Total E&P Myanmar

Block M5 – M6 Offshore 3D Seismic Campaign

Initial Environmental Examination

Report

Rev 1 – December 2017

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Myanmar

Block M5 – M6 Offshore 3D Seismic Campaign

Initial Environmental Examination

Revision 0

September 2017

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ABREVIATIONS

0-P	Zero-to-peak
AET	Apparent Effect Threshold
ALGAS	Asia Least Cost Greenhouse gas Abatement Strategy
DGPS	Differential Global Positioning Systems
EEZ	Exclusive Economic Zones
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
GHG	Green House Gases
IEE	Initial Environmental Examination
IFC	International Finance Corporation
IMO	International Maritime Organisation
IPIECA	International Petroleum Industry Environmental Conservation Association
IUCN	International Union for Conservation of Nature
JNCC	Joint Nature Conservation Committee
LC	Least Concern
MARPOL 73/78	International Convention for Prevention of Pollution from Ships 1973/78
MEDEVAC	MEDical EVACuation
Mlf, Mmf, Mhf	Frequency weightings for cetaceans sensitive to low, middle and high frequencies
MMO	Marine Mammal Observer
MOE	Ministry Of Energy
MOGE	Myanma Oil and Gas Entreprise
NCEA	National Commission for Environmental Affairs
OCHA	United Nation Office for the Coordination of Humanitarian Affairs
OGP	International Association of Oil and Gas Producers
PAM	Passive Acoustic Monitoring
PSC	Production Sharing Contract
RMS	Root Mean Square
SEL	Sound Exposure Level
SELmp	Sound Exposure Levels – multiple pulse
SELop	Sound Exposure Levels – single pulse
SPL	Sound Pressure Level
TL	Transmission Loss
TSS	Total Suspended Solids
TTS	Temporary Threshold Shift (refer to noise exposure limit of the marine mammal
VU	Vulnerable
WHO	World Health Organisation
WMP	Waste Management Plan

TEPM'S LETTER OF ENDORSEMENT

TOTAL E&P MYANMAR

Yangon Branch

Director General
Environmental Conservation
Department
Ministry of Natural Resource and
Environmental Conservation
Complex No.53

Date: 7th November 2017
Ref.: L/787-17/MM-TEP

SUBJECT: M5-M6 3D SEISMIC CAMPAIGN IEE AND EMP REPORT

Dear Sir,

In reference to the above mentioned subject, we, Total Exploration & Production Myanmar (TEPM), hereby submitted IEE including EMP which is prepared and finalized by Artelia Co., Ltd to Environmental Conservation Department (MONREC) so as to be in line with the Environmental Conservation Law (2012), Environmental Conservation Rules (2014) and Environmental Impact Assessment Procedure (2015).

TEPM has carefully supervised Artelia during the preparation of the report. TEPM confirms that in the context of M5-M6 3D Seismic acquisition activities, the IEE report is

a) Accurate and complete
b) Prepared in strict compliance with applicable Laws, Rules, Procedures and Administrative Instructions
c) And that operation by TEPM and its contractors on Block M5-M6 will at all times comply fully with the commitments, mitigation measures, and plans outlined in the IEE report

The undersigned is authorized to issue this Letter of Endorsement on behalf of TEPM.

Yours Sincerely,

Romaric ROIGNAN
General Manager
Total E&P Myanmar

No. 5, Sacred Tooth Relic Lake Avenue, Punn Pin Gone Quarter No. 5, Mayangone Township, The Republic of the Union of Myanmar
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SECTION 0. အကျဉ်းချုပ်အစီရင်ခံစာ

0.1 နိဒါန်း

0.1.1 နောက်ခံအကြောင်းအရာ

Total မြန်မာ့ရေနံနှင့်သဘာဝဓါတ်ငွေ့တူးဖော်ထုတ်လုပ်ရေး (Total Exploaration & Production Myanmar (TEPM)) သည် ကမ်းလွန်လုပ်ကွက်အမှတ် M5-M6၏ တူးဖော်ရေးအစီအစဉ်၏ တစိတ်တပိုင်းအဖြစ် သုံးဖက်မြင် ဆိုက်စမစ်တိုင်းတာရေးလုပ်ငန်းစဉ်ကို ဆောင်ရွက်ရန် စီစဉ်လျက်ရှိပါသည်။

ပတ်ဝန်းကျင်ထိန်းသိမ်းရေးအာဏာပိုင်များက ဤစီမံကိန်းသည် ပတ်ဝန်းကျင် သို့မဟုတ် လက်ရှိ လူမှုစီးပွါးရေး ဆိုင်ရာ လုပ်ငန်းများအား ထိခိုက်ခြင်း ရှိ/မရှိကို ဆုံးဖြတ်နိုင်စေရန်နှင့် စီမံကိန်းအား ခွင့်ပြုမည်/ ခွင့်မပြုမည်ကို ဆုံးဖြတ်နိုင်စေရန်အတွက် ဤ IEE အစီရင်ခံစာကို ပြင်ဆင်ခဲ့ခြင်းဖြစ်ပါသည်။ ဤ IEE အစီရင်ခံစာ၏ ပုံစံ၊ ပါဝင်သည့်အကြောင်းအရာများနှင့် ဖွဲ့စည်းထားပုံတို့သည် စီစဉ်ထားသော ကမ်းလွန်ရေနံရှာဖွေရေး လုပ်ငန်းစဉ်အတွင်း ပတ်ဝန်းကျင်ထိခိုက်မှုများကို ကာကွယ်ရေးအတွက် ထည့်သွင်းစဉ်းစားရမည့် ပတ်ဝန်းကျင်ဆိုင်ရာ ပြဿနာများနှင့် ယင်းတို့အားလျော့ပါးစေရေး နည်းလမ်းများနှင့်ပတ်သက်သည့် အချက်အလက်များကို ထောက်ပံ့ပေးထားသောကြောင့် စည်းကမ်းသတ်မှတ်ချက်များနှင့် ကိုက်ညီမှုရှိပါသည်။ယခုတင်ပြသည့် စာတမ်းမှာ IEE အစီရင်ခံစာ၏ အကျဉ်းချုပ်စာတမ်းဖြစ်ပါသည်။

ဤ IEE အစီရင်ခံစာကို (၂၀၁၂ ခုနှစ်တွင် ပြဌာန်းခဲ့သည့်) မြန်မာနိုင်ငံ ပတ်ဝန်းကျင် ထိန်းသိမ်းရေး ဥပဒေ ၊ (၂၀၁၅ ခုနှစ်တွင် ပြဌာန်းခဲ့သည့်) ပတ်ဝန်းကျင် ထိခိုက်မှု ဆန်းစစ်ခြင်းဆိုင်ရာ လုပ်ထုံးလုပ်နည်း များနှင့် အညီ ရေးဆွဲပြုစုထားပြီး၊ ပတ်ဝန်းကျင်စီမံခန့်ခွဲရေးစီမံချက် (Environmental Management Plan – EMP) လည်း ပါဝင်ပါသည်။ ဤအစီရင်ခံစာပြုစုရာတွင် ကမ်းလွန်ရေနံတူးဖော်ခြင်းလုပ်ငန်းနှင့်သက်ဆိုင်သည့် နိုင်ငံတကာ ဥပဒေများအပြင်၊ TOTAL E&P Myanmar ကုမ္ပဏီ၏ စံနှုန်းများကိုလည်း ထည့်သွင်းစဉ်းစားထားပါသည်။

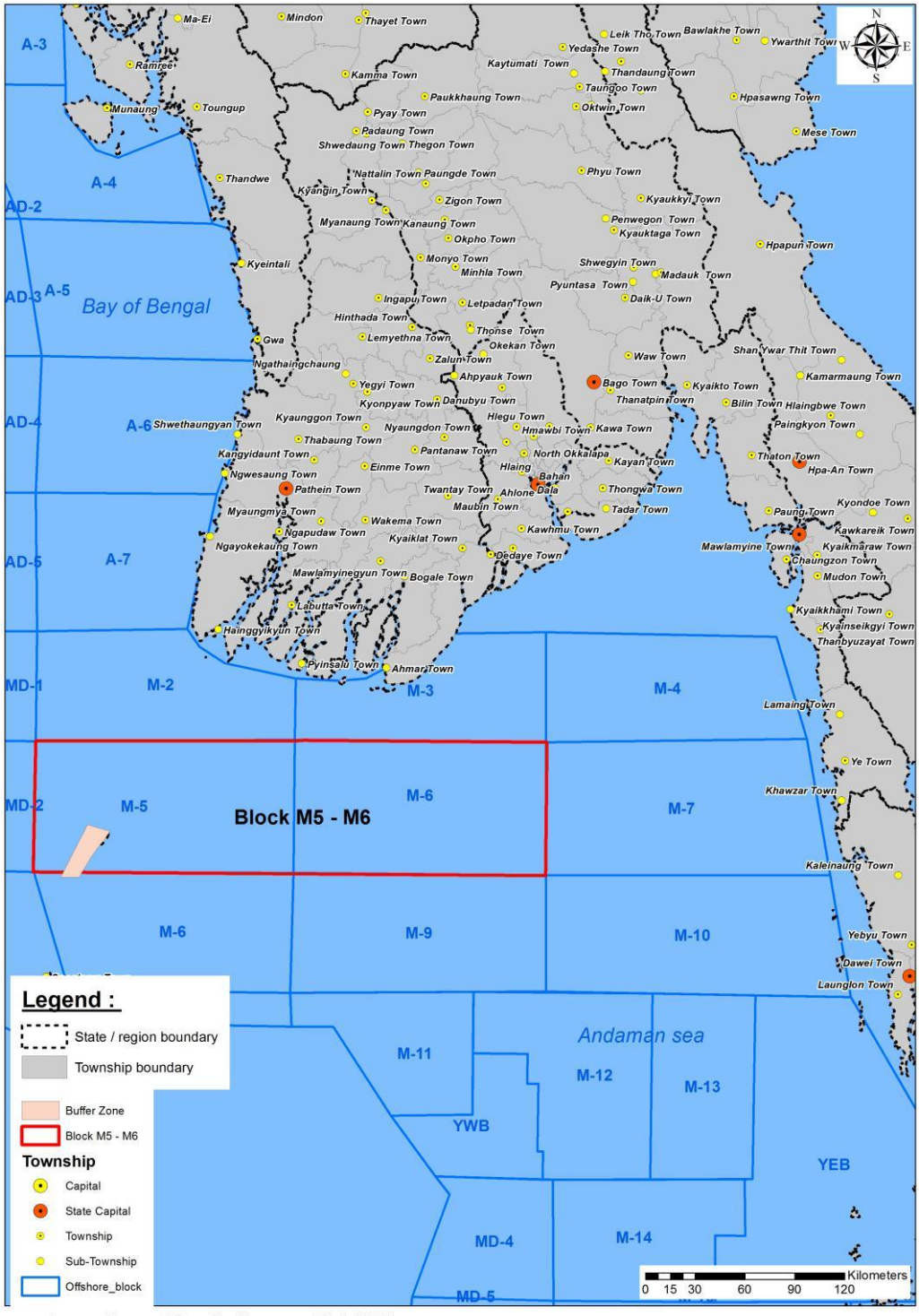
ဤစာတမ်းကို ၂၀၁၂ ခုနှစ်၊အောက်တိုဘာလမှစ၍ ရန်ကုန်မြို့တွင် ရုံးခွဲဖွင့်လှစ်ဆောင်ရွက်နေသော Artelia အဖွဲ့၏ Risk, Siciety & Environment ဌာနခွဲက ပြုစုထားခြင်းဖြစ်ပါသည်။ Artelia အဖွဲ့မှ ကျွမ်းကျင်ပညာရှင်များသည် ဆိုက်စမစ်တိုင်းတာခြင်းလုပ်ငန်းနှင့်ပတ်သက်သည့် ပတ်ဝန်းကျင်နှင့် လူမှုဆိုင်ရာ ပြဿနာများကို ကောင်းစွာသိရှိထားပါသည်။ ကျွမ်းကျင်ပညာရှင်အဖွဲ့တွင် အင်္ဂလန်နိုင်ငံ (JNCC) ၌ အသုံးပြုနေသည့် MMO စံနှုန်းများအကြောင်း ကျွမ်းကျင်အင်ဂျင်နီယာတစ်ဦး၊ အာရှဒေသကမ်းလွန်ဆိုက်စမစ်တိုင်းတာခြင်း လုပ်ငန်း စီမံခန့်ခွဲရာတွင် အတွေ့အကြုံရှိသည့် ကျွမ်းကျင်ပညာရှင်တစ်ဦး၊ ရန်ကုန်မြို့တွင် အခြေစိုက်သည့် ပတ်ဝန်းကျင် ထိန်းသိမ်းရေးအင်ဂျင်နီယာတစ်ဦးတို့ ပါဝင်ပါသည်။ ရန်ကုန်မြို့ရှိရုံးခွဲသည် အချက်အလက်စုဆောင်းခြင်းနှင့် ပေါင်းစပ်ညှိနှိုင်းရေးလုပ်ငန်းများကို စီစဉ်ပံ့ပိုးကူညီပေးပါသည်။

0.1.2 စီမံကိန်းအကြောင်းအရာဖော်ပြချက်

စီမံကိန်းသည် ဘူမိဗေဒဆိုင်ရာအချက်အလက်များကိုသိရှိစေရန်အတွက် ကနဦးပတ်ဝန်းကျင်လေ့လာရေးအစီအရင်ခံစာတွင် သတ်မှတ်ထားသော စီမံကိန်းနယ်မြေဖြစ်သည့်

လုပ်ကွက်အမှတ်များဖြစ်သော M5-M6 တို့၏ ထိစပ်နေသောနေရာများတွင် သုံးဖက်မြင်ဆိုက်စမစ်တိုင်းတာသည့် စီမံကိန်းဖြစ်သည်။ ရတန နှင့် စိန် လုပ်ကွက်နှစ်ခု
သည် M5-M6၏ အလည်ဗဟိုတွင်တည်ရှိပြီး ထိုနေရာမှ တိုင်းတာရရှိသည့် ရလာဒ်ကို လေးဖက်မြင်ဆိုက်စမစ် ဆီသို့ပေါင်းစပ်မည် ဖြစ်သည်။လေးဖက်မြင်ဆိုက်စမစ်တိုင်းတာမှုသည် သုံးဖက်မြင်ဆိုက်စမစ်တိုင်းတာမှုကဲ့သို့ ပင်ဖြစ်ပါသည်။ သို့သော် မတူညီသည့်ကာလများတွင် ယင်းကိုထပ်ခါပြုလုပ်မည်ဖြစ်သည်။ သို့သော် သိုလှောင်ကန် (reservoir) ပြောင်းလဲမှုအနေအထား၏ ကောင်းမွန်သည့် ရုပ်ပုံဖမ်းယူနိုင်ရန် ယခင်တိုင်းတာသည့် အချက်အလက်ထက်မတူညီသည့်အချိန်ကာလတွင် ထိုနေရာတွင်ပင် ထပ်မံတိုင်းတာ သည့်အချက်အလက်ကိုရယူမည်ဖြစ်သည်။ ထိုကဲ့သို့ ပြုလုပ်ခြင်းသည် သင့်တော်ကောင်းမွန်သည့် ထုတ်ယူမှုကို အကူအညီပေးပါသည်။

