5
11:01:00 AM	63.6	66.9	61.6	82.3
11:02:00 AM	63.2	68.4	61.1	82.9
11:03:00 AM	62.7	64.6	61.5	78.1
11:04:00 AM	63.1	72.6	61.4	85.5
11:05:00 AM	62.7	65.1	61.5	79.8
11:06:00 AM	62.7	67.6	61.2	79.4
11:07:00 AM	62.3	68.8	60.8	82.8
11:08:00 AM	62.4	67	61.2	84.7
11:09:00 AM	63	65.6	61.5	79.3
11:10:00 AM	63.4	65.3	61.9	83.9
11:11:00 AM	63.6	68.3	62	85
11:12:00 AM	63.3	67.7	61.8	79.7
11:13:00 AM	63.4	70.9	62.3	87.1
11:14:00 AM	62.7	64.7	61.6	76.2
11:15:00 AM	62.6	65.8	61.3	79.2

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
11:16:00 AM	63	65.8	61.6	78.4
11:17:00 AM	62.8	66.4	61.5	79.8
11:18:00 AM	63.3	67.2	61.9	80.2
11:19:00 AM	62.7	65.9	60.9	78.3
11:20:00 AM	62.6	65	61.3	77.9
11:21:00 AM	62.7	64.7	61.1	76.9
11:22:00 AM	62.3	68.2	60.5	82.2
11:23:00 AM	62.7	65.4	61.2	84.2
11:24:00 AM	62.8	65.8	61.2	79.2
11:25:00 AM	62.9	66	60.9	81.3
11:26:00 AM	62.7	66.5	60.8	80.8
11:27:00 AM	63.4	71.9	61.2	90.3
11:28:00 AM	62.5	67.4	61	78.6
11:29:00 AM	63	67.9	61.2	81.4
11:30:00 AM	63	67.3	61.4	81
11:31:00 AM	63.4	78.1	61.4	94.3
11:32:00 AM	63	68.3	61.5	81.3
11:33:00 AM	63.1	66.7	61.5	82.9
11:34:00 AM	63	67	61.5	81.8
11:35:00 AM	62.9	67.7	61.5	83.5
11:36:00 AM	63.6	68.5	61.7	82.8
11:37:00 AM	63.1	68.2	61.4	87.2
11:38:00 AM	63.9	67.8	62.1	80.9
11:39:00 AM	65.4	68.9	63.4	82.2
11:40:00 AM	65.2	67.3	63.6	79.3
11:41:00 AM	63.9	69.3	61.5	85.6
11:42:00 AM	63.9	66.5	61.7	80.5
11:43:00 AM	63	68.1	61.5	80.2
11:44:00 AM	64.7	70.1	62.2	81.8
11:45:00 AM	66.2	69.5	62.4	81.6
11:46:00 AM	65.6	70.1	62.2	83.1
11:47:00 AM	65.9	69.6	62.3	82
11:48:00 AM	66.4	72.6	64.7	83.1
11:49:00 AM	66.8	72.9	63.4	85.3
11:50:00 AM	66.2	69.3	62.7	84
11:51:00 AM	63.4	69.5	61.8	88.1
11:52:00 AM	64	75.4	61.9	89.3
11:53:00 AM	63.2	68.6	62.1	82.8
11:54:00 AM	63.3	66.8	61.9	80

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
11:55:00 AM	64.2	74.8	62	90
11:56:00 AM	67.5	76.7	62	91.9
11:57:00 AM	64.4	67.9	61.9	81
11:58:00 AM	63.7	69.9	61.9	80.5
11:59:00 AM	63.2	66.1	61.8	82
12:00:00 PM	64.7	67.7	62.1	80.4
12:01:00 PM	65.1	74.8	62.5	88
12:02:00 PM	64.2	71.6	62.1	84.6
12:03:00 PM	63.2	66.2	61.8	78.9
12:04:00 PM	63.1	70.4	61.8	83.3
12:05:00 PM	62.9	64.9	61.8	77.6
12:06:00 PM	63	69.4	61.6	82.7
12:07:00 PM	64.5	67.7	61.6	81.3
12:08:00 PM	67.1	73.9	62.1	83.5
12:09:00 PM	67.5	72.6	61.8	83.9
12:10:00 PM	63.1	66.8	61.1	80.2
12:11:00 PM	64.9	67.2	62.2	79.9
12:12:00 PM	64.4	74.2	61.6	90.9
12:13:00 PM	62.9	66.2	61.3	80.4
12:14:00 PM	63	67.9	61	78.8
12:15:00 PM	67.2	70.8	64.4	85
12:16:00 PM	65.7	68.4	61.7	81
12:17:00 PM	64.6	67.4	61.5	81.2
12:18:00 PM	63	71	61.4	84.9
12:19:00 PM	62.9	67.7	61.4	80.6
12:20:00 PM	64.6	72.4	61.6	87.7
12:21:00 PM	63.9	66.5	61.8	78.3
12:22:00 PM	65.3	68.2	61.7	80.1
12:23:00 PM	64	67.8	61.8	79.8
12:24:00 PM	68.5	76.6	62.6	90.8
12:25:00 PM	64.1	68.7	60.9	80.7
12:26:00 PM	63.6	68.8	61.8	80.7
12:27:00 PM	64.8	67.6	61.2	80.6
12:28:00 PM	64.1	69.7	61.6	81
12:29:00 PM	66.4	69.8	64.4	86.2
12:30:00 PM	65.1	69.1	62	83.7
12:31:00 PM	65.7	67.4	61.9	79.7
12:32:00 PM	63.2	73.5	61.3	85.4
12:33:00 PM	63.1	66.7	61.5	80.5

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
12:34:00 PM	62.4	65.3	60.7	77.7
12:35:00 PM	63.6	68.6	60.8	81.5
12:36:00 PM	63.4	72.3	61.8	93
12:37:00 PM	63	65	61.8	78.9
12:38:00 PM	63.5	66.4	61.8	78.7
12:39:00 PM	62.4	67.3	61	82.5
12:40:00 PM	62.2	64.5	60.9	76.6
12:41:00 PM	62.3	67.4	60.3	80.4
12:42:00 PM	62.2	64.6	60.9	77
12:43:00 PM	62.1	64	60.4	77.8
12:44:00 PM	62.5	64.9	60.9	77.4
12:45:00 PM	62.5	65.8	61	82.9
12:46:00 PM	62.4	65.7	60.8	79.5
12:47:00 PM	62.1	66.2	60.6	78.9
12:48:00 PM	62.2	65.2	60.8	77.1
12:49:00 PM	61.9	64.5	60.7	76.6
12:50:00 PM	62.3	68.3	60.9	86.3
12:51:00 PM	62.4	65.4	60.8	81.8
12:52:00 PM	62.6	65.4	61.2	79
12:53:00 PM	62.1	64.9	60.6	76.7
12:54:00 PM	62.2	69.2	60.6	82.4
12:55:00 PM	62.6	66.9	61.2	82.6
12:56:00 PM	62.2	65.9	61.1	77.3
12:57:00 PM	62.3	66.7	60.6	83.8
12:58:00 PM	62.7	67.2	61.2	82.7
12:59:00 PM	62.5	66.5	60.5	79.8
1:00:00 PM	62.2	65.1	60.4	80.4
1:01:00 PM	62.2	67	60.9	82.1
1:02:00 PM	62.1	66.1	60.7	84
1:03:00 PM	62.4	65	60.9	83.5
1:04:00 PM	62.3	67.8	60.4	81.5
1:05:00 PM	63	72	60.8	84.9
1:06:00 PM	62.3	66.9	60.8	80.8
1:07:00 PM	62.6	66.2	61.2	86.6
1:08:00 PM	62.5	67.6	60.9	84.9
1:09:00 PM	62.3	67.4	61	82.6
1:10:00 PM	62.5	67.5	61	84.3
1:11:00 PM	62.8	66.1	61	82.4
1:12:00 PM	62.7	68.6	61	85.1

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
1:13:00 PM	62.6	68.8	60.8	84
1:14:00 PM	62.5	67.7	61	80.2
1:15:00 PM	62.7	66.7	60.7	78.3
1:16:00 PM	62.7	65.9	60.7	80.1
1:17:00 PM	62.7	65.9	61.1	79.1
1:18:00 PM	62.3	65.8	60.7	83.7
1:19:00 PM	62.5	65.9	61.2	83.2
1:20:00 PM	62.3	64	60.9	77.6
1:21:00 PM	62.3	64.4	60.8	79.2
1:22:00 PM	62.5	71.4	60.7	87.6
1:23:00 PM	62.2	68	60.4	82.7
1:24:00 PM	62.4	69.2	60.3	86.1
1:25:00 PM	62.3	67.8	60.5	82.5
1:26:00 PM	64	72.1	61.2	86
1:27:00 PM	62	64.8	60.8	81
1:28:00 PM	64.1	68.2	62.2	81.5
1:29:00 PM	63.6	68.9	60.9	82
1:30:00 PM	63.8	68.6	61.4	84.3
1:31:00 PM	64.7	67.1	63	79.9
1:32:00 PM	62.8	67.1	61	85
1:33:00 PM	62.3	63.8	60.9	76.2
1:34:00 PM	62.5	72.6	60.8	86.4
1:35:00 PM	62.9	73.8	60.8	86.2
1:36:00 PM	62.1	71.2	60.7	81.8
1:37:00 PM	62	64.6	60.6	78.2
1:38:00 PM	61.9	64.9	60.7	78.9
1:39:00 PM	62.6	75	61.2	89.9
1:40:00 PM	62	64.3	60.9	76.8
1:41:00 PM	62.1	67.3	60.6	81.1
1:42:00 PM	62.1	68.5	60.7	81.5
1:43:00 PM	62.1	63.9	60.5	76.1
1:44:00 PM	62.1	64.5	61	77.7
1:45:00 PM	61.9	64.3	60.7	76
1:46:00 PM	62.1	69.8	60.7	84.2
1:47:00 PM	62.6	67.2	61.4	79.6
1:48:00 PM	62.5	65.2	60.8	76.7
1:49:00 PM	62.4	66.7	60.8	78.7
1:50:00 PM	62.5	69.2	61.1	81.8
1:51:00 PM	62.1	69.2	60.8	83.5

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
1:52:00 PM	62.6	67.5	61	80.6
1:53:00 PM	62.3	66.2	60.5	80.3
1:54:00 PM	62.7	68	61.3	83
1:55:00 PM	62.9	71.4	61	86.3
1:56:00 PM	63.2	71.1	61.6	85.8
1:57:00 PM	62.8	67.8	61.2	83.3
1:58:00 PM	63	65.6	61.4	77.8
1:59:00 PM	62.5	64.5	61.1	76.6
2:00:00 PM	62.6	69.6	61.1	81.3
2:01:00 PM	64.3	69.1	61.6	81.9
2:02:00 PM	64.3	67.3	61.9	80.2
2:03:00 PM	64	70.6	61.5	87.1
2:04:00 PM	62.9	67.9	61	81.1
2:05:00 PM	63.1	66.4	61	81.2
2:06:00 PM	62.9	65.9	61	87.4
2:07:00 PM	62.4	64.3	60.9	78.3
2:08:00 PM	63	67.6	61.4	81.6
2:09:00 PM	62.9	68.2	61.2	83.1
2:10:00 PM	62.9	65	60.6	81.2
2:11:00 PM	62.9	65.9	61.2	81.1
2:12:00 PM	62.6	64.3	61.3	76.4
2:13:00 PM	62.5	64.5	61.2	78.1
2:14:00 PM	62.8	72.8	60.8	86.4
2:15:00 PM	62.8	67.9	61.2	86.7
2:16:00 PM	62.3	66.6	61.1	78.1
2:17:00 PM	62.5	66	61.1	80.7
2:18:00 PM	62.3	65.2	61	77.7
2:19:00 PM	62.3	65.3	60.9	80.9
2:20:00 PM	62.4	64.4	60.9	76.5
2:21:00 PM	62.3	64.4	61.2	76.7
2:22:00 PM	62.3	63.7	60.8	76.5
2:23:00 PM	62.2	63.8	60.8	78.5
2:24:00 PM	62.9	72.6	60.8	86.9
2:25:00 PM	62.5	64.2	61.1	76.4
2:26:00 PM	62.6	66.6	60.8	80.9
2:27:00 PM	62.8	64.9	61.3	77.4
2:28:00 PM	62.4	64.4	61.2	81
2:29:00 PM	62.7	64.9	61.6	82.2
2:30:00 PM	62.7	65.2	61.6	78.3

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
2:31:00 PM	62.9	65.9	61.4	78.6
2:32:00 PM	62.7	64.2	61.6	76.9
2:33:00 PM	62.5	64.6	61	78.9
2:34:00 PM	62.2	64.3	60.8	76.3
2:35:00 PM	62.7	64.3	61.4	76.9
2:36:00 PM	62.4	64.1	61	83.8
2:37:00 PM	62.4	64.3	60.9	76.7
2:38:00 PM	62.6	65.6	61	77.5
2:39:00 PM	62.5	63.9	61.4	76.8
2:40:00 PM	62.1	63.4	61.1	77.4
2:41:00 PM	62.6	64.4	60.8	76.2
2:42:00 PM	62.4	64.4	60.9	83.4
2:43:00 PM	62.8	66.1	61.5	88.8
2:44:00 PM	62.6	63.9	61.3	77.3
2:45:00 PM	62.8	64.7	60.9	77.8
2:46:00 PM	63	65.6	61.2	80.1
2:47:00 PM	62.5	64.6	60.9	77.5
2:48:00 PM	62.5	64.8	61	78.8
2:49:00 PM	62.8	64.5	61.5	79.4
2:50:00 PM	63.1	64.7	61.9	77.4
2:51:00 PM	62.8	64.3	61.3	76.9
2:52:00 PM	63	64.3	61.3	79.6
2:53:00 PM	62.8	64.2	61.2	78.9
2:54:00 PM	62.7	64	61.3	76.8
2:55:00 PM	62.9	64.1	61.7	76.3
2:56:00 PM	62.8	64.8	61.5	77.5
2:57:00 PM	62.6	66.1	61.2	78.5
2:58:00 PM	62.6	68.4	60.9	83.5
2:59:00 PM	62.8	70.5	60.9	83.7
3:00:00 PM	62.8	66.9	61.2	81.6
3:01:00 PM	62.8	67.7	61.2	82.5
3:02:00 PM	62.8	65.3	61	77.1
3:03:00 PM	62.6	63.7	61.1	76.8
3:04:00 PM	63	64.5	61.6	79
3:05:00 PM	62.6	63.8	61.5	76
3:06:00 PM	63	67.5	61.6	80.1
3:07:00 PM	62.7	65	61.3	77.1
3:08:00 PM	62.7	65	61.3	77.1
3:09:00 PM	63.2	67.4	61.8	84.5

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
3:10:00 PM	63.1	69.8	61.1	85
3:11:00 PM	62.8	65.8	61.5	79.1
3:12:00 PM	63	69	61.2	83.2
3:13:00 PM	63.6	77.2	61.6	90.5
3:14:00 PM	63.1	64.9	61.2	77.4
3:15:00 PM	62.7	66.1	61.5	80
3:16:00 PM	63	67.9	61.1	81.5
3:17:00 PM	63.3	67.3	61.6	81.8
3:18:00 PM	62.8	64.7	61.5	77.4
3:19:00 PM	62.8	64.7	61.2	77.1
3:20:00 PM	62.6	64.3	61.1	76.4
3:21:00 PM	63.2	65	61.5	77.3
3:22:00 PM	63	65	61.6	77.5
3:23:00 PM	63	65	61.2	77.1
3:24:00 PM	62.6	65.4	60.9	77.7
3:25:00 PM	62.4	65	61	76.7
3:26:00 PM	63.1	65.6	61.5	78
3:27:00 PM	63.1	66.7	61.3	80.6
3:28:00 PM	63.1	69	61.1	82.2
3:29:00 PM	62.8	66.3	61.4	78.4
3:30:00 PM	62.9	65.8	61.7	77.7
3:31:00 PM	63.1	65.2	61.5	77.3
3:32:00 PM	62.6	63.9	61.2	76.3
3:33:00 PM	63	64.9	61	76.7
3:34:00 PM	62.5	65.2	61.1	78.5
3:35:00 PM	62.8	64.7	61.5	77.5
3:36:00 PM	62.6	64.5	61.2	84
3:37:00 PM	62.8	64.8	61.6	77.5
3:38:00 PM	62.7	64.3	60.9	77.4
3:39:00 PM	63.3	65.2	61.2	77.6
3:40:00 PM	62.7	64.3	61	79.8
3:41:00 PM	62.9	64.5	61.2	76.9
3:42:00 PM	62.8	65	61.5	83.7
3:43:00 PM	62.6	65.9	61.2	78
3:44:00 PM	62.6	67.7	61.1	80.9
3:45:00 PM	62.7	64.7	61.2	77.2
3:46:00 PM	63.4	70.1	61.5	85.8
3:47:00 PM	63.1	71.6	61	84.6
3:48:00 PM	62.9	65.3	61.7	78

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
3:49:00 PM	62.7	65.1	61.3	79.6
3:50:00 PM	63.1	65.9	61.7	77.9
3:51:00 PM	63	64.9	61.7	82.9
3:52:00 PM	62.7	65	61.5	79.8
3:53:00 PM	62.9	65.3	61.5	79.4
3:54:00 PM	62.9	67.6	61.6	80.8
3:55:00 PM	62.6	65.2	60.8	80.5
3:56:00 PM	62.3	68.1	60.9	86.1
3:57:00 PM	62.8	72.5	60.9	93.9
3:58:00 PM	62.3	73	60.3	96.1
3:59:00 PM	62.9	69.4	60.7	91.6
4:00:00 PM	62.6	68.1	61.4	82.8
4:01:00 PM	62.9	69.3	61.1	87.4
4:02:00 PM	62.8	65.3	61.6	79.9
4:03:00 PM	62.9	65.9	61.3	80.5
4:04:00 PM	62.9	64.8	61.3	77.1
4:05:00 PM	62.9	66.9	61.5	81.6
4:06:00 PM	63.1	69.7	61.5	83.4
4:07:00 PM	62.6	68	61.1	80.7
4:08:00 PM	63.1	67.4	61.5	82.2
4:09:00 PM	62.7	64.2	61.3	77.3
4:10:00 PM	63	67.2	61.4	81.7
4:11:00 PM	62.9	64.9	61.7	77.1
4:12:00 PM	62.9	65.1	61.5	76.6
4:13:00 PM	62.6	64	61.4	76.4
4:14:00 PM	63.1	66	61.6	79.7
4:15:00 PM	62.5	64.1	60.7	77.1
4:16:00 PM	62.6	64.8	61	76.8
4:17:00 PM	62.8	64.5	61	78
4:18:00 PM	62.2	63.7	61	77
4:19:00 PM	62.6	68	60.9	85.5
4:20:00 PM	62.5	63.9	60.6	76.5
4:21:00 PM	63.1	65.3	61.3	79.9
4:22:00 PM	62.8	70	61.2	85.7
4:23:00 PM	62.9	64.4	61.4	77.2
4:24:00 PM	63.1	65	62	77.3
4:25:00 PM	62.8	64.9	61.2	77.1
4:26:00 PM	62.9	64.6	61.4	77
4:27:00 PM	63.1	66.4	62	81.5

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
4:28:00 PM	63	64.8	61.4	77
4:29:00 PM	62.7	64.7	61.5	76.2
4:30:00 PM	62.5	66.7	61.3	79.9
4:31:00 PM	62.6	63.7	61.3	76
4:32:00 PM	62.9	64.8	61.7	77.2
4:33:00 PM	63.2	67.6	61.5	80
4:34:00 PM	63.2	68.2	61.6	80.9
4:35:00 PM	63.1	70.9	61.7	86.2
4:36:00 PM	62.9	73.5	60.9	87.6
4:37:00 PM	63.2	71	61.6	83.8
4:38:00 PM	63.3	66.9	61.9	78.4
4:39:00 PM	62.8	67	61.3	77.3
4:40:00 PM	62.9	66.7	61.3	77.6
4:41:00 PM	62.6	64.4	61.4	76.8
4:42:00 PM	62.8	64.9	61.2	77.1
4:43:00 PM	62.6	64.7	61.1	77
4:44:00 PM	62.9	64.7	61.5	77.7
4:45:00 PM	62.8	65.5	61.7	78.2
4:46:00 PM	62.8	64.3	61.5	77.6
4:47:00 PM	62.8	64.2	61.4	77
4:48:00 PM	62.8	64.8	61.3	76.7
4:49:00 PM	62.7	64.4	61.6	76.7
4:50:00 PM	62.6	65.8	61.2	78.7
4:51:00 PM	63.3	68	61.6	91.9
4:52:00 PM	63	65.3	61.1	79.4
4:53:00 PM	63.1	65.3	61.6	77.5
4:54:00 PM	63.2	66.9	61.3	83.1
4:55:00 PM	62.9	68.3	61.2	87.6
4:56:00 PM	63.1	70.8	61.5	82.9
4:57:00 PM	63.1	65.5	61.6	79.1
4:58:00 PM	62.8	65	61.5	76.2
4:59:00 PM	62.5	65.1	61	79.9
5:00:00 PM	62.6	64.4	60.9	76.7
5:01:00 PM	62.7	64.3	61.5	76.8
5:02:00 PM	62.8	64.9	61.6	80.9
5:03:00 PM	62.6	64.1	61.3	76.3
5:04:00 PM	62.3	67	60.9	82.4
5:05:00 PM	62.5	65.9	60.8	78.7
5:06:00 PM	62.6	64.1	61.1	76.8

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
5:07:00 PM	62.8	64.5	61.3	77.6
5:08:00 PM	62.8	65.3	61.3	77.4
5:09:00 PM	62.7	64.6	61.1	77.8
5:10:00 PM	62.5	63.9	61.1	76.5
5:11:00 PM	62.8	67.1	60.5	81
5:12:00 PM	62.8	65.2	61.2	77
5:13:00 PM	62.9	64.9	61.7	79.6
5:14:00 PM	62.8	70.1	61.2	83
5:15:00 PM	62.5	64.2	61.2	77.7
5:16:00 PM	62.7	67.7	61.2	82.6
5:17:00 PM	62.9	66.8	61.5	81.3
5:18:00 PM	62.9	65.9	60.8	80.9
5:19:00 PM	62.7	65.7	61.3	80.2
5:20:00 PM	62.8	65.4	61.4	77.2
5:21:00 PM	62.6	65.5	61.1	78.5
5:22:00 PM	62.7	65.5	61.2	77.9
5:23:00 PM	62.6	64.5	61.3	77.8
5:24:00 PM	62.8	67.9	61.2	81.8
5:25:00 PM	63.1	70.3	60.9	83.7
5:26:00 PM	63	66.1	61.4	78.5
5:27:00 PM	63.4	70.1	61.5	83.2
5:28:00 PM	63.1	66.8	61.4	78.1
5:29:00 PM	62.1	63.5	60.9	76.7
5:30:00 PM	63	65.2	61.5	79.4
5:31:00 PM	63	64.7	61.4	79.2
5:32:00 PM	63.3	68.5	61.5	81.6
5:33:00 PM	63.4	72.8	61.6	89.2
5:34:00 PM	63	64.4	61.7	77.5
5:35:00 PM	62.9	66.9	61.1	80.6
5:36:00 PM	62.9	70.1	61.2	84.5
5:37:00 PM	62.5	64	60.9	76.7
5:38:00 PM	62.8	65.1	61.3	76.9
5:39:00 PM	63.4	71.9	61.2	95.5
5:40:00 PM	63.3	75	61.1	101.8
5:41:00 PM	62.7	67.3	61	91.2
5:42:00 PM	62.7	64.2	61.4	77
5:43:00 PM	63	64.6	61.6	76.4
5:44:00 PM	62.8	65.2	61.4	77.1
5:45:00 PM	62.1	63.4	60.7	75.9

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
5:46:00 PM	62.5	64	61.1	76.6
5:47:00 PM	62.5	64.4	60.7	77.3
5:48:00 PM	62.4	64.5	60.6	76.2
5:49:00 PM	62.4	71	60.8	90.2
5:50:00 PM	62.7	65.7	61.2	81.3
5:51:00 PM	62.4	63.6	60.6	76
5:52:00 PM	62.4	64	60.7	77.5
5:53:00 PM	62.7	64.5	61.2	76.7
5:54:00 PM	62.6	64.5	61.2	76.9
5:55:00 PM	62.7	64.5	61.3	78.6
5:56:00 PM	62.6	64.9	61.4	84.1
5:57:00 PM	62.3	63.6	61.2	79.8
5:58:00 PM	62.5	63.7	61.1	76.2
5:59:00 PM	62.7	64.1	61.3	77.6
6:00:00 PM	62.7	64.1	61.6	76.8
6:01:00 PM	62.7	63.9	61.6	77.5
6:02:00 PM	62.7	64	61.7	76.8
6:03:00 PM	62.8	64.7	61.2	76.9
6:04:00 PM	63.1	64.5	61.8	77.4
6:05:00 PM	62.9	64.7	61.8	76.5
6:06:00 PM	63.2	65	61.5	78.3
6:07:00 PM	63	64.6	61.8	76.8
6:08:00 PM	63	64.1	61.6	76.8
6:09:00 PM	62.6	64.1	61.3	76.8
6:10:00 PM	62.5	63.9	61.4	76.9
6:11:00 PM	63.4	64.8	61.7	77
6:12:00 PM	63.1	64.3	61.7	77.4
6:13:00 PM	62.9	64.1	61.7	76.5
6:14:00 PM	62.7	64	61.7	76.4
6:15:00 PM	62.8	64.1	61.7	76.9
6:16:00 PM	62.9	64.2	61.7	76.5
6:17:00 PM	62.9	64.2	61.7	77.5
6:18:00 PM	62.5	63.7	61.6	76.7
6:19:00 PM	63.1	64.4	61.7	77.2
6:20:00 PM	62.9	63.9	61.5	76.8
6:21:00 PM	62.9	64.1	61.8	76.7
6:22:00 PM	62.8	63.9	61.6	76.9
6:23:00 PM	63.2	64.4	62.1	77.3
6:24:00 PM	63.2	64.2	62.2	77.2

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
6:25:00 PM	62.8	64	61.3	76.5
6:26:00 PM	62.9	64.1	61.6	77
6:27:00 PM	63.1	65	61.9	77
6:28:00 PM	63	64	61.6	77
6:29:00 PM	62.9	64.1	61.8	76.7
6:30:00 PM	63.5	65.2	61.9	78.4
6:31:00 PM	63.3	65.3	61.6	77.7
6:32:00 PM	63.1	64.8	61.8	76.8
6:33:00 PM	63.6	65.5	61.8	79.1
6:34:00 PM	62.7	64	61.7	76.5
6:35:00 PM	63.1	64.3	62	76.7
6:36:00 PM	62.8	64.1	61.8	77
6:37:00 PM	63.2	64.3	61.9	77.1
6:38:00 PM	62.8	64.4	61.7	76.7
6:39:00 PM	62.9	64	62	77.2
6:40:00 PM	62.8	63.8	61.9	76.5
6:41:00 PM	63.1	64.3	62	77.3
6:42:00 PM	63	64.1	61.7	77.3
6:43:00 PM	63	64.2	62	78
6:44:00 PM	62.9	64.1	61.8	77.2
6:45:00 PM	62.9	63.8	62.1	76.7
6:46:00 PM	63	64.3	62	76.9
6:47:00 PM	63.3	64.4	62	76.9
6:48:00 PM	63.2	64.7	62	77.8
6:49:00 PM	63	64.6	61.8	77.1
6:50:00 PM	63.2	64.3	61.9	77.9
6:51:00 PM	63.2	64.5	61.9	77.5
6:52:00 PM	63	64.3	61.9	77
6:53:00 PM	63.3	65	61.9	78.1
6:54:00 PM	62.9	63.8	61.9	76.2
6:55:00 PM	63	64.6	61.3	77.1
6:56:00 PM	63.3	64.6	62.3	77.2
6:57:00 PM	63.1	64.5	61.6	77
6:58:00 PM	62.9	64.1	61.9	76.9
6:59:00 PM	63.4	65	61.9	77.6
7:00:00 PM	63.1	65.4	61.6	77.8
7:01:00 PM	63.7	65.2	62.5	78.5
7:02:00 PM	63.2	64.6	62	77.2
7:03:00 PM	63.4	64.8	62.2	77.2

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
7:04:00 PM	63.3	64.5	62.2	77.2
7:05:00 PM	63.1	64.3	61.9	77.7
7:06:00 PM	63	64.3	61.9	77.4
7:07:00 PM	63.1	64.4	61.8	77.2
7:08:00 PM	63.2	64.4	62.1	77.3
7:09:00 PM	63.5	65	61.9	77.6
7:10:00 PM	63	63.9	62	76.7
7:11:00 PM	63.1	64.2	62	76.4
7:12:00 PM	63.2	64.5	62.1	77.3
7:13:00 PM	62.8	64.1	61.7	78
7:14:00 PM	62.9	64.6	61.8	77.9
7:15:00 PM	63	64.2	61.8	77.2
7:16:00 PM	63.2	64.8	61.9	77.2
7:17:00 PM	62.9	64.3	61.9	77.1
7:18:00 PM	62.8	64.3	61.9	77.1
7:19:00 PM	62.8	64	61.6	76.2
7:20:00 PM	63.1	64.7	61.7	77
7:21:00 PM	62.9	64.4	61.8	77.2
7:22:00 PM	62.8	64.1	61.6	76.6
7:23:00 PM	62.9	64.2	61.6	77
7:24:00 PM	63.1	64.3	61.6	80.1
7:25:00 PM	62.9	64.5	61.6	77
7:26:00 PM	62.9	64.2	61.6	77.7
7:27:00 PM	63.1	66.5	61.9	90.3
7:28:00 PM	63	64.4	62	87
7:29:00 PM	63.2	64.7	61.9	86.8
7:30:00 PM	63.1	64.2	62	77.8
7:31:00 PM	63.1	64.8	61.8	76.4
7:32:00 PM	63.1	64.4	62	77.1
7:33:00 PM	62.9	64.1	61.8	76.8
7:34:00 PM	63	64.5	61.5	77.2
7:35:00 PM	63	64.4	61.8	76.6
7:36:00 PM	63	64.5	61.8	77.6
7:37:00 PM	63	64.6	61.7	77.9
7:38:00 PM	62.9	64.4	61.7	77.3
7:39:00 PM	63	64.3	61.6	77.4
7:40:00 PM	62.9	63.9	61.9	76.4
7:41:00 PM	62.9	64.7	61.8	76.4
7:42:00 PM	62.8	64.6	61.5	76.5

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
7:43:00 PM	62.6	63.9	61.3	76.6
7:44:00 PM	62.7	64.3	61.5	76.6
7:45:00 PM	63	64.4	61.8	78.2
7:46:00 PM	62.8	64.1	61.7	76.4
7:47:00 PM	62.9	64.4	61.9	76.9
7:48:00 PM	63	64.5	61.9	78.6
7:49:00 PM	62.9	63.9	61.8	77.7
7:50:00 PM	62.9	64.4	61.9	77.2
7:51:00 PM	62.9	64	61.9	77.8
7:52:00 PM	63	64.2	62.1	77.1
7:53:00 PM	62.9	64.1	61.7	77
7:54:00 PM	62.9	64.2	61.7	76.7
7:55:00 PM	63	64.7	61.5	77.2
7:56:00 PM	62.9	64.2	61.8	76.9
7:57:00 PM	63	64.2	61.7	76.9
7:58:00 PM	63.1	64.3	62.1	77.4
7:59:00 PM	62.9	63.9	62	77.2
8:00:00 PM	63.2	64.6	61.9	78.2
8:01:00 PM	63.2	64.8	61.7	77
8:02:00 PM	62.9	64.2	61.5	77.1
8:03:00 PM	63	64.4	61.9	77.3
8:04:00 PM	63.1	64.6	61.7	76.8
8:05:00 PM	63	64.3	62	76.6
8:06:00 PM	63	64.4	61.8	76.6
8:07:00 PM	62.9	64	61.7	77
8:08:00 PM	62.9	64.4	61.6	76.7
8:09:00 PM	62.8	64.8	61.6	79.6
8:10:00 PM	62.9	64	61.9	76.6
8:11:00 PM	62.9	64	61.7	76.4
8:12:00 PM	63.2	64.4	62.1	77.7
8:13:00 PM	63	64.2	61.9	76.7
8:14:00 PM	62.9	64.5	61.7	77.6
8:15:00 PM	62.9	64.2	61.6	77
8:16:00 PM	63	64.6	61.8	77.7
8:17:00 PM	62.9	64.3	61.6	77.2
8:18:00 PM	63.1	64.8	61.9	77.6
8:19:00 PM	63.3	64.9	61.8	77.4
8:20:00 PM	62.9	64.5	61.7	76.7
8:21:00 PM	62.8	64.2	61.6	77.1

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
8:22:00 PM	63.1	64.6	61.8	77.2
8:23:00 PM	62.8	64.4	61.3	77.8
8:24:00 PM	62.9	64.2	61.7	76.5
8:25:00 PM	63.1	64.5	61.9	77.1
8:26:00 PM	62.9	64.4	61.9	76.8
8:27:00 PM	62.9	64.2	62	76.7
8:28:00 PM	63.1	64.7	61.9	77.4
8:29:00 PM	63	64.1	61.9	77.8
8:30:00 PM	63	64.4	62	77.3
8:31:00 PM	63	64.8	62	77.2
8:32:00 PM	63.2	64.4	61.7	77.5
8:33:00 PM	63	64.2	61.8	76.9
8:34:00 PM	63.1	64.6	62	76.8
8:35:00 PM	63.1	64.4	61.8	77.3
8:36:00 PM	63	64.2	61.7	77.3
8:37:00 PM	63.1	64.6	61.9	76.8
8:38:00 PM	63.2	64.2	62.2	77.1
8:39:00 PM	63.1	64.3	61.9	77.3
8:40:00 PM	63.2	64.8	62	77.8
8:41:00 PM	63.1	64.8	62	77.2
8:42:00 PM	63.2	64.8	61.8	77
8:43:00 PM	63	64.1	62.2	78.2
8:44:00 PM	63	64.1	61.8	77.8
8:45:00 PM	63.2	64.6	62.1	77.8
8:46:00 PM	63.1	64.1	62.1	77.1
8:47:00 PM	63.1	64.3	62	77.5
8:48:00 PM	63	64.4	61.8	77
8:49:00 PM	63.1	64.2	62.1	77.1
8:50:00 PM	63.1	64.4	62.1	77.5
8:51:00 PM	63.2	64.3	62	76.8
8:52:00 PM	63.2	64.6	62	77.4
8:53:00 PM	63.2	64.3	62	77.5
8:54:00 PM	63.2	64.6	62.1	77.7
8:55:00 PM	63.2	64.4	62.1	77
8:56:00 PM	63.2	64.5	61.9	77.1
8:57:00 PM	63.2	65.7	62.4	77.4
8:58:00 PM	63.2	64.4	62.2	77.1
8:59:00 PM	63.3	64.3	62.2	76.7
9:00:00 PM	62.9	64	61.8	76.6

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
9:01:00 PM	63.1	64.1	62	77.3
9:02:00 PM	63.2	64.3	62	76.8
9:03:00 PM	63.2	64.4	62.2	77.2
9:04:00 PM	63.2	64.3	62	76.6
9:05:00 PM	63.5	64.7	62.1	77.3
9:06:00 PM	63.3	64.6	62.1	77.3
9:07:00 PM	63.3	64.4	62.3	77.5
9:08:00 PM	63.3	64.7	62.1	77.4
9:09:00 PM	63.1	64.5	62.1	77.9
9:10:00 PM	63.4	64.8	62.1	77.2
9:11:00 PM	63.3	64.5	62.2	77.2
9:12:00 PM	63.1	64.5	62	77
9:13:00 PM	63.1	64.5	61.8	77.6
9:14:00 PM	63.2	64.5	62	77.3
9:15:00 PM	63.3	64.6	62	77.2
9:16:00 PM	63.3	64.5	62.3	77.3
9:17:00 PM	63.3	64.5	62.2	76.7
9:18:00 PM	63.2	64.4	62	77.2
9:19:00 PM	63.5	64.6	62.5	77.4
9:20:00 PM	63.3	64.6	62.2	77
9:21:00 PM	63.5	64.6	62.3	77.5
9:22:00 PM	63.3	64.4	62.4	76.9
9:23:00 PM	63.4	64.4	62.4	78.2
9:24:00 PM	63.4	64.7	62.1	77.4
9:25:00 PM	63.3	64.6	62.3	78.2
9:26:00 PM	63.4	64.7	62.4	78.4
9:27:00 PM	63.3	64.4	62	76.6
9:28:00 PM	63.3	64.4	61.8	76.8
9:29:00 PM	63.2	64.4	62	76.9
9:30:00 PM	63.3	64.4	62.1	76.8
9:31:00 PM	63.4	64.5	62.4	77.6
9:32:00 PM	63.4	64.7	62.4	76.8
9:33:00 PM	63.3	64.4	62.4	77.4
9:34:00 PM	63.2	64.7	62.1	77.7
9:35:00 PM	63	64.2	62	77.2
9:36:00 PM	63.2	64.2	62	76.5
9:37:00 PM	63.2	64.2	62.2	77.5
9:38:00 PM	63.2	64.2	62.2	77.6
9:39:00 PM	63.2	64.2	62.1	76.8

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
9:40:00 PM	63.1	64.6	62	76.3
9:41:00 PM	63.2	64.4	62.1	78.1
9:42:00 PM	63.1	64.1	62.1	76.8
9:43:00 PM	63.1	64.3	62	76.5
9:44:00 PM	63.2	64.4	62.2	76.9
9:45:00 PM	63	64.3	61.7	76.9
9:46:00 PM	63	64.2	61.9	78.4
9:47:00 PM	63	64.6	62	76.9
9:48:00 PM	63.1	64.4	61.9	78.4
9:49:00 PM	63.4	64.6	62.2	77.1
9:50:00 PM	63.1	64.3	61.9	76.6
9:51:00 PM	63.1	64.2	62	76.9
9:52:00 PM	63.1	64.4	61.9	77.5
9:53:00 PM	63.1	64.3	61.9	76.8
9:54:00 PM	63.3	64.8	62.4	77.1
9:55:00 PM	63.2	69	62.1	82.2
9:56:00 PM	63.2	64.4	62.2	77.3
9:57:00 PM	63.3	64.4	62.2	77.5
9:58:00 PM	63.1	64.5	61.8	76.9
9:59:00 PM	63.1	64.1	62.1	76.9
10:00:00 PM	63	64.5	62	77

Session Report

Information Panel

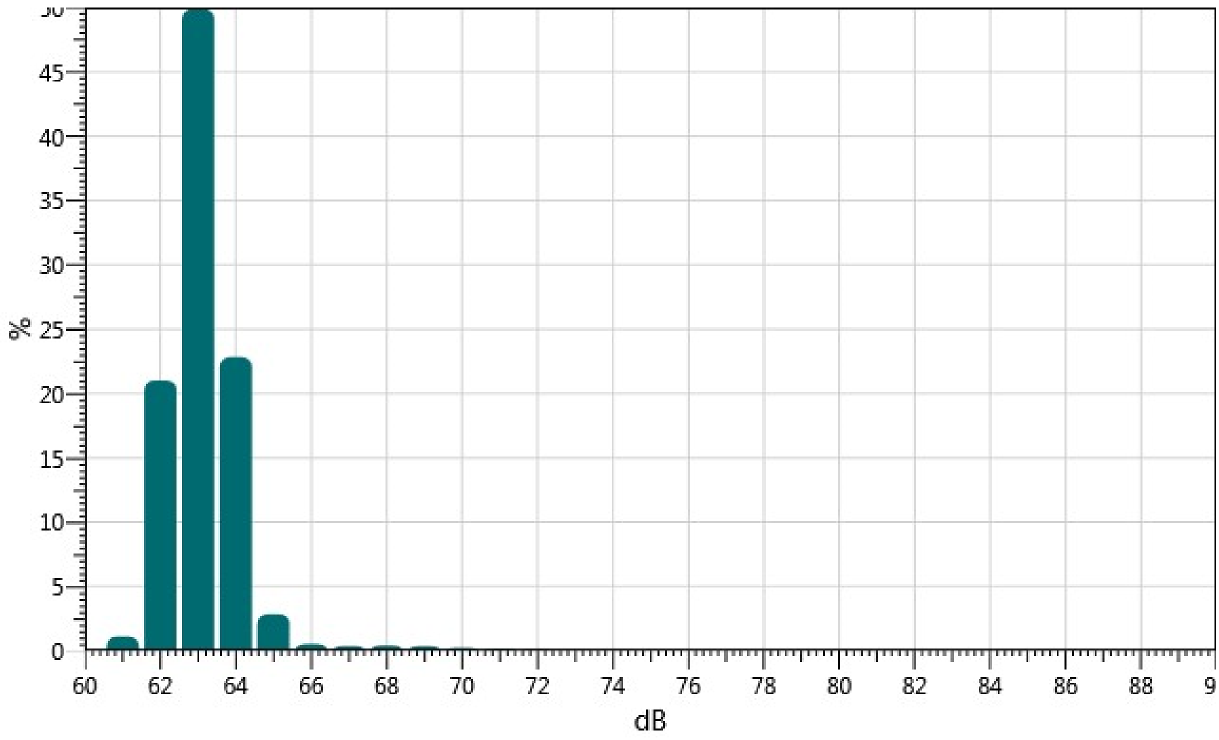
Company Name	Sarawak Energy Berhad
Description	CK/EV103-708/17
Location	N5 (Night Time)
Start Time	01-Feb-18 10:03:00 PM
Stop Time	02-Feb-18 7:03:00 AM
Run Time	09:00:00
Model Type	SoundPro DL
Comments	Vehicular movement, human activities, windblow.

Summary Data Panel

Description	Meter	Value	Description	Meter	Value
Leq	1	63.9 dB	Lmax	1	89.5 dB
Lmin	1	60.7 dB	Lpk	1	115.8 dB
L10	1	64.4 dB	L90	1	62.5 dB
Mntime	1	02-Feb-18 6:51:16 AM	Mxtime	1	02-Feb-18 12:57:42 AM
Rtime	1	09:00:00	Dose	1	0.3 %
Exchange Rate	1	3 dB	Weighting	1	A
Response	1	FAST	Bandwidth	1	OFF

Statistics Chart

N5N - 24hrs: Statistics Chart



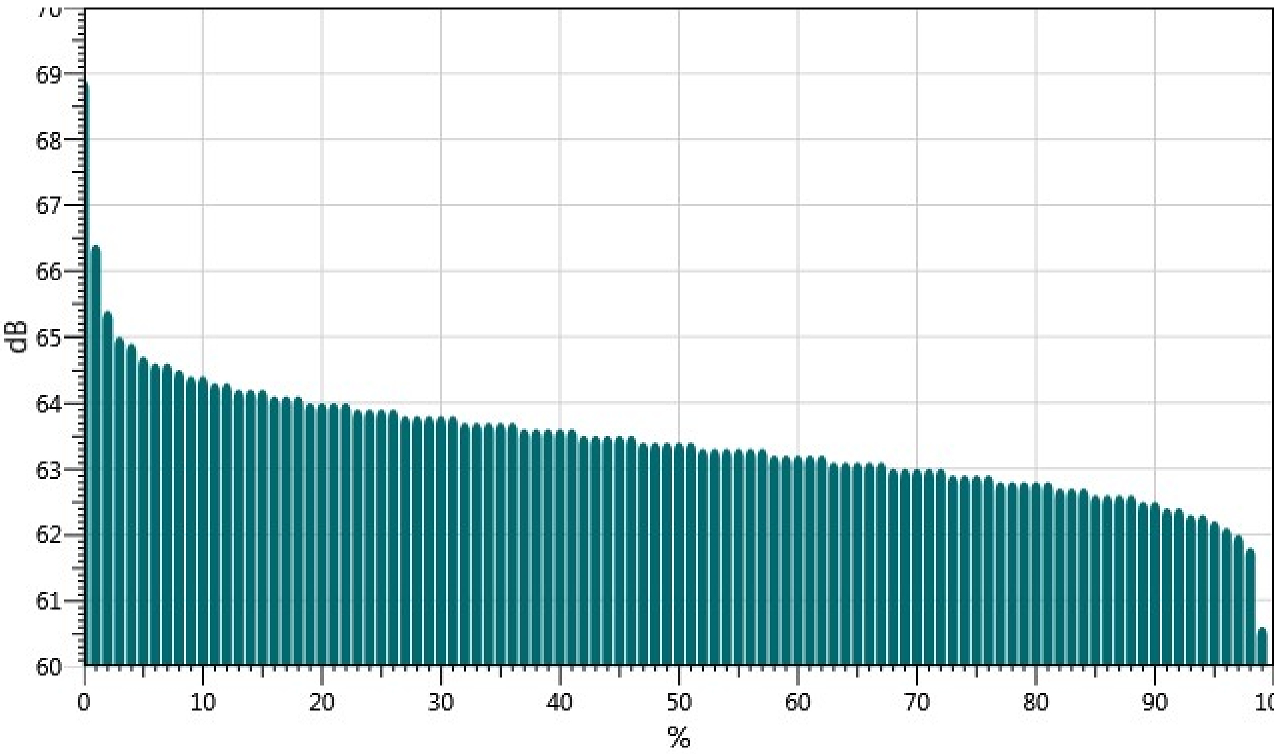
Statistics Table

dB:	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	%
60:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
61:	0.00	0.01	0.01	0.03	0.04	0.07	0.12	0.18	0.26	0.38	1.10
62:	0.57	0.84	0.73	1.27	1.68	2.14	2.64	3.19	3.74	4.23	21.03
63:	4.62	4.92	5.04	5.15	5.19	5.18	5.16	5.06	4.92	4.65	49.89
64:	4.27	3.79	3.29	2.77	2.30	1.88	1.52	1.22	1.00	0.79	22.83
65:	0.65	0.55	0.31	0.33	0.26	0.22	0.17	0.14	0.12	0.10	2.84
66:	0.08	0.07	0.06	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.53
67:	0.04	0.04	0.03	0.04	0.03	0.03	0.03	0.04	0.04	0.04	0.36
68:	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.40
69:	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.35
70:	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.23
71:	0.02	0.02	0.02	0.01	0.02	0.02	0.02	0.01	0.01	0.01	0.16
72:	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.11
73:	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.06
74:	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
75:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
76:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02

dB:	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	%
77:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
78:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
79:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
80:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
81:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
82:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
83:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
84:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
85:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
86:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
87:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
88:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
89:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Exceedance Chart

N5N - 24hrs: Exceedance Chart



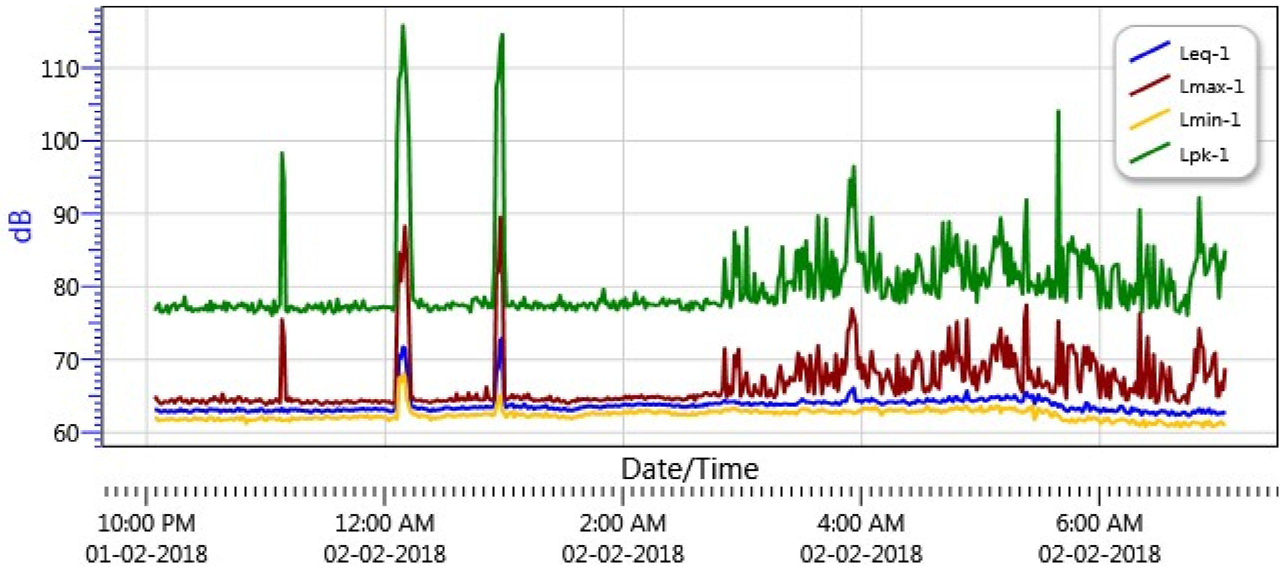
Exceedance Table

.	0%	1%	2%	3%	4%	5%	6%	%7	%8	%9
0%:		68.9	66.4	65.4	65.0	64.9	64.7	64.6	64.6	64.5
10%:	64.4	64.4	64.3	64.3	64.2	64.2	64.2	64.1	64.1	64.1
20%:	64.0	64.0	64.0	64.0	63.9	63.9	63.9	63.9	63.8	63.8

.	0%	1%	2%	3%	4%	5%	6%	%7	%8	%9
30%:	63.8	63.8	63.8	63.7	63.7	63.7	63.7	63.7	63.6	63.6
40%:	63.6	63.6	63.6	63.5	63.5	63.5	63.5	63.5	63.4	63.4
50%:	63.4	63.4	63.4	63.3	63.3	63.3	63.3	63.3	63.3	63.2
60%:	63.2	63.2	63.2	63.2	63.1	63.1	63.1	63.1	63.1	63.0
70%:	63.0	63.0	63.0	63.0	62.9	62.9	62.9	62.9	62.8	62.8
80%:	62.8	62.8	62.8	62.7	62.7	62.7	62.6	62.6	62.6	62.6
90%:	62.5	62.5	62.4	62.4	62.3	62.3	62.2	62.1	62.0	61.8
100%:	60.6									

Logged Data Chart

N5N - 24hrs: Logged Data Chart



Logged Data Table

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
01-Feb-18 10:04:00 PM	63.2	65	62	76.7
10:05:00 PM	63.1	64.6	62	77.2
10:06:00 PM	63	64.2	61.6	77.7
10:07:00 PM	62.8	63.9	61.8	76.5
10:08:00 PM	62.9	64	61.7	76.5
10:09:00 PM	63	64.3	61.8	76.8
10:10:00 PM	62.9	64.2	61.9	77.4
10:11:00 PM	62.8	64.1	61.7	76.4
10:12:00 PM	63	64.5	61.9	77.1
10:13:00 PM	62.9	64.5	61.9	77.5
10:14:00 PM	62.8	64	61.8	77.7
10:15:00 PM	63	64.5	61.7	76.8

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
10:16:00 PM	62.9	64.7	61.7	77.3
10:17:00 PM	63.2	64.8	61.9	77.5
10:18:00 PM	62.9	64.2	61.8	77.4
10:19:00 PM	63	64.2	61.9	78.6
10:20:00 PM	63	64.5	61.9	76.9
10:21:00 PM	62.8	64	61.7	76.8
10:22:00 PM	62.8	64	61.7	77.2
10:23:00 PM	62.9	64.6	61.8	76.6
10:24:00 PM	63.1	64.3	62.1	76.8
10:25:00 PM	63.1	64.4	61.9	76.9
10:26:00 PM	63.1	64.3	61.8	76.7
10:27:00 PM	63	64	62	77
10:28:00 PM	63	64.5	61.8	77
10:29:00 PM	63	64.2	61.8	76.8
10:30:00 PM	62.8	63.9	61.6	77.5
10:31:00 PM	63.1	64.3	62	76.7
10:32:00 PM	63.2	64.6	62.1	78
10:33:00 PM	63.1	64.4	62	76.7
10:34:00 PM	63.1	64.9	61.6	77.6
10:35:00 PM	63.1	64.6	61.8	77.1
10:36:00 PM	63.1	64.4	62	77.3
10:37:00 PM	62.8	64.1	61.6	77.2
10:38:00 PM	63	65.3	61.7	76.9
10:39:00 PM	63.1	64.6	61.8	77.9
10:40:00 PM	62.9	64.1	61.8	76.7
10:41:00 PM	63	64.3	61.8	77.8
10:42:00 PM	63.1	64.5	61.9	77.3
10:43:00 PM	62.9	64.6	61.9	77.1
10:44:00 PM	62.9	64	61.7	76.9
10:45:00 PM	63.1	64.5	62	77.1
10:46:00 PM	63.3	64.9	62.1	77.6
10:47:00 PM	63	64.8	61.7	77.3
10:48:00 PM	63.2	64.2	62.2	77.8
10:49:00 PM	63.1	64.3	62	77.2
10:50:00 PM	62.9	64.6	61.2	77.6
10:51:00 PM	62.8	64.4	61.8	76.7
10:52:00 PM	62.9	64	61.6	76.9
10:53:00 PM	63	64.3	61.8	77.7
10:54:00 PM	62.9	64.2	61.7	76.4

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
10:55:00 PM	63.1	64.5	61.8	76.7
10:56:00 PM	62.9	64.3	61.9	76.9
10:57:00 PM	63.2	64.6	62	78.1
10:58:00 PM	63.2	64.2	62.2	77.2
10:59:00 PM	62.9	64.1	61.8	77.2
11:00:00 PM	62.8	63.8	61.6	76.8
11:01:00 PM	63	64	62.1	77.3
11:02:00 PM	62.9	64.4	62	76.8
11:03:00 PM	62.9	64	62	76.1
11:04:00 PM	63	64.2	62	78.1
11:05:00 PM	63.1	64.6	61.8	76.5
11:06:00 PM	63.1	64.4	61.7	77.1
11:07:00 PM	62.9	64	62	77.5
11:08:00 PM	63.3	75.5	61.6	98.3
11:09:00 PM	62.9	73.2	61.6	94.7
11:10:00 PM	63.1	64.6	61.8	76.8
11:11:00 PM	62.8	64.3	61.8	76.5
11:12:00 PM	63.2	64.8	61.5	77.3
11:13:00 PM	63.1	64.2	62.1	77.3
11:14:00 PM	63.1	64.5	61.9	76.8
11:15:00 PM	63.2	64.4	61.9	77
11:16:00 PM	63	64.5	61.8	77
11:17:00 PM	63.1	64.3	62	76.5
11:18:00 PM	63	63.9	62	76.6
11:19:00 PM	63	64.1	62	76.9
11:20:00 PM	62.9	64	61.9	76.6
11:21:00 PM	63	64.4	61.9	77.6
11:22:00 PM	62.8	64	62	77.3
11:23:00 PM	62.8	64	61.9	77
11:24:00 PM	63	64.3	62.1	77
11:25:00 PM	63.1	64.4	62.1	77.6
11:26:00 PM	63	64.2	62	77
11:27:00 PM	63	64	62	77
11:28:00 PM	62.8	63.8	61.9	77.8
11:29:00 PM	62.9	63.9	61.9	76.4
11:30:00 PM	63	64.2	62.2	76.8
11:31:00 PM	63.1	64.3	62.2	77.2
11:32:00 PM	63	64	62.1	78
11:33:00 PM	62.9	64.1	62	76.9

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
11:34:00 PM	62.9	63.9	62	76.4
11:35:00 PM	63	64.3	62	76.6
11:36:00 PM	63.2	64.2	61.9	78.3
11:37:00 PM	63	63.9	62.1	76.7
11:38:00 PM	63	64.1	62.1	77.2
11:39:00 PM	63.2	64.3	62.2	77
11:40:00 PM	63.1	64.2	62.1	77.4
11:41:00 PM	63.1	64.4	62.1	77.4
11:42:00 PM	63	64.1	62	76.5
11:43:00 PM	63.1	64.3	62	77.5
11:44:00 PM	63	64	62.2	77
11:45:00 PM	63.2	64.1	62.2	78
11:46:00 PM	63.1	64.2	62	77.2
11:47:00 PM	63.2	64.3	62.3	76.8
11:48:00 PM	63.2	64.5	62.3	77.3
11:49:00 PM	63.3	64.3	62.2	78.1
11:50:00 PM	63.1	64.4	62.1	77
11:51:00 PM	63.2	64.2	62.4	76.9
11:52:00 PM	63.2	64.4	62	76.7
11:53:00 PM	63.1	64.2	62	77
11:54:00 PM	63.2	64.1	62.2	77.1
11:55:00 PM	63.3	64.4	62.1	77.1
11:56:00 PM	63.2	64.3	62.3	76.9
11:57:00 PM	63.1	64	62.1	77.2
11:58:00 PM	63.2	64.3	62.2	77.1
11:59:00 PM	63.2	64.3	62.1	77.3
02-Feb-18 12:00:00 AM	63.1	64.3	62.1	77.1
12:01:00 AM	63.1	64.1	62	77.2
12:02:00 AM	62.9	64.3	61.6	77.1
12:03:00 AM	62.9	64	61.9	77.2
12:04:00 AM	62.9	63.9	62.1	76.7
12:05:00 AM	63.2	64.4	62.1	77.6
12:06:00 AM	64.8	76	61.9	100.3
12:07:00 AM	70.6	84.6	67.5	108.3
12:08:00 AM	70.2	80.8	66.9	109.6
12:09:00 AM	71.7	84	68.1	115.8
12:10:00 AM	71.5	88.3	67.6	111.6
12:11:00 AM	68.4	83.8	64.5	107
12:12:00 AM	66.6	75.4	63.6	100.1

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
12:13:00 AM	63.8	65	62.8	85.7
12:14:00 AM	63.4	64.8	62.5	78.2
12:15:00 AM	63.5	64.4	62.6	78.1
12:16:00 AM	63.3	64.4	62.4	77.9
12:17:00 AM	63.2	64.4	62.1	77.1
12:18:00 AM	63.4	64.5	62.4	78.3
12:19:00 AM	63.3	64.2	62.3	77.3
12:20:00 AM	63.2	64.3	62.3	77.3
12:21:00 AM	63.2	64.3	62.3	77.6
12:22:00 AM	63	64.1	62.1	76.7
12:23:00 AM	62.9	64.1	61.7	76.6
12:24:00 AM	63.2	64.3	62.1	77
12:25:00 AM	63	64.2	61.9	77.3
12:26:00 AM	63.1	64.5	62.1	77.4
12:27:00 AM	63.1	64.4	62	76.8
12:28:00 AM	63.2	64.2	62.1	77.1
12:29:00 AM	63.2	64.4	62.2	77
12:30:00 AM	63.4	64.3	62.2	76.9
12:31:00 AM	63.4	64.3	62.5	77.6
12:32:00 AM	63.4	64.5	62.4	77.6
12:33:00 AM	63.3	64.7	62.4	77
12:34:00 AM	63.2	64.3	62.2	77.9
12:35:00 AM	63.2	64.3	62.3	77.5
12:36:00 AM	63.3	65.3	62.3	77.6
12:37:00 AM	63.3	64.4	62.4	77.4
12:38:00 AM	63.3	64.6	62.3	77.4
12:39:00 AM	63.5	64.8	62.5	77.6
12:40:00 AM	63.3	64.4	62.5	77.3
12:41:00 AM	63.3	64.5	62.3	77.4
12:42:00 AM	63.3	65.4	62.3	77.1
12:43:00 AM	63.4	64.5	62.4	76.5
12:44:00 AM	63.4	64.8	62.5	78.3
12:45:00 AM	63.5	64.6	62.3	78.3
12:46:00 AM	63.4	65.3	62.5	78.5
12:47:00 AM	63.4	64.5	62.4	78
12:48:00 AM	63.5	64.5	62.4	77.8
12:49:00 AM	63.4	64.5	62.5	77.2
12:50:00 AM	63.4	64.5	62.6	78.6
12:51:00 AM	63.6	66.2	62.6	77.8

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
12:52:00 AM	63.4	64.8	62.5	77.1
12:53:00 AM	63.5	64.5	62.6	77.8
12:54:00 AM	63.4	64.4	62.3	77.1
12:55:00 AM	63.7	64.9	62.5	82.7
12:56:00 AM	68.2	81.7	63.6	107.3
12:57:00 AM	68.9	82	64.6	108.6
12:58:00 AM	72.7	89.5	65.1	113
12:59:00 AM	72.9	85.8	63	114.6
1:00:00 AM	63.8	65	62.6	84.7
1:01:00 AM	63.4	64.5	62.1	77.3
1:02:00 AM	63.7	64.7	62.5	77.4
1:03:00 AM	63.7	64.8	62.7	77.3
1:04:00 AM	63.9	65.2	62.8	78
1:05:00 AM	63.4	64.7	62.1	77.5
1:06:00 AM	63.6	65	62.7	77.1
1:07:00 AM	63.6	65	62.5	76.9
1:08:00 AM	63.4	64.6	62.4	77.8
1:09:00 AM	63.5	64.6	62.6	77.3
1:10:00 AM	63.9	65.1	62.4	78.5
1:11:00 AM	63.6	64.7	62.3	77.1
1:12:00 AM	63.3	65.3	62.1	77.5
1:13:00 AM	63.5	64.6	62.2	77.1
1:14:00 AM	63.5	64.6	62.5	76.9
1:15:00 AM	63.2	64.3	62.3	77.8
1:16:00 AM	63.4	64.5	62.5	77.9
1:17:00 AM	63.4	64.4	62.3	77
1:18:00 AM	63.4	64.4	62.5	77.7
1:19:00 AM	63.5	64.6	62.3	77.5
1:20:00 AM	63.5	64.4	62.2	76.9
1:21:00 AM	63.7	64.7	62.7	77.3
1:22:00 AM	63.3	64.5	62.3	77.4
1:23:00 AM	63.3	65	62.2	77.1
1:24:00 AM	63.4	64.4	62.4	77.6
1:25:00 AM	63.2	64.2	62.3	76.8
1:26:00 AM	63.2	64.5	62.4	77.8
1:27:00 AM	63.3	64.7	62.1	77.4
1:28:00 AM	63.1	64.2	62	78.8
1:29:00 AM	63.1	64.2	62.2	77.3
1:30:00 AM	63.3	64.4	62.3	77.9

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
1:31:00 AM	63.2	64.1	62	76.8
1:32:00 AM	63	63.9	62.1	77.3
1:33:00 AM	63.1	64.1	62.1	77.8
1:34:00 AM	63	64.3	61.9	76.9
1:35:00 AM	63.1	64.4	62.1	77.2
1:36:00 AM	63.2	64.2	62.1	76.7
1:37:00 AM	63.2	64.7	62.2	77.6
1:38:00 AM	63.4	64.4	62.4	77.3
1:39:00 AM	63.4	64.6	62.2	77.4
1:40:00 AM	63.5	64.6	62.4	77.8
1:41:00 AM	63.5	64.5	62.6	77.4
1:42:00 AM	63.6	64.7	62.5	77
1:43:00 AM	63.6	64.4	62.5	77.7
1:44:00 AM	63.6	64.5	62.7	77.8
1:45:00 AM	63.5	64.6	62.7	77.5
1:46:00 AM	63.5	64.6	62.5	76.8
1:47:00 AM	63.5	64.5	62.6	77.4
1:48:00 AM	63.4	64.4	62.5	78.3
1:49:00 AM	63.4	64.4	62.6	78
1:50:00 AM	63.6	64.5	62.5	79.6
1:51:00 AM	63.5	64.5	62.6	77.6
1:52:00 AM	63.7	64.8	62.8	77.9
1:53:00 AM	63.6	64.6	62.4	77.1
1:54:00 AM	63.6	64.5	62.7	77.1
1:55:00 AM	63.6	64.6	62.7	78.1
1:56:00 AM	63.7	64.7	62.7	77
1:57:00 AM	63.6	64.6	62.6	76.8
1:58:00 AM	63.6	64.6	62.6	77.8
1:59:00 AM	63.7	64.7	62.6	78.1
2:00:00 AM	63.8	64.6	62.8	77.2
2:01:00 AM	63.9	65	62.9	78.4
2:02:00 AM	63.7	64.7	62.6	77
2:03:00 AM	63.8	65	63	77.7
2:04:00 AM	63.7	64.6	62.9	77.4
2:05:00 AM	63.7	64.9	62.6	77.6
2:06:00 AM	63.8	64.9	62.7	79.2
2:07:00 AM	63.9	64.9	62.8	77.6
2:08:00 AM	63.9	64.8	63.1	77.6
2:09:00 AM	63.9	65.1	62.9	78.1

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
2:10:00 AM	63.8	64.8	62.8	78.5
2:11:00 AM	63.8	64.6	63	77
2:12:00 AM	63.9	64.9	63.1	77.8
2:13:00 AM	63.8	64.8	62.9	77.6
2:14:00 AM	63.8	64.9	62.9	77.5
2:15:00 AM	63.9	64.9	62.7	77.6
2:16:00 AM	63.8	64.8	62.7	77.4
2:17:00 AM	63.8	65	62.6	77.5
2:18:00 AM	63.9	64.9	63	77.5
2:19:00 AM	63.8	64.8	62.9	78
2:20:00 AM	63.8	64.8	62.8	78.4
2:21:00 AM	63.8	64.6	62.9	77.5
2:22:00 AM	63.7	64.7	62.7	77.4
2:23:00 AM	63.8	64.8	62.9	78.2
2:24:00 AM	63.7	64.5	62.5	77.8
2:25:00 AM	63.6	64.5	62.5	78
2:26:00 AM	63.6	64.7	62.7	77.7
2:27:00 AM	63.7	64.7	62.4	78.1
2:28:00 AM	63.7	64.7	62.5	78.2
2:29:00 AM	63.5	64.6	62.5	76.9
2:30:00 AM	63.5	64.4	62.4	77
2:31:00 AM	63.5	64.6	62.6	76.9
2:32:00 AM	63.5	64.6	62.4	77.6
2:33:00 AM	63.6	65	62.4	76.7
2:34:00 AM	63.6	64.8	62.4	77.9
2:35:00 AM	63.8	65.1	62.7	77
2:36:00 AM	63.5	64.4	62.4	77.9
2:37:00 AM	63.6	65.1	62.5	77.8
2:38:00 AM	63.6	65	62.7	77.5
2:39:00 AM	63.7	65	62.7	77
2:40:00 AM	63.6	65.1	62.6	76.8
2:41:00 AM	63.9	65.4	62.7	78.1
2:42:00 AM	63.7	65.4	62.6	78.3
2:43:00 AM	64	65.2	63	77.6
2:44:00 AM	63.9	65.1	62.9	77.7
2:45:00 AM	63.9	65.3	62.9	77.8
2:46:00 AM	64	65.5	62.9	77.8
2:47:00 AM	64	65.1	62.9	77.6
2:48:00 AM	63.9	65	62.9	77.4

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
2:49:00 AM	64	65.2	62.7	77.3
2:50:00 AM	64.2	66	63	78.2
2:51:00 AM	64.4	71.5	63.1	83.8
2:52:00 AM	64.1	64.9	63.2	78.5
2:53:00 AM	64.2	66.4	63	79.3
2:54:00 AM	64.2	65.2	63.1	77.2
2:55:00 AM	64.2	65.7	63.3	79.1
2:56:00 AM	64.3	70.6	63.3	87.5
2:57:00 AM	64	69	63.1	81.5
2:58:00 AM	64.2	71.4	63.1	85.6
2:59:00 AM	63.9	65	62.9	78.1
3:00:00 AM	63.8	65.7	62.9	78.4
3:01:00 AM	64	67.1	63	79
3:02:00 AM	63.9	68.2	63	88.1
3:03:00 AM	64.1	65.5	63	78.5
3:04:00 AM	63.7	65.1	62.7	78.1
3:05:00 AM	63.8	65	62.9	78
3:06:00 AM	64	66.5	63	81.8
3:07:00 AM	63.9	65.7	63.1	77.8
3:08:00 AM	63.9	65.4	62.9	78.3
3:09:00 AM	64	65.1	62.7	79.5
3:10:00 AM	64.1	67.8	62.8	80.5
3:11:00 AM	63.9	67.6	62.8	78.5
3:12:00 AM	63.7	65	62.8	79.1
3:13:00 AM	63.7	65	62.8	77.8
3:14:00 AM	64.1	65.9	62.8	78.2
3:15:00 AM	63.8	65.2	62.8	78.7
3:16:00 AM	63.7	64.8	62.5	77.5
3:17:00 AM	63.9	65.3	62.8	77.8
3:18:00 AM	63.8	67.7	62.7	81
3:19:00 AM	63.8	69.1	62.5	81.8
3:20:00 AM	63.8	67.4	62.7	85.5
3:21:00 AM	63.9	65.5	62.8	77.9
3:22:00 AM	63.9	67	62.9	80.1
3:23:00 AM	63.8	66.5	62.6	80.7
3:24:00 AM	63.8	67.6	62.7	80.6
3:25:00 AM	63.8	67.2	62.7	80.8
3:26:00 AM	63.8	67.1	62.8	79.5
3:27:00 AM	63.8	68.5	62.5	84.8

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
3:28:00 AM	64.1	70.9	62.8	85
3:29:00 AM	64.2	67.2	63.1	79.6
3:30:00 AM	64.6	70.2	63.2	85.3
3:31:00 AM	64.4	69.5	63.2	82.5
3:32:00 AM	64.1	68.4	63.1	86.3
3:33:00 AM	64.2	65.6	63.2	78.6
3:34:00 AM	64.1	70.6	62.8	83.2
3:35:00 AM	64.1	67.4	62.9	81.1
3:36:00 AM	63.9	65.3	62.7	78.5
3:37:00 AM	64.2	69.3	62.9	82.4
3:38:00 AM	64.2	71.9	63	89.7
3:39:00 AM	64.2	68.5	62.9	82.9
3:40:00 AM	64	65.3	63.2	78.2
3:41:00 AM	64.3	67.1	63	79.7
3:42:00 AM	64.1	69.5	62.9	89.3
3:43:00 AM	64.1	66.5	62.9	79.9
3:44:00 AM	64	67.9	62.7	79.7
3:45:00 AM	63.9	68.1	62.8	84.8
3:46:00 AM	63.9	66.2	62.7	78.6
3:47:00 AM	64.2	70.7	62.9	83.8
3:48:00 AM	63.9	65.7	62.8	78.9
3:49:00 AM	63.8	67.7	62.6	80.1
3:50:00 AM	64.3	70	62.9	82.2
3:51:00 AM	64.3	68	63	82.1
3:52:00 AM	64.2	69.3	62.9	83.3
3:53:00 AM	65	73.9	62.9	88.7
3:54:00 AM	65.5	74.4	62.9	94.7
3:55:00 AM	65.8	76.9	62.8	91.1
3:56:00 AM	66.1	75.8	62.6	96.5
3:57:00 AM	64.3	74.7	62.7	88.8
3:58:00 AM	64.3	68.8	62.8	83.5
3:59:00 AM	64.4	70.3	63.1	84.6
4:00:00 AM	64.1	67.5	63	83.3
4:01:00 AM	64.4	69.3	63.3	84.6
4:02:00 AM	64.5	67.2	63.3	80.1
4:03:00 AM	64.5	66.2	63.3	79.3
4:04:00 AM	64.2	68.8	63.1	83.5
4:05:00 AM	64.7	71.1	63.3	89.5
4:06:00 AM	64.4	68.9	63.1	81.9

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
4:07:00 AM	64.4	68.2	63.5	79.6
4:08:00 AM	64.1	68.2	63.1	82.7
4:09:00 AM	64.1	68.1	63	84.5
4:10:00 AM	63.8	65.3	62.4	78.4
4:11:00 AM	63.9	67.2	62.8	78.5
4:12:00 AM	64	67.3	63	78.7
4:13:00 AM	64.2	68.6	63	81.1
4:14:00 AM	64.2	67.9	63.2	80.4
4:15:00 AM	64.2	66.5	63.1	80.1
4:16:00 AM	64.2	65.9	62.9	78.3
4:17:00 AM	64	65.1	63.1	78.1
4:18:00 AM	64.2	70.6	63	82.7
4:19:00 AM	64.2	65.3	63.1	77.8
4:20:00 AM	64.2	65.9	63.1	78.6
4:21:00 AM	64.5	68.8	63.2	81.9
4:22:00 AM	64.1	65.5	62.9	77.9
4:23:00 AM	64.1	67.5	62.8	82.2
4:24:00 AM	63.8	65.9	62.8	82
4:25:00 AM	64	66.1	62.9	79.1
4:26:00 AM	64.2	69.9	62.8	81.7
4:27:00 AM	64	68.8	62.9	80.6
4:28:00 AM	64.5	71.1	62.8	84.4
4:29:00 AM	64.3	70.3	63	83.8
4:30:00 AM	64.2	69.7	62.9	82.5
4:31:00 AM	64.1	65.9	62.9	80.4
4:32:00 AM	64.2	65.5	63.2	79.2
4:33:00 AM	64.7	66.2	63.6	80.3
4:34:00 AM	64.3	65.7	63.1	79.5
4:35:00 AM	64.3	66.8	62.9	79
4:36:00 AM	64.6	71	63.2	85.4
4:37:00 AM	64.2	66.4	62.9	80.1
4:38:00 AM	64.3	66.7	63.1	78.6
4:39:00 AM	64.1	66	63	78.5
4:40:00 AM	64.1	70.8	62.7	82.9
4:41:00 AM	64.5	71.1	63	88.8
4:42:00 AM	64.2	69.3	62.8	82
4:43:00 AM	64.4	69.6	63	82.2
4:44:00 AM	64.9	74.4	63.1	88.9
4:45:00 AM	64.5	70.1	63.3	83.2

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
4:46:00 AM	64.2	68.6	63.1	82.8
4:47:00 AM	64.9	71.9	63.3	86.7
4:48:00 AM	64.9	75.2	63.5	87.1
4:49:00 AM	64.4	69.8	63.2	83
4:50:00 AM	64.5	70.3	63.3	84.3
4:51:00 AM	64.2	67	63.1	79.6
4:52:00 AM	64.9	67.3	63.6	80.1
4:53:00 AM	65.7	75.5	63.6	86.2
4:54:00 AM	64.5	69.1	63.1	82.4
4:55:00 AM	64.4	67.7	63	79.8
4:56:00 AM	64.2	66.6	62.8	79.5
4:57:00 AM	64.4	69	63.1	85.6
4:58:00 AM	64.4	65.8	63.2	77.9
4:59:00 AM	64.6	67.8	63	81.6
5:00:00 AM	64.7	68.5	63.6	80.3
5:01:00 AM	64.7	69.8	62.8	82.5
5:02:00 AM	64.3	69.6	62.9	81.5
5:03:00 AM	64.4	66.9	63	79.9
5:04:00 AM	64.6	67.5	63.1	80.4
5:05:00 AM	64.9	70	63.6	83.1
5:06:00 AM	64.8	72	63.2	84
5:07:00 AM	64.8	71.8	63.3	86.8
5:08:00 AM	64.9	69.9	63.6	85.5
5:09:00 AM	65	72.7	63.6	85.9
5:10:00 AM	64.5	74.2	62.7	89.4
5:11:00 AM	64.7	70.8	63.3	85.9
5:12:00 AM	64.6	69	63.2	81.8
5:13:00 AM	65.1	73.1	63.3	86
5:14:00 AM	64.8	68.9	63.3	80.2
5:15:00 AM	64.7	71.9	63.4	85.3
5:16:00 AM	64.7	69	63.1	80.5
5:17:00 AM	65.1	70.8	63.4	83.2
5:18:00 AM	64.7	69.2	63	81.1
5:19:00 AM	64.3	66.9	62.9	82
5:20:00 AM	64.2	66.1	62.9	80.6
5:21:00 AM	64.2	65.5	62.7	79
5:22:00 AM	65.2	75.6	62.9	87.3
5:23:00 AM	65.5	77.5	62.9	91.9
5:24:00 AM	64.9	67.3	63.4	79.3

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
5:25:00 AM	64.9	68.5	63.1	80.7
5:26:00 AM	65.1	67.4	63.6	80.2
5:27:00 AM	63.9	66.2	61.8	80.1
5:28:00 AM	64.5	66.3	62.4	78.9
5:29:00 AM	65.2	68.8	63.3	81.7
5:30:00 AM	64.5	66.6	63	79.2
5:31:00 AM	64.3	66.2	62.7	79.2
5:32:00 AM	64.7	66.4	62.9	80.8
5:33:00 AM	64.6	67	63.1	80.2
5:34:00 AM	64.5	66.7	62.9	82.8
5:35:00 AM	64	65.6	62.4	78.5
5:36:00 AM	63.7	65.5	62.2	80.9
5:37:00 AM	64.1	65.5	62.8	78.5
5:38:00 AM	63.9	66.9	62.5	80.7
5:39:00 AM	63.5	75.3	62.3	104.1
5:40:00 AM	63.8	66.5	62.1	78.6
5:41:00 AM	63.6	72.3	61.7	85.4
5:42:00 AM	63.2	66.9	61.6	79.3
5:43:00 AM	63	64.7	61.7	78
5:44:00 AM	62.9	71.8	61.6	85.9
5:45:00 AM	63.3	71.7	61.4	84.9
5:46:00 AM	63.4	72	61.9	86.8
5:47:00 AM	63.2	70.8	61.5	84.7
5:48:00 AM	63.1	70.8	61.4	85.1
5:49:00 AM	63.3	66.4	61.9	84.1
5:50:00 AM	63.3	65.6	61.8	78.5
5:51:00 AM	62.8	68.7	61.7	84.9
5:52:00 AM	63.2	71.7	61.5	84.8
5:53:00 AM	64.1	69.4	61.8	83.2
5:54:00 AM	63.9	71.7	62.2	85.7
5:55:00 AM	63	68.5	61.8	82.5
5:56:00 AM	63.4	70.9	62	83.8
5:57:00 AM	63.5	70	62.1	82.3
5:58:00 AM	63.1	69.7	61.8	82.9
5:59:00 AM	63.2	67.2	61.9	80.2
6:00:00 AM	62.8	64.8	61.3	77
6:01:00 AM	63	69.1	61.3	82.8
6:02:00 AM	63.3	66.8	61.9	79.9
6:03:00 AM	62.9	65	61.6	77.2

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
6:04:00 AM	63.1	68.2	62	79.2
6:05:00 AM	62.9	64.7	61.6	77.1
6:06:00 AM	63.1	67.9	61.2	82.1
6:07:00 AM	62.9	68.7	61.3	82.9
6:08:00 AM	62.9	67.3	61.6	83
6:09:00 AM	63	67	61.7	83.1
6:10:00 AM	63.5	66.7	61.7	78.6
6:11:00 AM	63.6	65.2	61.9	77.5
6:12:00 AM	63.2	67.5	61.8	80.8
6:13:00 AM	62.8	64.5	61.7	77.4
6:14:00 AM	62.7	64.5	61.5	76.8
6:15:00 AM	62.6	66	61.2	80.3
6:16:00 AM	63.4	65.9	61.7	79.5
6:17:00 AM	63	65.5	61.7	77.7
6:18:00 AM	63.2	66.9	61.1	80.4
6:19:00 AM	63	65.2	61.3	78.9
6:20:00 AM	63	76.3	60.9	90.6
6:21:00 AM	62.4	64.8	61.2	76.5
6:22:00 AM	62.9	65.6	61.7	81.1
6:23:00 AM	62.9	68.9	60.8	81.7
6:24:00 AM	62.8	73.1	61.2	85.7
6:25:00 AM	62.6	64.8	61.4	77.1
6:26:00 AM	62.7	65	61.1	77.9
6:27:00 AM	62.8	70.7	61.2	85.6
6:28:00 AM	62.4	64.1	61.1	77.3
6:29:00 AM	62.7	64.1	61.7	77.1
6:30:00 AM	62.8	65.4	61.6	78.2
6:31:00 AM	63	69.6	61.5	83.6
6:32:00 AM	62.9	68.5	61.2	81.1
6:33:00 AM	62.9	66.8	61.1	79.3
6:34:00 AM	62.6	64.4	60.9	77.4
6:35:00 AM	62.4	68.9	60.9	82.4
6:36:00 AM	62.9	65.6	61.2	79.5
6:37:00 AM	62.7	65.7	61	80.7
6:38:00 AM	62.4	64.4	60.9	76.7
6:39:00 AM	62.6	64.4	61.5	76.8
6:40:00 AM	62.4	64.1	60.9	76.4
6:41:00 AM	62.6	64.5	60.8	77.9
6:42:00 AM	62.8	65	61.4	77.4

Date/Time	Leq-1	Lmax-1	Lmin-1	Lpk-1
6:43:00 AM	62.7	65.1	61.3	78.8
6:44:00 AM	62.4	64	61	76.1
6:45:00 AM	62.3	66.5	60.9	79.4
6:46:00 AM	62.6	65.9	61.3	81.3
6:47:00 AM	62.9	67.1	61.5	81.9
6:48:00 AM	62.7	71.4	61.3	83.3
6:49:00 AM	63	68.3	61.3	83.9
6:50:00 AM	63.2	74.2	61.3	92.2
6:51:00 AM	62.7	72	61.1	84.7
6:52:00 AM	63.1	71.5	60.7	85.8
6:53:00 AM	62.7	66.9	61.5	81.6
6:54:00 AM	62.9	68	61.1	82.1
6:55:00 AM	63.2	67.8	61.6	83
6:56:00 AM	62.6	68.8	60.9	85.2
6:57:00 AM	62.9	70.4	60.8	83.9
6:58:00 AM	62.8	70.9	61	85.8
6:59:00 AM	62.5	65	61	82.5
7:00:00 AM	62.6	65	61.3	78.5
7:01:00 AM	62.7	66.9	61.5	83.5
7:02:00 AM	62.6	65.9	61.1	82.3
7:03:00 AM	62.9	68.8	60.9	85

Appendix 4.2.14

DOE's The Planning Guidelines for Noise Limits and Control, 2007

ANNEX A
SCHEDULE OF PERMISSIBLE SOUND LEVELS

SCHEDULE 1

MAXIMUM PERMISSIBLE SOUND LEVEL (L_{Aeq}) BY RECEIVING LAND USE FOR PLANNING AND NEW DEVELOPMENT

Receiving Land Use Category	Day Time 7.00 am - 10.00 pm	Night Time 10.00 pm - 7.00 am
Noise Sensitive Areas, Low Density Residential, Institutional (School, Hospital), Worship Areas.	50 dBA	40 dBA
Suburban Residential (Medium Density) Areas, Public Spaces, Parks, Recreational Areas.	55dBA	45 dBA
Urban Residential (High Density) Areas, Designated Mixed Development Areas (Residential - Commercial).	60 dBA	50 dBA
Commercial Business Zones	65 dBA	55 dBA
Designated Industrial Zones	70 dBA	60 dBA

SCHEDULE 2

MAXIMUM PERMISSIBLE SOUND LEVEL (L_{Aeq}) OF NEW DEVELOPMENT (ROADS, RAILS, INDUSTRIAL) IN AREAS OF EXISTING HIGH ENVIRONMENTAL NOISE CLIMATE

Receiving Land Use Category	Day Time 7.00 am - 10.00 pm	Night Time 10.00 pm -7.00am
Noise Sensitive Areas, Low Density Residential	L_{90} + 10 dBA	L_{90} + 5 dBA
Suburban and Urban Residential Areas	L_{90} + 10 dBA	L_{90} + 10 dBA
Commercial, Business	L_{90} + 10 dBA	L_{90} + 10 dBA
Industrial	L_{90} + 10 dBA	L_{90} + 10 dBA

L_{90} is the measured ninety percentile sound level for the respective time period of the existing areas of interest in the absence of the proposed new development.