M5-M6 ကမ်းလွန်လုပ်ကွက်များသည် လုပ်ကွက်အမှတ် M5 ၏ အနောက်တောင်ထောင့် ဘင်္ဂလားပင်လယ်အော်ဆီသို့ Preparis ကျွန်းကို ကျော်လွန်၍ တိုးချဲ့သွားပြီး ကပွလီပင်လယ်၏ အနောက်မြောက်ထောင့်တွင်တည်ရှိပါသည်။ ဇရိယာအကျယ်အဝန်း ၂၄၅၄ စတုရန်းကီလိုမီတာကျယ်ဝန်းပါသည်။ လုပ်ကွက်များ၏ မြောက်ဘက်စွန်းစွန်းသည် ကုန်းတွင်းပိုင်းမှ ၃၅ ကီလိုမီတာအကွာတွင် တည်ရှိပါသည်။ သို့သော် လုပ်ကွက်နေရာ၏ အရှေ့ အနောက်ဆုံးရာ အလယ် မျည်းကြောင်းသည် ကမ်းခြေမှ ၈၀ ကီလိုမီတာအကွာတွင် တည်ရှိပါသည်။ လုပ်ကွက်အမှတ် M5-M6 နေရာအားလုံးသည် ကမ်းလွန်ရေတိမ်ပိုင်း တွင်တည်ရှိသည်။ ဆိုလိုသည်မှာ ရေအနက် ၂၀၀ မီတာထက်နည်းသည့် အနေအထားတွင် ရှိသည်ဟု ဆိုလိုခြင်းဖြစ်သည်။ သို့သော် လုပ်ကွက်နှစ်ခုလုံး၏ အနောက်ဘက်စွန်းစွန်းရှိ ဆင်ခြေလျှောပုံစံ ကမ်းလွန်နေရာသည် သမုဒ္ဒရာအနက် ၂၀၀၀မီတာနှင့်အထက်ရှိသောနေရာဆီသို့ လျှောဆင်းသွားပါသည်။ Preparis ကျွန်းသည် ကပွလီပင်လယ်နှင့် ဘင်္ဂလားပင်လယ်အော်အကြား အကူအသန်းလုပ်သည့်နေရာတွင်တည်ရှိသည်။



Source : Myanmar Information Management Unit (MIMU)

ပုံ (၁) - စီမံကိန်းဧရိယာ၏ တည်နေရာ , လုပ်ကွက်အမှတ် M5 နှင့် M6

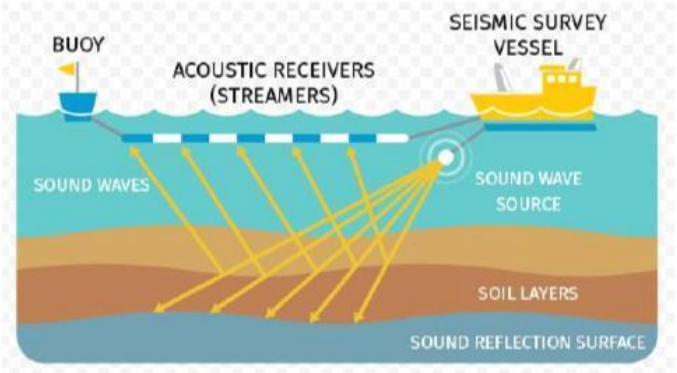
0.1.3 လုပ်ငန်းဆောင်ရွက်မည့် အချိန်ကာလ

စုစုပေါင်းဧရိယာအကျယ်အဝန်း ၂၄၅၄၁ စတုရန်းကီလိုမီတာ သည် အတော်အသင့်ကျယ်သည့် အကျယ်အဝန်းဖြစ်သည့်အတွက် ဆောင်ရွက်မည့်လုပ်ငန်းကာလကို ပိုင်းခြားချိုပြုလုပ်ရမည်ဖြစ်သည်။ သုံးဖက်မြင် ဆိုက်စမစ်တိုင်းတာခြင်း အတွက်အဆင့်သုံးဆင့်ရှိပါသည်။ မုတ်သုံရာသီဥတုမတိုင်မီ ၂၀၁၈ခုနှစ် ဧပြီတွင် တလ၊ ၂၀၁၈ မုတ်သုံရာသီအကုန် ၂၀၁၈-၂၀၁၉တွင် ခုနှစ်လ၊ ၂၀၁၉ မုတ်သုံရာသီအကုန် ၂၀၁၉-၂၀၂၀ တွင် ခြောက်လ လုပ်ကိုင်ဆောင်ရွက်မည် ဖြစ်သည်။ စုစုပေါင်းခန့်မှန်းထားသည့် ကြာချိန်မှာ ရက်ပေါင်း ၄၀၉ ရက်ဖြစ်ပါသည်။

0.2 အဆိုပြုထားသော စီမံကိန်း၏ ရှင်းလင်းဖော်ပြချက်

0.2.1 ဆိုက်စမစ်တိုင်းတာခြင်း

ပင်လယ်ပြင်တွင် ဆိုက်စမစ်တိုင်းတာခြင်းလုပ်ငန်းသည် အထူးသဘော်ဖြင့် ဆွဲယူသွားမည့် စွမ်းအင်အရင်းအမြစ်များမှ ထုတ်လွှတ်လိုက်သည့် အသံလှိုင်းများကို အခြေခံထားပါသည်။ အသံလှိုင်းသည် ပင်လယ်ရေအောက်အလွှာနှင့် အောက်ခံကျောက်သားများကိုဖြတ်သန်းသွားပြီး မတူညီသော အသံလှိုင်းများ (ဥပမာအားဖြင့် မတူညီသောပါဝင်ပစ္စည်းများအကြား ကျောက်သားအမျိုးအစားပြောင်းလဲမှုကြောင့်) အဖြစ်ပြန်လည် သက်ရောက်လာပါသည်။ ထိုသို့တန်ပြန်သက်ရောက်လာသော အသံလှိုင်းစွမ်းအင်ကို ထိုအထူးသဘော်ဖြင့်ပင် ဆွဲလာသည့် ကေဘယ်ကြိုးများ (Streamers) အတွင်းထည့်သွင်းတပ်ဆင်ထားသော အသံလှိုင်းဖမ်းစက်များ (hydrophones) များက လျှပ်စစ်စီးကြောင်းများ အဖြစ်သို့ ပြောင်းလဲပေးပါသည်။ ထိုလျှပ်စစ်စီးကြောင်းများကို အထူးသဘော်ပေါ်ရှိ ဓါတ်ခွဲခန်းမှ မှတ်တမ်းတင်ထားပါမည်။ သုံးဖက်မြင်ဆိုက်စမစ်တိုင်းတာမှုများတွင် hydrophone ထည့်သွင်းတပ်ဆင်ထားသော ကေဘယ်ကြိုးများကို တိုင်းတာရေးသဘော်နောက်တွင် ချိတ်ဆွဲသွားပါမည်။ ပုံမှန်အားဖြင့် ဆိုက်စမစ်ထုတ်လွှင့်သည့် စက် (၂)ခုကို အသုံးပြုပါမည်။



ပုံ (၂) - ပင်လယ်ပြင်တွင် ဆိုက်စမစ်တိုင်းတာ၍ အချက်အလက်ကောက်ယူသည့် နည်းစနစ်

သုံးဖက်မြင်ဆိုက်စမစ်တိုင်းတာရာတွင် အချက်အလက်များကို ပုံ(၂) တွင်ပြထားသည့်အတိုင်း ပြေးလမ်းကြောင်း (racetrack) ပုံစံဖြင့်ရရှိနိုင်ပါသည်။ ထိုပုံစံကိုသုံးခြင်းဖြင့် တိုင်းတာရေးသဘော်လှည့်ရန် လိုအပ်သောအချိန်ကို လျော့ချနိုင်ပြီး ကပ်လျက်ရှိနေသော လမ်းကြောင်းများရှိ အချက်အလက်များကို တူညီသောလားရာဖြင့် မှတ်တမ်းတင်နိုင်ပါသည်။ ထိုလျော့ချရေးနည်းစနစ်သည် အချက်အလက်များအားအဓိပ္ပါယ်ဖော်ရာတွင် အနှောင့်အယှက်ဖြစ်စေသည့် အမှားများကို အနည်းဆုံးဖြစ်စေပါသည်။ ယေဘူယျအားဖြင့် တိုင်းတာမည့် ဧရိယာကို အကွက်ငယ်များအဖြစ်ခွဲခြားပြီး၊ ယင်းအကွက်ငယ်များရှိ နမူနာလမ်းကြောင်းများကို အဆင့်လိုက်တိုင်းတာပါသည်။

မှတ်ချက်။ ဆိုက်စမစ်တိုင်းတာရေးသဘော်ကို M5-M6 လုပ်ကွက်များအပြင်တွင် လှည့်လည်သွားလာရန်အတွက်ကျွမ်းကျင်နိုင်နင်းစွာ စီမံခန့်ခွဲရန် လိုအပ်ပါလိမ့်မည်။ လုပ်ကွက်များအပြင်တွင် ဆိုက်စမစ်တိုင်းတာရေးသဘော်လှည့်လည်စဉ်တွင် ဆိုက်စမစ်လွှင့်ထုတ်သည့် စက်ကို ပိတ်ထားပါမည်။

(ကုမ္ပဏီသည် တိုင်းတာရေးလုပ်ငန်းကို ဆောင်ရွက်ပေးမည့် ဘူမိရူပဆိုင်ရာ ကန်ထရိုက်တာကို မရွေးချယ်ရသေးပါ။ သို့ဖြစ်၍ အောက်တွင်ဖော်ပြထားသော ဆိုက်စမစ်ကိရိယာအကြောင်း ရှင်းပြချက်သည် ယေဘူယျ ပုံစံကိုသာ အခြေခံထားပါသည်။)

ကမ်းလွန်ပင်လယ်ပြင်တွင် ဆိုက်စမစ်တိုင်းတာရာတွင် အောက်ပါကိရိယာများကို အသုံးပြုပါသည်။

- ဆိုက်စမစ်တုန်ခါမှုများကို airguns များဖြင့် ထုတ်လွှတ်ပါသည်။ airguns များသည်ရေအောက်အသံလှိုင်းများကို ထုတ်လွှတ်ရန် အတွက် ဖိသိပ်ထားသောလေကို အသုံးပြုပါသည်။ ယင်းရေအောက်အသံလှိုင်းများက ပင်လယ်ကြမ်းပြင်အောက်တွင် ထိတွေ့သော ဘူမိအလွှာအမျိုးအစားပေါ် မူတည်၍ အနှေး၊အမြန် မတူညီဘဲ ပြန်ထွက်လာပါသည်။ ဆိုက်စမစ်ထုတ်လွှတ်သည့်စက်ကို လျှပ်စီးကြောင်းတခုဖြင့် အသက်ဝင်စေသောအခါ ပတ်ဝန်းကျင်ရှိ ရေထဲသို့ဖိအားပေးထားသော လေပူဖောင်းများကို ထုတ်လွှတ်လိုက်ပါသည်။ ထိုထုတ်လွှတ်သည့်ဖြစ်စဉ်မှာ အလွန်လျင်မြန်ပြီး နောက်တစ်ကြိမ် ပြန်လည်ထုတ်လွှတ်ရန် စက္ကန့်အနည်းငယ်သာကြာမြင့်ပါသည်။ အသံချဲ့ပေးသော ကိရိယာများက ၁၀ မှ ၁၀၀ khertz အထိရှိသော ကြိမ်နှုန်းမြင့် အသံလှိုင်းများအဖြစ် ပြောင်းလဲပေးပါသည်။ အမြင့်ဆုံးထုတ်လွှတ်နိုင်သည့် ပမာဏမှာ တစ်မီတာအကွာအဝေးတွင် ၂၅၄ dB re ၁ µPa ခန့်ဖြစ်ပါသည်။ (ဆိုက်စမစ်ထုတ်လွှတ်သည့် နေရာမှ တစ်မီတာအကွာတွင် ရှိသော အသံလှိုင်း၏ အင်အားဖြစ်ပါသည်။)

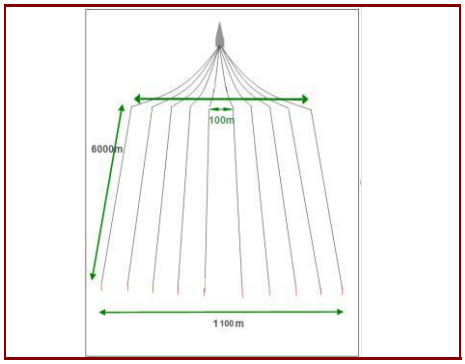
ပုံ (၃) - ဆိုက်စမစ်ထုတ်လွှတ်သည့် စက်

လမ်းကြောင်းတစ်ခုနှင့် တစ်ခုဖြတ်သောနေရာများတွင် ဆိုက်စမစ် တုန်ခါမှုများကို ခန့်မှန်းခြေအားဖြင့် ၁၀ စက္ကန့်တိုင်းတွင် ထုတ်လွှတ်ပါမည်။

- ဆိုက်စမစ်တိုင်းတာရေးသင်္ဘောမှ ချိတ်ဆွဲထားသည့် ဆိုက်စမစ်အသံလိုင်းလက်ခံသည့် ကေဘယ်ကြိုး (seismic streamers)များတွင် အသံဖမ်းကိရိယာ (hydrophones)များ ပါရှိပါသည်။ ထို hydrophone များသည် အောက်ခံကျောက်သားအလွှာမတူခြင်းကြောင့် ပြန်ထွက်လာသော ပဲ့တင်သံများကို ဖမ်းယူပါသည်။ ပဲ့တင်ပြန်လာသော အသံလိုင်းအချက်ပြမှုများကို မှတ်တမ်းတင်ရန်အတွက် ဂကီလိုမီတာရှည်လျားသော တဖက်ပိတ် (သို့) အပိတ်ကေဘယ်ကြိုး ၁၀ ချောင်းကို သင်္ဘောဖြင့်ဆွဲသွားမည်ဖြစ်သည်။ ပဲ့တင်သံများကို analog အချက်ပြလိုင်းများအဖြစ်စုဆောင်းပြီး ဒီဂျစ်တယ်ပုံစံ ပြောင်းလဲကာ သင်္ဘောပေါ်ရှိ ကွန်ပြူတာများအတွင်းသို့ ထည့်သွင်းပါမည်။ ထိုတိုင်းတာမှုပြီးဆုံးချိန်တွင် ဆိုက်စမစ်အချက်အလက် အကြမ်းများကို ကမ်းပေါ်ရှိ တွက်ချက်ရေးဌာနများဆီသို့ ပေးပို့ပြီး ဘူမိဗေဒပညာရှင်များမှ ခွဲခြမ်းစိပ်ဖြာကာ အဓိပ္ပါယ်ဖွင့်ဆိုပါလိမ့်မည်။ ရတန-စိန် reservoirs များ (လေးဖက်မြင် အစိတ်အပိုင်း) ၏ လုပ်ဆောင်ပုံကို နားလည်ရန်နှင့် သုံးဖက်မြင်တိုင်းတာထားသောနေရာ၏ အသေးစိတ်ကျသည့် ဘူမိဗေဒပုံရိပ်ကို တည်ဆောက်ရန် အခြားသောအချက်အလက်များ (ကျောက်သားနမူနာများ၊ ဒေသတွင်းတွင် တူးထားသော တွင်းများမှ ရလာဒ်များ၊ သိရှိထားပြီးသော ဘူမိအချက်အလက်များ စသည်ဖြင့်) နှင့် ရလာဒ်ကို ညှိနှိုင်းပါမည်။

ပုံ (၄) - ပဲ့တင်အသံလိုင်းလက်ခံ ကေဘယ်ကြိုး

- တိုင်းတာမှုတွင် စောင်းနေသည့် streamer ပုံစံကို အသုံးပြုခြင်းအားဖြင့် streamer သည် ပင်လယ်ကြမ်းပြင်ပေါ်တွင် လွဲနေမည့်အစား ရေကော်လံ ထဲသို့ တဖြည်းဖြည်းနစ်ဝင်သွားပါလိမ့်မည်။ ထိုသို့ပြုလုပ်ခြင်းသည် ပင်လယ်မျက်နှာပြင်ပေါ်သို့ ဆိုက်စမစ်လှိုင်းများ တန်ပြန်သက်ရောက်မှုကြောင့် ဖြစ်ပေါ်လာမည့် ghost signal များကိုတွက်ချက်ရာတွင် အထောက်အပံ့ပေးပါလိမ့်မည်။ ထို့ကြောင့် မြေလွှာများ၏ ပိုမိုကောင်းမွန်သည့် ဘူမိဗေဒဆိုင်ရာ ရုပ်ပုံရရှိရန် ယင်းတို့ကိုတွက်ချက်ရမည်ဖြစ်သည်။



ပုံ (၅) – Fan Mode Geometry

- ပြန့်ပြူးသည့်မြင်ကွင်းတွင် paravane များ(ဆိုက်စမစ်လုပ်ငန်းတွင် ၎င်းကို ငှက်ပုံစံကိရိယာအဖြစ်ခေါ်တွင်သည်) နှင့်အတူ streamer များကို ခွဲဖြားခြင်းအားဖြင့် တည်ဆောက်ပါသည်။လက်ခံ ကေဘယ်ကြိုးများအတွက် ပန်ကာလည်သည့် ပုံစံ နမူနာကို ပုံ (၅)တွင် ဖော်ပြထားပါသည်။

နှစ်ဖက်မြင်ဆိုက်စမစ်တိုင်းတာခြင်းသည်လည်း streamer တခုနှင့် source တခု အသုံးပြုသည်မှလွဲ၍ တူညီသည့် လုပ်ငန်းစဉ်သာဖြစ်သည်။ သို့သော်ထိုင်းစုဆောင်းထားသည့် အသေးစိတ်အချက်အလက်များ၏ ရလာဒ်အဆင့်သည် အများကြီးနည်းပါးပါလိမ့်မည်။

0.2.2 ဆိုက်စမစ်တိုင်းတာခြင်းလုပ်ငန်းအတွက် ထောက်ပံ့ဖြည့်ဆည်းရေးကိစ္စရပ်များ

ဆိုက်စမစ်တိုင်းတာရေးလုပ်ငန်းများဆောင်ရွက်ရန်အတွက် အထူးတည်ဆောက်ထားသော ဆိုက်စမစ်လက်ခံကောဘယ်ကြိုးဆွဲသည့် သင်္ဘောတစ်စင်းလိုအပ်ပါသည်။ ကန်ထရိုက်တာအား ထိုအတွက် ရွေးချယ်ထားခြင်းမရှိသေးပါ။ပုံ(၆)တွင် လက်ရှိတိုင်းတာခြင်းလုပ်ကိုင်နေသော သင်္ဘောနှင့် ဆင်တူသည့် ပုံအားဖော်ပြထားပါသည်။ သုံးဖက်မြင် ဆိုက်စမစ်တိုင်းတာခြင်းလုပ်ငန်းကို အပြည့်အဝဆောင်ရွက်နိုင်ရန် သင်္ဘောတွင် အများဆုံး လူ (၇၀)ဦး အထိ နေရာပေးနိုင်ရပါမည်။

သုံးဖက်မြင်တိုင်းတာရေးဆောင်ရွက်မှုတွင်အမှုထမ်း ၂၀ နှင့်အတူ ထောက်ပံ့ရေးသင်္ဘောတစ်စင်းပါရှိပြီး အကူသင်္ဘောများစွာလည်းပါရှိပါသည်။ မည်သည့် အရေးပေါ်ကိစ္စကိုမဆို အထောက်အပံ့ပေးနိုင်ရန်နှင့် တိုင်းတာရေးဇုန်ကို စောင့်ကြည့်နိုင်ရန် အဓိက သင်္ဘောတွင် အကူသင်္ဘောများ လိုက်ပါရပါလိမ့်မည်။

ဤတိုင်းတာရေးလုပ်ငန်းအတွက် တစ်ခုတည်းသော မြေပြင်လုပ်ငန်းမှာ ထောက်ပံ့ရေးသင်္ဘောနှင့် သက်ဆိုင်ပြီး တိုင်းတာရေးသင်္ဘောအတွက် ရိက္ခာနှင့် လောင်စာဆီ ပြန်လည်ထောက်ပံ့နိုင်ရန် ရန်ကုန်မြို့ ဆိပ်ကမ်းကို အသုံးပြုပါမည်။ အဓိက တိုင်းတာရေးသင်္ဘောသည် လိုအပ်ပါက ပင်လယ်ပြင်တွင် လောင်စာဆီဖြည့်တင်းပါသည်။ သို့ရာတွင် ပုံမှန်အားဖြင့် ထိုသင်္ဘောများသည် ကာလရှည်အတွက် လောင်စာဆီလုံလောက်စေရန် စီမံရွေးချယ်ထားသောကြောင့် သင်္ဘောသားများ လဲလှယ်ရန် မလိုအပ်ဟု ယူဆထားပါသည်။

ပုံ (၆) - ဆိုက်စမစ်တိုင်းတာရေး သင်္ဘော၏ ဓါတ်ပုံ

Source: Total E&P

0.2.3 အမှိုက်များ၊ စွန့်ထုတ်ပစ္စည်းများ၊ ထုတ်လွှတ်မှုများကို စာရင်းကောက်ခြင်း

ပထမအမျိုးအစားမှာ သုံးဖက်မြင် ဆိုက်စမစ်တိုင်းတာရေးလုပ်ငန်းများနှင့် ပတ်သတ်နေပါသည်။

- **ရေအောက်အသံဆူညံမှု** - ဆိုက်စမစ်ထုတ်လွှတ်သည့် အတန်းများကြောင့် (တိုင်းတာဖရိယာအတွင်း airguns များဖြင့် ပစ်ခြင်းကြောင့်) အသံဆူညံမှု ဖြစ်ပေါ်လာနိုင်ပါသည်။ သို့သော် ထိုဆူညံမှုမာ ကာလတိုအတွင်းသာဖြစ်ပြီး ပမာဏအားဖြင့် နည်းပါးပါသည်။

ဒုတိယအမျိုးအစားမှာ တိုင်းတာရေးသင်္ဘောများ၏ လှုပ်ရှားမှုများနှင့် ပတ်သတ်နေပါသည်။

- **ရုပ်ပိုင်းဆိုင်ရာ နှောင့်ယှက်မှု** - တိုင်းတာရေးသင်္ဘောများသည် အဓိက သင်္ဘောလမ်းကြောင်းများနှင့် စီးပွားဖြစ် ငါးဖမ်းခြင်းကို အနှောင့်အယှက်ဖြစ်နိုင်ပါသည်။ထို့အပြင် အဏ္ဏဝါ နို့တိုက်သတ္တဝါများ၊ အထူးသဖြင့် ကာကွယ်ထားသော မျိုးစိတ်များအား တိုက်မိခြင်းများဖြစ်နိုင်ပါသည်။
- **လေထုအတွင်းသို့ ထုတ်လွှတ်မှုများ**- တိုင်းတာရေးသင်္ဘောများ၏ ဒီဇယ်အင်ဂျင်များကြောင့် ကမ်းလွန်တိုင်းတာရေးလုပ်ငန်းများမှ လေထုထုတ်လွှတ်မှုများ ရှိပါသည်။ ဤစီမံကိန်းမှ မှန်လုံအိမ်အာနိသင်ဓါတ်ငွေ့ (GHG) ထုတ်လွှတ်မှုမှာ ကာဗွန်ဒိုင်အောက်ဆိုဒ် တန် ၁၃၄၁၃ တန်နှင့် ညီမျှမည်ဟု ခန့်မှန်းထားပါသည်။
- **ရေဆိုးစွန့်ထုတ်မှု** - ရေဆိုးစွန့်ထုတ်မှုမှာ ယေဘူယျအားဖြင့် သင်္ဘောတွင်းနှင့် သန့်ရှင်းရေးမှ ရေဆိုးများ (အမည်းရောင်ရေ နှင့် မီးခိုးရောင်ရေများ) ၊ သင်္ဘောဝမ်းဗိုက်တွင်း နှင့် ကုန်းပတ်မှ ရေများနှင့် သက်ဆုံ ဤစီမံကိန်း ကာလတစ်လျှောက်လုံးအတွက် သင်္ဘောတွင်းနှင့် သန့်ရှင်းရေးမှရေဆိုးမှာ ၂၃၃၁ ကုဗမီတာ ရှိမည်ဟု ခန့်မှန်းထားပြီး၊ သင်္ဘော ဝမ်းဗိုက်နှင့် ကုန်းပတ်မှ ရေဆိုးမှာ ၁၇၀ ကုဗမီတာ ရှိမည်ဟု ခန့်မှန်းပါ သည်။ ထိုရေစီးကြောင်းများကို MARPOL စည်းမျဉ်းနှင့် အညီ သင်္ဘောပေါ်ရှိ ရေသိုလှောင်ရေးနှင့် သန့်စင်ရေးကိရိယာများ အသုံးပြု၍ စီမံခန့်ခွဲပါမည်။
- **အစိုင်အခဲ စွန့်ပစ်ပစ္စည်းများ** - သင်္ဘောများဖြင့် လုပ်ဆောင်ခြင်းကြောင့် အန္တရာယ်ရှိသော စွန့်ပစ်ပစ္စည်းများ နှင့် အန္တရာယ်မရှိသော စွန့်ပစ်ပစ္စည်းများ နှစ်မျိုးလုံးထွက်နိုင်ပါသည်။ တိုင်းတာရေးသင်္ဘောတစ်စီးသည် အရွယ်တူ ကုန်တင်သင်္ဘောတစ်စီးမှ ထွက်ရှိသော စွန့်ပစ်ပစ္စည်းများအတိုင်းပင် ထွက်ရှိပါသည်။ YWB လုပ်ကွက်အတွင်း စမ်းသပ်တူးဖော်ရေးအစီအစဉ်၏ ဆိုက်စမစ်တိုင်းတာရေး လုပ်ငန်းများအတွင်းတွင် တစ်ကိုယ်ရည်သုံး စွန့်ပစ်ပစ္စည်း၄၂ တန်ခန့် ထွက်ရှိမည်ဟု ခန့်မှန်းထားပြီး အန္တရာယ်ရှိသည့် စွန့်ပစ်ပစ္စည်းနှင့် အန္တရာယ်မရှိသည့် စွန့်ပစ်ပစ္စည်းများ ၃၉၀ တန်ခန့် ထွက်ရှိပါလိမ့်မည်။
- **အန္ဒုနှင့်အလင်းရောင်**-လုပ်ငန်းနှင့်ဆက်စပ်မှုမရှိသော အလင်းရောင်များကြောင့် ထိခိုက်နိုင်သောအလားအလာမှာ အလွန်နည်းမည်ဟု မျှော်မှန်းထားပါသည်။ ဆိုက်စမစ်တိုင်းတာရေးလုပ်ငန်းဆောင်ရွက်နေစဉ်အတွင်း ထူးခြားသော အန္ဒုမထွက်ရှိနိုင်ကြောင်း မျှော်မှန်းထားပါသည်။
- **မတော်တဆ ထုတ်လွှတ်မှုများ** - တိုင်းတာရေး သင်္ဘောများရှိ လောင်စာကန်များမှ မမျှော်မှန်းထားသော ယိုစိမ့်မှုများ ရှိနိုင်ပါသည်။

TEPM မှ သတ်မှတ်ထားသော ကုန်းပိုင်းစွန့်ပစ်ပစ္စည်းစွန့်ထုတ်ရမည့် နေရာသည် သာကေတ တွင်ရှိပါသည်။

0.3 လက်ရှိ ပတ်ဝန်းကျင်အခြေအနေဖော်ပြချက်

0.3.1 ရုပ်ပိုင်းဆိုင်ရာ ပတ်ဝန်းကျင်

0.3.1.1 လေထုပတ်ဝန်းကျင်

မြန်မာနိုင်ငံသည် မုတ်သုန်ရာသီလွှမ်းမိုးနေသည့် ပူအိုက်စွတ်စိုသော ရာသီဥတုရှိပါသည်။ မြန်မာနိုင်ငံ၏ ရာသီဥတုကို အားကောင်းသော မုတ်သုန်လေစီးကြောင်းများရှိသည့် ပုံမှန်မုတ်သုန်ရာသီ၊ နေရောင်ခြည် အသင့်အတင့်ရရှိမှု၊ မိုးရေချိန်များခြင်း (ကမ်းရိုးတန်းဒေသများတွင် နှစ်စဉ်မိုးရေချိန် ၅၀၀၀ မီလီမီတာကျော် ရရှိပါသည်) နှင့် လေထုစိုထိုင်းဆများခြင်းတို့ဖြင့် ဖော်ပြနိုင်ပါသည်။ မြန်မာနိုင်ငံ၏ အပူချိန်မှာ ၁၉ °C မှ ၃၈ °C အကြားရှိပြီး၊ လေထုစိုထိုင်းဆမှာ ၆၆% မှ ၈၃% အထိရှိပါသည်။ M5-M6 ဆိုက်စမစ်တိုင်းတာသည့် စီမံကိန်းကာလအတွင်း (ဇူလိုလနှင့် အောက်တိုဘာ မှ မတ်/ဇူလိုင်) မိုးအနည်းငယ်ရွာသွန်းနိုင်ချေရှိသည်ဟု ခန့်မှန်းထားပြီး အောက်တိုဘာလတွင် ရွာသွန်းနိုင်ချေအများဆုံး ရှိပါသည်။

ရတန နှင့် စိန်ဓါတ်ငွေ့ထုတ်လုပ်ရေးလုပ်ငန်းများနှင့် သဘော်များသွားလာမှုကြောင့် M5-M6 ရှိလေထုအရည်အသွေးကို ထိခိုက်စေနိုင်ပါသည်။ သို့သော် လုပ်ကွက်၏ အကျယ်အဝန်းကြောင့် ထိခိုက်စေမှုမရှိနိုင်ပါ။ ရန်ကုန်ဆိပ်ကမ်းမှ သယ်ယူပို့ဆောင်သည့် သဘော်များလုပ်ဆောင်ခြင်းသည်လေထုအရည်အသွေးကိုထိခိုက်စေနိုင်ပါသည့် စိုးရိမ်ရမည့် အချက်ဖြစ်ပါသည်။

ရေပြင်၏ ထိခိုက်နိုင်မှု (sensitivity) မှာ အလွန်နည်းပါးသည်ဟု အဆင့်သတ်မှတ်ပါသည်။

0.3.1.2 ကမ်းလွန်ပင်လယ်ပြင်ရှိ အနည်အနှစ်များ (နှန်းများ)