SCHEDULE 3

MAXIMUM PERMISSIBLE SOUND LEVEL (L_{Aeq}) TO BE MAINTAINED AT THE EXISTING NOISE CLIMATE

Existing Levels	New Desirable Levels	Maximum Permissible Levels
L_{Aeq}	L_{Aeq}	L_{Aeq} + 3 dBA

Appendix 4.2.15

DOE's Permissible Maximum Noise Limit

JABATAN ALAM SEKITAR

NEGERI SARAWAK
KEMENTERIAN SUMBER ASLI DAN ALAM SEKITAR,
TINGKAT 7, 8 DAN 9, WISMA STA,
26, JALAN DATUK ABANG ABDUL RAHIM,
93450 KUCHING, SARAWAK.

Telefon : 082-482535 / 339535 / 342354
Faks : 082-480863

Ruj. Tuan	:	SEB/EIA/TKCCP/ JA/JR/MZ/17(01)
Ruj. Kami	:	AS(SWK)(B):41/010/ 100/025 Jld 3 (9)
Tarikh	:	12 Jun 2017

Pengarah Projek
(Bintulu Tanjung Kidurong Combined-Cycle Power Plant)
Sarawak Energy Berhad
No. 1, The Isthmus
93050 KUCHING
(u.p : En. Julaidi Rasidi)

No. Faks: 082-344 433

Tuan,

EIA FOR THE PROPOSED TANJUNG KIDURONG COMBINED-CYCLE POWER PLANT, BINTULU, SARAWAK (GTG UNIT-10 AND STG UNIT-11) - APPEAL FOR AMENDMENT ON THE BOUNDARY NOISE LIMIT STIPULATED IN THE EIA APPROVAL CONDITIONS

Saya merujuk kepada surat Tuan bertarikh 28 Februari 2017 mengenai perkara di atas dan mesyuarat di Jabatan ini pada 1 Mac 2017 adalah berkaitan.

2. Setelah meneliti permohonan yang dikemukakan, Jabatan ini mempertimbangkan permohonan tersebut dengan had bunyi bising di sempadan premis *Tanjung Kidurong Combined-Cycle Power Plant,* Bintulu adalah 75 dB(A) untuk waktu siang (7.00 pagi – 10.00 malam) dan 70 dB(A) pada waktu malam (10.00 malam – 7.00 pagi) di semua lokasi pengawasan bunyi bising semasa fasa pembinaan dan juga operasi.

3. Pihak Tuan diingatkan untuk mematuhi had bunyi bising di perkara 2 di atas sepanjang tempoh pembinaan dan operasi premis Tuan.

4. Sebarang pertanyaan, pihak Tuan boleh menghubungi pegawai dari Jabatan ini, En. Al-Hafiz Che Harun (alch@doe.gov.my/samb. 107).

Sekian.

"BERKHIDMAT UNTUK NEGARA"
"NEGARAKU, ALAM SEKITARKU"

Saya yang menurut perintah,

CORPORATE SHARED SERVICES DEPARTMENT
Date Recd: 16 JUN 2017
VP (CSS):
To: Remarks:
① SrMgr(EIA) 16/6/2017.
② Julaidi Fyaplr 16/6

(HAJAH AZURI AZIZAH BT. HAJI SAEDON)
Pengarah
Jabatan Alam Sekitar Negeri Sarawak

...2/-

Appendix 4.4.1

Survey Questionnaire

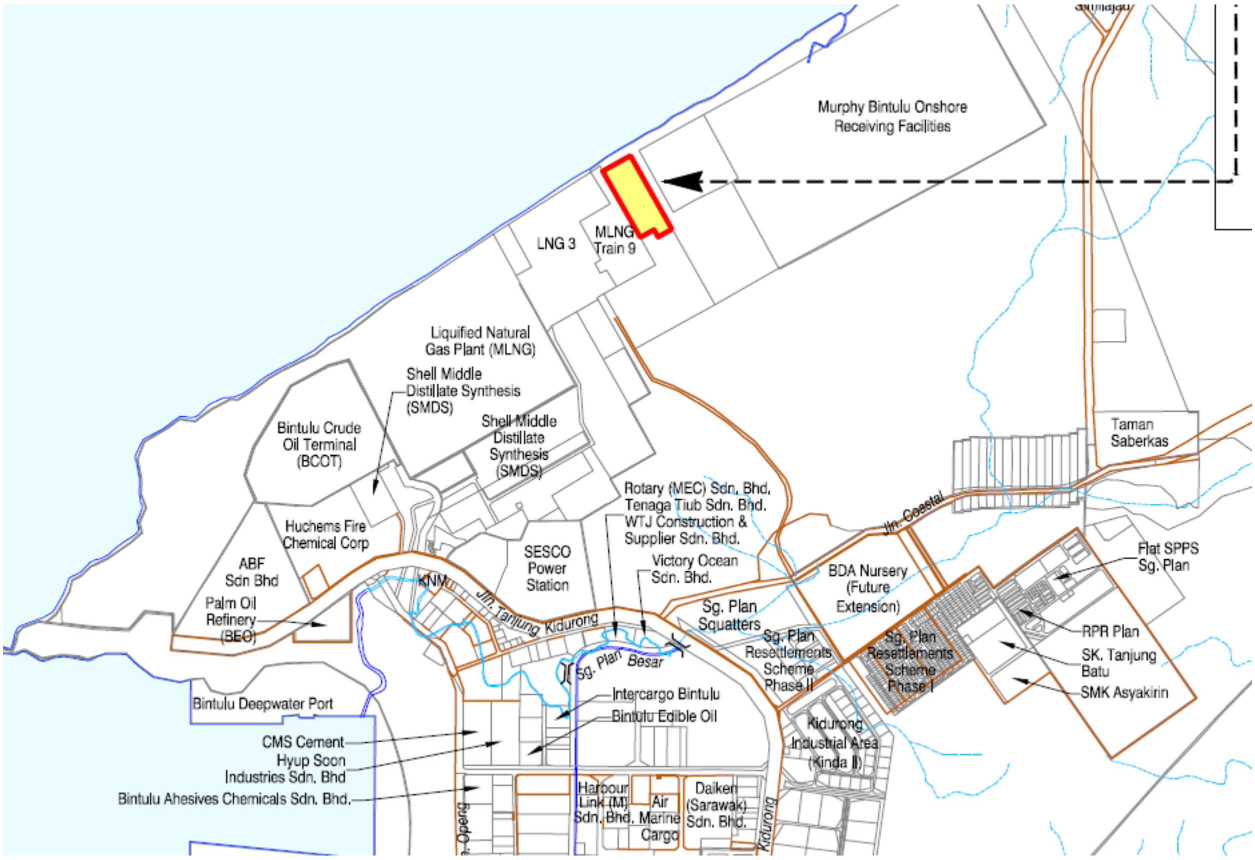
No.

Soal-selidik ini adalah bertujuan untuk mendapatkan maklumat-maklumat asas serta pendapat penduduk mengenai projek *Proposed Tg. Kidurong Combined Cycle Power Plant Project (Unit 12 & 13), Bintulu Division, Sarawak*.

PENGENALAN: LATAR BELAKANG PROJEK

Projek ini adalah untuk pembinaan Blok 400 MW Combined Cycle Gas Turbine (CCGT) di Tanjung Kidurong, Bintulu. Projek itu akan menyaksikan kemajuan baharu teknologi turbin gas yang lebih efisien dalam kitaran padu gas menggantikan turbin yang sedia ada di Stesen Janakuasa Tanjung Kidurong, Bintulu.

Blok CCGT baharu itu akan dibina di dalam kawasan Stesen Janakuasa Tanjung Kidurong, Bintulu, bersebelahan dengan CCGT Block 1. Projek ini dijangka siap pada Suku 4, 2020, dan kuasa elektrik yang dihasilkan akan disalurkan kepada pengguna projek-projek SCORE.



Chemsain Konsultant Sdn Bhd (Syarikat Perunding Alam Sekitar) sedang menjalankan kajian kesan alam sekitar yang mungkin timbul akibat daripada pembinaan dan operasi loji ini.

Kerana loji yang berkenaan terletak berdekatan dengan kawasan petempatan kekal ini, Chemsain ingin mendapatkan maklumat sosio-ekonomi serta pendapat/pandangan penduduk tentang projek yang dicadangkan ini.

Kami amat menghargai kerjasama anda untuk mengisi borang ini. Sila kembalikan borang yang siap diisi kepada wakil Chemsain iaitu En. Benji Jihen, atau En. Elvinson Rosedy.

No. ☐

A: Latar Belakang Responden

Sila isi tempat kosong atau tanda ✓ di mana sesuai.

1. Nama Kampung/Perumahan: ____

2. Tempat Asal (berasal dari mana?): ____

3. Berapa lama anda telah menetap di sini? ________________________________

4. Adakah anda ketua keluarga? a. ☐ Ya b. ☐ Tidak

5. Umur/Usia:
   - ☐ 18 – 24 tahun
   - ☐ 25 – 34 tahun
   - ☐ 35 – 44 tahun
   - ☐ 45 – 54 tahun
   - ☐ 55 – 64 tahun
   - ☐ 65 tahun dan ke atas

6. Jantina: a. ☐ Lelaki b. ☐ Perempuan

7. Bangsa: a. ☐ Melayu b. ☐ Iban c. ☐ Bidayuh d. ☐ Lain-lain: __________________

8. Agama: ______________________

9. Apakah tahap pendidikan saudara:
   - a. ☐ Tidak pernah ke sekolah
   - b. ☐ Darjah 1 sehingga 6
   - c. ☐ Tingkatan 1 sehingga 3
   - d. ☐ Tingkatan 4 sehingga 6
   - e. ☐ Kolej & Institut
   - f. ☐ Univerisiti
   - g. ☐ Lain-Lain: ____________________________

10. Apakah pekerjaan dan punca pendapatan utama anda?
    - a. ☐ Pekerja kilang berdekatan
    - b. ☐ Makan gaji dengan sektor swasta di luar bidang perkilangan
    - c. ☐ Kerja sendiri termasuk perniagaan/bisnes
    - d. ☐ Kakitangan Kerajaan/Awam
    - e. ☐ Petani
    - f. ☐ Surirumah
    - g. ☐ Tidak bekerja/ menganggur
    - h. ☐ Bersara
    - i. ☐ Lain-lain, nyatakan: ____

B: Latar Belakang Isirumah

11. Berapa buah keluarga yang tinggal bersama dalam rumah ini? ______

12. Senaraikan orang yang menetap dalam rumah ini * (termasuk responden). Sila tuliskan/nyatakan bilangan mengikut umur ahli keluarga.

Umur	**Jumlah**	**Lelaki**	**Perempuan**	**Tidak tinggal di rumah**
1 – 14				
15 – 24				
25 – 34				
35 – 64				
65+				
Jumlah besar				

**Termasuk mereka yang tinggal di luar tetapi bukan secara tetap dan juga mereka yang bersekolah di luar. Mereka ini akan balik ke rumah kalau tidak menpunyai perkerjaan atau tidak bersekolah lagi*.

No. [ ]

13. Perkerjaan/Kegiatan/Peranan **semua** anggota isirumah. Sila tuliskan/nyatakan bilangan.

Sektor pekerjaan/ Kegiatan/Peranan	**Lelaki**	**Perempuan**	**Jumlah**	**Tempat kerja/sekolah/ tinggal & Bilangan** (Jika **bukan** di kampong/ perumahan)
Pembinaan/buruh				
Kerja kilang				
Berniaga/business				
Pembantu jualan/ supermarket; restoran dll.				
Sektor swasta				
Sektor awam				
Petani				
Menganggur/sedang mencari kerja				
Pencen/bersara				
Suri rumah				
Tua/cacat/sakit				
Bersekolah				
Anak kecil				
Jumlah besar				

14. Tahap pencapaian tertinggi pendidikan semua anggota isirumah yang **bekerja atau sedang mencari kerja** (tidak termasuk yang sudah bersara). Sila tuliskan/nyatakan bilangan.

Tahap sekolah	**Lelaki**	**Perempuan**	**Jumlah**
Tidak pernah bersekolah			
Darjah 1 sehingga 6			
Tingkatan 1 sehingga 3			
Tingkatan 4 sehingga 6			
Kolej/Institut (Sjil kemahiran/ vokasional/teknikal/Diploma)			
Ijazah/Universiti			
Lain-lain:			
Jumlah			

15. Pendapatan bulanan isirumah (**pendapatan semua orang** yang tinggal dalam rumah ini):

Sektor pekerjaan	**Jumlah (RM)**
Gaji/Upah/Komisen/Bonus	
Perniagaan/Kerja sendiri	
Pertanian/Kebun	
Hasil hutan/ Sungai/ Laut	
Pemberian anak/anggota keluarga	
Sewaan/Dividen	
Lain-lain:	
Jumlah besar	

No. ☐

C. Survei Pendapat

Bahagian ini bertujuan untuk mengumpulkan pandangan dan pendapat saudara/saudari tentang Projek ini. Sila ambil maklum bahawa semua pendapat yang diutarakan adalah sulit dan akan hanya dilaporkan dalam bentuk statistik dan tidak boleh dikaitkan dengan orang atau individu tertentu.

16. Pernahkah anda mendengar mengenai projek ini?

    a. ☐ Ya b. ☐ Tidak

17. Jika **Ya**, daripada siapa/dari mana anda mendengarnya?

    ☐ TV/radio ☐ Taklimat rasmi di kampung
    ☐ Surat khabar ☐ sanak saudara/kawan
    ☐ Pejabat Daerah/agensi kerajaan ☐ Lain-lain ____

18. Pada pendapat anda, adakah projek ini membawa manfaat kepada penduduk sekitar?

    a. ☐ Ya b. ☐ Tidak c. ☐ Tidak pasti

19. Jika **Ya**, apakah kebaikan-kebaikan ini pada pendapat anda? ___________________________________

    ____

    ____

20. Berdasarkan pengetahuan dan fahaman anda, adakah saudara merasa bimbang Projek ini terletak berdekatan?

    a. ☐ Ya b. ☐ Tidak c. ☐ Tidak kisah d. ☐ Tidak pasti

21. Sekiranya **Ya**, apakah kebimbangan anda (*contoh: kesesakan lalu lintas, habuk, bising, lain lain*).

    ____

    ____

    ____

22. Adakah anda sebarang komen atau soalan tambahan tentang Projek ini?

    ____

    ____

    ____

23. Sila nilaikan kualiti alam sekitar dan kemudahan awam di kampong/kawasan kediaman anda sekarang. Tik (✓) ruang yang berkenaan.

Faktor alam sekitar, Kemudahan awam	**Kualiti alam sekitar,** Tik (✓)				
	Baik	Memuskan	Tidak memuaskan	Sangat tidak memuaskan	Tidak pasti
Udara					
Air					
Bunyi					
Ketenteraman					
Pemandangan					
Jalan raya					
Keselamatan awam					

TAMAT. Banci diperiksa: ____________________ Tarikh diperiksa: _________________

Appendix 5.3.1

Coastal Hydraulic Study

The Proposed Bintulu Tanjung Kidurong Combined Cycle Power Plant Project (Unit 9 - 13), Bintulu Division, Sarawak

Hydraulic Study

Sarawak Energy Berhad

February 2018

DR. NIK & ASSOCIATES SDN. BHD.
No. 22 & 24, Jalan Wangsa Delima 6, Seksyen 5, Pusat Bandar Wangsa Maju (KLSC), 53300 Kuala Lumpur
T 603 4145 8888 F 603 4145 8877

DECLARATION FROM THE PROJECT PROPONENT

TITLE : Hydraulic Study for the for the Proposed Tg. Kidurong Combined Cycle Power Plant Project (Units 9 - 13), Bintulu Division, Sarawak

PROJECT PROPONENT : Sarawak Energy Berhad

I declare the following:

i) I have provide correct and relevant information to the hydraulic study team;

ii) I have allowed the Hydraulic Study Team to conduct the hydraulic study professionally and independently;

iii) I have read and understood the content of the Coastal Engineering Hydraulic Study and Impact Evaluation Report;

iv) I agree to implement all mitigating measures proposed in this Coastal Engineering Hydraulic Study and Impact Evaluation Report; and

v) I understand that additional mitigating measures may also be imposed by Department of Irrigation and Drainage Malaysia; should the original mitigating measures proposed in this Coastal Engineering Hydraulic Study and Impact Evaluation Report found not to be adequate to comply with the relevant legal requirements.

Signature :

Official Stamp : SARAWAK ENERGY BERHAD (007199-D)

Name : Haji Johari Atok

I/C No / Passport : 580902-13-5857

Position : Senior Manager EIA, HSSE

Date : 21/02/18

DECLARATION FROM HYDRAULIC STUDY TEAM LEADER

TITLE : Hydraulic Study for the Proposed Bintulu Tanjung Kidurong Combined Cycle Power Plant Project (Unit 9 - 13), Bintulu Division, Sarawak

TEAM LEADER : Ir. Iwan Tan Sofian Tan

I declare the following:

i. I have read and checked the content of this hydraulic report;
ii. My study team members have conducted the study professionally acceptable methodologies;
iii. The study findings are correct to the best of my knowledge; and have not been altered in any manner;
iv. The mitigating measures proposed (whenever relevant) to the best of my knowledge are reliable, practical and adequate to comply with the relevant legal requirement; and
v. Myself and my team shall be accountable for any misleading information in any part of this report

Signature :

Official Stamp : DR. NIK & ASSOCIATES SDN. BHD. (327055-V)

Name : Ir. Iwan Tan Sofian Tan

I/C No / Passport : 680716-13-5085

Position : Manager

Date : 22/02/18

Document Verification

Rev	Date	Description	Prepared by	Reviewed by	Approved by
1	26/02/2018	For submission to JPS	FHKA	ITST	ITST

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Tel: +603 4145 8866
Fax: +603 4145 8877

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FIGURES

Chapter 1

INTRODUCTION

Chapter 1

INTRODUCTION

1.1 Introduction

Sarawak Energy Berhad (hereafter known as “the Client”) intends to construct new intake and outfall structures for the Tanjung Kidurong Combined Cycle Power Plant (CCGT). The Project components (Figure 1.1) are as follows:

a) A new plant consisting of Block 1 (Units 10 and 11) and Block 2 (Units 12 and 13) is constructed within the vicinity of the existing plant. A set of intake and outfall will be installed to support the once-through cooling system for both blocks. The intake and the outfall pipelines are 1,450 m and 320 m from the pumphouse respectively; and
b) Relocation of the existing intake (Unit 9) to a new location that is parallel to the intake of Block 1 and Block 2. The existing outfall will remain functional.

Raw sea water supplied by the proposed intake subsea structure will be pumped into the power plant to cool the condenser units. The cooling water system is designed to be a once-through water supply system. The water exiting from the Heat Recovery Steam Generator (HRSG) as blowdown water will undergo cooling and neutralisation process prior to being discharged to the sea via the outfall structure.

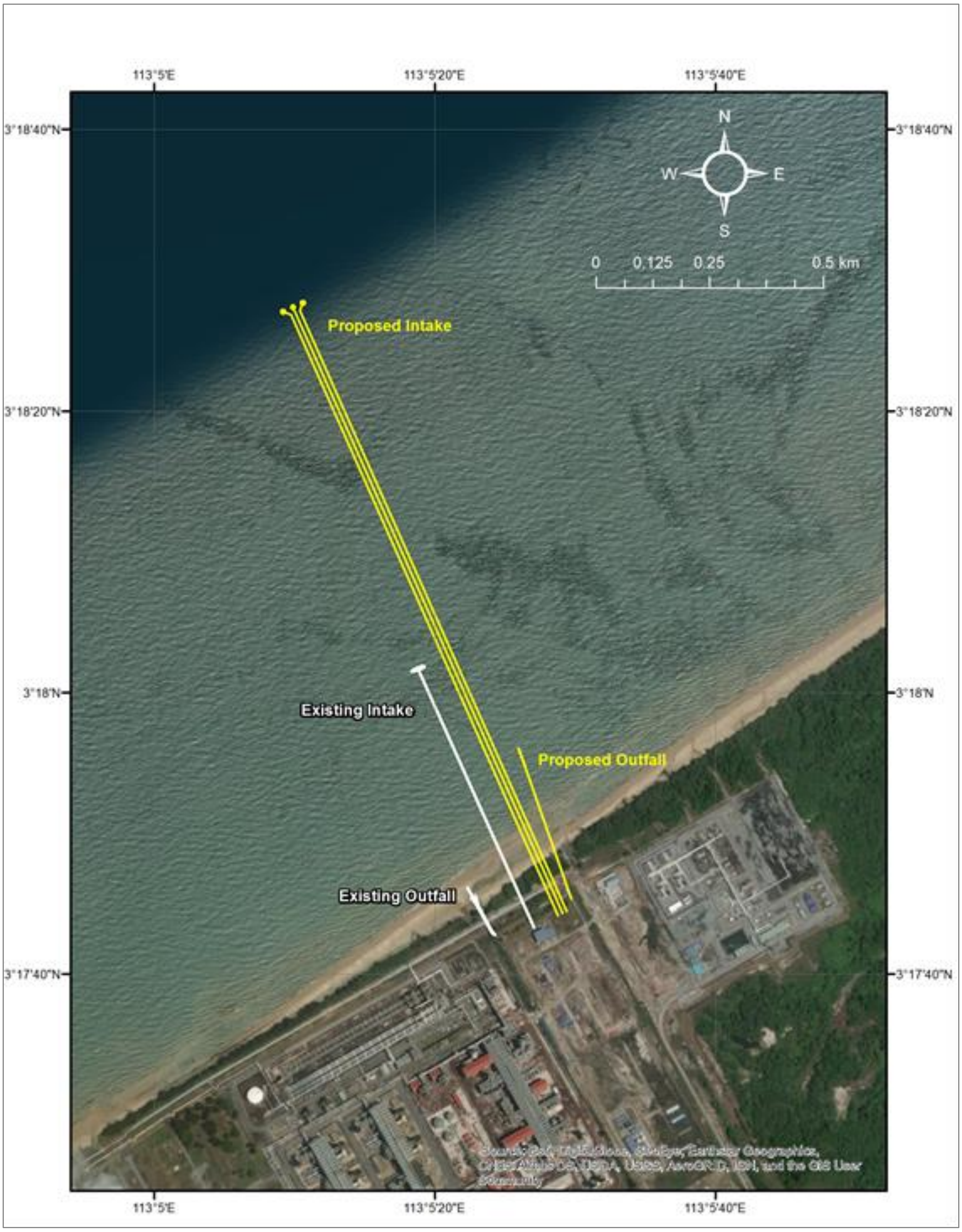


Figure 1.1 Overall view of the proposed new intake and outfall structures for the CCGT Unit 9, Block 1 (Units 10 and 11) and Block 2 (Units 12 and 13)

For a coastal development project such as this, it is important to carry out a hydraulic study to ensure that the Project is implemented successfully and to address possible environmental impacts due to the development. The main thrust of the hydraulic study shall be numerical modelling. The hydraulic study adheres to the “Guidelines for Preparation of Coastal Engineering Hydraulic Study and Impact Evaluations’ (JPS, 2001) and JPS’ 2013 circular regarding additional requirements for the guidelines’ [JPS ref. no. (45) dlmPPS.14/2/23 Jld.2].

In the study, an assessment of oceanographic and coastal conditions within and around the Project site is initially done to determine the existing marine environment. Subsequently, an analysis is carried out to predict potential changes to be expected in the study area in lieu of the “with Project” and during construction conditions through extensive numerical modelling simulations. Results obtained from the model simulations are used for impact assessment of the coastal region within the study area due to Project implementation during construction and operation stages. Recommendations for adequate mitigating measures to minimise potential negative impacts on the environment are then proposed.

DR. NIK & ASSOCIATES SDN BHD (DNASB), an MS ISO 9001 certified engineering consulting company specialising in hydraulics, environmental and coastal engineering, was engaged to conduct the hydraulic study for this Project.

1.2 Project Proponent

The address and contact information for the Project Proponent is as follows:

Sarawak Energy Berhad,
Level 4, South Wing,
No.1, The Isthmus,
93050 Kuching,
Sarawak.

Contact person	:	Haji Johari Atok (Senior Manager, EIA)
Telephone	:	082-388388
Facsimile	:	082-330708
E-mail	:	johari@sarawakenergy.com.my

1.3 Hydraulic Study Consultant

This hydraulic study was carried out by Dr. Nik & Associates Sdn. Bhd. The address and contact information is as follows:

Dr. Nik & Associates Sdn. Bhd.,
No. 22 & 24, Jalan Wangsa Delima 6,
Section 5, Pusat Bandar Wangsa Maju (KLSC),
53300 Kuala Lumpur.

Contact person : Ir. Iwan Tan Sofian Tan
Telephone : 03-4145 8888
Facsimile : 03-4145 8877
E-mail : iwan@drnik.com.my

1.4 Report Presentation

The contents of the report are shown in Table 1.1.

Table 1.1 Report presentation

Chapter		Description
1	Introduction	A brief introduction, scope of works and content of the report is given
2	Site Assessment	Description of the Project site and its surrounding areas, meteo-marine conditions based on field data collection and secondary data with literature review
3	Project Description and Study Approach	A description of the Project and the overall assessment approach is described
4	Hydrodynamics	Assess water levels and current flow utilising a hydrodynamic numerical model
5	Waves	Assess wave propagation using a wave simulation model
6	Thermal Plume and Chlorine Dispersion	Assess dispersion of the cooling water and chlorine discharged from the existing and proposed outfalls
7	Sediment Spill Dispersion	Assess extent and magnitude of suspended sediment dispersion during dredging works
8	Sediment Transport	Assess potential impact due to Project implementation
9	Mitigation Measures	Appropriate mitigating measures are proposed to alleviate potential impacts
10	Conclusion	An overall summary of the findings are presented
References		A list of references used in preparing the report is given

Chapter 2

SITE ASSESSMENT AND METEO-MARINE CONDITION

Chapter 2

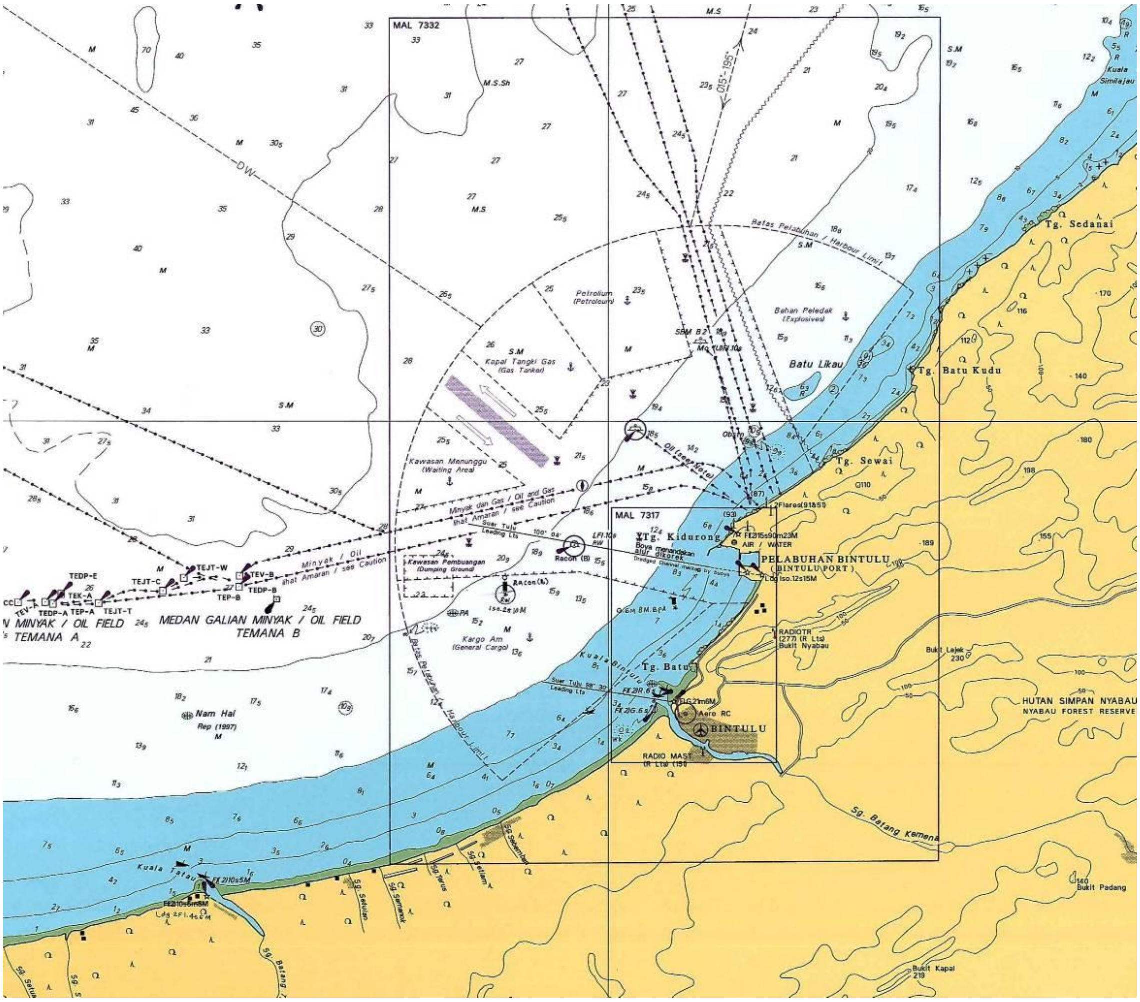
SITE ASSESSMENT AND METEO-MARINE CONDITION

2.1 Introduction

Findings from the site assessment and results from the field investigation works are discussed in this chapter. This information complements the Consultant's general knowledge of the area and data gathered from reports, publications and personal communications. A visit to the site was done in November 2017. This involved about 15 km of the coastline between Bintulu Port (south) and Sungai Likau river mouth (north). Field data including current, water level, seabed and water samples were collected in November 2017. The information obtained forms the basis for the study.

2.2 Location

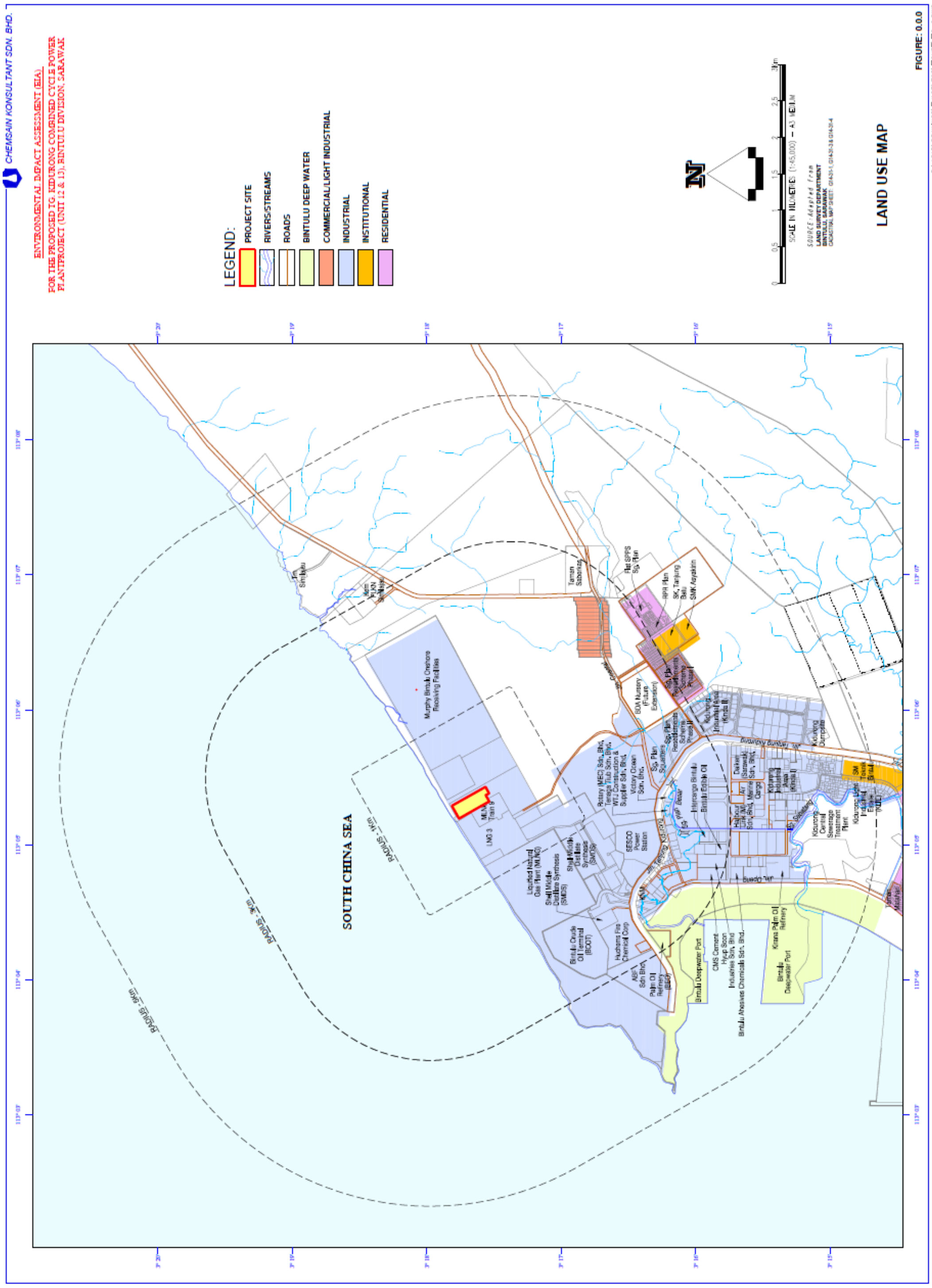
The Project site is about 5 km northeast of Bintulu Port. Figure 2.1 shows the harbour limit for Bintulu Port in the form of a semi-circle from 03° 08.40'N, 112° 57.87'E to 03° 19.74'N, 112° 54.60'E. The Project site is situated within the harbour limit. The Project site is bounded by the headlands of Tanjung Kidurong and Tanjung Payung.



Source: MAL741
Figure 2.1 Project site located within Bintulu Port harbour limit

2.3 Site and Surrounding Areas

The land use within a 5 km radius of the Project site is illustrated in Figure 2.2. Figure 2.3 shows the Project area and its surroundings around the Project site.



Source: Chemsain Konsultant Sdn. Bhd., 2018
Figure 2.2 Landuse within a 5 km radius of the Project site

Figure 2.3 Project site and surrounding areas

Sungai Likau is located about 10 km northeast of the Project site. The coastline immediately north of the river mouth appears to be eroding as evidenced by fallen trees and a high scarp (Figure 2.4). The coastline south of the river mouth is stable; casuarinas vegetate the backshore (Figure 2.5). The coastline located about 6.5 km northeast of the Project site is also stable (Figure 2.6). Vegetation has been cleared to make way for Kampung Nelayan Batu Mandi, a settlement along the coastline about 5 km from the Project site (Figure 2.7).

Figure 2.4
Coastline north of Sungai Likau river mouth

Figure 2.5 Coastline condition south of Sungai Likau river mouth

Figure 2.6 Coastline condition about 6.5 km northeast of Project site

Figure 2.7 Coastline in front of Kampung Nelayan Batu Mandi located about 5 km northeast of Project site

The coastline is rocky and sandy about 3.4 and 2 km northeast of Project site respectively (Figures 2.8 and 2.9). The coastline immediately northeast of the power plant is relatively straight, gentle-sloping and stable (Figures 2.10 and 2.11). The Bintulu Onshore Receiving Facility (BORF) is sited inland of the beach. The plant is owned by Murphy Sarawak Oil Co. Ltd.

Figure 2.8 Rocky coastline about 3.4 km northeast of Project site

Figure 2.9 Coastline condition about 2 km northeast of Project site

Figure 2.10 Coastline immediately northeast of Project site

Figure 2.11 Coastline condition northeast of the power plant

The Project site is situated about 3.5 km northeast of Tanjung Kidurong headland. The relatively straight coastline in front of the Project site is generally sandy and gentle-sloping (Figures 2.12 and 2.13). The scarp behind the beach is vegetated. The sea was rough during the site visit in November 2017 (Figure 2.14). Wave heights of up to 1 m were experienced near the existing intake structure during the site visit. The seawater appeared turbid at the Project site. An outfall discharging foamy warm water can be seen on the beach in front of the power plant. The gentle-sloping beach northeast and southwest of the outfall is separated from the outfall by a pair of training structures made of rocks (Figure 2.15). Tree trunks were found on the beach adjacent to the power plant's outfall (Figure 2.16). The hot water is discharged in the sea via a shallow channel connected to a concrete structure with wing walls (Figure 2.17).

Figure 2.12 Coastline condition at the Project site (facing southwest)

Figure 2.13 Gentle-sloping beach at the Project site

Figure 2.14 Wave condition during site visit

Figure 2.15 Coastline northeast of the power plant's outfall

Figure 2.16 Tree trunks found on the beach adjacent to the power plant's outfall

Figure 2.17 Rocks protecting the outfall located on the beach in front of power plant

Petronas' Malaysian Liquefied Natural Gas (MLNG) facility is located adjacent to the power plant. A rock revetment protects much of the plant's coastline (Figures 2.18 to 2.20). Scarps are evident along the stretch of coastline that is unprotected. A rock revetment protects much of the coastline at the MLNG plant that extends towards Tanjung Kidurong headland (Figures 2.21 and 2.22). The coastline is rocky adjacent to Bintulu Port's northern breakwater (Figure 2.23).

Figure 2.18 Coastline southwest of the power plant's outfall

Figure 2.19 Gentle-sloping beach fronting a rock revetment at the MLNG plant adjacent to the power plant

Figure 2.20 Coastline protected by rock revetment at MLNG plant

Figure 2.21 Coastline protected by rock revetment at MLNG plant about 0.8 km northeast of Tanjung Kidurong headland

Figure 2.22 Rocky coastline protected at Tanjung Kidurong headland

Figure 2.23 Coastline (left) adjacent to Bintulu Port's northern breakwater (right)

2.4 Main Geographical Features

2.4.1 Offshore and Nearshore Conditions

The offshore bathymetry of the Project site is generally governed by the degree of exposure to the wave climate and presence of nearby features such as headlands. A survey conducted in December 2016 is used to ascertain the current bed condition within the immediate vicinity of the Project site. The survey data was supplemented with bathymetric data from Sarawak Nautical chart no. SAR 1 (published in 2009), SAR 401 (published in 2016) and SAR 402 (published in 2013) and most of the offshore bathymetry data is provided by CMAP. The interpolated bathymetry data is shown in Figure 2.24 where it can be seen that the seabed contours are relatively parallel near the coastline.

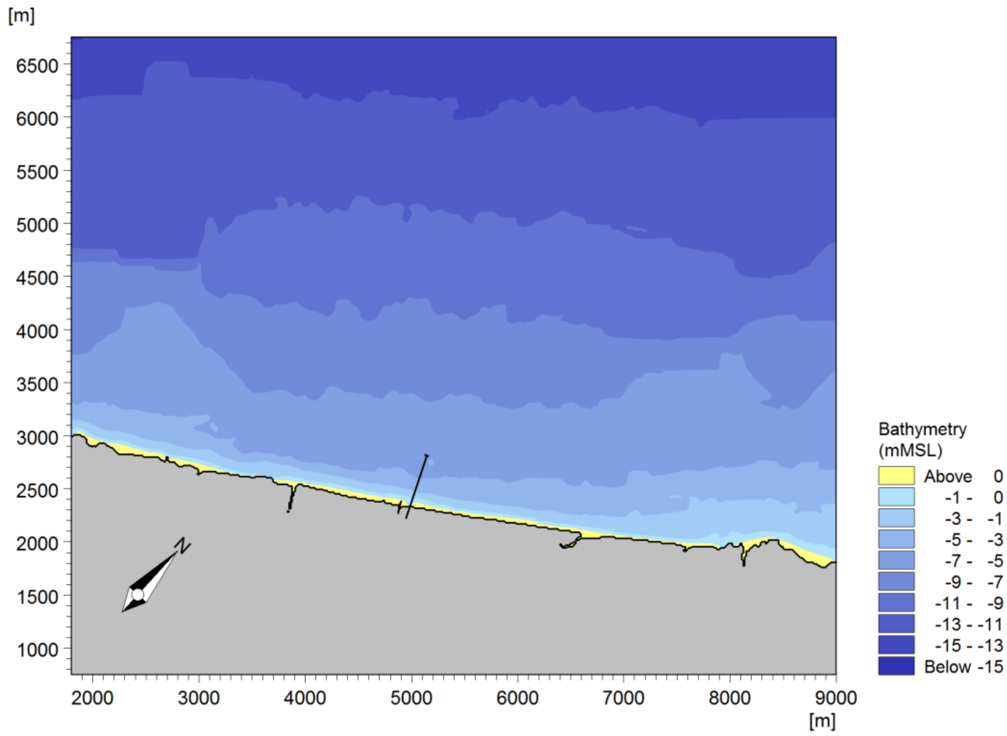


Figure 2.24 Interpolated bathymetry data within and around Project site

2.5 Environmental Forces

2.5.1 Tides

Water level variation within and around the Project site is mainly due to astronomical tides. The tidal and non-tidal processes play a major role in driving forces of dynamics along the South China Sea. River discharges and local meteorological conditions (e.g. wind) play a minor role compared to the tidal and ocean forcing. These driving forces and the local bathymetry form the local hydrodynamics. Tidal information from the Malaysian Tide Tables 2017 published by the National Hydrographic Centre (NHC) for Bintulu Port (a standard port) was referred to (Table 2.1). The tides are mixed but predominantly diurnal. The maximum, mean high water and mean low water tidal range are 2.57, 1.96 and 1.20 m respectively.

Tidal Levels	m CD
Highest Astronomical Tide (HAT)	2.57
Mean Higher High Water (MHHW)	2.50
Mean Lower High Water (MLLW)	2.12
Mean Sea Level (MSL)	1.52
Mean Higher Low Water (MHLW)	0.92
Mean Lower Low Water (MLLW)	0.54
Lowest Astronomical Tide (LAT)	0.00

Source: NHC, 2017

Table 2.1
Tidal datum levels for Bintulu Port, Sarawak

In-situ water level measurements were carried out using two stationary Acoustic Doppler Current Profilers (ADCPs) at the locations shown in Figure 2.25 and Table 2.2. The tidal measurements were done from 9th until 30th November 2017. The recorded water levels are shown in Figure 2.26. The maximum tidal range was about 1.5 and 1 m during spring and neap period respectively during the measurement duration. The tidal measurements are used to validate the hydrodynamic model, MIKE 21 HD.

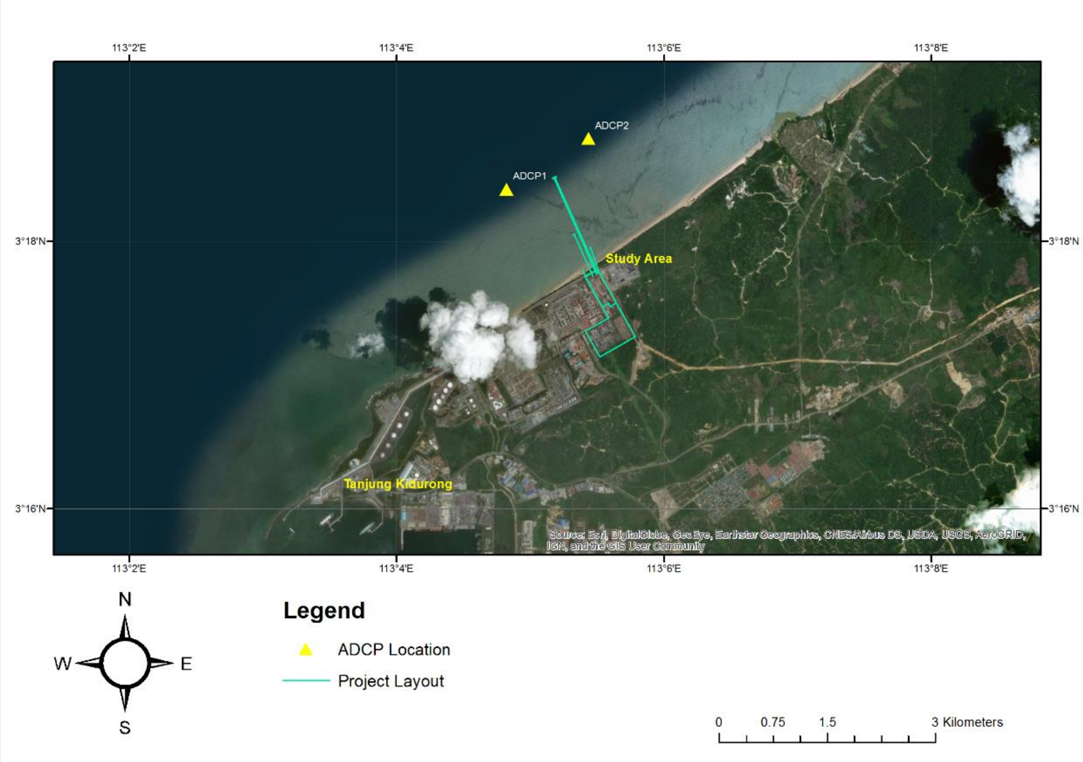


Figure 2.25 Water level measurement locations

Table 2.2
Water level and current measurement locations

Location	Coordinates	
	Longitude (E)	Latitude (N)
ADCP1	113^0 4' 49.4"	3^0 18' 23.3"
ADCP2	113^0 5' 26.2"	3^0 18' 46.0"

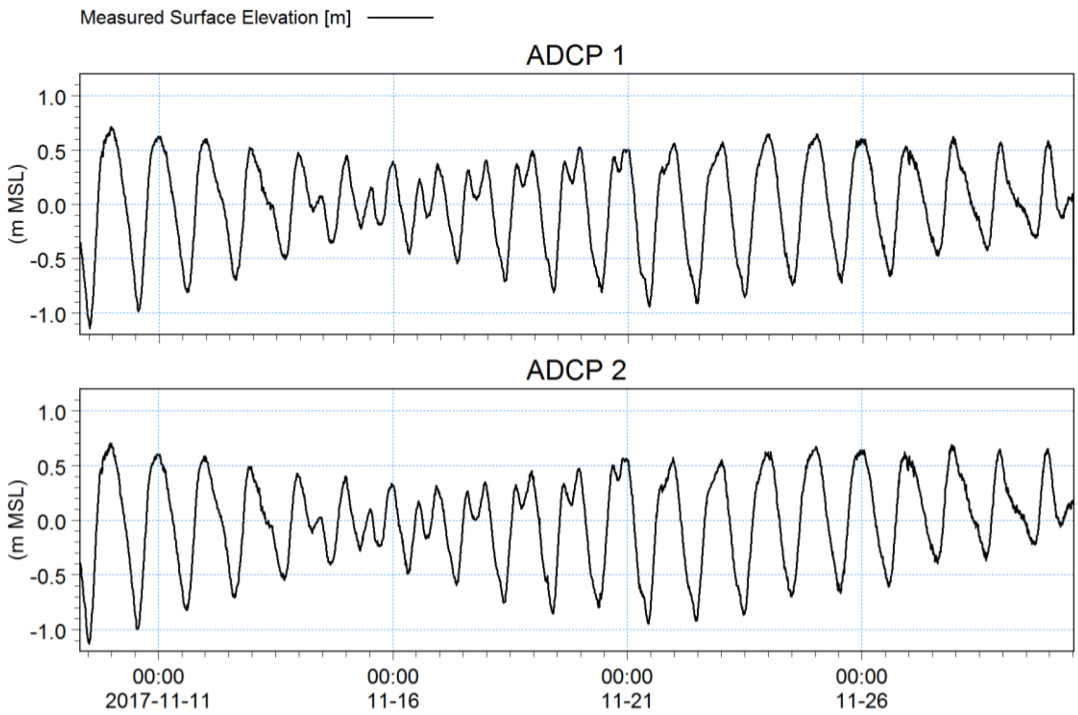


Figure 2.26 Measured water levels

2.5.2 Currents

Sediments are moved in the littoral zone under the action of tides, currents and waves. Coastal currents exert significant influence on the movements of marine sediments and pollutants. Wave-generated long-shore surface currents are primary current-types that occur in the coastal waters.

In-situ measurements of current speed and direction were done at the same locations of the tidal measurements (Figure 2.30) using ADCPs. Current speed and direction were measured at every 1 m cells. Time series of current and water levels measured by both ADCPs are presented in Figures 2.27 and 2.28. The rose plots for current measured are shown in Figure 2.29. It can be deduced from the measurements that the current speed ranges from 0 to 0.8 m/s with dominant directions of 60 and 240°N. The current measurements are used to validate the hydrodynamic model, MIKE 21 HD.

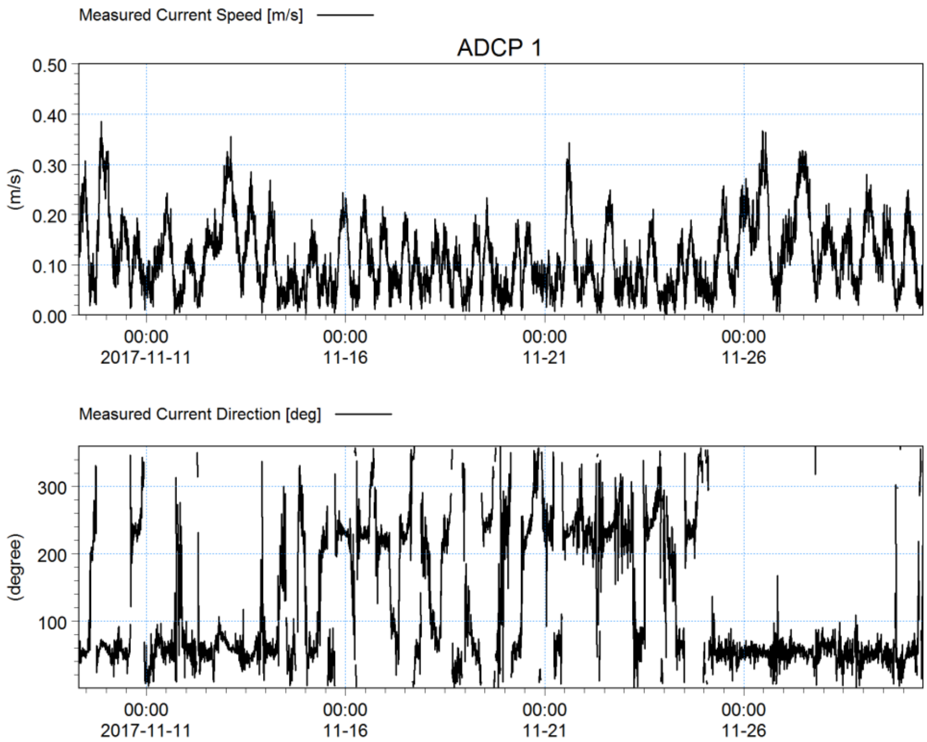


Figure 2.27 Time series plot for current measurement at ADCP1

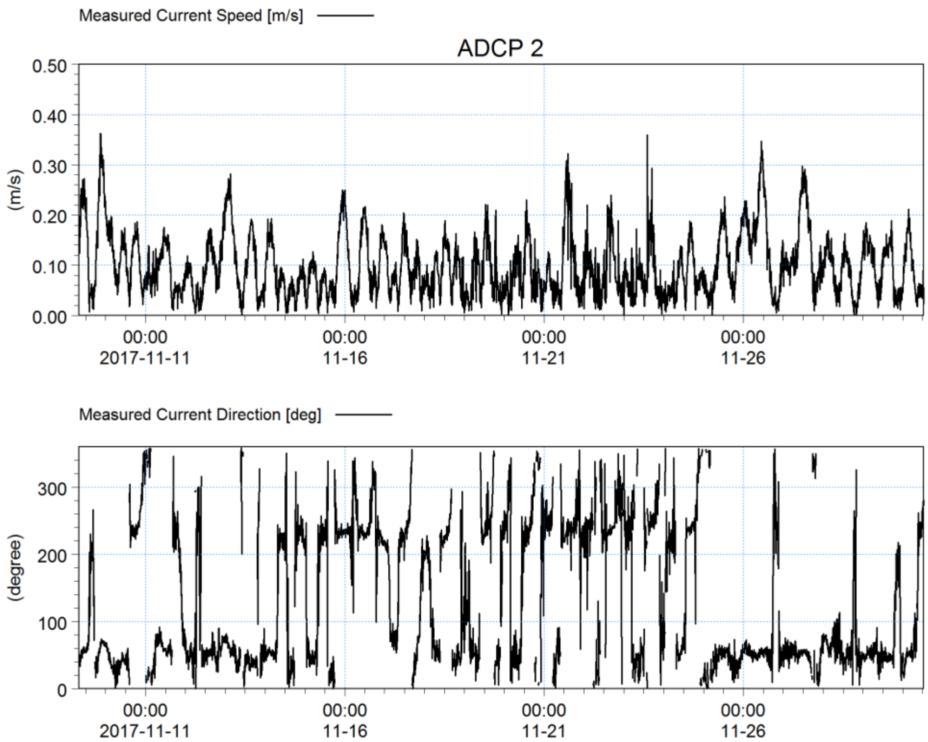


Figure 2.28 Time series plot for current measurement at ADCP2

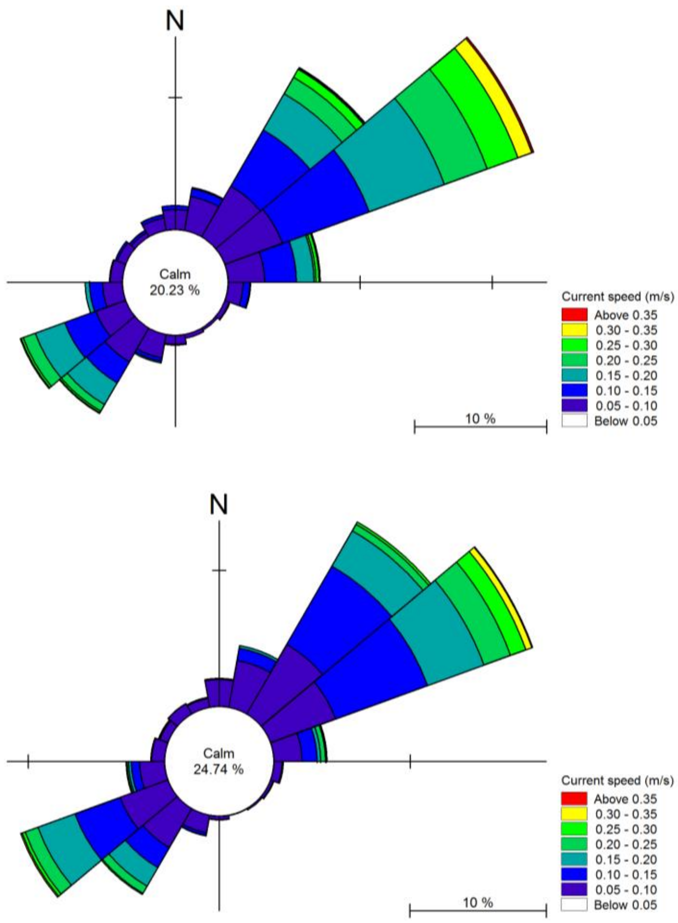


Figure 2.29 Rose plots for current measurement at ADCP1 (top) and ADCP2 (bottom)

2.5.3 Winds

Wind is the primary wave-generating mechanism for wave incident to the study area. Winds at the Project area are mainly governed by the monsoons. The winds are much stronger during the northeast monsoon periods. 6-hourly offshore wind conditions between 1991 and 2010 (20 years) at 112°11.25'E, 3°54.102'N as indicated in Figure 2.30 from Climate Forecast System Reanalysis (CSFR) provided by the National Centre for Environmental Prediction (NCEP).

Figure 2.30 Offshore wind and wave extraction locations

The annual offshore wind rose is shown in Figure 2.31. Based on the annual wind rose, the dominant wind directions are predominantly from the northeastern and southwestern sectors. Calm periods (wind speeds of less than 2 m/s) occur about 15% of the time annually. Seasonal wind roses for both locations are shown in Figure 2.32.

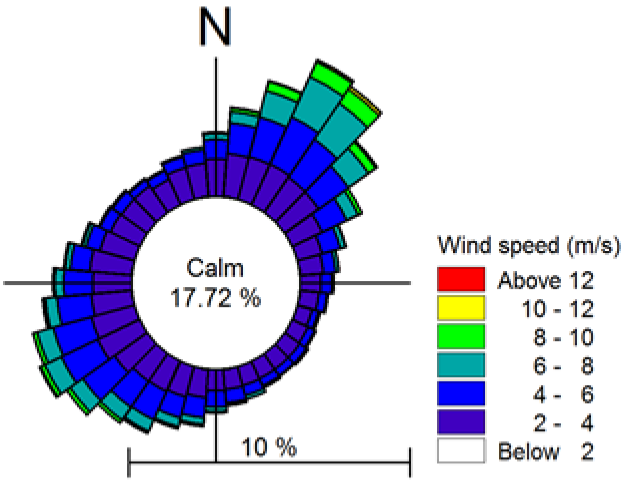
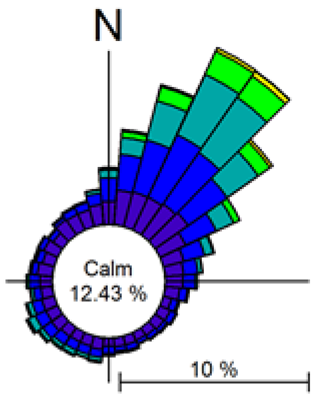
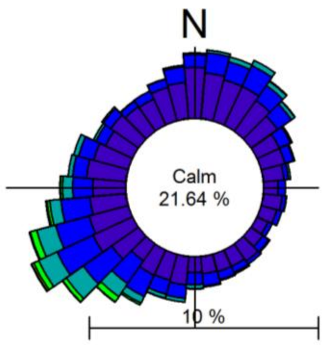


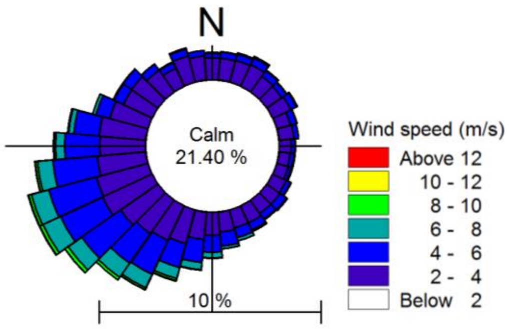
Figure 2.31 Annual offshore wind roses off Project site



a) Northeast Monsoon



b) Inter-monsoon (April and October)



c) Southwest Monsoon

Figure 2.32 Seasonal offshore wind roses

The general meteorological situation off the Project site between November and March implies that winds blow mainly from northeast to southwest at an average speed of about 4 to 8 m/s respectively. The winds blow mainly from the southwest from May to September (Southwest Monsoon) at an average speed of about 2 to 6 m/s respectively. Percentage of wind speed of less than 2 m/s is highest (about 22%) in inter-monsoon period.

Wind measurement (speed and direction) for November and December 2017 at Bintulu Airport (113° 01’ 29” E, 3° 07’ 12” N) was procured from the Malaysian Meteorological Department. The measurement has a temporal resolution of 1 hr. Measurements were made at an elevation of 24.29 m MSL. For modelling purposes, the measurements were converted to 10 m MSL wind speed using the wind profile power law. A roughness parameter of 0.0024 (indicating open terrain with smooth surface) was adopted. The wind rose is shown in Figure 2.33. The rose plot shows that wind primarily comes from the northwest and southeast (landward) during the measurement period. Wind speed of up to 7 m/s from the northwest was observed. The highest wind speed was only up to 4 m/s from the southeast due to the effect of landmass.

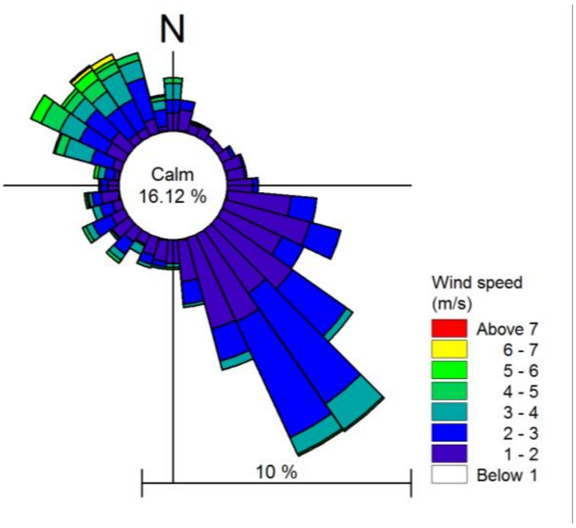


Figure 2.33 Wind rose at Bintulu Airport based on measurement in November and December 2017

2.5.4 Waves

Wave conditions normally experienced within the study area are due to:

a) Wind-generated waves propagate more or less in the wind direction. Wind waves are generated and influenced by local wind fields. The waves are generally relatively steep, irregular and directional. Wind waves shape the coastline as offshore movement of sediments is generated, resulting in a generally flat shoreface and steep foreshore; and

b) Swell waves travelling beyond the generating area to reach the study area. Swell waves travel great distances over deep water after being generated by a far-away wind field. The waves are relatively long, moderate in height, regular and unidirectional. The direction of propagation is dissimilar with the local wind direction. Swell waves tend to build up the coastal profile to a steep shoreface.

Annual offshore wave roses were extracted at the same location of the wind data extraction points. The annual wave rose is shown in Figure 2.34.

It can be inferred from the offshore wave data that offshore waves propagating from the northeast are predominant. Seasonal wave roses are shown in Figure 2.35. Waves from 20 and 260°N are dominant during the Northeast and Southwest Monsoon respectively. The orientation and location of the landmass influences offshore wave propagation. Propagation of waves from the northeast shows influence of waves from the South China Sea. Calm period (wave height of less than 0.5 m) is highest during the Southwest Monsoon period with about 65% occurrence.

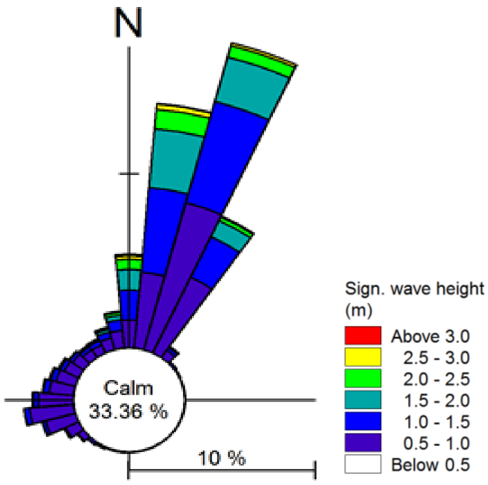
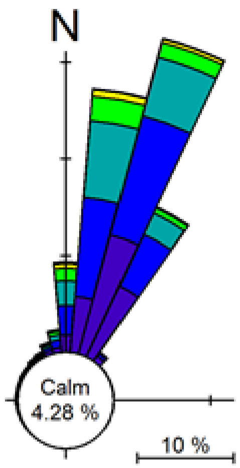
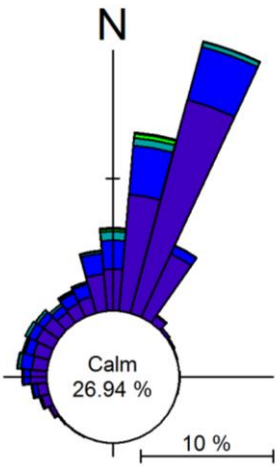
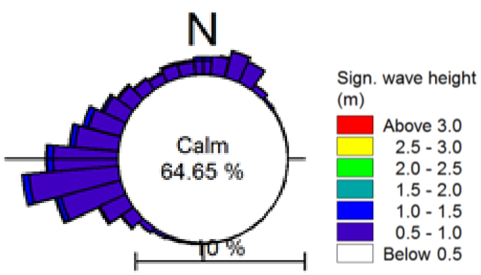


Figure 2.34 Annotated offshore wave roses off the Project area





a) Northeast Monsoon b) Inter-monsoon (April and October)



c) Southwest Monsoon

Figure 2.35 Seasonal offshore wave roses at the Project area

The two ADCPs were also set up to measure waves at the study area. Waves were measured at 1 Hz intervals, which is equivalent to 1 s. The parameters measured include significant wave height, average wave height, peak wave period, mean wave period, mean wave direction and also peak wave direction. The measurement shows relatively high wave heights as the measurement were taken during the Northeast monsoon period.

The time series plots for wave measurements (i.e. wave height, period and direction) are shown in Figures 2.36 and 2.37. Figure 2.38 shows the wave rose during the measurement period for both ADCPs. It can be observed during the measurement period that significant wave height (H_{m0}) of up to 1.5 m can occur with relatively long wave period (T_p) reaching 10 s. The dominant incoming waves are from 320 to 350°N.

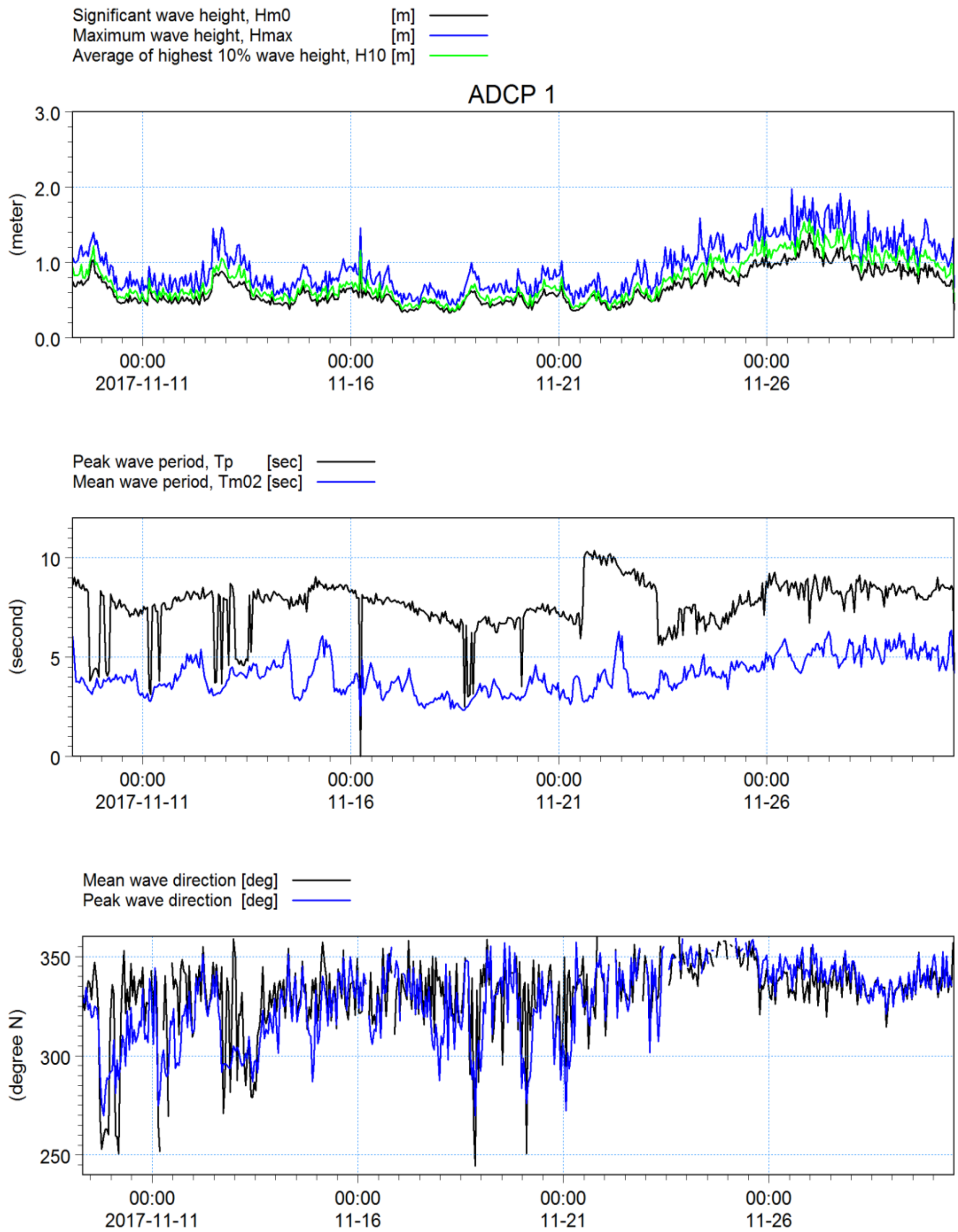


Figure 2.36 Time series plot for wave measurement at ADCP1

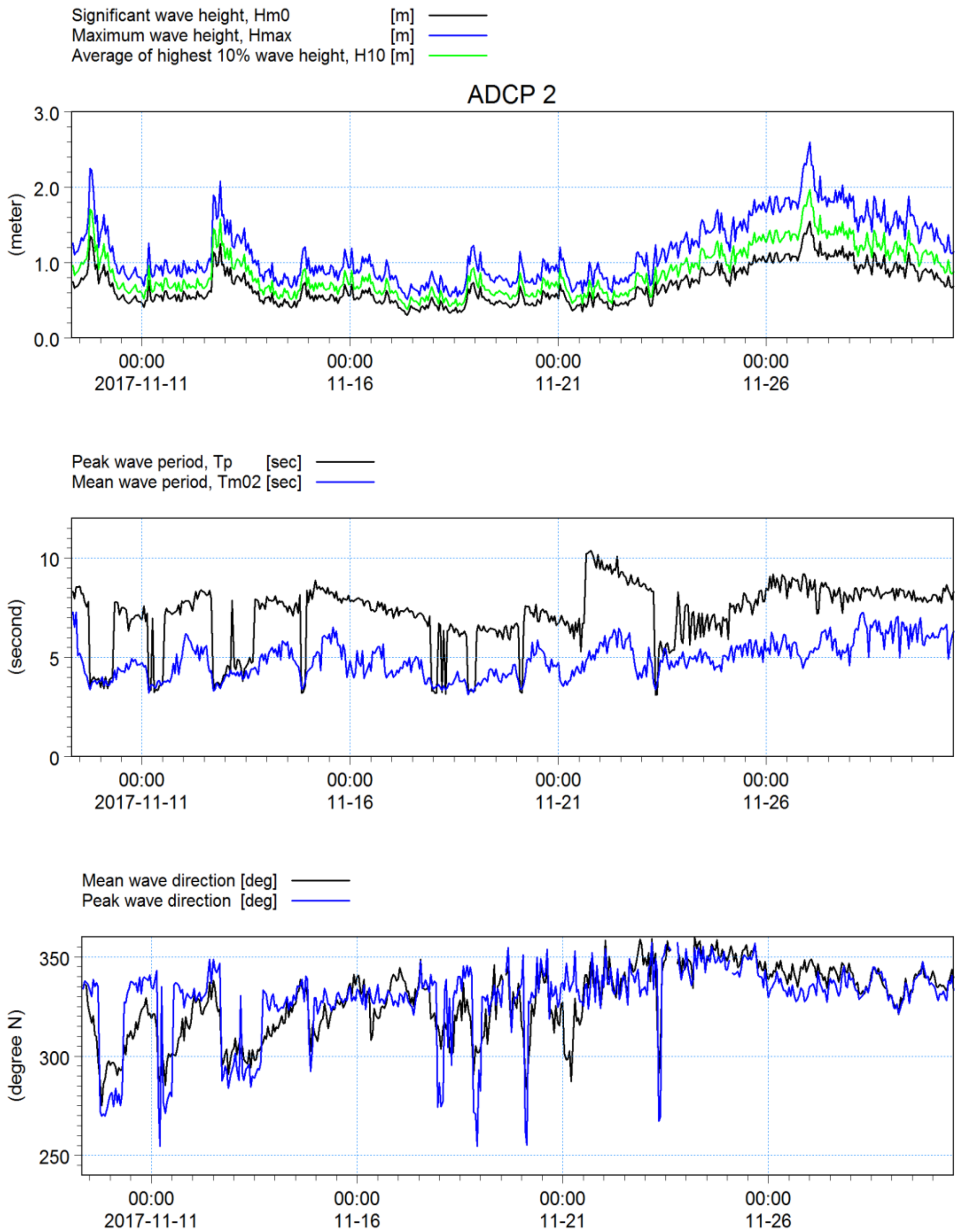


Figure 2.37 Time series plot for wave measurement at ADCP2

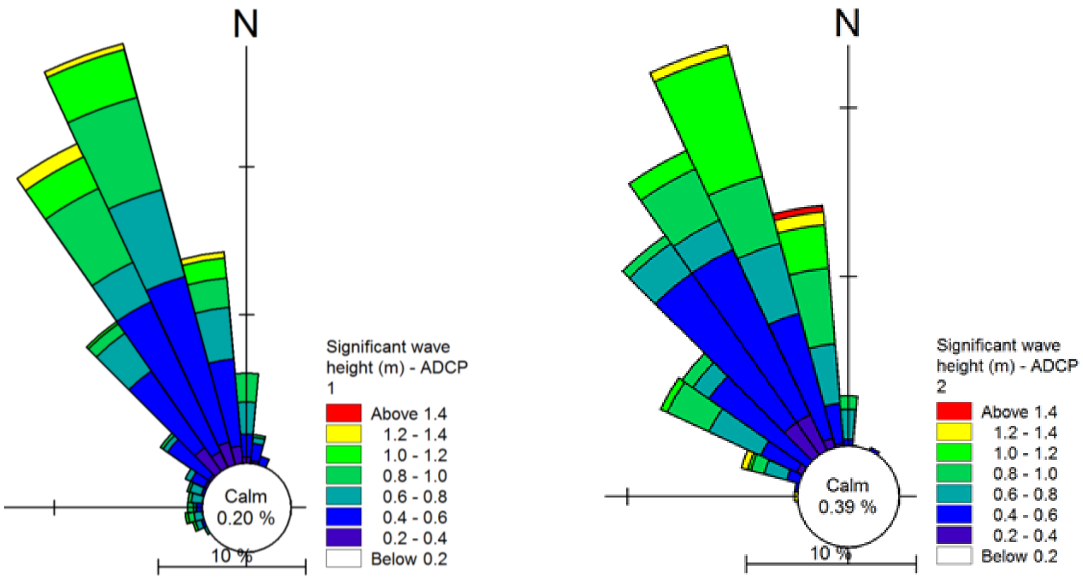


Figure 2.38 Rose plots for wave measurements at ADCP1 (left) and ADCP2 (right)

2.5.5 Seabed Sediment Sampling

Seabed sediment samples were collected at 15 locations using a Van Veen grab sampler. Sediment samples were taken to determine their grain sizes as well as the percentages of fine sediment. The samples were analysed by Soilpro Technical Services Sdn. Bhd. The results will be used for sediment transport modelling as well as sediment plume dispersion. Figure 2.39 shows the sampling locations. The coordinates for the seabed sampling stations are presented in Table 2.3. Results for the analysis of the seabed samples are tabulated in Table 2.4.

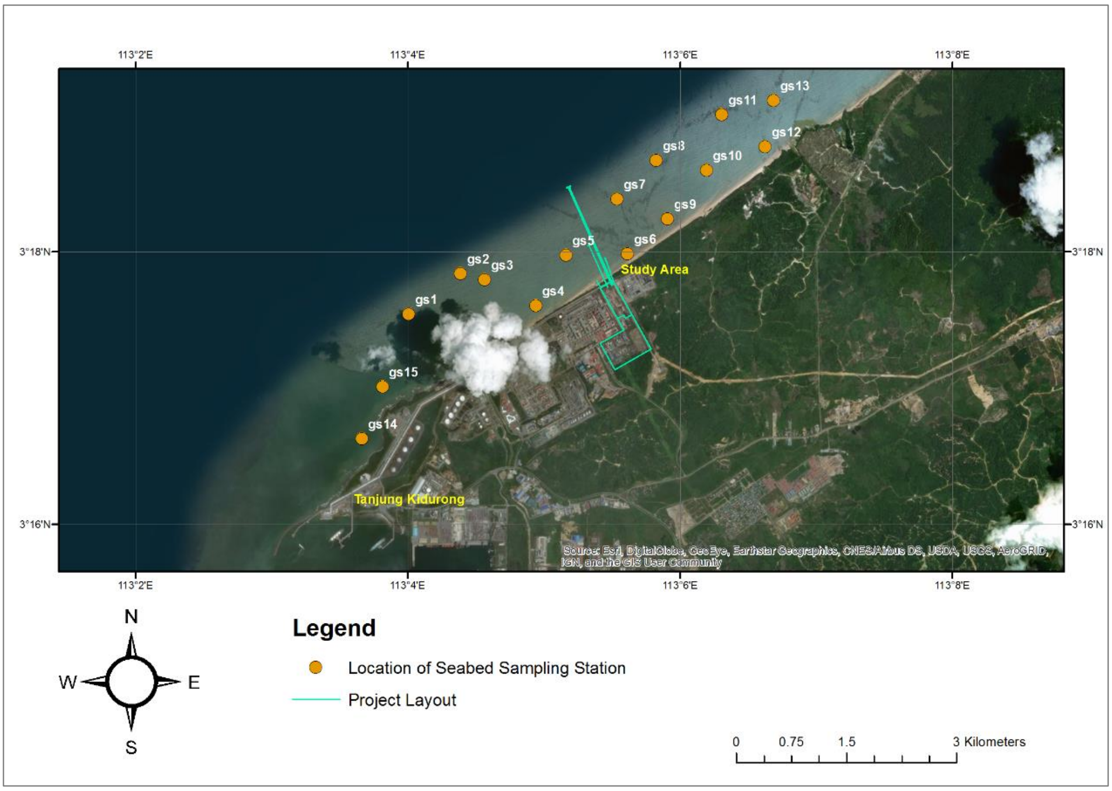


Figure 2.39 Location of seabed sampling stations

Table 2.3 Coordinates of seabed sampling stations

Station	Coordinate (in WGS 84)	
	Longitude (E)	Latitude (N)
gs1	113° 4' 00.2"	3° 17' 32.5"
gs2	113° 4' 23.2"	3° 17' 50.4"
gs3	113° 4' 33.8"	3° 17' 47.7"
gs4	113° 4' 56.3"	3° 17' 36.2"
gs5	113° 5' 09.6"	3° 17' 58.6"
gs6	113° 5' 36.7"	3° 17' 59.2"
gs7	113° 5' 32.1"	3° 18' 23.2"
gs8	113° 5' 49.5"	3° 13' 40.2"
gs9	113° 5' 54.5"	3° 13' 14.4"
gs10	113° 6' 11.6"	3° 18' 35.9"
gs11	113° 6' 18.9"	3° 19' 00.4"
gs12	113° 6' 37.5"	3° 18' 46.2"
gs13	113° 6' 41.2"	3° 19' 06.7"
gs14	113° 3' 39.6"	3° 16' 37.8"
gs15	113° 3' 48.8"	3° 17' 0.5"

Table 2.4 Soil classification and median grain size (D_{50}) for collected seabed sediment samples

Station	Soil Classification (%)				D_{50} (mm)
	Clay	Silt	Sand	Gravel	
GS1	7	44	49	0	0.0623
GS2	36	63	1	0	0.0055
GS3	17	34	49	0	0.0609
GS4	18		82	0	0.2144
GS5	19	43	38	0	0.0338
GS6	16		83	1	0.2234
GS7	26	50	24	0	0.0198
GS8	23	55	22	0	0.0288
GS9	20	39	41	0	0.0409
GS10	23	49	28	0	0.2402
GS11	17	51	32	0	0.0495
GS12	5	25	70	0	0.1655
GS13	27	46	27	0	0.0245
GS14	3	41	56	0	0.0870
GS15	27	71	2	0	0.0134

Based on the analysed results of the seabed samples, it can be deduced that the seabed sediment around the Project area is a combination of silt and sand. The D_{50} for all the stations is very fine sand based on Wentworth Size Class soil classification. Figure 2.40 shows seabed samples taken at site.

a) GS2 b) GS10

Figure 2.40 Examples of collected seabed sediment samples

2.5.6 Water Sampling

Water samples were collected at four stations to determine the Total Suspended Sediments (TSS) concentration within and around the Project area. The samples were collected using a van Dorn sampler at two depths i.e. 0.2D and 0.8D, where D is the height of the water column. The samples were analysed at Chemsain Konsultant Sdn. Bhd.'s laboratory. The results will be used to establish as the model's baseline condition for TSS concentration. Figure 2.41 shows the sampling locations. Table 2.5 shows the coordinates of the water sampling stations. Based on the TSS results (Table 2.6), the water quality at the study area falls between Class 1 and Class 2 of the Malaysia Marine Water Quality and Standard. Station WS1 showed the highest TSS levels among all the stations. This could be due to its location being relatively near BCOT's outlet. WS2, which is the station slightly offshore of the existing discharge outlet of Tanjung Kidurong Power Plant shows TSS levels of up to 35.5 mg/L. Relatively lower TSS levels were detected at station WS3 although it is located near a small stream outlet. The lowest TSS levels were recorded at WS4. This is probably due to its relatively offshore location.