တိုင်းတာရေးနယ်မြေမှ မြောက်ဘက် ၃၅ ကီလိုမီတာအကွာတွင်ဇရောဝတီမြစ်ဝကျွန်းပေါ်ဒေသရှိပြီး စီမံကိန်းနေရာနှင့်နီးကပ်နေသောကြောင့် အပေါ်ယံအလွှာများ အလျင်အမြန် အသစ်ပြန်လည် ဖြစ်ပေါ်သည့် နှန်းဖြစ်ပေါ်မှုနှုန်းမှာလည်း မြင့်မားမည်ဟု ခန့်မှန်းထားပါသည်။

ကမ်းလွန်ပင်လယ်ပြင် နှန်းဖြစ်ပေါ်နိုင်မှု (sensitivity) မှာ အလွန်နည်းပါးသည်ဟု အဆင့်သတ်မှတ်ပါသည်။

0.3.1.3 ရေအရည်အသွေး

လုပ်ကွက်အမှတ် M5-M6သည် ရေအနက်၁၀၀ မီတာဝန်းကျင်တွင် တည်ရှိပြီး စီမံကိန်းနေရာတွင် ရေအနက်မှာ ၁၀မှ ၂၀၀၀ မီတာနှင့်အထက်ရှိပါသည်။ဇရောဝတီမြစ်ရေဝင်ရောက်မှုမှာ စီမံကိန်းလုပ်ကွက်များ၏ မြောက်ဘက် သုံးပုံနှစ်ပုံခန့် အထိ သက်ရောက်လျက်ရှိသည်။

ရေအရည်အသွေး ထိခိုက်နိုင်မှု (sensitivity) မှာ အလွန်နည်းပါးသည်ဟု အဆင့်သတ်မှတ်ပါသည်။

0.3.2 သက်ရှိဇီဝ ပတ်ဝန်းကျင်

0.3.2.1 Plankton မျောလေးများ(ရေထဲ၌ တွေ့ရသော အနုဇီဝသက်ရှိများ) အုပ်စုများ

စီမံကိန်းနယ်မြေတွင် ဂဏန်းငယ်များ၊ မျောလှေစားပုစွန်ငယ်များနှင့် အင်းစက်စားအကောင်ငယ်များ၏ ပေါများမှုမှာ နည်းပါးသော်လည်း မြန်မာနိုင်ငံ၏ ရေပြင်ပိုင်နက်တောင်ပိုင်းတွင် ယခင်ကပြုလုပ်ခဲ့သော ပတ်ဝန်းကျင်ဆိုင်ရာအခြေခံကောက်ယူသည့် တိုင်းတာမှုများလုပ်ခဲ့စဉ်အတွင်း zooplankton အုပ်စုဝင်များ (calanoik

copepods, poecilostamatioid copepods, arrow worms များအပါအဝင်) ကို ပေါများစွာတွေ့ရှိခဲ့ပါသည်။ မကြာသေးမီအထိ မျှောလွှေများကို ဆိုက်စမစ်တိုင်းတာရေးအတွက် စိုးရိမ်မှုနည်းပါးသည့် နယ်မြေအဖြစ်စဉ်းစားခဲ့သည်။ သို့သော် မကြာသေးမီက တွေ့ရှိချက်များအရ ထိုအချက်ကိုပြန်လည်စဉ်းစားရန် ထောက်ပြထားပါသည်။

***Plankton* မျှောလွှေးအုပ်စုများ၏ ထိခိုက်နိုင်မှု (*sensitivity*) အဆင့်မှာ အလွန်နည်းပါးသည်ဟု သတ်မှတ်ပါသည်။**

0.3.2.2 ငါးများ

မုတ်သုန်စနစ်၏ ရာသီအလိုက်ပြောင်းလဲမှုများက လွှမ်းမိုးထားသောကြောင့် Pleaginc ငါးအုပ်စုများကို နေရာအနှံ့အပြားတွင် အများအားဖြင့် တွေ့ရှိရပါသည်။ ထိုငါးအုပ်စုတွင် မျိုးစိပ်များစွာပါဝင်ပြီး ၎င်းတို့ကို အိန္ဒိယသမုဒ္ဒရာ တစ်ခုလုံးတွင် တွေ့ရှိရပါသည်။

ငါးမျိုးစိပ်များ၏ ထိခိုက်နိုင်မှု (sensitivity) အဆင့် မှာ အသင့်အတင့် ရှိသည်ဟု သတ်မှတ်ပါသည်။

0.3.2.3 ပင်လယ်ပြင်နို့တိုက်သတ္တဝါများ

ကပ္ပလီပင်လယ်ပြင်တွင် IUCN အဖွဲ့က ထိခိုက်နိုင်မှု (Vulnerability) အဆင့်အမျိုးမျိုးဖြင့် မှတ်တမ်းတင်ထားသော နို့တိုက်သတ္တဝါမျိုးစိတ် (၂၉) မျိုးရှိသည့်အနက်၊ စီမံကိန်းဧရိယာအတွင်းတွင် (၂၁)မျိုးကို တွေ့ရှိရနိုင်ပါသည်။

- ဂေလငါးပြာ (Blue Whale – Balaenoptermusculus) နှင့် ဆူးတောင်ပါဂေလငါး (Balaenopteraphysalus) မျိုးစိတ် (၂) မျိုးတို့မှာ မျိုးသုဉ်းလုနီးပါး (EN) အဆင့်တွင် ပါဂင်ပြီး၊ သဘာဂအခြေအနေတွင် မျိုးသုဉ်း ပျောက်ကွယ်တော့မည့် အလားအလာမြင့်မားပါသည်။
- Sperm Whale (Physetermacrocephalus) ဂေလငါးမျိုးစိတ်မှာ မျိုးသုဉ်းလွယ် (VU) အဆင့်တွင် ပါဂင်ပြီး၊သဘာဝအခြေအနေတွင် မျိုးသုဉ်းပျောက်ကွယ်တော့မည့် အလားအလာမြင့်မားသည်။

ပင်လယ်နို့တိုက်သတ္တဝါ ထိခိုက်နိုင်မှု (sensitivity) အဆင့်မှာ မြင့်မားသည်ဟု သတ်မှတ်သည်။

0.3.2.4 လိပ်များ

မြန်မာနိုင်ငံ ကမ်းရိုးတန်းတစ်လျှောက်ရှိ ကမ်းခြေအချို့ကို ကာကွယ်ထားသော လိပ်မျိုးစိတ်(၅)မျိုးအတွက် သားပေါက်ရာ နေရာများအဖြစ် သတ်မှတ်ထားပါသည်။ ယင်း မျိုးစိတ် (၅)မျိုးမှာ **Olive Ridley Turtle, Loggerhead Turtle, Green Turtle, Hawksbill Turtle နှင့် Leather Back Turtle** တို့ဖြစ်ကြပါသည်။

ထိုမျိုးစိတ်များကို နိုင်ငံတကာတွင် ကာကွယ်ထားပြီး IUCN red list တွင်လည်း မျိုးသုန်းလွယ် (သို့) မျိုးသုန်းလုနီးပါး (VU or EN) အဆင့်သတ်မှတ်ထားပါသည်။ လိပ်များသည် စက်တင်ဘာလကုန်မှ မတ်လအတွင်း (အများဆုံးမှာ ဇန်နဝါရီလမှဖေဖော်ဝါရီလအတွင်း) တွင် မြန်မာကမ်းခြေများသို့ လာရောက်ပါသည်။ ထို့ကြောင့်စီမံကိန်းနယ်မြေသည် လိပ်များ၏ ရွှေ့ပြောင်းရာလမ်းကြောင်းပေါ်တွင် ကျရောက်နိုင်ချေရှိပါသည်။ ကာကွယ်ထားသည့် ရေတိမ်ပိုင်းဒေသ (ရေအနက်၂၂ မှ ၂၅ မီတာအထိ) တွင် ကမ်းရိုးတန်းမှ ၁၅ ကီလိုမီတာခန့်၊ စီမံကိန်းနယ်မြေမှ မဝေးလှသော အကွာအဝေးတွင် လိပ်များကို အများဆုံး တွေ့ရှိရပါသည်။ သို့သော်လည်းထိုလိပ်မျိုးစိတ်များမှာ ရွှေ့ပြောင်းသွားလာနေသည့် မျိုးစိတ်များဖြစ်သည့်အတွက် အချို့သော မျိုးစိတ်များကို စီမံကိန်းဧရိယာ အတွင်းတွင်လည်း တွေ့ရှိနိုင်ပါသည်။

လိပ်မျိုးစိပ်များ၏ ထိခိုက်နိုင်မှု (sensitivity) အဆင့်မှာ မြင့်မားသည်ဟု သတ်မှတ်သည်။

0.3.2.5 အက္ကာဝါ ငှက်မျိုးစိတ်များ

မြန်မာနိုင်ငံရေပြင်ပိုင်နက်တွင် အက္ကာဂါငှက်မျိုးစိတ် စုစုပေါင်း (၂၀) မျိုးကို IUCN အဖွဲ့မှ မှတ်တမ်းတင်ထားပါသည်။ ယင်းတို့အနက် (၄)မျိုးမှာ ခြိမ်းခြောက်ခံရလုနီးပါး (near threatened) အဆင့်နှင့် ကျန် (၁၆) မျိုးမှာ သာမန် (least concern) အဆင့်ဖြစ်ပါသည်။

အက္ကာဂါငှက်များ၏ ထိခိုက်နိုင်မှု (sensitivity) မှာ နည်းပါးသည့် အဆင့်ဟု သတ်မှတ်ပါသည်။

0.3.2.6 *Benthic* မျောလှေး (ပင်လယ်ကြမ်းပြင်၌ တွေ့ရသော အနုဇီဝသက်ရှိများ) အုပ်စုများ

ဧရာဝတီကမ်းရိုးတန်းဒေသ၏ နေရာများအတွင်း စီမံကိန်း၏ နေရာအများစုမှာကမ်းလွန်ရေတိမ်ပိုင်းတွင် တည်ရှိပါသည်။ ထို့ကြောင့် မျောလှေးအုပ်စုများကိုအနည်းငယ် အနှောင့်အယှက်ဖြစ်စေနိုင်သည်ဟု ယူဆရပါသည်။ ထိုအုပ်စုဝင်များသည် အစာကွင်းဆက်အတွက် အရေးကြီးသည့် အုပ်စုဖြစ်ပါသည်။

***Benthic* မျောလှေးအုပ်စုများ၏ ထိခိုက်နိုင်မှု (*sensitivity*) မှာ အလွန်နည်းပါးသည်ဟု အဆင့်သတ်မှတ်ပါသည်။**

0.3.2.7 ဒီရေတောများ

ဒီရေတောများသည် အရေးကြီးသည့်ဂေဟစနစ်တွင် ပါဝင်ပါသည်။ ဒီရေတောသည် ငါးပေါက်လေးများ သီးသန့်နေသည့် နေရာတခုဖြစ်ပါသည်။ဧရာဝတီမြစ်ဝကျွန်းပေါ်ဒေသ၏ ဒီရေတောများသည် လူတို့၏လုပ်ဆောင်မှုများနှင့် စိုက်ပျိုးရေးမြေအဖြစ် ပြောင်းလဲမှုအများကြီးကို တွေ့ကြုံနေရပါသည်။ သို့သော်လည်း ၎င်းတို့သည် စီမံကိန်းနယ်မြေမှ ၃၅ ကီလိုမီတာအကွာတွင် တည်ရှိပါသည်။

ဒီရေတောများ၏ ထိခိုက်နိုင်မှု (sensitivity) အဆင့်မှာ နည်းပါးသည်ဟု သတ်မှတ်ပါသည်။

0.3.2.8 သန္တာကျောက်တန်း ဂေဟစနစ်

တိုင်းတာရေးဇုန်၏ အနောက်တောင်ဘက်ရှိ Preparis ကျွန်း၏ သန္တာကျောက်တန်းများသည် ဧရာဝတီမြစ်ဝကျွန်းပေါ်ဒေသမှ ရေချိုများနှင့် နုန်းများရှိသည့် နေရာ၏ အပြင်ဘက်တွင် တည်ရှိပါသည်။Prepairs ကျွန်းနှင့်ကိုးကိုးကျွန်းတို့ဆီသို့ ဦးတည်လျက် ရခိုင်တောင်များဆီချဲ့ထွင်သွားသော လမ်းကြောင်းတလျှောက်ရှိ ရေတိမ်ပိုင်းတွင် ရှိလိမ့်မည်ဟု မျှော်လင့်ရပါသည်။ ဒါ့အပြင် အကယ်၍ ကျောက်တန်းများတွင်နေထိုင်ပြီး ရွှေ့လျားသွားလာနိုင်သော မျိုးစိတ်များ (ငါးများအပါအဝင်) ကို အနှောင့်အယှက်ဖြစ်စေခဲ့လျှင် ၎င်းတို့သည် ကျောက်တန်းများမှ ထွက်ခွာရန် မဖြစ်နိုင်ပါ။

သန္တာကျောက်တန်းဂေဟ စနစ်များ၏ ထိခိုက်နိုင်မှု (sensitivity) အဆင့်မှာ မြင့်သည်ဟု သတ်မှတ်ပါသည်။

0.3.2.9 ထိခိုက်နိုင်မှု နှင့် ထိန်းသိမ်းရေးနယ်မြေများ

ကမ်းရိုးတန်းနှင့် နီးကပ်စွာ တည်ရှိနေသော တရားဝင်ဖော်ပြထားသည့် ထိန်းသိမ်းရေးနယ်မြေများမှာ ကျွန်းများပင်ဖြစ်ပါသည်။ အချို့မှာ စီမံကိန်း၏ မြောက်ဘက် ၃၅ ကီလိုမီတာအကွာတွင် ရှိပါသည်။ Preparis ကျွန်းသည် သန္တာကျောက်တန်းများဝန်းရံကာ သဘာဝအတိုင်းရှိနေသော်လည်း အထူးထိန်းသိမ်းကာကွယ်ရမည့် နယ်မြေအဖြစ် ဖော်ပြထားခြင်းမရှိပါ။

ထိခိုက်နိုင်မှု နှင့် ထိန်းသိမ်းရေးနယ်မြေများ၏ ထိခိုက်လွယ်မှု အဆင့်မှာ နည်းပါးသည်ဟု သတ်မှတ်ပါသည်။

0.3.3 လူမှုစီးပွားဆိုင်ရာ ပတ်ဝန်းကျင်

0.3.3.1 ငါးဖမ်းလုပ်ငန်းများ

စီမံကိန်းနေရာသည် စတုရန်းကီလိုမီတာ ၄၈၀၀၀၀ ကျော်ရှိသော ကမ်းဝေးငါးဖမ်းဇုန်တွင် တည်ရှိပြီး လိုင်စင်ရဒေသခံ ငါးဖမ်းသင်္ဘော ၂၀၀၀ခန့်ကသာအသုံးပြုနေပါသည်။ သို့သော်လည်း ကမ်းဝေးငါးဖမ်းဇုန်တွင်(ကမ်းနီးငါးဖမ်းဇုန်တွင် ငါးဖမ်းသင်္ဘော ၃၀၀၀ ရှိပြီး ကမ်းဝေးငါးဖမ်းဇုန်တွင် ၂၀၀၀ခန့်သာရှိပါသည်) ငါးဖမ်းရန် ခွင့်ပြုထားသည့်ငါးဖမ်းသမားများနည်းပါးခြင်း ၊ လုပ်ကွက်၏တည်နေရာ၊ ငါးဖမ်းကွက်များ၏ ပြင်ပတွင်ရှိနေခြင်းနှင့် မြန်မာရေပိုင်နက်တွင် နိုင်ငံခြားသင်္ဘောများငါးဖမ်းခြင်းကို တားဆီးထားခြင်း(တရားမဝင်ငါးဖမ်းသမားများအားလျော့ချခြင်း)တို့ကြောင့် ငါးဖမ်းသမားများနှင့် ထိတွေ့ဆက်ဆံရမှု နည်းပါးမည်ဟုခန့်မှန်းထားပါသည်။ စီပွားရေးအရ ငါးဖမ်းခြင်းသည် အရေးကြီးပြီး ဒီရေတောများဆုံးရှုံးမှုကလည်း ငါးဖမ်းခြင်းကို ထိခိုက်စေနိုင်ပါသည်။