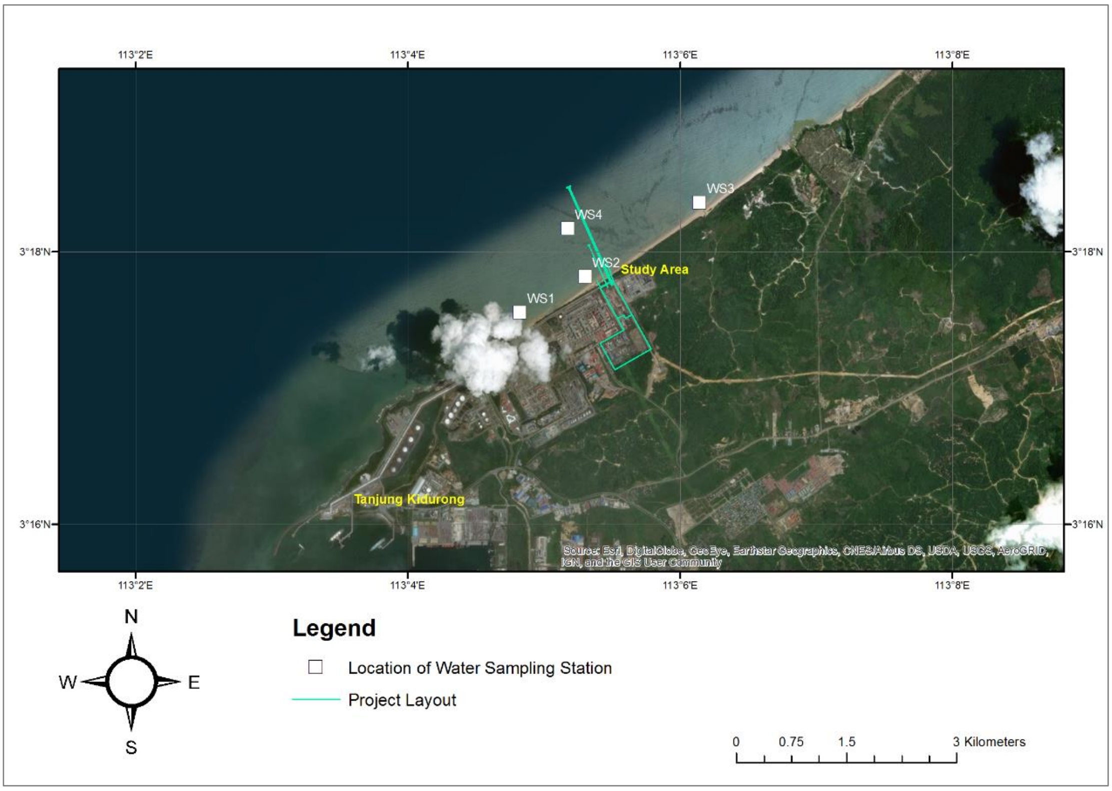


Figure 2.41 Location of water sampling stations

Table 2.5
Coordinates of water sampling stations

Station	Coordinate (in WGS1984)	
	Longitude (E)	Latitude (N)
WS1	113^0 4' 45.93"	3^0 17' 24.33"
WS2	113^0 5' 17.57"	3^0 17' 55.15"
WS3	113^0 6' 06.43"	3^0 18' 27.77"
WS4	113^0 4' 45.93"	3^0 17' 24.33"

Table 2.6 Analysed TSS at the water sampling stations

Station	Period	Tidal Phase	Depth (m)	TSS (mg/L)
WS1	Spring	Flood	0.2D	24.3
			0.8D	25.0
		Ebb	0.2D	54.5
			0.8D	52.5
	Neap	Flood	0.2D	19.5
			0.8D	22.0
		Ebb	0.2D	12.8
			0.8D	20.0
WS2	Spring	Flood	0.2D	15.5
			0.8D	17.0
		Ebb	0.2D	35.5
			0.8D	24.5
	Neap	Flood	0.2D	22.0
			0.8D	20.0
		Ebb	0.2D	15.0
			0.8D	20.5
WS3	Spring	Flood	0.2D	14.5
			0.8D	21.0
		Ebb	0.2D	19.5
			0.8D	25.0
	Neap	Flood	0.2D	14.0
			0.8D	14.5
		Ebb	0.2D	20.5
			0.8D	14.5
WS4	Spring	Flood	0.2D	21.5
			0.8D	17.0
		Ebb	0.2D	22.5
			0.8D	16.0
	Neap	Flood	0.2D	16.5
			0.8D	19.0
		Ebb	0.2D	15.0
			0.8D	12.5

2.5.7 Seawater Temperature

The seawater temperature was measured in-situ using a YSI 556 MPS multi-parameter device at the Project area at 1 m depth intervals at the locations where the ADCPs were deployed. Measurements were done over a 24-hr cycle during spring and neap periods (Figures 2.42 and 2.43). The seawater temperature ranged from about 29 to 31°C based on the measurements. Surface temperature during daytime was generally up to about 1°C higher than the seawater temperature at the bottom of the water column. A relatively similar range of temperature was observed at both measurement locations.

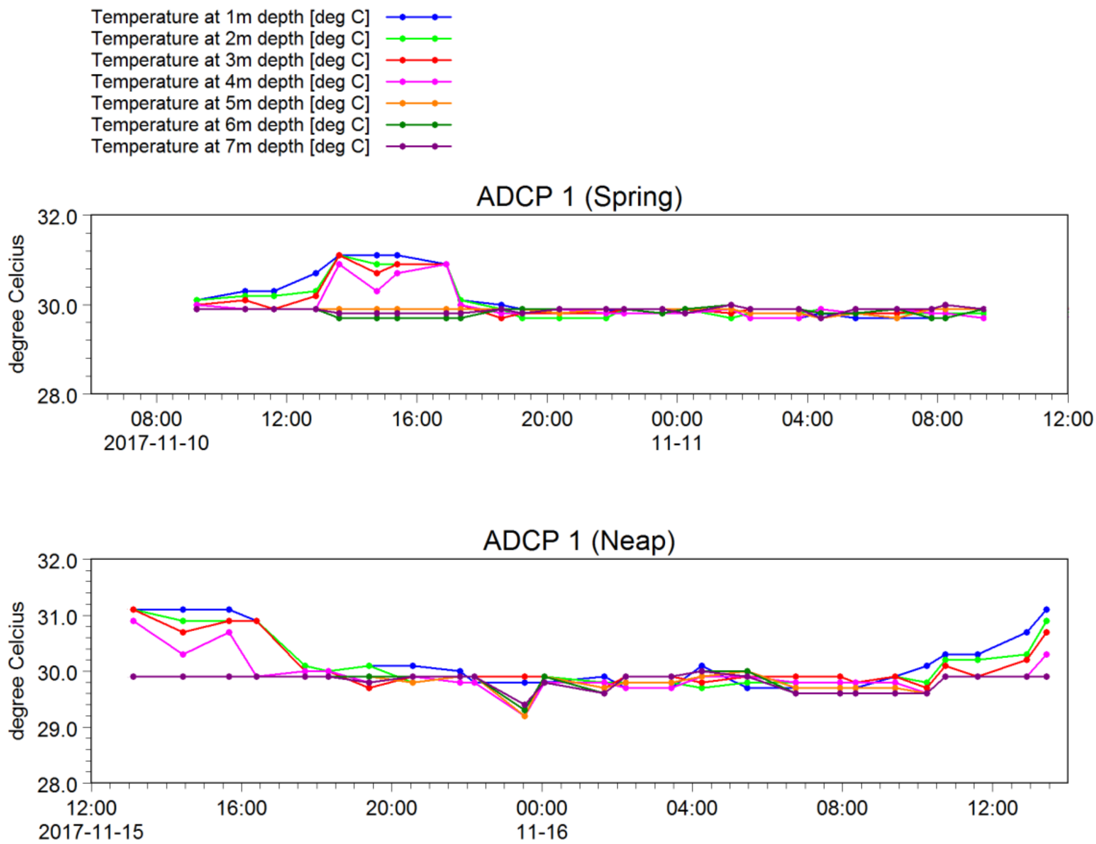


Figure 2.42 In-situ temperature measurements at ADCP1

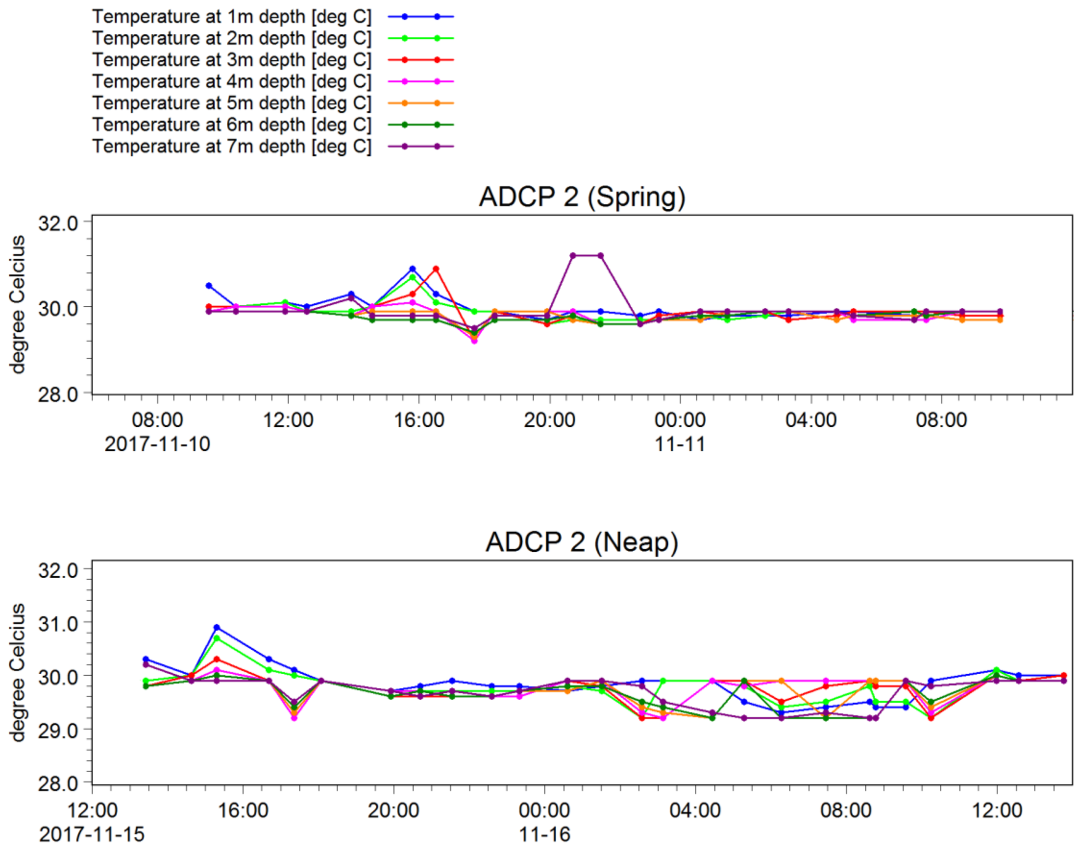


Figure 2.43 In-situ temperature measurements at ADCP2

Seawater temperature measured at the existing intake from January 2016 to December 2017 was provided by the Client (Figure 2.44). The lowest water temperature of 28.3°C was recorded in February 2016. The highest water temperature of 31.5°C was recorded in July 2017.

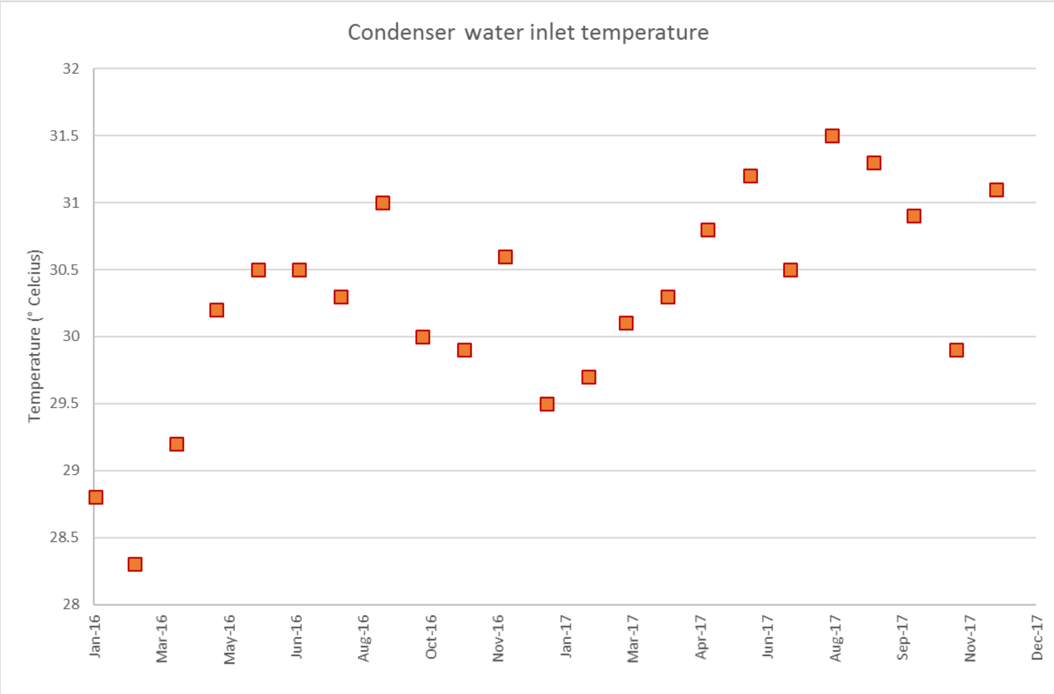
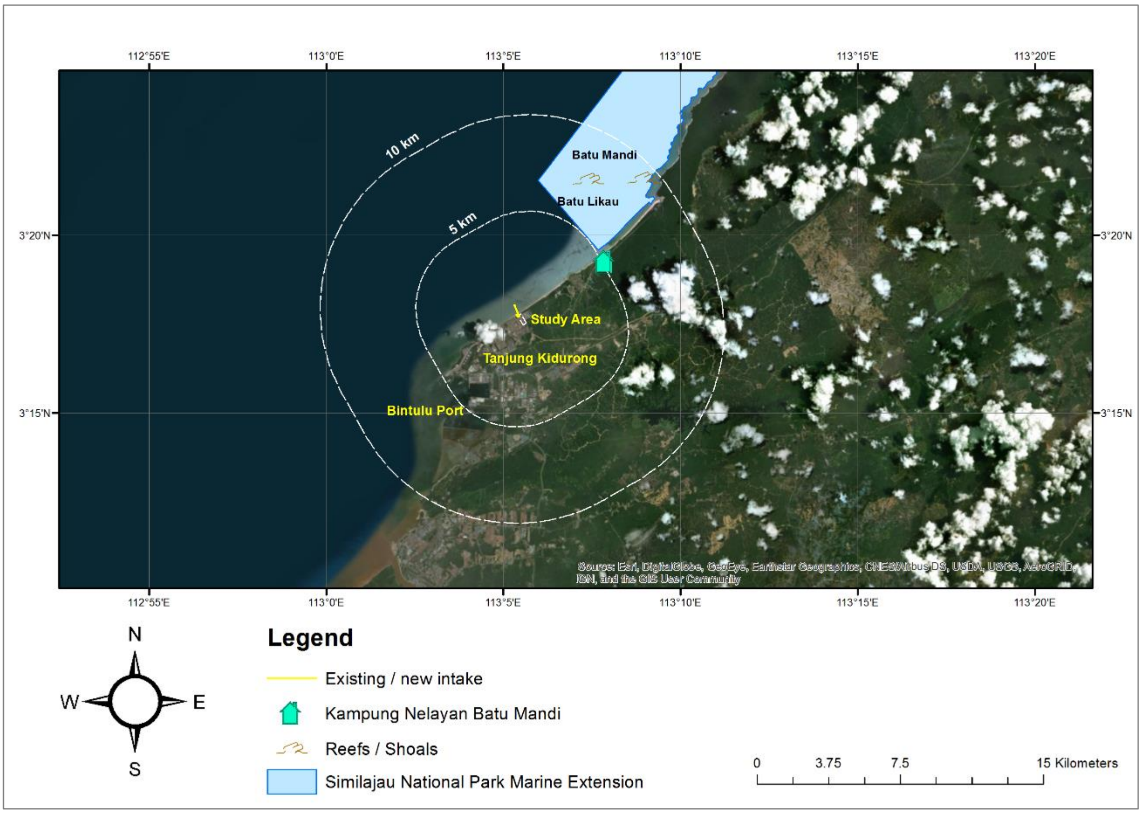


Figure 2.44 Condenser water inlet temperature at the existing power plant

2.6 Environmentally Sensitive Areas (ESAs)

Information on Environmentally Sensitive Areas (ESAs) was obtained from Chemsain Konsultant Sdn. Bhd. These areas are within 10 km radius of the Project area. The identified ESAs are illustrated in Figure 2.45 and tabulated in Table 2.7.



Source: Chemsain Konsultant Sdn. Bhd., 2018

Figure 2.45 ESAs within 10 km radius of the Project area

Table 2.7 List of ESAs within 10 km radius of the Project area

ID	Description	Distance from Project Area (km)
1	Existing intake	-
2	New intake	-
3	Kampung Nelayan Batu Mandi	5
4	Bintulu Port	5
5	Similajau National Park marine extension	5
6	Batu Likau	8
7	Batu Mandi	10

Source: Chemsain Konsultant Sdn. Bhd., 2018

Chapter 3

PROJECT DESCRIPTION AND STUDY APPROACH

Chapter 3

PROJECT DESCRIPTION AND STUDY APPROACH

3.1 Introduction

This chapter describes the marine-related activities associated with the Project, which includes trenching and temporary disposal, pipe jacking, pipe-laying as well as backfilling. This chapter also provides an introduction to the impact assessment approach as well as the basis and methodology of the numerical modelling works carried out for impact assessment.

3.2 Project Description

The existing Tg. Kidurong combined cycle gas turbine (CCGT) power plant generates 450 MW of electricity. The Balingian Power Plant with 600 MW (expected commercial operation in 2018) and Tg. Kidurong Power Plant's Block 1 (Unit 11) generating 413 MW (expected commercial operation in 2020) have been fully allocated to forecast Sarawak Corridor of Renewable Energy (SCORE) Phase 1 development. Due to the postponement of the Samalaju CCGT project, the Client has initiated an additional CCGT Block 2 (Units 12 and 13 generating 413 MW) adjacent to Block 1 at Tg. Kidurong. This is required to support the SCORE Phase 2 development before Samalaju CCGT project and Baleh hydroelectric power (HEP) dam (expected commercial operation in 2024) comes online. The study evaluates the impact of both the proposed Blocks 1 and 2 developments (Figure 3.1).

Source: SEB, 2017

Figure 3.1 Aerial view of proposed Tg. Kidurong Power Plant's expansion

The power plant's existing intake is to be relocated parallel to the new intake structures for Block 1 and 2 as illustrated in Figure 3.2. In total, there will be three pipelines located at 1.45 km seawards of the pump house. An additional outfall is sited 320 m seawards of the plant. The existing intake structure will be dismantled after the new intake is constructed. The existing outfall at the beach will still be operational after the development. The coordinates of the existing and proposed structures are shown in Table 3.1.

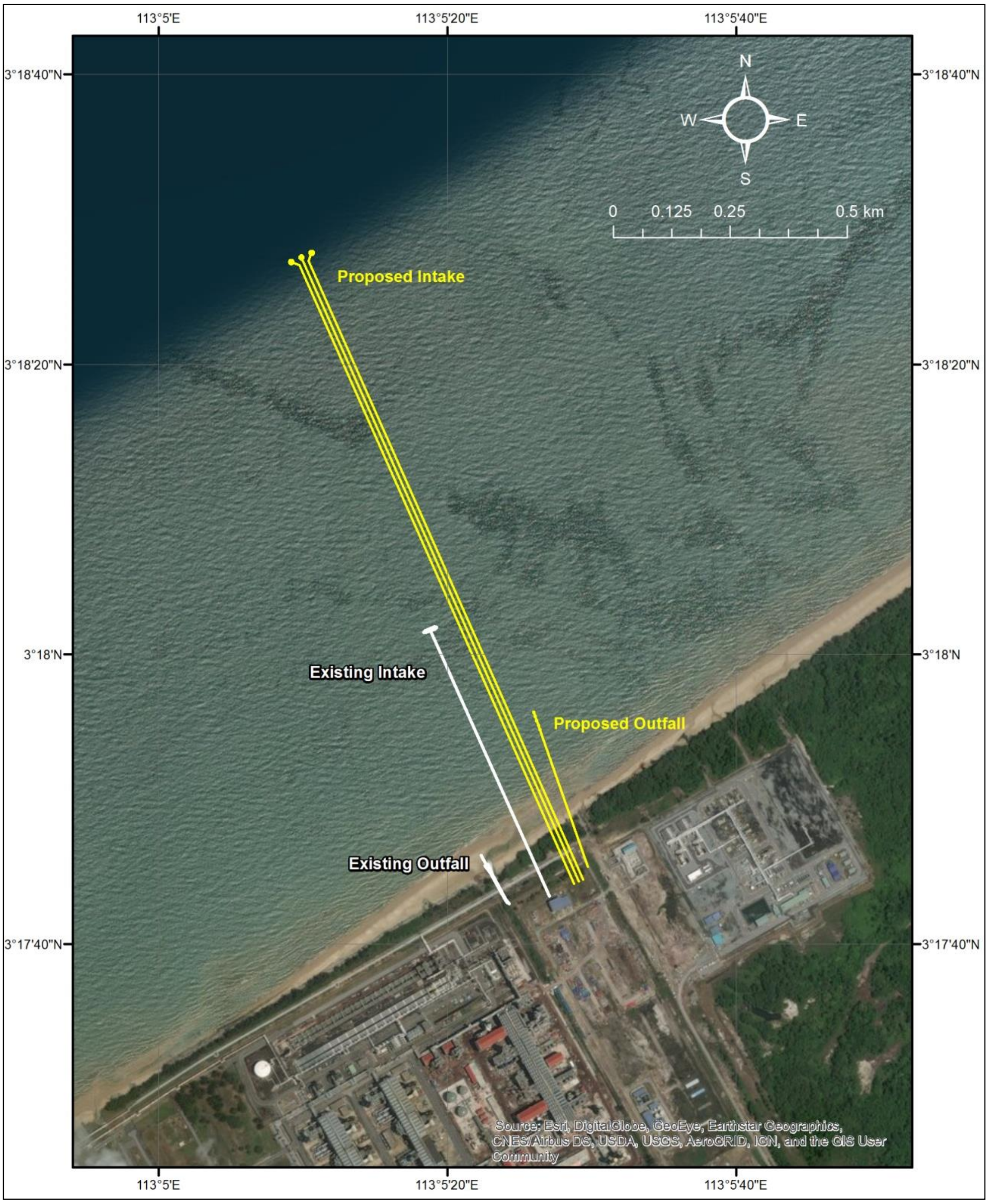


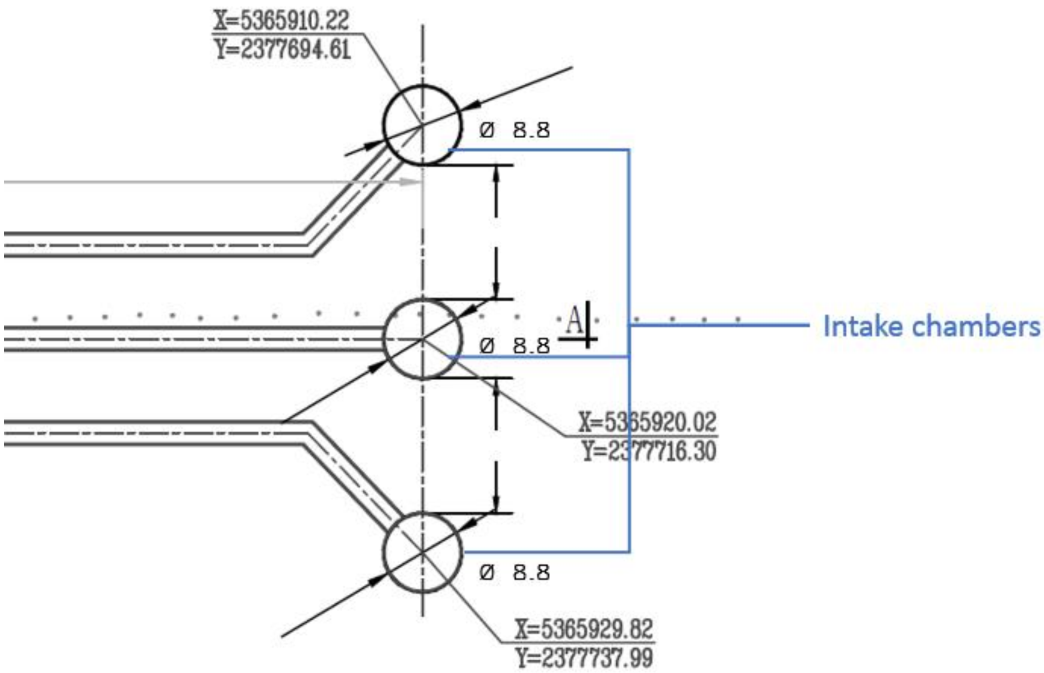
Figure 3.2 Overview of the proposed intake and outfall structures for the Tg. Kidurong Combined Cycle Power Plant

Table 3.1
Coordinates of the intake and outfall structures

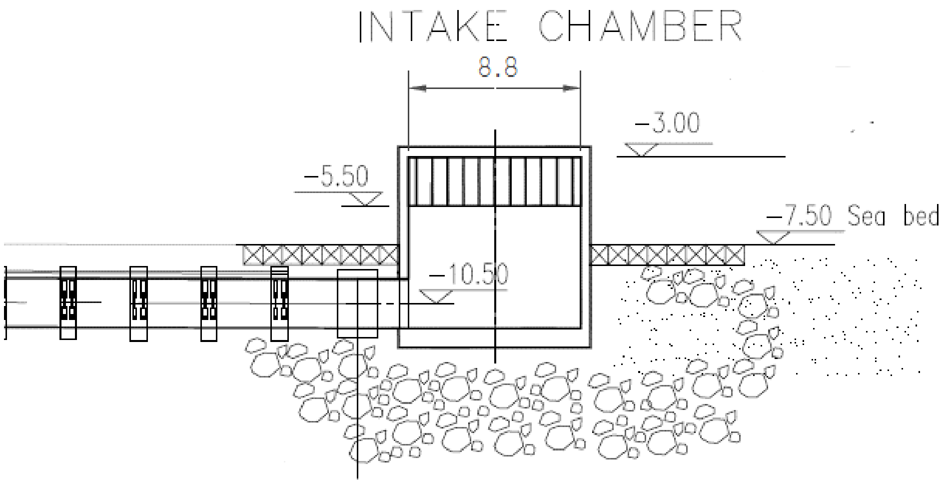
Structure	Coordinates	
	Latitude (N)	Longitude (E)
Existing intake	3° 18.00'	113° 5.33'
Existing outfall	3° 17.75'	113° 5.39'
Existing intake (relocated)	3° 18.45'	113° 5.15'
Proposed intake	3° 18.46'	113° 5.17'
Proposed intake	3° 18.46'	113° 5.18'
Proposed outfall (offshore end)	3° 17.94'	113° 5.43'

Three water intake chambers will be installed with the plant expansion. The details of the proposed intake structure are shown in Figure 3.2. The intake chambers will be located on the seabed, 1.45 km away from the pump house. The intakes will be buried at about 5.0 m below seabed. The intake chambers are circular glass-fibre reinforced plastics (GRP) structure with diameter of 8.8 m as shown in Figure 3.3.

A 2.5 m inner diameter HDPE pipeline connects each water intake chamber to supply sea water to the pump house. Each pipe is about 1.45 km long. The pipelines will be buried with a cover of 1.5 m below seabed level (Figure 3.4).



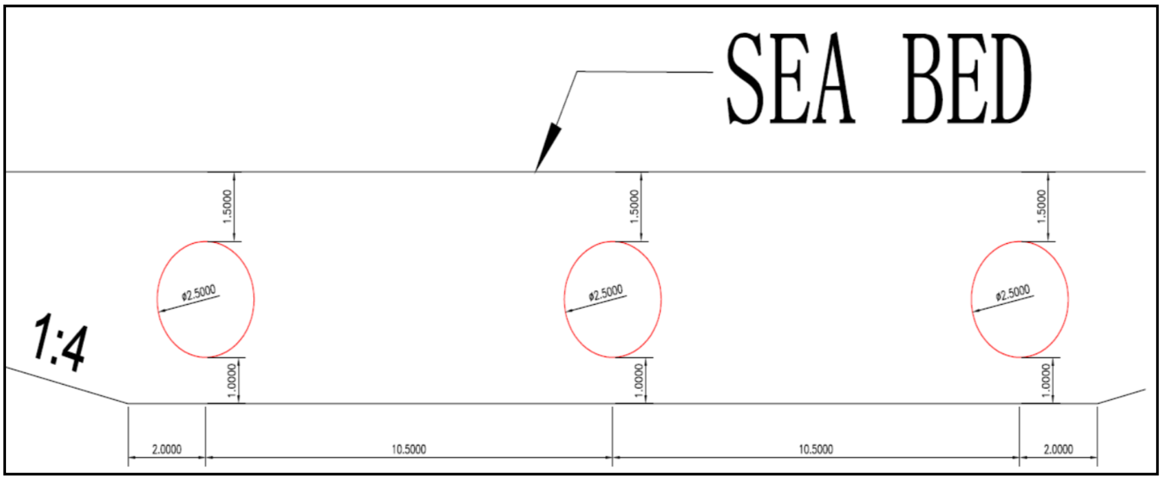
a) Plan layout of the proposed intake structures



b) Typical cross-sectional view of the intake chamber

Source: Sinohydro,2018

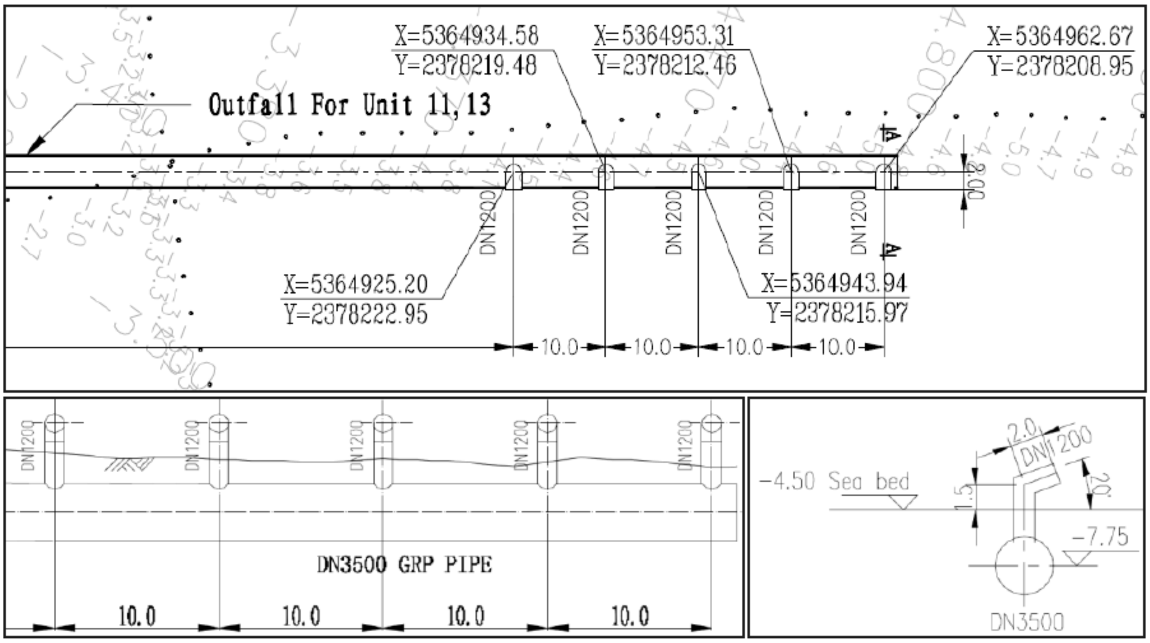
Figure 3.3 Details of the proposed intake structures



Source: Sinohydro, 2018

Figure 3.4 Cross section of the trench for the proposed intake pipelines

The proposed outfall structure is a 3.5 m diameter GRP pipe and 320 m in length. The proposed outfall structure utilises five diffusers operating simultaneously at the offshore end of the structure (Figure 3.5). The diffusers are about 1.6 m wide and protrude 2.5 m above the seabed. The diffusers are spaced at 10 m intervals. The outfall pipeline is buried with a cover of 1.5 m below seabed level.



Source: Sinohydro, 2018

Figure 3.5 Details of the proposed outfall structure

The design specifications for the proposed intake and outfall are described in Table 3.2.

Table 3.2 Design specifications for proposed intake and outfall

Description	Existing Intake	Existing Outfall	Proposed Intake	Proposed Outfall
Source temperature (°C)	n.a.	38	n.a.	38
Source chlorine concentration (mg/L)	n.a.	0.2	n.a.	0.2
Flow rate (m^3/s)	7.77	7.77	9.3	18.6

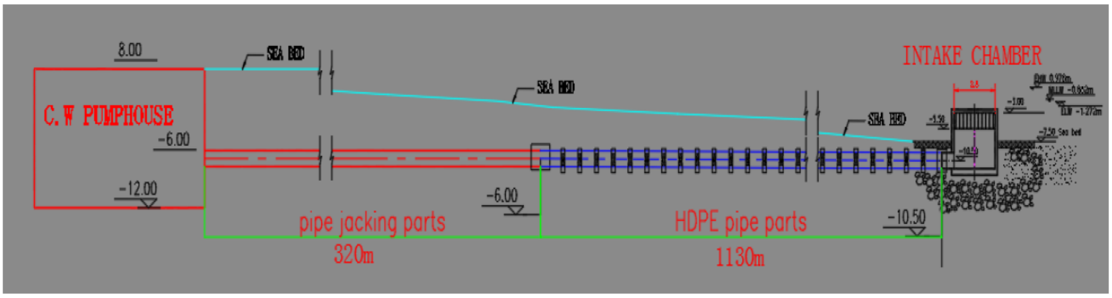
3.3 Construction Methodology

GE Power Solutions (Malaysia) Sdn. Bhd. and Sinohydro Corporation (Malaysia) Sdn. Bhd. Consortium (hereafter known as "the Contractor") has been appointed to perform the construction of this Project. Due to time constraint, the Contractor has devised a construction schedule that traverses 2018 and 2019 (Table 3.3).

Table 3.3 Construction schedule for intake and outfall

Phase	Duration	Activity
1	April to September 2018	Trenching works
2	October 2018 to February 2019	No activity due to Northeast Monsoon
3	March to September 2019	Backfilling and pipe-laying works

Pipe-jacking will be done for 320 m of the intake pipelines commencing from the pump house of the (Figure 3.6). The pipe-jacking method is also utilised to construct the outfall pipeline. Pipe-jacking is a trenchless technology method for installing a prefabricated pipe through the ground. By applying this method, very small to no sediment spill is introduced to the surrounding waters. Beyond 320 m of the proposed intake structures, a trench will be excavated in order to place the HDPE pipes and intake chambers.



Source: Sinohydro, 2018

Figure 3.6 Overview of construction method for the proposed intake structure

A cutter suction dredger (CSD) will be used to excavate and backfill the trench. Table 3.4 shows the specifications of the whole operation while the following sub-sections will describe the operation in further details.

Table 3.4 Specifications for the trenching and disposal works

Items	Information
Type of dredger	Cutter suction dredger
No. of dredger	1
Volume to be Excavated (m^3)	250,000
Production Rate (m^3/hour)	500
Disposal Rate (m^3/hour)	200

3.3.1 Trench Excavation and Temporary Disposal

Trenching works will be done over a 5-month period from April to September 2018. A CSD will be used for excavating the trench where the intake and outfall pipelines will be laid. The dredger will commence dredging from offshore towards land. The trench for the intake pipelines has a bottom width of 25 m with 1: 4 side slopes to cater for the three intake pipelines with diameter of 5 m each. About 250,000 m^3 of material is anticipated to be excavated from the seabed for the pipe trench.

The dredged material will be placed via a pipeline at a temporary offshore site located 500 m east of the trench (Figure 3.7). The temporary disposal site will be used to store the excavated material between October 2018 and February 2019. The excavated material will be reused to backfill the trench once the pipes are laid commencing in March 2019. The temporary disposal site has a width and length of about 130 and 1,014 m respectively constituting an area of 131,820 m2. With 250,000 m^3 of excavated material placed on the disposal site, it is anticipated that the height inside the temporary disposal site will be increased by 2 m.

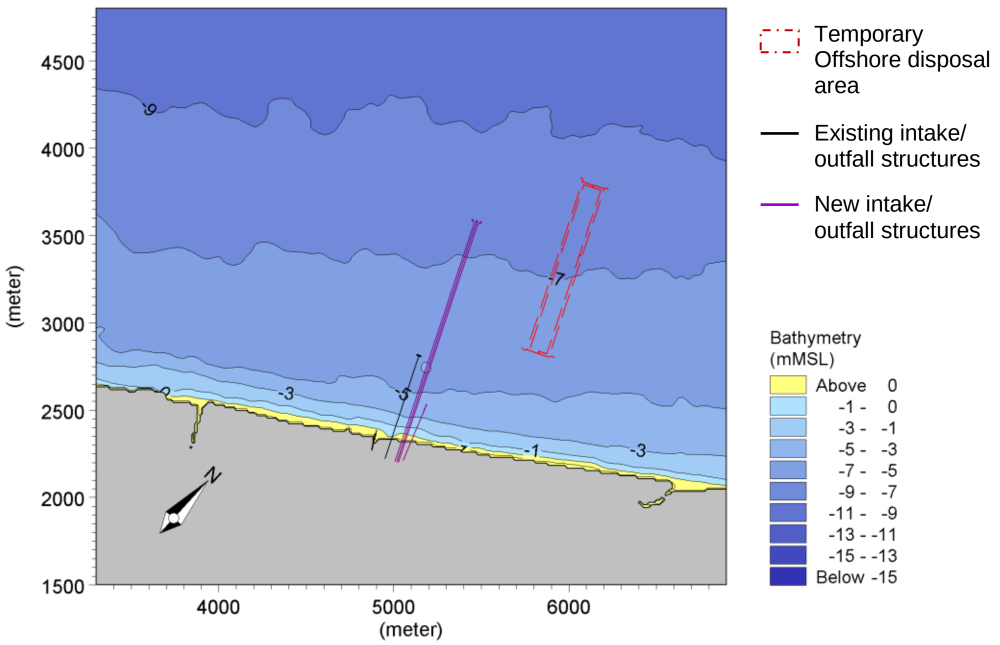


Figure 3.7 Location of proposed intake and outfall pipelines with respect to the temporary disposal area (indicated in red)

3.3.2 Pipeline Laying and Backfilling

The entire pipelines are planned to be laid in the trench within 6 months between March and September 2019. Balancing weights (Figure 3.8) will be installed when laying the pipelines to ensure that the pipelines do not float. Sea water will slowly be injected into the pipelines to further reduce buoyancy until the pipelines are fully laid in the trench. The laid pipelines will then be covered with the excavated material removed from the temporary disposal area. A CSD will be used to remove the material at the temporary offshore disposal site and backfill until the pre-trench seabed level is achieved.

Source: Sinohydro, 2018
Figure 3.8 Addition of balancing weights onto the pipelines

3.4 Impact Assessment Approach

This hydraulic study covers the potential impact on the hydraulic conditions associated with activities related to the Project. The type of impact is further described in the following sub-sections.

3.4.1 Type of Impacts

The types of impact assessed are:

a) Long-term impact; and

This is related to more permanent changes after the new intake and outfall structures are in operation, together with the existing outfall structure. These changes are related to the physical modification of the existing environment due to water levels, current flow conditions, wave conditions, thermal and chlorine dispersion.

b) Temporary impact.

Sediment spill dispersion is assessed during the trenching, disposal and backfilling works are carried. For the period of no construction activity from October 2018 to February 2019, impact on currents, waves and sediment transport are evaluated.

3.4.2 Potential Long-term Impact

3.4.2.1 Water Levels and Current Flow

The existing water levels and current flow conditions are determined using MIKE 21 Hydrodynamics ("HD") modelling approach. The model is simulated for a 14-day simulation period covering a full spring and neap cycle. The model is calibrated and verified using the measured water levels and current flow conditions in accordance with JPS guidelines. The model is used to simulate the water levels and current flow conditions for the “with Project” and “period of no work during construction” scenario over the same simulation period. Changes in water level and current flow conditions are calculated with respect to the existing condition. Details of the MIKE 21 HD modelling including its calibration and verification, as well as impact assessment on current flow conditions are described in Chapter 4.

3.4.2.2 Waves

Representative wave conditions for the monsoonal conditions are derived from long-term wave data at an offshore location. These are transformed to near-shore wave conditions at the Project site using MIKE 21 Nearshore Spectral Wave (“NSW”) module. Changes in the near-shore wave conditions are assessed by comparing results of the “with Project” scenario against the existing condition. Details of the NSW model setup and the impact assessment on wave conditions are given in Chapter 5.

3.4.2.3 Thermal and Chlorine Dispersion

The potential impact of thermal and chlorine dispersion is assessed using MIKE 21 Advection-Dispersion (“AD”) module. This module simulates the movement and scattering of particles in fluid due to the resolved and non-resolved flow processes with the concept of tracer/dye released to the water surface. Details of the modelling and impact assessment are explained in Chapter 6.

3.4.3 Potential Temporary Impact

3.4.3.1 Water Levels and Current Flow

During the period of no activity during Northeast Monsoon (October 2018 to February 2019), the existing current flow is predicted to be modified with deepening of the seabed from the trenching work and depth-reduction at the temporary disposal ground. The impact to current flow during the period of no activity is assessed using the current flow model.

3.4.3.2 Waves

The existing wave pattern is predicted to be altered with deepening of the seabed at the trench and depth reduction at the temporary disposal ground during the Northeast Monsoon. The impact in wave condition is assessed using the nearshore wave model.

3.4.3.3 Sediment Spill Dispersion

During construction, there will be sediment spills from the trenching and disposal activities. The model simulations determine the movement and dispersion of the excess suspended sediment concentration associated with the plumes generated from these activities. The potential temporary impact of these activities is represented by the level of suspended sediment concentration as well as the eventual fate of the re-suspended sediment. Details of the model set up and the temporary impact assessment on sediment transport are given in Chapter 7.

3.4.3.4 Sediment Transport

The potential impact to sediment transport is assessed using MIKE 21 Sand Transport (“ST”) module. This module is chosen to simulate the sediment transport pattern during the Northeast Monsoon condition in which the transport is mostly governed by waves. The hydrodynamic and wave modelling results are used to drive the sand transport model. The module is also used to evaluate the stability of the trench during the period of no activity. Details of the modelling and impact assessment on sediment transport are given in Chapter 8.

3.4.4 Modelling Scenarios

Three model bathymetries are setup for the impact assessment. The local model incorporating the survey data (representing the existing condition) are reproduced for the ‘with Project’ and ‘during construction’ scenarios (Figure 3.9). For the ‘with Project’ condition, there is very slight change in bathymetry, i.e. +4.5 m at the intake chambers and +2 m at the outfall diffusers. The period of no activity during construction is simulated with the trench fully excavated by 5 m and the bed level of temporary disposal ground is raised by 2 m.

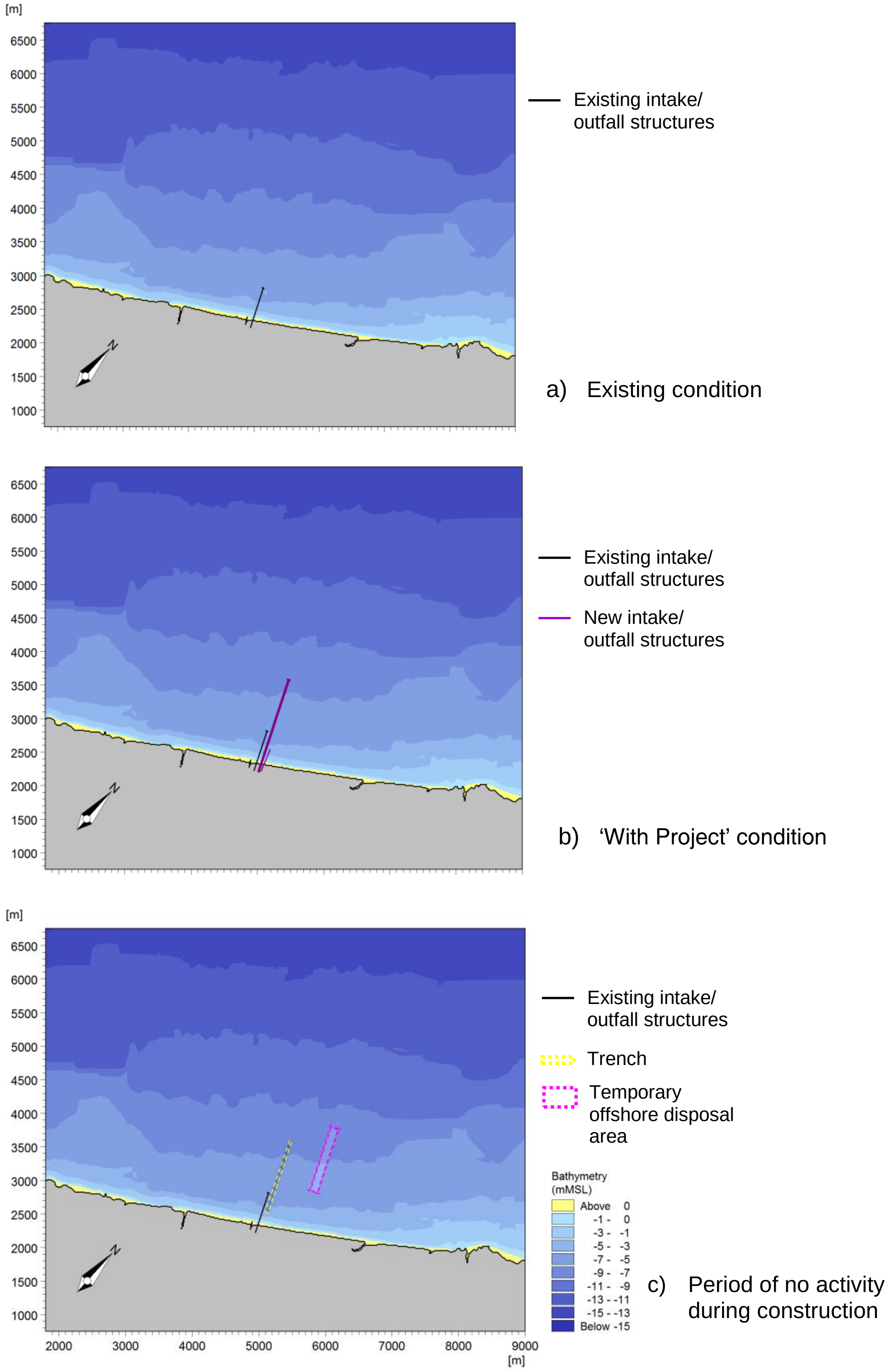


Figure 3.9 Model bathymetries for existing condition, 'with Project' condition and Period of no activity during construction

3.4.5 Climatic Conditions and Simulation Periods

The hydrodynamic model simulation period is simulated over a 17-days period including a 3-day warm-up period to include a full spring and neap cycle. The warm-up period is allocated to avoid initial numerical instabilities during the simulation period. The thermal and chlorine dispersion modelling is simulated over a slightly longer period i.e. 31-days including a 3-day warm-up period to ensure model's stability.

Simulations for the hydrodynamic model were carried out for three scenarios to simulate typical monsoon conditions in Malaysia, i.e. Northeast and Southwest Monsoons and the inter-monsoon period. The Northeast Monsoon condition represents meteorological condition during the November to March period. The Southwest Monsoon condition represents meteorological conditions during May to September. Seasonal conditions are highly variable where the Northeast Monsoon conditions will also be representative of some occurrences happening outside the Northeast Monsoon period. This is also applicable for the Southwest Monsoon and inter-monsoon conditions. As such, the monsoonal scenarios are applied in general terms.

The monsoonal conditions are represented by the representative wind conditions, derived from wind data extracted from the Climate Forecast System Reanalysis (CFSR) for 20 years from 1991 to 2010. The data is extracted at the location offshore of the Project area as shown in Section 2.5.3 and the representative speed condition are as described below:

a) Inclusion of wind blowing constantly from 30°N at 5.0 m/s to simulate Northeast Monsoon condition; and
b) Inclusion of wind blowing constantly from 240°N at 3.9 m/s representing the inter-monsoon or transitional period; and
c) Inclusion of wind blowing constantly from 250°N at 3.9 m/s to simulate Southwest Monsoon condition.

Chapter 4

HYDRODYNAMICS

Chapter 4

HYDRODYNAMICS

4.1 Introduction

Modelling of water flow and current patterns constitutes the basis of the coastal engineering study. Impact due to the proposed development is studied. Modelling of sediment transport and dispersion processes is carried out once the flows are properly modelled. MIKE 21 HD was used for this study.

4.2 MIKE 21 HD

MIKE 21 HD is the basic module of the MIKE 21 system. It provides the hydrodynamic basis for computations performed in most of the other modules. It simulates water level fluctuations and flows in response to a variety of forcing functions in lakes, estuaries, bays and coastal areas. The water levels and flows are resolved on a rectangular grid covering the area of interest when provided with bathymetry, bed resistance coefficients, wind and wave fields and hydrographic boundary conditions.

4.3 Model Setup

“Setting up the model” means transforming real world events and data into a format that can be understood by the numerical model. All data collected have to be resolved on the spatial grid selected including the time-step required. The bathymetry data for the model setup is based on Sarawak Navigation Charts, CMAP digital chart as well as a survey of around the Project site. The bathymetry data was then transformed into a MIKE 21-readable format. A survey in the vicinity of the Project area was incorporated within the model bathymetry.

The nesting capability of MIKE 21 HD was applied to describe the area of interest. This permits a model extent that encompasses regional scale processes. Multiple model domains of varying grid resolutions were used. All grids were dynamically linked and solved simultaneously. The regional, intermediate, medium and fine grid models were nested. A specific model for the study area was constructed, i.e. the local model. The model utilised water levels and fluxes from the regional nested model. The smaller domain and higher grid resolution assists in impact assessment.

For regional model, three nested model bathymetry domains with varying resolutions i.e. 1,215, 405 and 135 m were setup as illustrated in Figure 4.1. Two nested model bathymetry domains with resolutions of 45 and 15 m were setup as the local model (Figure 4.2).

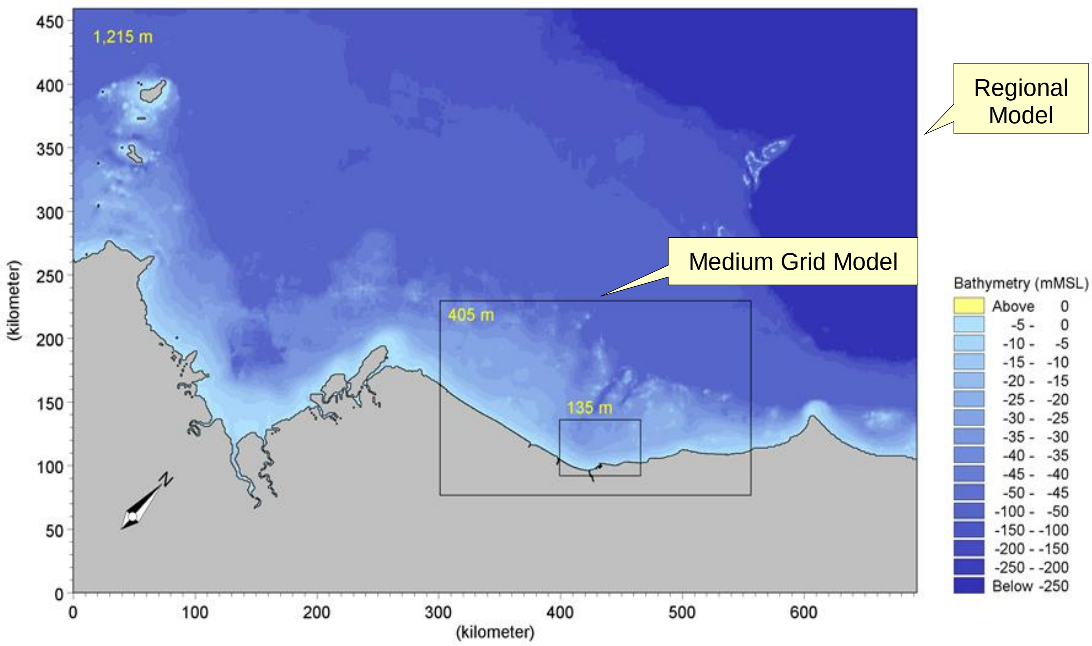


Figure 4.1 Nested regional model bathymetries

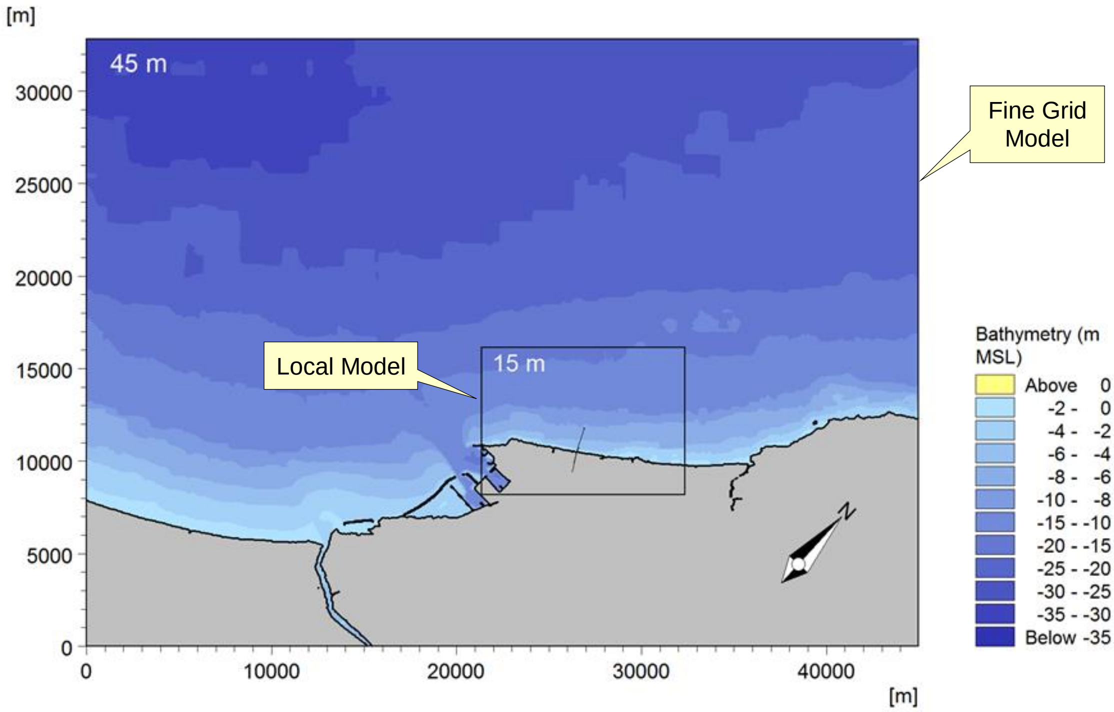


Figure 4.2 Nested local model bathymetries

Sufficient details of the bathymetry and nearshore area within the study area need to be well-represented within the numerical model. A review done on the source of data used in producing each chart revealed that surveys done as far back as 1951 were used to map the nearshore area. Although recent information was also incorporated into each chart, these updates were localised in nature, e.g. relating to dredging, rough layout of coastal development, wrecks, etc. A survey was considered necessary in order to ascertain the current bed and nearshore levels. Bathymetry of the study area was updated in the local model where data from a survey done in December 2016 was integrated. The local model that incorporates the survey data (representing the existing condition) are reproduced for the "with Project" and for the period of no activity during construction scenarios. The model bathymetries are shown in Figure 3.9.

Bed resistance is used to ensure that the model is capable of replicating the measured conditions as much as possible. A constant value for bottom friction can be assigned over the model area. Otherwise, a map with varying values is specified as a function of depth or on a point by point basis. For this case, similar Manning number of 40 $m^{1/3}/s$ was used for all models.

Simulations for the hydrodynamic model were carried out for the scenarios and seasonal conditions as described in Section 3.4.5.

4.4 Boundary Conditions

The regional model contains four open boundaries. The boundary conditions are water levels generated based on the established tidal constituents extracted from MIKE 21's Global Tide Model. Figure 4.3 shows the position of each open boundary (represented by red lines).

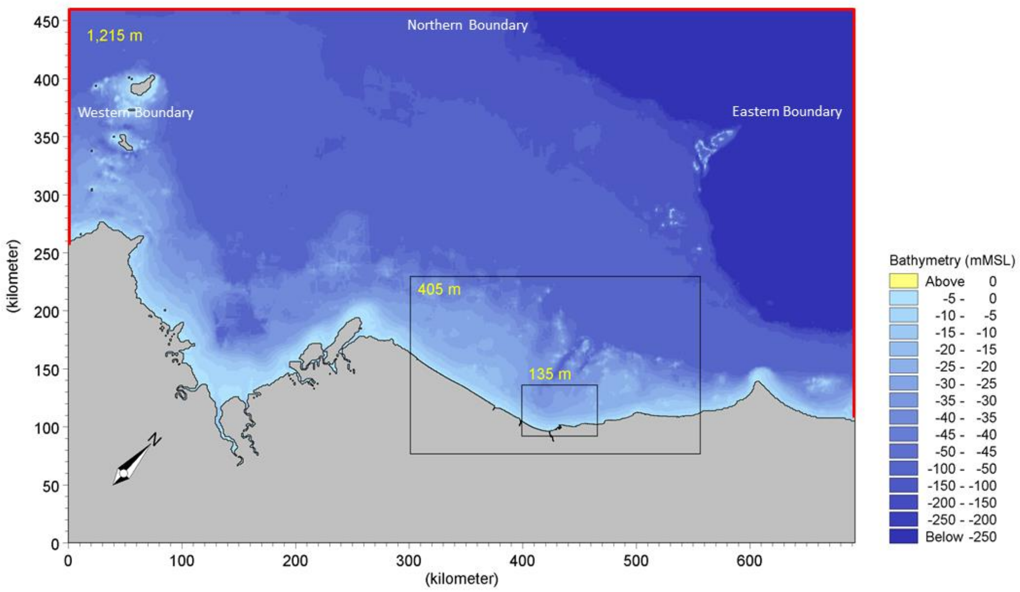


Figure 4.3 Position of open boundaries for the regional model

The local model is driven by water level condition transferred from the regional model. This allows more detailed flow condition to the local model, given the relatively coarse spatial resolution of the Global Tide Model. The red lines in Figure 4.4 indicate the position of each open boundary in the local model.

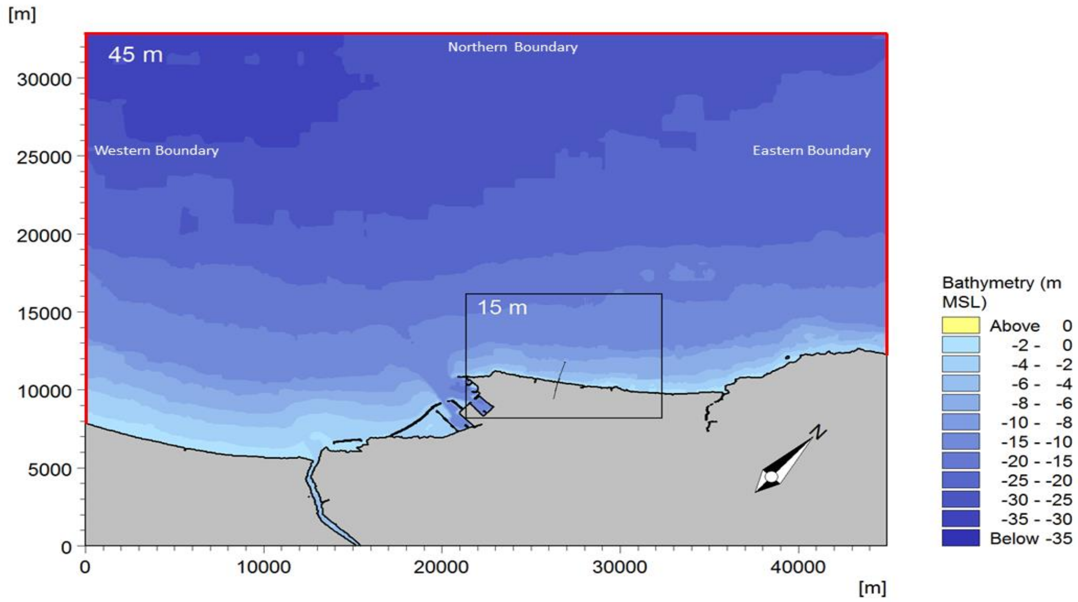


Figure 4.4 Position of open boundaries for the local model

4.5 Design Simulation Period

A design simulation period of 17 days was selected to correspond with typical spring-neap conditions during the year. The simulation included three days as a "warm up" period.

4.6 Calibration and Verification

Model verification is a process where primary governing conditions of the model are adjusted to represent as much as possible measured data from the calibration period. This is also known as model validation. The main governing conditions affecting performance of the hydrodynamic model are boundary conditions, bathymetry, bed resistance and eddy viscosity. Water levels were used to validate the regional model. Validation of the local model was done using water levels and currents.

In order to assess the deviation between measured and predicted or simulated data, a normalised root mean square deviation (NRMSD) is used to measure the differences between values predicted by a model and measured or predicted values. The NRMSD is the root mean square deviation (RMSD) divided by the range of predicted or measured values in which the RMSD is defined as the square root of the mean square error.

4.6.1 Water Levels

The regional hydrodynamic model was validated using water levels from tidal stations as shown in Figure 4.5. Comparisons between simulated and predicted water levels to validate the regional model are shown in Figure 4.6. The comparisons show a good match and satisfactory agreement between the model simulation results and the measurements where the averaged NRMSD is less than 10%.

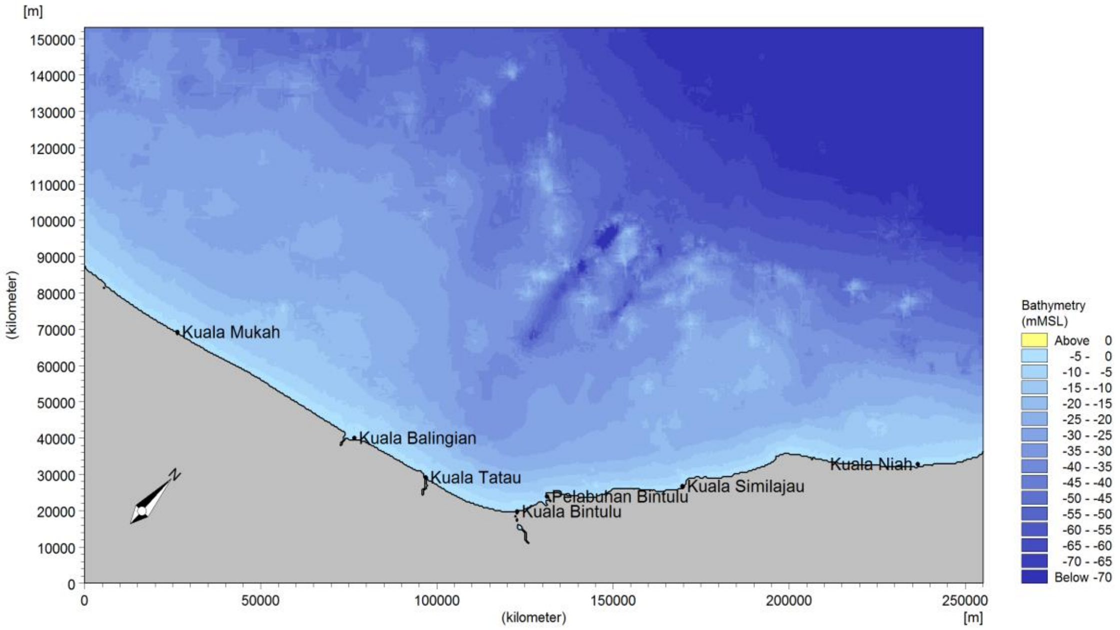


Figure 4.5 Location of tidal stations

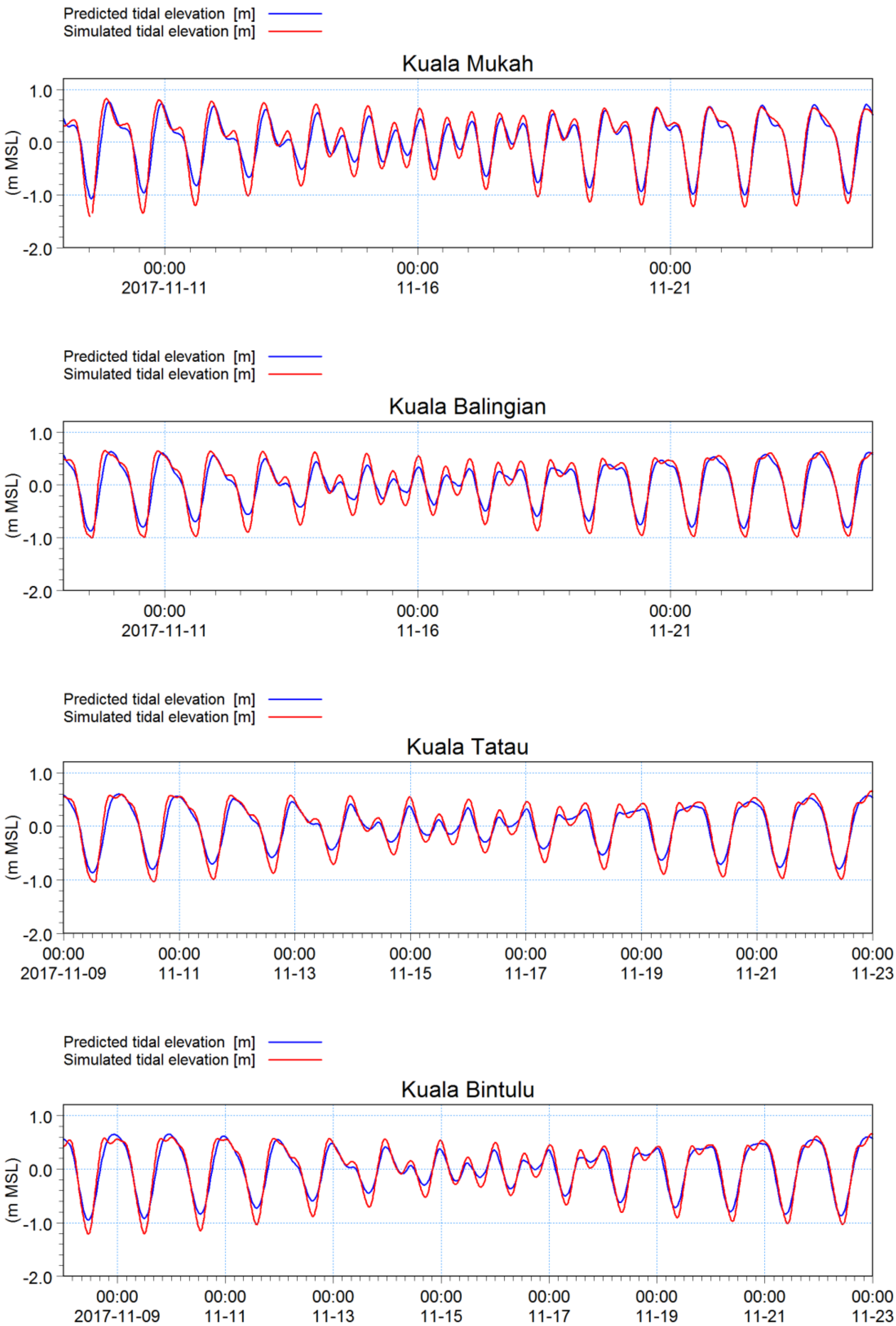


Figure 4.6 Regional model validation: Comparison between predicted and simulated water levels

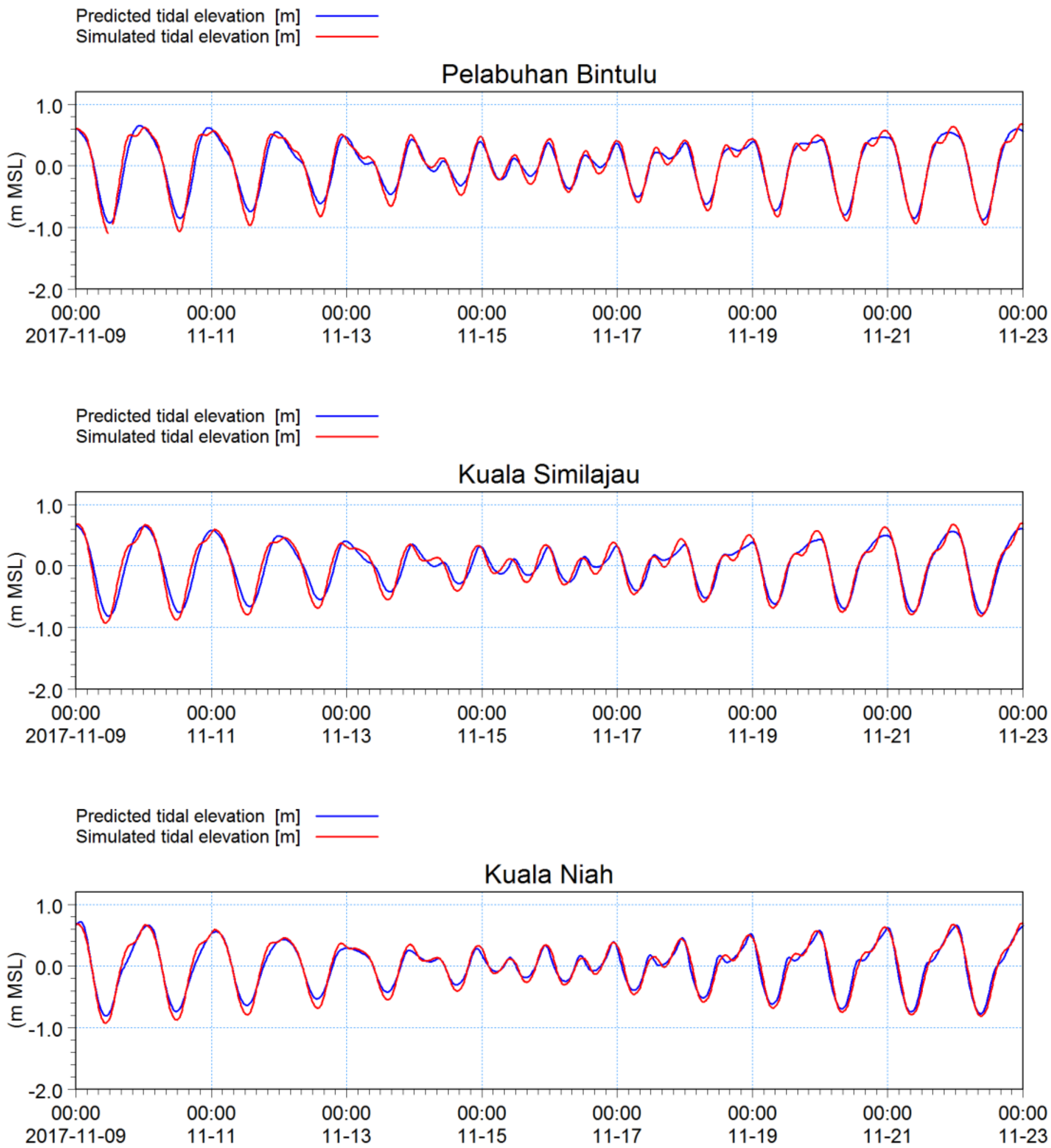


Figure 4.6 (cont'd) Regional model validation: Comparison between predicted and simulated water levels

For the local hydrodynamic model, comparisons between simulated and measured water levels based on measurements taken during field data collection at the two ADCP locations are shown in Figure 4.7.

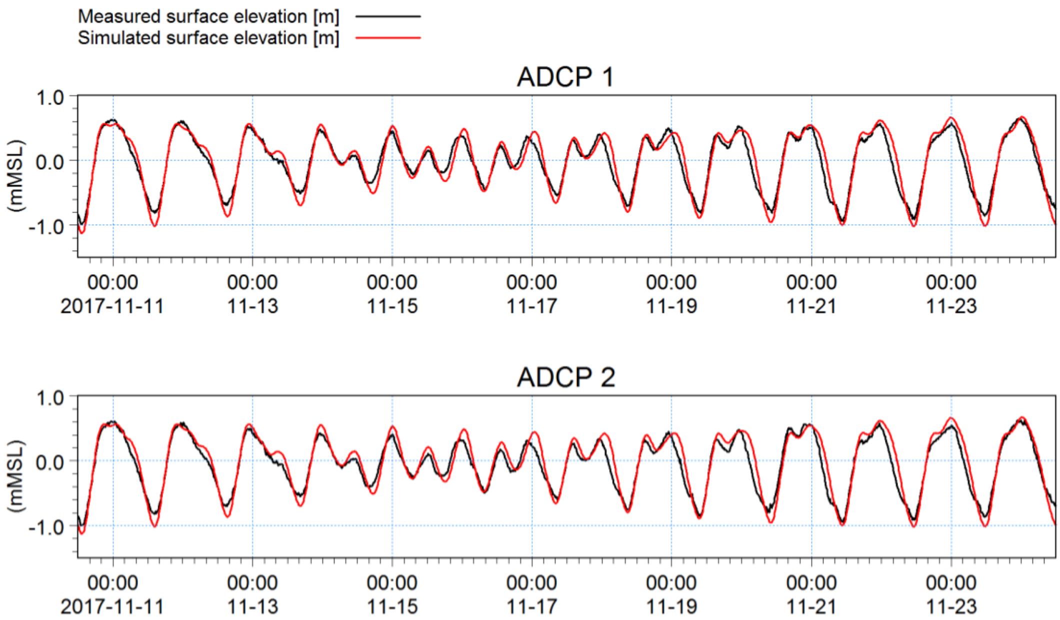


Figure 4.7 Local model validation: Comparison between measured and simulated water levels

The extracted water levels from the model simulation compared well with the measured water levels during the 14-day measurements (covering spring and neap period) with NRMSD indicated as follows:

a) 7% for ADCP 1; and
b) 6% for ADCP 2.

These values are below the acceptable deviation of 10% specified in JPS' 2013 guidelines.

4.6.2 Currents

Current measurements made during the fieldwork were compared with currents extracted from the modelling results. Results of the model calibration (spring period) and verification (neap period) are shown in Figures 4.8 and 4.9 respectively.

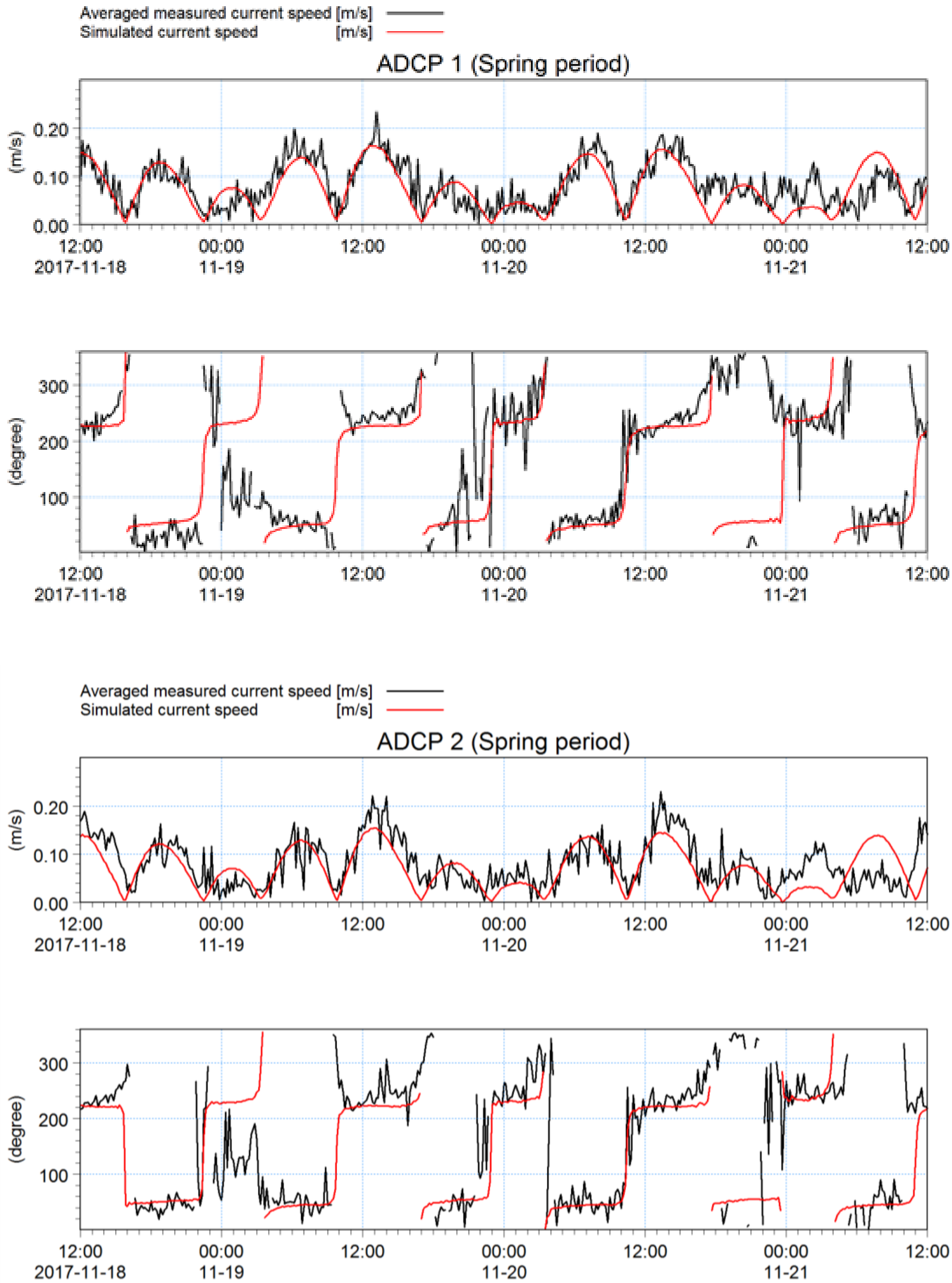


Figure 4.8 Model calibration: Comparison between measured and simulated current speed and direction at ADCP1 and ADCP2

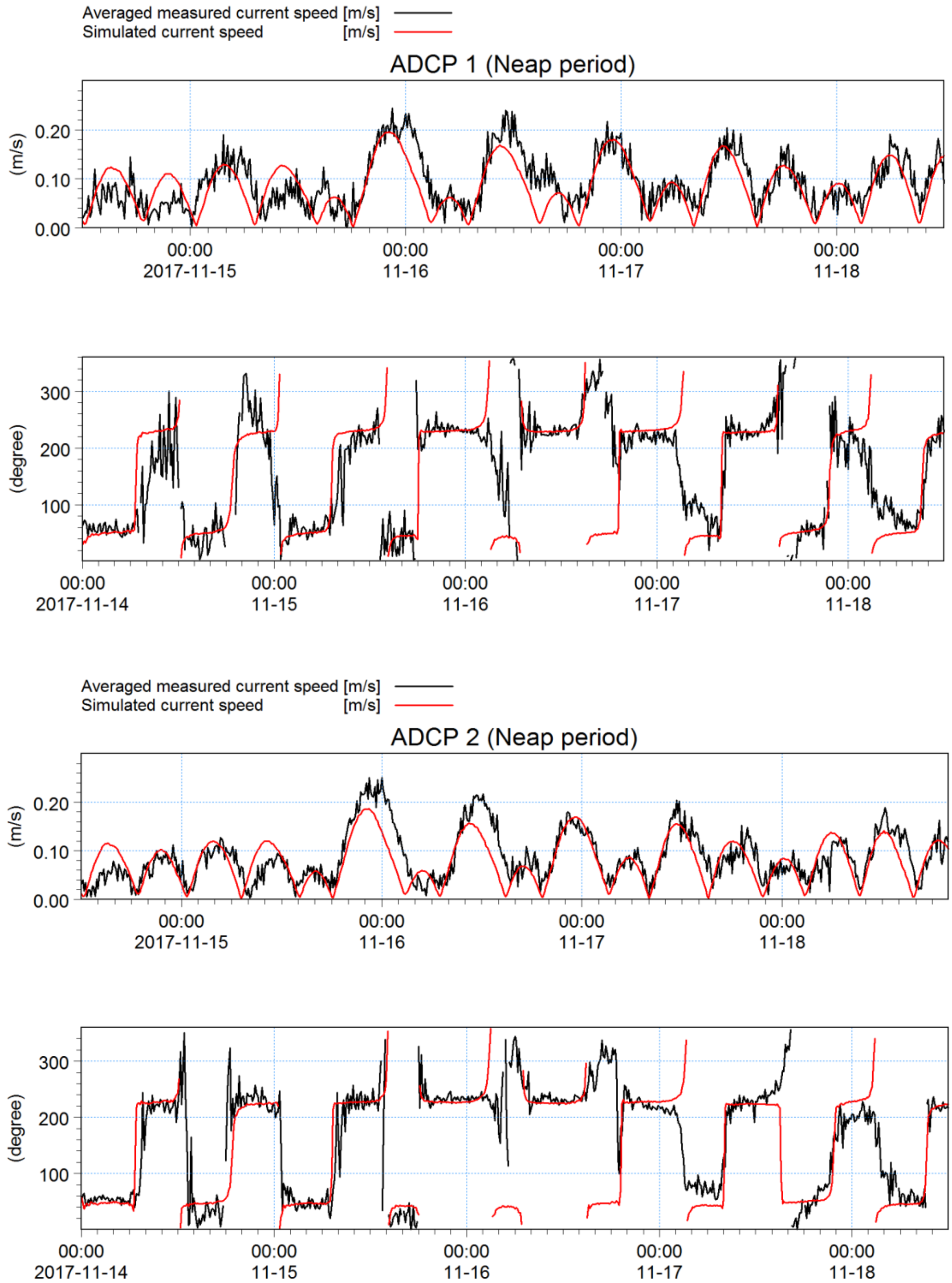


Figure 4.9 Model verification: Comparison between measured and simulated current speed and direction at ADCP1 and ADCP2

An acceptable agreement between the measurements and model simulation results is considered to be achieved when the simulated current speeds and directions were comparable with the measured data, complying with JPS requirements for numerical modelling works. Given that the measurement was conducted in the Northeast Monsoon period, the values are still within the acceptable deviation specified in the JPS' 2013 guidelines as summarised in Table 4.1.

Table 4.1 NRMSD for current speed and direction at ADCP1 and ADCP2

Location	NRMSD			
	Model Calibration (Spring period)		Model Verification (Neap period)	
	Speed (%)	Direction (°)	Speed (%)	Direction (°)
ADCP 1	15	18	16	18
ADCP 2	19	20	15	14

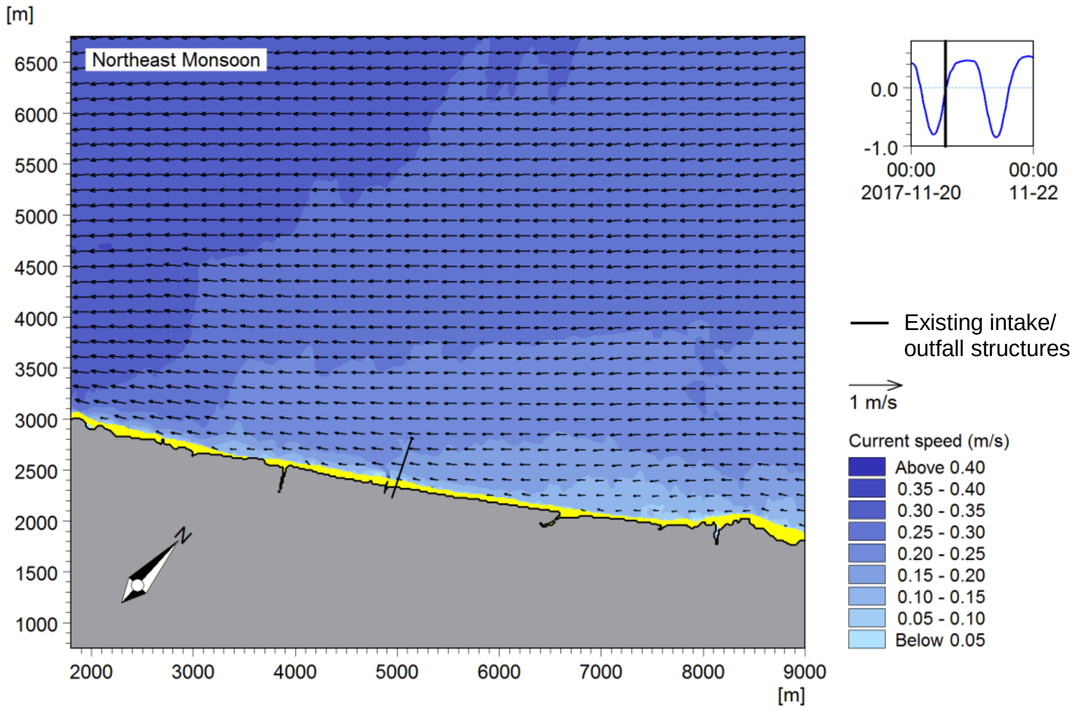
Irregularities in the comparison of current speed and direction at the Project area may still occur. The measurements were conducted fronting an open coastline that is influenced by prevailing winds. Wind condition is driven in the local model by applying a wind map procured from Global Forecast System (GFS) produced by the National Centre for Environmental Prediction (NCEP) in the first half of the simulation period when the sea condition is rough due to stormy conditions. Time series of wind measured at Bintulu Airport purchased from Meteorological Department of Malaysia were used for the second half of the simulation period. It was not feasible to use wind condition at Bintulu Airport during stormy conditions due to landmass effect.

4.7 Results

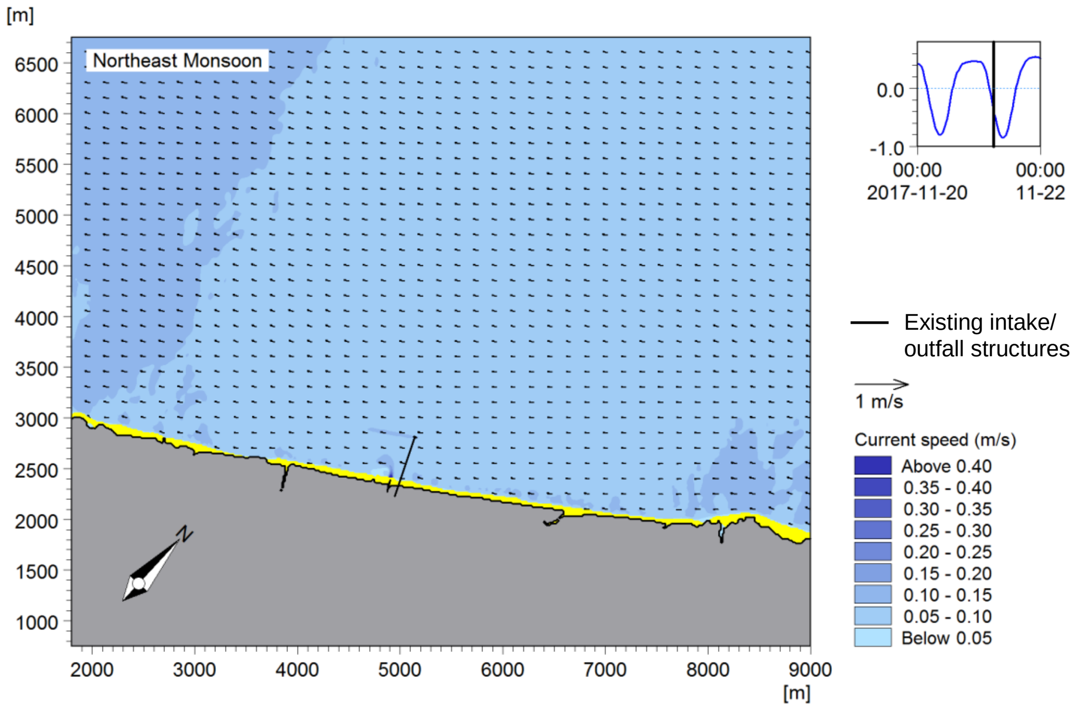
4.7.1 Existing Condition

Peak flood and ebb flow currents around the Project area for each monsoonal condition are shown in Figures 4.10 to 4.12. Currents within the South China Sea flow towards the southwest during flood flow. The currents reverse during ebb flow.

Mean and maximum current speed plots for seasonal conditions are shown in Figure 4.13. The mean and maximum current speed within the Project area is generally up to 0.1 and 0.2 m/s respectively for the Northeast Monsoon condition. Current speed is highest in the vicinity of the existing outfall with mean and maximum speed of above 0.4 and 0.55 m/s respectively. The overall current speeds at the Project area are relatively lower during the inter-monsoon and Southwest Monsoon conditions.

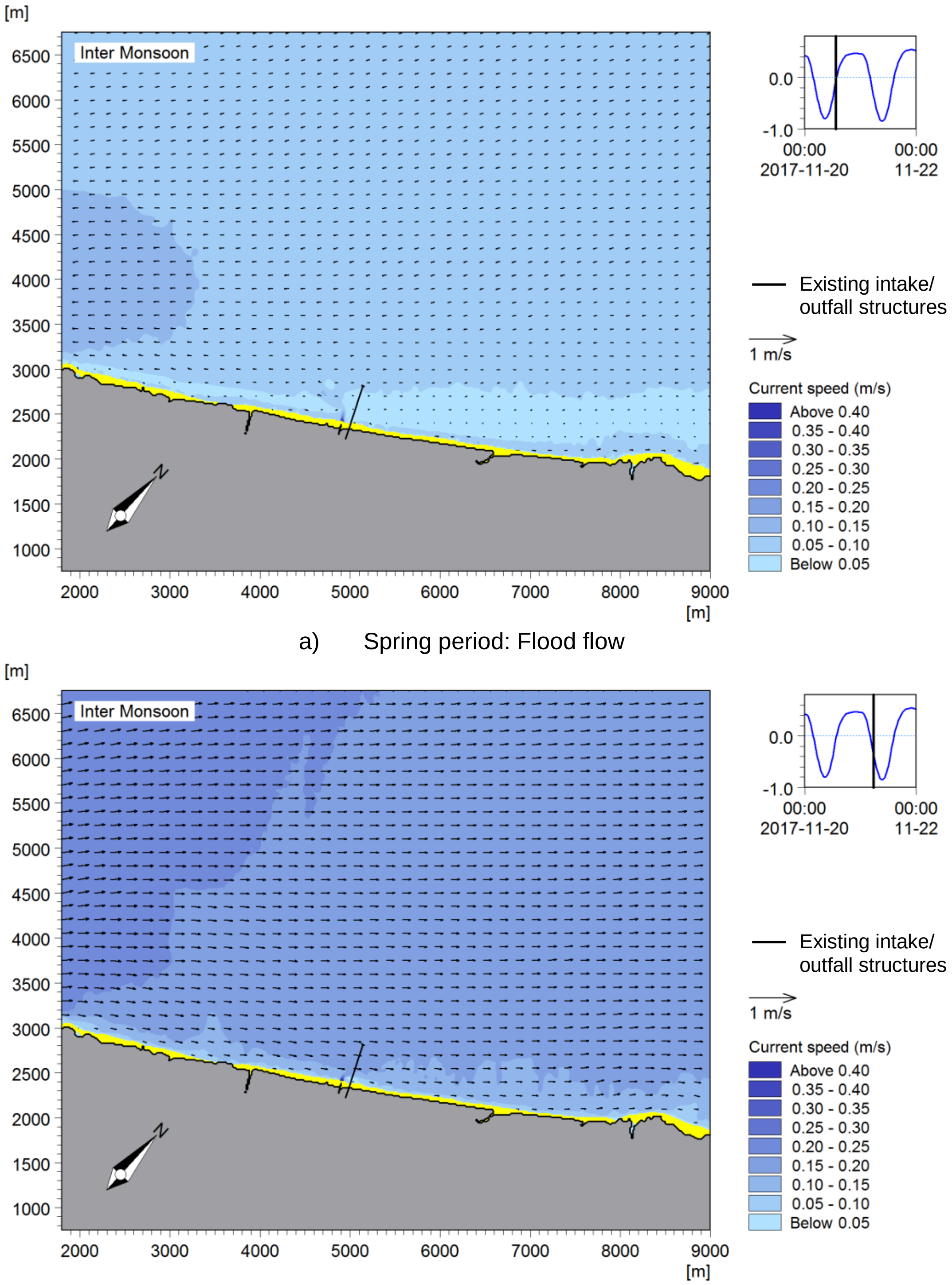


a) Spring period: Flood flow



b) Spring period: Ebb flow

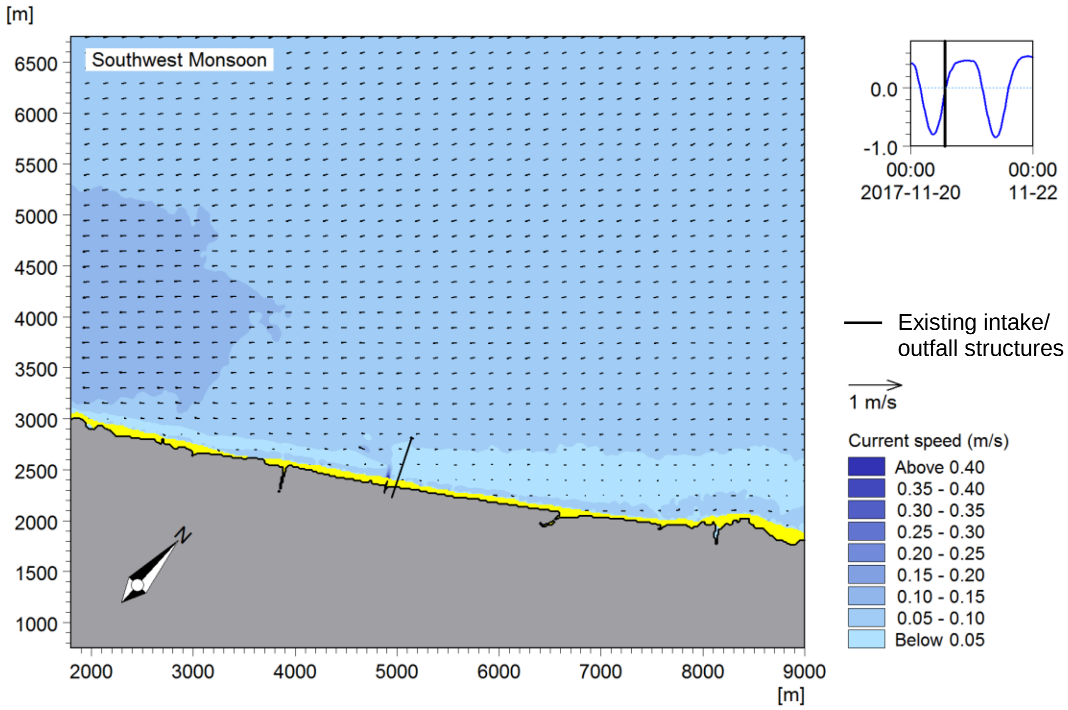
Figure 4.10 Flow pattern during peak ebb and flood condition: Existing condition (Northeast Monsoon condition)



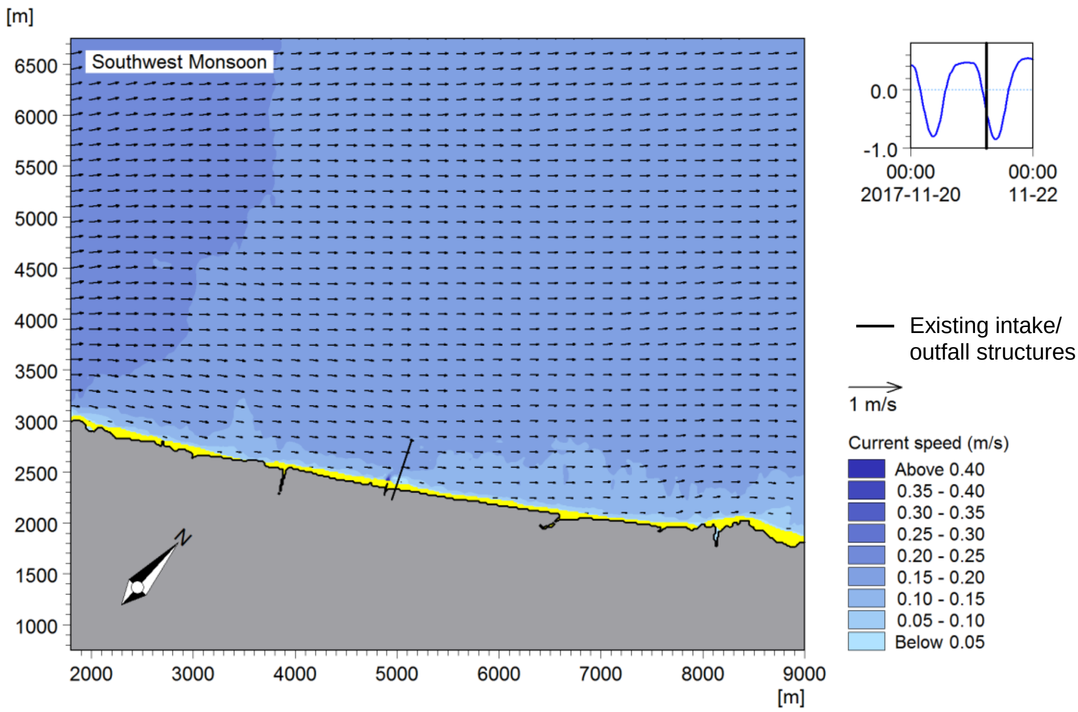
a) Spring period: Flood flow

b) Spring period: Ebb flow

Figure 4.11 Flow pattern during peak ebb and flood condition: Existing condition (inter-monsoon condition)

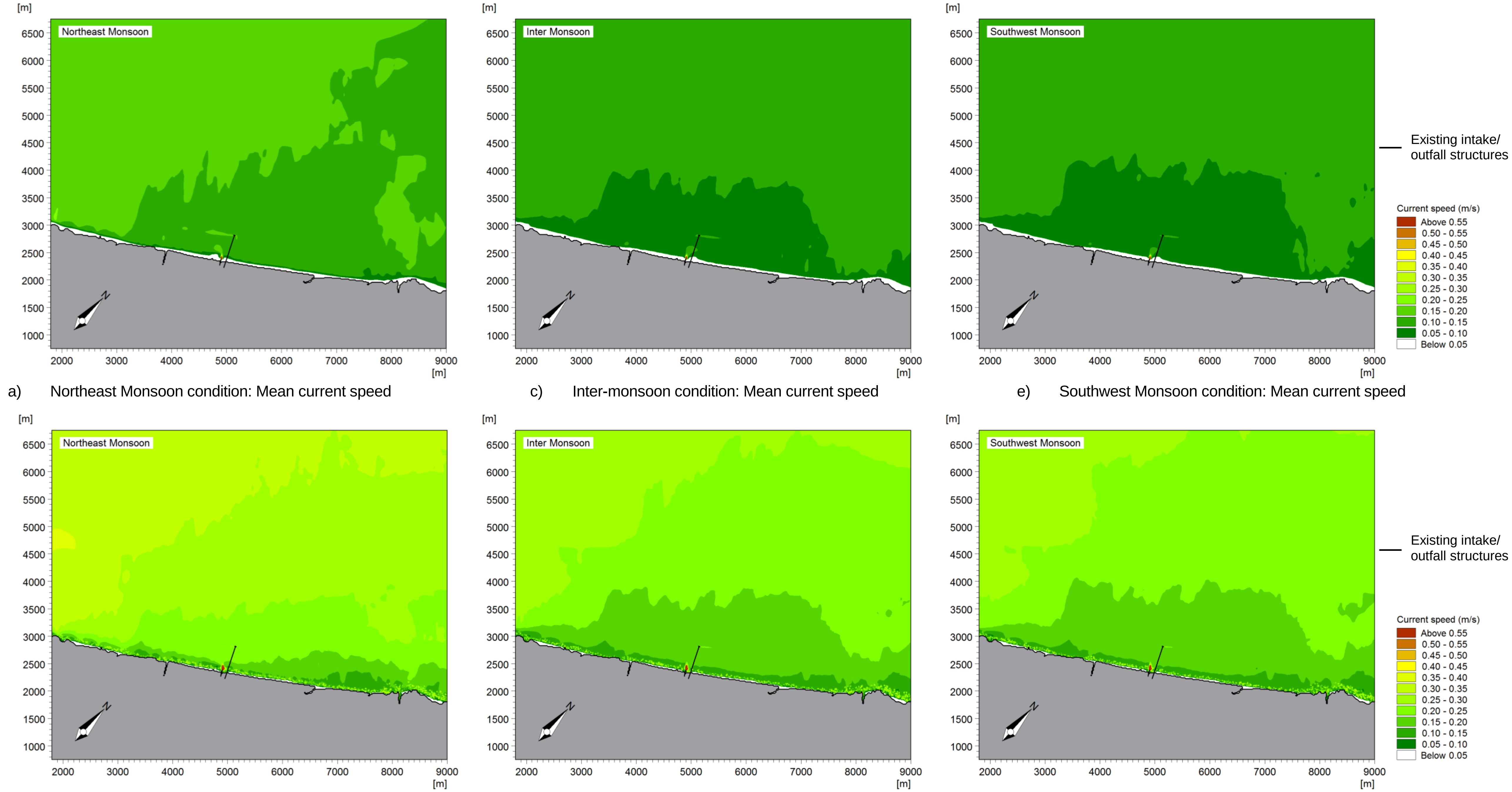


a) Spring period: Flood flow



b) Spring period: Ebb flow

Figure 4.12 Flow pattern during peak ebb and flood condition: Existing condition (Southwest Monsoon condition)



a) Northeast Monsoon condition: Mean current speed

c) Inter-monsoon condition: Mean current speed

e) Southwest Monsoon condition: Mean current speed

b) Northeast Monsoon condition: Maximum current speed

d) Inter-monsoon condition: Maximum current speed

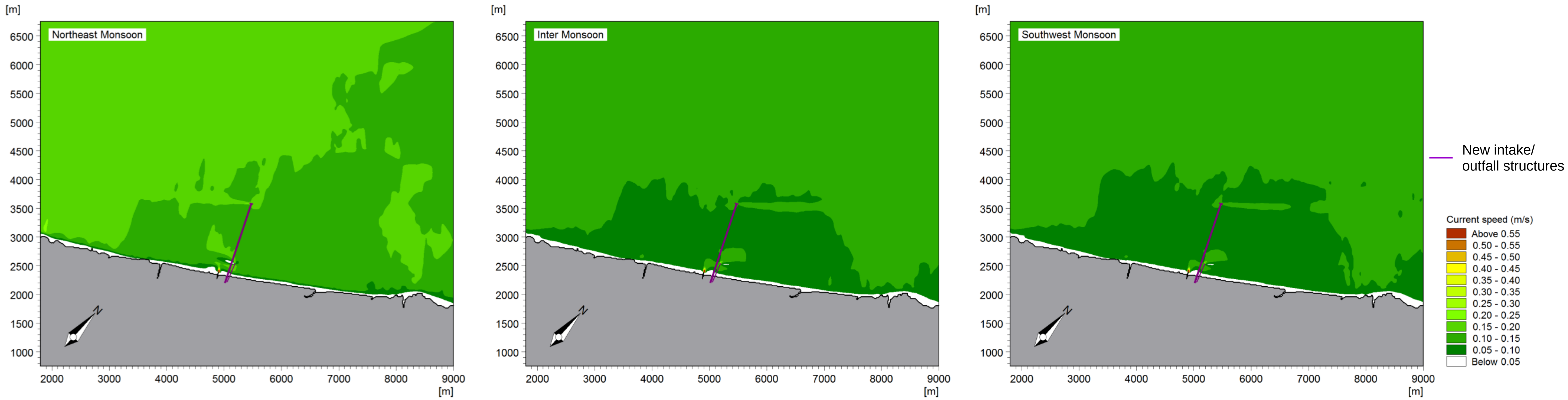
f) Southwest Monsoon condition: Maximum current speed

Figure 4.13 Mean and maximum current speeds plots: Existing condition

4.7.2 **"With Project" condition**

Identifying hydrodynamic impact due to the Project is done by assessing changes that occur with respect to the existing condition. This is done by obtaining mean and maximum current speeds with implementation of the proposed intake and outfall structures. The changes introduced by the "with Project" condition with respect to the existing condition are then analysed.

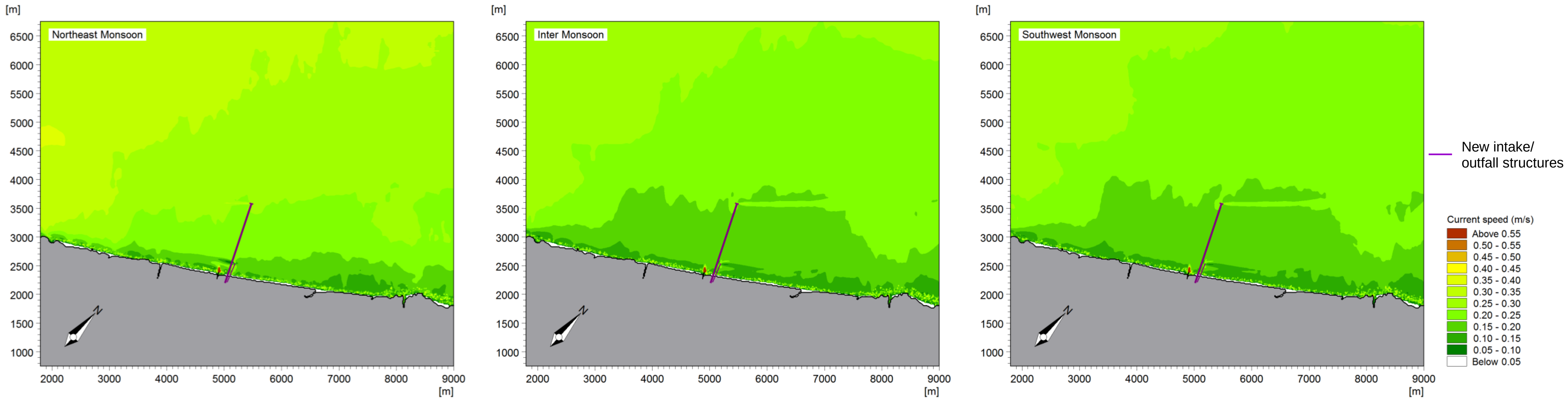
Mean and maximum current speed plots for the "with Project" condition as well as current speed difference plots during each monsoonal condition are shown in Figures 4.14 and 4.15. From the analysis, it can be deduced that the proposed Project creates localised changes to current flow patterns. These changes are primarily a result of additional flow from the source (outfall) and sink (intake) introduced into the Project area and slight reduction in depth at the intake and outfall structures. This causes flow acceleration and deceleration within the Project site. It is predicted during the Northeast Monsoon condition that the mean and maximum current speed increases by up 0.1 m/s at the intake head extending approximately 150 and 300 m to the west of the proposed intake and outfall structures respectively. During the Southwest and inter-monsoon conditions, the increase is less than 0.05 m/s for mean speed while an increase in maximum speed of up to 0.1 m/s is predicted extending approximately 300 m to the east of the proposed intake and outfall structures as influenced by the prevailing wind direction.



a) Northeast Monsoon condition: Mean current speed

c) Inter-monsoon condition: Mean current speed

e) Southwest Monsoon condition: Mean current speed

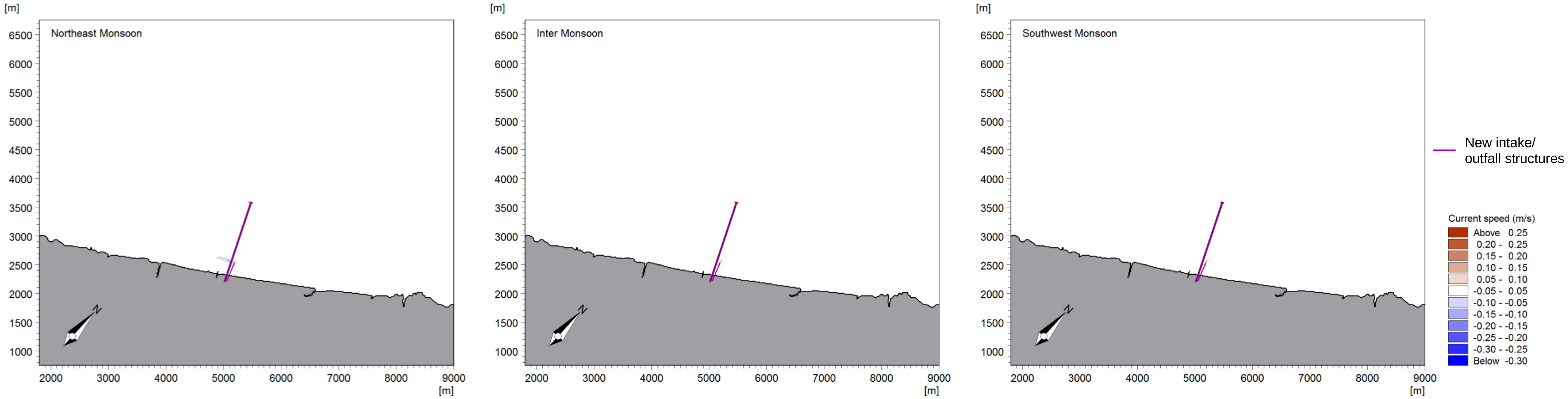


b) Northeast Monsoon condition: Maximum current speed

d) Inter-monsoon condition: Maximum current speed

f) Southwest Monsoon condition: Maximum current speed

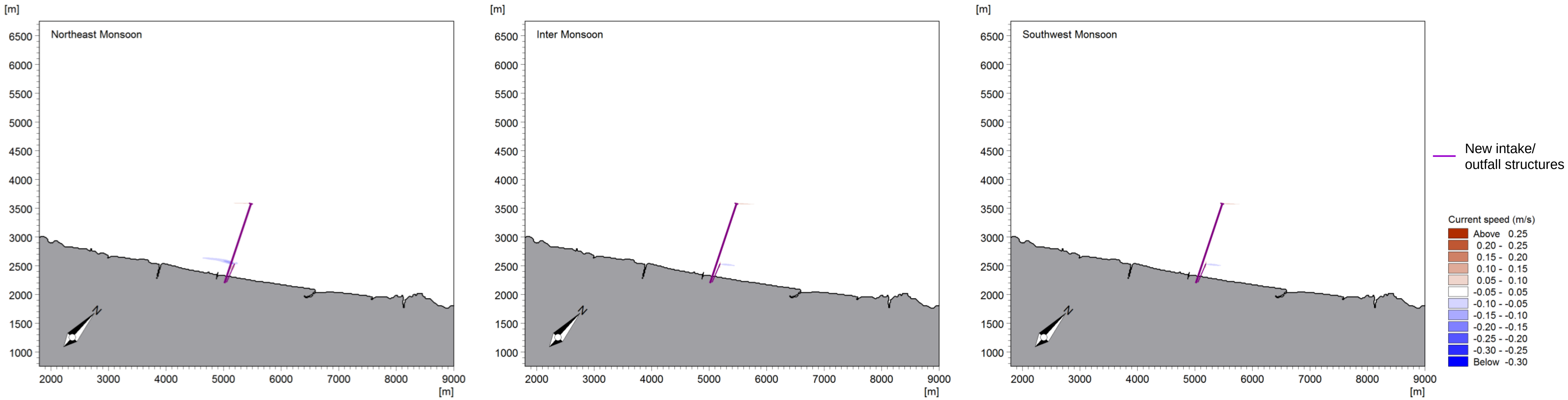
Figure 4.14 Mean and maximum current speed plots: "With Project" condition



a) Northeast Monsoon condition: Mean current speed

c) Inter-monsoon condition: Mean current speed

e) Southwest Monsoon condition: Mean current speed



b) Northeast Monsoon condition: Maximum current speed

d) Inter-monsoon condition: Maximum current speed

f) Southwest Monsoon condition: Maximum current speed

Figure 4.15 Difference in mean and maximum current speed plots: "With Project" condition vs. existing condition

Table 4.2 shows the predicted changes in current speeds at the identified ESAs for the Northeast Monsoon condition, where the current speed difference is higher compared to other monsoon conditions. The Project is not expected to create any changes in current speed at the ESAs locations except at the new intake where the mean and maximum current speed increases by 40 and 20% respectively due to the sink from the new intake. Table 4.3 shows the predicted changes in maximum water levels at the identified ESAs for the Northeast Monsoon condition. No impact in water levels is predicted at all the ESAs.

Table 4.2 Changes in current speeds due to Project implementation at the ESAs within the vicinity of the Project area (Northeast Monsoon condition)

ID	Description	Existing		With Project		Difference (%)	
		Mean Speed (m/s)	Max Speed (m/s)	Mean Speed (m/s)	Max Speed (m/s)	Mean Speed	Max Speed
1	New intake	0.15	0.26	0.21	0.31	+40	+20
2	Kampung Nelayan Batu Mandi	0.11	0.13	0.11	0.13	0	0
3	Similajau National Park marine extension	0.13	0.23	0.13	0.23	0	0
4	Bintulu Port	0.08	0.21	0.08	0.21	0	0
5	Batu Likau	0.13	0.27	0.13	0.27	0	0
6	Batu Mandi	0.12	0.22	0.12	0.22	0	0

Table 4.3 Changes in maximum water levels due to Project implementation at the ESAs within the vicinity of the Project area (Northeast Monsoon condition)

ID	Description	Max surface Elevation (m MSL)		Difference (%)
		Existing	With Project	
1	New intake	0.67	0.67	0
2	Kampung Nelayan Batu Mandi	0.68	0.68	0
3	Similajau National Park marine extension	0.68	0.68	0
4	Bintulu Port	0.59	0.59	0
5	Batu Likau	0.60	0.60	0
6	Batu Mandi	0.60	0.60	0

4.7.3 Period of No Activity During Construction

It is anticipated that there will be impact in terms of current speed caused by changes in bathymetry due to the trenching works to lay the intake pipelines and presence the temporary disposal ground. A close-up view of bathymetry during period of no activity during construction is shown in Figure 4.16.

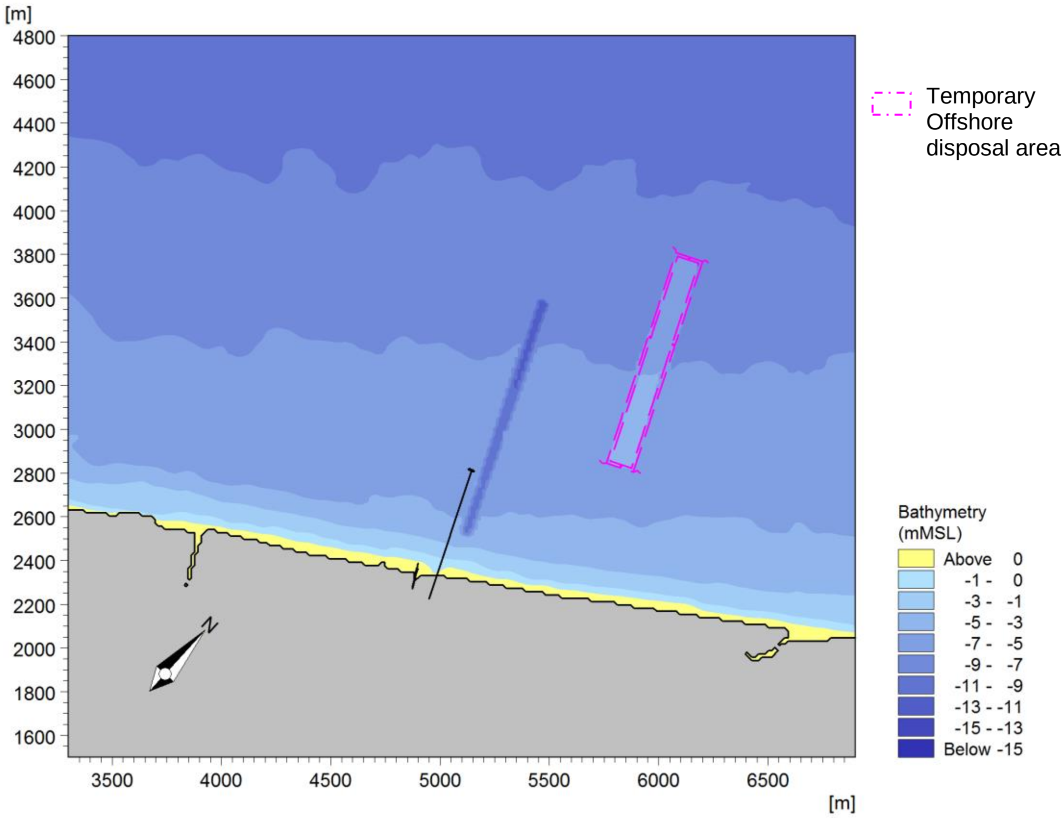
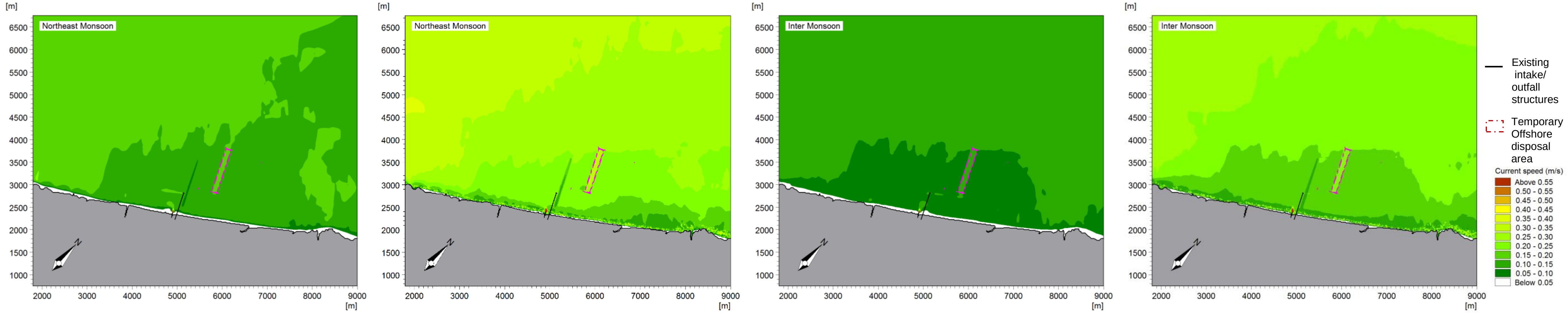


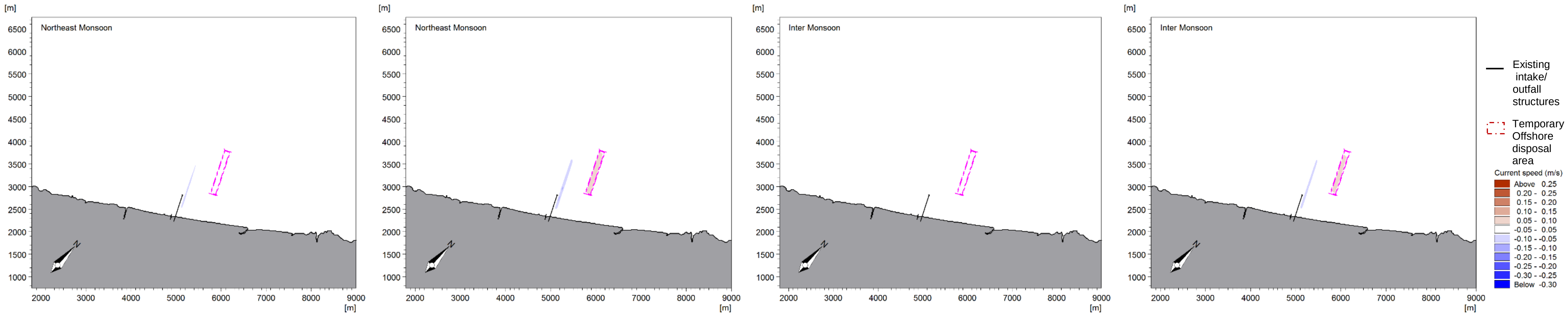
Figure 4.16 Close-up view of bathymetry during period of no activity during construction

Identifying the temporary impacts in current speed and water level is done by assessing changes that occur with respect to the existing condition. This, in turn, is done by analysing the change in mean and maximum current speed and maximum surface elevation with respect to the existing condition. Figures 4.17 and 4.18 present the mean, maximum and the differences in current speed during this period. The trench may cause mean and maximum current speed reduction of up to 0.1 m/s of during the Northeast Monsoon condition but less than 0.05 m/s during the inter-monsoon condition. The presence of the excavated material at the temporary disposal ground is predicted to increase the mean and maximum current speed by less than 0.05 and 0.1 m/s respectively. The changes in current speed for all monsoonal conditions are localised.



a) Northeast Monsoon condition: Mean speed
b) Northeast Monsoon condition: Maximum speed
c) Inter-monsoon condition: Mean speed
d) Inter-monsoon condition: Maximum speed

Figure 4.17 Mean and maximum current speed plots: Period of no activity during construction



a) Northeast Monsoon condition: Mean speed
b) Northeast Monsoon condition: Maximum speed
c) Inter-monsoon condition: Mean speed
d) Inter-monsoon condition: Maximum speed

Figure 4.18 Difference in mean and maximum current speed plots: Period of no activity during construction

Tables 4.4 and 4.5 show the predicted changes in mean and maximum current speed and surface elevation at the ESAs for the Northeast Monsoon condition. The Project is not expected to create any changes in current speed at the ESAs locations except at the existing intake where the mean and maximum current speed reduces by 20 and 22% due to deepening of seabed at the trench. There are insignificant changes in current speed and water levels expected at other ESAs during this period.

Table 4.4 Changes in current speeds during period of no activity during construction at the ESAs within the vicinity of the Project area (Northeast Monsoon condition)

ID	Description	Existing		During Construction		Difference (%)	
		Mean Speed (m/s)	Max Speed (m/s)	Mean Speed (m/s)	Max Speed (m/s)	Mean Speed	Max Speed
1	Existing intake	0.15	0.23	0.12	0.18	-20	-22
2	Kampung Nelayan Batu Mandi	0.11	0.13	0.11	0.13	0	0
3	Similajau National Park marine extension	0.13	0.23	0.13	0.23	0	0
4	Bintulu Port	0.08	0.21	0.08	0.21	0	0
5	Batu Likau	0.13	0.27	0.13	0.27	0	0
6	Batu Mandi	0.12	0.22	0.12	0.22	0	0

Table 4.5 Changes in maximum water levels during period of no activity during construction at the ESAs within the vicinity of the Project area (Northeast Monsoon condition)

ID	Description	Max surface Elevation (m MSL)		Difference (%)
		Existing	With Project	
1	Existing intake	0.67	0.67	0
2	Kampung Nelayan Batu Mandi	0.68	0.68	0
3	Similajau National Park marine extension	0.68	0.68	0
4	Bintulu Port	0.59	0.59	0
5	Batu Likau	0.60	0.60	0
6	Batu Mandi	0.60	0.60	0

4.8 Findings

The simulated existing mean and maximum current speed within the Project area is generally up to 0.1 and 0.2 m/s respectively. Current speed is highest in the vicinity of the existing outfall with mean and maximum speed of above 0.4 and 0.55 m/s respectively. The overall current speeds at the Project area are relatively lower during the inter-monsoon and Southwest Monsoon conditions.

During the period of no activity, the presence of the trench may cause mean and maximum current speed reduction of up to 0.1 m/s of for the Northeast Monsoon condition. The presence of the excavated material at the temporary disposal ground is predicted to increase the mean and maximum current speed by less than 0.05 and 0.1 m/s respectively. However, these changes are temporary as the trench will be backfilled with the material placed at the temporary disposal ground once the pipelines are laid beginning in March 2019. There are insignificant changes in current speed during this period at the ESAs locations.

Upon Project implementation, it is predicted that the mean and maximum current speed increases by up 0.1 m/s at the intake head extending approximately 150 and 300 m to the west of the proposed intake and outfall structures for the Northeast Monsoon condition. The Project is not expected to create any changes in current speed at any of the ESAs locations except at the existing and new intake.

The changes in current speeds are localised during the period of no activity during construction and upon Project implementation. There are insignificant changes in water levels expected for both scenarios at the ESAs locations.

Chapter 5

WAVES

Chapter 5

WAVES

5.1 Introduction

An appraisal of wave conditions at the Project site assists in determining the impact of waves on the surrounding vicinity of the Project area. The assessment of wave conditions at the Project area and the impact in terms of wave conditions are performed via two-dimensional wave modelling using MIKE 21 Nearshore Spectral Waves (MIKE21 NSW).

5.2 MIKE 21 NSW

MIKE 21 NSW is a wind-wave model describing propagation, growth, decay and transformation of wind generated waves and also swells in coastal areas. The model inputs include bathymetry, wave conditions along the offshore model boundary, bottom roughness, water level and breaking parameters. The generated model output comprises of significant wave height, mean wave direction, mean wave period, wave velocity components and also wave radiation stresses.

5.3 Boundary Conditions

Offshore wave data has been obtained from the regional wave model to determine the boundary condition to drive the nearshore wave model. Offshore wave data was extracted at depths around -15 m MSL and analysed to obtain representative wave conditions to simulate the nearshore wave patterns. Table 5.1 tabulates the analysed parameters that are used to drive wave to nearshore for each monsoonal condition.

Table 5.1 Parameters applied at local wave model boundary

Condition	Significant wave height (H_{m0}, m)	Mean wave period (T_m,s)	Mean wave direction (°N)
Northeast Monsoon	1.2	4.5	20
Inter-monsoon	0.8	3.5	20
Southwest Monsoon	0.5	3.0	270

5.4 Model Setup

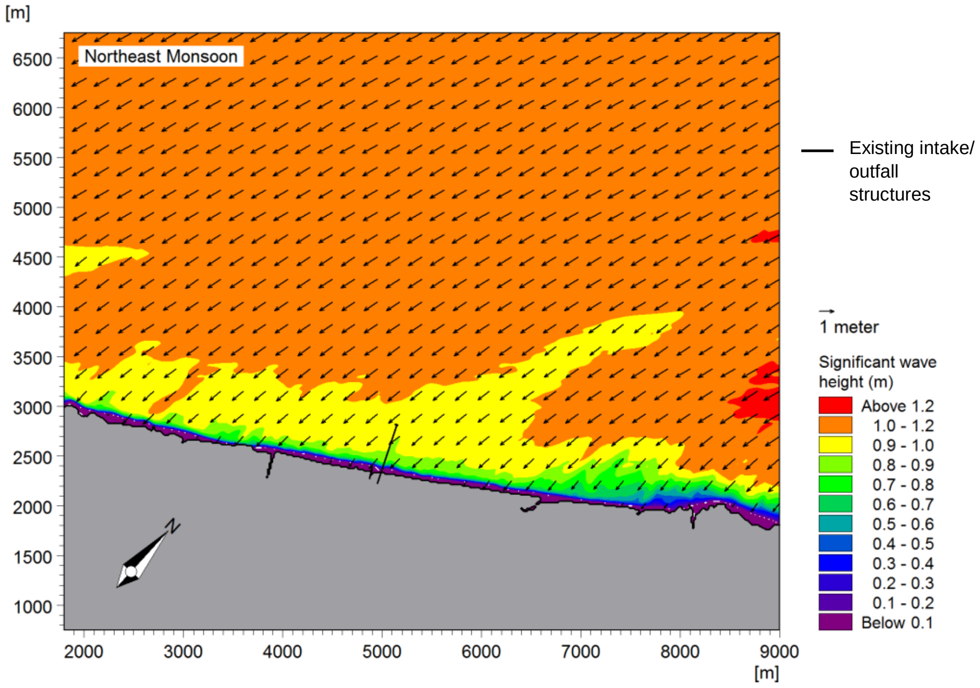
A local wave model similar to the finest domain of the hydrodynamic model has been set up. The local model has a rectilinear grid resolution of 15 x 3.75 m which is considered adequate to resolve the nearshore wave processes.

Simulations were carried out for the existing, “with Project” and during construction conditions for all monsoonal conditions. The results are compared and the impact on the wave conditions in the vicinity of the Project area is assessed

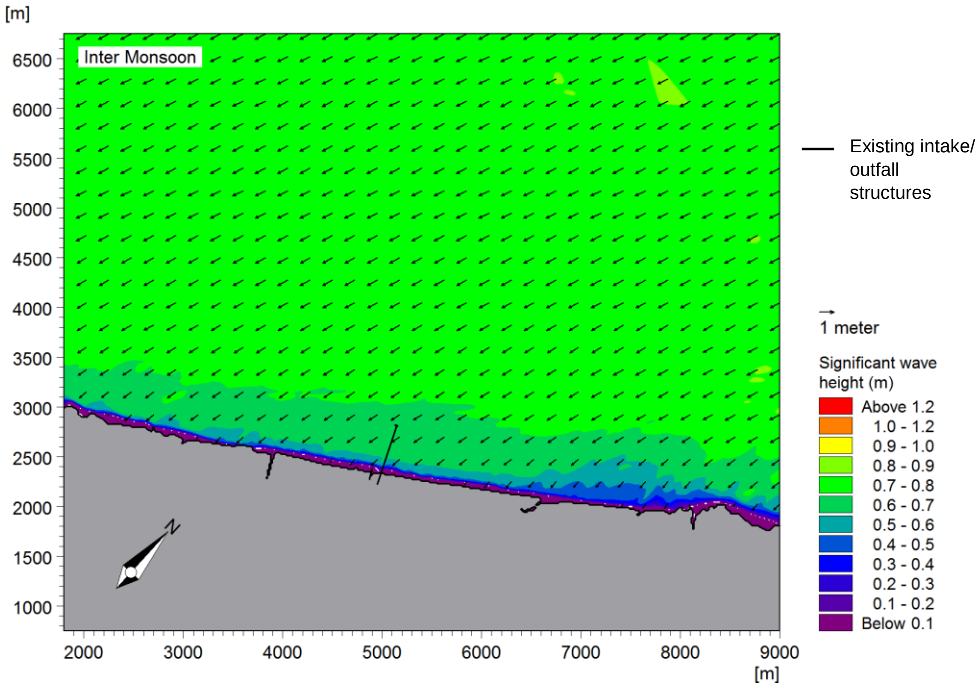
5.5 Model Results

5.5.1 Existing Condition

Significant wave height plots for each monsoonal condition during existing condition are shown in Figure 5.1. It can be inferred from the results that north-easterly waves are dominant during Northeast and inter-monsoon conditions. North-westerly waves are present during Southwest Monsoon condition but at relatively low wave heights. The waves during all monsoonal conditions are slightly oblique to the coastline. During the Northeast Monsoon condition, wave height of up to 1 m reaches the existing intake location. Wave heights are up to 0.7 and 0.5 m during the inter-monsoon and Southwest Monsoon condition respectively at the same location.

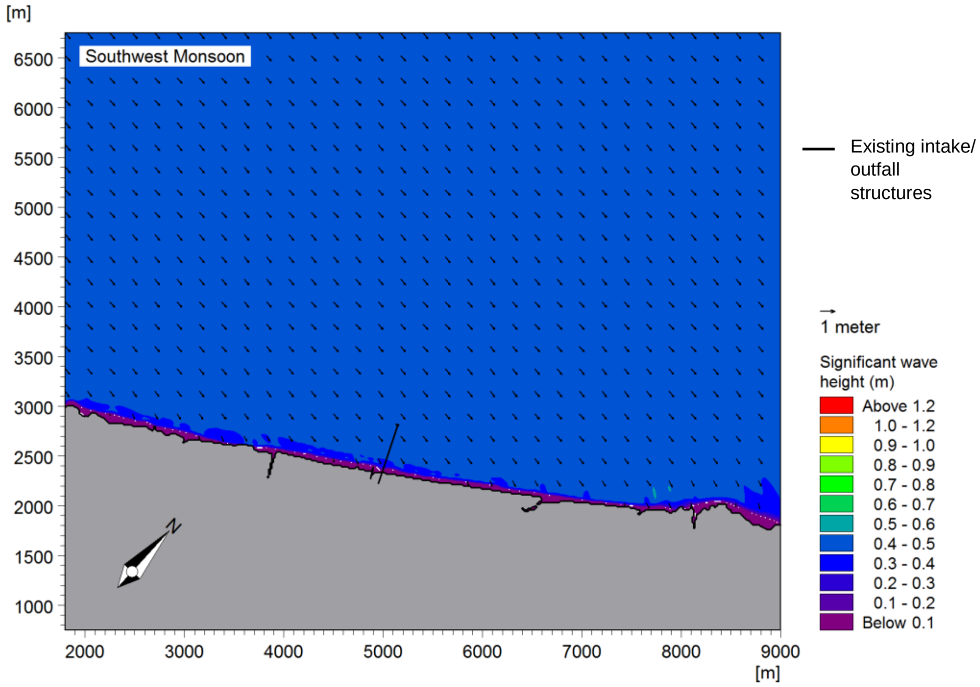


a) Northeast Monsoon condition



b) Inter-monsoon condition

Figure 5.1 Significant wave height: Existing condition



c) Southwest Monsoon condition

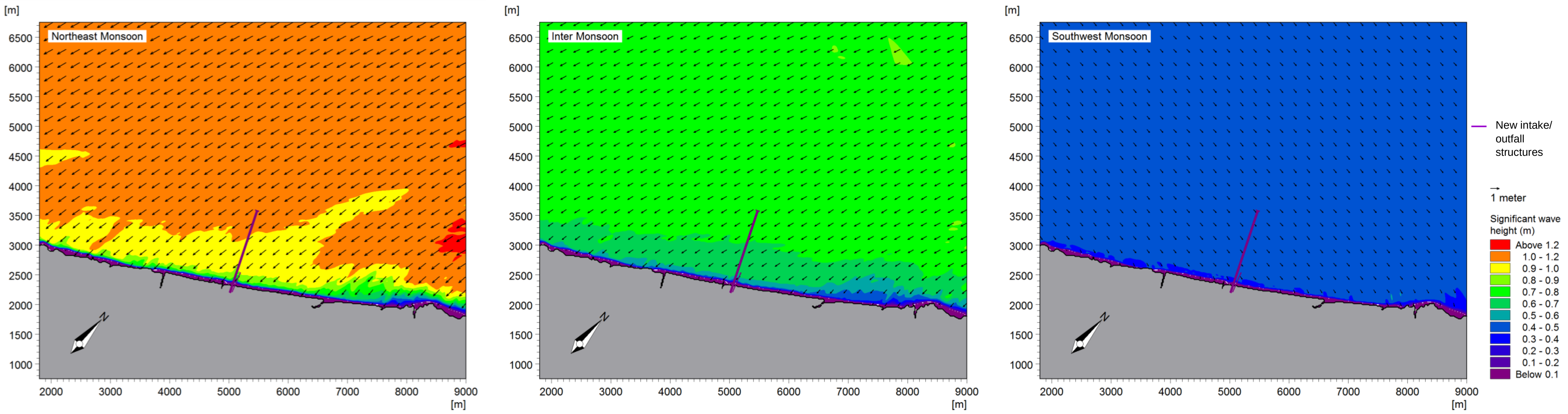
Figure 5.1 (cont'd) Significant wave height: Existing condition

5.5.2 "With Project" Condition

Identifying impacts due to the Project is done by assessing changes that occur with respect to the existing condition. Wave heights are relatively higher during the Northeast Monsoon condition. This is followed by the inter-monsoon and Southwest Monsoon condition.

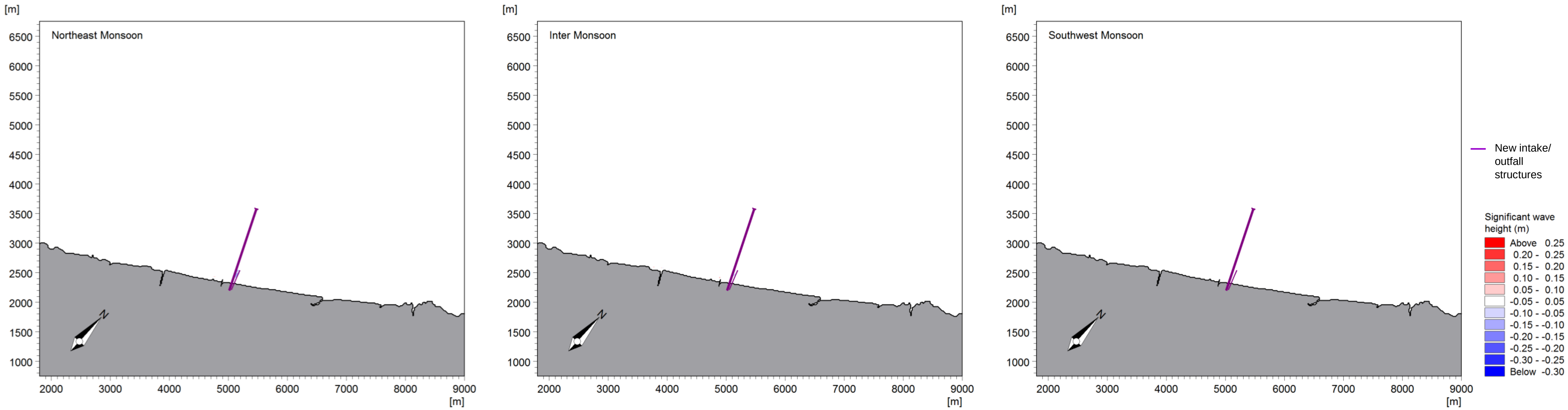
Significant wave height and wave height difference plots for each monsoonal condition are shown in Figures 5.2 and 5.3. It can be inferred from the results that the impact in waves with implementation of the Project is negligible for all monsoonal conditions.

Table 5.2 shows the predicted changes in significant wave height at the identified ESAs for the Northeast Monsoon. The impact in waves with Project implementation is negligible for all monsoonal conditions at the ESAs.



a) Northeast Monsoon condition b) Inter-monsoon condition c) Southwest Monsoon condition

Figure 5.2 Significant wave height: "With Project" condition



a) Northeast Monsoon condition b) Inter-monsoon condition c) Southwest Monsoon condition

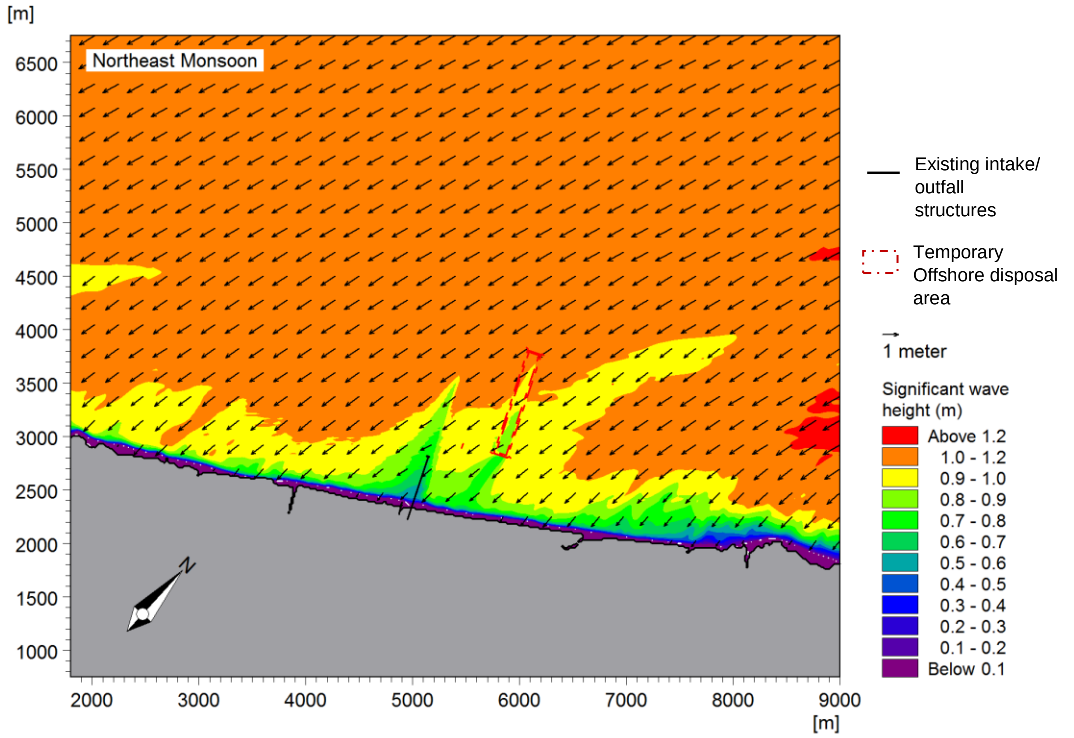
Figure 5.3 Difference in significant wave height: "With Project" condition vs. existing condition

Table 5.2 Changes in significant wave height at the ESAs within the vicinity of the Project area with Project implementation (Northeast Monsoon condition)

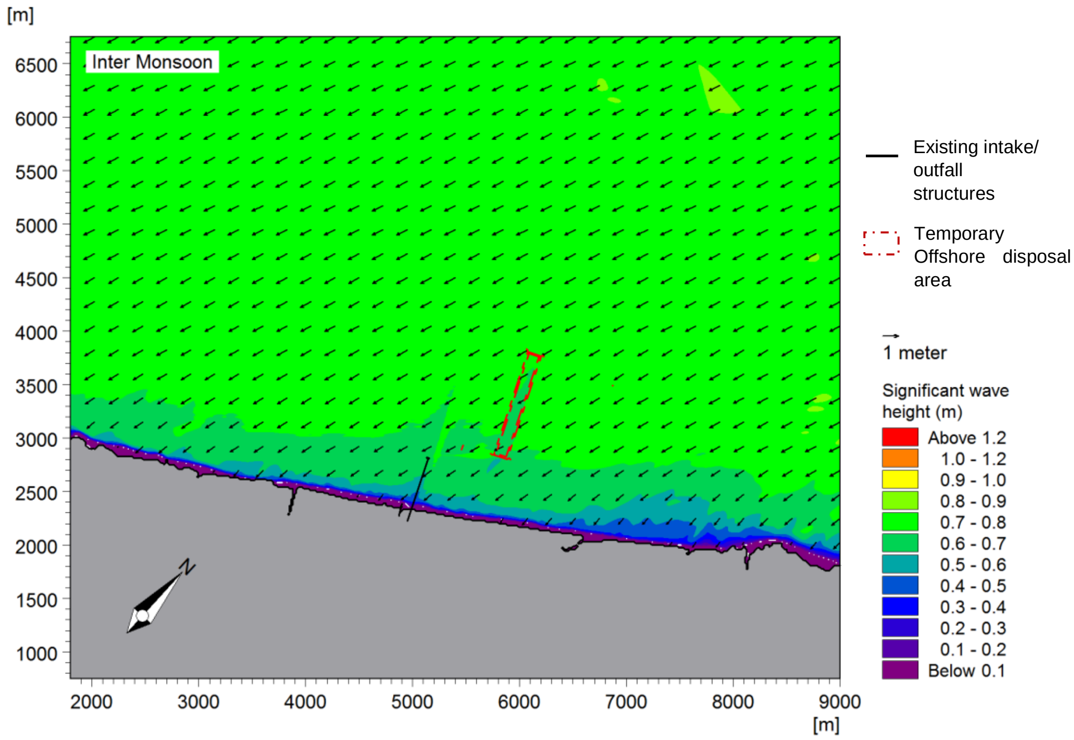
ID	Description	Significant Wave Height (m)		
		Existing	With Project	Difference (%)
1	New intake	1.0	1.0	0
2	Kampung Nelayan Batu Mandi	0.6	0.6	0
3	Similajau National Park marine extension	1.2	1.2	0
4	Bintulu Port	0.6	0.6	0
5	Batu Likau	1.2	1.2	0
6	Batu Mandi	0.9	0.9	0

5.5.3 Period of No Activity During Construction

Identifying the temporary impact in waves is done by assessing changes during the period of no marine construction activity that occur from October 2018 to February 2019 with respect to the existing condition (Figures 5.4 and 5.5). The period traverses from the inter-monsoon (October) to the Northeast Monsoon (November to February) condition. It is anticipated that the trench and temporary disposal ground may cause reduction of up to 0.3 m of wave height during Northeast Monsoon condition. Wave height reduction is less than 0.1 and 0.05 m during inter-monsoon and Southwest Monsoon condition respectively. The changes are localised. The magnitude of change is highest at the trench and temporary disposal ground. The wave height reduction of 0.1 m during the Northeast Monsoon covers about 0.5 km of the coastline fronting the plant.

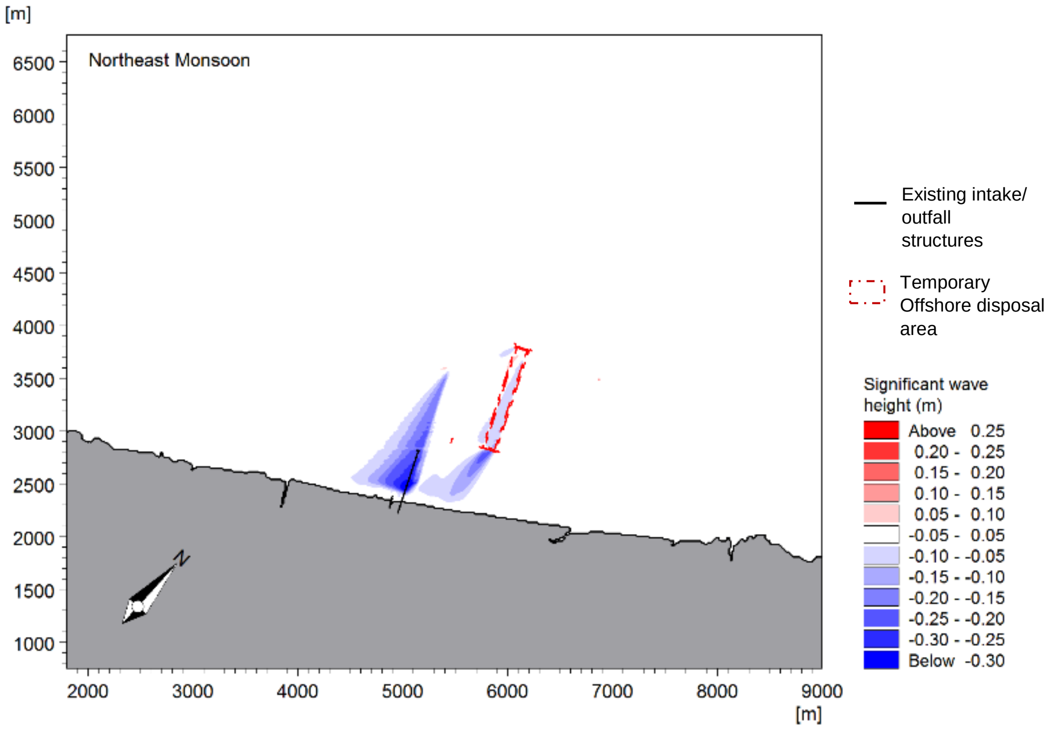


a) Northeast Monsoon condition

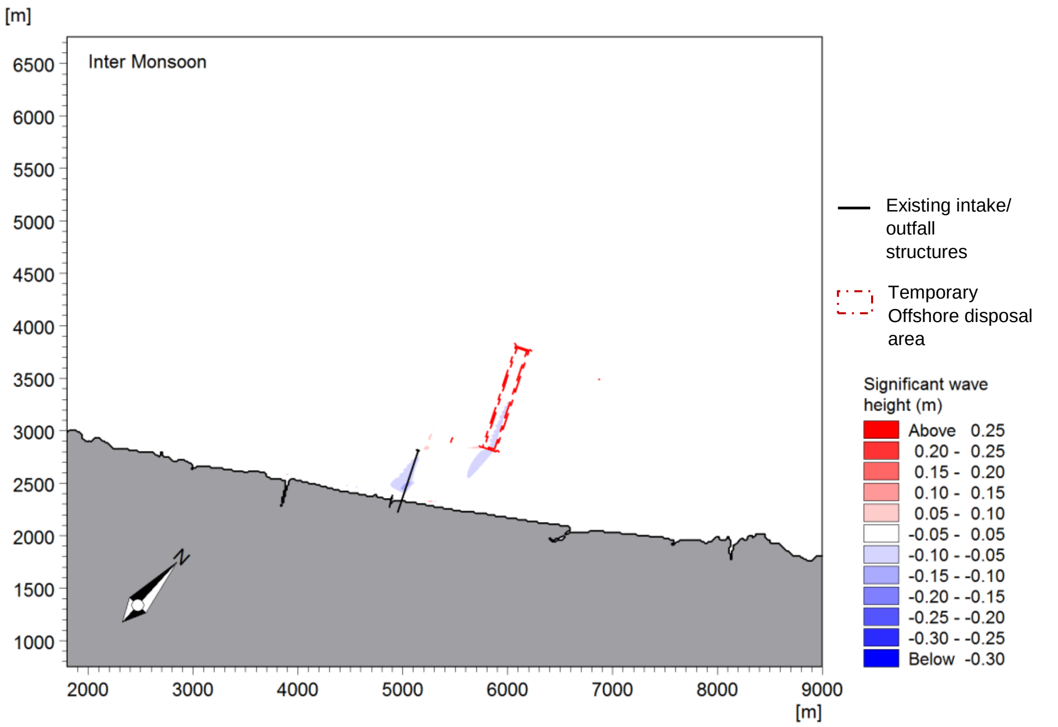


b) Inter-monsoon condition

Figure 5.4 Significant wave height: During construction



a) Northeast Monsoon condition



b) Inter-monsoon condition

Figure 5.5 Difference in significant wave height: During construction vs. existing condition

Table 5.3 shows the predicted changes in wave height extracted at the ESAs for Northeast Monsoon condition. There is generally no change in wave height at the ESAs except at the existing intake structure where a 20% reduction in wave height occurs.

Table 5.3 Changes in significant wave height at the ESAs within the vicinity of the Project area during period of no activity during construction (Northeast Monsoon condition)

ID	Description	Significant Wave Height (m)		
		Existing	Period of No Activity During Construction	Difference (%)
1	Existing intake	1.0	0.8	-20
2	Kampung Nelayan Batu Mandi	0.6	0.6	0
3	Similajau National Park marine extension	1.2	1.2	0
4	Bintulu Port	0.6	0.6	0
5	Batu Likau	1.2	1.2	0
6	Batu Mandi	0.9	0.9	0

5.6 Findings

There is a slight reduction in wave height due to the presence of the trench and temporary disposal ground during the period of no activity during construction. It is anticipated that the trench and temporary disposal ground causes localised wave height reduction. The magnitude of change is highest at the trench and temporary disposal ground. The wave height reduction of 0.1 m during the Northeast Monsoon covers about 0.5 km of the coastline fronting the plant. A 20% wave height reduction is anticipated at the existing intake structure. This condition is temporary as the trench will be backfilled with material removed from the temporary disposal area after March 2019. There is generally insignificant change in wave height after the Project implementation with respect to the existing condition.

Chapter 6

THERMAL PLUME AND CHLORINE DISPERSION

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Chapter 6

THERMAL PLUME AND CHLORINE DISPERSION

6.1 Introduction

Simulations to assess the recirculation of cooling water from the proposed power plant expansion are performed. The excess temperature that can occur due to the heat discharge is evaluated. The dispersion of chlorine that is discharged together with the heated water at the outfall is also investigated. Simulations for the cooling water recirculation study and chlorine dispersion were done using MIKE 21 AD.

6.2 Regulations

The Department of Environment (DOE) has produced the Malaysian Marine Water Quality Criteria and Standard (MMWQCS) that regulates the Malaysian marine water quality. Table 6.1 provides information extracted from the MMWQCS for temperature increase for the various classes of marine water. The Project site is classified under ports, oil and gas field vicinity (Class 3). Based on the table, any activity conducted in a Class 3 area should not cause the temperature of the seawater to increase more than 2°C above the maximum ambient seawater temperature.

Table 6.1 Malaysian Marine Water Quality Criteria and Standard (MMWQCS)

Parameter	Class 1	Class 2	Class 3	Class E
Beneficial Uses	Preservation, marine protected areas, marine parks	Marine life, fisheries, coral reefs, recreational and mariculture	Ports, oil & gas fields	Mangroves estuarine & river mouth water
Temperature (°C)	$\leq$2 increase over maximum ambient	$\leq$2 increase over maximum ambient	$\leq$2 increase over maximum ambient	$\leq$2 increase over maximum ambient

Source: DOE, 2015

The 'Environmental, Health, and Safety Guidelines for Thermal Power Plants' Draft for Second Public Consultation) prepared by the International Finance Corporation (IFC) of the World Bank Group in 2017 states that:

"The effluent should result in a temperature change of no more than 3°C at the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors, and assimilative capacity.*"*

The World Bank Group has also specified in its 'Pollution Prevention and Abatement Handbook – Thermal Power: Guidelines for New Plants' that:

"Where the mixing zone is not defined, use 100 m from the point of discharge when there are no sensitive aquatic ecosystems within this distance."

The United States Environmental Protection Agency (USEPA) stated in its 'Assessment of the Effects of Chlorinated Seawater from Power Plants on Aquatic Organisms' that toxic effect caused by Chlorine concentration towards marine organisms in seawater is 0.5 ppm. The IFC's 'Environmental, Health, and Safety Guidelines for Thermal Power Plants' that the maximum concentration total residual chlorine is 0.2 mg/L.

6.3 MIKE 21 AD

MIKE 21 AD is the advection-dispersion module of MIKE 21. The module solves the two-dimensional, depth-integrated transport equation of the advection-dispersion type for dissolved or suspended substances when provided with the flow field from MIKE 21 HD. It simulates the spreading of dissolved or suspended substances subject to advection and dispersion processes in lakes, estuaries and coastal regions. The features include linear decay and heat dissipation to the atmosphere.

6.4 Model Setup

Simulations of the thermal plumes and chlorine dispersion apply similar model domains to the current flow model. MIKE 21 AD simulations were carried out for the existing and 'with Project' conditions for all monsoonal conditions. A summary of the input data for the simulation is shown in Table 6.2. Both the existing and proposed outfalls have similar outfall temperature and excess chlorine concentration of 38°C and 0.2 mg/L.

Table 6.2 Input data for MIKE 21 AD simulations

Description	Existing Intake	Existing Outfall	Proposed Intake	Proposed Outfall
Outfall temperature (°C)	n.a.	38	n.a.	38
Excess chlorine concentration (mg/L)	n.a.	0.2	n.a.	0.2
Flow rate (m^3/s)	7.77	7.77	9.3	18.6

n.a. –not applicable

Seawater temperature at the Project site was recorded from January 2016 to December 2017. The measurements were made at the existing condenser water inlet temperature. The information was provided by the Client as basis of the site's ambient seawater temperature. Simulations for low ambient temperature takes into account the lowest recorded seawater temperature of 28.3°C. The simulations with high ambient temperature utilises the highest recorded temperature of 31.5°C. Chlorine was simulated as a conservative substance in which the ambient concentration was set to zero.

6.5 Design Simulation Period

A design simulation period covering a 31-day period was adopted. It includes a 3-day 'warm-up' period.

6.6 Thermal Plume Dispersion

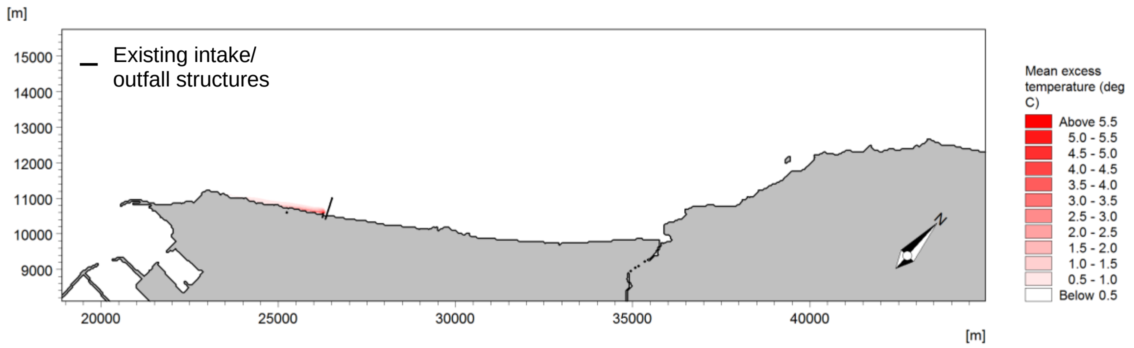
6.6.1 Existing Condition

The results are in the form of depth-averaged temperature, which is more conservative than the temperature in any single model layer as practically, water from various depths in the water column will inevitably be mixed. Plots of contours of mean and maximum excess temperature as well as plots for the probability of exceedance for 2 and 3°C rise in temperature are presented in:

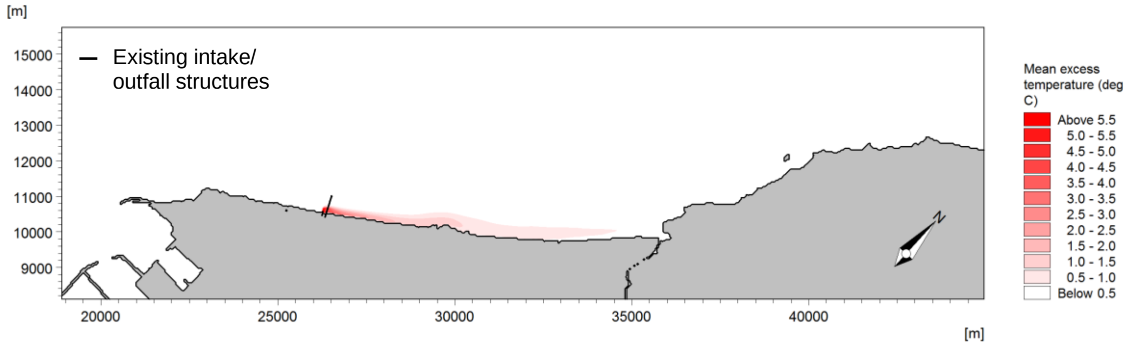
(a) Figures 6.1 to 6.4 for simulations with low ambient seawater temperature; and
(b) Figures 6.5 to 6.8 for simulations with high ambient seawater temperature.

It can be observed that the plume disperses southwest during the Northeast Monsoon condition. The plume extends northeast during the Southwest and inter-monsoon conditions due to the prevailing wind directions. The plume concentration is much smaller in magnitude during the Northeast Monsoon condition due to higher wind speed that aids the advection and spreading process of the outfall discharge.