ငါးဖမ်းခြင်း၏ ထိခိုက်နိုင်မှုအဆင့်မှာ အလယ်အလတ်အဆင့် ဟု သတ်မှတ်ထားပါသည်။

0.3.3.2 ပင်လယ်ရေကြောင်းလမ်း

စီမံကိန်းနယ်မြေသည် ရန်ကုန်မှ Cape of Good Hope ဆီသို့ ဖြတ်ရာ သင်္ဘောလမ်းကြောင်းတွင် တည်ရှိပါသည်။ Cape of Good Hope သည် ရတန-စိန် နယ်မြေများနှင့် နီးကပ်စွာတည်ရှိနေပြီး လုပ်ကွက်ကိုဖြတ်သွားသည့် လမ်းကြောင်းတဝက်ကို ကမ်းလွန် ထောက်ပံ့ရေးသင်္ဘောများက အသုံးပြုပါသည်။ဘင်္ဂလားဒေ့ရှ် မှ စင်ကာပူသို့ သွားသည့်လမ်းကြောင်း (Malacca Strait) သည် ထိုလုပ်ကွက်ကို ဖြတ်သန်းသွားပြီး စင်ကာပူ မှ NE အိန္ဒိယဆီသို့ သွားသည့် လမ်းကြောင်းသည် လုပ်ကွက်၏ အနောက်တောင်ကို ဖြတ်သန်းသွားပါသည်။ M5-M6 တွင် Preparis ကျွန်းရှိသောကြောင့် တိုင်းတာရေးသင်္ဘော၏ တည်နေရာအပေါ်မူတည်၍ သင်္ဘောများကို လမ်းကြောင်းမှန်စွာ ဖြတ်သန်းသွားနိုင်ရန်အတွက် ကြိုတင်ခန့်မှန်းရပါမည်။
စီးပွားရေးသုံး သင်္ဘောများကို စီမံကိန်းနယ်မြေတွင် တွေ့ရှိရန် မျှော်လင့်ရပါသည်။

ပင်လယ်ရေလမ်းကြောင်း၏ ထိခိုက်နိုင်မှုမှာ အလယ်အလတ် အဆင့်ဟု သတ်မှတ်ထားပါသည်။

0.4 အဆိုပြုထားသောစီမံကိန်း၏ ပတ်ဝန်းကျင်ဆိုင်ရာထိခိုက်မှုများနှင့် လျော့ပါးစေရေးနည်းလမ်းများ

ဆန်းစစ်မှုကို အဓိက အဆင့် (၃)ဆင့်ဖြင့် ဆောင်ရွက်ခဲ့ပါသည်။

- စီမံကိန်းအကြောင်းအရာဖော်ပြချက်မှတစ်ဆင့် ထိခိုက်နိုင်သော အရင်းအမြစ်များ (impact source) ကို သတ် မှတ်ဖော်ထုတ်ခြင်းနှင့် ကနဦးအခြေအနေဖော်ပြချက်များမှတစ်ဆင့် ပတ်ဝန်းကျင်၏ ထိခိုက်နိုင်မှု (environmental sensitivity) ကို သတ်မှတ်ဖော်ထုတ်ခြင်း။
- ထိခိုက်နိုင်သောအရင်းအမြစ်တစ်ခုချင်းဆီမှပတ်ဝန်းကျင်အစိတ်အပိုင်းတစ်ခုချင်းအပေါ် ထိခိုက်နိုင်မှုများကို ခန့်မှန်းခြင်း။

- ဖြစ်နိုင်ချေရှိသော ထိခိုက်မှုများကိုထိန်းချုပ်ရန်နှင့် လျော့ချရန်အတွက်လျော့ပါးစေရေးနည်းလမ်းများကို သတ်မှတ်ဖော်ထုတ်ခြင်းနှင့်ထိုနည်းလမ်းများကို အကောင်အထည်ဖော်ပြီးပါက ကြွင်းကျန်နိုင်သော ထိခိုက် မှု (recidual impacts) များကို ခန့်မှန်းခြင်း။

လေ့လာဆန်းစစ်မှုအရ ပတ်ဝန်းကျင်နှင့် လူမှုစီးပွားဆိုင်ရာ အခြေအနေတို့အပေါ် အဓိကထိခိုက်မှုများမှာ -

- ဆိုက်စမစ်တိုင်းတာခြင်းလုပ်ငန်းများ (airguns များ) မှ ထုတ်လွှတ်သော ဆူညံသံသည် အချို့သော အက္ကာပါနို့တိုက်သတ္တဝါများ၊ လိပ်နှင့် ငါးမျိုးစိတ်များ၏ အပြုအမူအပေါ် ထိခိုက်မှုများရှိနိုင်ပါသည်။
- ပုံမှန်အားဖြင့် ရေတိမ်ပိုင်းအောက်ခြေများနှင့် ရေထဲသို့ တိုးချဲ့ပြီး အသုံးပြုသော streamer များ အသုံးပြုခြင်းကြောင့် သန္ဓာကျောက်တန်းတို့အပေါ် တိုက်ရိုက် ထိခိုက်နိုင်မှု ရှိပါသည်။
- တိုင်းတာရေးသင်္ဘောများရှိခြင်းကြောင့် ကုန်သွယ်ရေလမ်းကြောင်းနှင့် ကမ်းပေးငါးဖမ်းလုပ်ငန်းကဏ္ဍတို့ အပေါ် အလွန်နည်းသော ထိခိုက်မှုများ ရှိနိုင်ပါသည်။

အောက်ပါဇယားတွင် စီမံကိန်းမှ ပြုပြင်ရေးနည်းလမ်းများ သို့မဟုတ် လျော့ပါးစေရေးနည်းလမ်းများကို အကောင်အထည်ဖော်ပြီးနောက် ကြွင်းကျန်နိုင်သော ထိခိုက်မှုများကို ဖော်ပြထားပါသည်။ `လစ်လျူရှုနိုင်သော´ အဆင့်အဖြစ် စဉ်းစားသော ထိခိုက်မှု (၇)ခု နှင့် `အသေးစား´ အဆင့်အဖြစ် စဉ်းစားသော ထိခိုက်မှု (၂) ခုပါဝင်ပါသည်။

0.4.1 ပတ်ဝန်းကျင်ဆိုင်ရာ ထိခိုက်မှုများနှင့် လျော့ပါးစေရေးနည်းလမ်းများ

Table 0.1 ဖြစ်နိုင်သော ထိခိုက်မှုများကို စုစည်းဖော်ပြခြင်း - ရုပ်ပိုင်းဆိုင်ရာနှင့် သဘာဝအစိတ်အပိုင်းများ

ကြွင်းကျန်နိုင်သော ထိခိုက်မှုများအကြောင်း ဖော်ပြချက်	ကြွင်းကျန်နိုင်သော ထိခိုက်မှု (R)
လေထုအရည်အသွေး	
ဆိုက်စမစ်တိုင်းတာခြင်းလုပ်ငန်းများမှ လေထုတွင်းသို့ ထုတ်လွှတ်မှုများမှာ အချိန်နှင့်နေရာအားဖြင့်အကန့်အသတ်ဖြင့်သာထုတ်လွှတ်သည်ဟု စဉ်းစားပါသည်။ထိုထုတ်လွှတ်မှုများမှာ ပုံမှန်ကုန်သွယ်သင်္ဘောတစ်စင်းမှ ထုတ်လွှတ်မှုများနှင့် ဆင်တူပါသည်။ သို့သော်လည်း ရန်ကုန်ဆိပ်ကမ်းတွင်ပုံမှန် အသုံးပြုနေသော ထောက်ပံ့ရေးသင်္ဘောများရှိပါသည်။ ထိုနေရာတွင် လေအရည်အသွေးမှာ ကြီးမားသည့် ကိစ္စရပ်တခုဖြစ်ပြီး ဖန်လုံအိမ်ဓါတ်ငွေ့ ပူနွေးလာမှု၊ သမုဒ္ဒရာတွင် အက်ဆစ်ဖြစ်ပေါ်မှုများသည် တစ်ကမ္ဘာလုံးဆိုင်ရာ ပြဿနာဖြစ်သည့်အတွက် မြန်မာနိုင်ငံကိုလည်းထိခိုက်စေနိုင်ပါသည်။ သင်္ဘောစွမ်းအင်အကျိုးရှိစေရေး စီမံခန့်ခွဲမှုတွင်အဓိကသင်္ဘောတစ်စင်းပါရှိမည်ဖြစ်ပြီး ဆာလဖာပါဝင်မှုနည်းသည့်လောင်စာ (၀.၅%ထက်နည်းသည့် ပါဝင်မှု) ကို အသုံးပြုပါလိမ့်မည်။	လစ်လျူရှုနိုင်သည့် အဆင့်
ကမ်းလွန် အနည်အနှစ်များ (နုန်းများ)	
စီမံကိန်းသည် မြစ်ဝကျွန်းပေါ်ဒေသနှင့် နီးကပ်စွာတည်ရှိနေပါသည်။ ထိုနေရာတွင် နုန်းပို့ချသည့်နှုန်းမှာ သဘာဝအားဖြင့် မြင့်မားပြီးနုန်းများရွှေ့လျားမှုမှာ အရေးကြီးသည့် ကိစ္စတစ်ခုမဟုတ်ပါ။ MAPROL စည်းမျဉ်းအရ ရေပေါ်တွင်ပေါ်နိုင်သည့် စွန့်ပစ်ပစ္စည်းများမှလွဲ၍ ရေအောက်သို့ကျနိုင်သည့် စွန့်ပစ်ပစ္စည်းများကိုသန့်စင်ပြီး သင်္ဘောပေါ်တွင် စွန့်ပစ်ပစ္စည်းများမရှိရအောင် ဆောင်ရွက်ပါလိမ့်မည်။	လစ်လျူရှုနိုင်သည့် အဆင့်
ရေထုထည်	

စီမံကိန်းသည် စွန့်ထုတ်မှု လုံးဝမရှိသည့်စည်းမျဉ်းကို ရေယာဉ်များအတွက် ကုန်းပတ်ပေါ်ရှိရေများအားလျော့ချမှုလုပ်ဆောင်ရာတွင် ဆောင်ရွက်ပါလိမ့်မည်။ သဘော်ပေါ်ရှိ ဆီသိုလှောင်ကန်များတွင် ဆီဖြည့်တင်းခြင်း၊ မိလ္လာရေများ (သို့)စွန့်ပစ်ပစ္စည်းများစွန့်ထုတ်မှု ကို မှောင်သည့်အချိန်များတွင် မပြုလုပ်ပါ။ ဆီဖြည့်တင်းနေစဉ်အတွင်း ယိုဖိတ်မှုအနည်းငယ်ကို ထိန်းထားနိုင်ရန် SOPEPsကို ယိုဖိတ်မှု တုံ့ပြန်သည့် လုပ်ထုံးလုပ်နည်းတွင် ထည့်သွင်းလုပ်ဆောင်ပါမည်။	လစ်လျူရှုနိုင်သည့် အဆင့်

Plankton မျောလှေးအုပ်စုများ

Plankton မျောလှေးများအပေါ် ထိခိုက်မှုကို ဆိုက်စမစ်အသံလှိုင်းလွှင့်ထုတ်သည့်နေရာအနီး (၅) မီတာပတ်လည်တွင် ယေဘုယျအားဖြင့် တွေ့ရပါသည်။ အစဉ်အလာအားဖြင့် မျောလှေများသည် ဂရုစိုက်ရမည့် အကြောင်းအရာဖြစ်သော်လည်း ၎င်းတို့အပေါ် တွင် ဆိုက်စမစ်လုပ်ငန်းများမှ သက်ရောက်မှုများကို စာရင်းအင်းဖြင့် အတိအကျဖော်ပြ စဉ်းစားထားခြင်းမရှိခဲ့ပါ။ သက်ရောက်မှုများ၏ အခြားသော အရင်းအမြစ်အားလုံးကို ထုတ်လွှတ်မှု လုံးဝမရှိစေရေးစဉ်းမျဉ်း (zero discharge policy) နှင့် ယိုဖိတ်မှုကြိုတင်ကာကွယ်ရေး နည်းလမ်းများ (ညအမှောင်အချိန်တွင် မည်သည့်အရာမှ မထုတ်လွှတ်ရ) အရ တွက်ချက်ပါသည်။	လစ်လျူရှုနိုင်သည့် အဆင့်

အဏ္ဏဝါ နှိုတိုက်သတ္တဝါများ

အဏ္ဏဝါနှိုတိုက်သတ္တဝါများသည် ရေအောက်ဆူညံမှုများကြောင့် ထိခိုက်နိုင်သော်လည်း၊ အနီးကပ် စောင့်ကြည့်ခြင်းဖြင့် ရုပ်ပိုင်းဆိုင်ရာထိခိုက်မှုများ၊ အမူအကျင့်ပိုင်း ထိခိုက်မှုများ (ရေအောက်ငုပ်ခြင်း၊ အသက် ရှူခြင်းပုံစံများ၊ အသံပြုခြင်းပုံစံများ)၊ ရွှေ့ပြောင်းမှုကို နှောင့်ယှက်မှုများ၊ အချင်းချင်းဆက်ဆံရေးတွင် ပြောင်း လဲမှုများ စသည်တို့အပါအဝင် ဘူမိရူပတိုင်းတာမှုများကြောင့် ထိခိုက်မှုများကို သိသာစွာလျော့ချ နိုင်ပါသည်။ ဆိုက်စမစ်လုပ်ဆောင်မှု၏ soft-start procedure သည် ဝေလငါးကြီးများကို ထိုနေရာမှ ထွက်ခွာရန် အချိန်ပေးပါလိမ့်မည်။ ညအချိန်တွင် ရှာဖွေမှုများကို အသံထိန်းချုပ်ရေးစနစ် (PAM)(သို့) အလင်းရောင်ချွေ့ကားခြင်းစနစ်များ (သို့) အနီအောက်ရောင်ခြည်များ အသုံးပြု၍ ထိန်းသိမ်းပါမည်။ ထိုလုပ်ဆောင်ချက် ကာလအတွင်း အဏ္ဏဝါနှိုတိုက်သတ္တဝါစောင့်ကြည့်သူ (MMO)၏ မှန်ကန်သည့်အဆင့်ကိုထိန်းသိမ်းထားနိုင်ရန် အဏ္ဏဝါနှိုတိုက်သတ္တဝါ ရှာဖွေသည့် ကျွမ်းကျင်ပညာရှင် နှစ်ယောက်လိုအပ်ပါလိမ့်မည်။	အလယ်အလတ် အဆင့်