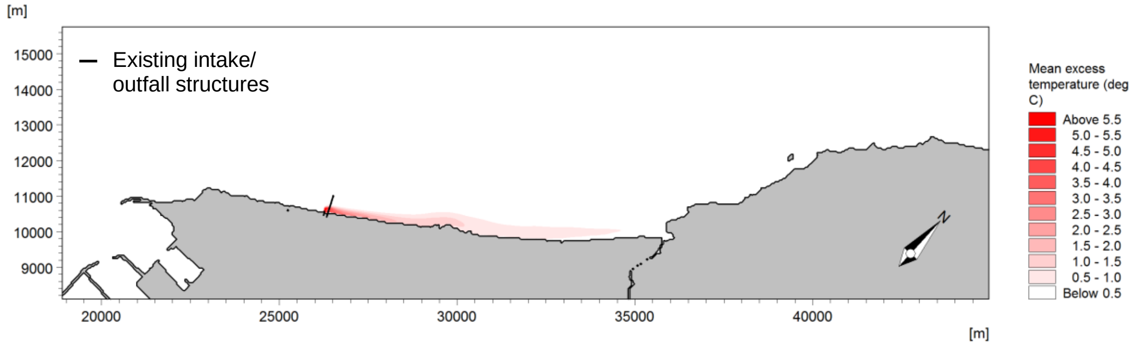
Simulations with a low ambient temperature during the Northeast Monsoon condition show that a plume with mean excess temperature of at least 0.5°C disperses up to 2.5 km southwest of the outfall. For the Southwest and inter-monsoon conditions, the plume extends up to 8 km northeast. For maximum excess temperature of the same value, the plume extends 4 km southwest during the Northeast Monsoon condition and 10 km during the Southwest and inter-monsoon conditions. The areal extent where 2°C is exceeded by at least 5% of time is about 1.5 km during the Northeast Monsoon and 2 km during the Southwest and inter-monsoon conditions. The extent reduces to 0.5 km and 1 km during the Northeast Monsoon and Southwest/inter-monsoon conditions for excess temperature of 3°C for the same percentage of exceedance.



a) Northeast Monsoon condition

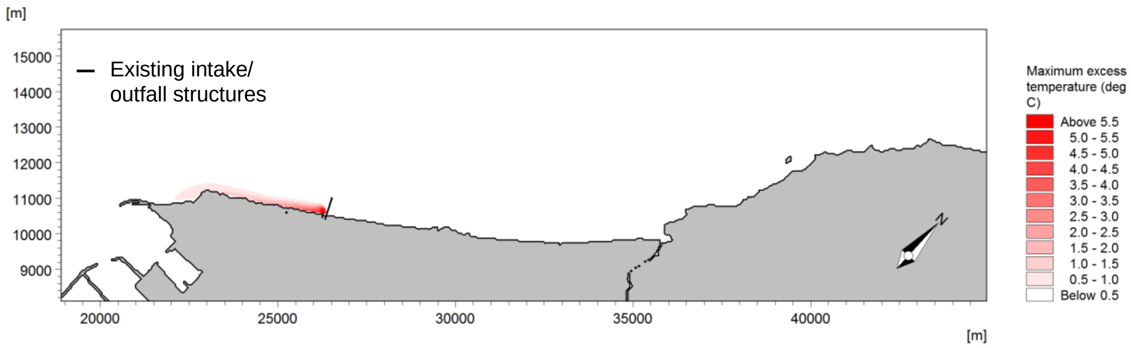


b) Inter-Monsoon condition

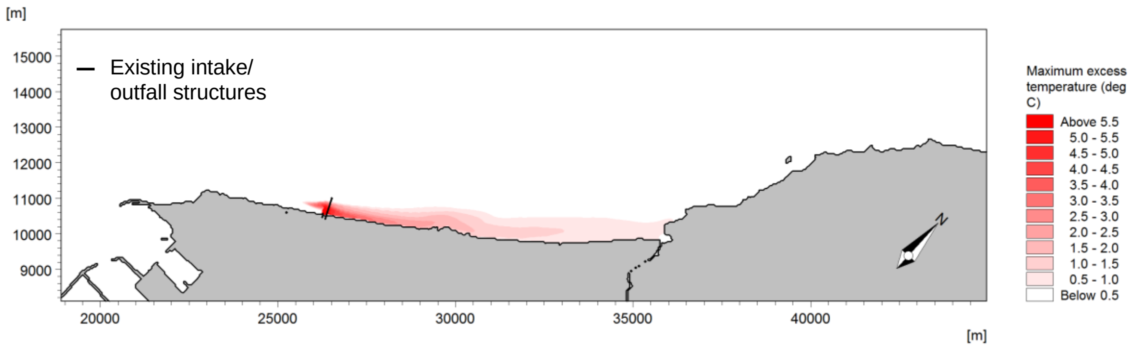


c) Southwest Monsoon condition

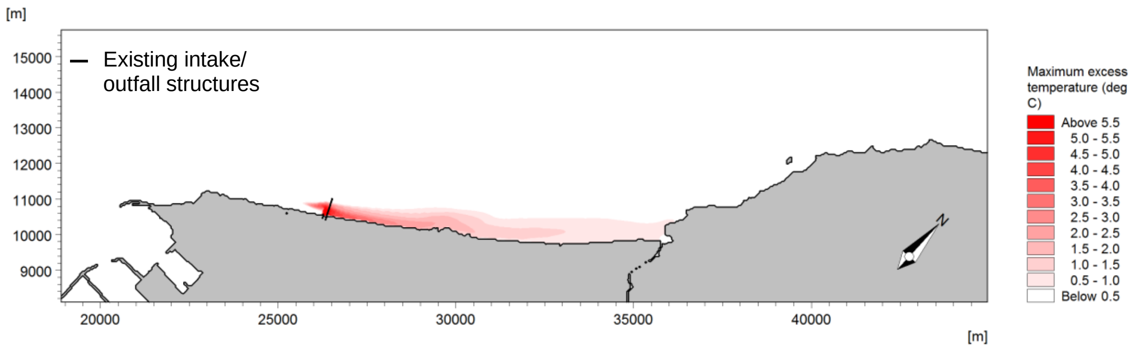
Figure 6.1 Simulations with low ambient temperature: Mean excess temperature for existing condition



a) Northeast Monsoon condition

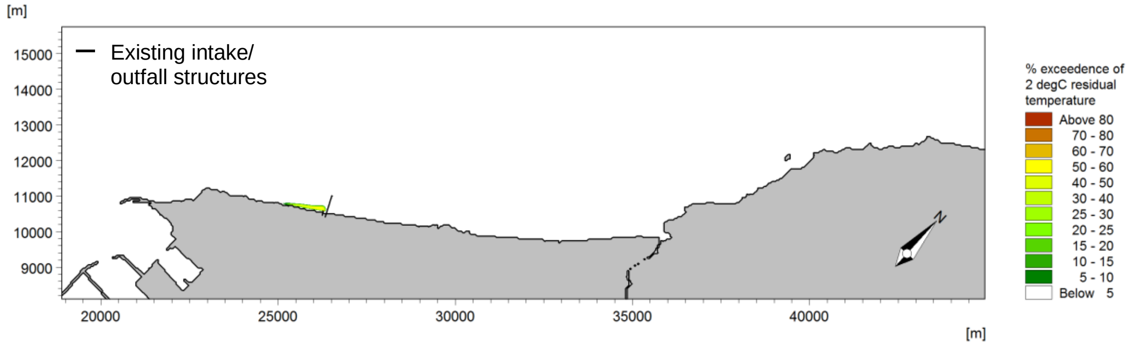


b) Inter-Monsoon condition

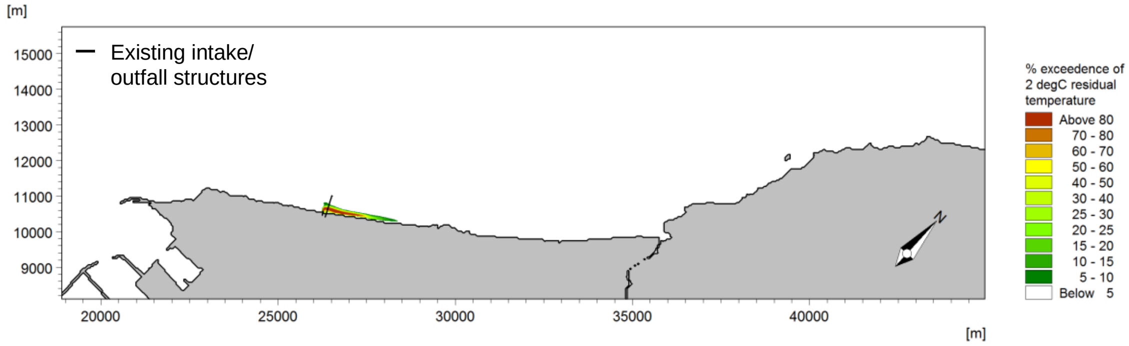


c) Southwest Monsoon condition

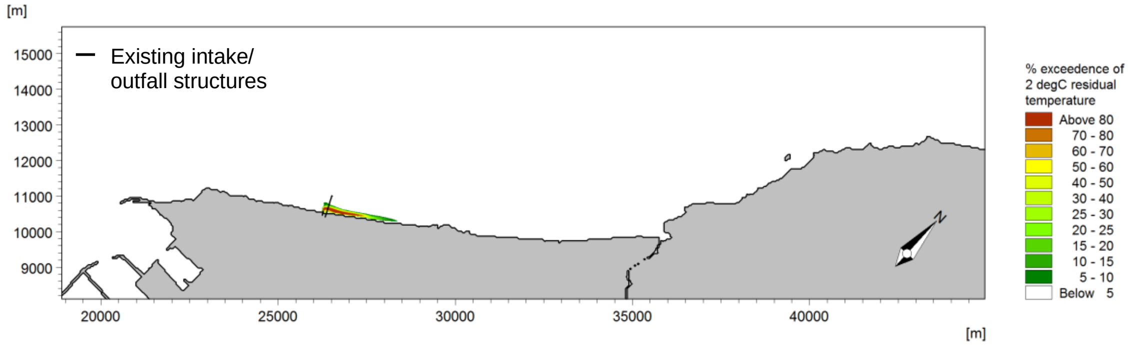
Figure 6.2 Simulations with low ambient temperature: Maximum excess temperature for existing condition



a) Northeast Monsoon condition

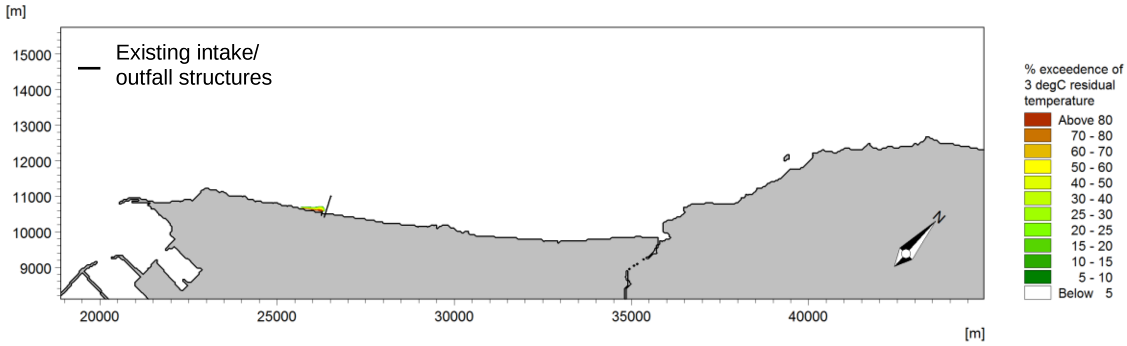


b) Inter-Monsoon condition

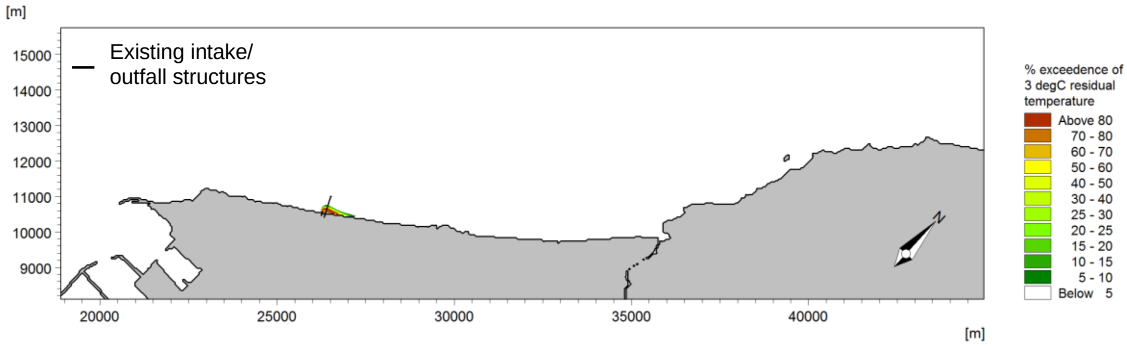


c) Southwest Monsoon condition

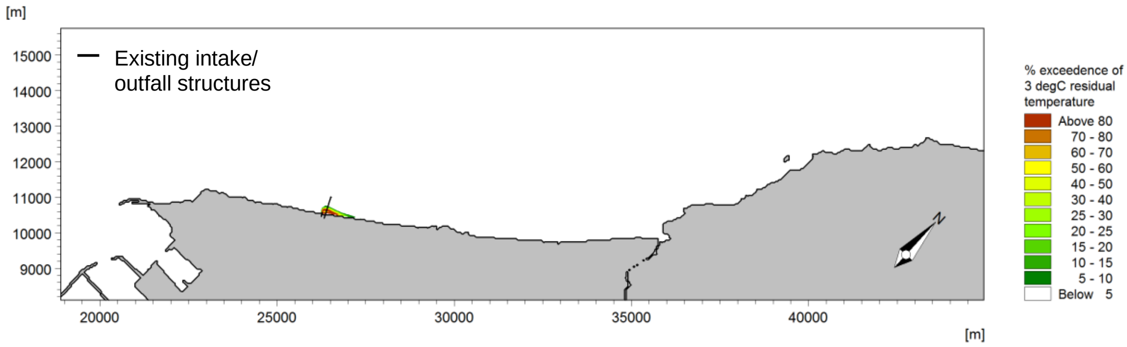
Figure 6.3 Simulations with low ambient temperature: Contours for probability exceedance of 2°C rise of temperature for existing condition



a) Northeast Monsoon condition



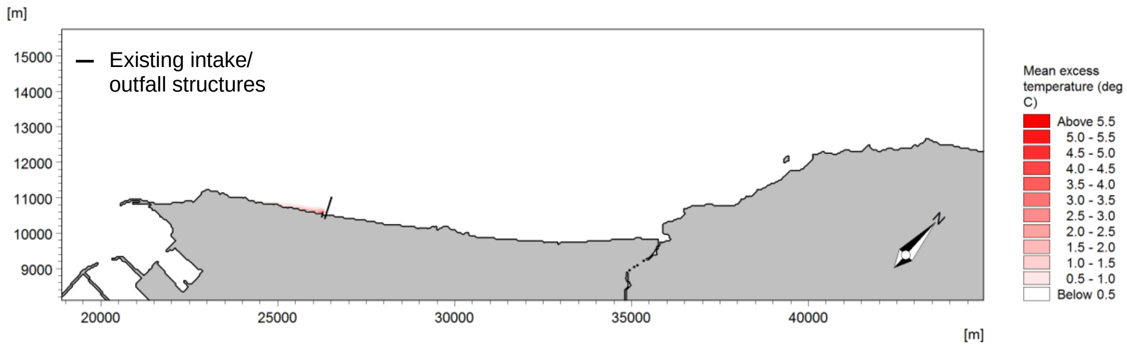
b) Inter-Monsoon condition



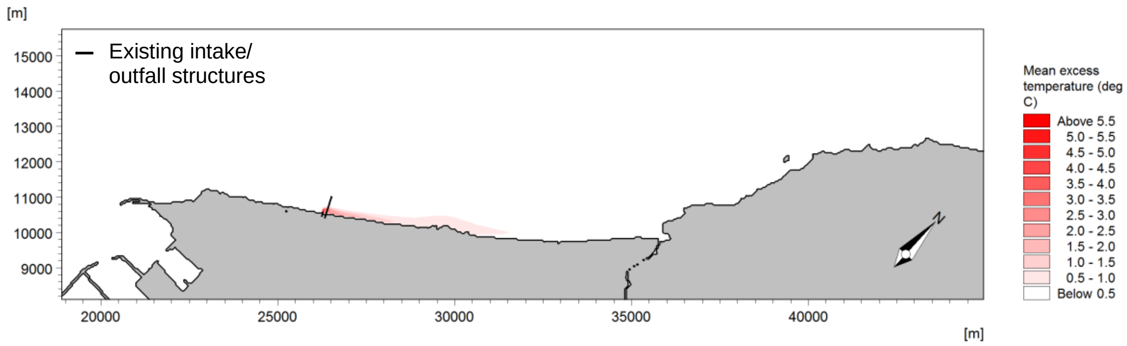
c) Southwest Monsoon condition

Figure 6.4 Simulations with low ambient temperature: Contours for probability exceedance of 3°C rise of temperature for existing condition

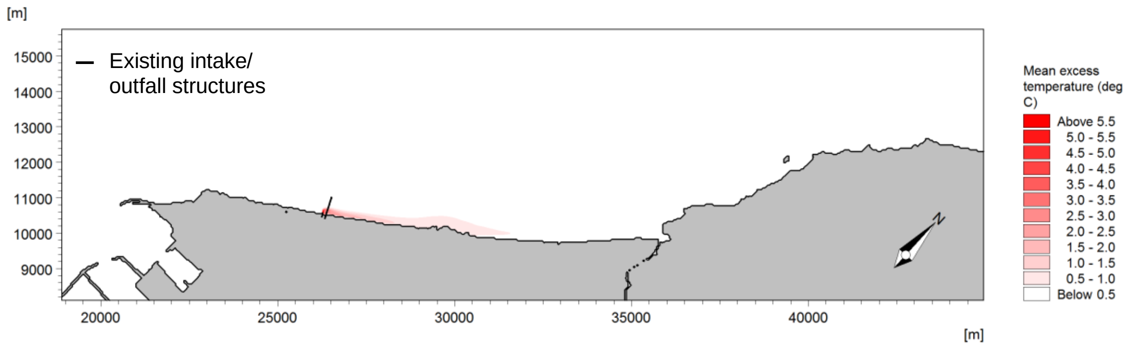
Simulations with a high ambient temperature during the Northeast Monsoon condition indicate that a plume with mean excess temperature of at least 0.5°C disperses up to 2 km away. The plume extends up to 5 km from the outfall for the Southwest and inter-monsoon conditions. For maximum excess temperature of the same value, the plume extends 4 km southwest during the Northeast Monsoon condition and 8 km during the Southwest and inter-monsoon conditions. The areal extent where 2°C is exceeded by at least 5% of time is about 0.6 km during the Northeast Monsoon and 1 km during the Southwest and inter-monsoon conditions. The extent where 3°C is exceeded by at least 5% of time is about 0.2 km during the Northeast Monsoon and 0.3 km during the Southwest and inter-monsoon conditions.



a) Northeast Monsoon condition

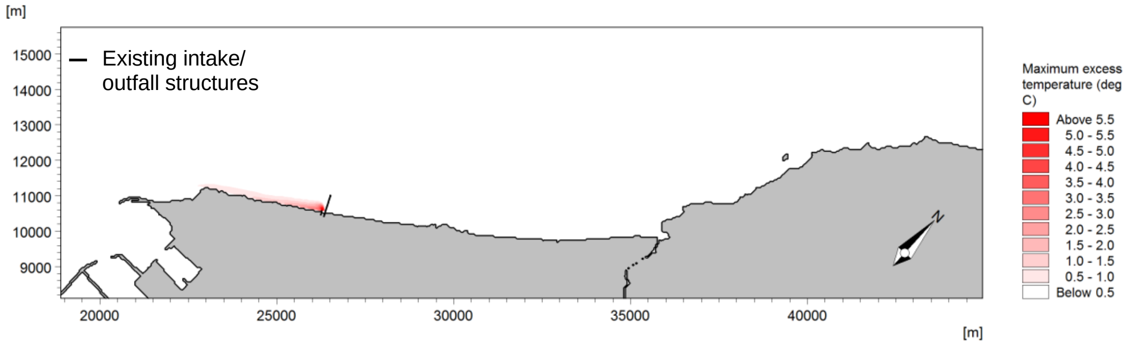


b) Inter-Monsoon condition

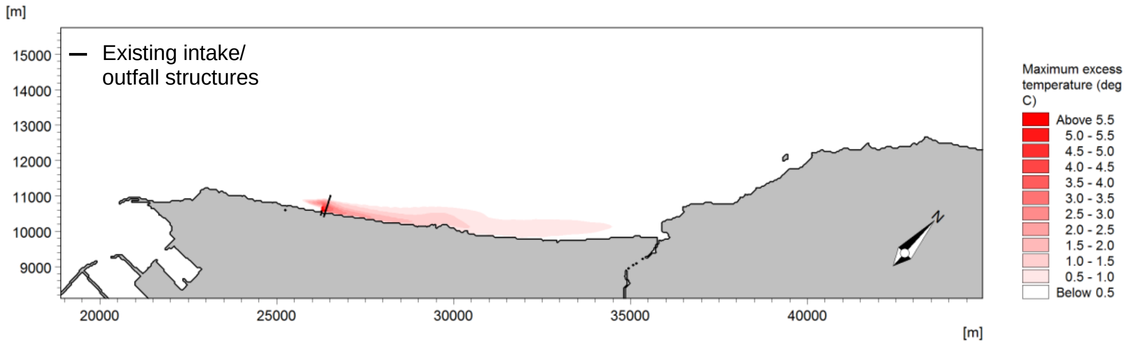


c) Southwest Monsoon condition

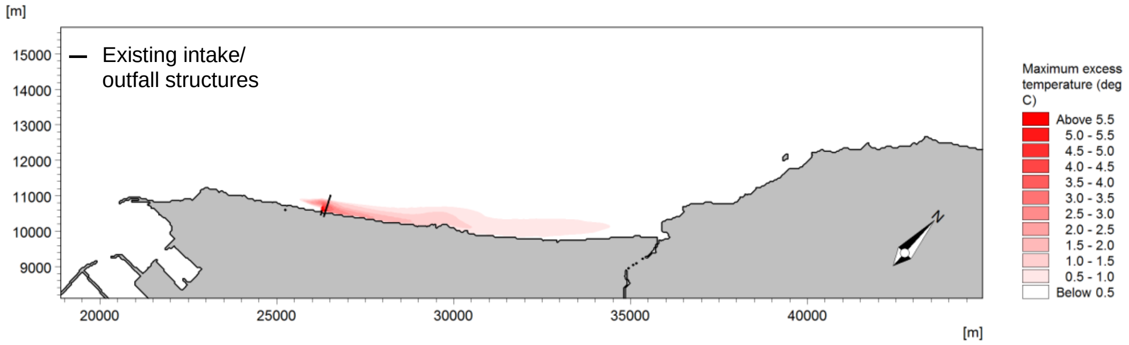
Figure 6.5 Simulations with high ambient temperature: Mean excess temperature for existing condition



a) Northeast Monsoon condition

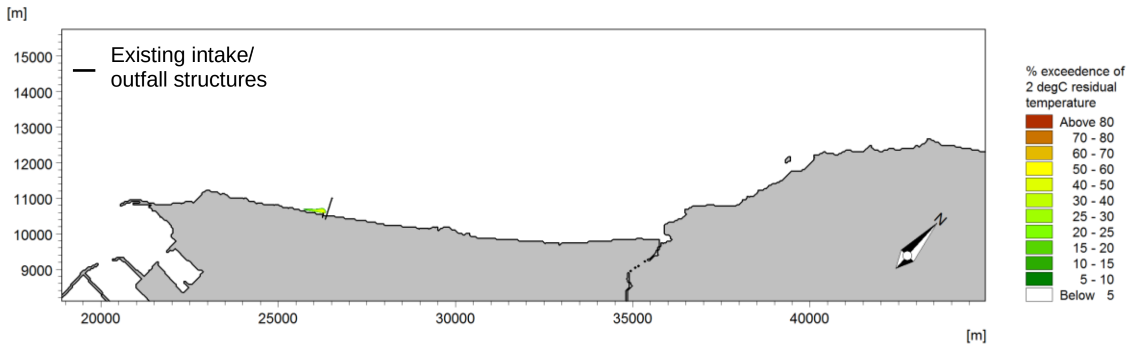


b) Inter-Monsoon condition

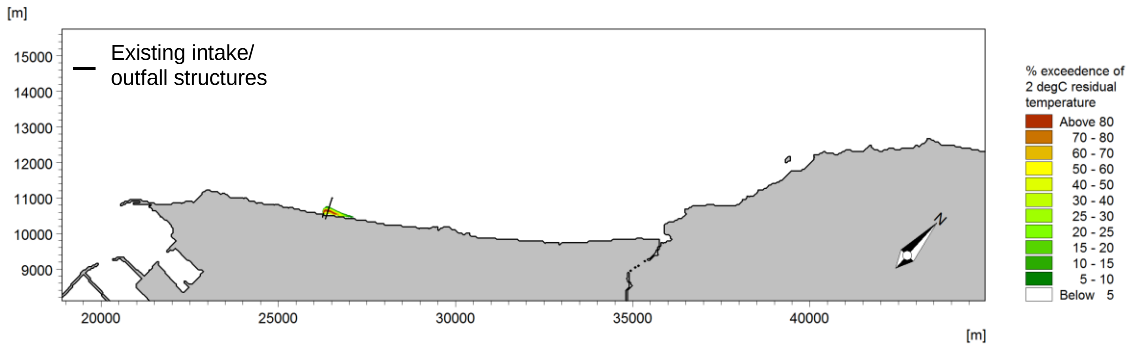


c) Southwest Monsoon condition

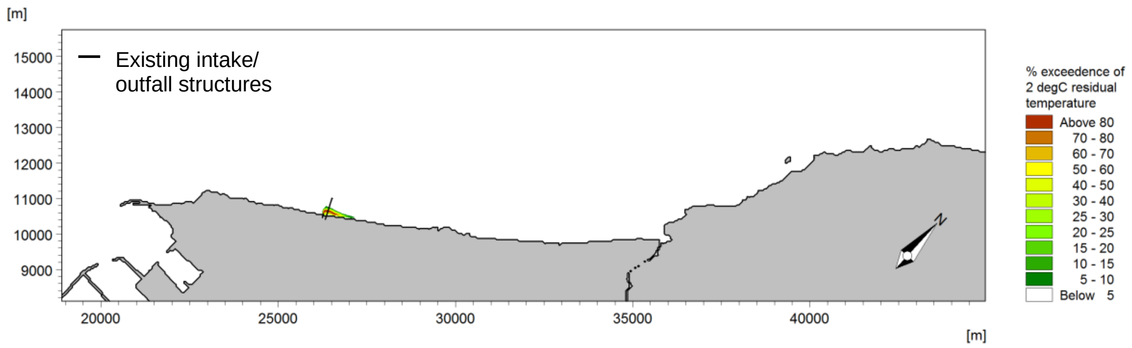
Figure 6.6 Simulations with high ambient temperature: Maximum excess temperature for existing condition



a) Northeast Monsoon condition

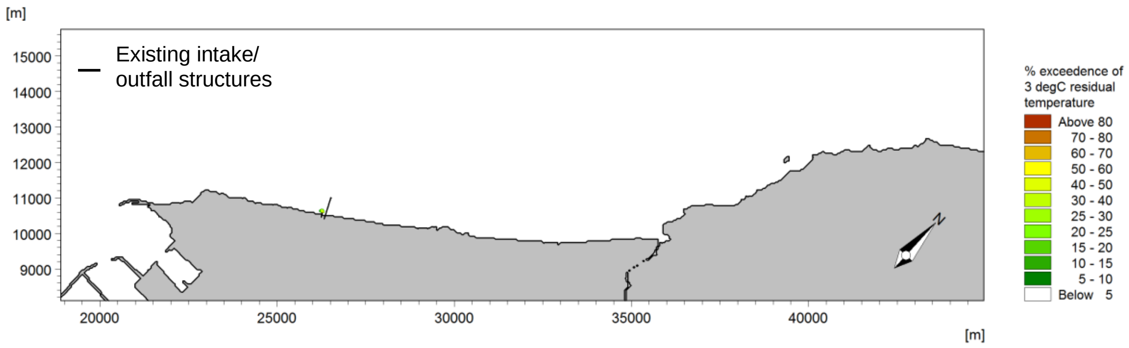


b) Inter-Monsoon condition

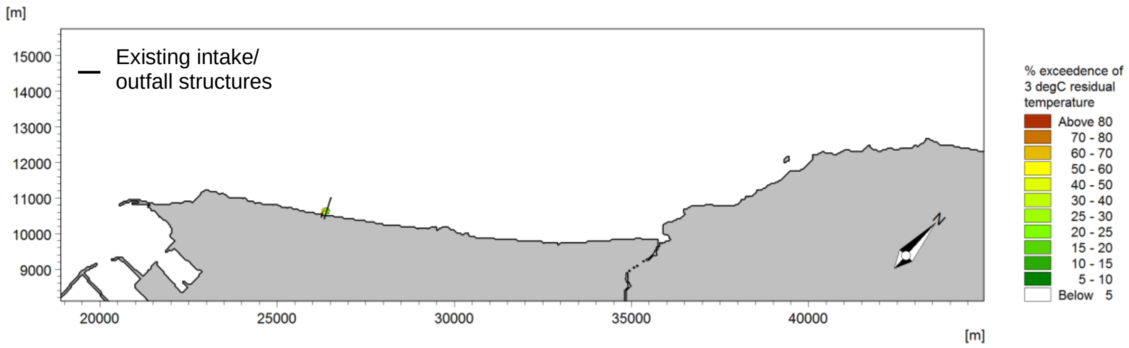


c) Southwest Monsoon condition

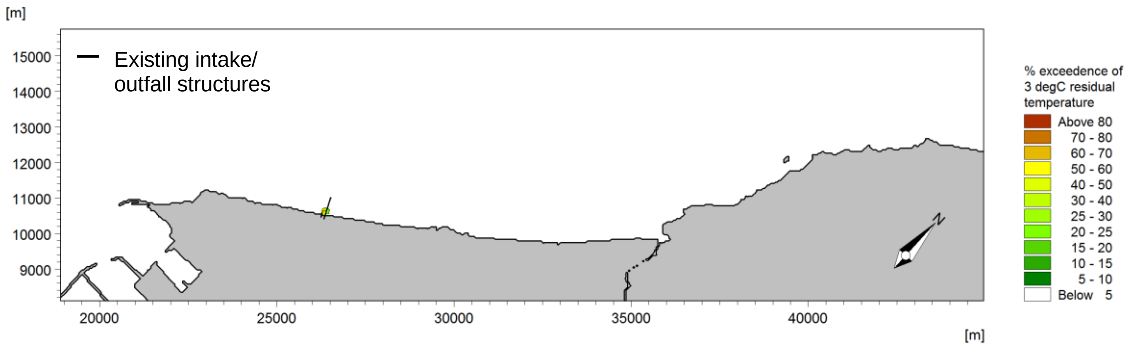
Figure 6.7 Simulations with high ambient temperature: Contours for probability exceedance of 2°C rise of temperature for existing condition



a) Northeast Monsoon condition



b) Inter-Monsoon condition



c) Southwest Monsoon condition

Figure 6.8 Simulations with high ambient temperature: Contours for probability exceedance of 3°C rise of temperature for existing condition

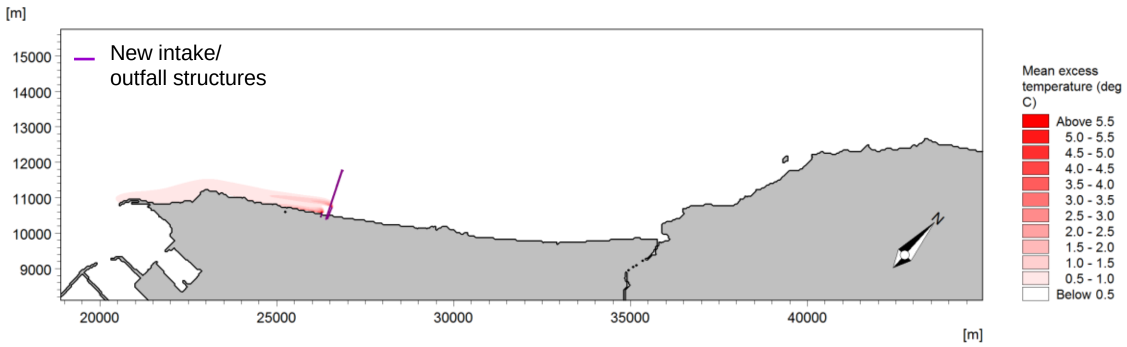
6.6.2 'With Project' Condition

Plots of contours of mean and maximum excess temperature as well as plots for the probability of exceedance for 2 and 3°C rise in temperature are presented in:

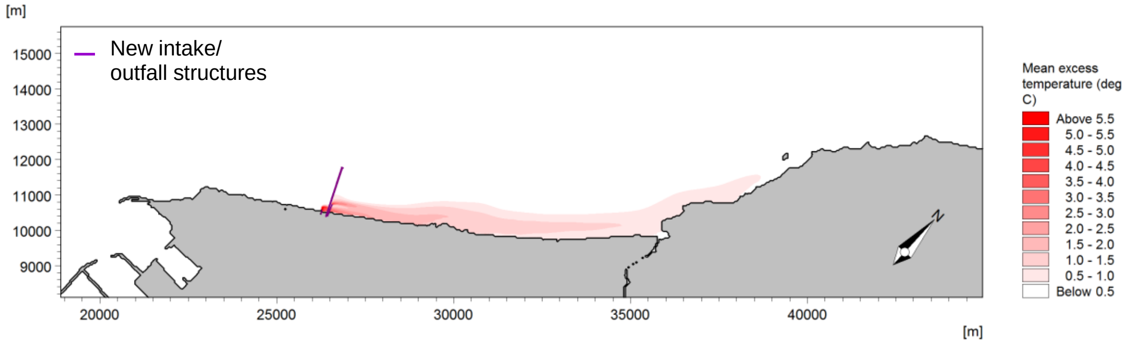
(a) Figures 6.9 to 6.12 for simulations with low ambient seawater temperature; and
(b) Figures 6.13 to 6.16 for simulations with high ambient seawater temperature.

Simulations with a low ambient temperature during the Northeast Monsoon condition show that a plume with mean excess temperature of at least 0.5°C disperses up to 5.5 km southwest of the outfall. For the Southwest and inter-monsoon conditions, the plume extends up to 13 km northeast. For maximum excess temperature of the same value, the plume extends 7 km southwest during the Northeast Monsoon condition and 14 km during the Southwest and inter-monsoon conditions. The areal extent from the new outfall where 2°C is exceeded by at least 5% of time is about 0.7 km during the Northeast Monsoon condition and 3 km during the Southwest and inter-monsoon conditions. The increase of 3°C from the new outfall with the same percentage exceedance extends to about 0.2 and 0.6 km during the Northeast Monsoon and Southwest/inter-monsoon condition respectively.

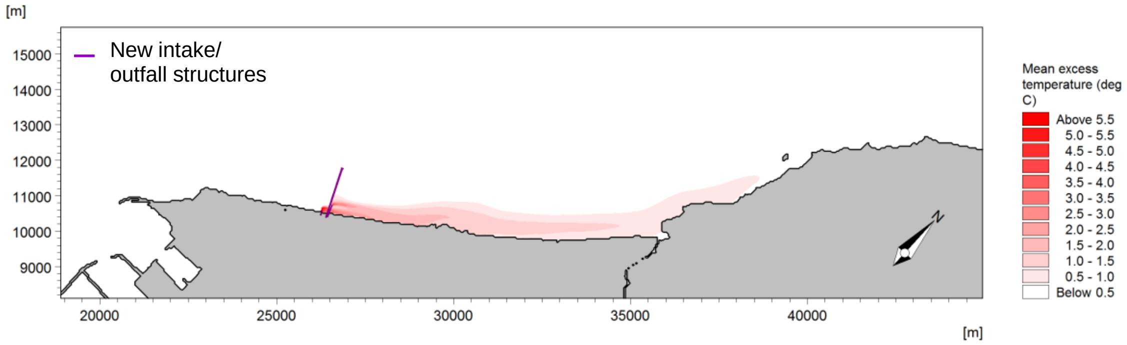
Simulations with a high ambient temperature during the Northeast Monsoon condition indicate that a plume with mean excess temperature of at least 0.5°C disperses up to 5 km away. The plume extends up to 10 km for the Southwest and inter-monsoon conditions. For maximum excess temperature of the same value, the plume extends 7 km southwest during the Northeast Monsoon condition and 14 km during the Southwest and inter-monsoon conditions. The areal extent from the new outfall where 2°C is exceeded by at least 5% of time is about 0.2 and 0.6 km during the Northeast Monsoon and Southwest/inter-monsoon condition respectively. The increase of 3°C from the new outfall with the same percentage exceedance has a spread of up to 30 m from the outfall for all monsoonal conditions.



a) Northeast Monsoon condition

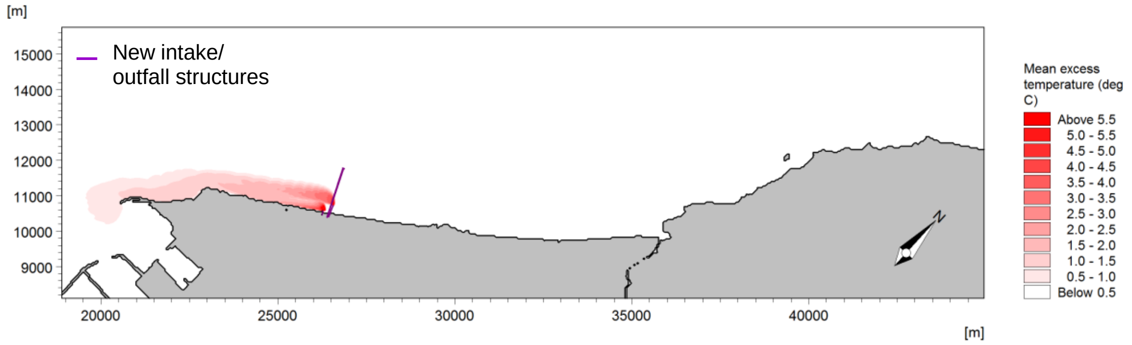


b) Inter-Monsoon condition

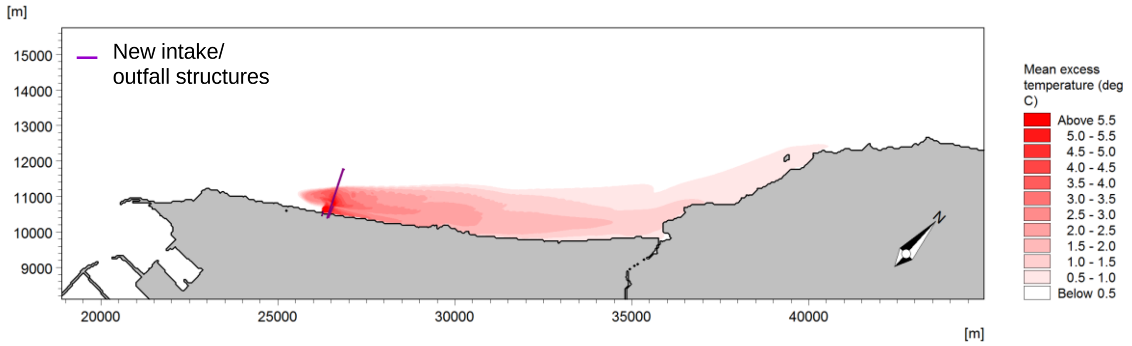


c) Southwest Monsoon condition

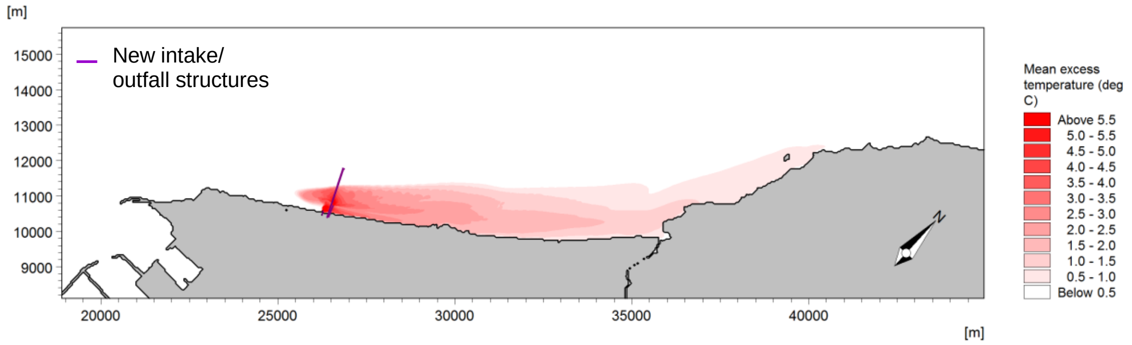
Figure 6.9 Simulations with low ambient temperature: Mean excess temperature for 'with Project' condition



a) Northeast Monsoon condition

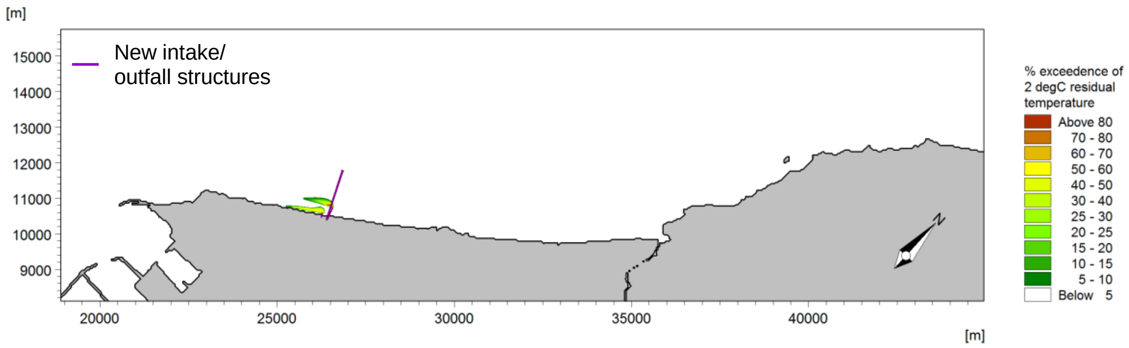


b) Inter-Monsoon condition

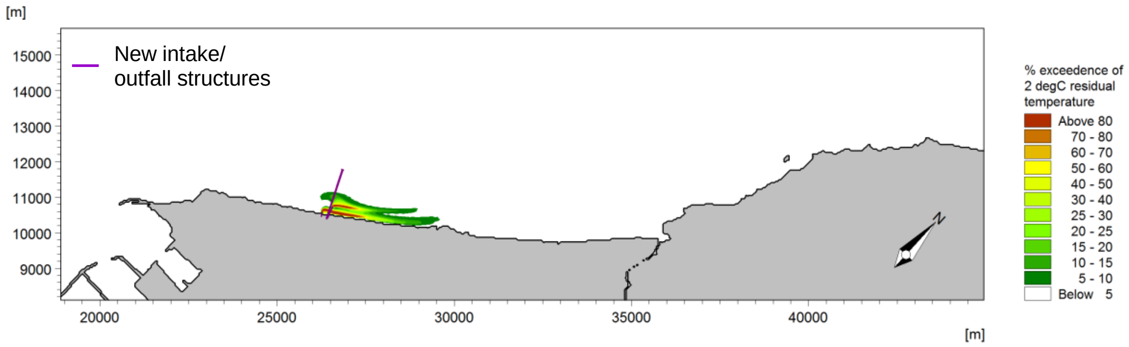


c) Southwest Monsoon condition

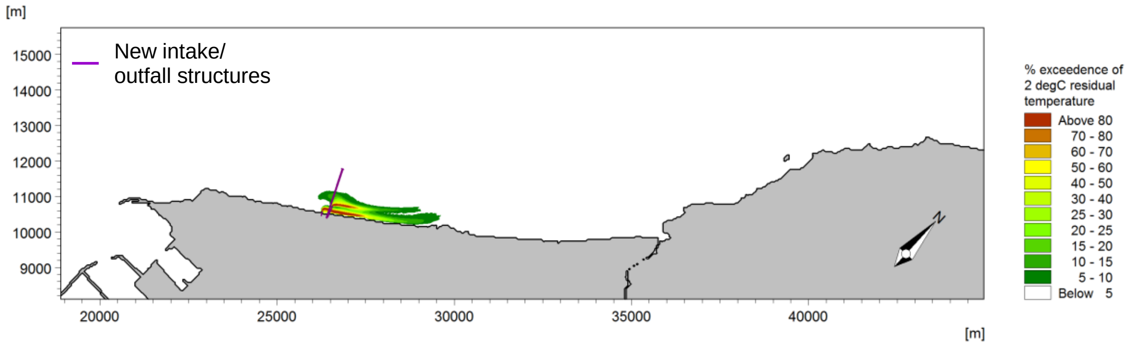
Figure 6.10 Simulations with low ambient temperature: Maximum excess temperature for 'with Project' condition



a) Northeast Monsoon condition

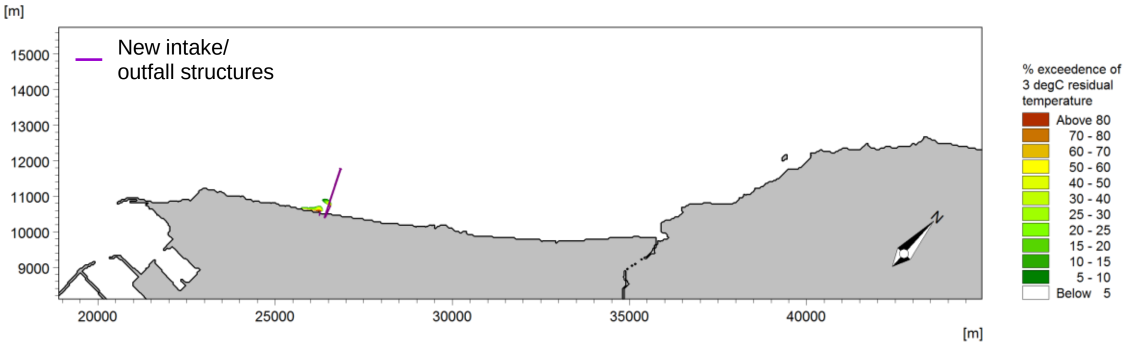


b) Inter-Monsoon condition

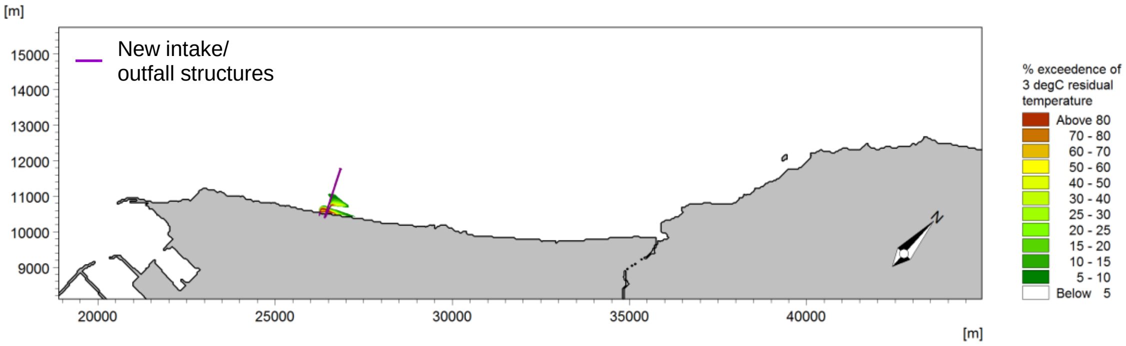


c) Southwest Monsoon condition

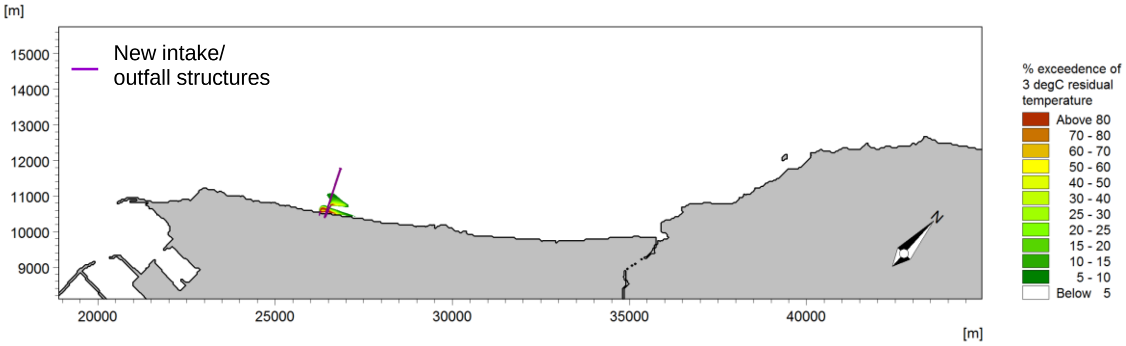
Figure 6.11 Simulations with low ambient temperature: Contours for probability exceedance of 2°C rise of temperature for ‘with Project’ condition



a) Northeast Monsoon condition

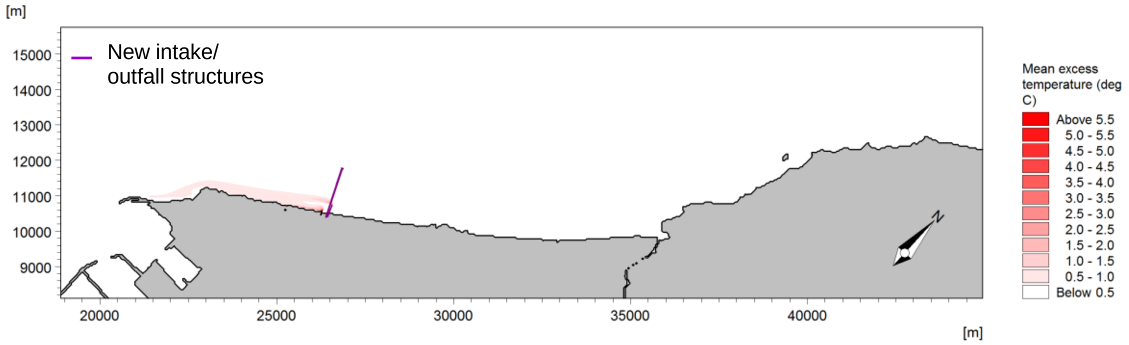


b) Inter-Monsoon condition

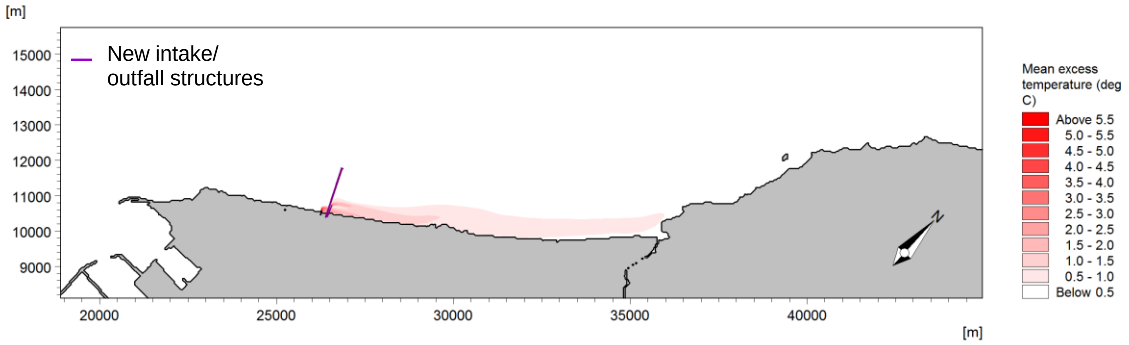


c) Southwest Monsoon condition

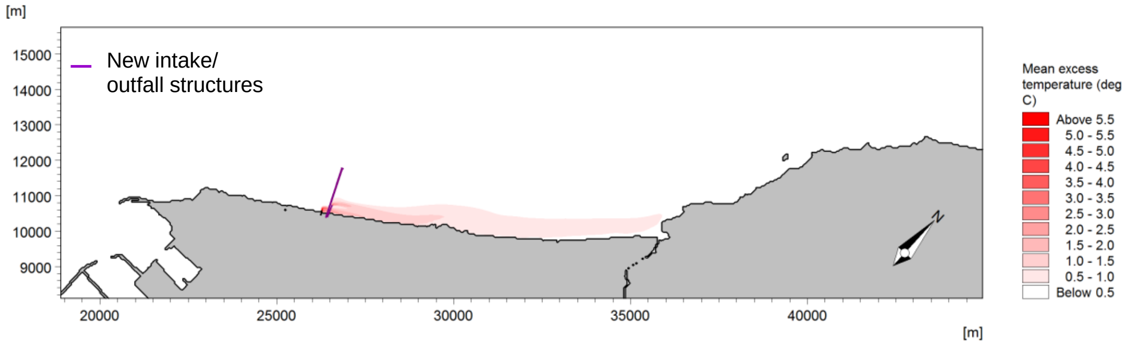
Figure 6.12 Simulations with low ambient temperature: Contours for probability exceedance of 3°C rise of temperature for 'with Project' condition



a) Northeast Monsoon condition

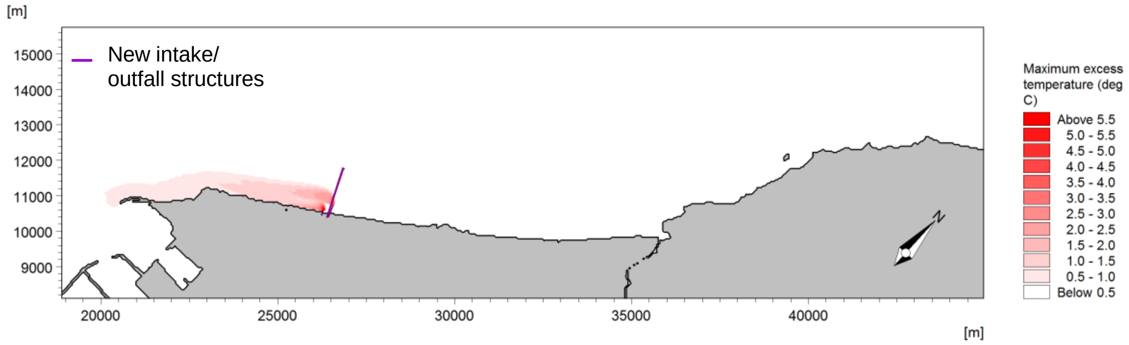


b) Inter-Monsoon condition

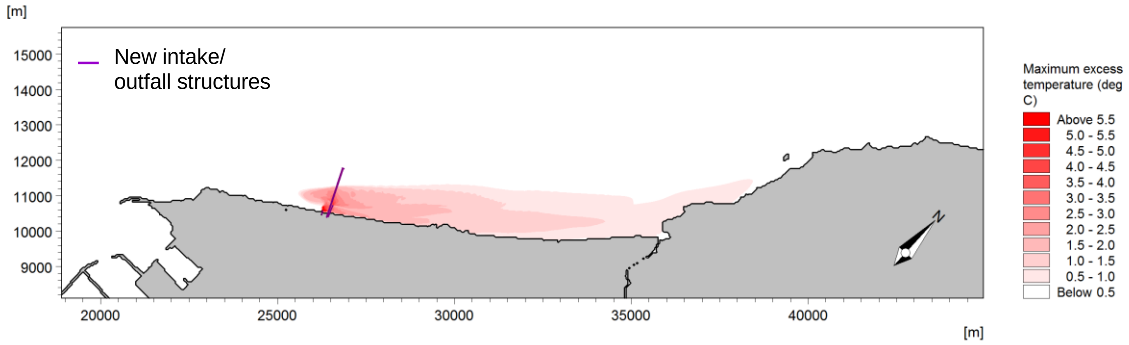


c) Southwest Monsoon condition

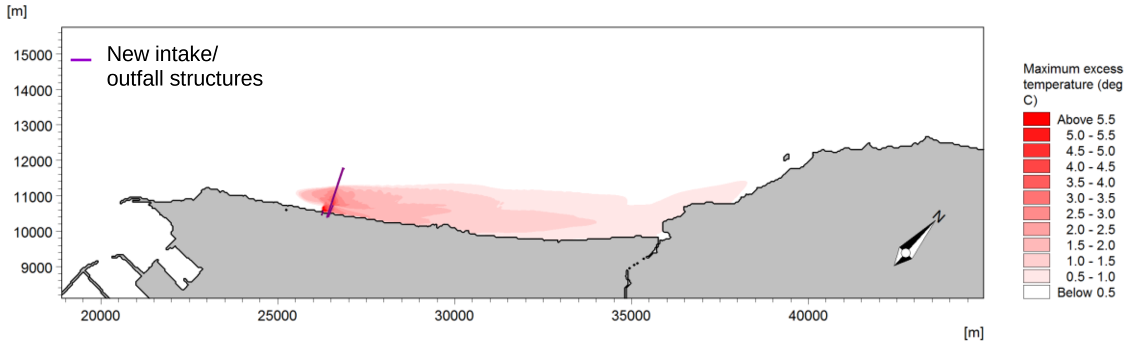
Figure 6.13 Simulations with high ambient temperature: Mean excess temperature for 'with Project' condition



a) Northeast Monsoon condition

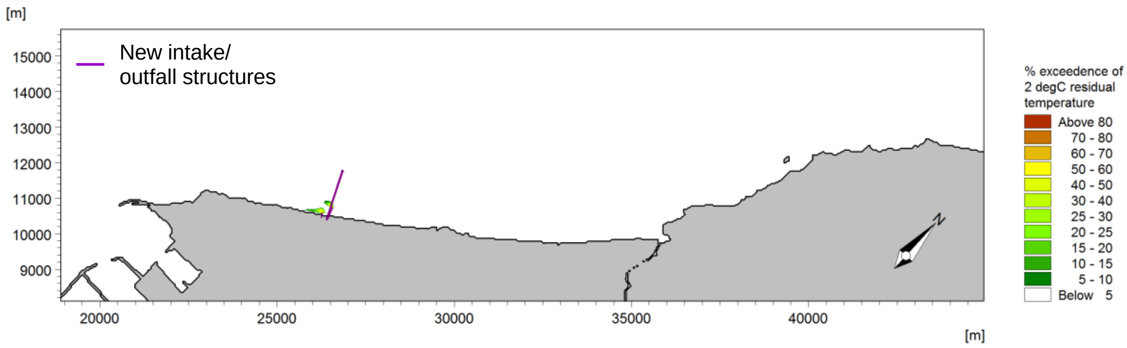


b) Inter-Monsoon condition

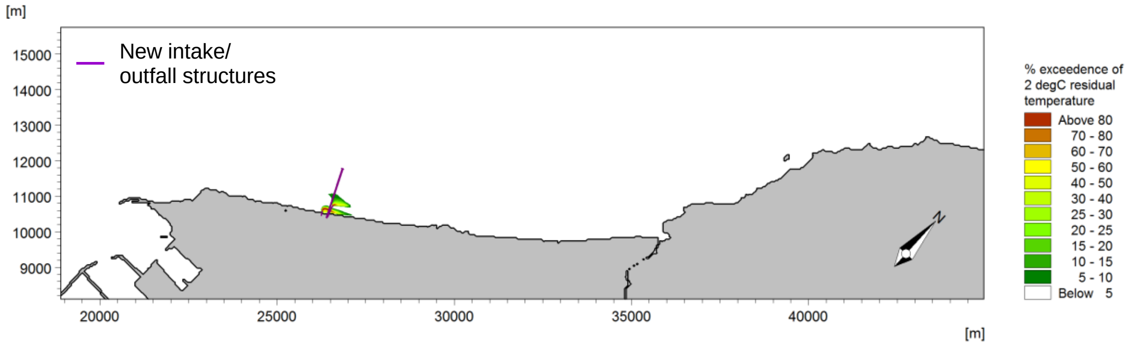


c) Southwest Monsoon condition

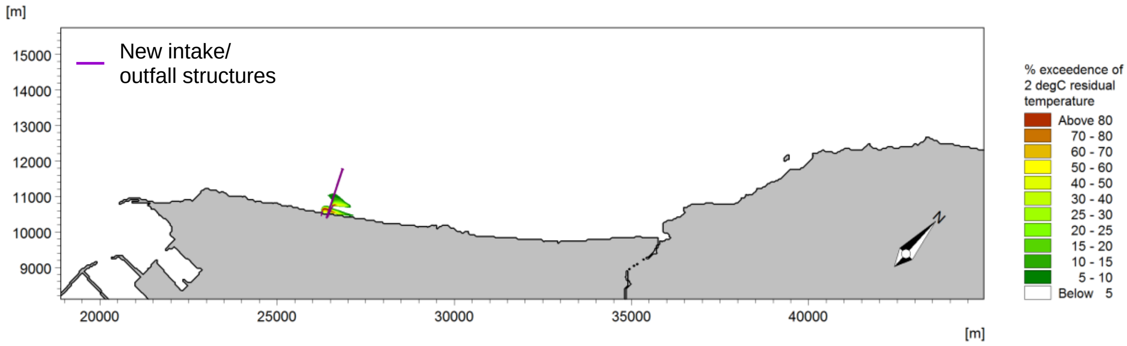
Figure 6.14 Simulations with high ambient temperature: Maximum excess temperature for 'with Project' condition



a) Northeast Monsoon condition

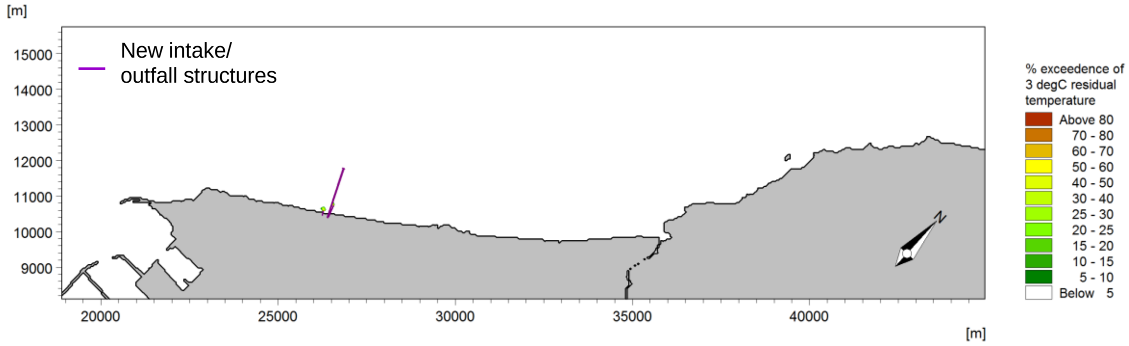


b) Inter-Monsoon condition

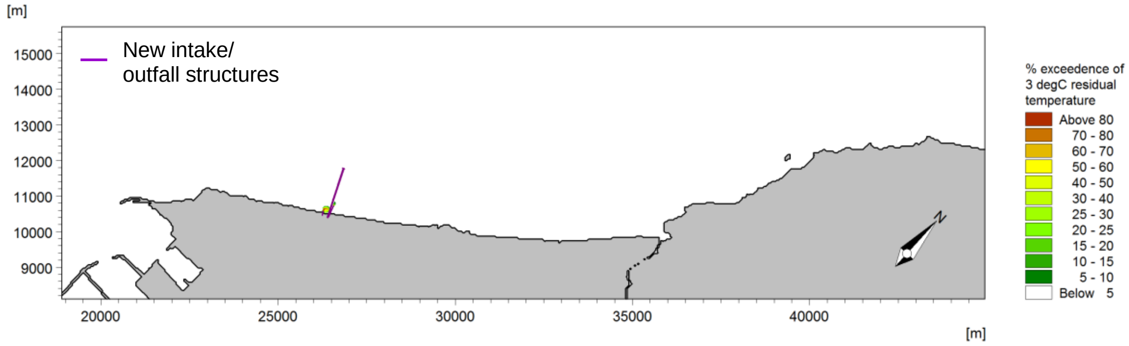


c) Southwest Monsoon condition

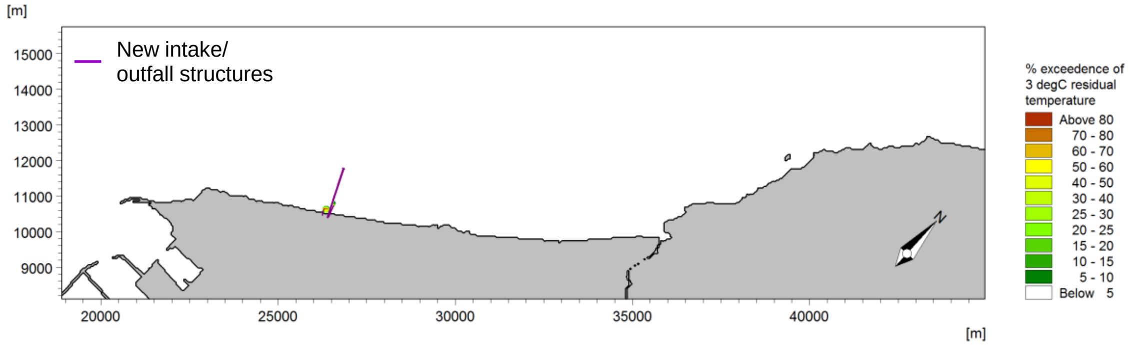
Figure 6.15 Simulations with high ambient temperature: Contours for probability exceedance of 2°C rise of temperature for 'with Project' condition



a) Northeast Monsoon condition



b) Inter-Monsoon condition



c) Southwest Monsoon condition

Figure 6.16 Simulations with high ambient temperature: Contours for probability exceedance of 3°C rise of temperature for 'with Project' condition

Tables 6.3 and 6.4 show the predicted excess temperature extracted at the locations of the ESAs during the Northeast Monsoon. It can be observed that there is no change in mean and maximum excess temperature at all of the ESAs including the new intake after Project implementation.

Table 6.3 Excess temperature extracted at the ESAs for simulations with low ambient temperature during the Northeast Monsoon condition

ID	Description	Excess Temperature (°C)				Difference (%)	
		Existing		With Project			
		Mean	Maximum	Mean	Maximum	Mean	Maximum
1	New intake	0	0	0	0	0	0
2	Kampung Nelayan Batu Mandi	0	0	0	0	0	0
3	Similajau National Park marine extension	0	0	0	0	0	0
4	Bintulu Port	0	0	0	0	0	0
5	Batu Likau	0	0	0	0	0	0
6	Batu Mandi	0	0	0	0	0	0

Table 6.4 Excess temperature extracted at the ESAs for simulations with high ambient temperature during the Northeast Monsoon condition

ID	Description	Excess Temperature (°C)				Difference (%)	
		Existing		With Project			
		Mean	Maximum	Mean	Maximum	Mean	Maximum
1	New intake	0	0	0	0	0	0
2	Kampung Nelayan Batu Mandi	0	0	0	0	0	0
3	Similajau National Park marine extension	0	0	0	0	0	0
4	Bintulu Port	0	0	0	0	0	0
5	Batu Likau	0	0	0	0	0	0
6	Batu Mandi	0	0	0	0	0	0

Tables 6.5 and 6.6 present the predicted excess temperature extracted at the locations of the ESAs during the Southwest Monsoon. It can be deduced that there is no change in mean excess temperature at all of the ESAs after Project implementation. It is anticipated that there an increase in maximum excess temperature of 0.5 and 0.3°C increase above low and high ambient temperature respectively at the waters fronting Kampung Nelayan Batu Mandi. This represents a 2 and 1% increase over the low and high ambient temperature respectively. However, there is no change in maximum excess temperature at the other ESAs after Project implementation.

Table 6.5 Excess temperature extracted at the ESAs for simulations with low ambient temperature during the Southwest Monsoon condition

ID	Description	Excess temperature (°C)				Difference (%)	
		Existing		With Project			
		Mean	Maximum	Mean	Maximum	Mean	Maximum
1	New intake	0	0	0	0	0	0
2	Kampung Nelayan Batu Mandi	0	1.3	0	1.8	0	+2
3	Similajau National Park marine extension	0	0	0	0	0	0
4	Bintulu Port	0	0	0	0	0	0
5	Batu Likau	0	0	0	0	0	0
6	Batu Mandi	0	0	0	0	0	0

Table 6.6 Excess temperature extracted at the ESAs for simulations with high ambient temperature during the Southwest Monsoon condition

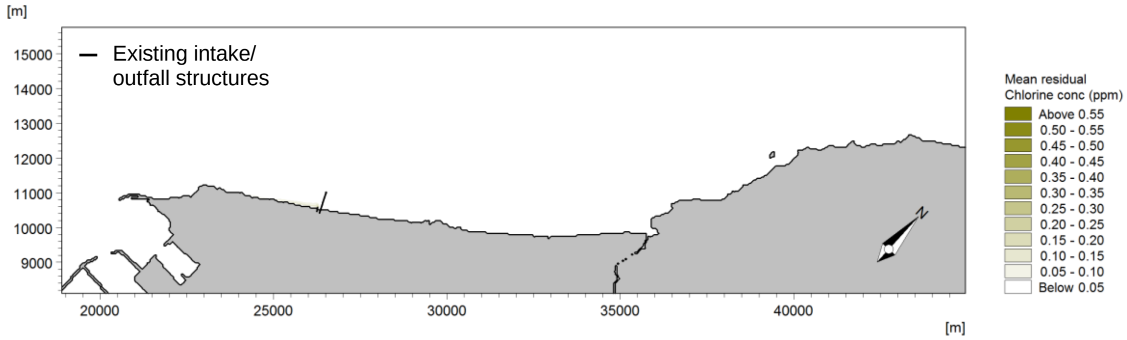
ID	Description	Excess temperature (°C)				Difference (%)	
		Existing		With Project			
		Mean	Maximum	Mean	Maximum	Mean	Maximum
1	New intake	0	0	0	0	0	0
2	Kampung Nelayan Batu Mandi	0	0.9	0	1.2	0	+1
3	Similajau National Park marine extension	0	0	0	0	0	0
4	Bintulu Port	0	0	0	0	0	0
5	Batu Likau	0	0	0	0	0	0
6	Batu Mandi	0	0	0	0	0	0

6.7 Chlorine Dispersion

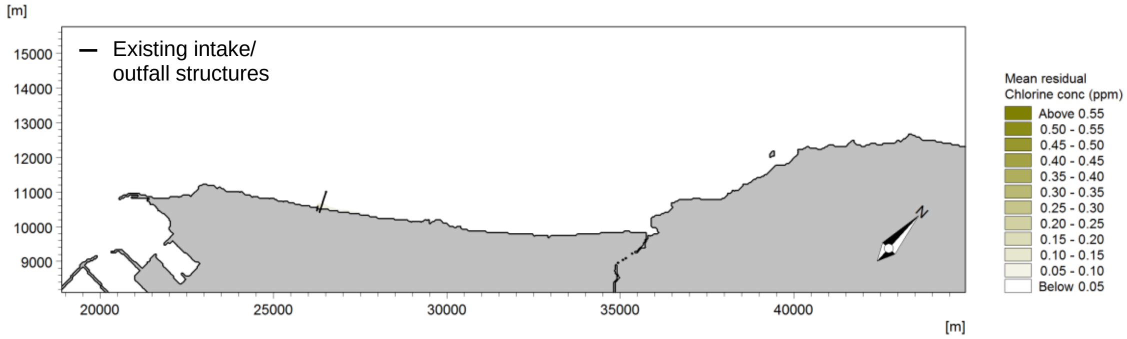
6.7.1 Existing Condition

Figures 6.17 and 6.18 present the plots of mean and maximum residual chlorine dispersion. It can be observed that the chlorine residual concentration plume disperses to the southwest for the Northeast Monsoon condition and to the northeast for the Southwest and inter-monsoon conditions. The plume concentration is much smaller in magnitude during the Northeast Monsoon condition due to higher wind speeds that aid the advection and spreading process of the outfall discharge.

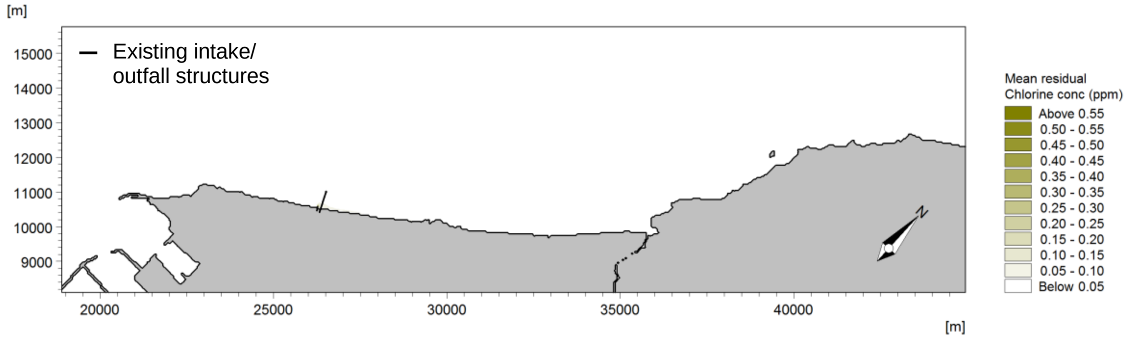
The mean residual chlorine concentration dispersion of above 0.05 and 0.1 ppm is about 1.5 km and generally less than 0.8 km respectively for all monsoonal conditions. The maximum residual chlorine concentration dispersion of above 0.05 ppm is up to 9.5 km for the Southwest and inter-monsoon conditions and 5 km for Northeast Monsoon condition. The spread for maximum residual chlorine concentration of above 0.1 ppm is predicted to be up to 5.5 and 3.5 km for Southwest/inter-monsoon and Northeast Monsoon condition respectively.



a) Northeast Monsoon condition

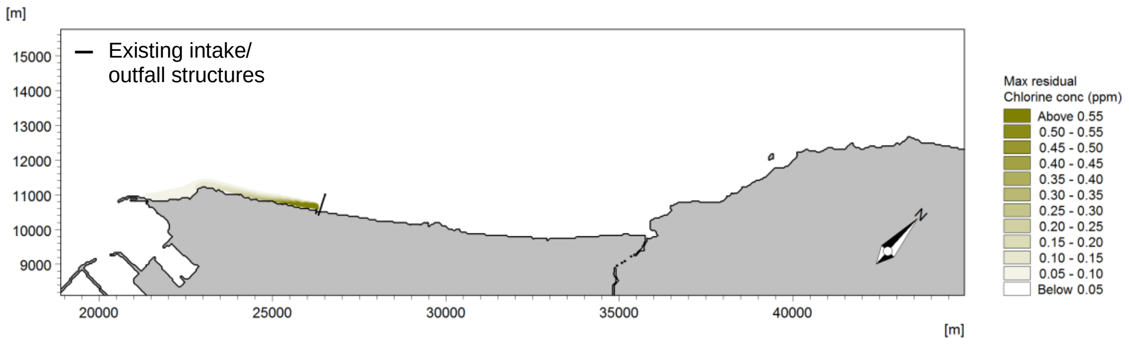


b) Inter-monsoon condition

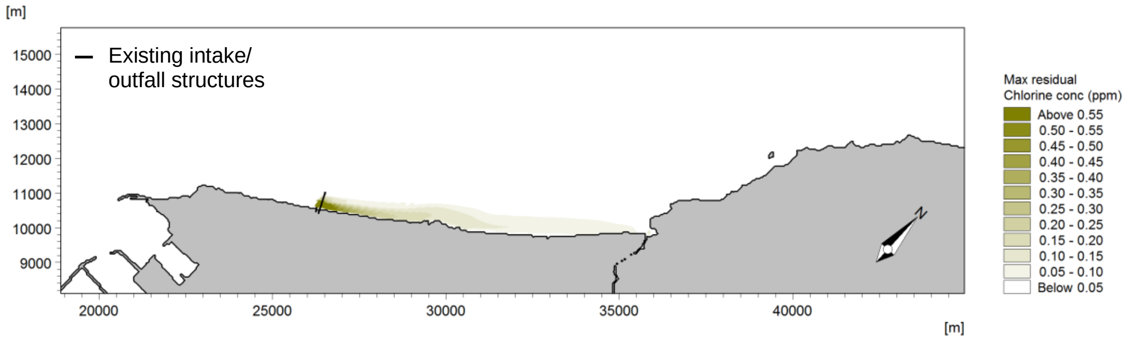


c) Southwest Monsoon condition

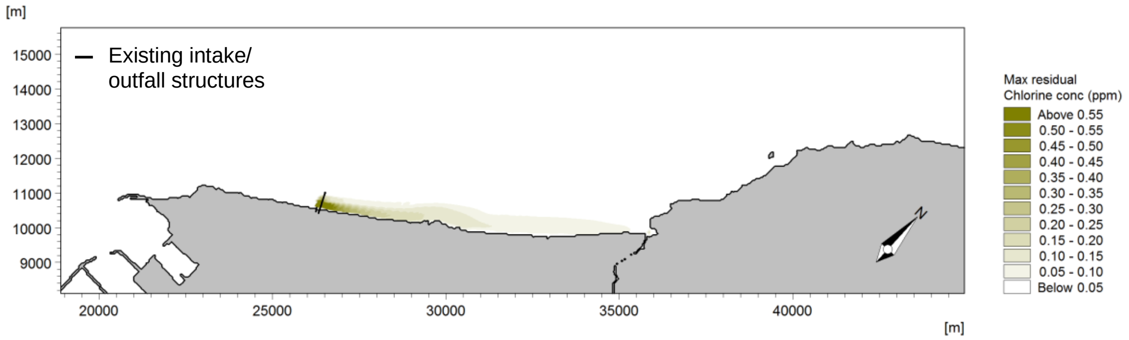
Figure 6.17 Mean residual chlorine dispersion for existing condition



a) Northeast Monsoon condition



b) Inter-monsoon condition



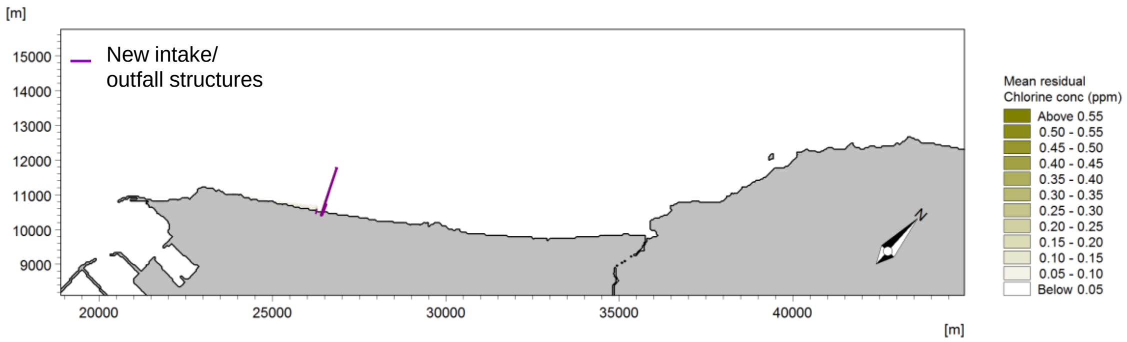
c) Southwest Monsoon condition

Figure 6.18 Maximum residual chlorine dispersion for existing condition

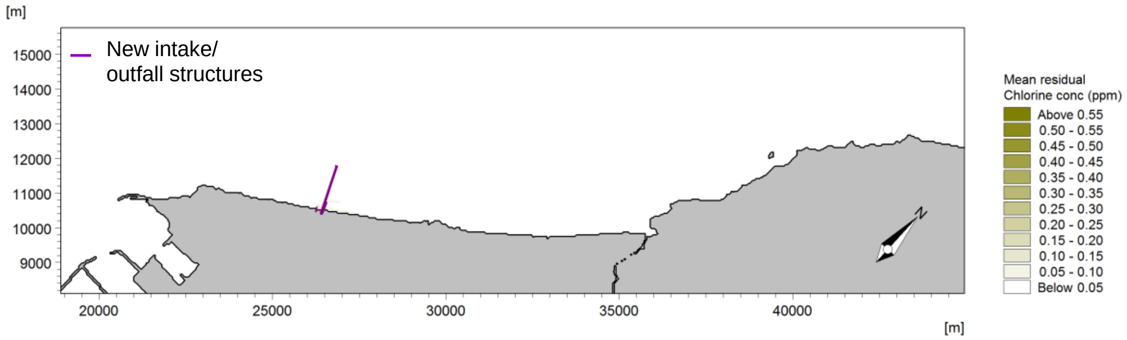
6.7.2 'With Project' Condition

The plots of mean and maximum residual chlorine dispersion for all monsoonal conditions are illustrated in Figures 6.19 and 6.20.

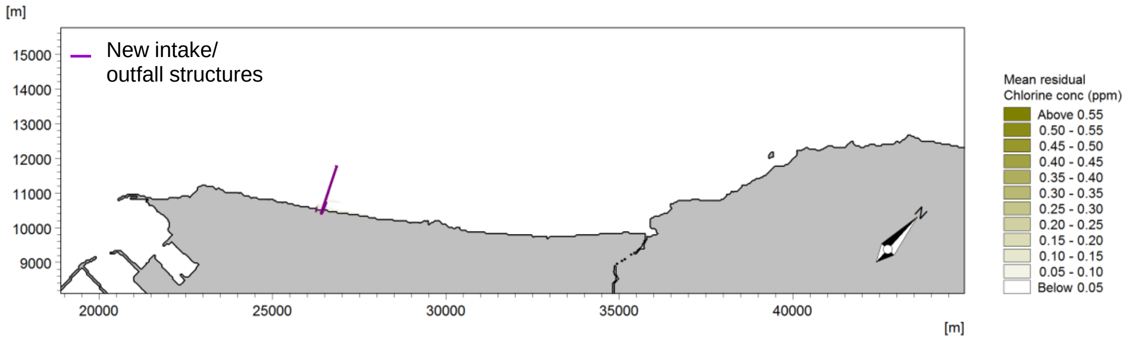
The mean residual chlorine concentration dispersion of above 0.05 and 0.1 ppm is about 1.5 km and generally less than 0.8 km respectively for all monsoonal conditions. The maximum residual chlorine concentration dispersion of above 0.05 ppm is up to 9.5 km for the Southwest and inter-monsoon conditions and 5.5 km for Northeast Monsoon condition. The spread for maximum residual chlorine concentration of above 0.1 ppm is predicted to be up to 7 and 3 km for Southwest/inter-monsoon and Northeast Monsoon condition respectively.



a) Northeast Monsoon condition

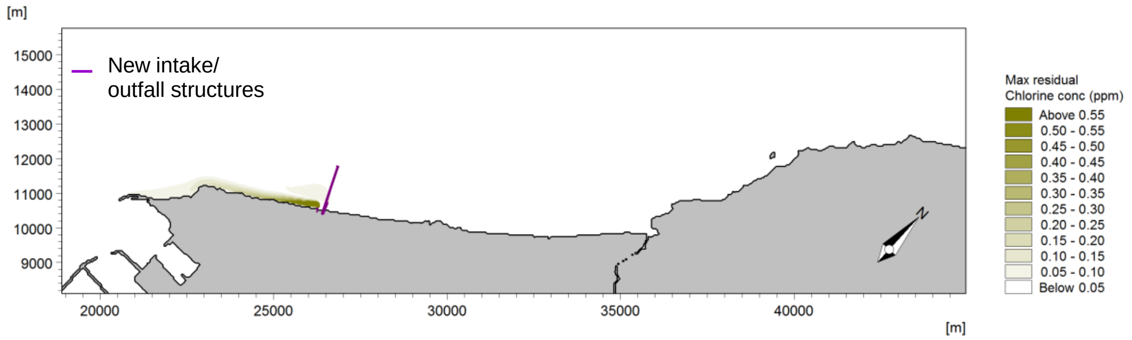


b) Inter-monsoon condition

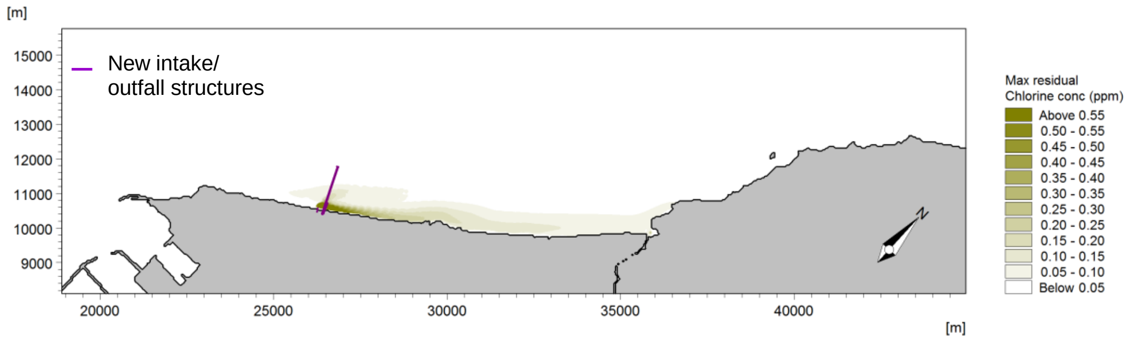


c) Southwest Monsoon condition

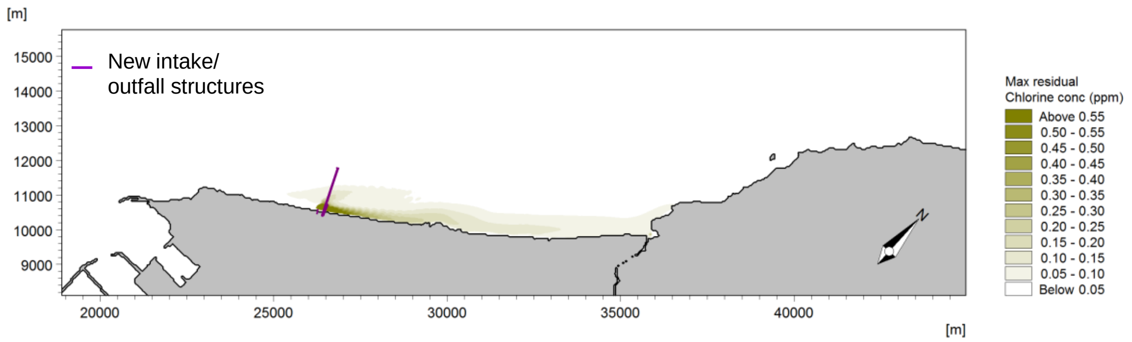
Figure 6.19 Mean residual chlorine dispersion for 'with Project' condition



a) Northeast Monsoon condition



b) Inter-monsoon condition



c) Southwest Monsoon condition

Figure 6.20 Maximum residual chlorine dispersion for 'with Project' condition

Tables 6.7 and 6.8 show the extracted values for residual chlorine concentration at the ESAs during the Northeast and Southwest Monsoon conditions. It can be inferred that the impact of residual chlorine concentration introduced by the new outfall is insignificant at all ESA locations.

Table 6.7 Residual chlorine concentration extracted at the ESAs (Northeast Monsoon condition)

ID	Description	Residual Chlorine Concentration (ppm)				Difference (%)	
		Existing		With Project			
		Mean	Maximum	Mean	Maximum	Mean	Maximum
1	New intake	0	0	0	0	0	0
2	Kampung Nelayan Batu Mandi	0	0	0	0	0	0
3	Similajau National Park marine extension	0	0	0	0	0	0
4	Bintulu Port	0	0	0	0	0	0
5	Batu Likau	0	0	0	0	0	0
6	Batu Mandi	0	0	0	0	0	0

Table 6.8 Residual chlorine concentration extracted at the ESAs (Southwest Monsoon condition)

ID	Description	Residual Chlorine Concentration (ppm)				Difference (%)	
		Existing		With Project			
		Mean	Maximum	Mean	Maximum	Mean	Maximum
1	New intake		0	0	0	0	0
2	Kampung Nelayan Batu Mandi		0.1	0	0.1	0	0
3	Similajau National Park marine extension		0	0	0	0	0
4	Bintulu Port		0	0	0	0	0
5	Batu Likau		0	0	0	0	0
6	Batu Mandi		0	0	0	0	0

6.8 Findings

Temperature gradient plays a significant role where discharging in lower ambient temperature (higher gradient) causes higher excess temperature compared to discharging in higher ambient temperature (lower gradient). The horizontal extent of the thermal plume where 2°C is exceeded by at least 5% of time is relatively similar with the existing condition. As the Project area is located within an open sea, heat dissipation is considered relatively good. There is no change in mean excess temperature at the identified ESA locations. However, there could be an increase of 0.5 and 0.3°C in maximum excess temperature above low and high ambient seawater temperature at the waters fronting Kampung Nelayan Batu Mandi during the Southwest Monsoon. This is not expected to negatively impact the village as the coastline has been disturbed and the waters are primarily used for navigation. No impact in seawater temperature is predicted at the other ESAs.

The residual chlorine disperses to the southwest for the Northeast Monsoon condition and to the northeast for the Southwest and inter-monsoon conditions. The plume is influenced by the net current flow pattern. With the discharge from the new outfall, it can be observed that the residual chlorine dispersion’s extent and magnitude is relatively similar with the existing condition.

Chapter 7

SEDIMENT SPILL DISPERSION

Chapter 7

SEDIMENT SPILL DISPERSION

7.1 Introduction

An environmental concern of the Project is the potential spilling of fine sediments into the sea from the dredging and disposal activities that generate a sediment plume that could reach the ESAs. This has been investigated via sediment spill dispersion modelling. The purpose of the sediment dispersion study is to determine the spatial and temporal concentration as well as the direction of the suspended sediments concentrations. These factors are assessed to determine the potential impact to the surroundings. This forms the input for assessment on the potential impact on marine biology, water quality and other sensitive receptors in the vicinity of the Project area.

7.2 MIKE 21 MT

For the purpose of this Study, the impact assessment criteria recommended by PIANC (2010) have been used. The World Association for Waterborne Transport Infrastructure (PIANC) has jointly developed with the United Nations Environment Program (UNEP) guidelines for implementation of best practice methodology in environmental assessment and environmental management for dredging and port construction activities around coral reefs and their associated communities.

Table 7.1 and Table 7.2 show the tolerable limits of excess suspended sediment and sedimentation rate respectively. These tolerable limits for coral organisms constitute a conservative indicator of potential stresses that is added on other natural receptors. For the assessment of the sediment plume dispersion results, tolerable limits associated with the “slight impact” category have been adopted.

Table 7.1 Impact severity categories for suspended sediment concentration

Category	Definition	Description
No impact	Excess suspended sediment concentration (SSC) > 5 mg/L for less than 5% of the time	Changes are significantly below physical detection level and below reliability of numerical models, so that no change to the quality or functionality of the receptor will occur.
Slight impact	▪ Excess SSC > 5 mg/L for less than 20% of the time ▪ Excess SSC >10 mg/L for less than 5% of the time	Changes can be resolved by numerical models, but are difficult to detect in the field as they are associated with changes that cause stress, not mortality, to marine ecosystems. Slight impacts may be recoverable once the stress factor has been removed.
Minor impact	▪ Excess SSC > 5 mg/L for more than 20% of the time ▪ Excess SSC > 10 mg/L for less than 20% of the time	Changes can be resolved in the numerical models are likely to be detected in the field as localised mortalities, but to a spatial scale that is unlikely to have any secondary consequences.
Moderate impact	▪ Excess SSC > 10 mg/L for more than 20% of the time ▪ Excess SSC > 25 mg/L for more than 5% of the time	Changes can be resolved by numerical models and are detectable in the field. Moderate impacts are expected to be locally significant.
Major impact	▪ Excess SSC > 25 mg/L for more than 20% of the time ▪ Excess SSC > 100 mg/L for more than 1% of the time	Changes are detectable in the field and are likely to be related to complete habitat loss. Major impacts are likely to have secondary influences on other ecosystems.

Source: PIANC, 2010

Table 7.2 Impact severity categories for sedimentation

Severity	Definition	Description
No impact	Sedimentation < 0.05kg/m^2/day	(<1.7mm/14days)
Slight impact	Sedimentation <0.1kg/m^2/day	(<3.5mm/14 days)
Minor impact	Sedimentation <0.2kg/m^2/day	(<7.0mm/14 days)
Moderate impact	Sedimentation <0.5kg/m^2/day	(<17.5mm/14 days)
Major impact	Sedimentation >0.5kg/m^2/day	(>17.5mm/14 days)

Source: PIANC, 2010

7.3 MIKE 21 MT

This Study is carried out using MIKE21 MT, a two-dimensional mud transport model. The model uses the output from the hydrodynamic model, MIKE 21 HD. MIKE 21 MT is used to study transport, deposition, erosion, dispersion and consolidation of cohesive sediments under the influence of tides and currents. This model is capable of resolving horizontal spatial variation of water depths. It takes into account the changes in the flow field or wave conditions in two dimensions. The model setup is based on available information from previous studies, field data collected, surveys and general scientific literature.

7.4 Model Setup

Sediment plume originating from the dredging and disposal operations are simulated. The model uses similar model domain with the hydrodynamic model. The simulations are conducted for Southwest Monsoon condition when the dredging and disposal works will be conducted. The dredging and disposal operation is simulated for three sections to represent the impact for the whole dredging operation as the dredger starts operating from offshore, dredging towards nearshore. The simulated dredging or disposal spill point is represented by a single source point located at the middle of each section in Figure 7.1.

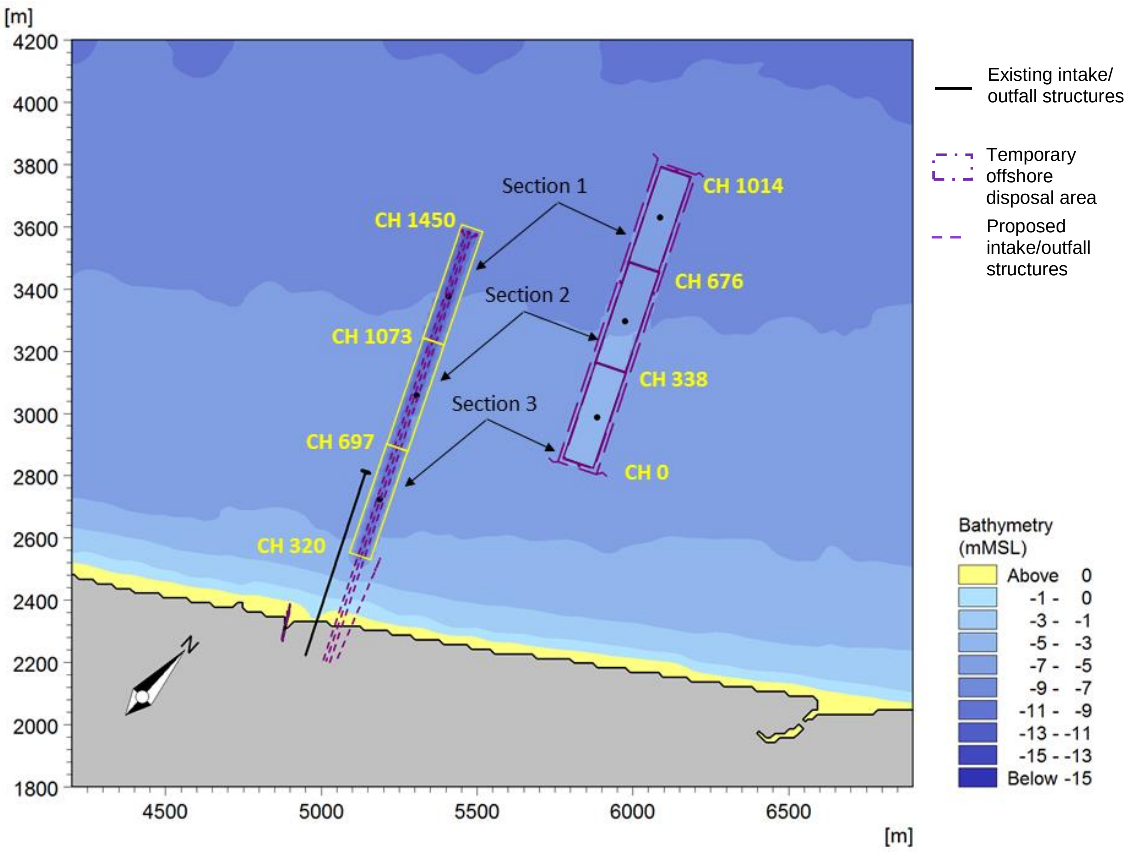


Figure 7.1 Location of dredging and disposal operations

7.5 Sediment Spill Rate

The sediment spill rate used in the model is based on the volume of material dredged by a cutter suction dredger (CSD). The dredged material is transferred via a pipeline to the temporary offshore disposal ground as described in Chapter 3. The daily production and spill rates of the dredging operation are given in Table 7.3. The model assumes that the dredging operation is conducted continuously for a period of 12 hrs daily i.e. from 7:00 a.m. to 7:00 p.m.

Table 7.3 Daily production and spill rates of one cutter suction dredger during dredging and disposal cycle

Description	Value	Source
Volume to be excavated (m^3)	250,000	Contractor
Sediment density (kg/m^3)	1,540	Analysis of seabed samples
Percentage of fines (%)	60	Analysis of seabed samples
Percentage of spill from drag head (%)	2	DID guidelines (2001)
Percentage of spill during disposal (%)	20	DID guidelines (2001)
Dredging production rate (m^3/hour)	500	Contractor
Disposal rate (m^3/hour)	200	Contractor
Daily spilled volume (tonnes)	444	Calculation

7.6 Design Simulation Period

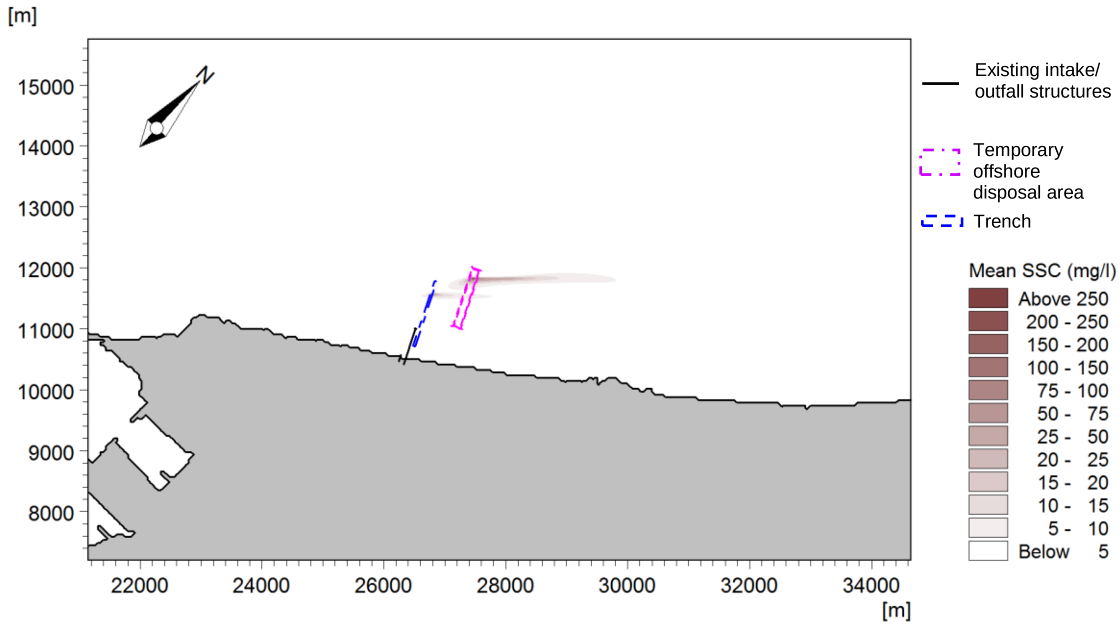
A design simulation period covering a 17-day period was adopted. It includes a 3-day 'warm-up' period.

7.7 Results

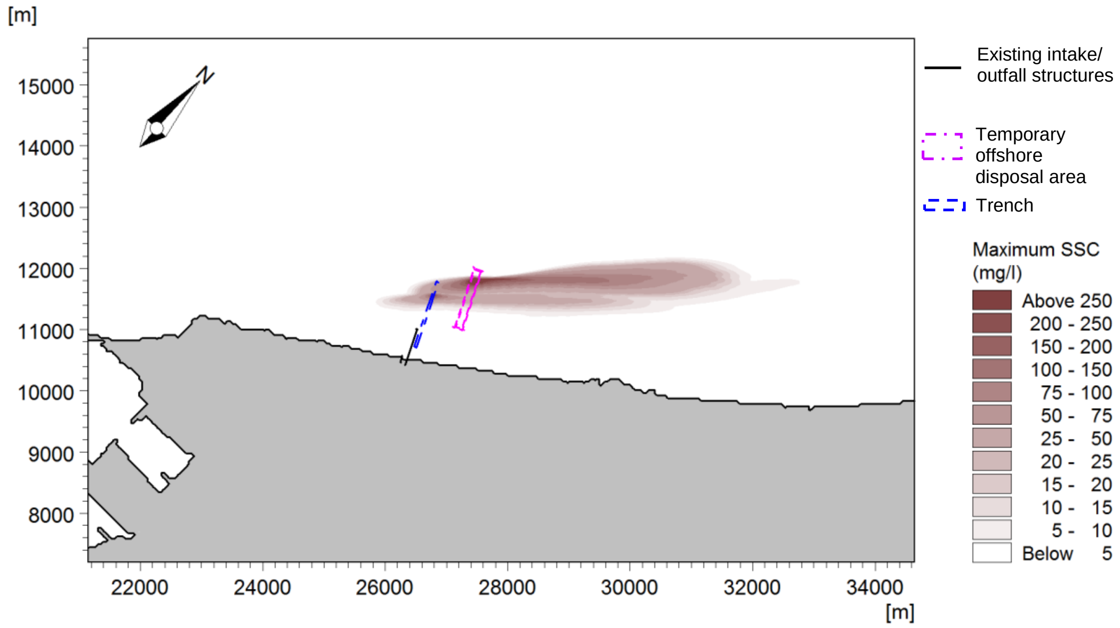
The sediment spill dispersion modelling results are presented in the forms of mean, maximum and exceedance plots for 5, 10, 25 and 50 mg/L concentration as shown in Figures 7.2 to 7.10. It is observed that the plume extends dominantly to the northeast as influenced by the wind direction during the Southwest Monsoon. The model also predicts that the extent and concentration of suspended sediment is fairly similar for all sections.

The mean and maximum excess suspended sediment dispersion is about 2.5 and 5.5 km from the source at the dredging site respectively for suspended sediment concentration of more than 5 mg/L. The mean and maximum plume excursion for concentration of more than 10 mg/L is up to about 1.5 and 4.5 km respectively from the source.

The exceedance probability for 5 mg/L exceeding more than 10% of the time has a spread of about 4 km from the spill source at the disposal area and 3.5 km from source at the trench. The exceedance probability for 10 mg/L exceeding more than 10% of the time would have a spread of about 3.5 km at the disposal area and 2 km at the trench. The extent for 25 mg/L reduces significantly for the same exceedance time, i.e. up to 2 and 0.6 km for sediment spill at the disposal ground and trench respectively. For 50 mg/L concentration, the extent for the same time exceedance is about 1.5 km from the disposal area but is very localised at the trench.

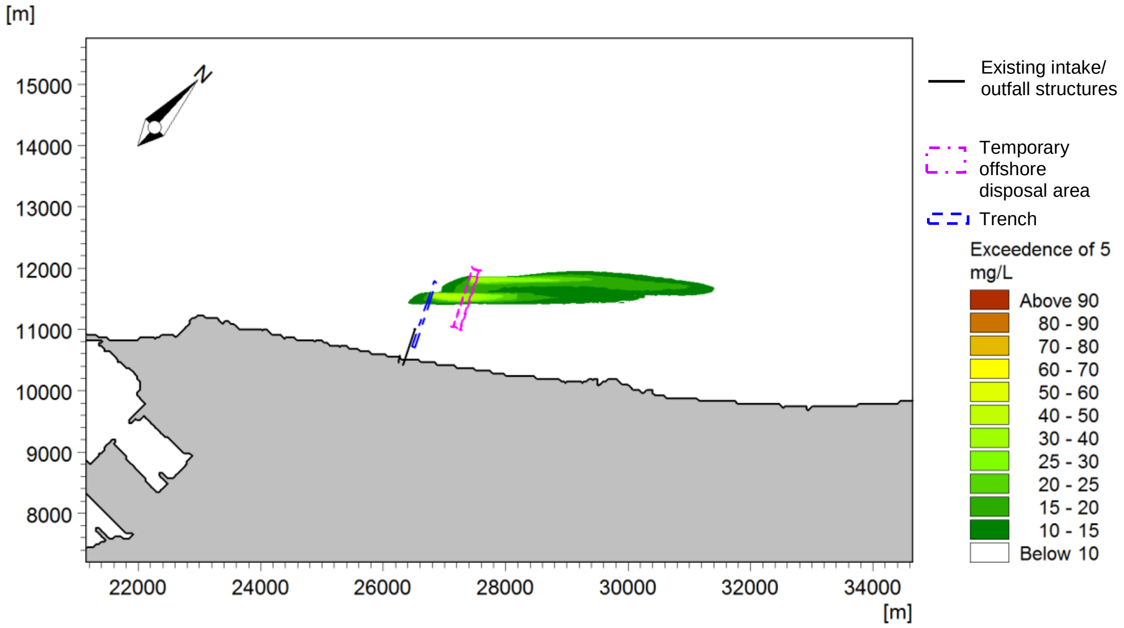


a) Mean

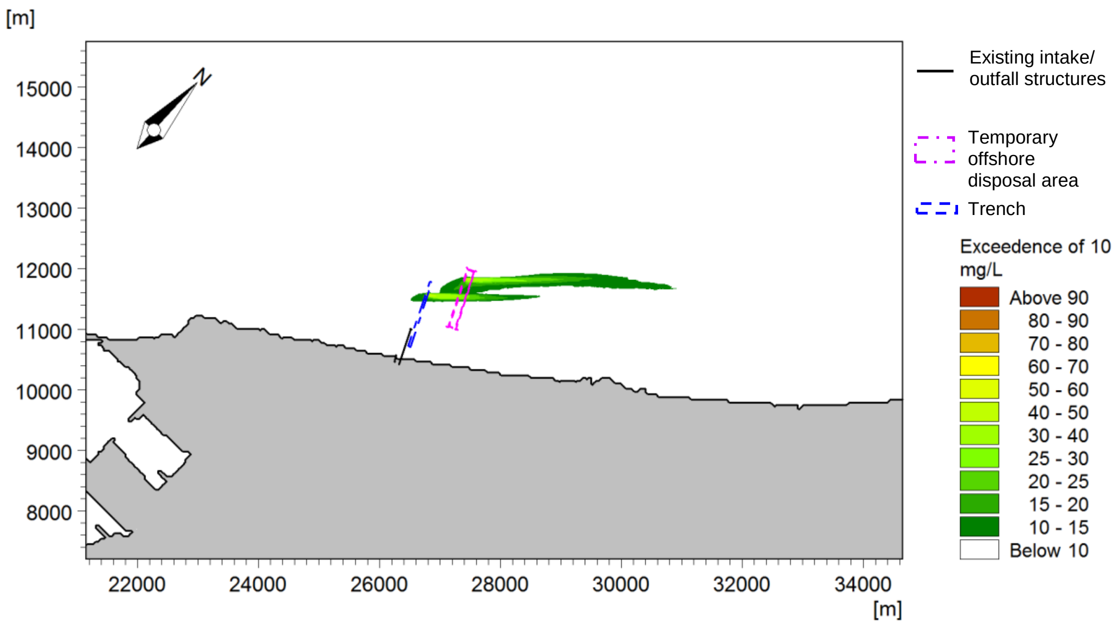


b) Maximum

Figure 7.2 Mean and maximum excess suspended sediment concentration for Section 1

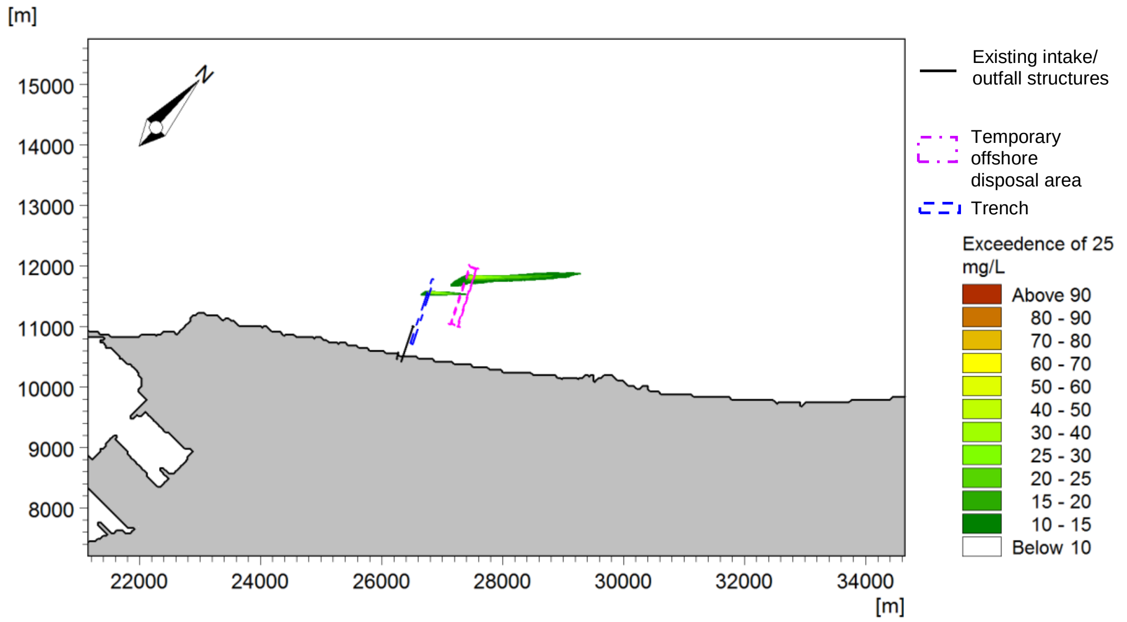


a) Exceedance of 5 mg/L

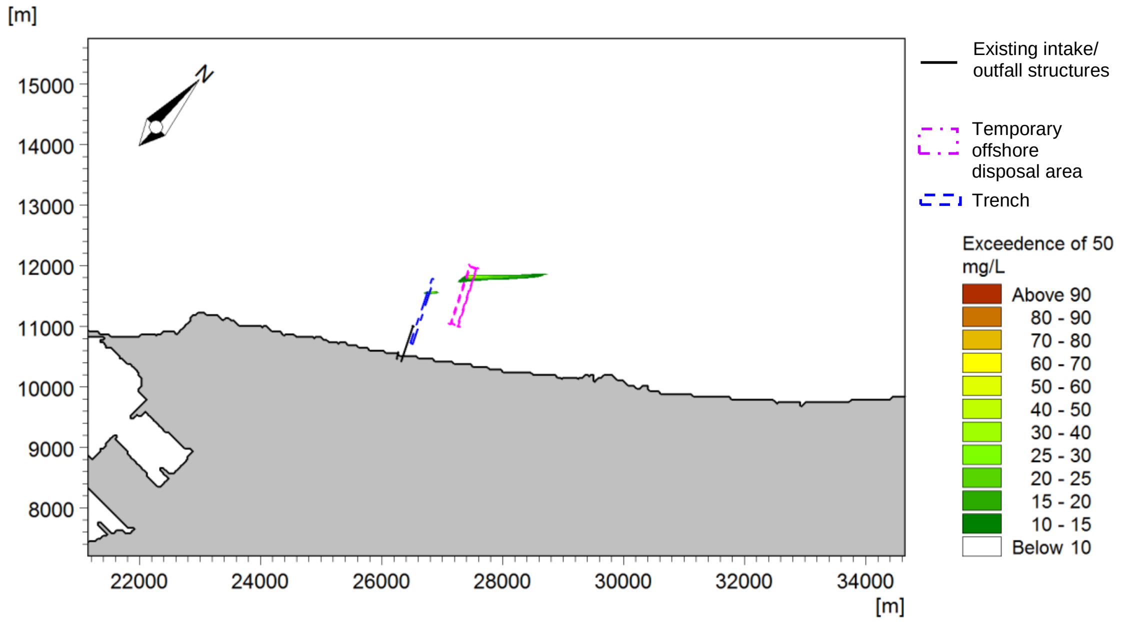


b) Exceedance of 10 mg/L

Figure 7.3 Percentage of time exceedance of suspended sediment concentration above 5 and 10 mg/L for Section 1

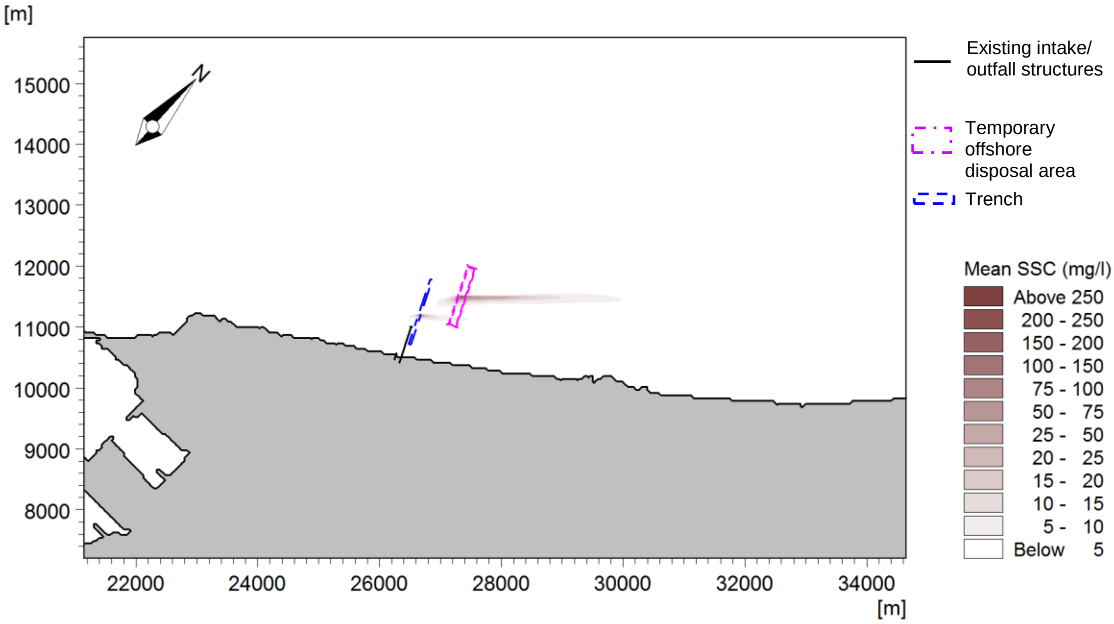


a) Exceedance of 25 mg/L

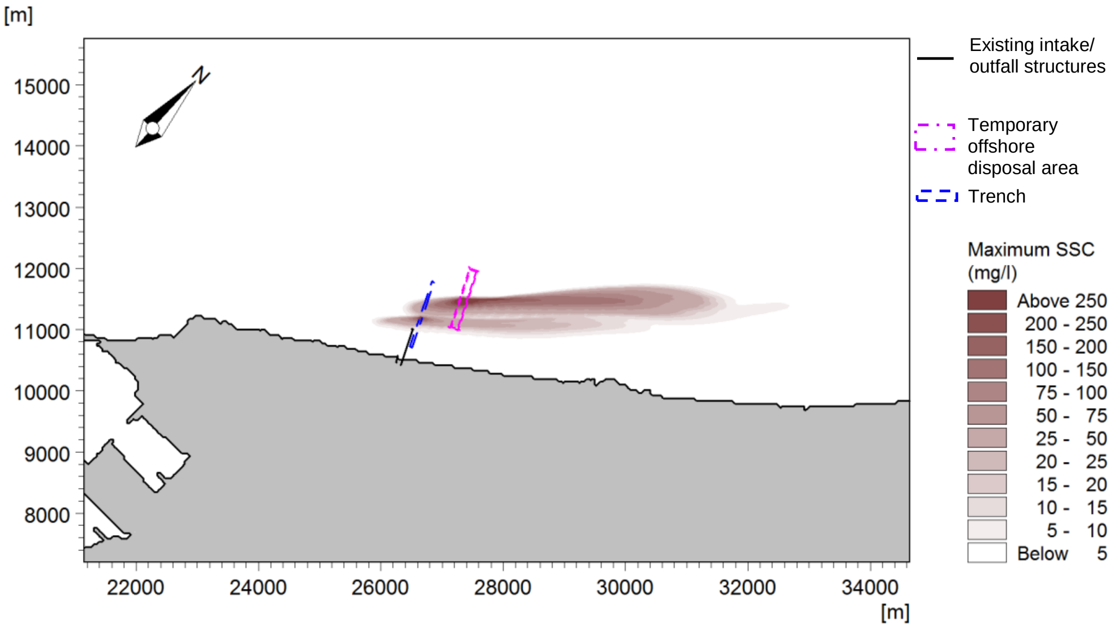


b) Exceedance of 50 mg/L

Figure 7.4 Percentage of time exceedance of suspended sediment concentration above 25 and 50 mg/L for Section 1

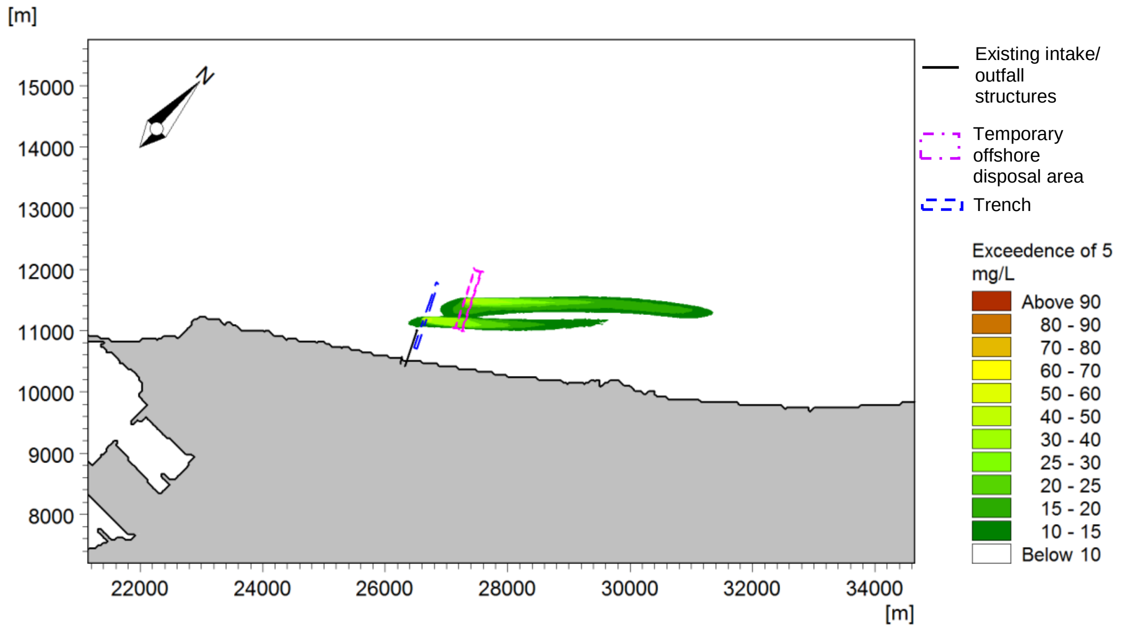


a) Mean

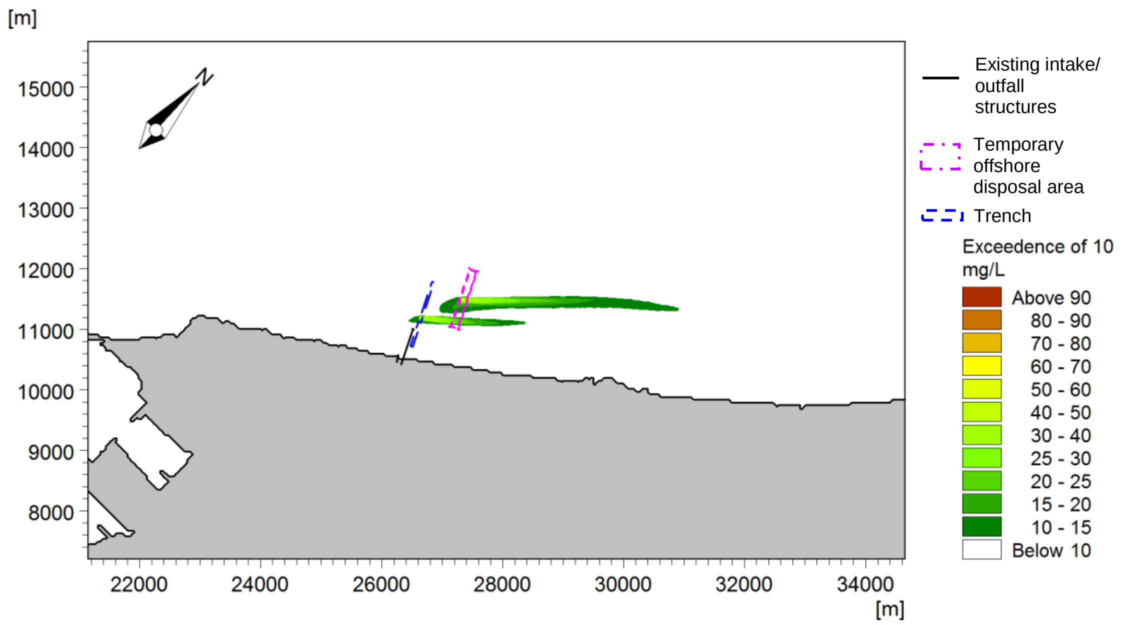


b) Maximum

Figure 7.5 Mean and maximum excess suspended sediment concentration for Section 2

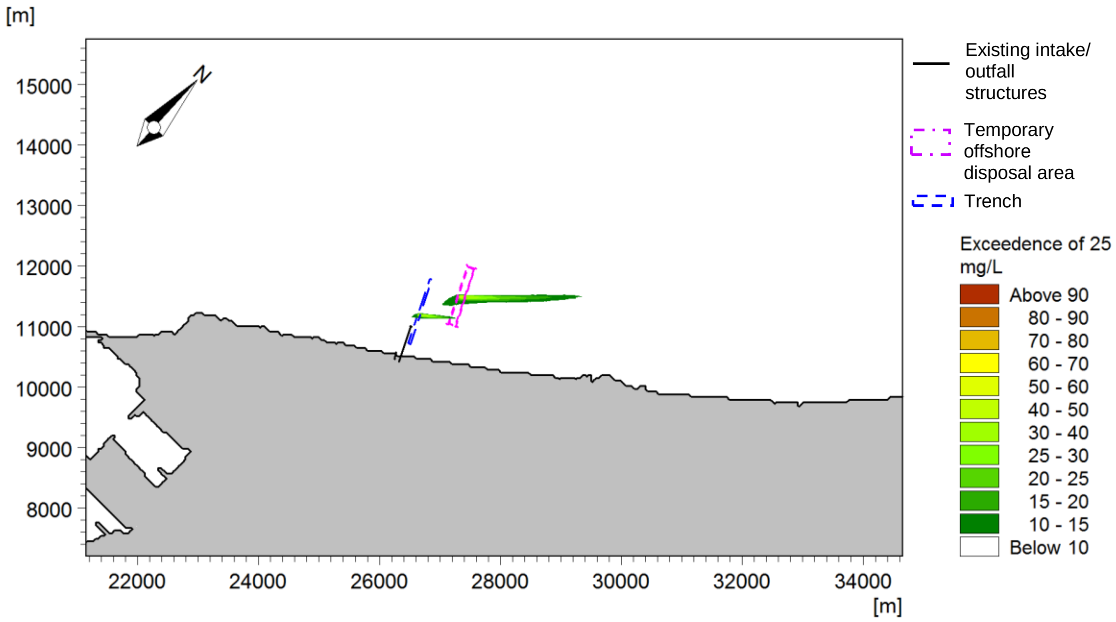


a) Exceedance of 5 mg/L

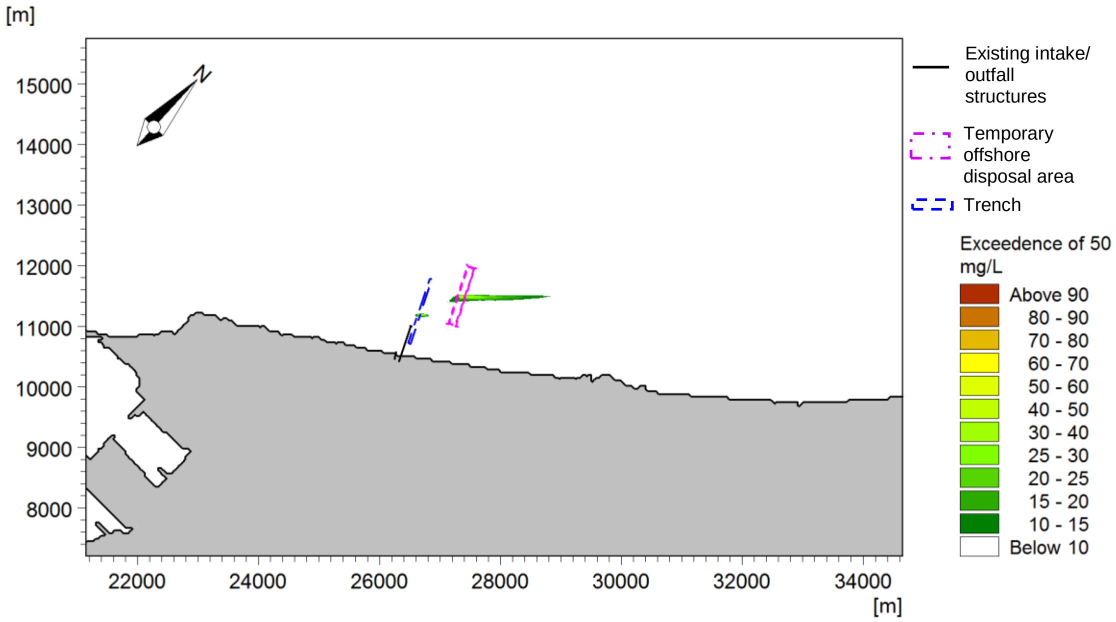


b) Exceedance of 10 mg/L

Figure 7.6 Percentage of time exceedance of suspended sediment concentration above 5 and 10 mg/L for Section 2

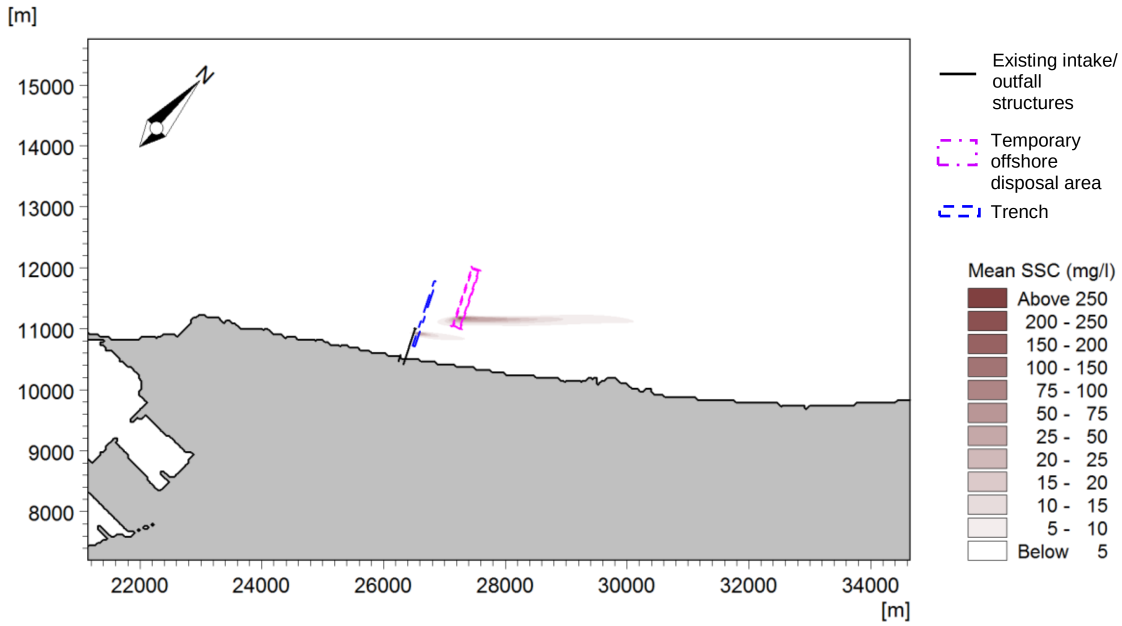


a) Exceedance of 25 mg/L

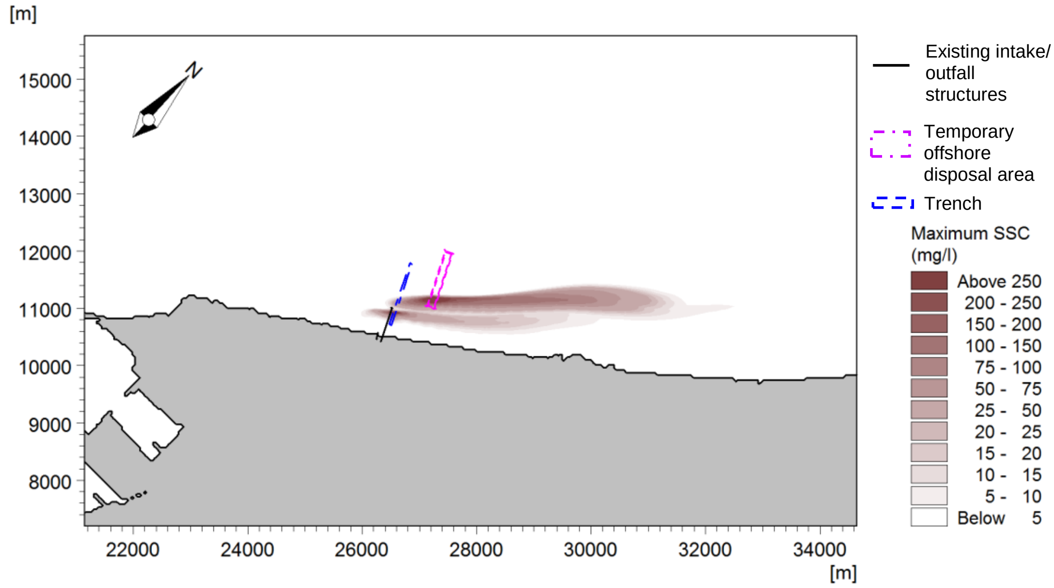


b) Exceedance of 50 mg/L

Figure 7.7 Percentage of time exceedance of suspended sediment concentration above 25 and 50 mg/L for Section 2

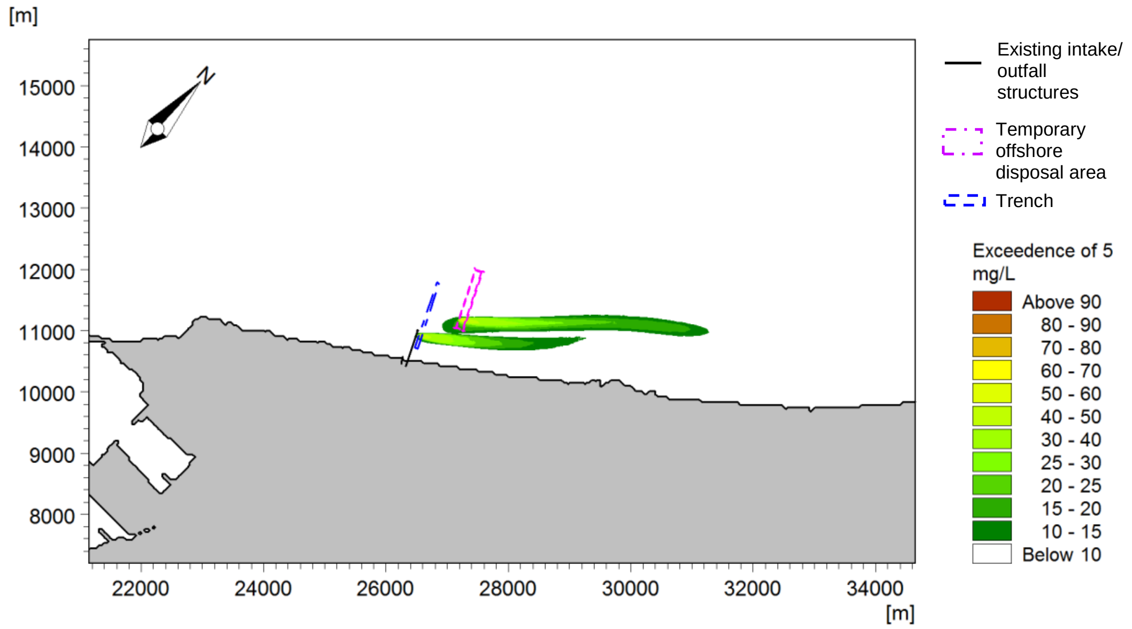


a) Mean

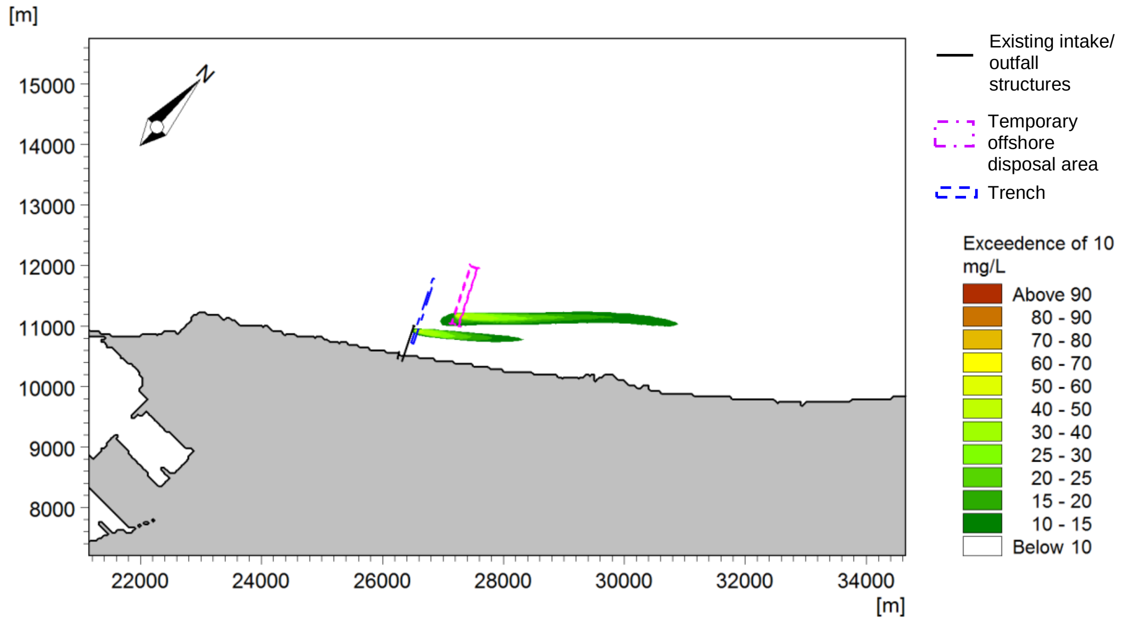


b) Maximum

Figure 7.8 Mean and maximum excess suspended sediment concentration for Section 3

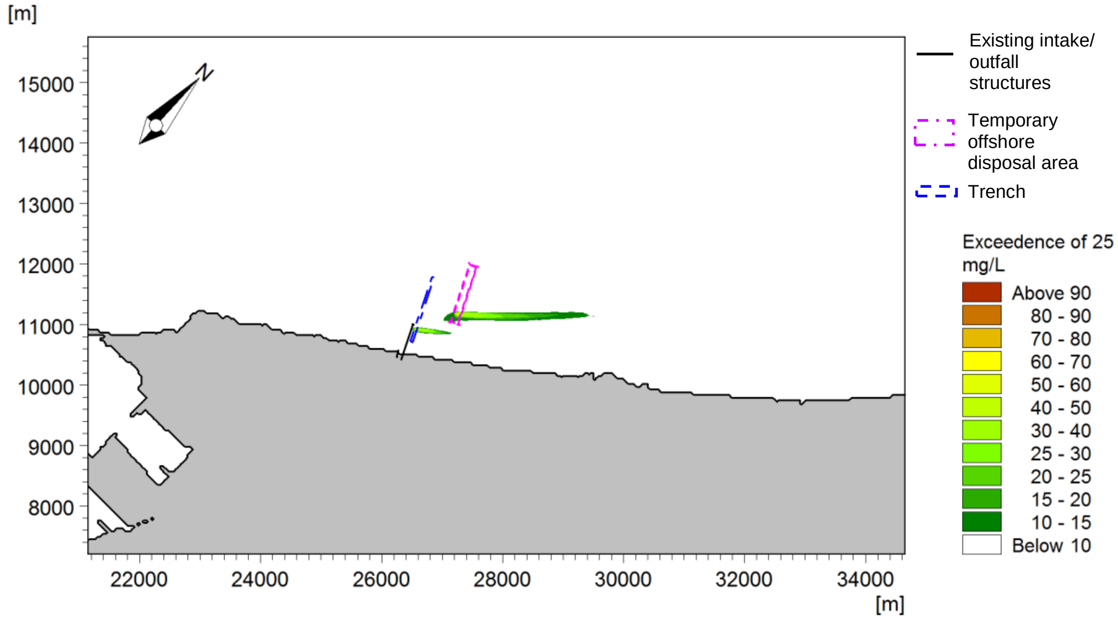


a) Exceedance of 5 mg/L

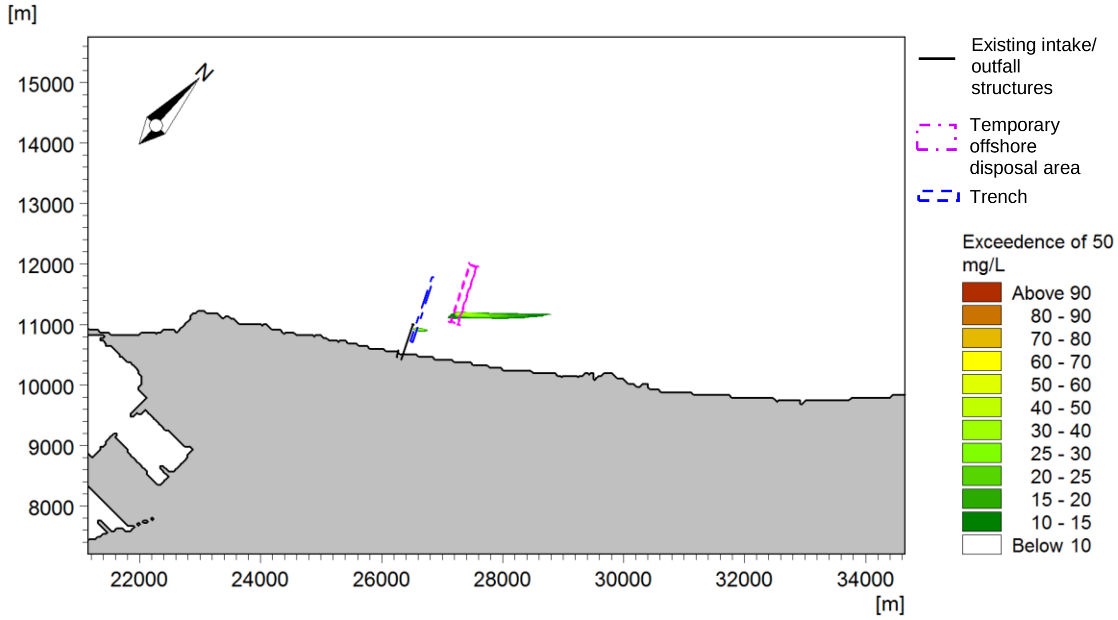


b) Exceedance of 10 mg/L

Figure 7.9 Percentage of time exceedance of suspended sediment concentration above 5 and 10 mg/L concentration for Section 3



a) Exceedance of 25 mg/L



b) Exceedance of 50 mg/L

Figure 7.10 Percentage of time exceedance of suspended sediment concentration above 25 and 50 mg/L concentration for Section 3

Table 7.4 shows the concentration for excess TSS at the ESAs within the vicinity of the Project area. The mean excess SSC is generally zero at all the ESAs. A maximum concentration of 5 and 3 mg/L is predicted at Similajau National Park marine extension while dredging at Sections 2 and 3 respectively. A maximum concentration of 9 and 14 mg/L is predicted at the existing intake while dredging at Sections 2 and 3 respectively. No excess TSS concentration is expected at the other ESAs.

Table 7.4 Excess suspended sediment concentration at the ESAs within the vicinity of the Project area during construction without mitigation

ID	Description	Excess Suspended Sediment Concentration (mg/L)					
		Mean			Maximum		
		Section 1	Section 2	Section 3	Section 1	Section 2	Section 3
1	Existing intake	0	0	0	0	9	14
2	Kampung Nelayan Batu Mandi	0	0	0	0	0	0
3	Similajau National Park marine extension	0	0	0	1	5	3
4	Bintulu Port	0	0	0	0	0	0
5	Batu Likau	0	0	0	0	0	0
6	Batu Mandi	0	0	0	0	0	0

7.7.1 Sediment Spill during Backfilling Operation

The effect of the backfilling work is expected to be similar with the trenching works. Backfilling will be conducted during the monsoonal condition similar with that for the previous dredging works. It involves removing the dredged material placed at the temporary disposal area and placing it in the trench.

7.8 Findings

The model predicts that the suspended sediment plume will spread more dominantly to the east during the Southwest Monsoon period. The prevailing wind direction prevents the plume from encroaching too much at the existing intake. However, it is predicted that the maximum suspended sediment concentration of up to 5 mg/L can occur at Similajau National Park marine extension during dredging and disposal operations at Sections 2 and 3. The concentration is considered acceptable given that the ambient concentration is considerably high.

Chapter 8

SEDIMENT TRANSPORT

Chapter 8

SEDIMENT TRANSPORT

8.1 Introduction

An appraisal of sediment transport conditions at the Project area is done to determine the impact in sediment transport. Though it is highly unlikely that the proposed sufficiently-spaced intake and outfall structures to pose any permanent changes in sediment transport capacity when they fully operate, the period of no activity (October 2018 to February 2019) is expected to cause temporary impact.

It is estimated that 250,000 m^3 of sediment will be excavated from the trench to place the intake pipelines. From the seabed sediment sampling done (as shown in Table 2.4), approximately 60% of each sediment sample is classified as fine sediment. It is predicted that 20% of fine sediment from the total volume of excavated sediment will be spilled during trenching and temporary disposal works. Although the fine sediment could settle into the trench, such deposition is unlikely to consolidate enough in a way that it could affect the invert level of the pipelines. Therefore, the sediment transport during this period will be evaluated via two-dimensional modelling using MIKE 21 Non-cohesive Sediment Transport (MIKE21 ST) module.

8.2 MIKE 21 ST

MIKE 21 ST is a module that calculates the rate of non-cohesive sediment transport for pure currents or combined action of waves and currents, which in the Project area, is the latter. MIKE21 ST utilises the simulated flow conditions from the current flow model and the wave pattern from the nearshore wave model. The model inputs include current flow and nearshore wave modelling results, typical median sediment size (D_{50}) and average sediment gradation.

8.3 Model Setup

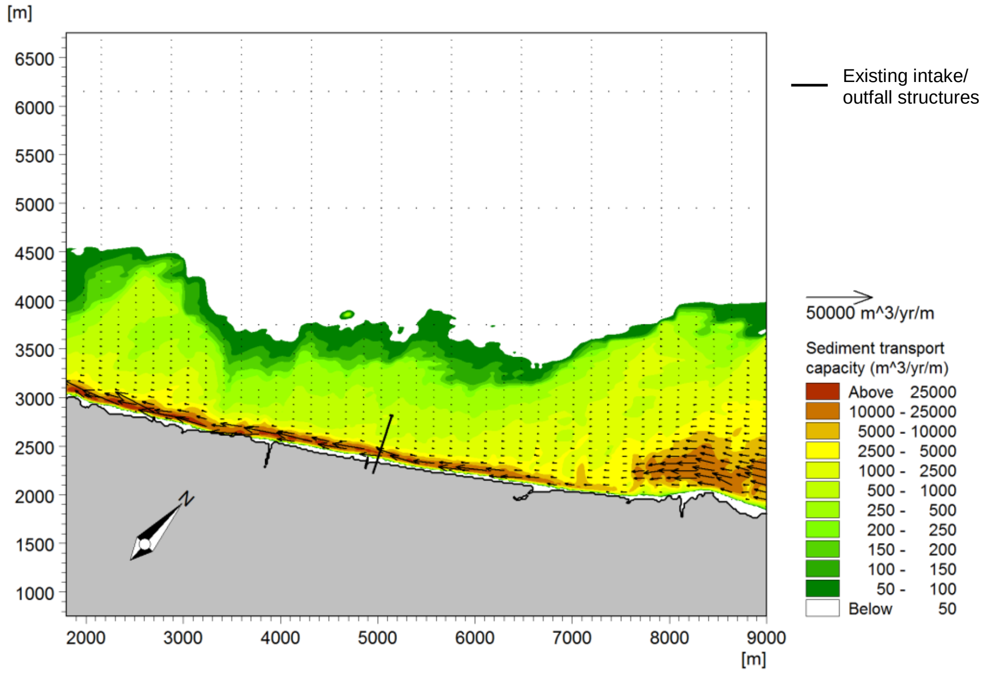
A local wave model similar to the finest domain of the hydrodynamic model has been setup. The local model has a rectilinear grid resolution of 15 m, which is considered adequate to resolve the nearshore sediment transport processes.

Simulations were carried out for the period of no activity during construction for Northeast Monsoon condition, which coincides with the period of highest wave activity at the Project site. The impact in terms of sediment transport capacity in the vicinity of the Project area is assessed.

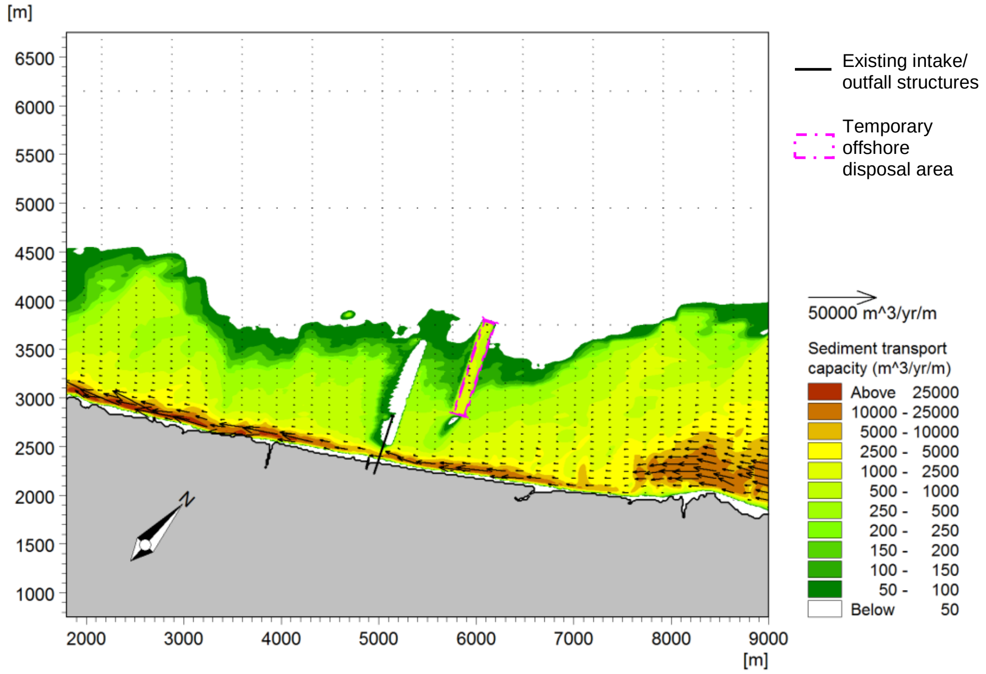
8.4 Model Results

The sediment transport capacity plots for Northeast Monsoon condition for the existing condition and the period of no construction is shown in Figure 8.1. The change in sediment transport capacity is shown in Figure 8.2. The north-easterly waves cause the sediment to be transported from east to west. The sediment transport capacity where the trench and the temporary disposal area are located is between 500 and 1,000 m^3/year/m. It is relatively smaller compared to the nearshore transport, which is typically about 5,000 to 10,000 m^3/year/m.

The deepening of the seabed due to the trench excavation and the increase in bed level at the temporary offshore disposal area causes sediment transport capacity to be decreased significantly. This especially occurs at the nearshore area, i.e. about 1 km to the west and 0.7 km to the east of the existing intake structure. The predicted reduction of sediment transport capacity is highest near the Project area. It also causes the transport capacity further west (in front of PETRONAS' LNG Complex) to increase by up to 2,000 m^3/year/m. The area is currently protected by a rock revetment that is able to withstand erosion. However, the localised increase and decrease in sediment transport is temporary. The normal sediment transport will return to its original pattern after the trench is backfilled.



a) Existing condition



b) During period of no construction

Figure 8.1 Average sediment transport capacity for Northeast Monsoon condition

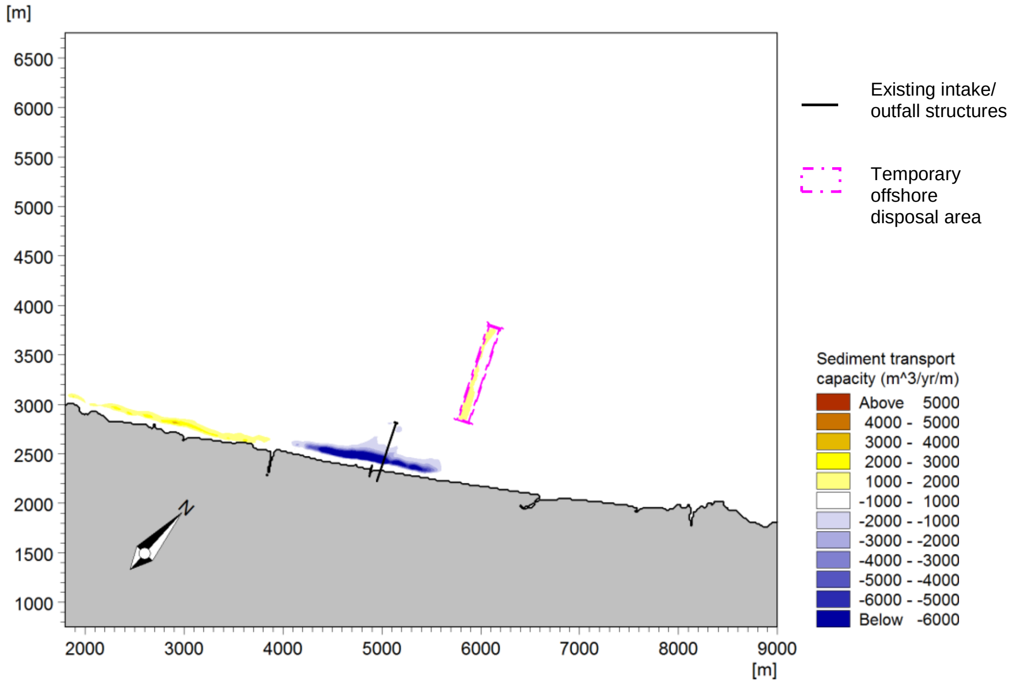


Figure 8.2 Difference (existing condition vs. period of no construction) in average sediment transport capacity for Northeast Monsoon condition

Table 8.1 shows the predicted changes in sediment transport capacity extracted at the ESAs for Northeast Monsoon condition. There is generally no change in sediment transport capacity at the ESAs except at the existing intake structure where a 97% reduction in in sediment transport capacity occurs.

Table 8.1 Changes in sediment transport capacity at the ESAs within the vicinity of the Project area during period of no activity during construction (Northeast Monsoon condition)

ID	Description	Sediment Transport Capacity (m3/year/m)		
		Existing	Period of No Activity During Construction	Difference (%)
1	Existing intake	680	20	-97
2	Kampung Nelayan Batu Mandi	4,660	4,660	0
3	Similajau National Park marine extension	1,200	1,200	0
4	Bintulu Port	10	10	0
5	Batu Likau	25	25	0
6	Batu Mandi	50	50	0

Sediment discharge is extracted from the two-dimensional simulation results at two profiles as indicated in red in Figure 8.3. From the extracted sediment discharges, the volume of sediment that is trapped inside the trench is calculated by subtracting the incoming and outgoing sediment moving from both east and west of the extraction profiles as illustrated in Figure 8.4. It is predicted that about 200,000 m^3 of sediment can settle inside the trench during this period.

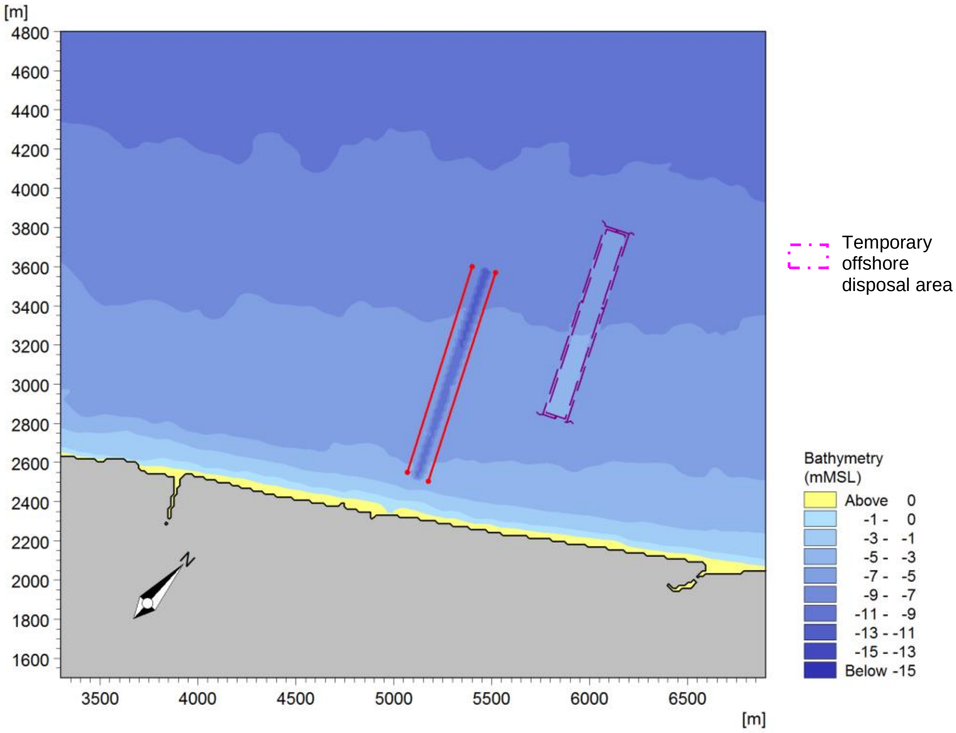


Figure 8.3 Locations for extraction of sediment discharge profiles (denoted by the red lines)

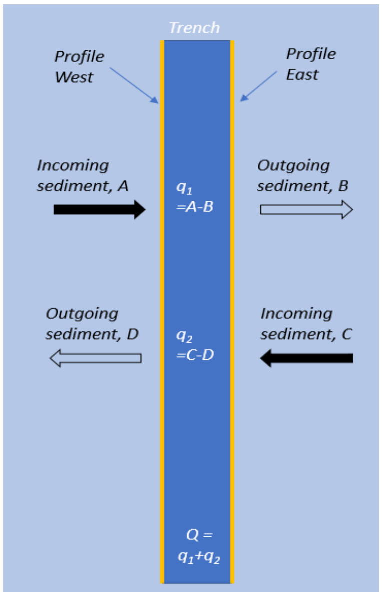


Figure 8.4 Method in calculating the volume of sediment trapped inside the excavated trench, Q

8.5 Findings

There will unlikely be any significant change in sediment transport once the properly-installed intake and outfall structures are operational. For the period of no activity during construction between October 2018 and February 2019, the trench and temporary offshore disposal area could cause sedimentation at the coastline within 1 km radius surrounding the Project area. It can also lead to deficit of sediment supply to the western coastline (1 to 3 km to the west of the existing intake structure) with an erosion potential. It is not expected to affect the ESAs except the existing intake structure. Sediment placed at the temporary disposal ground and the surrounding area can also move towards and settle within the excavated trench during this period. The trench needs to be re-dredged prior to pipeline laying work due to the sedimentation occurring in the trench. The existing sediment transport regime would return to its original pattern after the backfilling work is completed.

Chapter 9

PROPOSED MITIGATION MEASURES

Chapter 9

PROPOSED MITIGATION MEASURES

9.1 Introduction

Several mitigation measures can be implemented to reduce impacts caused by the proposed development. Measures are also recommended to address potential impact to the surrounding during and after construction.

9.2 Monitoring System During Construction

A monitoring system may be applied during construction to address the uncertainties that may occur in hydraulic study and design. Two online turbidity sensors can be installed to the northeast and southwest of the existing intake structure. An ADCP can be deployed near the existing intake. The online monitoring is to be established at the onset of the marine construction works. Works are to be temporarily stopped when values recorded by the sensors reach the trigger value. Work can resume after the measured values fall below the trigger value.

9.3 Temporary Offshore Disposal Area

Measures have to be taken by the contractor when removing and transferring the dredged material at the temporary disposal area. Only the dredged material initially deposited at the disposal area may be removed. The contractor shall not remove more material than that initially placed at the temporary disposal area during the backfilling process.

9.4 Post-construction Survey

A pre- and post-construction survey as well as progress surveys shall be conducted at the trenching location and the temporary offshore disposal area. These are done to monitor the seabed levels before, during and after the works are completed. The proposed survey extent is indicated by the blue-hatched area in Figure 9.1. The coordinates of the boundary points are given in Table 9.1. The survey line interval shall be 100 m.

Table 9.1 Coordinates for boundary of proposed pre- and post-construction survey extent

Point	Longitude	Latitude
A	113° 5’ 08.5”	3° 18’ 27.1”
B	113° 5’ 10.9”	3° 18’ 28.2”
C	113° 5’ 23.2”	3° 17’ 54.3”
D	113° 5’ 25.6”	3° 17’ 55.5”
E	113° 5’ 18.6”	3° 18’ 46.6”
F	113° 5’ 23.3”	3° 18’ 48.8”
G	113° 5’ 32.5”	3° 18’ 15.2”
H	113° 5’ 37.2”	3° 18’ 17.4”

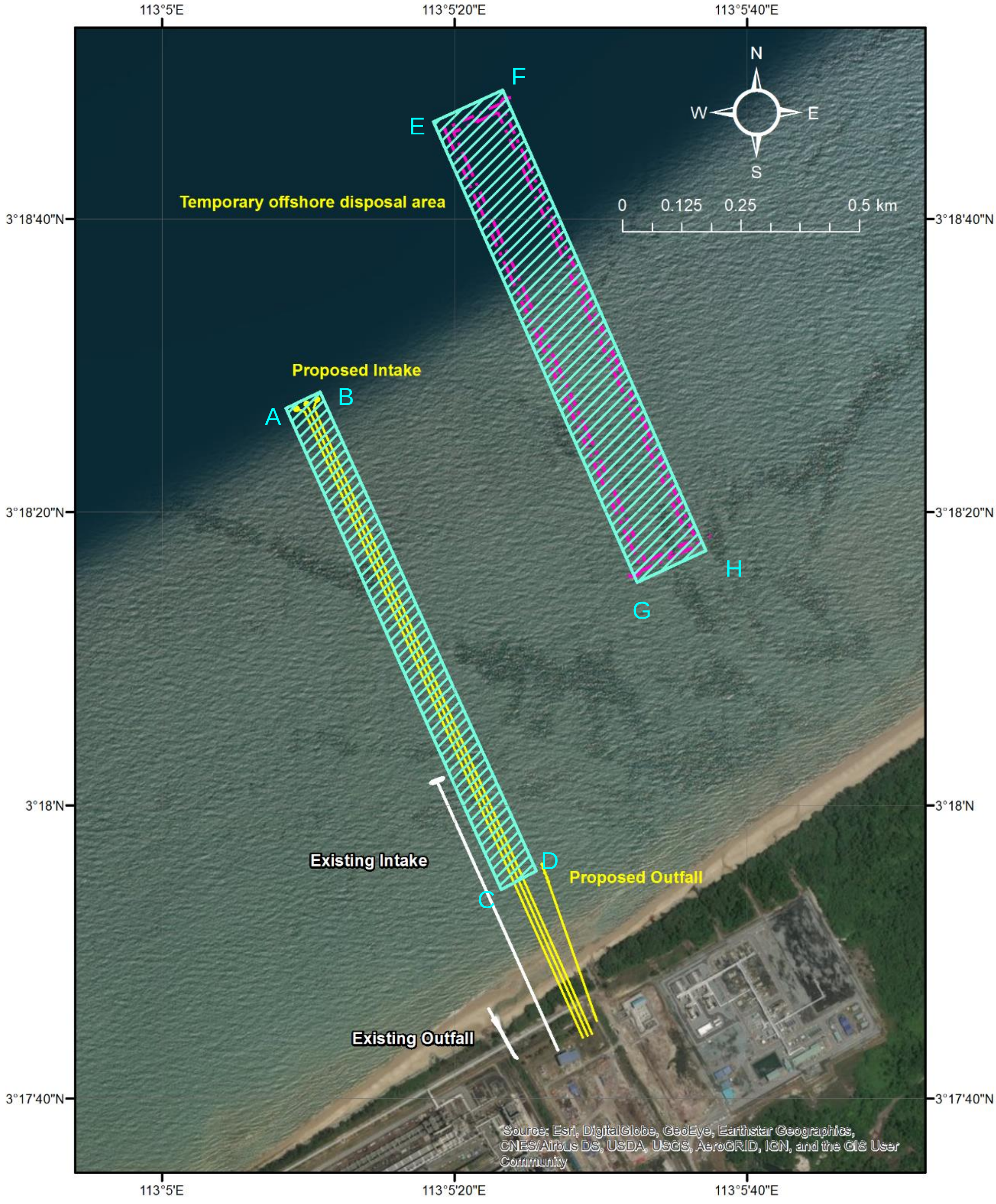


Figure 9.1 Proposed pre- and post-construction survey extent

9.5 Water Quality Monitoring

Water quality monitoring can be done within and around the Project area especially near the outfall and intake structures to monitor changes in seawater temperature and chlorine concentration. The proposed water quality monitoring stations are indicated in Figure 9.2. The coordinates of the monitoring stations are tabulated in Table 9.1. The water quality monitoring shall be done on a monthly basis where measurements are taken at the bottom, middle and near surface elevations of the water column. A report on the results of the monitoring shall be prepared and submitted to the relevant authority every three months during construction and on a half-yearly basis for up to two years after the construction is completed.

Table 9.2 Coordinates of proposed water quality monitoring locations

Station	Longitude	Latitude
WQ1	113° 5’ 02.2”	3° 18’ 22.1”
WQ2	113° 5’ 02.8”	3° 18’ 27.1”
WQ3	113° 5’ 07.2”	3° 18’ 34.1”
WQ4	113° 5’ 16.0”	3° 18’ 33.6”
WQ5	113° 5’ 21.2”	3° 18’ 32.7”
WQ6	113° 5’ 20.3”	3° 18’ 01.5”
WQ7	113° 5’ 25.5”	3° 18’ 03.9”
WQ8	113° 5’ 17.7”	3° 17’ 49.8”
WQ9	113° 5’ 21.3”	3° 17’ 52.7”

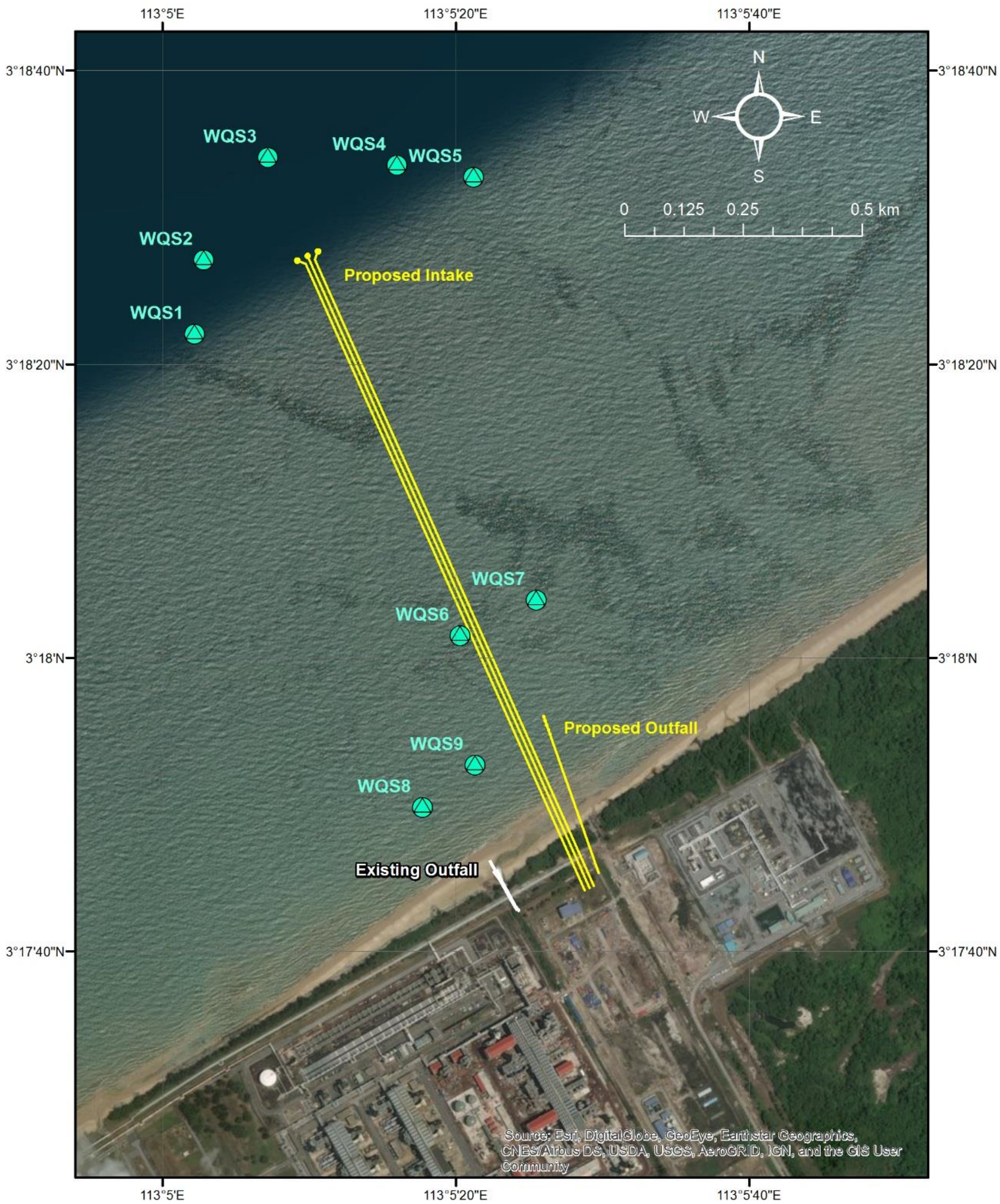


Figure 9.2 Proposed water quality monitoring locations for the Project

Chapter 10

CONCLUSION

Chapter 10

CONCLUSION

10.1 Introduction

Sarawak Energy Berhad intends to relocate the existing intake structure and at the same time construct new intake and outfall structures for the Tanjung Kidurong Combined Cycle Power Plant. The Project components are:

a) A new plant consisting of Block 1 (Units 10 and 11) and Block 2 (Units 12 and 13) is constructed within the vicinity of the existing plant. A set of intake and outfall will be installed to support the once-through cooling system for both blocks. The intake and the outfall pipelines are 1,450 m and 320 m from the pumphouse respectively; and

b) Relocation of the existing intake (Unit 9) to a new location that is parallel to the intake of Block 1 and Block 2. The existing outfall will remain functional.

10.2 Site Assessment

The Project site is located within the harbour limit about 5 km northeast of Bintulu Port. It is bounded by the headlands of Tanjung Kidurong and Tanjung Payung. The bathymetric survey conducted in December 2016 shows that the nearshore seabed contours are relatively parallel with the coastline.

The tides at the Project area are mixed but predominantly diurnal. The mean high water tidal range is 1.96 m. The maximum current speed measured during November 2017 field campaign was less than 0.4 m/s, indicating the current speeds at the Project area are generally low. The period of measurement also coincided with the Northeast Monsoon. Long-term statistics of offshore wind shows that wind typically blows from northeast and southwest, characterised by the monsoonal conditions. Wind speed can reach up to 12 m/s especially during monsoonal condition. Wind-generated waves at the Project area typically propagates from the northeast, influenced by the wind and fetch directions. Offshore wave heights could reach up to 3 m during the Northeast Monsoon. Smaller waves of less than 0.5 m are notable outside the monsoon season.

Seabed samples taken in and around the Project area shows that the seabed is composed of a combination of sand and fine sediments (clay and silt). Water quality at the Project area falls between Class 1 and Class 2 of the Malaysia Marine Water Quality and Standard based on the collected water samples. The measured seawater temperature ranged from 29 to 31°C over the water column with higher temperature observed during the daytime.

Six ESAs were identified by the environmental consultant. These consisted of the plant's existing/new intake, coastal village, marine park, coral reefs and harbour area.

10.3 Project Description

The power plant's existing intake structure is to be relocated and two new intake structures will be constructed. In total, there will be three intake outlets located 1.45 km seawards of the pump house. An additional outfall is sited 320 m seawards of the plant. The existing intake structure will cease to operate after the new intake is functional. The existing outfall at the beach will still be operational after the development. The proposed outfall will be discharging treated blowdown water at 38°C with 0.2 ppm chlorine concentration.

The contractor has devised a construction schedule that traverses 2018 and 2019 due to time constraint (Table 10.1). Pipe-jacking will be done for 320 m of the intake pipelines commencing from the pump house and the entire outfall pipeline. Beyond 320 m of the proposed intake structures, a trench will be excavated in order to place the HDPE pipes and intake chambers.

Table 10.1 Construction schedule for intake and outfall

Phase	Duration	Activity
1	April to September 2018	Trenching and temporary disposal works
2	October 2018 to February 2019	No activity due to Northeast Monsoon
3	March to September 2019	Backfilling works

A cutter suction dredger will be used to excavate the trench. The dredger will commence dredging from offshore towards land. About 250,000 m^3 of material is anticipated to be excavated. The dredged material will be placed via a pipeline at a temporary offshore disposal area located 500 m east of the trench (Figure 10.1). The temporary disposal area will be used to store the excavated material between October 2018 and February 2019. The excavated material will be reused to backfill the trench once the pipes are laid commencing in March 2019. The temporary disposal site has a width and length of about 130 and 1,014 m respectively. The seabed at the temporary disposal area is anticipated to rise by 2 m.

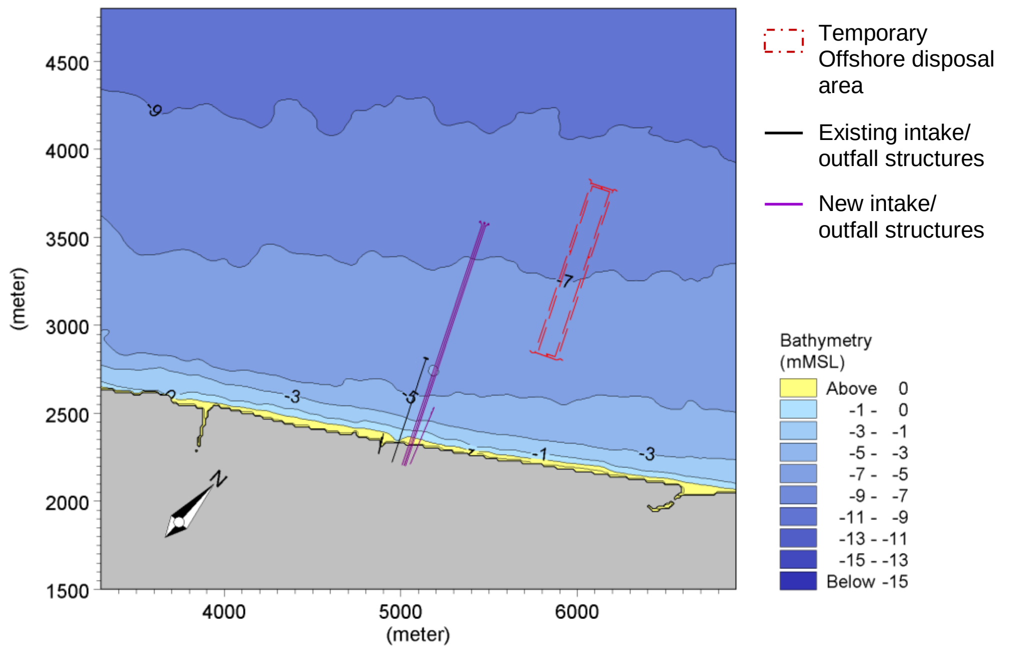


Figure 10.1 Location of proposed intake and outfall pipelines with respect to the temporary offshore disposal area

10.4 Hydrodynamics

Assessment of the impacts in terms of current flow and water level utilised the calibrated and verified model based on measured currents and water levels. The simulated existing mean and maximum current speed within the Project area is generally up to 0.1 and 0.2 m/s respectively. Current speed is generally stronger during the Northeast Monsoon. Relatively weak current is predicted outside of the Northeast Monsoon period. The changes in current speeds are localised during the period of no activity during construction and upon Project implementation. There are insignificant changes in water levels expected for both scenarios at the identified ESAs.

With Project implementation, it can be deduced that the proposed Project creates only localised changes to current flow patterns. The Project is not expected to create any changes in current speed at the ESAs except at the existing intake where the mean and maximum current speed increases by 40 and 20% respectively.

During the period of no activity, the presence of the trench may cause mean and maximum current speed reduction of up to 0.1 m/s for the Northeast Monsoon condition. The presence of the excavated material at the temporary disposal area is predicted to increase the mean and maximum current speed by less than 0.05 and 0.1 m/s respectively. However, these changes are temporary as the trench will be backfilled with the material placed at the temporary disposal area once the pipelines are laid beginning in March 2019. There are insignificant changes in current speed during this period at the ESAs.

10.5 Waves

It is anticipated that the magnitude of impact caused by the period of no activity is higher than with Project implementation. The change in seabed level created by the excavated trench and temporary disposal area causes localised wave height reduction (approximately 0.1 m for about 0.5 km stretch of the coastline). This condition is temporary as the trench will be backfilled with material removed from the temporary disposal area after March 2019. There is negligible impact on terms of wave with Project implementation.

10.6 Thermal and Chlorine Dispersion

The plumes disperse to the southwest for the Northeast Monsoon condition and to the northeast for the Southwest and inter-monsoon conditions. The plumes are influenced by the net current flow pattern.

Temperature gradient plays a significant role where discharging in lower ambient temperature (higher gradient) causes higher excess temperature compared to discharging in higher ambient temperature (lower gradient). The areal extent where 2°C is exceeded by at least 5% of time is relatively similar with the existing condition. As the Project area is located within an open sea, heat dissipation is considered relatively good. There is no change in mean excess temperature at the identified ESA locations. However, there could be an increase of 0.5 and 0.3°C in maximum excess temperature above low and high ambient seawater temperature at the waters fronting Kampung Nelayan Batu Mandi during the Southwest Monsoon. This is not expected to negatively impact the village as the coastline has been disturbed and the waters are primarily used for navigation. No impact in seawater temperature is predicted at the other ESAs.

With the discharge from the new outfall, it can be observed that the residual chlorine dispersion's extent and magnitude is relatively similar with the existing condition.

10.7 Sediment Plume Dispersion

Dredging work will be conducted by using a cutter suction dredger with a production rate of 500 m^3/hr. The dredged material is transferred via a pipeline to a temporary disposal area located 500 m east of the trench. Dredging work is simulated to be conducted 12 hrs daily (i.e. 7.00 a.m. to 7.00 p.m.) without any downtime.

Dredging and temporary disposal operations are represented in the model by dividing the trench and temporary disposal area into three sections (Figure 10.2). Dredging at Section 1 (offshore) shows negligible impact to all the ESAs. Dredging at Sections 2 and 3 shows slight impact at the ESAs especially at the existing intake and Similajau National Park marine extension. The concentration is deemed tolerable given that the ambient TSS concentration at the Project area is considerably high.