လိပ်များ

အဏ္ဏဝါနှိုတိုက်သတ္တဝါစောင့်ကြည့်သူ (MMO) များဖြင့်လိပ်မျိုးစိတ်များအား အနီးကပ်စောင့်ကြည့်ခြင်း နည်းလမ်းဖြင့် ရုပ်ပိုင်းဆိုင်ရာ ထိခိုက်မှုများ၊ အမူအကျင့်ပိုင်းထိခိုက်မှုများ (အထူးသဖြင့် သားပေါက် သောအခါ)၊ ရွှေ့ပြောင်းမှုကို နှောင့်ယှက်မှုများ စသည်တို့အပါအဝင် ဘူမိရူပတိုင်းတာမှုများကြောင့် လိပ်များအပေါ် ထိခိုက်မှုများကို သိသာစွာ လျော့ချနိုင်ပါသည်။ Soft start procedure သည် ဆိုက်စမစ် ပစ်လွှတ်မှု မစခင် ထိုနေရာများမှ လိပ်များထွက်ခွာရန် အချိန်တခုပေးပါလိမ့်မည်။ နောက်ယောင်ခံသည့်စက် ကိုအသုံးပြုခြင်းအားဖြင့် လိပ်များ သေဆုံးခြင်း နှင့် ဆုံးရှုံးခြင်းများကို ရှောင်ရှားနိုင်ပါသည်။ ထို့အပြင် တစောင်းပုံစံ streamer များအသုံးပြုခြင်းသည် ပင်လယ်ရေမျက်နှာပြင်ပေါ် တလျောက်streamerများမသွားခြင်းအားဖြင့် လျော့ချစေနိုင်ပါသည်။	အလယ်အလတ် အဆင့်

ပင်လယ်ရေပေါ်ရေလွှာနေငါးမျိုး

အရွယ်ရောက်ငါးများ - စီမံကိန်းဇရိယာအတွင်းတွင် (IUCN အဖွဲ့မှ မျိုးသုန်းရန် အန္တရာယ်ရှိသည်ဟု သတ်မှတ်ထားသော မျိုးစိတ်များအပါအဝင်) အရွယ်ရောက်ငါးများ ရှိနိုင်ပါသည်။ သို့ရာတွင် ဆိုက်စမစ် တိုင်းတာရေးလုပ်ငန်းများတွင် ယေဘူယျအားဖြင့် တွေ့ရမည့် အပြုအမူများကို ရှောင်ရှားခြင်းဖြင့် ထိုငါးများအပေါ် ထိခိုက်မှုများကို လျော့ချနိုင်ပါသည်။ ထို့အပြင်လုပ်ငန်းများအား တဆင့်ပြီးတဆင့် စတင်ခြင်းဖြင့်လည်း ငါးများအတွက် လုပ်ငန်းဇရိယာအတွင်းမှ ထွက်ခွာချိန်ရရှိစေနိုင်ပါသည်။ ထို့ကြောင့် ငါးများအပေါ် ထိခိုက်မှုကို လစ်လျူရှုနိုင်သည်ဟု စဉ်းစားပါသည်။	လစ်လျူရှုနိုင်သည့် အဆင့်
အရွယ်မရောက်သေးသောငါးများ - ဆိုက်စမစ်တိုင်းတာခြင်းလုပ်ငန်းများကြောင့် စုပေါင်း၍ သားပေါက်သည့် ဓလေ့ရှိသော အချို့ငါးမျိုးစိတ်များ၏ မျိုးပွားမှုပုံစံများကို အနှောင့်အယှက်ဖြစ်စေပါသည်။ ဆိုက်စမစ် အသံလှိုင်းသည် ပိုးလောင်းကောင်များကို ထိခိုက်စေနိုင်သော်လည်း airgun ပစ်လွှတ်သည့် အကွာအဝေးသည် အလွန်တိုတောင်းပါသည်။ ထိုအရာကြောင့် ဆုံးရှုံးမှုနှုန်းသည် ကြီးမားသော ငါးပေါက်ဝေးများ၏ သဘာဝအတိုင်းသေဆုံးမှုနှုန်း နှင့် ယှဉ်လျှင် လျစ်လျူရှုနိုင်သည့် အခြေအနေဖြစ်ပါသည်။	လစ်လျူရှုနိုင်သည့် အဆင့်

ငှက်များ

ငှက်များအတွက်အစားအစာရင်းမြစ်များ (ငါးများ၊စွန့်ပစ်အစားအစာများ) ကို ဖယ်ရှားထားပါက၊ တိုင်းတာ ရေးသဘော်ဘားအနီးသို့ ငှက်များ လာရောက်မည်မဟုတ်ပါ။ ထို့အပြင် မတော်တဆ အခြေအနေများတွင် ပင်၊ဆိုက်စမစ်တိုင်းတာခြင်းကြောင့်အကျော်ငါငှက်များကို အန္တရာယ်ဖြစ်စေနိုင်သည့် ကြီးမားသော လောင်စာ ဆီယိုဖိတ်မှုမဖြစ်နိုင်ပါ။ (ဤ ဘူမိရုပသွင်ပြင် လေ့လာမှုအတွင်း ရေနံထုတ်လုပ်မှုလည်း မရှိပါ။)။ ထိုသုံးသပ်ချက်အတိုင်း ထိခိုက်မှုသည် အလွန်နည်းပါးနိုင်ပါသည်။	လစ်လျူရှုနိုင်သည့် အဆင့်

Benthic မျှောလှေးအုပ်စုများ (သန္တာကောင်များထက် အခြားအုပ်စုများ)

စွန့်ပစ်မှုလုံးဝမရှိအောင် ပြုလုပ်မည်ဖြစ်ပြီး benthic မျှောလှေးအုပ်စုဝင်များအပေါ် ထိခိုက်မှု မဖြစ်ပေါ်အောင် လုပ်ဆောင်ပါမည်။	လစ်လျူရှုနိုင်သည့် အဆင့်

ဒီရေတောများ

ဇရာဝတီမြစ်ဝကျွန်းပေါ်တလျှောက်ရှိ ဒီရေတောများသည် ငါးပေါက်ဖွားရာနေရာအဖြစ် အရေးကြီးသည့် နေရာများဖြစ်ပါသည်။ ထိုဒီရေတောများကို ပုစွန်မွေးမြူရေးများ (သို့) စိုက်ပျိုးမြေများအဖြစ်ပြောင်းလဲခြင်းကြောင့် ထိခိုက်မှုများစွာ ဖြစ်ပေါ်လျက်ရှိပါသည်။ သို့သော်လည်း ထိုဂေဟစနစ်သည် စီမံကိန်းနယ်မြေမှ ၃၅ ကီလိုမီတာအကွာတွင် တည်ရှိနေပြီး ဆီဖြည့်တင်းခြင်းနှင့် ဆက်စပ်နေသော မည်သည့်ယိုစိမ့်မှုမှ ၎င်းနေရာဆီရောက်ရှိလိမ့်မည် မဟုတ်ပါ။	လစ်လျူရှုနိုင်သည့် အဆင့်

သန္တာကျောက်တန်းဂေဟစနစ်များ

သန္တာကျောက်တန်းများကို Preparis ကျွန်းဝန်းကျင်တွင် တွေ့ရှိရပါသည်။ ကျွန်းနှင့် ကျောက်တန်းများကြား ရေတိမ်ပိုင်းအောက်ခြေများတွင် မြစ်ဝကျွန်းပေါ်မှ နုန်းပို့ချမှု အများကြီးမရှိပါ။ သန္တာကျောက်တန်းများတွင် နေထိုင်သော ထိခိုက်လွယ်နိုင်သည့် လူပ်ရှားသွားလာနေသော သက်ရှိသတ္တဝါများသည် ပင်လယ်ရေပေါ် နေငါးမျိုးစိတ်များကဲ့သို့ အသံလှိုင်းသက်ရောက်မှုမှ အဝေးကို အလွယ်တကူမရှောင်ရှားနိုင်ပါ။ ထို့အပြင် ပင်လယ်ရေမျက်နှာပြင်အောက်ရှိ တစ်စောင်းပုံစံရှိသော streamer သည် ကျောက်တန်းများကို ထိမိစေပြီး သန္တာကောင်မျိုးစိတ်အများစုသည် တိုက်ရိုက်ထိတွေ့ရန် ထိခိုက်လွယ်သောမျိုးစိတ်များဖြစ်ကြပါသည်။ အဆက်မပြတ်ပဲ့တင်မြည်သည့်အသံပြုလုပ်ခြင်းအားဖြင့် ထိုထိခိုက်နိုင်မှုများကို လျော့ချပေးနိုင်ပါလိမ့်မည်။	အလယ်အလတ် အဆင့်

ထိခိုက်လွယ်သည့်နယ်မြေများနှင့် ထိန်းသိမ်းရေးနယ်မြေများ

ဒီရေတောများကဲ့သို့ပင် အနီးဆုံးတွင်ရှိသော တရားဝင်ထိန်းသိမ်းရေးနယ်မြေများကို စီမံကိန်း၏ မည်သည့် သက်ရောက်မှုမှ မရှိစေပါ။ ဘူမိဗေဒတိုင်းတာချက်အရ တည်ရှိနေသော Preparis ကျွန်းကို ထိန်းသိမ်းရေးနယ်မြေအဖြစ် သတ်မှတ်ထားခြင်းမရှိပါ။ သို့သော် ထိုကျွန်းသည် သဘာဝအတိုင်း တည်ရှိနေပြီး သန္ဓာကျောက်တန်းများက ဝန်းရံလျက်ရှိပါသည်။	အရေးမကြီးပါ။

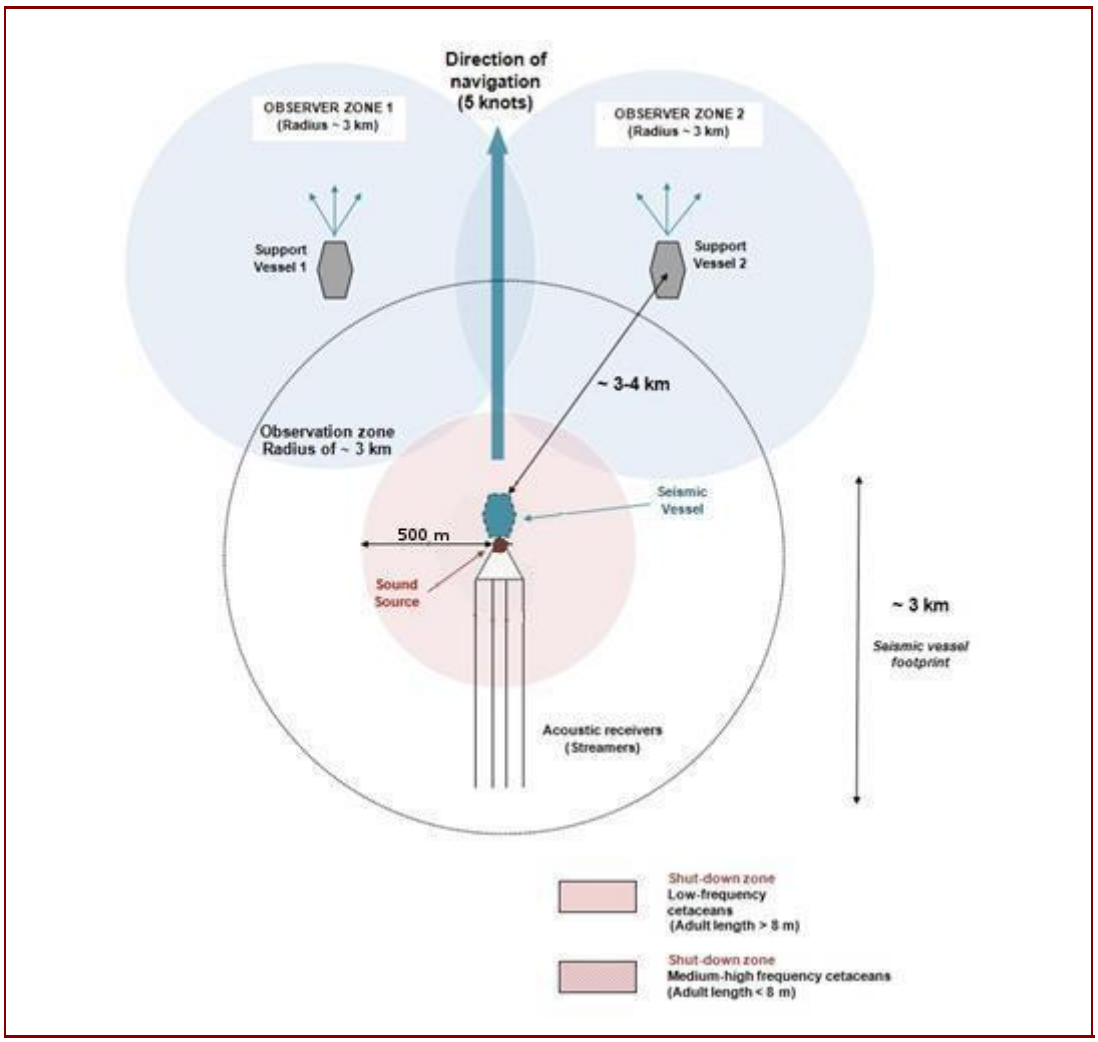
အောက်ပါ လျော့ပါးစေရေးနည်းလမ်းများကို အဆိုပြုအပ်ပါသည်။ထိုနည်းလမ်းများသည် တစ်ကမ္ဘာလုံးဆိုင်ရာ ကောင်းမွန်သည့် အလေ့အကျင့်များကို အသုံးပြုထားသော UK JNCC စံချိန်စံညွှန်းအပေါ်တွင် အခြေခံထားပါသည်။

- အချင်းဝက် ၅၀၀ မီတာ (airgun၏ ဝိသေသ လက္ခဏာများတွင် တကြိမ် သတ်မှတ်သောအကွာအဝေး)တွင် စက်များပိတ်ရမည့် ဇုန်(shutdown zone) သတ်မှတ်ပါသည်။
- ဆိုက်စမစ်ထုတ်လွှင့်စက်များ၏ ဗဟိုမှ အချင်းဝက် ၃ ကီလိုမီတာအတွင်း စောင့်ကြည့်ရေးဇုန် (observation zone) သတ်မှတ်ပါသည်။ဤစောင့်ကြည့်ဧရိယာအတွင်းတွင် တိုင်းတာရေးသင်္ဘောပေါ်တွင် နေရာယူထားသော ကျွမ်းကျင်သည့် အဏ္ဏဝါနှံ့တိုက်သတ္တဝါစောင့်ကြည့်သူ (Marine Mammal Observer) တစ်ဦးက မျက်မြင်အခြေအနေကို အချိန်ပြည့် စောင့်ကြည့်ပါမည်။ ထိုစောင့်ကြည့်ခြင်းလုပ်ငန်းတွင် (ရေနက်ပိုင်းတွင် အသုံးပြုမည့်) airguns များ မပစ်လွှတ်မီ အနည်းဆုံး ၆၀ မိနစ်အလိုမှစ၍ အချိန်ပြည့် စောင့်ကြည့်ခြင်းလည်း ပါဝင်ပါသည်။
- airguns များ မပစ်လွှတ်မီ စောင့်ကြည့်စဉ်တွင်၊ သတ်မှတ်ဇရိယာအတွင်း အဏ္ဏဝါနှံ့တိုက်သတ္တဝါများကို တွေ့ရှိပါက ဆိုက်စမစ်တိုင်းတာခြင်းလုပ်ငန်းကို ရပ်ဆိုင်းပါမည်။ အကယ်၍ ငါးသည် လုပ်ငန်းများ စတင်ပြီး နောက်ပိုင်းမှ သတ်မှတ်ဇရိယာအတွင်းသို့ ဝင်ရောက်လာပါက JNCC တွင် အကြံပြုထားသည့်အတိုင်းပင်၊ မည်သည့် လျော့ပါးစေရေးနည်းလမ်းကိုမျှ ဆောင်ရွက်မည်မဟုတ်ပါ။
- တိုင်းတာရေးသင်္ဘောပေါ်မှMMOတစ်ဦးအပြင်၊အကူသင်္ဘောနှစ်စင်းတွင်လည်း တစ်စင်းလျှင်စောင့်ကြည့်သူတစ်ဦးစီ နေရာယူထားပါမည်။ ထိုစောင့်ကြည့်သူများမှာ သက်ဆိုင်ရာ အကူသင်္ဘောမှ ဝန်ထမ်းများ ဖြစ်ပြီး၊ တိုင်းတာရေးလုပ်ငန်းမစတင်မီတွင်
၄င်းတို့ကိုMMOကလေ့ကျင့်သင်တန်းပေးထားပါမည်။ထိုစောင့်ကြည့်သူများသည် သတ်မှတ်ဇရိယာအတွင်းသို့ အဏ္ဏဝါနှံ့တိုက်သတ္တဝါများ ဝင်ရောက်လာပါက သတင်းပို့ရန် တာဝန်ရှိပါသည်။
- စက်များပိတ်ရမည့်ဇရိယာအတွင်းတွင်အဏ္ဏဝါနှံ့တိုက်သတ္တဝါများကို နောက်ဆုံးအကြိမ်အဖြစ် စောင့်ကြည့်ပြီး နောက်တွင်လည်း (soft-start လုပ်ငန်းအဆင့်များအပါအဝင်) လုပ်ငန်းများကို ၂၀ မိနစ်စောင့်ဆိုင်းပြီးမှ စတင်ပါမည်။ မျက်မြင်စောင့်ကြည့်ခြင်းကို တစ်ဆင့်ခံအသံလှိုင်းဖြင့်စောင့်ကြည့်ခြင်း (Passive Acoustic Monitoring – PAM) ဖြင့်လည်း အားဖြည့်ပေးပါမည်။ ထိုကိရိယာများကို သုံးခြင်းအားဖြင့် ညအချိန်များတွင်လည်းကောင်း၊ မြင်နိုင်စွမ်းအလွန်နည်းသည့်အချိန်များတွင်လည်းကောင်း၊ (ရေအောက်တွင် အချိန်ကြာ မြင့်စွာ ငုပ်နေသည့်တိုင်အောင်) ဇေလငါးများက အသံပြုသည့်အချိန်တွင် အသံလှိုင်းများကို ဖမ်းယူနိုင်စွမ်း ရှိပါသည်။
- Soft-start လုပ်ထုံးလုပ်နည်းများကို လိုက်နာ အကောင်အထည်ဖော်ခြင်း - ဆိုက်စမစ်လိုင်းတစ်ခုချင်းစီမှ အချက်အလက်များကိုမရယူမီတွင်လည်းကောင်း၊လုပ်ငန်းတစ်ခု ပြန်လည်စတင်ချိန်တွင်လည်းကောင်း၊ ဆိုက်စမစ်လိုင်းများသို့ပေးပို့သည့် လျှပ်စစ်ဓါတ်အားကို ၂၀ မိနစ်အတွင်း (၄၀မိနစ်ထက်မပိုစေရပါ) ဖြည်း

ဖြည်းချင်းတိုးမြှင့်ပေးရပါမည်။ သို့မှသာ ထိခိုက်ခံရနိုင်သော သတ္တဝါများအနေဖြင့် ထိဇရိယာအတွင်းမှ ထွက်ခွါရန်/ရှောင်ရှားရန် အချိန်ရပါမည်။

ညီမျှသောအချင်းဝက်နှင့် ကန့်သတ်ထားသည့်ဇုန် (exclusion zone) ကို ကြိမ်နှုန်းမြင့် အလွှာဝါသတ္တဝါကြီးများအတွက် လိပ်များဆီတွင် အသုံးပြုပါမည်။ ထို့အပြင် အသံလှိုင်းလက်ခံ ကေဘယ်ကြိုးများ (streamers) နောက်တွင် ချည်နှောင်ထားသော ဗော်ယာများ၏ ဒလက်များနှင့် ထိခိုက်မိ၍ လိပ်များ ထိခိုက်ဒဏ်ရာရမှုမှ ကာကွယ်ရန်အတွက် ကာကွယ်ရေးစနစ်များ တပ်ဆင်ပါမည်။

ပုံ(၇) တွင် စိမ်ကိန်း လုပ်ကွက်အတွင်း ဆိုက်စမစ်တိုင်းတာခြင်းလုပ်ငန်းအတွက် အဆိုပြုထားသော စက်ပိတ်ဇုန်နှင့် စောင့်ကြည့်ဇုန်များပုံကို ဖော်ပြထားပါသည်။



ပုံ(၇) - စိမ်ကိန်း လုပ်ကွက်အတွင်း ဆိုက်စမစ်တိုင်းတာခြင်းလုပ်ငန်းအတွက် အဆိုပြုထားသော စက်ပိတ်ဇုန်နှင့်စောင့်ကြည့်ဇုန်များပုံ

0.4.2 လူမှုစီးပွားဆိုင်ရာ ထိခိုက်မှုများနှင့် လျော့ပါးစေရေးနည်းလမ်းများ

ဇယား (၄) - ဖြစ်နိုင်သော ထိခိုက်မှုများကို စုစည်းဖော်ပြခြင်း - လူသားများနှင့် ပတ်သတ်သော အစိတ်အပိုင်း

ကြွင်းကျန်နိုင်သော ထိခိုက်မှုများအကြောင်း ဖော်ပြချက်	ကြွင်းကျန်နိုင်သော ထိခိုက်မှု (R)
ပင်လယ်ရေကြောင်းသွားလာရေး	
လုပ်ငန်းများမစတင်မီတွင်ကန်ထရိုက်တာ၏ဂန်ထမ်းများအား HSEသို့မဟုတ်စီမံကိန်းဆောင်ရွက်ချိန်တွင် စီမံကိန်းဇရိယာအတွင်း၌ ငါးဖမ်းသင်္ဘောနှင့် ကုန်သွယ်သင်္ဘောများ ရှိနေခြင်းကြောင့် ထိခိုက်နိုင်မှုအလားအလာများကိုအသိပေးထားရန်နှင့် လျော့ပါးစေရေးနည်းလမ်းများကို ပြင်ဆင်ထားရန် လိုအပ်ပါသည်။ ထို့အပြင် မြန်မာ့ပင်လယ်ပြင်အာဏာပိုင်အဖွဲ့များ (MPA, DMA, မြန်မာနိုင်ငံရေတပ်နှင့်ကမ်းခြေစောင့်တပ်ဖွဲ့)နှင့်ဆက်သွယ်၍ ယင်းအာဏာပိုင်အဖွဲ့များက ဆိုက်စမစ်တိုင်းတာရေးလုပ်ငန်းများနှင့်ပတ်သက်၍ ပင်လယ်ရေကြောင်းသွားလာသူများအား သတိပေးချက်များ ထုတ်ပြန်ရန် လိုအပ်ပါမည်။ ဆိုက်စမစ်တိုင်းတာရေးသင်္ဘောများ၏ ရွေ့လျားမှု (5 Knots ခန့်) ကြောင့်၊ ထိုလုံခြုံရေးဇုန်များကို နာရီ အနည်းငယ်သာ ပိတ်ထားရန် လိုအပ်ပါ ရေဒီယိုဆက်သွယ်ရေးစနစ်မပါဝင်သော သင်္ဘောများနှင့် ဆက်သွယ်ရန်အတွက် အသံချဲ့စက်များတပ်ဆင် ခြင်းဖြင့် အခြားသင်္ဘောများနှင့် တိုက်မိနိုင်သော အန္တရာယ်ကို လျှော့ချနိုင်ပါမည်။ သင်္ဘောတစ်စင်းသည် လမ်းကြောင်းအတွင်းရောက်ရှိလာပြီး၊ ခေါ်ဆိုမှုများကို တုန့်ပြန်ဖြေကြားခြင်းမရှိပါက၊ အကူသင်္ဘောများက ထိုသင်္ဘောအနီးသို့ ကပ်သွား၍ အသိပေးရပါမည်။ Preparis ကျွန်းသည် တောင်-မြောက် ကူးသန်းခြင်းအတွက် အတားအဆီးဖြစ်ပါသည်။ ထိုကူးသန်းသည့် လမ်းကြောင်းသည်ကျွန်း၏ သွားရလွယ်သည့်အခြမ်းမှ ဖြတ်သန်းခွင့်ရှိရန် မျှော်လင့်ရပါသည်။	အရေးမကြီးပါ။

ငါးဖမ်းခြင်း	
စီမံကိန်းနယ်မြေသည် ကမ်းဝေးငါးဖမ်းဇုန်များကို ကျူးကျော်နိုင်ပါသည်။ အဓိကအားဖြင့် တိုင်းတာရေးသင်္ဘောများ ရှိနေခြင်း(တစ်နေရာတွင် အချိန်အနည်းငယ်သာ)နှင့် ပင်မသင်္ဘောအနီးမှ ငါးများကို မောင်းထုတ်ရန်ရည်ရွယ်သည့်လုပ်ငန်းများ (soft-start) များကြောင့် ငါးဖမ်း လုပ်ငန်းများကို ထိခိုက်စေနိုင်ပါသည်။ လုပ်ငန်းများမစတင်မီတွင် ဆိုက်စမစ်တိုင်းတာခြင်းလုပ်ငန်းနှင့်ပတ်သက်သည့် လက်ကမ်းစာစောင်များကို မြန်မာ၊ ထိုင်းနှစ်ဘာသာဖြင့် ပြင်ဆင်ဖြန့်ဝေပါမည်။ ဆိုက်စမစ်လုပ်ငန်းများမစတင်ခင်တွင် ဆိုက်စမစ်လုပ်မည့် နေရာမှာ ငါးဖမ်းလုပ်ငန်းများအား ကင်းထောက်လှေလာခြင်းကို ပြုလုပ်သင့်ပါသည်။ ဆိုက်စမစ်တိုင်းတာခြင်းလုပ်ငန်းဆောင်ရွက်နေစဉ်အတွင်းတွင် ပင်လယ်ရေကြောင်းလုပ်ငန်းများအား အနှောင့်အယှက်ဖြစ်မှုကို လျော့ချနိုင်ရန်အတွက် တိုင်းတာရေးသင်္ဘောများ၏ တည်နေရာနှင့် ခန့်မှန်းရောက်ရှိမည့်နေရာတို့ကို ပင်လယ်ပြင်အာဏာပိုင်များ၊ အဓိကငါးဖမ်းလုပ်ငန်း ဆက်စပ်ပတ်သက်သူများ (DoF, MFF) သို့ အချိန်နှင့်တစ်ပြေးညီ အသိပေးသွားပါမည်။ ဆိုက်စမစ်တိုင်းတာရေးသင်္ဘောများ၏ ရွေ့လျားမှုကြောင့် ငါးဖမ်းသင်္ဘောများ၏ လမ်းကြောင်းများ သွေဖည် သွားခြင်း မရှိနိုင်ပါ။ထို့အပြင် ထောက်ပံ့ရေးသင်္ဘောများကရေဒါများ၊ မျက်မြင်စောင့်ကြည့်ခြင်းများဖြင့် အခြားသင်္ဘောများ တည်ရှိမှုကို စစ်ဆေးနေပြီး၊ အခြားသင်္ဘောများအားတွေ့ရှိပါက ရေဒီယိုများ၊ အသံချဲ့ စက်များသုံး၍ လုပ်ငန်းဇရိယာအကြောင်းနှင့် လမ်းကြောင်းပြောင်းလဲရန် အသိပေးပါမည်။ အကူသင်္ဘောများကို လိုအပ်ပါက ငါးဖမ်းခြင်းလုပ်ငန်း ဆောင်ရွက်ရန် အသုံးပြုပါလိမ့်မည်။ ကာလရှည်ငါးဖမ်းပိုက်ထောင်၍ ငါးဖမ်းခြင်းများ ရှိနေသောကြောင့် ငါးဖမ်းလုပ်ငန်းအသင်းမှ သတိပေးရမည့်အချိန်ကို ၄၅ ရက်နှင့်အထက်ရှိရန် တောင်းဆိုထားပါသည်။	အရေးမကြီးပါ။

ပတ်ဂန်းကျင် ကနဦးလေ့လာမှုအရ၊ စီမံကိန်းလုပ်ငန်းများနှင့် ငါးဖမ်းလုပ်ငန်းများအကြားတွင် ထိတွေ့ဆက်ဆံမှု များရှိနိုင်ကြောင်း ဖော်ပြနေပါသည်။ ထိုထိခိုက်မှုကို ရှောင်ရှားရန်အတွက်၊ ပင်လယ်ပြင်အာဏာပိုင် အဖွဲ့များနှင့် ဆက်သွယ်ရေးစီမံချက်တစ်ခုကို အကောင်အထည်ဖော်ပြီး၊ ငါးဖမ်းသင်္ဘောများအားဆိုက်စမစ် တိုင်းတာရေးသင်္ဘော များ၏တည်နေရာကိုအသိပေးရန်နှင့်ဘေးကင်းသည့် အကွာအဝေးမှသာ အလေးထားခုတ်မောင်းရန် အသိပေးရပါမည်။လုပ်ငန်းများ ဆောင်ရွက်နေစဉ်တွင် အဓိကတိုင်းတာရေးသင်္ဘော၏ အနီးတစ်ဝိုက်တွင် ရှိနေသော ငါးဖမ်း သင်္ဘောများကို အကူသင်္ဘောများက ဆက်သွယ်ပြောကြားရပါမည်။

0.5 ပတ်ဝန်းကျင်နှင့် လူမှုဆိုင်ရာ စီမံခန့်ခွဲရေး စီမံချက်

ပတ်ဂန်းကျင်နှင့် လူမှုဆိုင်ရာ စီမံခန့်ခွဲရေး စီမံချက် (Environmental and Social Management Plan) သည် IEEတွင်သတ်မှတ်ဖော်ထုတ်ထားသော ထိခိုက်မှုလျော့ပါးစေရေးနည်းလမ်းများအားလုံးကို သင့်တော်သော စီမံချက် တစ်ခုဖြင့် အကောင်အထည်ဖော်မည်ဖြစ်ကြောင်း သေချာစေပါသည်။ စီမံချက်တွင် အောက်ပါ အကြောင်းအရာများ ပါဝင်ပါသည်။