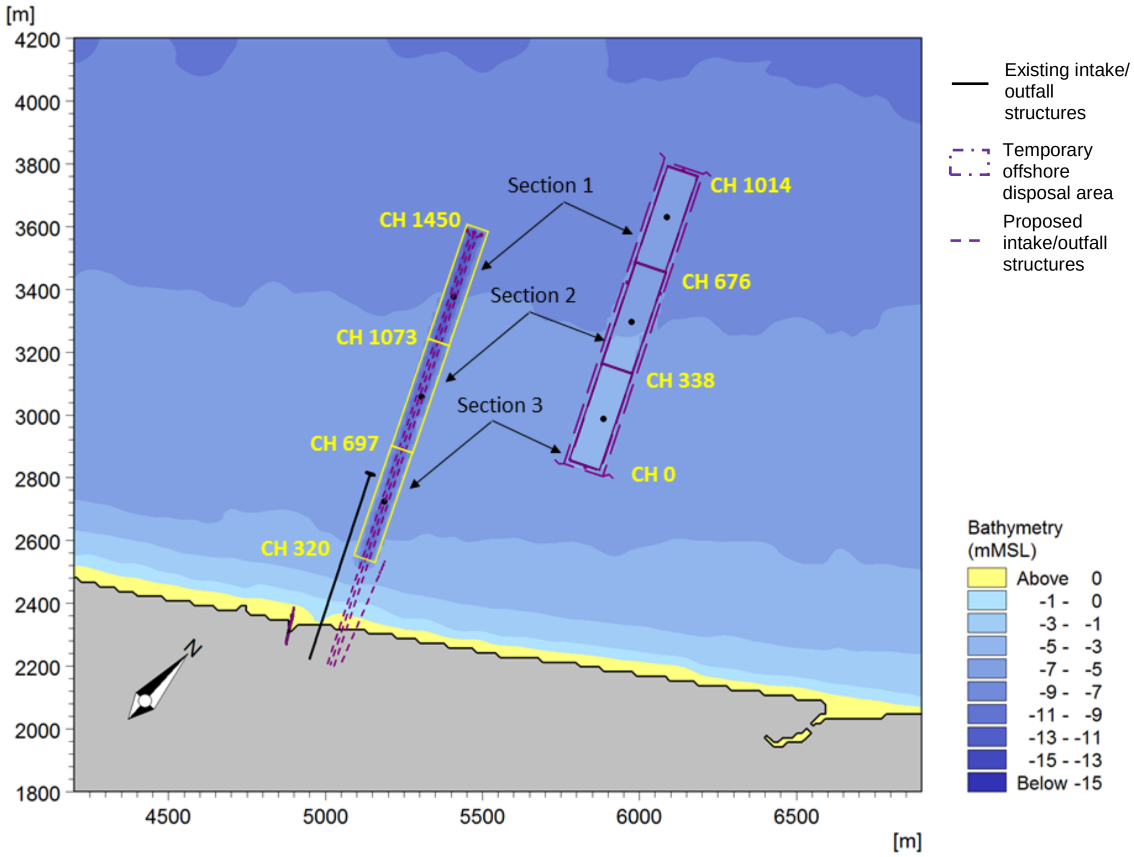


Figure 10.2 Location of dredging and disposal operations

The model predicts that the suspended sediment plume will spread more dominantly to the east during the Southwest Monsoon period. The prevailing wind direction prevents the plume from encroaching too much at the existing intake. However, it is predicted that the maximum suspended sediment concentration of up to 14 mg/L occurs at the existing intake when dredging at Section 2 and 3. The concentration is considered acceptable given that the ambient concentration is considerably high.

10.8 Sediment Transport

The presence of the intake and outfall structures is not anticipated to induce changes to sediment transport upon Project implementation. For the period of no activity during construction between October 2018 and February 2019, the trench and temporary offshore disposal area could cause sedimentation at the coastline within 1 km radius surrounding the Project area. It can also lead to deficit of sediment supply to the western coastline (1 to 3 km to the west of the existing intake structure) with an erosion potential. It is not expected to affect the ESAs except the existing intake structure. Sediment placed at the temporary disposal ground and the surrounding area can also move towards and settle within the excavated trench during this period. The trench needs to be re-dredged prior to pipeline laying work due to the sedimentation occurring in the trench. The existing sediment transport regime would return to its original pattern after the backfilling work is completed.

10.9 Mitigation Measures

Several measures are proposed in mitigating the impacts introduced by the Project especially that the construction work involves re-handling of dredged material. The measures suggested are monitoring system during construction where online turbidity sensors and an ADCP is installed near the existing intake structure. The Client is also responsible to mitigate coastal erosion caused by the proposed development, in which the level of protection is to be accounted for in the engineering design. The Contractor has to ensure that no over-dredging to be made while dredging the disposed material and a post-construction survey is also recommended to validate that. Water quality monitoring is also proposed to be conducted on a monthly basis within and around the Project area to monitor changes in seawater temperature and chlorine concentration.

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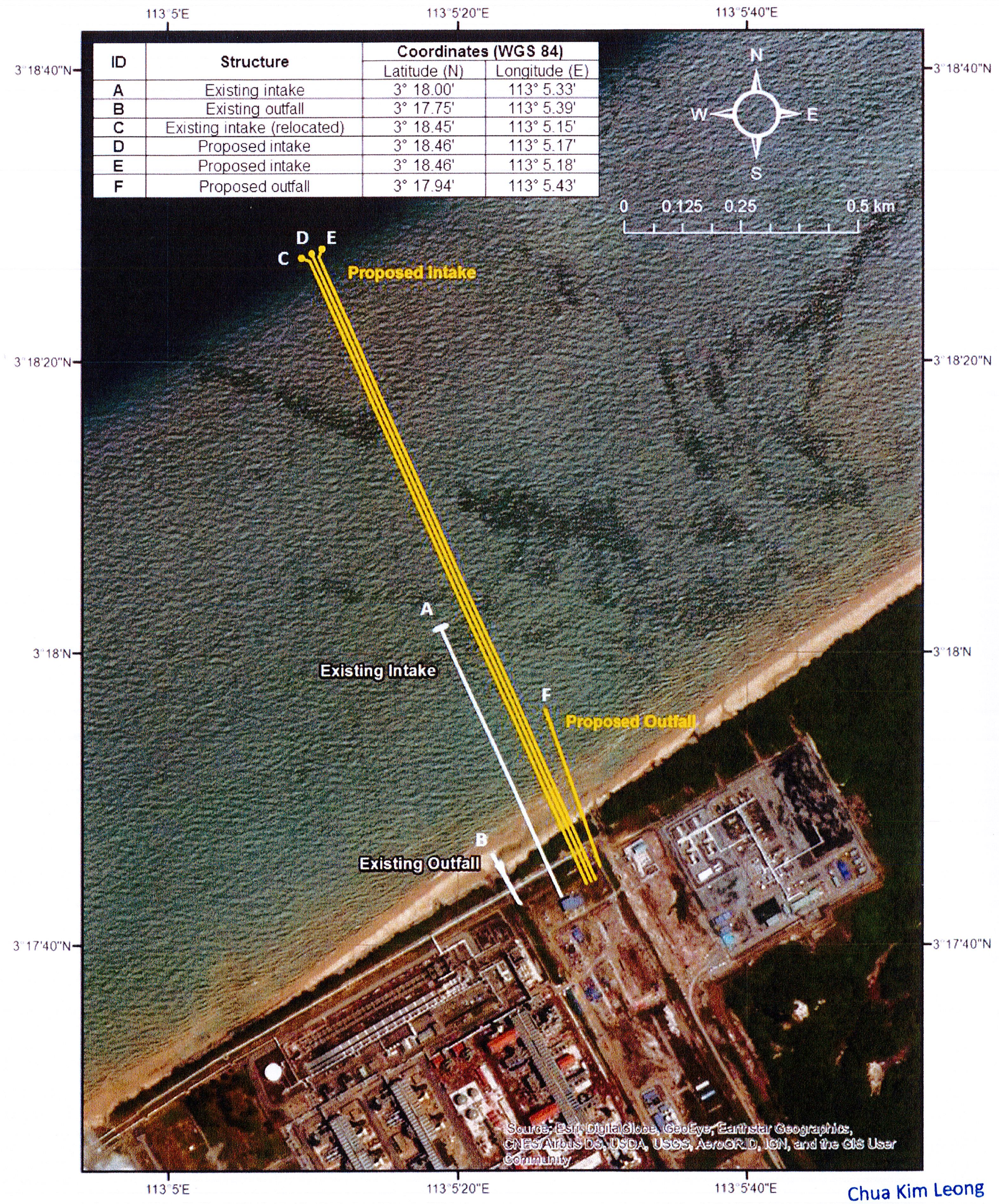
APPENDIX

Hydraulic Study for the Proposed Bintulu Tanjung Kidurong Combined Cycle Power Plant Project (Unit 9 - 13)

Project Layout



ID	Structure	Coordinates (WGS 84)	
		Latitude (N)	Longitude (E)
A	Existing intake	3° 18.00'	113° 5.33'
B	Existing outfall	3° 17.75'	113° 5.39'
C	Existing intake (relocated)	3° 18.45'	113° 5.15'
D	Proposed intake	3° 18.46'	113° 5.17'
E	Proposed intake	3° 18.46'	113° 5.18'
F	Proposed outfall	3° 17.94'	113° 5.43'

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Project Director
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Appendix 5.4.1

Marine Traffic Risk Assessment (MTRA) for Proposed Cooling Water Intake at Tanjung Kidurong, Bintulu, Sarawak

Marine Traffic Risk Analysis (MTRA) for Proposed Cooling Water Intake Pipeline at Tanjung Kidurong, Bintulu, Sarawak

Final Report

Prepared for

Sinohydro Corporation (M) Sdn Bhd

April 2018

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Marine Traffic Risk Analysis (MTRA) Study for the Proposed Cooling Water Intake Pipeline at Tanjung Kidurong, Bintulu, Sarawak

Final Report

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ABBREVIATIONS

BPA	Bintulu Port Authority
BPSB	Bintulu Port Sdn Bhd
CCGT	Combined Cycle Gas Turbine
COLREGS	Collision Regulations
CPA	Closest Point of Approach
FI	Frequency Index
HAZID	Hazard Identification
HDPE	High Density Polyethylene
KASI	KASI (Malaysia) Sdn Bhd
km	Kilometres
LOA	Length Overall
m	Metre
mm	Millimetre
MTRA	Marine Traffic Risk Analysis
PIP	Pre Incident Plan
SI	Severity Index
Sinohydro	Sinohydro Corporation (M) Sdn Bhd
t	Tonnes

Executive Summary

KASI (Malaysia) Sdn. Bhd. was appointed by Sinohydro Corporation (M) Sdn. Bhd. (Sinohydro) to carry out a Marine Traffic Risk Analysis (MTRA) to assess the risks associated with the construction and operation of the proposed cooling water intake pipeline for the 400MW Combined Cycle Gas Turbine (CCGT) power plant at Tanjung Kidurong, Bintulu.

The MTRA looked at four (4) main construction activities namely excavation for pipe trenches at the project site, transportation of HDPE pipeline weight blocks within the Bintulu Port, transportation of HDPE pipeline from Bintulu Port to the project site and installation of HDPE pipeline at the project site.

The identified common risks for all four (4) construction activities are crew fatigue, inadequate emergency plan and lack of planning / documentation / procedure.

For the excavation for pipe trenches and installation of HDPE pipeline, additional risks identified are severe weather conditions and night operations / poor visibility.

The transportation of HDPE pipeline weight blocks within Bintulu Port and transportation of HDPE pipeline from the Bintulu Port to project site, two (2) additional risks are identified namely collision of barges with existing traffic and failure of propulsion, steering or power of tugboat.

Mitigation measures have been identified for the risks discussed above including reference to the International Regulation for Preventing Collisions at Sea (COLREGS).

The anchor chains of the cutter suction dredger are to be between two (2) to three (3) shackles while maintaining a distance of at least 50m away from the existing gas pipe.

Installation works of weight balancing blocks and connection works for HDPE pipes should not encroach into the adjacent navigation channel or manoeuvring basin of the Bintulu Port Inner Harbour 2 so as to cause hindrance to marine traffic and should be conducted in compliance with the requirements of Bintulu Port Authority and Bintulu Port Sdn Bhd at all times.

The MTRA concludes that the identified risks associated with the construction and operation of the proposed cooling water intake pipeline for the 400MW Combined Cycle Gas Turbine (CCGT) power plant at Tanjung Kidurong, Bintulu can be safely managed, subject to compliance with the mitigation measures identified in this report.

1.0 Introduction

1.1 Background

Sarawak Energy Sdn Bhd is developing a 400MW Combined Cycle Gas Turbine (CCGT) power plant behind the existing Kidurong power station. The project site is located at Kidurong Industrial district, Bintulu, Sarawak. The CCGT power plant includes the construction of a cooling water system together with its associated water intake and outfall pipelines.

The Engineering Procurement & Construction (EPC) contractor for the above project is GE-Sinohydro consortium comprising of four (4) companies namely, GE Power Solutions (Malaysia) Sdn Bhd, GE (Switzerland) GmbH, Sinohydro Corporation (M) Sdn Bhd, and Sinohydro Corporation Ltd (China).

KASI (Malaysia) Sdn Bhd (KASI) was appointed by Sinohydro Corporation (M) Sdn Bhd (Sinohydro) to carry out a Marine Traffic Risk Analysis (MTRA) to assess the risks associated with the construction and operation of the proposed cooling water intake pipeline.

The location of the proposed cooling water intake pipeline is approximately 7km away from Bintulu Port and is shown in **Figure 1** below.

Figure 1: Location of the project site

1.2 Project Overview

The High-Density Polyethylene (HDPE) pipes required for the proposed cooling water intake pipeline will be transported from Norway to a designated storage site at the Bintulu Port. The transportation date from Norway is expected to be during the period of 30th March 2018 to 4th August 2018. The pipes are expected to be stored at the Bintulu Port until July 2019. Transportation of the pipes to the project site is anticipated to take place during May 2019 to July 2019.

1.3 General Layout of the Proposed Cooling Water Intake Pipeline

The length of the proposed cooling water intake pipeline is approximately 1.2km seawards with three (3) intake chambers at the end. There is an existing gas pipe buried under seabed located approximately 95m away from the proposed intake pipeline.

The general layout of the proposed intake pipeline is shown in **Figure 2** below.

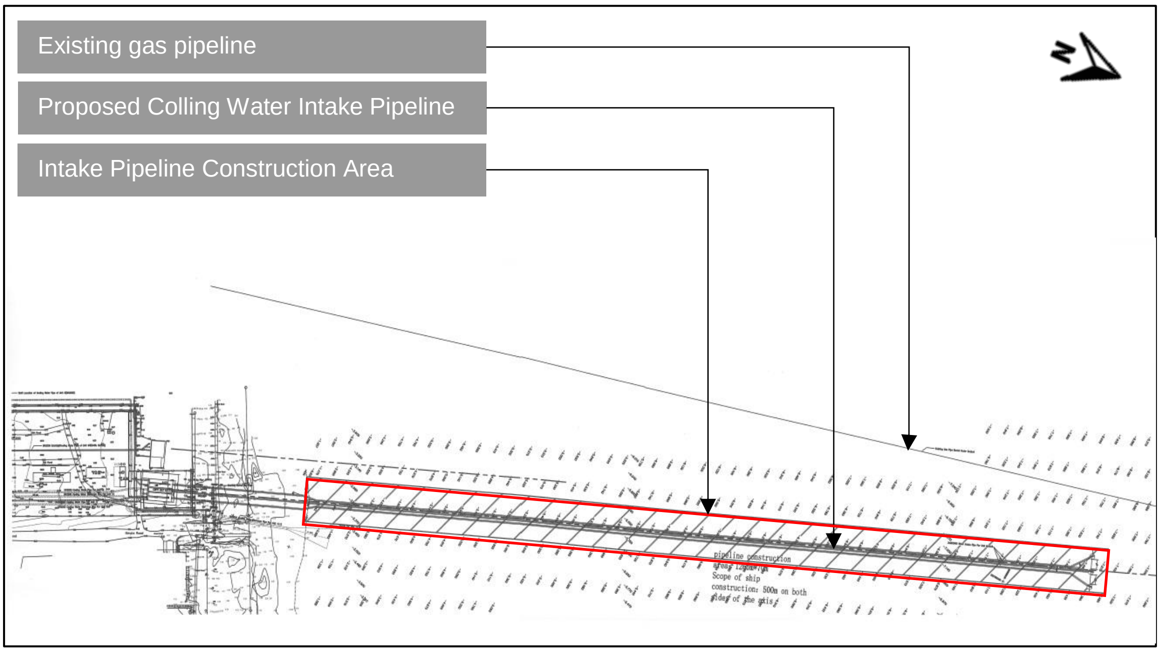


Figure 2: General layout of the proposed cooling water intake pipeline (Source: General Layout (with bathy).jpg, received on 7th February from Sinohydro)

1.4 Objective of the MTRA Study

The key objectives of the MTRA are as follows:

- Assess the level of risk to marine traffic due to the construction and operation of the proposed cooling water intake pipeline;
- Recommend measures to mitigate the identified risk.

1.5 Scope of Work

The proposed scope of work for the Marine Traffic Risk Analysis (MTRA) is as follows:

- An assessment of the cooling water intake pipeline layout and pipe laying method will be carried out taking the following factors into consideration:
  - Method of pipe laying
  - Details of pipe laying barge and support craft (if applicable)
  - Marine traffic flow, i.e. the volume and types of vessels, in the vicinity of the proposed pipeline route
  - Estimated duration of pipe laying operations and work plan
  - Seabed obstructions and pipeline / cable spans along the proposed pipeline route
  - Anchoring and fishing zones in the vicinity of the pipeline
  - Proposed pipeline protection measures
- Once the above details regarding the pipeline layout, method, etc. have been established, a risk assessment will be carried out to determine navigational risks during the construction and operational phases of the pipeline.
- Appropriate risk mitigation measures will be recommended to reduce the level of risks associated with the construction and post-construction stages, covering the following:
  - Marine traffic management plan including mobilization to site through Bintulu Port and the provision of appropriate safety measures by the contractor
  - Anchoring prohibited corridor for the pipeline route
  - Notices to Mariners and relevant authorities
- A report incorporating the above information will be produced for the purpose of obtaining necessary approvals from Bintulu Port Sdn Bhd and the Sarawak Rivers Board.

1.6 Methodology of MTRA Study

The methodology flow chart of the MTRA study is shown below:-

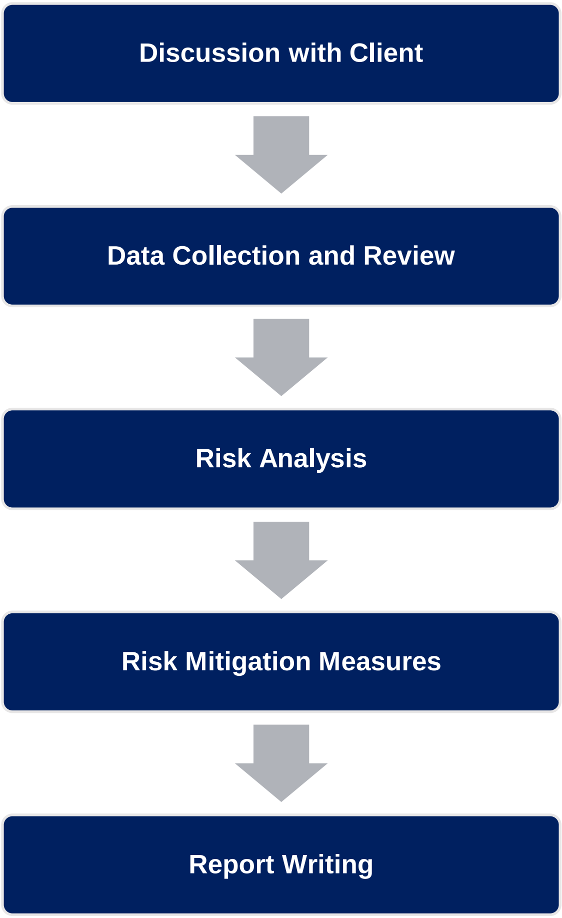


Figure 3: Study Methodology

2.0 Data Collection

2.1 Project Site

A site survey was conducted on 7th February 2018 by KASI with representative from Sinohydro to collect site data such as photographs of the project site and surrounding area.

Ariel photograph of the project site provided by the Client is shown in **Figure 4**.

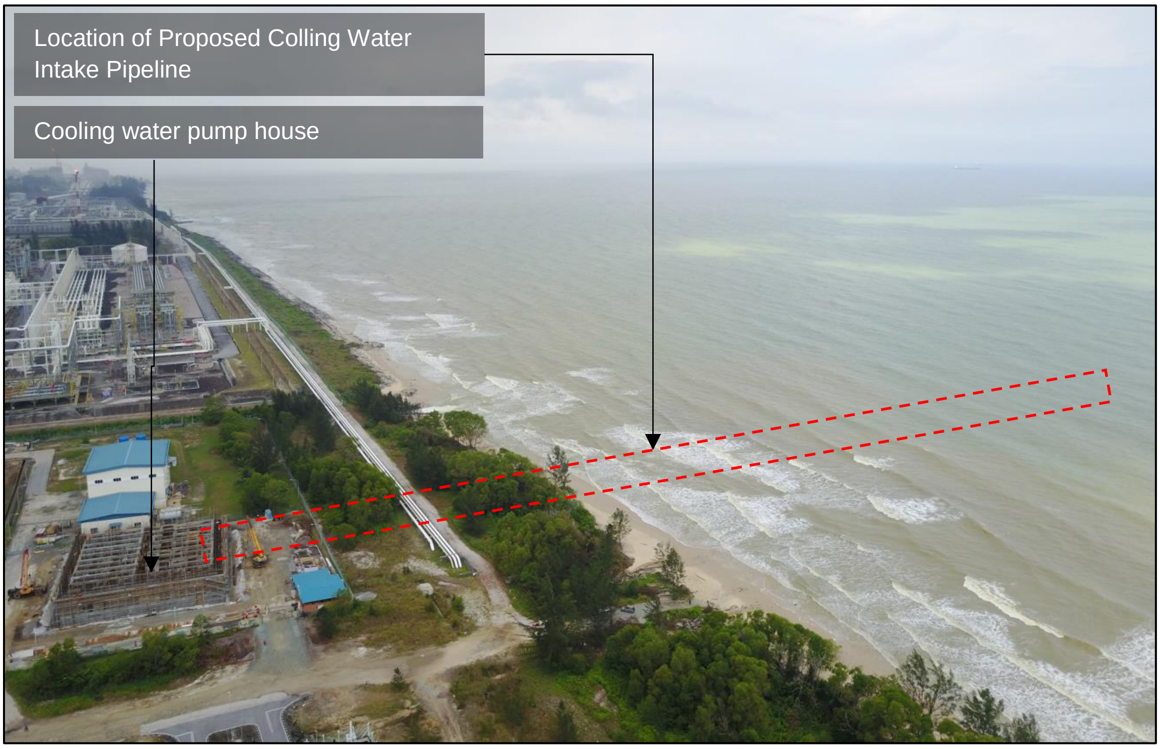


Figure 4: Ariel photograph of cooling water pump house and proposed cooling water intake pipeline (source: Sinohydro)

There are no designated fishing grounds in the vicinity of the project site. However, there are fishing vessels that may transit the project site.

2.1.1 General Layout of Cooling Water System

The cooling water system is shown in **Figure 5**. It is divided into three (3) parts namely:

- Cooling water pump house
- Cooling water intake pipeline
- Cooling water intake chamber

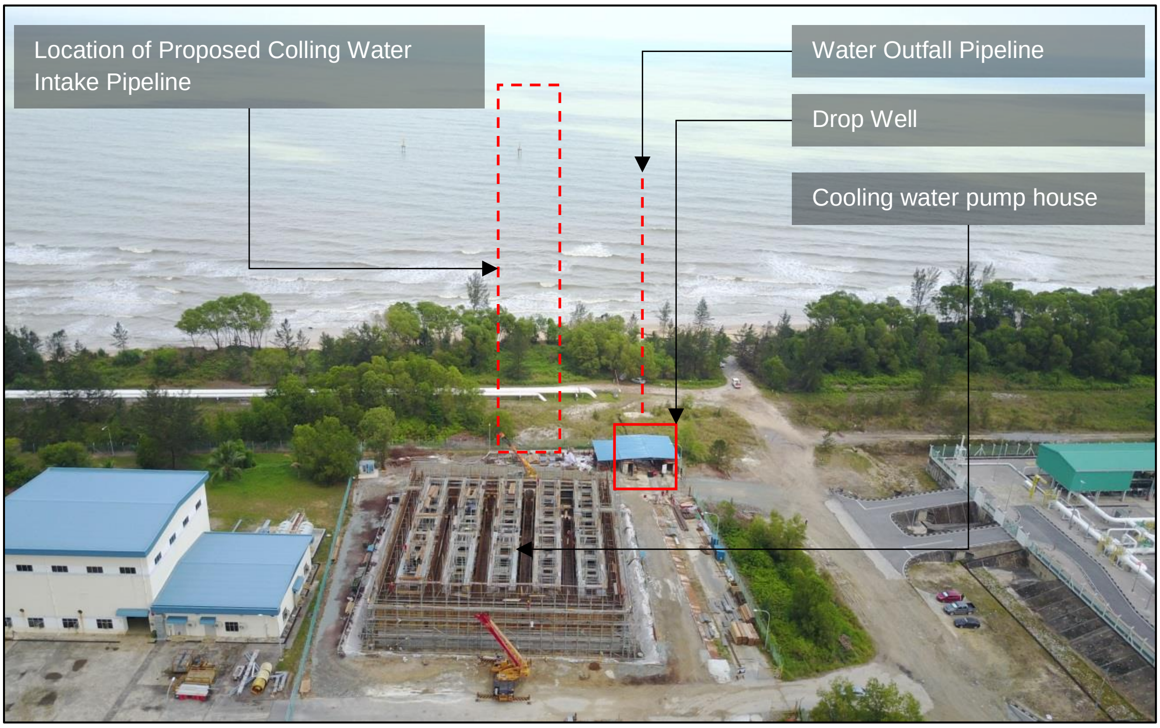


Figure 5: Location of cooling water pump house and proposed cooling water intake pipeline (source: Sinohydro)

The cooling water intake pipeline part is further divided into two (2) parts, pipe jacking part and High-Density Polyethylene (HDPE) pipeline part as shown in **Figure 6** below. The laying of the HDPE pipeline section requires excavation work, pipe laying and backfilling.

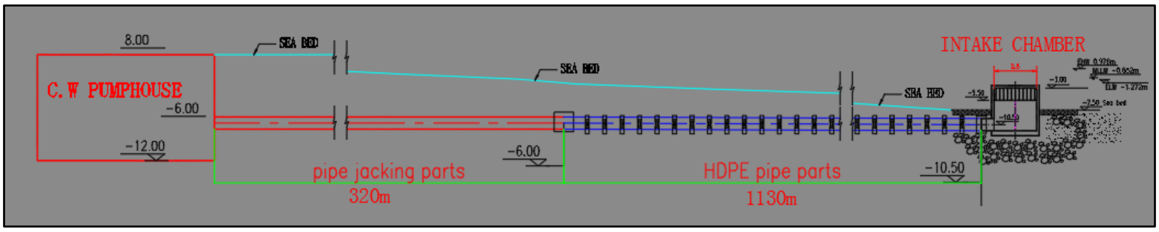


Figure 6: General layout of cooling water system (source: PowerPoint for HDPE Pipeline Transportation, Storage and Assembly received on 12th February 2018 from Sinohydro)

2.1.2 Pipe Trench Excavation

The excavation work of the pipe trench will be carried out using cutter suction dredger. The anchor boundary of the dredger provided by Client is proposed to be 500m away from the construction vessel as shown below:

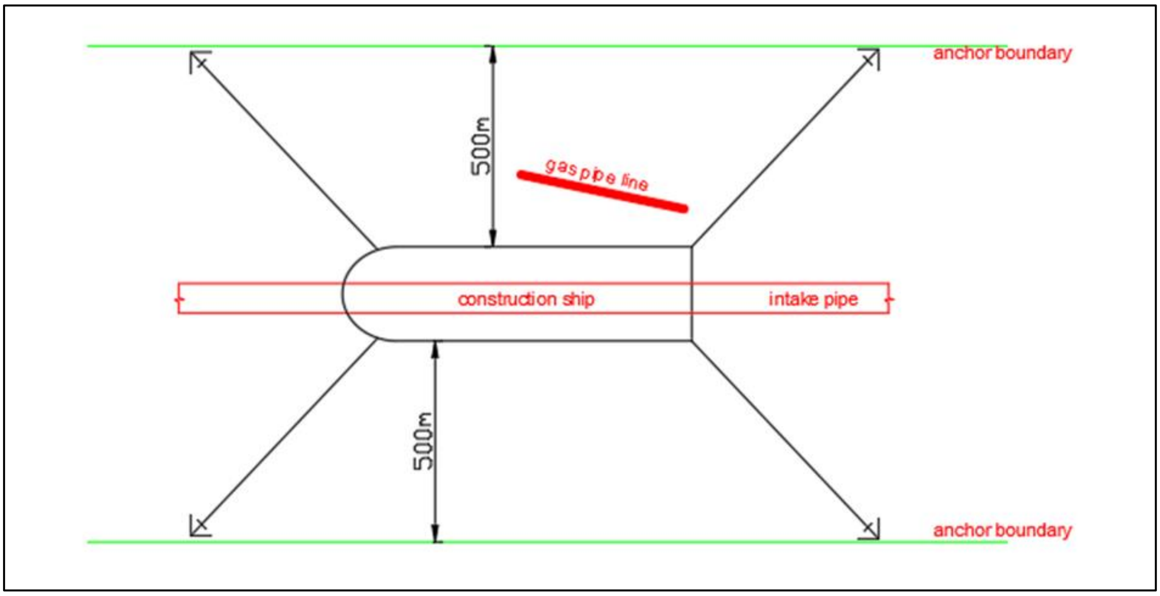


Figure 7: Proposed anchor boundary for the cutter suction dredger (source: PowerPoint for HDPE Pipeline Transportation, Storage and Assembly received on 12th February 2018 from Sinohydro)

2.1.3 Seabed Obstruction and Pipeline / Cable Spans

Based on marine chart SAR 401, there are a total of nine (9) submarine pipelines and one (1) submarine cable located in the vicinity of the project site as shown in **Figure 8** below. The nearest submarine pipeline is located approximately 95m away from the proposed cooling water intake pipeline.

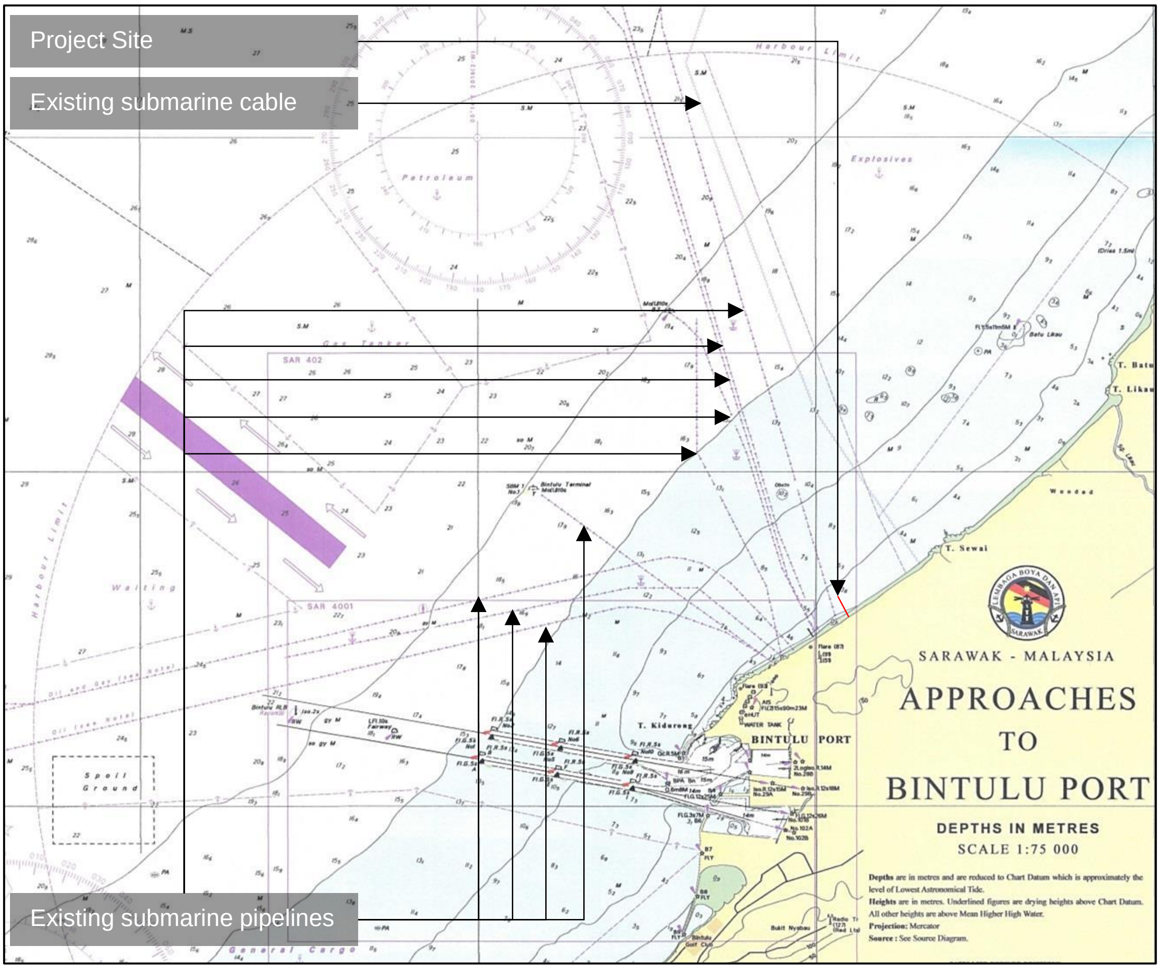


Figure 8: Existing submarine pipelines and cable in the vicinity of the project site (source: Marine Chart SAR 401, dated 30th December 2016)

2.2 Marine Traffic Flow at Bintulu Port

2.2.1 Commercial Vessel

Bintulu Port is located approximately 7km away from the project site. The berthing facilities and capacities of Bintulu Port are shown in **Table 1** below:

Berthing Facilities & Capacities	Nos.	Berth Length (m)	Depth (m)	Maximum Vessel Size (DWT)
General Cargo Wharf	3	515.4	10.5	25,000
Bulk Cargo wharf	1	270	13.5	60,000
LNG Jetty	3	-	15	80,000
LPG Jetty	1	-	11	51,000
Petrochemical Terminal	2	-	11	30,000
Shell MDS Jetty	1	-	13	40,000
Container Terminal	2	450	14	55,000
Edible Oils Terminal	2	-	14	50,000
Multipurpose Terminal	5	950	14	55,000
Single Buoy Mooring	2	-	19.5	320,000
Oil Barge Berth	1	65	7	2,000
Coastal Terminal	1	120	4.5	1,000

Table 1: Berthing facilities and capacities of Bintulu Port (Source: BPSB)

The numbers of vessel calls to Bintulu Port from year 2012 to 2016 are as shown below:

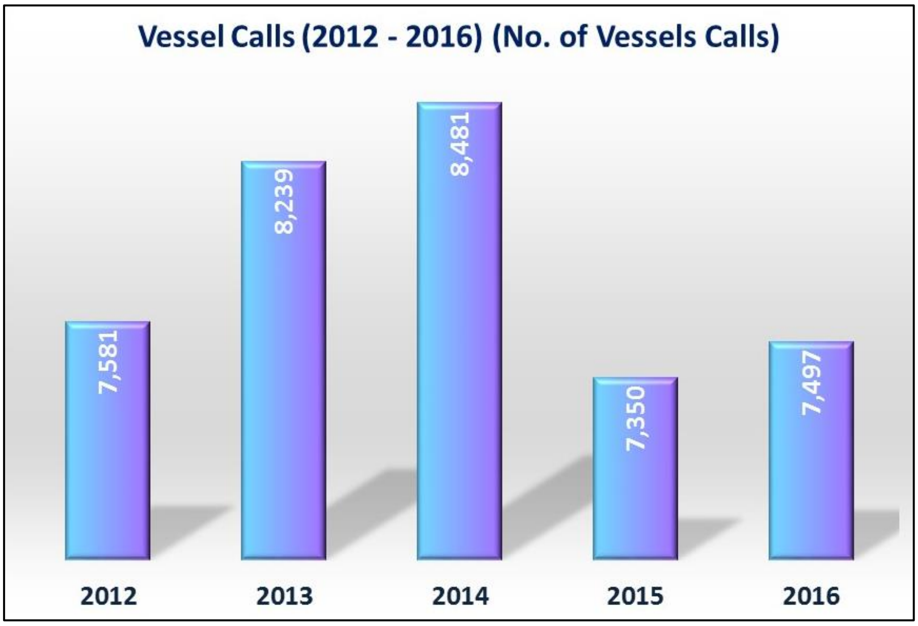


Figure 9: Number of vessel calls at Bintulu Port from year 2012 to 2016 (source: BPSB)

2.2.2 Anchorage Areas

There are five (5) designated anchorage areas within the Bintulu Port Harbour Limit. The limit of explosive anchorage area is located approximately 2km northeast from the project site. The areas with the submarine pipelines and cable are prohibited for anchoring.

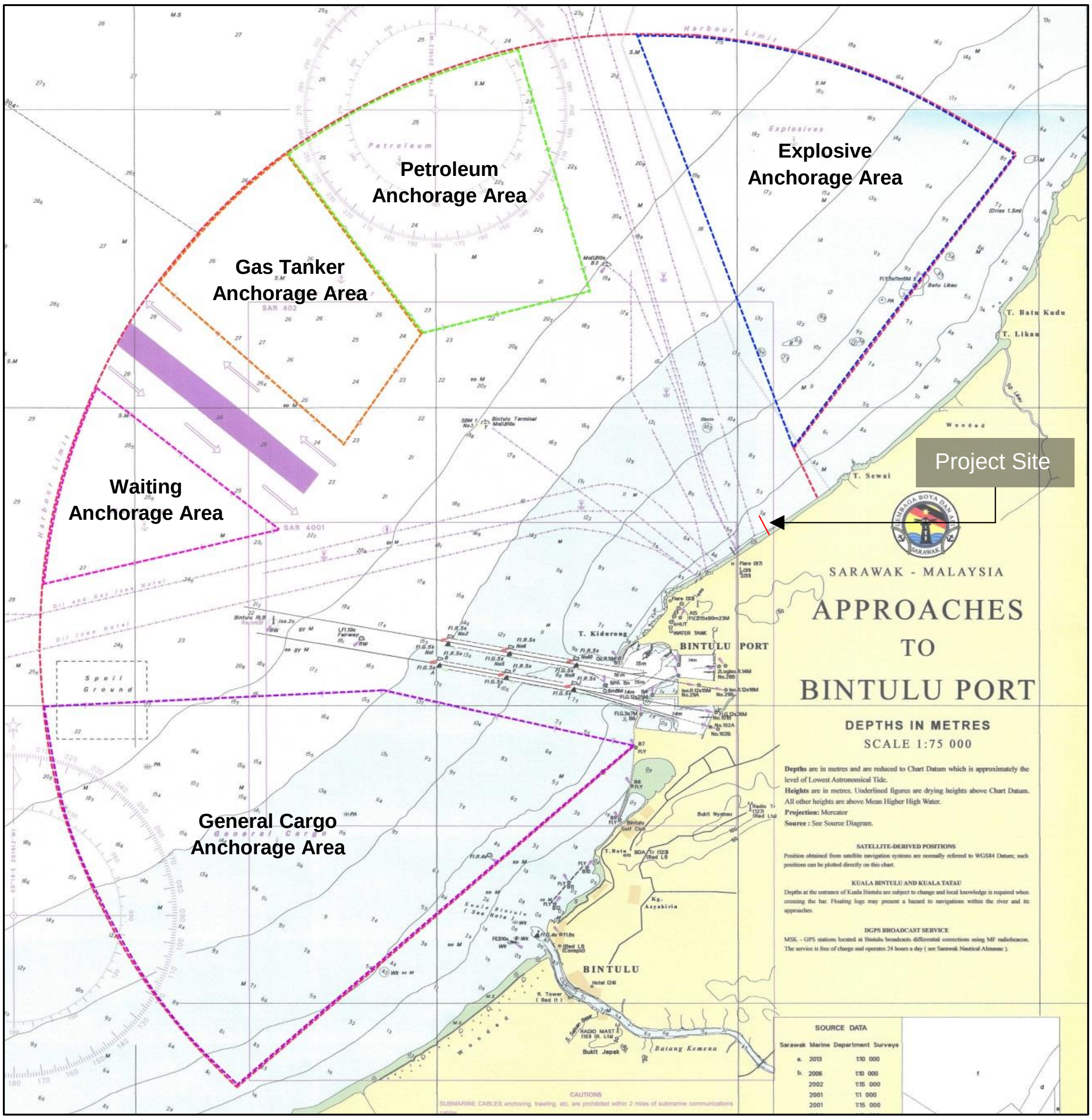


Figure 10: Anchorage areas within Bintulu Port Harbour Limit (source: Marine Chart SAR 401, dated 30th December 2016)

2.2.3 Transportation of HDPE Pipes to Bintulu Port

The HDPE pipes will be transported from Norway to the storage site at the Bintulu Port. The transportation data is expected to be during the period of 30th March 2018 to 4th August 2018.

There will be a total of six (6) pipes, three (3) pipes with 555m in length and three (3) pipes with 505m in length. The diameter of the pipes is 2.5m

2.2.4 Storage of HDPE Pipes in Bintulu Port

The pipes will be stored at a designated area in Bintulu Port as shown in **Figure 11** below. The pipes will be firmly anchored to fixed piles with nylon cables (see **Figure 12**). Warning buoys will be installed surrounding the pipes to alert other port users.

It is expected that the HDPE pipelines will be stored in Bintulu Port until July 2019.

Figure 11: Designated storage area for HDPE pipes (source: PowerPoint for HDPE Pipeline Transportation, Storage and Assembly received on 12th February 2018 from Sinohydro)

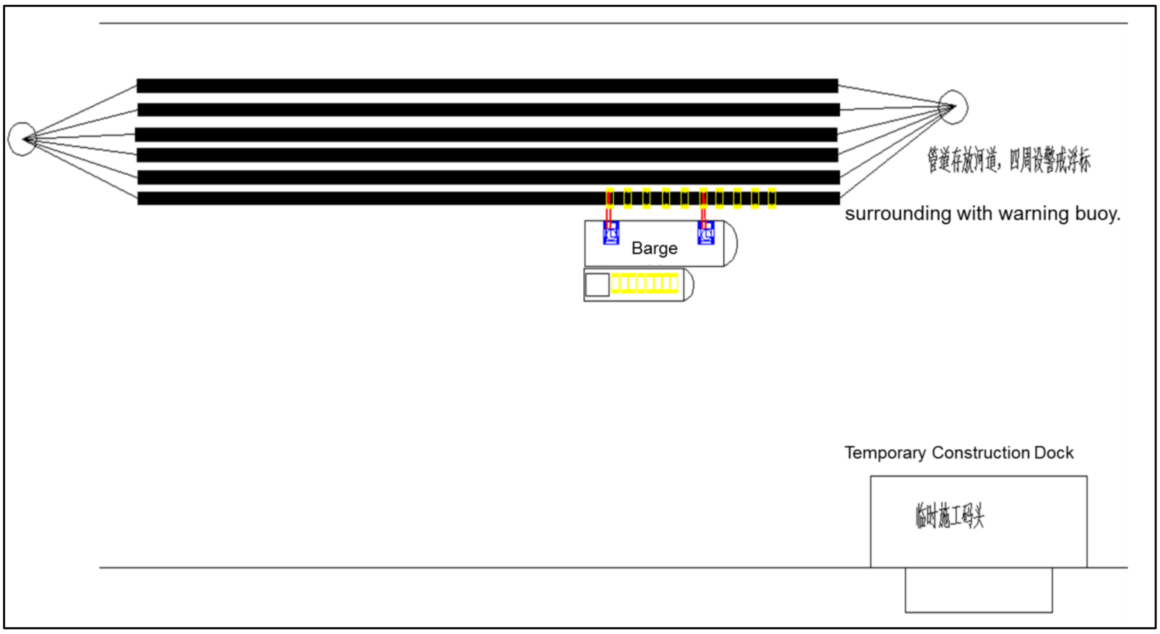


Figure 12: Securing of pipe at designated storage area (source: PowerPoint for HDPE Pipeline Transportation, Storage and Assembly received on 12th February 2018 from Sinohydro)

2.2.5 Transportation and Installation of Weight Balancing Block

The weight balancing block will be fabricated in Bintulu and is to be transferred to Bintulu Port Inner Harbour 1 by road transport from the proposed pre-casting yard. The marine traffic route for the weight balancing block between Inner Harbour 1 and Inner Harbour 2 is shown in **Figure 13** below.

Barge and tugboat will be used to transport the weight balancing block. There will be a total of 825 sets of weight balancing block and 17 barge trips are planned to transport 50 sets of weight block each time.

Figure 13: Proposed barge route for transportation of weight balancing blocks (source: PowerPoint for HDPE Pipeline Transportation, Storage and Assembly received on 12th February 2018 from Sinohydro)

2.2.6 Installation of Weight Balancing Block and Connection of HDPE Pipes

Weight balancing blocks will be installed onto the pipes as per the standards of space between each other with the help of a floating crane.

It is expected that installation of weight balancing blocks and connection of the HDPE pipes for one (1) pipeline will take about eight (8) days. The proposed location for the installation of weight balancing blocks and connection of HDPE pipes is shown in **Figure 15** below.

Figure 14: Example of installation of weight balancing block (source: PowerPoint for HDPE Pipeline Transportation, Storage and Assembly received on 12th February 2018 from Sinohydro)

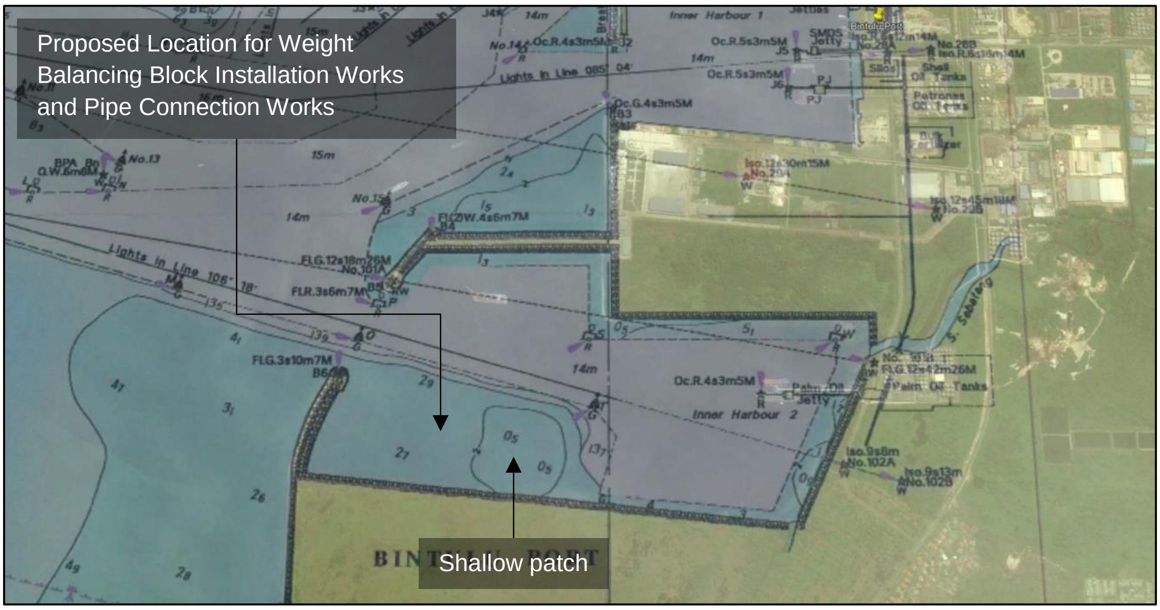


Figure 15: Proposed location for installation of weight balancing blocks and connection of pipes (source: Sinohydro)

2.2.7 Transportation of HDPE Pipelines to Project Site

The HDPE pipelines will be transported to project site after the preparatory works such as installation of weight balancing blocks, connections of the pipes, etc. has been completed. The HDPE pipelines will be towed by one (1) 300HP tugboat and two (2) 45HP mooring crafts to the project site. The tugboat is used for towing and the mooring crafts are used to control the direction and line handling.

Bintulu Port will be informed seven (7) days in advance of the HDPE pipeline transportation date in order to make announcement to other vessels. It is expected that the HDPE pipe transportation will take about eight (8) hours. There will be a total of three (3) HDPE pipelines to be transported to the project site.

The proposed transportation route for the HDPE pipelines is shown in **Figure 16** below:

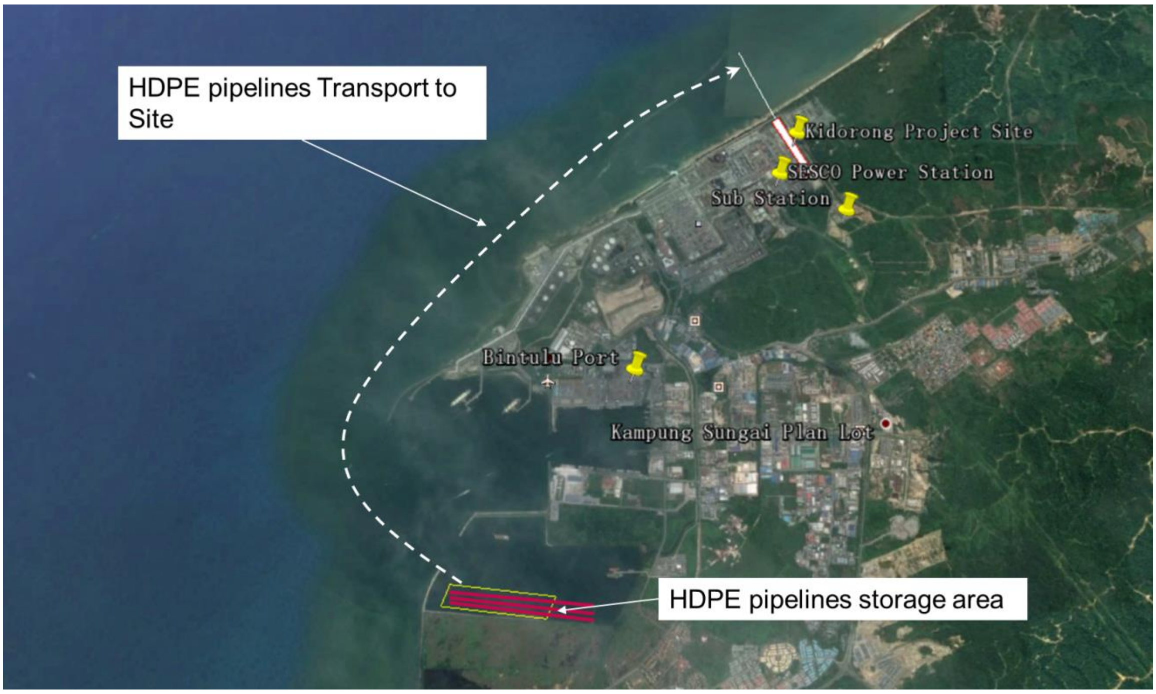


Figure 16: Proposed transportation route for HDPE pipelines transportation to the project site (source: PowerPoint for HDPE Pipeline Transportation, Storage and Assembly received on 12th February 2018 from Sinohydro)

2.3 Environmental Conditions

2.3.1 Wind

The annual wind data at Bintulu provided by Client was extracted from Jabatan Meteorology Malaysia from year 1950 to 2013. The percentage frequencies of occurrence for concurrent wind direction and speed within the specified ranges are shown in **Table 2** below.

Percentage Frequencies of Occurrence for Concurrent Wind Direction and Speed Within Specified Ranges (%)								
Direction	**Wind Speed Range (m/s)**							
	0.3 – 1.5	**1.6 – 3.3**	**3.4 – 5.4**	**5.5 – 7.9**	**8.0 – 10.7**	**>10.7**	**Total**	**Mean Speed**
Calm	-	-	-	-	-	-	17.1	-
Variable	0	0	0	0	0	0	0	-
N	2.5	2.8	1.2	0.1	0	0	6.6	2.2
NE	1.4	0.5	0.1	0	0	0	1.9	1.3
E	7.8	3.6	0.1	0	0	0	11.6	1.3
SE	10	2.7	0.1	0	0	0	12.8	1.1
S	3	0.8	0	0	0	0	3.8	1.1
SW	1.4	0.7	0.2	0	0	0	2.3	1.6
W	2	2.3	0.7	0	0	0	5.1	2.1
NW	3.1	5.1	2.1	0.1	0	0	10.4	2.3

Table 2: Occurrence of wind direction and speed at Bintulu (source: Regular Wave Height and Period.pdf, received on 7th February 2018 from Sinohydro)

The summary of the wind data is as follows:

Variables	Summary Values
Prevailing Direction	Calm
Mean Speed	1.2 m/s
Direction of Maximum Gust	80°
Maximum Gust Speed	25.6 m/s
Direction of Maximum Speed	80°
Maximum Speed	25.6 m/s

Table 3: Summary of wind data Bintulu (source: Regular Wave Height and Period.pdf, received on 7th February 2018 from Sinohydro)

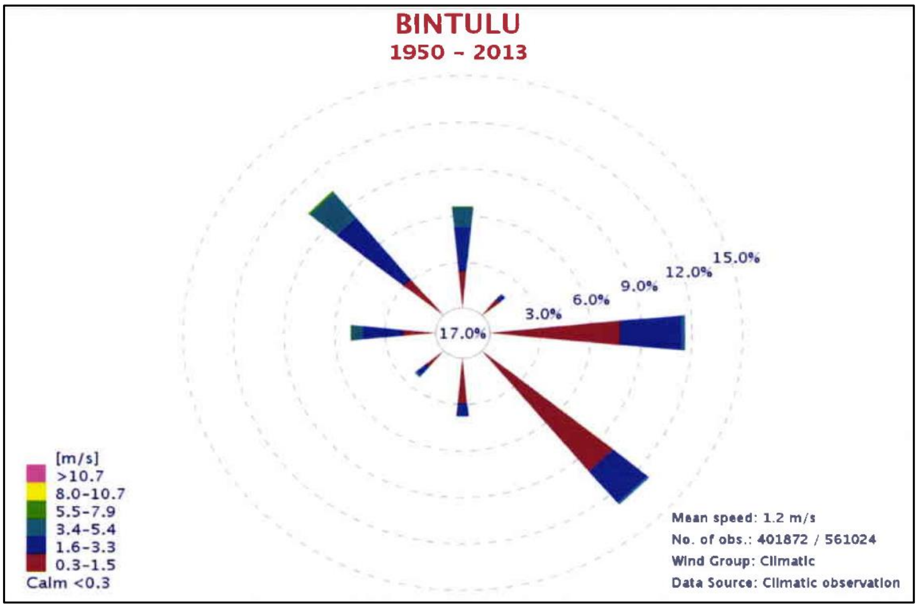


Figure 17: Annual wind rose (1953 – 2013) at Bintulu Bintulu (source: Regular Wave Height and Period.pdf, received on 7th February 2018 from Sinohydro)

2.3.2 Wave

According to the wave data provided by the Client, the maximum wave height recorded from year 2000 to 2014 is 2m.

2.4 Construction Vessels

The construction vessels expected to be involved in the excavation work of the pipe trench and transportation activities are listed below:

Vessel Name	Bonspeed Tiga	Hai Yien II	Viking 9	Global Star No. 1
Vessel Type	Barge	Barge	Tugboat	Tugboat
Length Overall (LOA), m	52.7	52.67	17.6	21.33
Beam, m	18.3	17.07	5.51	6.1
Depth, m	3.66	3.66	1.72	2.75
Engine	-	-	2 x 365 kW	2 x 294 kW
Ship Speed	-	-	9 knots at 1,800 rpm	10 knots at 1,800 rpm
Purpose	Cutter suction dredger	Transport ship	Pipe towing and other works	Pipe towing and other works

Table 4: Specifications of construction vessels (source: Sinohydro)

2.5 Construction Schedule

The planned construction schedule is shown below.

No.	Actions	Start Date	Finish Date	Duration
1	HDPE Pipes transportation	30 March 2018	4 August 2018	128 days
2	HDPE pipes delivery to storage area	4 August 2018	4 August 2018	1 day
3	HDPE pipes storage	4 August 2018	1 July 2019	331 days
4	Weight Block pre-casting	1 December 2018	30 March 2019	76 days
5	Weight Block Installation and HDPE pipelines connection	1 February 2019	30 June 2019	149 days
6	HDPE pipelines transport to site for laydown (1st Pipeline)	1 May 2019	1 May 2019	1 day
7	HDPE pipelines transport to site for laydown (2nd Pipeline)	1 June 2019	1 June 2019	1 day
8	HDPE pipelines transport to site for laydown (3rd Pipeline)	1 July 2019	1 July 2019	1 day

Table 5: Planned construction schedule (source: PowerPoint for HDPE Pipeline Transportation, Storage and Assembly received on 12th February 2018 from Sinohydro)

Dredging activities at the project site is anticipated from 2nd April 2018 to 29th September 2018.

It is to be noted that there will be no workers working in Bintulu Port during HDPE pipeline storage. Workers planned to start work in the port from 1st February 2019 to 1st July 2019.

3.0 Risk Analysis

3.1 Considerations for Desktop Review of Risks to Marine Traffic in the Region

- Construction activities at the project site will not interfere with large commercial vessel traffic but may interfere with the movement of coastal and fishing vessel traffic in the region.
- Transportation activities for weight balancing blocks will interfere with the vessel movements in Bintulu Port.
- Transportation of HDPE pipelines from Bintulu Port to project site will interfere with the vessel movements in Bintulu Port as well as vessel approach / depart the navigation channel.
- Fishing / coastal vessels will have to change their courses to transit away from the construction area.
- In the operation phase of the proposed siting of the cooling water intake pipeline, the pipeline is vulnerable to anchor damage. Anchoring is prohibited along the pipeline.
- No fishing activity can be conducted over the pipeline.

3.2 Risk Analysis using Hazard Identification (HAZID)

The risk analysis will be carried out using Hazard Identification (HAZID) method the details of which are given in **Appendix A**.

3.3 HAZID Process

The process flow of the HAZID is as follows:

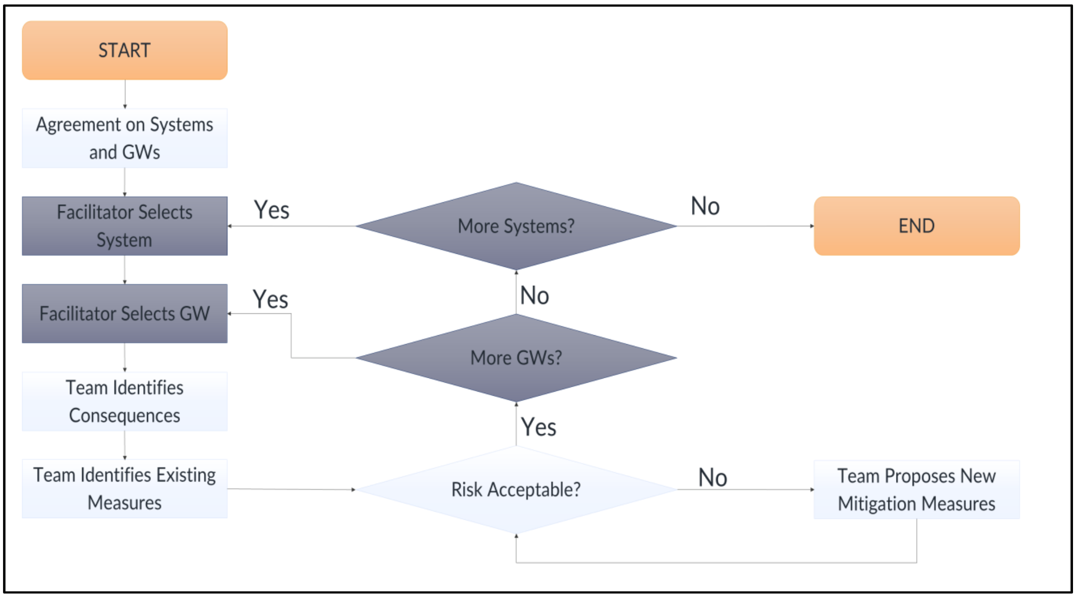


Figure 18: HAZID process flow

3.3.1 Use of a Risk Matrix

If deemed necessary by the HAZID Facilitator or Team, a risk matrix can be deployed to assist in the determination of a conclusion. KASI uses the risk matrix (**Table 8**) extracted from Revised Guidelines for Formal Safety Assessment (FSA) For Use In The IMO Rule-Making Process, published by International Maritime Organization (IMO). The risk matrix is a function of frequency of event occurrence (see **Table 6**) against the consequence of the event occurrence (see **Table 7**).

Frequency Index (FI)			
FI	**Severity**	**Definition**	**F (per ship year)**
7	Frequent	Likely to occur once per month on one ship.	10
5	Reasonably probable	Likely to occur once per year in a fleet of 10 ships, i.e. likely to occur a few times during the ship's life.	0.1
3	Remote	Likely to occur once per year in a fleet of 1,000 ships, i.e. likely to occur in the total life of several similar ships.	10^{-3}
1	Extremely remote	Likely to occur once in the lifetime (20 years) of a world fleet of 5,000 ships.	10^{-5}

Table 6: Frequency Index (FI)

Severity Index (SI)				
SI	**Severity**	**Effects of Human Safety**	**Effects on Ship**	**S (Equivalent fatalities)**
1	Minor	Single or minor injuries	Local equipment damage	0.01
2	Significant	Multiple or severe injuries	Non-severe ship damage	0.1
3	Severe	Single fatality or multiple severe injuries	Severe damage	1
4	Catastrophic	Multiple fatalities	Total loss	10

Table 7: Severity Index (SI)

Risk Index (RI)					
FI	Frequency	Severity Index (SI)			
		1	2	3	4
		Minor	Significant	Severe	Catastrophic
7	Frequent	8	9	10	11
6		7	8	9	10
5	Reasonably Probable	6	7	8	9
4		5	6	7	8
3	Remote	4	5	6	7
2		3	4	5	6
1	Extremely Remote	2	3	4	5
(red)	Intolerable				
(yellow)	As Low As Reasonably Practicable (ALARP)				
(green)	Negligible				

Table 8: Risk Matrix

3.3.2 HAZID Team

- Datuk Captain Walter J. Nair (Facilitator)
- Benjamin Nair
- Captain Bo Caspersen
- Tan Seng Leong
- Low Hui Jin

3.3.3 HAZID Workshop Results

The following list of Systems (Key Prescribed Activities, see **Appendix A**) was adopted during the workshop:

- Excavations for pipe trenches
- Transportation of HDPE pipeline weight block within Bintulu Port
- Transportation of HDPE pipeline from Bintulu Port to project site
- Installation of HDPE pipeline

The list of 'What-if' scenarios (see **Appendix A**) identified during the workshop is shown below:

- Severe weather conditions (such as Sumatra Squall)
- Collision of construction / transportation vessel with other vessels
- Communication issues/failure (language, misunderstanding etc., including failure to communicate the start of operations, emergency plan, etc.)
- Night operations / Poor visibility
- Failure of propulsion, steering or power of construction vessels
- Crew fatigue
- Inadequate emergency plan
- Lack of planning / documentation / procedure

The HAZID results (risk and mitigation measures captured) are shown below in HAZID Worksheets #1, #2, #3 and #4 for the above identified four (4) activities.

HAZID Worksheet #1

System : Excavations for pipe trenches

#	What if?	Consequences	Initial Probability / Frequency Index (FI)	Consequence / Severity Index (SI)	Initial Risk Index (RI)	*Mitigation Measures	Recommendations	Responsible	Residual Risk Index (RI)
	Guideword i.e. the failure under analysis	Description of the consequences of the possible impact of the cause				Description of the current mitigation measures in place	Description of the recommendation(s) that could be in place	Description of the responsible(s) of the recommendation(s)	
a)	Severe weather conditions	1. Delay operation 2. Increased risk of collision	5	2	7	-	1. Define weather operation thresholds 2. Check weather forecast at the start of each work day 3. Monitor weather throughout each working day and stop work if weather operation thresholds are exceeded 4. Develop and implement a contingency plan	Contractor	5
b)	Collision of construction vessels with local vessels (particularly fishing boats)	1. Damage to vessel 2. Man overboard 3. Delay of operations 4. Loss of life	1	3	4	-	1. Notice to Mariners to be issued regarding restricted navigation areas 2. Watch keeping with chaser boat patrol near the construction area 3. The construction vessel displays the navigation lights and navigation shapes, configures the VHF telephones, sets up specially-assigned persons to listen for 24 hours, and keeps an uninterrupted lookout according to the International Regulations for Preventing Collisions at Sea (COLREGS) 4. Develop and implement a contingency plan 5. Develop emergency response plans and ensure proper briefings are provided to construction crews	Contractor / Authority	3
c)	Communication issues / failure (language, misunderstanding etc., including failure to communicate the start of operations, emergency plan, etc.)	1. Delay operation 2. Injury/Accident 3. Damage to vessel 4. Man overboard	2	1	3	-	1. Use licensed crew (with adequate maritime certificates) 2. Conduct appropriate training for crews whenever new vessel crews are employed 3. Employ key personnel that able to communicate in English / Malay	Contractor	2
d)	Night operations / Poor visibility	1. Accident 2. Increased risk of collision (see "Collision") 3. Delay operation	6	1	7	1. There shall be sufficient lighting around the operation area during night construction 2. To protect safety of night navigation, construction and mooring, the ship shall be assigned with full-time safety officers	1. The construction vessel displays the navigation lights and navigation shapes, configures the VHF telephones, sets up specially-assigned persons to listen for 24 hours, and keeps an uninterrupted lookout according to the International Regulations for Preventing Collisions at Sea (COLREGS) 2. Use search lights and communication / warning signals 3. Develop proper communication procedures such as set up control centre with manned telephone system available whenever construction activities are on-going 4. Develop and implement a contingency plan 5. Increase watch keeping during construction works	Contractor	4
e)	Failure of propulsion, steering or power of construction vessel	1. Delay operation 2. Increased risk of collision (see "Collision")	2	1	3	-	1. Carry out proper maintenance 2. Develop and implement a contingency plan	Contractor	2
f)	Crew fatigue	1. Accident 2. Injury	5	2	7	-	1. Conduct appropriate training for crews whenever there are new vessel crews 2. Prepare proper manpower arrangements (i.e. shift) 3. Ensure proper first-aid availability on board construction vessels	Contractor	4
h)	Inadequate emergency plan	1. Inadequate response 2. Injury/Death 3. Damage to assets 4. Delay operation	3	4	7	-	1. Conduct emergency drills 2. Develop and implement a contingency plan	Contractor	3
i)	Lack of planning / documentation / procedure	1. Inadequate response 2. Delay operation	3	3	6	-	1. Conduct appropriate training for crews whenever new vessel crews are employed	Contractor	3

Note (*): See Client's Risk Assessment in Appendix B.

HAZID Worksheet #2

System : Transportation of HDPE pipeline weight block within Bintulu Port

#	What if?	Consequences	Initial Probability / Frequency Index (FI)	Consequence / Severity Index (SI)	Initial Risk Index (RI)	Mitigation Measures	Recommendations	Responsible	Residual Risk Index (RI)
	Guideword i.e. the failure under analysis	**Description of the consequences of the possible impact of the cause**				**Description of the current mitigation measures in place**	**Description of the recommendation(s) that could be in place**	**Description of the responsible(s) of the recommendation(s)**	
a)	Severe weather conditions	1. Delay operation	2	1	3	-	1. Follow Port Standard Operating Procedure 2. Check weather forecast prior to movement 3. Develop and implement a contingency plan	Contractor	2
b)	Collision of barges with existing traffic	1. Damage to vessel 2. Man overboard 3. Delay of operations 4. Loss of life	4	3	7	-	1. Schedule vessel movements with Marine Services of BPSB as there should be no other movements within the Port while the tow is in progress. However, it should be noted that priority will always be given to LNG vessel operations. 2. Develop and implement a contingency plan	Contractor / Port Operator	5
c)	Communication issues / failure (language, misunderstanding etc., including failure to communicate the start of operations, emergency plan, etc.)	1. Delay operation 2. Injury/Accident 3. Damage to vessel 4. Man overboard	2	3	5	-	1. Use licensed crew (with adequate maritime certificates) 2. Conduct appropriate training for crews whenever new vessel crews are employed 3. Employ key personnel that able to communicate in English / Malay	Contractor	3
d)	Night operations / Poor visibility	1. Accident 2. Increased risk of collision (see "Collision") 3. Delay operation	3	1	4	-	1. Proper communication between barge and Marine Services of BPSB 2. Develop and implement a contingency plan	Contractor	3
e)	Failure of propulsion, steering or power of tugboat	1. Delay operation 2. Increased risk of collision (see "Collision")	3	3	6	-	1. Carry out proper maintenance 2. Develop and implement a contingency plan	Contractor	5
f)	Crew fatigue	1. Accident 2. Injury	6	2	8	-	1. Conduct appropriate training for crews whenever there are new vessel crews 2. Prepare proper manpower arrangements (i.e. shift) 3. Ensure proper first-aid availability on board construction vessels	Contractor	4
h)	Inadequate emergency plan	1. Inadequate response 2. Injury/Death 3. Damage to assets 4. Delay operation	3	3	6	-	1. Conduct emergency drills 2. Develop and implement a contingency plan	Contractor	3
i)	Lack of planning / documentation / procedure	1. Inadequate response 2. Delay operation	3	3	6	-	1. Conduct appropriate training for crews whenever new vessel crews are employed	Contractor	3

HAZID Worksheet #3

System : Transportation of HDPE pipeline from Bintulu Port to project site

#	What if? Guideword i.e. the failure under analysis	Consequences Description of the consequences of the possible impact of the cause	Initial Probability / Frequency Index (FI)	Consequence / Severity Index (SI)	Initial Risk Index (RI)	Mitigation Measures Description of the current mitigation measures in place	Recommendations Description of the recommendation(s) that could be in place	Responsible Description of the responsible(s) of the recommendation(s)	Residual Risk Index (RI)
a)	Severe weather conditions	1. Delay operation	2	1	3	-	1. Follow Port Standard Operating Procedure 2. Check weather forecast prior to movement 3. Develop and implement a contingency plan	Contractor	2
b)	Collision of barges with existing traffic	1. Damage to vessel 2. Man overboard 3. Delay of operations 4. Loss of life	4	3	7	-	1. Schedule vessel movements with Marine Services of BPSB as there should be no other movements within the Port and channel while the tow is in progress. However, it should be noted that priority will always be given to LNG vessel operations. 2. Develop and implement a contingency plan	Contractor / Port Operator	5
c)	Communication issues / failure (language, misunderstanding etc., including failure to communicate the start of operations, emergency plan, etc.)	1. Delay operation 2. Injury/Accident 3. Damage to vessel 4. Man overboard	2	3	5	-	1. Use licensed crew (with adequate maritime certificates) 2. Conduct appropriate training for crews whenever new vessel crews are employed 3. Employ key personnel that able to communicate in English / Malay	Contractor	3
d)	Night operations / Poor visibility	1. Accident 2. Increased risk of collision (see "Collision") 3. Delay operation	3	1	4	-	1. Proper communication between barge and Marine Services of BPSB 2. Develop and implement a contingency plan	Contractor	3
e)	Failure of propulsion, steering or power of tugboat	1. Delay operation 2. Increased risk of collision (see "Collision")	3	3	6	-	1. Carry out proper maintenance 2. Develop and implement a contingency plan	Contractor	5
f)	Crew fatigue	1. Accident 2. Injury	6	2	8	-	1. Conduct appropriate training for crews whenever there are new vessel crews 2. Prepare proper manpower arrangements (i.e. shift) 3. Ensure proper first-aid availability on board construction vessels	Contractor	4
h)	Inadequate emergency plan	1. Inadequate response 2. Injury/Death 3. Damage to assets 4. Delay operation	3	3	6	-	1. Conduct emergency drills 2. Develop and implement a contingency plan	Contractor	3
i)	Lack of planning / documentation / procedure	1. Inadequate response 2. Delay operation	3	3	6	-	1. Conduct appropriate training for crews whenever new vessel crews are employed	Contractor	3

HAZID Worksheet #4

System : Installation of HDPE pipeline

#	What if?	Consequences	Initial Probability / Frequency Index (FI)	Consequence / Severity Index (SI)	Initial Risk Index (RI)	*Mitigation Measures	Recommendations	Responsible	Residual Risk Index (RI)
	Guideword i.e. the failure under analysis	Description of the consequences of the possible impact of the cause				Description of the current mitigation measures in place	Description of the recommendation(s) that could be in place	Description of the responsible(s) of the recommendation(s)	
a)	Severe weather conditions	1. Delay operation 2. Increased risk of collision	5	2	7	-	1. Define weather operation thresholds 2. Check weather forecast at the start of each work day 3. Monitor weather throughout each working day and stop work if weather operation thresholds are exceeded 4. Develop and implement a contingency plan	Contractor	5
b)	Collision of construction vessels with local vessels (particularly fishing boats)	1. Damage to vessel 2. Man overboard 3. Delay of operations 4. Loss of life	1	3	4	-	1. Notice to Mariners to be issued regarding restricted navigation areas 2. Watch keeping with chaser boat patrol near the construction area 3. The construction vessel displays the navigation lights and navigation shapes, configures the VHF telephones, sets up specially-assigned persons to listen for 24 hours, and keeps an uninterrupted lookout according to the International Regulations for Preventing Collisions at Sea (COLREGS) 4. Develop and implement a contingency plan 5. Develop emergency response plans and ensure proper briefings are provided to construction crews	Contractor / Authority	3
c)	Communication issues / failure (language, misunderstanding etc., including failure to communicate the start of operations, emergency plan, etc.)	1. Delay operation 2. Injury/Accident 3. Damage to vessel 4. Man overboard	2	1	3	-	1. Use licensed crew (with adequate maritime certificates) 2. Conduct appropriate training for crews whenever new vessel crews are employed 3. Employ key personnel that able to communicate in English / Malay	Contractor	2
d)	Night operations / Poor visibility	1. Accident 2. Increased risk of collision (see "Collision") 3. Delay operation	6	1	7	1. There shall be sufficient lighting around the operation area during night construction 2. To protect safety of night navigation, construction and mooring, the ship shall be assigned with full-time safety officers	1. The construction vessel displays the navigation lights and navigation shapes, configures the VHF telephones, sets up specially-assigned persons to listen for 24 hours, and keeps an uninterrupted lookout according to the International Regulations for Preventing Collisions at Sea (COLREGS) 2. Use search lights and communication / warning signals 3. Develop proper communication procedures such as set up control centre with manned telephone system available whenever construction activities are on-going 4. Develop and implement a contingency plan 5. Increase watch keeping while during construction works	Contractor	4
e)	Failure of propulsion, steering or power of construction vessel	1. Delay operation 2. Increased risk of collision (see "Collision")	2	1	3	-	1. Carry out proper maintenance 2. Develop and implement a contingency plan	Contractor	2
f)	Crew fatigue	3. Accident 4. Injury	5	2	7	-	4. Conduct appropriate training for crews whenever there are new vessel crews 5. Prepare proper manpower arrangements (i.e. shift) 6. Ensure proper first-aid availability on board construction vessels	Contractor	4
h)	Inadequate emergency plan	1. Inadequate response 2. Injury/Death 3. Damage to assets 4. Delay operation	3	4	7	-	1. Conduct emergency drills 2. Develop and implement a contingency plan	Contractor	3
i)	Lack of planning / documentation / procedure	1. Inadequate response 2. Delay operation	3	3	6	-	1. Conduct appropriate training for crews whenever new vessel crews are employed	Contractor	3

Note (*): See Client's Risk Assessment in Appendix B.

3.3.4 HAZID Workshop Findings

The identified common risks (risk level of 6 and above) for all four (4)) construction activities (excavations for pipe trenches, transportation of HDPE pipeline weight block within Bintulu Port, transportation of HDPE pipeline from Bintulu Port to project site, and installation of HDPE pipeline) are given below:

- Crew fatigue
- Inadequate emergency plan
- Lack of planning / documentation / procedure

For the Excavations for pipe trenches and installation of HDPE pipeline, an additional risk (risk level of 6 and above) was identified as given below.

- Severe weather conditions
- Night Operations/Poor Visibility

For the transportation of HDPE pipeline weight block within Bintulu Port and transportation of HDPE pipeline from Bintulu Port to project site, two (2) additional risks (risk level of 6 and above) were identified as given below.

- Collision of barges with existing traffic
- Failure of propulsion, steering or power of tugboat

Proposed risk mitigation measures arising from the HAZID Workshop are detailed in **Chapter 4.0**.

4.0 Risk Mitigation Measures

4.1 Proposed Risk Mitigation Measures for Construction Activities at Project Site

Mitigation measures for risks described in HAZID Worksheets #1 (excavations for pipe trenches) and #4 (Installation of HDPE pipeline) are categorised as shown below.

4.1.1 Construction Vessel Crew

- Use licensed crew (with adequate maritime certificates)
- Conduct appropriate training for crews whenever new vessel crews are employed
- Employ key personnel that are able to communicate in English / Malay
- Develop proper communication procedures to include set up of a control centre with manned telephone system available whenever construction activities are on-going
- Prepare manpower arrangements (i.e. shift)
- Conduct emergency drills

4.1.2 Weather Conditions

- Define weather operation thresholds
- Check weather forecast and tide tables at the start of each working day for operational planning
- Monitor weather throughout each working day and stop work if weather operation thresholds are exceeded

4.1.3 Emergency and Contingency Plans

- Develop and implement a contingency plan that includes credible Pre-Incident Plan (PIPs)
- Develop emergency response plans based on credible PIPs and ensure briefings are provided to construction crews

4.1.4 Construction Area

- Put in place watch keeping with chaser boat patrol near the construction area during construction period
- Notice to Mariners to be issued regarding restricted navigation areas

4.1.5 Construction Vessels

- The construction vessels to have in place safety measures in accordance to the International Regulations for Preventing Collisions at Sea (COLREGS) such as navigation lights and navigation shapes, configured VHF telephones, 24 hours control centre with especially-assigned persons that keeps an uninterrupted lookout on the construction activities.
- Use search lights and communication / warning signals in severe weather / poor visibility conditions
- Carry out proper maintenance
- Ensure proper first-aid availability on board construction vessels

4.2 Proposed Risk Mitigation Measures for Transportation Activities

Mitigation measures for risks described in HAZID Worksheets #2 (transportation of HDPE pipeline weight block within Bintulu Port) and #3 (transportation of HDPE pipeline from Bintulu Port to project site) are categorised as shown below.

4.2.1 Construction Vessel Crew

- Use licensed crew (with adequate maritime certificates)
- Conduct appropriate training for crews whenever new vessel crews are employed
- Employ key personnel that are able to communicate in English / Malay
- Proper communication between barge and Marine Services of BPSB
- Prepare manpower arrangements (i.e. shift)
- Conduct emergency drills

4.2.2 Weather Conditions

- Follow Port Standard Operating Procedure
- Check weather forecast prior to movements

4.2.3 Emergency and Contingency Plans

- Develop and implement a contingency plan that includes credible Pre Incident Plan (PIPs)

4.2.4 Construction Vessels for Transportation of Weight Block

- Schedule vessel movements with Marine Services of BPSB as there should be no other movements within the Port while the tow is in progress. However, it should be noted that priority will always be given to LNG vessel operations.
- Carry out proper maintenance
- Ensure proper first-aid availability on board construction vessels

4.2.5 Construction Vessels for Transportation of HDPE Pipeline

- Schedule vessel movements with Marine Services of BPSB as there should be no other movements within the Port and channel while the tow is in progress. However, it should be noted that priority will always be given to LNG vessel operations.
- Carry out proper maintenance
- Ensure proper first-aid availability on board construction vessels
- Ensure proper hand over of towed objects to site crew and to inform Marine Services of BPSB once handover is completed

4.3 Anchoring of Cutter Suction Dredger

The anchor chains of the cutter suction dredger are to be between two (2) to three (3) shackles while maintaining a distance of at least 50m away from the existing gas pipe.

4.4 Storage of HDPE Pipes in Bintulu Port

While the HDPE pipes are being stored at Inner Harbour 2, Bintulu Port, the following actions should be taken:

- Install sufficient lighting on the HDPE pipes to ensure that the pipes are visible to other port users during night and low visibility situations.
- Ensure the anchor piles are sufficient to keep the HDPE pipes in place securely during storage.
- Perform daily checks on the anchor piles and report to BPSB.
- Ensure that there is a standby support tug at all time in case the HDPE pipes need to be repositioned quickly.

4.5 Installation Works of Weight Balancing Blocks and Connection Works for HDPE Pipes

The above activity should not encroach into the adjacent navigation channel or manoeuvring basin of the Bintulu Port Inner Harbour 2 so as to cause hindrance to marine traffic and should be conducted in compliance with the requirements of Bintulu Port Authority (BPA) and Bintulu Port Sdn Bhd (BPSB) at all times.

4.6 Proposed Marine Traffic Management Plan

The proposed marine traffic management plan for the construction vessels for transportation of weight block and HDPE pipeline is as follows:

1. Schedule vessel movements with Marine Services of as there should be no other movements within the Port and / or channel while the tow is in progress.
2. Vessels to display appropriate navigation lights and navigation shapes as well as configure VHF telephones.
3. Maintain uninterrupted communication with Marine Services of BPSB during transportation period.

4.7 Proposed Marine Tower Beacons for Intake Pipeline

The Client has included a proposal for a pair of marine tower beacons to mark the extremity of the cooling water intake pipeline as shown in **Figure 19**. The proposed locations and specifications of the marine tower beacons are subject to the approval from Marine Department Sarawak.

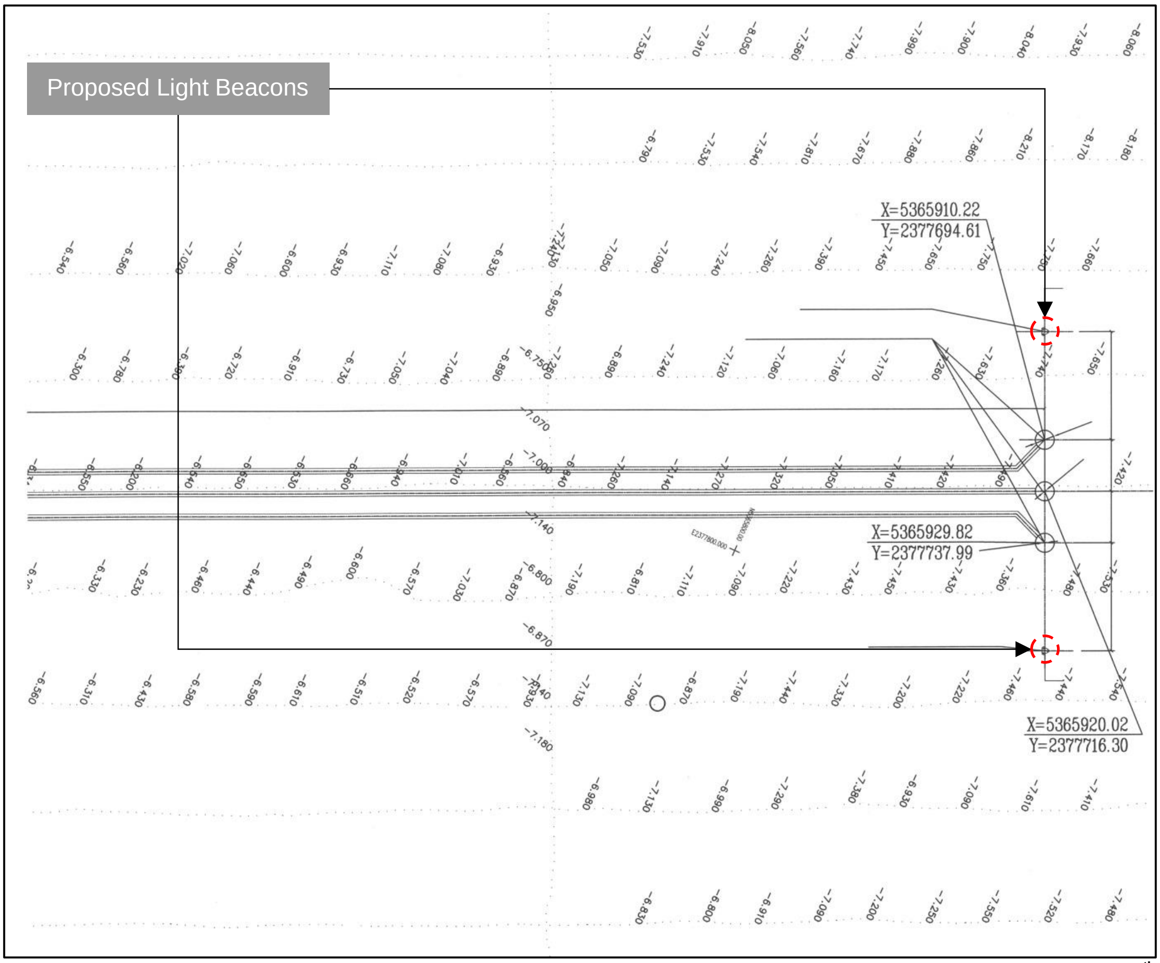


Figure 19: Proposed locations of light beacon provided by Client (source: Dwg no. FA08271S-, received on 8th March 2018 from Sinohydro)

4.8 Proposed Anchoring Prohibited Corridor for Intake Pipeline

A ‘no-anchoring’ zone should be setup, restricting the dropping of anchor 50m on either side of the intake pipeline.

5.0 Conclusion

The objective of the MTRA is to assess the level of risk to marine traffic due to the construction and operation of the proposed cooling water intake pipeline.

The MTRA looked at four (4) main construction activities namely excavation for pipe trenches at the project site, transportation of HDPE pipeline weight blocks within the Bintulu Port, transportation of HDPE pipeline from Bintulu Port to the project site and installation of HDPE pipeline at the project site.

The identified common risks for all four (4) construction activities are crew fatigue, inadequate emergency plan and lack of planning / documentation / procedure.

For the excavation for pipe trenches and installation of HDPE pipeline, additional risks identified are severe weather conditions and night operations / poor visibility.

The transportation of HDPE pipeline weight blocks within Bintulu Port and transportation of HDPE pipeline from the Bintulu Port to project site, two (2) additional risks are identified namely collision of barges with existing traffic and failure of propulsion, steering or power of tugboat.

Mitigation measures have been identified for the risks discussed above including reference to the International Regulation for Preventing Collisions at Sea (COLREGS).

The anchor chains of the cutter suction dredger are to be between two (2) to three (3) shackles while maintaining a distance of at least 50m away from the existing gas pipe.

Installation works of weight balancing blocks and connection works for HDPE pipes should not encroach into the adjacent navigation channel or manoeuvring basin of the Bintulu Port Inner Harbour 2 so as to cause hindrance to marine traffic and should be conducted in compliance with the requirements of Bintulu Port Authority and Bintulu Port Sdn Bhd at all times.

The MTRA concludes that the identified risks associated with the construction and operation of the proposed cooling water intake pipeline for the 400MW Combined Cycle Gas Turbine (CCGT) power plant at Tanjung Kidurong, Bintulu can be safely managed, subject to compliance with the mitigation measures identified in this report.

-END OF DOCUMENT-

Appendix A

Methodology of Risk Assessment

1.0 Methodology of Risk Assessment

1.1 Identification of Systems

There is no fixed rule to define a System. Ideally, a System should be as small as possible, to provide a more accurate assessment of each component, but this will result in a lot of repetition and can take too much time. However, if a system is too large, it will make the whole HAZID less accurate.

In order to meet the objectives of the MRA, each System was defined as a construction stage that will be performed during the Process.

1.2 Identification of Guide Words (GWs)

GWs are, in general, failure, miss-operations, human error or external events that could happen during the Process. These are keys to properly assessing the likely deviations from the normal state of operations.

In the first stage of the workshop, the team was encouraged to raise 'What-if' questions to jointly identify and evaluate what might go wrong in the envisaged System. The associated hazards of the 'What-if' scenarios were discussed at a later stage of the workshop.

1.3 Discussion of Identified Systems and Hazards

<u>Identification of Potential Failure Events</u>

After the Team agreed on the list of Systems and GWs / 'What-if' scenarios, as shown in Capter, the HAZID Facilitator selected a System to be discussed and will then run through the list of GWs, discussing with the team if that GW is applicable to that System and if it is, further discuss the potential consequences of such an event.

In shorter terms, the HAZID Facilitator will ask the Team "What happens if **GW** happens during this **System**?"

<u>Consequence Analysis</u>

The Team then identified and evaluated each hazard to determine the potential consequences, taking into account:

- Impact on personnel (safety issues)
- Impact on operation

At this stage, the consequences are assessed not considering the existing mitigation measures in place.

Analysis of Existing Mitigation Measures

Once the 'baseline' consequences have been identified, the Team will then assess existing mitigation measures in place to prevent the event from occurring or to reduce the consequences if the event does happen.

Mitigation measures are defined as devices, procedures or other means that can prevent or mitigate the consequences of a failure event. These measures must be fully independent from the potential 'failure event'.

Acceptability of Risk

At this stage, the Team will define whether the discussed failure event / risk is **acceptable** or **not acceptable**.

In order to facilitate the process, the Team is asked to choose from three possible conclusions:

i. The System is adequately protected against this failure event;

ii. The System is not adequately protected against this failure event;

iii. A final conclusion cannot be drawn, deeper analysis is necessary.

In Case (i), the HAZID Facilitator will move to the next GW or System.

In Case (ii), the Team will discuss the modification of existing measures or the addition of new mitigation measures.

In Case (iii) or in a situation of Case (ii) where additional measures cannot be determined, the HAZID Facilitator will make a note that a dedicated study will have to be conducted to address that particular 'failure event'.

Appendix B

Risk Assessment of Cooling Water Intake Pipeline by Sinohydro

Risk Assessment of Cooling Water Intake Pipeline by Sinohydro

Maritime operation risk analysis has been carried out according to information provided by Client. A total of 13 risks have been identified and the proposed preventive measures are proposed as follows:

No.	Item	Possible Damages	Evitable Or Not	Preventive Measures
1	Ship operation and departure from berth	Mooring rope breakage (severe wear or uneven stress) due to fault in mooring coordination; personal injuries due to standing in mooring rope circle or striding over mooring rope	Yes	1. Wear working clothes, safety helmet and protective gloves tidily. 2. During mooring, the operator shall keep a safe distance from the drum, operate at a safe location and follow the commands. 3. During mooring operation, ensure close fore-aft coordination and timely adjust the rope stress.
2	Collision avoidance between ships	Passing-by ships failing to avoid the anchor rope of the working ship; damage to ship equipment	Yes	1. During construction, deck watchmen shall pay attention to the movement of surrounding ships, to prevent the anchor rope of the working ship from being interfered by propellers of passing-by ships or approaching auxiliary vessels.
3	Dredge operation	Mechanical collision; personal injuries	Yes	1. During dredge equipment operation, nobody shall stand within its operating radius; the driver operating the grab must give a signal prior to starting up the dredge.
4	Ship navigation under bad visibility	Ship collision and grounding due to lack of observation in heavy fog, stormy conditions	Yes	1. Ship driver shall learn and master relevant marine navigation rules, correctly understand and grasp the requirements in combination of the ship features. 2. The captain and the driver shall fully understand the water depth, weather, tide, navigation marks, obstacles and other characteristics of the navigation area. 3. In case of bad visibility, the driver shall immediately take measures such as reducing speed, intensifying the observation and stopping the sailing, and report it to the captain.
5	Ship navigation or construction at night	Collision or formation of an urgent situation due to failure to distinguish buildings from sailing ships as a result of influence by background light at night	Yes	1. There shall be sufficient lighting around the operation area during night construction. 2. To protect safety of night navigation, construction and mooring, the ship shall be assigned with full-time safety officers.
6	Ship navigation in stormy waves or defence against typhoons	Ship getting out of control or water entering the ship due to violent storms and waves as well as bad condition of watertight facilities	Yes	1. Carry out inspections before a windstorm to ensure water tightness and smooth drainage of the ship, and take fixing and ballasting measures for emergency preparedness. 2. During sailing in violent storms and waves, it is required to take different operation measures according to the ship type, stability and draft, sea area and other specific situations, so as to reduce the ship roll and mitigate the wave impact till the sea restores calm. Alternatively, take positive measures to sail away from the stormy sea area.
7	Ship mooring operation	Ship dragging and collision due to influence by water flow, water depth and geological tide	Yes	1. Carry out mooring properly to avoid dragging. 2. For typhoon resistance, the means of mooring shall be reported to the management department

8	Operation in enclosed ship cabin	Operator asphyxia, poisoning or explosion and fire disaster due to lack of oxygen or existence of carbon monoxide and explosive mixed gases in the cabin	Yes	1. Prior to operation, it is required to measure the concentration of oxygen in the operating ambient air, and entering the workplace is allowed only when the oxygen content is higher than 18% and the carbon dioxide content is not higher than 2%. Operators shall be provided with safety education. 2. Personnel entering the oxygen-deficient workplace to rescue people must wear isolation-type respirators and carry out rescuing with the cooperation of special persons. 3. Seal off the place and post up signs at its entrance to avoid entering by mistake.
9	Loading and unloading of ship fuel oil and lubricating oil	Fire disaster, explosion and environmental pollution caused by flammable and explosive substances	Yes	1. The supplier and the receiver are responsible for pollution prevention and fire protection of oil supply facilities or ships as well as personal safety during the operation. 2. During oil reception, guarantee proper anti-pollution measures for ships to avoid fire disasters and personal accidents.
10	Ship lifting operation	Failure to fasten the safety belt, object falling from a high altitude	Yes	1. During derrick or machine maintenance, it is required to stop the ship and hang the “No Starting” sign; the operation site shall be under supervision by specially-assigned personnel. 2. Operators at heights shall wear helmets and corresponding labor protection equipment, recheck and confirm the rigidity and availability of such equipment, keep concentrated, fasten the safety belt and wear no leather gloves during operation.
11	Crew’s life	Smoking, electric shock, fire disaster	Yes	1. No smoking in the cabin. 2. Appliance switches, lighting, ventilation and heating equipment in the cabin shall be kept in good condition, and attention shall be paid to loose electric plugs and hot electric wires. 3. Prohibit the use of high-power electrical appliances.
12	Outboard operation	Falling into water and drowning failure to wear the life jacket	Yes	1. Always wear the life jacket correctly during outboard operation. 2. No outboard operation while sailing.
13	Diver’s operation	Underwater harm due to insufficient air supply and delayed communication between underwater and overwater personnel	Yes	1. Before underwater operation, the diver shall carefully check and confirm the safety performance and intactness of diving equipment. 2. The diver must follow the diving rules and prevent the diving equipment from being broken by obstacles during underwater operation. 3. During underwater operation, the diver shall keep in touch with the overwater correspondent. In case of failure of the contact phone, the signal rope. In case of failure of both the phone and the signal rope, the diver can use the air supply pipe for contact and shall get out of water immediately. 4. For underwater installation, the diver can enter the operation point only after the to-be-installed object is put in place and completely motionless. The overwater operator can be informed of lifting up the hook only after the diver unfastens the hook and leaves the operation area.

Appendix 5.6.1

Consequence Modelling Result

Pool Fire Small

Ref	Scenarios	Fatality Probability	Weather Condition 1F	Weather Condition 3C	Weather Condition 5D
			Downwind Distance	Downwind Distance	Downwind Distance
2	IS02_DO_GTB2_L_PF_S_1	1.00	Not reachable	Not reachable	Not reachable
	IS02_DO_GTB2_L_PF_S_0.5	0.50	26.54	26.60	26.96
	IS02_DO_GTB2_L_PF_S_0.03	0.03	52.87	63.58	68.21
14	IS14_DO_PIPEFOT5GTB1_L_PF_S_1	1.00	Not reachable	Not reachable	Not reachable
	IS14_DO_PIPEFOT5GTB1_L_PF_S_0.5	0.50	21.86	23.64	24.43
	IS14_DO_PIPEFOT5GTB1_L_PF_S_0.03	0.03	46.00	55.79	59.85
15	IS15_DO_PIPEFOT5GTB2_L_PF_S_1	1.00	Not reachable	Not reachable	Not reachable
	IS15_DO_PIPEFOT5GTB2_L_PF_S_0.5	0.50	24.35	25.09	25.59
	IS15_DO_PIPEFOT5GTB2_L_PF_S_0.03	0.03	49.50	59.86	64.30
16	IS16_DO_PIPEFOT6GTB1_L_PF_S_1	1.00	Not reachable	Not reachable	Not reachable
	IS16_DO_PIPEFOT6GTB1_L_PF_S_0.5	0.50	21.43	23.46	24.27
	IS16_DO_PIPEFOT6GTB1_L_PF_S_0.03	0.03	45.42	55.06	59.03
17	IS17_DO_PIPEFOT6GTB2_L_PF_S_1	1.00	Not reachable	Not reachable	Not reachable
	IS17_DO_PIPEFOT6GTB2_L_PF_S_0.5	0.50	24.04	24.86	25.46
	IS17_DO_PIPEFOT6GTB2_L_PF_S_0.03	0.03	49.03	59.35	63.75

Pool Fire Medium

Ref	Scenarios	Fatality Probability	Weather Condition 1F	Weather Condition 3C	Weather Condition 5D
			Downwind Distance	Downwind Distance	Downwind Distance
2	IS02_DO_GTB2_L_PF_M_1	1.00	Not reachable	Not reachable	Not reachable
	IS02_DO_GTB2_L_PF_M_0.5	0.50	76.84	74.50	73.16
	IS02_DO_GTB2_L_PF_M_0.03	0.03	134.70	155.00	166.00
14	IS14_DO_PIPEFOT5GTB1_L_PF_M_1	1.00	Not reachable	Not reachable	Not reachable
	IS14_DO_PIPEFOT5GTB1_L_PF_M_0.5	0.50	24.36	26.18	27.02
	IS14_DO_PIPEFOT5GTB1_L_PF_M_0.03	0.03	48.59	58.94	63.62
15	IS15_DO_PIPEFOT5GTB2_L_PF_M_1	1.00	Not reachable	Not reachable	Not reachable
	IS15_DO_PIPEFOT5GTB2_L_PF_M_0.5	0.50	27.01	27.92	28.71
	IS15_DO_PIPEFOT5GTB2_L_PF_M_0.03	0.03	52.37	63.77	69.12
16	IS16_DO_PIPEFOT6GTB1_L_PF_M_1	1.00	Not reachable	Not reachable	Not reachable
	IS16_DO_PIPEFOT6GTB1_L_PF_M_0.5	0.50	23.89	25.88	26.66
	IS16_DO_PIPEFOT6GTB1_L_PF_M_0.03	0.03	47.97	58.14	62.64
17	IS17_DO_PIPEFOT6GTB2_L_PF_M_1	1.00	Not reachable	Not reachable	Not reachable
	IS17_DO_PIPEFOT6GTB2_L_PF_M_0.5	0.50	26.67	27.66	28.41
	IS17_DO_PIPEFOT6GTB2_L_PF_M_0.03	0.03	51.86	63.11	68.42

Pool Fire Catastrophic

Ref	Scenarios	Fatality Probability	Weather Condition 1F	Weather Condition 3C	Weather Condition 5D
			Downwind Distance	Downwind Distance	Downwind Distance
2	IS02_DO_GTB2_L_PF_C_1	1.00	Not reachable	Not reachable	Not reachable
	IS02_DO_GTB2_L_PF_C_0.5	0.50	157.30	157.80	158.20
	IS02_DO_GTB2_L_PF_C_0.03	0.03	255.50	294.00	319.30
14	IS14_DO_PIPEFOT5GTB1_L_PF_C_1	1.00	Not reachable	Not reachable	Not reachable
	IS14_DO_PIPEFOT5GTB1_L_PF_C_0.5	0.50	17.21	18.79	19.76
	IS14_DO_PIPEFOT5GTB1_L_PF_C_0.03	0.03	41.49	51.84	56.71
15	IS15_DO_PIPEFOT5GTB2_L_PF_C_1	1.00	Not reachable	Not reachable	Not reachable
	IS15_DO_PIPEFOT5GTB2_L_PF_C_0.5	0.50	20.01	21.82	23.08
	IS15_DO_PIPEFOT5GTB2_L_PF_C_0.03	0.03	45.45	57.87	63.94
16	IS16_DO_PIPEFOT6GTB1_L_PF_C_1	1.00	Not reachable	Not reachable	Not reachable
	IS16_DO_PIPEFOT6GTB1_L_PF_C_0.5	0.50	16.74	18.58	19.47
	IS16_DO_PIPEFOT6GTB1_L_PF_C_0.03	0.03	40.86	50.99	55.71
17	IS17_DO_PIPEFOT6GTB2_L_PF_C_1	1.00	Not reachable	Not reachable	Not reachable
	IS17_DO_PIPEFOT6GTB2_L_PF_C_0.5	0.50	19.67	21.57	22.93
	IS17_DO_PIPEFOT6GTB2_L_PF_C_0.03	0.03	44.93	57.22	63.22

Jet Fire Small

Ref	Scenarios	Fatality Probability	Weather Condition 1F	Weather Condition 3C	Weather Condition 5D
			Downwind Distance	Downwind Distance	Downwind Distance
1	IS01_NG_GTB2_V_JF_S_1	1.00	Not reachable	Not reachable	Not reachable
	IS01_NG_GTB2_V_JF_S_0.5	0.50	11.20	11.04	10.88
	IS01_NG_GTB2_V_JF_S_0.03	0.03	13.07	12.87	12.66
2	IS02_DO_GTB2_L_JF_S_1	1.00	7.17	5.90	4.92
	IS02_DO_GTB2_L_JF_S_0.5	0.50	7.64	6.89	6.52
	IS02_DO_GTB2_L_JF_S_0.03	0.03	9.46	8.66	8.25
3	IS03_NG_MSB1_V_JF_S_1	1.00	11.55	11.46	11.28
	IS03_NG_MSB1_V_JF_S_0.5	0.50	14.54	14.46	14.36
	IS03_NG_MSB1_V_JF_S_0.03	0.03	16.94	16.74	16.51
4	IS04_NG_MSB2_V_JF_S_1	1.00	11.55	11.46	11.28
	IS04_NG_MSB2_V_JF_S_0.5	0.50	14.54	14.46	14.36
	IS04_NG_MSB2_V_JF_S_0.03	0.03	16.94	16.74	16.51
5	IS05_NG_GCB1_V_JF_S_1	1.00	Not reachable	Not reachable	Not reachable
	IS05_NG_GCB1_V_JF_S_0.5	0.50	8.53	8.42	8.34
	IS05_NG_GCB1_V_JF_S_0.03	0.03	10.25	10.08	9.90
6	IS06_NG_GCB2_V_JF_S_1	1.00	Not reachable	Not reachable	Not reachable
	IS06_NG_GCB2_V_JF_S_0.5	0.50	8.53	8.42	8.34
	IS06_NG_GCB2_V_JF_S_0.03	0.03	10.25	10.08	9.90
7	IS07_NG_PIPEBLGRS_V_JF_S_1	1.00	14.94	14.99	15.03
	IS07_NG_PIPEBLGRS_V_JF_S_0.5	0.50	18.08	18.01	17.93
	IS07_NG_PIPEBLGRS_V_JF_S_0.03	0.03	21.04	20.81	20.57
8	IS08_NG_PIPEBLGRSB1_V_JF_S_1	1.00	14.94	14.99	15.03
	IS08_NG_PIPEBLGRSB1_V_JF_S_0.5	0.50	18.08	18.01	17.93
	IS08_NG_PIPEBLGRSB1_V_JF_S_0.03	0.03	21.04	20.81	20.57
9	IS09_NG_PIPEBLGRSB2_V_JF_S_1	1.00	14.94	14.99	15.03
	IS09_NG_PIPEBLGRSB2_V_JF_S_0.5	0.50	18.08	18.01	17.93
	IS09_NG_PIPEBLGRSB2_V_JF_S_0.03	0.03	21.04	20.81	20.57
10	IS10_NG_PIPEGRSFGRSB1_V_JF_S_1	1.00	14.94	14.99	15.03
	IS10_NG_PIPEGRSFGRSB1_V_JF_S_0.5	0.50	18.08	18.01	17.93
	IS10_NG_PIPEGRSFGRSB1_V_JF_S_0.03	0.03	21.04	20.81	20.57
11	IS11_NG_PIPEGRSFGRSB2_V_JF_S_1	1.00	14.94	14.99	15.03
	IS11_NG_PIPEGRSFGRSB2_V_JF_S_0.5	0.50	18.08	18.01	17.93
	IS11_NG_PIPEGRSFGRSB2_V_JF_S_0.03	0.03	21.04	20.81	20.57
12	IS12_NG_PIPEFGRSHRSGB1_V_JF_S_1	1.00	14.94	14.99	15.03
	IS12_NG_PIPEFGRSHRSGB1_V_JF_S_0.5	0.50	18.08	18.01	17.93
	IS12_NG_PIPEFGRSHRSGB1_V_JF_S_0.03	0.03	21.04	20.81	20.57
13	IS13_NG_PIPEFGRSHRSGB2_V_JF_S_1	1.00	14.94	14.99	15.03
	IS13_NG_PIPEFGRSHRSGB2_V_JF_S_0.5	0.50	18.08	18.01	17.93
	IS13_NG_PIPEFGRSHRSGB2_V_JF_S_0.03	0.03	21.04	20.81	20.57
14	IS14_DO_PIPEFOT5GTB1_L_JF_S_1	1.00	7.47	6.14	5.24

Ref	Scenarios	Fatality Probability	Weather Condition 1F	Weather Condition 3C	Weather Condition 5D
			Downwind Distance	Downwind Distance	Downwind Distance
	IS14_DO_PIPEFOT5GTB1_L_JF_S_0.5	0.50	8.02	7.24	6.88
	IS14_DO_PIPEFOT5GTB1_L_JF_S_0.03	0.03	9.93	9.10	8.68
15	IS15_DO_PIPEFOT5GTB2_L_JF_S_1	1.00	7.47	6.14	5.24
	IS15_DO_PIPEFOT5GTB2_L_JF_S_0.5	0.50	8.02	7.24	6.88
	IS15_DO_PIPEFOT5GTB2_L_JF_S_0.03	0.03	9.93	9.10	8.68
16	IS16_DO_PIPEFOT6GTB1_L_JF_S_1	1.00	7.47	6.14	5.24
	IS16_DO_PIPEFOT6GTB1_L_JF_S_0.5	0.50	8.02	7.24	6.88
	IS16_DO_PIPEFOT6GTB1_L_JF_S_0.03	0.03	9.93	9.10	8.68
17	IS17_DO_PIPEFOT6GTB2_L_JF_S_1	1.00	7.47	6.14	5.24
	IS17_DO_PIPEFOT6GTB2_L_JF_S_0.5	0.50	8.02	7.24	6.88
	IS17_DO_PIPEFOT6GTB2_L_JF_S_0.03	0.03	9.93	9.10	8.68

Jet Fire Medium

Ref	Scenarios	Fatality Probability	Weather Condition 1F	Weather Condition 3C	Weather Condition 5D
			Downwind Distance	Downwind Distance	Downwind Distance
1	IS01_NG_GTB2_V_JF_M_1	1.00	31.50	32.29	32.93
	IS01_NG_GTB2_V_JF_M_0.5	0.50	38.89	39.15	39.38
	IS01_NG_GTB2_V_JF_M_0.03	0.03	46.42	46.31	46.18
2	IS02_DO_GTB2_L_JF_M_1	1.00	14.86	12.61	12.29
	IS02_DO_GTB2_L_JF_M_0.5	0.50	17.81	16.44	15.91
	IS02_DO_GTB2_L_JF_M_0.03	0.03	22.04	20.72	20.16
3	IS03_NG_MSB1_V_JF_M_1	1.00	38.54	39.79	41.16
	IS03_NG_MSB1_V_JF_M_0.5	0.50	48.66	49.28	49.87
	IS03_NG_MSB1_V_JF_M_0.03	0.03	58.90	58.98	59.03
4	IS04_NG_MSB2_V_JF_M_1	1.00	38.54	39.79	41.16
	IS04_NG_MSB2_V_JF_M_0.5	0.50	48.66	49.28	49.87
	IS04_NG_MSB2_V_JF_M_0.03	0.03	58.90	58.98	59.03
5	IS05_NG_GCB1_V_JF_M_1	1.00	25.05	25.50	25.95
	IS05_NG_GCB1_V_JF_M_0.5	0.50	30.98	31.21	31.43
	IS05_NG_GCB1_V_JF_M_0.03	0.03	36.79	36.72	36.62
6	IS06_NG_GCB2_V_JF_M_1	1.00	25.05	25.50	25.95
	IS06_NG_GCB2_V_JF_M_0.5	0.50	30.98	31.21	31.43
	IS06_NG_GCB2_V_JF_M_0.03	0.03	36.79	36.72	36.62
7	IS07_NG_PIPEBLGRS_V_JF_M_1	1.00	47.08	48.76	50.26
	IS07_NG_PIPEBLGRS_V_JF_M_0.5	0.50	59.35	60.05	60.72
	IS07_NG_PIPEBLGRS_V_JF_M_0.03	0.03	72.21	72.28	72.31
8	IS08_NG_PIPEBLGRSB1_V_JF_M_1	1.00	47.08	48.76	50.26
	IS08_NG_PIPEBLGRSB1_V_JF_M_0.5	0.50	59.35	60.05	60.72
	IS08_NG_PIPEBLGRSB1_V_JF_M_0.03	0.03	72.21	72.28	72.31
9	IS09_NG_PIPEBLGRSB2_V_JF_M_1	1.00	47.08	48.76	50.26
	IS09_NG_PIPEBLGRSB2_V_JF_M_0.5	0.50	59.35	60.05	60.72
	IS09_NG_PIPEBLGRSB2_V_JF_M_0.03	0.03	72.21	72.28	72.31
10	IS10_NG_PIPEGRSFGRSB1_V_JF_M_1	1.00	47.08	48.76	50.26
	IS10_NG_PIPEGRSFGRSB1_V_JF_M_0.5	0.50	59.35	60.05	60.72
	IS10_NG_PIPEGRSFGRSB1_V_JF_M_0.03	0.03	72.21	72.28	72.31
11	IS11_NG_PIPEGRSFGRSB2_V_JF_M_1	1.00	47.08	48.76	50.26
	IS11_NG_PIPEGRSFGRSB2_V_JF_M_0.5	0.50	59.35	60.05	60.72
	IS11_NG_PIPEGRSFGRSB2_V_JF_M_0.03	0.03	72.21	72.28	72.31
12	IS12_NG_PIPEFGRSHRSGB1_V_JF_M_1	1.00	47.08	48.76	50.26
	IS12_NG_PIPEFGRSHRSGB1_V_JF_M_0.5	0.50	59.35	60.05	60.72
	IS12_NG_PIPEFGRSHRSGB1_V_JF_M_0.03	0.03	72.21	72.28	72.31
13	IS13_NG_PIPEFGRSHRSGB2_V_JF_M_1	1.00	47.08	48.76	50.26
	IS13_NG_PIPEFGRSHRSGB2_V_JF_M_0.5	0.50	59.35	60.05	60.72
	IS13_NG_PIPEFGRSHRSGB2_V_JF_M_0.03	0.03	72.21	72.28	72.31
14	IS14_DO_PIPEFOT5GTB1_L_JF_M_1	1.00	15.51	13.23	12.86
	IS14_DO_PIPEFOT5GTB1_L_JF_M_0.5	0.50	18.71	17.24	16.65
	IS14_DO_PIPEFOT5GTB1_L_JF_M_0.03	0.03	23.14	21.74	21.11

Ref	Scenarios	Fatality Probability	Weather Condition 1F	Weather Condition 3C	Weather Condition 5D
			Downwind Distance	Downwind Distance	Downwind Distance
15	IS15_DO_PIPEFOT5GTB2_L_JF_M_1	1.00	15.51	13.23	12.86
	IS15_DO_PIPEFOT5GTB2_L_JF_M_0.5	0.50	18.71	17.24	16.65
	IS15_DO_PIPEFOT5GTB2_L_JF_M_0.03	0.03	23.14	21.74	21.11
16	IS16_DO_PIPEFOT6GTB1_L_JF_M_1	1.00	15.51	13.23	12.86
	IS16_DO_PIPEFOT6GTB1_L_JF_M_0.5	0.50	18.71	17.24	16.65
	IS16_DO_PIPEFOT6GTB1_L_JF_M_0.03	0.03	23.14	21.74	21.11
17	IS17_DO_PIPEFOT6GTB2_L_JF_M_1	1.00	15.51	13.23	12.86
	IS17_DO_PIPEFOT6GTB2_L_JF_M_0.5	0.50	18.71	17.24	16.65
	IS17_DO_PIPEFOT6GTB2_L_JF_M_0.03	0.03	23.14	21.74	21.11

Jet Fire Catastrophic

Ref	Scenarios	Fatality Probability	Weather Condition 1F	Weather Condition 3C	Weather Condition 5D
			Downwind Distance	Downwind Distance	Downwind Distance
1	IS01_NG_GTB2_V_JF_C_1	1.00	Not reachable	Not reachable	Not reachable
	IS01_NG_GTB2_V_JF_C_0.5	0.50	Not reachable	Not reachable	Not reachable
	IS01_NG_GTB2_V_JF_C_0.03	0.03	Not reachable	Not reachable	Not reachable
2	IS02_DO_GTB2_L_JF_C_1	1.00	Not reachable	Not reachable	Not reachable
	IS02_DO_GTB2_L_JF_C_0.5	0.50	Not reachable	Not reachable	Not reachable
	IS02_DO_GTB2_L_JF_C_0.03	0.03	Not reachable	Not reachable	Not reachable
3	IS03_NG_MSB1_V_JF_C_1	1.00	Not reachable	Not reachable	Not reachable
	IS03_NG_MSB1_V_JF_C_0.5	0.50	Not reachable	Not reachable	Not reachable
	IS03_NG_MSB1_V_JF_C_0.03	0.03	Not reachable	Not reachable	Not reachable
4	IS04_NG_MSB2_V_JF_C_1	1.00	Not reachable	Not reachable	Not reachable
	IS04_NG_MSB2_V_JF_C_0.5	0.50	Not reachable	Not reachable	Not reachable
	IS04_NG_MSB2_V_JF_C_0.03	0.03	Not reachable	Not reachable	Not reachable
5	IS05_NG_GCB1_V_JF_C_1	1.00	Not reachable	Not reachable	Not reachable
	IS05_NG_GCB1_V_JF_C_0.5	0.50	Not reachable	Not reachable	Not reachable
	IS05_NG_GCB1_V_JF_C_0.03	0.03	Not reachable	Not reachable	Not reachable
6	IS06_NG_GCB2_V_JF_C_1	1.00	Not reachable	Not reachable	Not reachable
	IS06_NG_GCB2_V_JF_C_0.5	0.50	Not reachable	Not reachable	Not reachable
	IS06_NG_GCB2_V_JF_C_0.03	0.03	Not reachable	Not reachable	Not reachable
7	IS07_NG_PIPEBLGRS_V_JF_C_1	1.00	Not reachable	Not reachable	Not reachable
	IS07_NG_PIPEBLGRS_V_JF_C_0.5	0.50	Not reachable	Not reachable	Not reachable
	IS07_NG_PIPEBLGRS_V_JF_C_0.03	0.03	Not reachable	Not reachable	Not reachable
8	IS08_NG_PIPEBLGRSB1_V_JF_C_1	1.00	Not reachable	Not reachable	Not reachable
	IS08_NG_PIPEBLGRSB1_V_JF_C_0.5	0.50	Not reachable	Not reachable	Not reachable
	IS08_NG_PIPEBLGRSB1_V_JF_C_0.03	0.03	Not reachable	Not reachable	Not reachable

Ref	Scenarios	Fatality Probability	Weather Condition 1F	Weather Condition 3C	Weather Condition 5D
			Downwind Distance	Downwind Distance	Downwind Distance
9	IS09_NG_PIPEBLGRSB2_V_JF_C_1	1.00	Not reachable	Not reachable	Not reachable
	IS09_NG_PIPEBLGRSB2_V_JF_C_0.5	0.50	Not reachable	Not reachable	Not reachable
	IS09_NG_PIPEBLGRSB2_V_JF_C_0.03	0.03	Not reachable	Not reachable	Not reachable
10	IS10_NG_PIPEGRSFGRSB1_V_JF_C_1	1.00	Not reachable	Not reachable	Not reachable
	IS10_NG_PIPEGRSFGRSB1_V_JF_C_0.5	0.50	Not reachable	Not reachable	Not reachable
	IS10_NG_PIPEGRSFGRSB1_V_JF_C_0.03	0.03	Not reachable	Not reachable	Not reachable
11	IS11_NG_PIPEGRSFGRSB2_V_JF_C_1	1.00	Not reachable	Not reachable	Not reachable
	IS11_NG_PIPEGRSFGRSB2_V_JF_C_0.5	0.50	Not reachable	Not reachable	Not reachable
	IS11_NG_PIPEGRSFGRSB2_V_JF_C_0.03	0.03	Not reachable	Not reachable	Not reachable
12	IS12_NG_PIPEFGRSHRSGB1_V_JF_C_1	1.00	Not reachable	Not reachable	Not reachable
	IS12_NG_PIPEFGRSHRSGB1_V_JF_C_0.5	0.50	Not reachable	Not reachable	Not reachable
	IS12_NG_PIPEFGRSHRSGB1_V_JF_C_0.03	0.03	Not reachable	Not reachable	Not reachable
13	IS13_NG_PIPEFGRSHRSGB2_V_JF_C_1	1.00	Not reachable	Not reachable	Not reachable
	IS13_NG_PIPEFGRSHRSGB2_V_JF_C_0.5	0.50	Not reachable	Not reachable	Not reachable
	IS13_NG_PIPEFGRSHRSGB2_V_JF_C_0.03	0.03	Not reachable	Not reachable	Not reachable
14	IS14_DO_PIPEFOT5GTB1_L_JF_C_1	1.00	Not reachable	Not reachable	Not reachable
	IS14_DO_PIPEFOT5GTB1_L_JF_C_0.5	0.50	Not reachable	Not reachable	Not reachable
	IS14_DO_PIPEFOT5GTB1_L_JF_C_0.03	0.03	Not reachable	Not reachable	Not reachable
15	IS15_DO_PIPEFOT5GTB2_L_JF_C_1	1.00	Not reachable	Not reachable	Not reachable
	IS15_DO_PIPEFOT5GTB2_L_JF_C_0.5	0.50	Not reachable	Not reachable	Not reachable
	IS15_DO_PIPEFOT5GTB2_L_JF_C_0.03	0.03	Not reachable	Not reachable	Not reachable
16	IS16_DO_PIPEFOT6GTB1_L_JF_C_1	1.00	Not reachable	Not reachable	Not reachable
	IS16_DO_PIPEFOT6GTB1_L_JF_C_0.5	0.50	Not reachable	Not reachable	Not reachable
	IS16_DO_PIPEFOT6GTB1_L_JF_C_0.03	0.03	Not reachable	Not reachable	Not reachable
17	IS17_DO_PIPEFOT6GTB2_L_JF_C_1	1.00	Not reachable	Not reachable	Not reachable

Ref	Scenarios	Fatality Probability	Weather Condition 1F	Weather Condition 3C	Weather Condition 5D
			Downwind Distance	Downwind Distance	Downwind Distance
	IS17_DO_PIPEFOT6GTB2_L_JF_C_0.5	0.50	Not reachable	Not reachable	Not reachable
	IS17_DO_PIPEFOT6GTB2_L_JF_C_0.03	0.03	Not reachable	Not reachable	Not reachable

Flash Fire Small

Ref	Scenarios	Fatality Probability	Weather Condition 1F	Weather Condition 3C	Weather Condition 5D
			Downwind Distance	Downwind Distance	Downwind Distance
1	IS01_NG_GTB2_V_FF_S_LFL	LFL	Not reachable	Not reachable	Not reachable
	IS01_NG_GTB2_V_FF_S_1/2 LFL	½ LFL	Not reachable	Not reachable	Not reachable
3	IS03_NG_MSB1_V_FF_S_LFL	LFL	Not reachable	Not reachable	Not reachable
	IS03_NG_MSB1_V_FF_S_1/2 LFL	½ LFL	Not reachable	Not reachable	Not reachable
4	IS04_NG_MSB2_V_FF_S_LFL	LFL	Not reachable	Not reachable	Not reachable
	IS04_NG_MSB2_V_FF_S_1/2 LFL	½ LFL	Not reachable	Not reachable	Not reachable
5	IS05_NG_GCB1_V_FF_S_LFL	LFL	Not reachable	Not reachable	Not reachable
	IS05_NG_GCB1_V_FF_S_1/2 LFL	½ LFL	Not reachable	Not reachable	Not reachable
6	IS06_NG_GCB2_V_FF_S_LFL	LFL	Not reachable	Not reachable	Not reachable
	IS06_NG_GCB2_V_FF_S_1/2 LFL	½ LFL	Not reachable	Not reachable	Not reachable
7	IS07_NG_PIPEBLGRS_V_FF_S_LFL	LFL	Not reachable	Not reachable	Not reachable
	IS07_NG_PIPEBLGRS_V_FF_S_1/2 LFL	½ LFL	Not reachable	Not reachable	Not reachable
8	IS08_NG_PIPEBLGRSB1_V_FF_S_LFL	LFL	Not reachable	Not reachable	Not reachable
	IS08_NG_PIPEBLGRSB1_V_FF_S_1/2 LFL	½ LFL	Not reachable	Not reachable	Not reachable
9	IS09_NG_PIPEBLGRSB2_V_FF_S_LFL	LFL	Not reachable	Not reachable	Not reachable
	IS09_NG_PIPEBLGRSB2_V_FF_S_1/2 LFL	½ LFL	Not reachable	Not reachable	Not reachable
10	IS10_NG_PIPEGRSFGRSB1_V_FF_S_LFL	LFL	Not reachable	Not reachable	Not reachable
	IS10_NG_PIPEGRSFGRSB1_V_FF_S_1/2 LFL	½ LFL	Not reachable	Not reachable	Not reachable
11	IS11_NG_PIPEGRSFGRSB2_V_FF_S_LFL	LFL	Not reachable	Not reachable	Not reachable
	IS11_NG_PIPEGRSFGRSB2_V_FF_S_1/2 LFL	½ LFL	Not reachable	Not reachable	Not reachable
12	IS12_NG_PIPEFGRSHRSGB1_V_FF_S_LFL	LFL	Not reachable	Not reachable	Not reachable
	IS12_NG_PIPEFGRSHRSGB1_V_FF_S_1/2 LFL	½ LFL	Not reachable	Not reachable	Not reachable
13	IS13_NG_PIPEFGRSHRSGB2_V_FF_S_LFL	LFL	Not reachable	Not reachable	Not reachable
	IS13_NG_PIPEFGRSHRSGB2_V_FF_S_1/2 LFL	½ LFL	Not reachable	Not reachable	Not reachable

Flash Fire Medium

Ref	Scenarios	Fatality Probability	Weather Condition 1F	Weather Condition 3C	Weather Condition 5D
			Downwind Distance	Downwind Distance	Downwind Distance
1	IS01_NG_GTB2_V_FF_M_LFL	LFL	20.25	16.75	16.58
	IS01_NG_GTB2_V_FF_M_1/2 LFL	1/2 LFL	20.25	16.75	16.58
3	IS03_NG_MSB1_V_FF_M_LFL	LFL	24.05	29.33	29.53
	IS03_NG_MSB1_V_FF_M_1/2 LFL	1/2 LFL	24.05	29.33	29.53
4	IS04_NG_MSB2_V_FF_M_LFL	LFL	24.05	29.33	29.53
	IS04_NG_MSB2_V_FF_M_1/2 LFL	1/2 LFL	24.05	29.33	29.53
5	IS05_NG_GCB1_V_FF_M_LFL	LFL	Not reachable	Not reachable	Not reachable
	IS05_NG_GCB1_V_FF_M_1/2 LFL	1/2 LFL	Not reachable	Not reachable	Not reachable
6	IS06_NG_GCB2_V_FF_M_LFL	LFL	Not reachable	Not reachable	Not reachable
	IS06_NG_GCB2_V_FF_M_1/2 LFL	1/2 LFL	Not reachable	Not reachable	Not reachable
7	IS07_NG_PIPEBLGRS_V_FF_M_LFL	LFL	30.16	39.15	39.41
	IS07_NG_PIPEBLGRS_V_FF_M_1/2 LFL	1/2 LFL	30.16	39.15	39.41
8	IS08_NG_PIPEBLGRSB1_V_FF_M_LFL	LFL	36.49	39.33	40.19
	IS08_NG_PIPEBLGRSB1_V_FF_M_1/2 LFL	1/2 LFL	36.49	39.33	40.19
9	IS09_NG_PIPEBLGRSB2_V_FF_M_LFL	LFL	39.46	39.33	40.19
	IS09_NG_PIPEBLGRSB2_V_FF_M_1/2 LFL	1/2 LFL	39.46	39.33	40.19
10	IS10_NG_PIPEGRSFGRSB1_V_FF_M_LFL	LFL	41.11	39.33	40.19
	IS10_NG_PIPEGRSFGRSB1_V_FF_M_1/2 LFL	1/2 LFL	41.11	39.33	40.19
11	IS11_NG_PIPEGRSFGRSB2_V_FF_M_LFL	LFL	41.11	39.33	40.19
	IS11_NG_PIPEGRSFGRSB2_V_FF_M_1/2 LFL	1/2 LFL	41.11	39.33	40.19
12	IS12_NG_PIPEFGRSHRSGB1_V_FF_M_LFL	LFL	40.85	39.33	40.19
	IS12_NG_PIPEFGRSHRSGB1_V_FF_M_1/2 LFL	1/2 LFL	40.85	39.33	40.19
13	IS13_NG_PIPEFGRSHRSGB2_V_FF_M_LFL	LFL	38.61	39.33	40.19
	IS13_NG_PIPEFGRSHRSGB2_V_FF_M_1/2 LFL	1/2 LFL	38.61	39.33	40.19

Flash Fire Catastrophic

Ref	Scenarios	Fatality Probability	Weather Condition 1F	Weather Condition 3C	Weather Condition 5D
			Downwind Distance	Downwind Distance	Downwind Distance
1	IS01_NG_GTB2_V_FF_C_LFL	LFL	32.92	33.45	34.83
	IS01_NG_GTB2_V_FF_C_1/2 LFL	1/2 LFL	32.92	33.45	34.83
3	IS03_NG_MSB1_V_FF_C_LFL	LFL	4.23	4.29	4.42
	IS03_NG_MSB1_V_FF_C_1/2 LFL	1/2 LFL	4.23	4.29	4.42
4	IS04_NG_MSB2_V_FF_C_LFL	LFL	4.23	4.29	4.42
	IS04_NG_MSB2_V_FF_C_1/2 LFL	1/2 LFL	4.23	4.29	4.42
5	IS05_NG_GCB1_V_FF_C_LFL	LFL	10.87	11.08	11.48
	IS05_NG_GCB1_V_FF_C_1/2 LFL	1/2 LFL	10.87	11.08	11.48
6	IS06_NG_GCB2_V_FF_C_LFL	LFL	10.87	11.08	11.48
	IS06_NG_GCB2_V_FF_C_1/2 LFL	1/2 LFL	10.87	11.08	11.48
7	IS07_NG_PIPEBLGRS_V_FF_C_LFL	LFL	5.00	5.06	5.21
	IS07_NG_PIPEBLGRS_V_FF_C_1/2 LFL	1/2 LFL	5.00	5.06	5.21
8	IS08_NG_PIPEBLGRSB1_V_FF_C_LFL	LFL	6.90	7.01	7.21
	IS08_NG_PIPEBLGRSB1_V_FF_C_1/2 LFL	1/2 LFL	6.90	7.01	7.21
9	IS09_NG_PIPEBLGRSB2_V_FF_C_LFL	LFL	8.43	8.57	8.82
	IS09_NG_PIPEBLGRSB2_V_FF_C_1/2 LFL	1/2 LFL	8.43	8.57	8.82
10	IS10_NG_PIPEGRSFGRSB1_V_FF_C_LFL	LFL	19.36	19.69	20.39
	IS10_NG_PIPEGRSFGRSB1_V_FF_C_1/2 LFL	1/2 LFL	19.36	19.69	20.39
11	IS11_NG_PIPEGRSFGRSB2_V_FF_C_LFL	LFL	20.82	21.18	21.95
	IS11_NG_PIPEGRSFGRSB2_V_FF_C_1/2 LFL	1/2 LFL	20.82	21.18	21.95
12	IS12_NG_PIPEFGRSHRSGB1_V_FF_C_LFL	LFL	9.57	9.73	10.02
	IS12_NG_PIPEFGRSHRSGB1_V_FF_C_1/2 LFL	1/2 LFL	9.57	9.73	10.02
13	IS13_NG_PIPEFGRSHRSGB2_V_FF_C_LFL	LFL	7.91	8.03	8.27
	IS13_NG_PIPEFGRSHRSGB2_V_FF_C_1/2 LFL	1/2 LFL	7.91	8.03	8.27

Explosion Small

Ref	Scenarios	Fatality Probability	Weather Condition 1F	Weather Condition 3C	Weather Condition 5D
			Downwind Distance	Downwind Distance	Downwind Distance
1	IS01_NG_GTB2_V_EXP_S_1	0.2068	Not reachable	Not reachable	Not reachable
	IS01_NG_GTB2_V_EXP_S_0.5	0.1379	Not reachable	Not reachable	Not reachable
	IS01_NG_GTB2_V_EXP_S_0.03	0.02068	Not reachable	Not reachable	Not reachable
3	IS03_NG_MSB1_V_EXP_S_1	0.2068	Not reachable	Not reachable	Not reachable
	IS03_NG_MSB1_V_EXP_S_0.5	0.1379	Not reachable	Not reachable	Not reachable
	IS03_NG_MSB1_V_EXP_S_0.03	0.02068	Not reachable	Not reachable	Not reachable
4	IS04_NG_MSB2_V_EXP_S_1	0.2068	Not reachable	Not reachable	Not reachable
	IS04_NG_MSB2_V_EXP_S_0.5	0.1379	Not reachable	Not reachable	Not reachable
	IS04_NG_MSB2_V_EXP_S_0.03	0.02068	Not reachable	Not reachable	Not reachable
5	IS05_NG_GCB1_V_EXP_S_1	0.2068	Not reachable	Not reachable	Not reachable
	IS05_NG_GCB1_V_EXP_S_0.5	0.1379	Not reachable	Not reachable	Not reachable
	IS05_NG_GCB1_V_EXP_S_0.03	0.02068	Not reachable	Not reachable	Not reachable
6	IS06_NG_GCB2_V_EXP_S_1	0.2068	Not reachable	Not reachable	Not reachable
	IS06_NG_GCB2_V_EXP_S_0.5	0.1379	Not reachable	Not reachable	Not reachable
	IS06_NG_GCB2_V_EXP_S_0.03	0.02068	Not reachable	Not reachable	Not reachable
7	IS07_NG_PIPEBLGRS_V_EXP_S_1	0.2068	Not reachable	Not reachable	Not reachable
	IS07_NG_PIPEBLGRS_V_EXP_S_0.5	0.1379	Not reachable	Not reachable	Not reachable
	IS07_NG_PIPEBLGRS_V_EXP_S_0.03	0.02068	Not reachable	Not reachable	Not reachable
8	IS08_NG_PIPEBLGRSB1_V_EXP_S_1	0.2068	Not reachable	Not reachable	Not reachable
	IS08_NG_PIPEBLGRSB1_V_EXP_S_0.5	0.1379	Not reachable	Not reachable	Not reachable
	IS08_NG_PIPEBLGRSB1_V_EXP_S_0.03	0.02068	Not reachable	Not reachable	Not reachable
9	IS09_NG_PIPEBLGRSB2_V_EXP_S_1	0.2068	Not reachable	Not reachable	Not reachable
	IS09_NG_PIPEBLGRSB2_V_EXP_S_0.5	0.1379	Not reachable	Not reachable	Not reachable
	IS09_NG_PIPEBLGRSB2_V_EXP_S_0.03	0.02068	Not reachable	Not reachable	Not reachable

Ref	Scenarios	Fatality Probability	Weather Condition 1F	Weather Condition 3C	Weather Condition 5D
			Downwind Distance	Downwind Distance	Downwind Distance
10	IS10_NG_PIPEGRSFGRSB1_V_EXP_S_1	0.2068	Not reachable	Not reachable	Not reachable
	IS10_NG_PIPEGRSFGRSB1_V_EXP_S_0.5	0.1379	Not reachable	Not reachable	Not reachable
	IS10_NG_PIPEGRSFGRSB1_V_EXP_S_0.03	0.02068	Not reachable	Not reachable	Not reachable
11	IS11_NG_PIPEGRSFGRSB2_V_EXP_S_1	0.2068	Not reachable	Not reachable	Not reachable
	IS11_NG_PIPEGRSFGRSB2_V_EXP_S_0.5	0.1379	Not reachable	Not reachable	Not reachable
	IS11_NG_PIPEGRSFGRSB2_V_EXP_S_0.03	0.02068	Not reachable	Not reachable	Not reachable
12	IS12_NG_PIPEFGRSHRSGB1_V_EXP_S_1	0.2068	Not reachable	Not reachable	Not reachable
	IS12_NG_PIPEFGRSHRSGB1_V_EXP_S_0.5	0.1379	Not reachable	Not reachable	Not reachable
	IS12_NG_PIPEFGRSHRSGB1_V_EXP_S_0.03	0.02068	Not reachable	Not reachable	Not reachable
13	IS13_NG_PIPEFGRSHRSGB2_V_EXP_S_1	0.2068	Not reachable	Not reachable	Not reachable
	IS13_NG_PIPEFGRSHRSGB2_V_EXP_S_0.5	0.1379	Not reachable	Not reachable	Not reachable
	IS13_NG_PIPEFGRSHRSGB2_V_EXP_S_0.03	0.02068	Not reachable	Not reachable	Not reachable

Explosion Medium

Ref	Scenarios	Fatality Probability	Weather Condition 1F	Weather Condition 3C	Weather Condition 5D
			Downwind Distance	Downwind Distance	Downwind Distance
1	IS01_NG_GTB2_V_EXP_M_1	0.2068	28.68	28.50	28.39
	IS01_NG_GTB2_V_EXP_M_0.5	0.1379	31.21	30.98	30.85
	IS01_NG_GTB2_V_EXP_M_0.03	0.02068	63.31	62.42	61.89
3	IS03_NG_MSB1_V_EXP_M_1	0.2068	30.08	41.31	41.27
	IS03_NG_MSB1_V_EXP_M_0.5	0.1379	33.02	44.62	44.57
	IS03_NG_MSB1_V_EXP_M_0.03	0.02068	70.30	86.47	86.25
4	IS04_NG_MSB2_V_EXP_M_1	0.2068	30.08	41.31	41.27
	IS04_NG_MSB2_V_EXP_M_0.5	0.1379	33.02	44.62	44.57
	IS04_NG_MSB2_V_EXP_M_0.03	0.02068	70.30	86.47	86.25
5	IS05_NG_GCB1_V_EXP_M_1	0.2068	Not reachable	Not reachable	Not reachable
	IS05_NG_GCB1_V_EXP_M_0.5	0.1379	Not reachable	Not reachable	Not reachable
	IS05_NG_GCB1_V_EXP_M_0.03	0.02068	Not reachable	Not reachable	Not reachable
6	IS06_NG_GCB2_V_EXP_M_1	0.2068	Not reachable	Not reachable	Not reachable
	IS06_NG_GCB2_V_EXP_M_0.5	0.1379	Not reachable	Not reachable	Not reachable
	IS06_NG_GCB2_V_EXP_M_0.03	0.02068	Not reachable	Not reachable	Not reachable
7	IS07_NG_PIPEBLGRS_V_EXP_M_1	0.2068	43.76	52.48	51.91
	IS07_NG_PIPEBLGRS_V_EXP_M_0.5	0.1379	47.79	56.12	55.39
	IS07_NG_PIPEBLGRS_V_EXP_M_0.03	0.02068	98.69	102.30	99.45
8	IS08_NG_PIPEBLGRSB1_V_EXP_M_1	0.2068	43.76	54.19	54.20
	IS08_NG_PIPEBLGRSB1_V_EXP_M_0.5	0.1379	47.79	58.34	58.35
	IS08_NG_PIPEBLGRSB1_V_EXP_M_0.03	0.02068	98.69	110.80	110.90
9	IS09_NG_PIPEBLGRSB2_V_EXP_M_1	0.2068	55.40	54.19	54.18
	IS09_NG_PIPEBLGRSB2_V_EXP_M_0.5	0.1379	59.91	58.34	58.33
	IS09_NG_PIPEBLGRSB2_V_EXP_M_0.03	0.02068	116.90	110.80	110.80
10	IS10_NG_PIPEGRSFGRSB1_V_EXP_M_1	0.2068	55.39	54.18	54.20
	IS10_NG_PIPEGRSFGRSB1_V_EXP_M_0.5	0.1379	59.89	58.32	58.35
	IS10_NG_PIPEGRSFGRSB1_V_EXP_M_0.03	0.02068	116.80	110.80	110.90
11	IS11_NG_PIPEGRSFGRSB2_V_EXP_M_1	0.2068	55.39	54.12	54.15
	IS11_NG_PIPEGRSFGRSB2_V_EXP_M_0.5	0.1379	59.89	58.25	58.29
	IS11_NG_PIPEGRSFGRSB2_V_EXP_M_0.03	0.02068	116.80	110.50	110.60
12	IS12_NG_PIPEFGRSHRSGB1_V_EXP_M_1	0.2068	55.40	54.17	54.17
	IS12_NG_PIPEFGRSHRSGB1_V_EXP_M_0.5	0.1379	59.91	58.31	58.31
	IS12_NG_PIPEFGRSHRSGB1_V_EXP_M_0.03	0.02068	116.90	110.70	110.70
13	IS13_NG_PIPEFGRSHRSGB2_V_EXP_M_1	0.2068	55.40	54.18	54.19
	IS13_NG_PIPEFGRSHRSGB2_V_EXP_M_0.5	0.1379	59.91	58.32	58.33
	IS13_NG_PIPEFGRSHRSGB2_V_EXP_M_0.	0.02068	116.90	110.80	110.80

Ref	Scenarios	Fatality Probability	Weather Condition 1F	Weather Condition 3C	Weather Condition 5D
			Downwind Distance	Downwind Distance	Downwind Distance
	03				

Explosion Catastrophic

Ref	Scenarios	Fatality Probability	Weather Condition 1F	Weather Condition 3C	Weather Condition 5D
			Downwind Distance	Downwind Distance	Downwind Distance
1	IS01_NG_GTB2_V_EXP_C_1	0.2068	128.30	128.10	126.60
	IS01_NG_GTB2_V_EXP_C_0.5	0.1379	157.10	156.80	154.90
	IS01_NG_GTB2_V_EXP_C_0.03	0.02068	520.90	519.60	512.30
3	IS03_NG_MSB1_V_EXP_C_1	0.2068	16.41	16.47	16.33
	IS03_NG_MSB1_V_EXP_C_0.5	0.1379	18.28	18.36	18.17
	IS03_NG_MSB1_V_EXP_C_0.03	0.02068	41.98	42.27	41.57
4	IS04_NG_MSB2_V_EXP_C_1	0.2068	16.41	16.47	16.33
	IS04_NG_MSB2_V_EXP_C_0.5	0.1379	18.28	18.36	18.17
	IS04_NG_MSB2_V_EXP_C_0.03	0.02068	41.98	42.27	41.57
5	IS05_NG_GCB1_V_EXP_C_1	0.2068	42.90	43.11	42.70
	IS05_NG_GCB1_V_EXP_C_0.5	0.1379	52.51	52.79	52.25
	IS05_NG_GCB1_V_EXP_C_0.03	0.02068	174.20	175.20	173.20
6	IS06_NG_GCB2_V_EXP_C_1	0.2068	42.90	43.11	42.70
	IS06_NG_GCB2_V_EXP_C_0.5	0.1379	52.51	52.79	52.25
	IS06_NG_GCB2_V_EXP_C_0.03	0.02068	174.20	175.20	173.20
7	IS07_NG_PIPEBLGRS_V_EXP_C_1	0.2068	Not reachable	Not reachable	Not reachable
	IS07_NG_PIPEBLGRS_V_EXP_C_0.5	0.1379	Not reachable	Not reachable	Not reachable
	IS07_NG_PIPEBLGRS_V_EXP_C_0.03	0.02068	Not reachable	Not reachable	Not reachable
8	IS08_NG_PIPEBLGRSB1_V_EXP_C_1	0.2068	Not reachable	Not reachable	Not reachable
	IS08_NG_PIPEBLGRSB1_V_EXP_C_0.5	0.1379	Not reachable	Not reachable	Not reachable
	IS08_NG_PIPEBLGRSB1_V_EXP_C_0.03	0.02068	Not reachable	Not reachable	Not reachable
9	IS09_NG_PIPEBLGRSB2_V_EXP_C_1	0.2068	Not reachable	Not reachable	Not reachable
	IS09_NG_PIPEBLGRSB2_V_EXP_C_0.5	0.1379	Not reachable	Not reachable	Not reachable
	IS09_NG_PIPEBLGRSB2_V_EXP_C_0.03	0.02068	Not reachable	Not reachable	Not reachable
10	IS10_NG_PIPEGRSFGRSB1_V_EXP_C_1	0.2068	50.14	51.53	77.92
	IS10_NG_PIPEGRSFGRSB1_V_EXP_C_0.5	0.1379	61.88	63.67	94.85
	IS10_NG_PIPEGRSFGRSB1_V_EXP_C_0.03	0.02068	210.40	217.30	309.10
11	IS11_NG_PIPEGRSFGRSB2_V_EXP_C_1	0.2068	86.98	79.29	82.12
	IS11_NG_PIPEGRSFGRSB2_V_EXP_C_0.5	0.1379	106.60	96.63	100.30
	IS11_NG_PIPEGRSFGRSB2_V_EXP_C_0.03	0.02068	354.30	315.90	330.00
12	IS12_NG_PIPEFGRSHRSGB1_V_EXP_C_1	0.2068	Not reachable	Not reachable	Not reachable
	IS12_NG_PIPEFGRSHRSGB1_V_EXP_C_0.5	0.1379	Not reachable	Not reachable	Not reachable
	IS12_NG_PIPEFGRSHRSGB1_V_EXP_C_0.03	0.02068	Not reachable	Not reachable	Not reachable

Ref	Scenarios	Fatality Probability	Weather Condition 1F	Weather Condition 3C	Weather Condition 5D
			Downwind Distance	Downwind Distance	Downwind Distance
13	IS13_NG_PIPEFGRSHRSGB2_V_EXP_C_1	0.2068	Not reachable	Not reachable	Not reachable
	IS13_NG_PIPEFGRSHRSGB2_V_EXP_C_0.5	0.1379	Not reachable	Not reachable	Not reachable
	IS13_NG_PIPEFGRSHRSGB2_V_EXP_C_0.03	0.02068	Not reachable	Not reachable	Not reachable

Appendix 5.6.2

Failure Frequency

No	Section ID	Hole Size	Total Failure Rate	Immediate Ignition	Immediate Ignition Frequency	Delayed Ignition 1	Delayed Ignition 1 Frequency	Delayed Ignition 2	Delayed Ignition 2 Frequency	Un-ignited / Toxic Frequency	Pool Fire + Pool Fire
1	IS01_NG_GTB2_V	S	4.32E-04	Jet Fire	4.32E-07	Explosion	1.56E-07	Flash Fire	3.73E-06	4.28E-04	0.00E+00
	IS01_NG_GTB2_V	M	2.54E-04	Jet Fire	8.89E-06	Explosion	1.07E-06	Flash Fire	7.82E-06	2.36E-04	0.00E+00
	IS01_NG_GTB2_V	C	1.43E-05	Jet Fire	2.57E-06	Explosion	5.15E-07	Flash Fire	1.20E-06	1.00E-05	0.00E+00
2	IS02_DO_GTB2_L	S	4.32E-04	Jet Fire	6.48E-06	Pool Fire	6.48E-06	-	0.00E+00	4.19E-04	0.00E+00
	IS02_DO_GTB2_L	M	2.54E-04	Jet Fire	3.81E-06	Pool Fire	3.81E-06	-	0.00E+00	2.46E-04	0.00E+00
	IS02_DO_GTB2_L	C	1.43E-05	Pool Fire	6.86E-07	Pool Fire	4.58E-07	-	0.00E+00	1.32E-05	1.14E-06
3	IS03_NG_MSB1_V	S	7.10E-05	Jet Fire	2.49E-06	Explosion	2.98E-07	Flash Fire	2.19E-06	6.60E-05	0.00E+00
	IS03_NG_MSB1_V	M	4.98E-05	Jet Fire	1.74E-06	Explosion	2.09E-07	Flash Fire	1.53E-06	4.63E-05	0.00E+00
	IS03_NG_MSB1_V	C	1.05E-05	Jet Fire	1.05E-08	Explosion	3.79E-09	Flash Fire	9.09E-08	1.04E-05	0.00E+00
4	IS04_NG_MSB2_V	S	7.10E-05	Jet Fire	2.49E-06	Explosion	2.98E-07	Flash Fire	2.19E-06	6.60E-05	0.00E+00
	IS04_NG_MSB2_V	M	4.98E-05	Jet Fire	1.74E-06	Explosion	2.09E-07	Flash Fire	1.53E-06	4.63E-05	0.00E+00
	IS04_NG_MSB2_V	C	1.05E-05	Jet Fire	1.05E-08	Explosion	3.79E-09	Flash Fire	9.09E-08	1.04E-05	0.00E+00
5	IS05_NG_GCB1_V	S	1.09E-02	Jet Fire	1.09E-05	Explosion	3.92E-06	Flash Fire	9.42E-05	1.08E-02	0.00E+00
	IS05_NG_GCB1_V	M	5.25E-04	Jet Fire	1.84E-05	Explosion	2.21E-06	Flash Fire	1.62E-05	4.88E-04	0.00E+00
	IS05_NG_GCB1_V	C	2.37E-04	Jet Fire	8.30E-06	Explosion	9.95E-07	Flash Fire	7.30E-06	2.20E-04	0.00E+00
6	IS06_NG_GCB2_V	S	1.09E-02	Jet Fire	1.09E-05	Explosion	3.92E-06	Flash Fire	9.42E-05	1.08E-02	0.00E+00
	IS06_NG_GCB2_V	M	5.25E-04	Jet Fire	1.84E-05	Explosion	2.21E-06	Flash Fire	1.62E-05	4.88E-04	0.00E+00
	IS06_NG_GCB2_V	C	2.37E-04	Jet Fire	8.30E-06	Explosion	9.95E-07	Flash Fire	7.30E-06	2.20E-04	0.00E+00
7	IS07_NG_PIPEBLGRS_V	S	4.90E-05	Jet Fire	1.71E-06	Explosion	2.06E-07	Flash Fire	1.51E-06	4.56E-05	0.00E+00

No	Section ID	Hole Size	Total Failure Rate	Immediate Ignition	Immediate Ignition Frequency	Delayed Ignition 1	Delayed Ignition 1 Frequency	Delayed Ignition 2	Delayed Ignition 2 Frequency	Un-ignited / Toxic Frequency	Pool Fire + Pool Fire
	IS07_NG_PIPEBLGRS_V	M	3.44E-05	Jet Fire	1.20E-06	Explosion	1.44E-07	Flash Fire	1.06E-06	3.20E-05	0.00E+00
	IS07_NG_PIPEBLGRS_V	C	7.26E-06	Jet Fire	7.26E-09	Explosion	2.61E-09	Flash Fire	6.27E-08	7.19E-06	0.00E+00
8	IS08_NG_PIPEBLGRSB1_V	S	1.20E-04	Jet Fire	4.19E-06	Explosion	5.02E-07	Flash Fire	3.68E-06	1.11E-04	0.00E+00
	IS08_NG_PIPEBLGRSB1_V	M	8.39E-05	Jet Fire	2.94E-06	Explosion	3.52E-07	Flash Fire	2.58E-06	7.80E-05	0.00E+00
	IS08_NG_PIPEBLGRSB1_V	C	1.77E-05	Jet Fire	6.20E-07	Explosion	7.45E-08	Flash Fire	5.46E-07	1.65E-05	0.00E+00
9	IS09_NG_PIPEBLGRSB2_V	S	2.13E-04	Jet Fire	7.46E-06	Explosion	8.95E-07	Flash Fire	6.56E-06	1.98E-04	0.00E+00
	IS09_NG_PIPEBLGRSB2_V	M	1.49E-04	Jet Fire	5.23E-06	Explosion	6.27E-07	Flash Fire	4.60E-06	1.39E-04	0.00E+00
	IS09_NG_PIPEBLGRSB2_V	C	3.16E-05	Jet Fire	1.10E-06	Explosion	1.33E-07	Flash Fire	9.72E-07	2.94E-05	0.00E+00
10	IS10_NG_PIPEGRSFGRSB1_V	S	2.31E-03	Jet Fire	8.08E-05	Explosion	9.69E-06	Flash Fire	7.11E-05	2.15E-03	0.00E+00
	IS10_NG_PIPEGRSFGRSB1_V	M	1.62E-03	Jet Fire	5.66E-05	Explosion	6.80E-06	Flash Fire	4.98E-05	1.51E-03	0.00E+00
	IS10_NG_PIPEGRSFGRSB1_V	C	3.42E-04	Jet Fire	1.20E-05	Explosion	1.44E-06	Flash Fire	1.05E-05	3.18E-04	0.00E+00
11	IS11_NG_PIPEGRSFGRSB2_V	S	2.85E-03	Jet Fire	9.98E-05	Explosion	1.20E-05	Flash Fire	8.78E-05	2.65E-03	0.00E+00
	IS11_NG_PIPEGRSFGRSB2_V	M	2.00E-03	Jet Fire	7.00E-05	Explosion	8.40E-06	Flash Fire	6.16E-05	1.86E-03	0.00E+00
	IS11_NG_PIPEGRSFGRSB2_V	C	4.22E-04	Jet Fire	1.48E-05	Explosion	1.77E-06	Flash Fire	1.30E-05	3.93E-04	0.00E+00
12	IS12_NG_PIPEFGRSHRSGB1_V	S	4.70E-04	Jet Fire	1.64E-05	Explosion	1.97E-06	Flash Fire	1.45E-05	4.37E-04	0.00E+00
	IS12_NG_PIPEFGRSHRSGB1_V	M	3.29E-04	Jet Fire	1.15E-05	Explosion	1.38E-06	Flash Fire	1.01E-05	3.06E-04	0.00E+00
	IS12_NG_PIPEFGRSHRSGB1_V	C	6.96E-05	Jet Fire	2.44E-06	Explosion	2.92E-07	Flash Fire	2.14E-06	6.47E-05	0.00E+00
13	IS13_NG_PIPEFGRSHRSGB2_V	S	2.76E-04	Jet Fire	9.67E-06	Explosion	1.16E-06	Flash Fire	8.51E-06	2.57E-04	0.00E+00
	IS13_NG_PIPEFGRSHRSGB2_V	M	1.94E-04	Jet Fire	6.78E-06	Explosion	8.14E-07	Flash Fire	5.97E-06	1.80E-04	0.00E+00

No	Section ID	Hole Size	Total Failure Rate	Immediate Ignition	Immediate Ignition Frequency	Delayed Ignition 1	Delayed Ignition 1 Frequency	Delayed Ignition 2	Delayed Ignition 2 Frequency	Un-ignited / Toxic Frequency	Pool Fire + Pool Fire
	IS13_NG_PIPEFGRSHRSGB2_V	C	4.09E-05	Jet Fire	1.43E-06	Explosion	1.72E-07	Flash Fire	1.26E-06	3.81E-05	0.00E+00
14	IS14_DO_PIPEFOT5GTB1_L	S	1.77E-03	Jet Fire	2.65E-05	Pool Fire	2.65E-05	-	0.00E+00	1.72E-03	0.00E+00
	IS14_DO_PIPEFOT5GTB1_L	M	1.24E-03	Jet Fire	1.86E-05	Pool Fire	1.86E-05	-	0.00E+00	1.20E-03	0.00E+00
	IS14_DO_PIPEFOT5GTB1_L	C	2.62E-04	Pool Fire	1.26E-05	Pool Fire	8.38E-06	-	0.00E+00	2.41E-04	2.10E-05
15	IS15_DO_PIPEFOT5GTB2_L	S	2.42E-03	Jet Fire	3.63E-05	Pool Fire	3.63E-05	-	0.00E+00	2.35E-03	0.00E+00
	IS15_DO_PIPEFOT5GTB2_L	M	1.70E-03	Jet Fire	2.55E-05	Pool Fire	2.55E-05	-	0.00E+00	1.65E-03	0.00E+00
	IS15_DO_PIPEFOT5GTB2_L	C	3.58E-04	Pool Fire	1.72E-05	Pool Fire	1.15E-05	-	0.00E+00	3.30E-04	2.87E-05
16	IS16_DO_PIPEFOT6GTB1_L	S	1.66E-03	Jet Fire	2.48E-05	Pool Fire	2.48E-05	-	0.00E+00	1.61E-03	0.00E+00
	IS16_DO_PIPEFOT6GTB1_L	M	1.16E-03	Jet Fire	1.74E-05	Pool Fire	1.74E-05	-	0.00E+00	1.13E-03	0.00E+00
	IS16_DO_PIPEFOT6GTB1_L	C	2.45E-04	Pool Fire	1.18E-05	Pool Fire	7.85E-06	-	0.00E+00	2.26E-04	1.96E-05
17	IS17_DO_PIPEFOT6GTB2_L	S	2.30E-03	Jet Fire	3.46E-05	Pool Fire	3.46E-05	-	0.00E+00	2.24E-03	0.00E+00
	IS17_DO_PIPEFOT6GTB2_L	M	1.62E-03	Jet Fire	2.42E-05	Pool Fire	2.42E-05	-	0.00E+00	1.57E-03	0.00E+00
	IS17_DO_PIPEFOT6GTB2_L	C	3.41E-04	Pool Fire	1.64E-05	Pool Fire	1.09E-05	-	0.00E+00	3.14E-04	2.73E-05

Appendix 7.1.1

Environment, Occupational Safety and Health Policy

ENVIRONMENT, OCCUPATIONAL SAFETY AND HEALTH POLICY

Sarawak Energy Berhad is committed to generate and supply energy in a reliable and efficient manner. In carrying out our business activities and operations and in ensuring customers' satisfaction, we promote environment protection and work safety for employees and the public.

In this respect, we are committed to:

- Compliance with environmental, safety and health legislations and other requirements as imposed under the relevant laws;
- Prevention of injury and ill-health or others adverse impact of our activities through management programmes, objectives and targets;
- The protection of the environment, including prevention of pollution and other specific commitment(s) relevant to the context of the organization;
- Provision of information, instruction, training, supervision and resources for the improvement of environment, safety and health performance;
- Continual improvement of our environmental, safety and health management systems through effective management reviews and enhancement; and
- Inculcate and sustain safety culture.

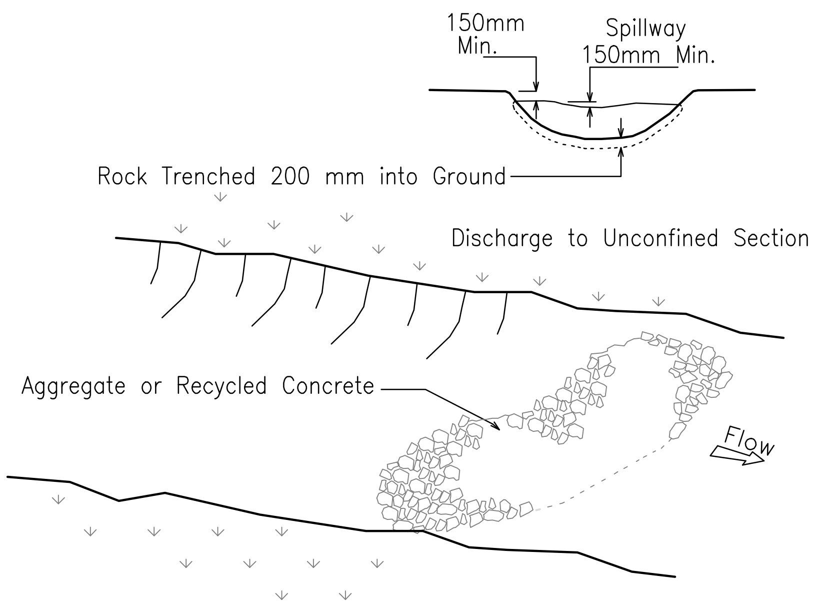
This policy is documented and available to the public upon request.

SHARBINI SUHAILI
GROUP CHIEF EXECUTIVE OFFICER

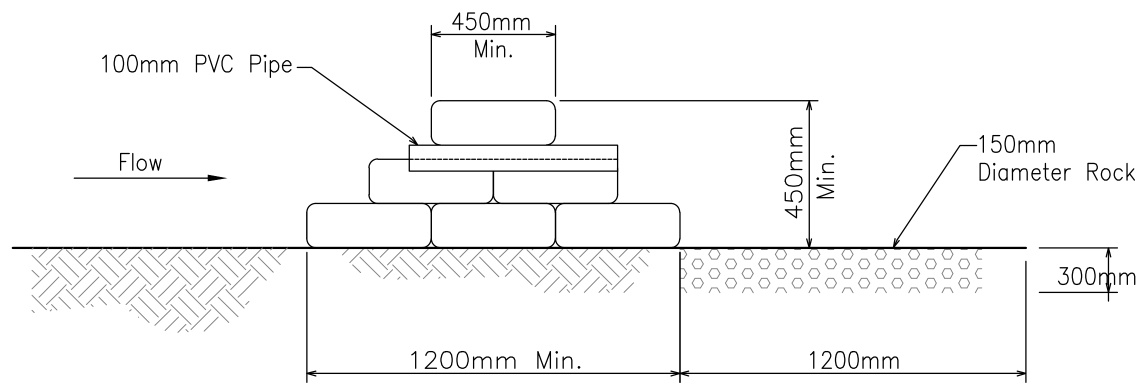
Date: 18th April 2017

Appendix 7.3.1

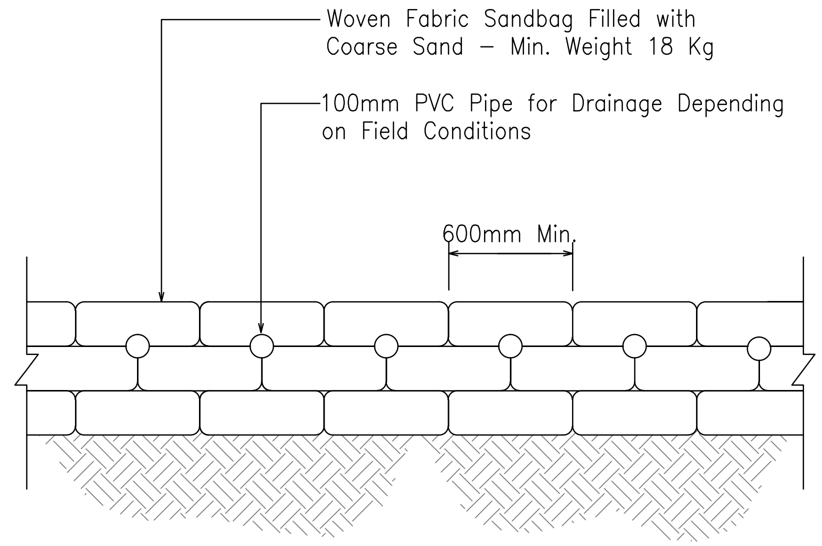
Examples of BMPs Design



Spacing of Check Dams along Centreline
and Scour Protection Below Each Check
Dam to be Specified on ESCP



SECTION



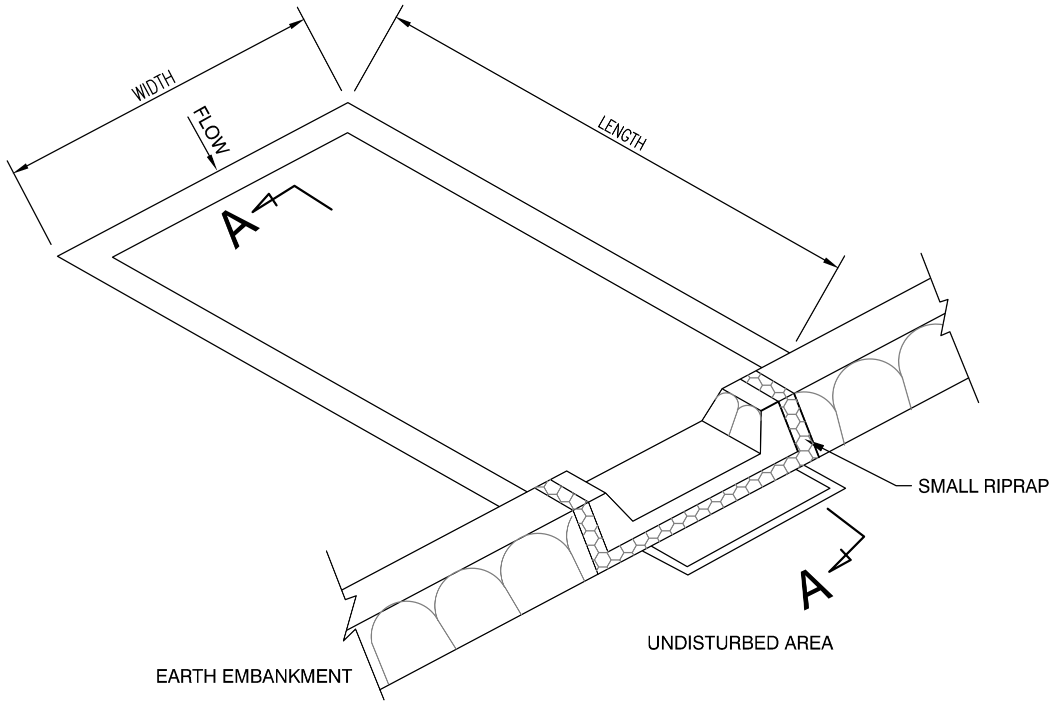
FRONT VIEW

CONSTRUCTION NOTES:

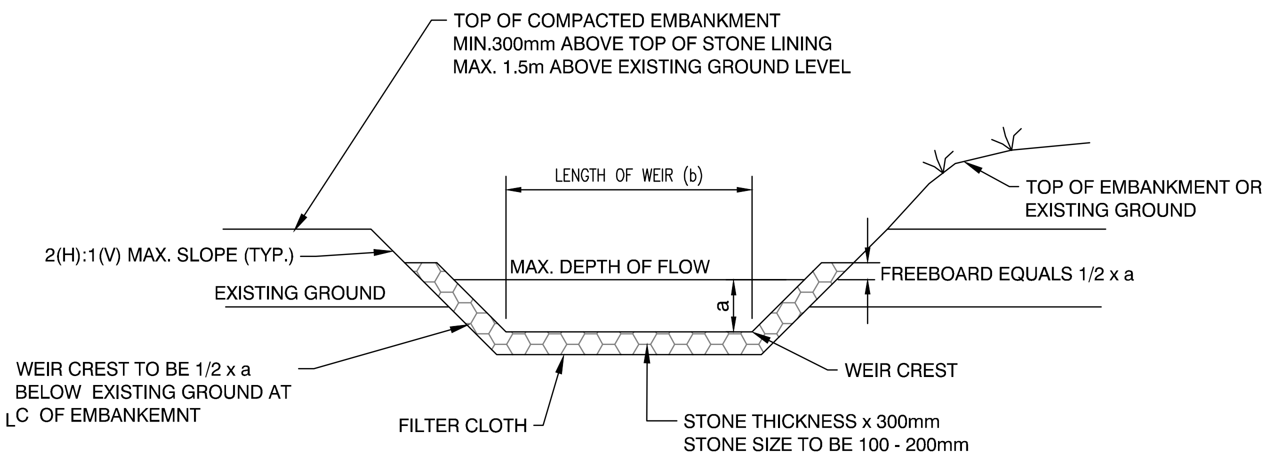
1. Trench Structure 200 mm into Ground Surface wherever the Structure Contacts the Gully Base. Fill Trenches to 100 mm Above Ground Surface to Reduce Risk of Undercutting.
2. Ensure Height of Spillway is Less than 1 Metre Above the Gully Floor.
3. Space Checks so the Toe of the Upstream Dam is Level with the Spillway of the Next Downstream Dam.

CHECK DAM

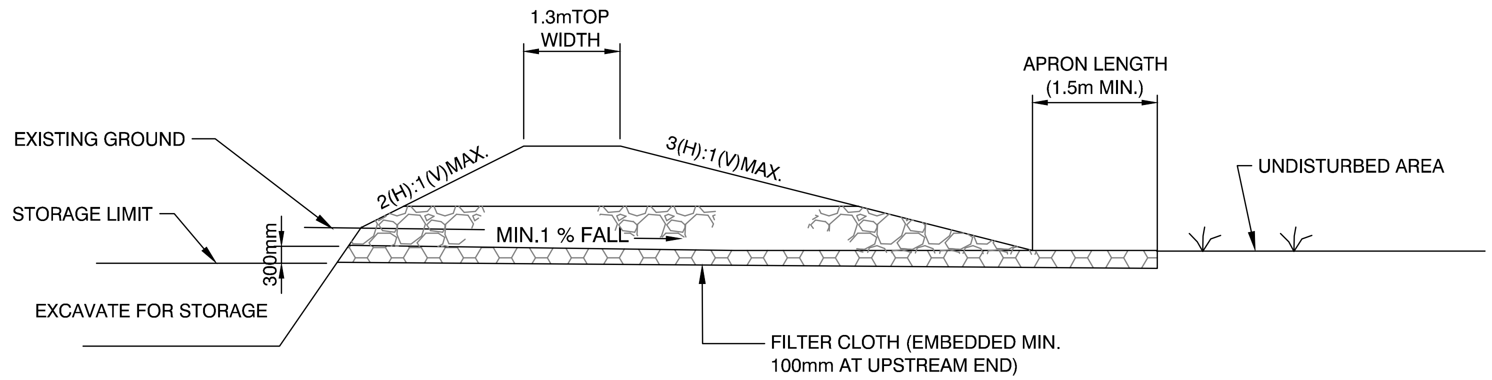
CHECK DAM AND SAND BAG BARRIERS



PLAN



PROFILE



SECTION A - A

SEDIMENT TRAP'S CROSS SECTION DETAILS

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