ကတိကဝတ် မှတ်တမ်းတွင် ပါဝင်မည်ဖြစ်သော အောက်ဖော်ပြပါ အကြောင်းအရာများ ပါဝင်ပါသည်။

- Airguns များပစ်လွှတ်မှု လုပ်ဆောင်ချက်များနှင့် အဏ္ဏဝါနှိုတိုက်သတ္တဝါစောင့်ကြည့်လေ့လာမှုများသည်ကန့်သတ်ဇုန်၅၀၀မီတာအတွင်းနှိုတိုက် သတ္တဝါများကို မတွေ့ရှိသည့်တိုင်အောင် ပစ်လွှတ်မှုစတင်ခြင်းကို နှောင့်နှေးစေခြင်းနှင့် soft-start

procedure လုပ်ဆောင်ချက်များပေါ်တွင် အခြေခံနေပါသည်။ ထို လုပ်ဆောင်ချက်များသည် ပင်လယ်လိပ်များအပေါ်လည်း အကျိုးရှိစေပါသည်။

- စောင့်ကြည့်လေ့လာရေးတွင် အဏ္ဏဂါနို့တိုက်သတ္တဂါစောင့်ကြည့်လေ့လာသူ နှစ်ယောက်ပါရှိပါလိမ့်မည်။ အကူသဘော်များပေါ်တွင် လေ့လာသူများထပ်ဖြည့်ရန်အတွက် ထိုနှစ်ယောက်ထဲမှ တစ်ယောက်ကိုသင်တန်းများ ပေးပါသည်။ ထိုသို့ လုပ်ဆောင်ခြင်းသည် ဆိုက်စမစ်လုပ်ငန်း၏ ကာလရှည်ကြာမည့် အချိန်ကို လျော့ချစေနိုင်ရန် အထောက်အပံ့ပေးပါလိမ့်မည်။
- အနီအောက်ရောင်ခြည်/ညအမြင်အာရုံ (သို့) တဆင့်ခံ အသံလှိုင်းစောင့်ကြည့်ခြင်း (PAM) ကို ညအခါတွင် အသုံးပြုပါသည်။
- ဆိုက်စမစ်လုပ်ငန်းမစတင်ခင်တစ်လနှင့်ဆိုက်စမစ်လုပ်ငန်းပြီး(ရတနာနယ်မြေနှင့်ရန်ကုန်အကြားရှိသည့် လုပ်ကွက်အပိုင်း) တစ်လတွင် စောင့်ကြည့်လေ့လာမှုများပါဝင်ပါသည်။

- အဆက်မပြတ်အသံလှိုင်းပဲ့တင်သည့် စနစ် သုံးခြင်းအားဖြင့် တစောင်းပုံစံ streamerများက သန္ဌာကျောက်တန်းများအား ထိခိုက်စေနိုင်မှုကို လျော့ချပေးနိုင်ပါလိမ့်မည်။
- ငါးဖမ်းလုပ်ငန်းနှင့် ကူးသန်းရောင်းဝယ်ရေးလုပ်ငန်းများကို အနှောင့်အယှက်အနည်းဆုံးဖြစ်စေရန် ပင်လယ်နှင့် ငါးဖမ်းလုပ်ငန်းများ၏ သက်ဆိုင်သူများနှင့် ပူးပေါင်းဆောင်ရွက်ခြင်း။
- ပင်လယ်ပြင်တွင် လောင်စာဆီသို့လောင်ထားမှု စည်းမျဉ်းများ (ဥပမာ - ညအချိန်တွင်မပြုလုပ်ရန်နှင့် ကျောက်တန်းများရှိသည့် အပေါ်ပိုင်းနေရာတွင်မပြုလုပ်ရ)
- အဓိကတိုင်းတာရေးသဘော်တွင် အကောင်းဆုံးရေကြောင်းအလေ့အကျင့်များ လုပ်ဆောင်ခြင်းနှင့် ယေဘူယျ အချက်များမှာ-
  - MARPOL, SOLAS, AIS စည်းမျဉ်းများ၊ Ballast Water Management Plan၊ Ship Energy Efficiency Management Plan အစရှိသည့် နည်းစဉ်များကို အပြည့်အဝလိုက်နာခြင်း။
  - ဆာလဖာပါဝင်မှုနည်းသည့် (ဆာလဖာ ပါဝင်မှု ၀.၅% အောက်) လောင်စာကိုအသုံးပြုခြင်း။
  - သဘော်ပေါ်တွင် စွန့်ပစ်ပစ္စည်း (သို့) စွန့်ပစ်ရေဆိုးမရှိစေရေး စည်းမျဉ်းများ နှင့် စွန့်ပစ်ပစ္စည်းစီမံခန့်ခွဲမှု အစီအစဉ်အားဆောင်ရွက်ခြင်း (လျှပ်စစ်စွန့်ပစ်ပစ္စည်း အနည်းငယ်မြင့်မားမှုမလွဲ၍ ပုံမှန် ရေကြောင်းသယ်ယူပို့ဆောင်ခြင်းအတွက် စွန့်ပစ်ပစ္စည်းထုတ်လွှတ်မှုမှာ အတူတူပင်ဖြစ်သည်။)
- စောင့်ကြပ်ကြည့်ရှုခြင်းတွင် ပါဝင်သည့် အချက်များသည် အောက်ပါအချက်များအပေါ် အခြေခံပါသည်။
  - အဏ္ဏဂါနို့တိုက်သတ္တဂါစောင့်ကြည့်လေ့လာသူများ၏ မှတ်တမ်းနှင့် ရှာဖွေတွေ့ရှိမှုများ၊
  - အားလုံးသောအခြား ထိန်းချုပ်ရေးပစ္စည်းများအား နေရာတကျရှိမရှိ အမြဲစစ်ဆေးခြင်း (ဥပမာ- မှန်ကန်သည့် လောင်စာကိုအသုံးပြုခြင်း၊ သဘော်ပေါ်တွင် စွန့်ထုတ်မှုများမရှိခြင်း၊ အစရှိသဖြင့်)
- စောင့်ကြပ်ကြည့်ရှုခြင်း အပေါ်တွင် စစ်ဆေးခြင်းကို ပြုလုပ်ပါလိမ့်မည်။(စွန့်ထုတ်ရာလမ်းကြောင်းအချို့၏ နောက်ဆုံးအခြေအနေကိုစစ်ဆေးခြင်း)

လုပ်ငန်းတွင်TEPM၏လုပ်ဆောင်သည့် လမ်းစဉ်များကို ကြားခံဆက်သွယ် လုပ်ကိုင်ပေးမည့် ကန်ထရိုက်တာများ လိုအပ်စဉ်ကတည်းက လက်တွေ့လုပ်ဆောင်မည့် အစီအစဉ်၏ နောက်ဆုံးလုပ်ဆောင်မှုမှာ ကန်ထရိုက်တာများအား သတ်မှတ်ခြင်းဖြစ်ပါသည်။ နောက်ဆုံးဖွဲ့စည်းပုံမှာ အောက်ပါအချက်အလက်များ ပါဝင်သင့်ပါသည်။

- ကျန်းမာရေး၊ ဘေးကင်းလုံခြုံရေးနှင့် ပတ်ဂန်းကျင်ဆိုင်ရာ မူဝါဒ
- အဖွဲ့အစည်း၊ ရင်းမြစ်များနှင့် မှတ်တမ်းထိန်းသိမ်းခြင်း
- အန္တရာယ်ရှိမှုကို သတ်မှတ်ဖော်ထုတ်ခြင်းနှင့် ထိခိုက်နိုင်မှုအလားအလာကို စီမံခန့်ခွဲခြင်း
- လုပ်ထုံးလုပ်နည်းများ၊ အရေးပေါ်အခြေအနေအပေါ် တုန့်ပြန်မှုနှင့် စီမံခန့်ခွဲမှုအပြောင်းအလဲများ
- စောင့်ကြည့်စစ်ဆေးခြင်းစနစ်ဖြင့် အလုပ်လုပ်ခြင်း - အစီရင်ခံခြင်းနှင့် ပြင်ဆင်ရေးလုပ်ငန်းများအား သုတေသန ပြုလုပ်ခြင်း
- စွန့်ပစ်ပစ္စည်း စီမံခန့်ခွဲရေး စီမံချက်
- ထုတ်လွှတ်မှုများ စီမံခန့်ခွဲရေးစီမံချက်
- လေ့ကျင့်သင်တန်းပေးခြင်း အစီအစဉ်
- ပတ်ဂန်းကျင်ကို စောင့်ကြည့်လေ့လာရေး စီမံချက်
- ဒေသခံပြည်သူများနှင့် ဆက်ဆံရေးအပါအဂင်၊ လူမှုစီးပွါးရေးအစီအစဉ်နှင့် ရေကြောင်းသွားလာရေးစီမံချက်။

SECTION 1. EXECUTIVE SUMMARY

1.1 INTRODUCTION

1.1.1 Context

Total Exploration & Production Myanmar (TEPM) plans to conduct a 3D seismic acquisition campaign as part of its exploration program of the M5-M6 blocks.

This Initial Environmental Examination was prepared to allow environmental authorities to determine whether the project affects the environment or existing socioeconomic activities, and to decide whether the project should be allowed or not. The form, content and structure of the report may satisfy regulatory requirements by providing relevant information on environmental issues and mitigation measures to be taken into account in order to protect environment during the scheduled offshore exploration campaign. The present document is the Executive Summary of the IEE report.

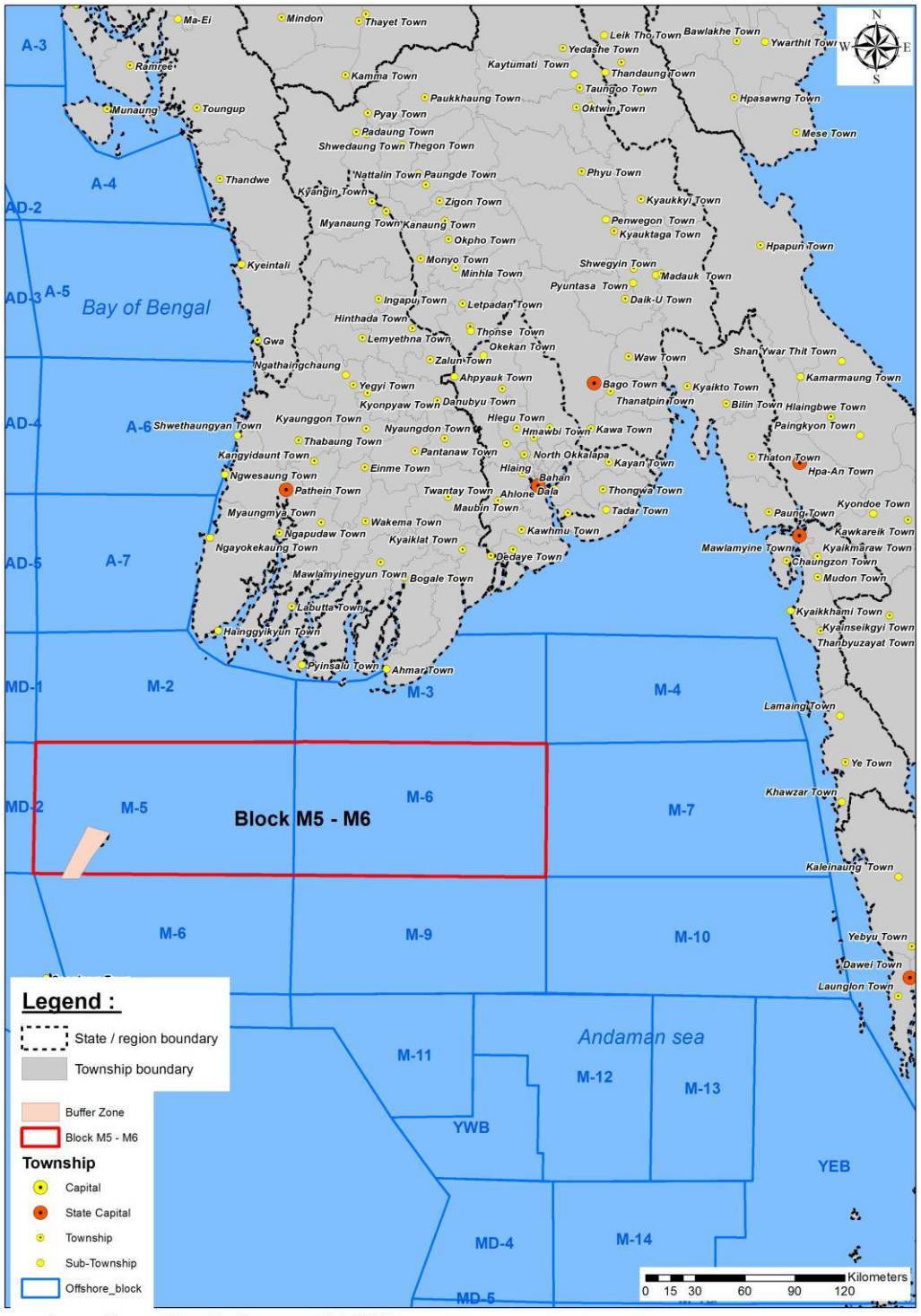
The IEE has been developed in accordance with Myanmar's Environmental Conservation Law (promulgated in 2012) and the Environmental Impact Assessment Procedure (promulgated in 2015) and includes the Environmental Management Plan (EMP). International legislation addressing offshore petroleum industry and Total E & P Myanmar standards are also taken into account.

The document was performed by the Risk, Society & Environment department of Artelia, which has operated a branch office in Yangon since October 2012. Artelia's experts have a good knowledge of seismic survey environmental & social issues. The project team included an environmental engineer trained to MMO standards in UK (JNCC), a social specialist experienced in the management of offshore seismic campaign in Asia, and an environmental engineer based in Yangon. The branch office in Yangon helped in facilitating data collection and local coordination.

1.1.2 Description of the project

The project comprises 3D exploration of the whole footprint of the contiguous blocks M5-M6, identified as «the project area» in the IEE report, in order to fulfil an optimal imaging of the geologic objectives in the area. The Yadana and Sein platforms are located in the centre of the M5-M6 whole area and overlay on both blocks and the survey results from that region will be consolidated into a 4D view of the field. A 4D seismic survey is like a 3D survey but it is repeated at different periods (in the present case, seismic data will be acquired at the same location than data acquired in previous survey) in order to get a good picture of how a reservoir changes over time; this helps optimize extraction.

The offshore blocks M5-M6 cover 24,541 km^2 located at the NW corener of the Andaman Sea, with the SW corner of block M5 extending beyond Preparis Island into the Bay of Bengal. The northern edge of the blocks is located some 35 km from the mainland, but the centerline of this E-W oriented 80 km from the shore. Virtually all of blocks M5-M6 are located on the continental shelf (i.e. with a water depth of less than 200 m), but the very western edge of this pair of blocks extends down the continental slope to oceanic depths of over 2000 m. The Preparis Island lies at the transition between the Andaman Sea and Bay of Bengal basins.



Source : Myanmar Information Management Unit (MIMU)

Figure 1-1 Project location, Blocs M5 and M6

1.1.3 Timing of operation

The total area of the survey 24,541 km^2, is quite large and hence the work has to be spread over several seasons. The 3D seismic campaign is planned to to include three phases: 1 month in April 2018, just before the monsoon, 7 months in 2018-2019 after the 2018 monsoon, and 6 months in 2019-2020 after the 2019 monsoon. The total expected duration is 409 days.

1.2 DESCRIPTION OF THE PROPOSED PROJECT

1.2.1 Seismic survey

A seismic marine survey is based on the transmission of sound waves emitted by energy sources towed by a specific boat. The sound travels through the water layer and the underlying rocks and are reflected back on acoustic contrasts (lithological changes between layers of different composition, for example). The reflected energy is transformed into electric pulses on receivers (hydrophones) inserted within cables (streamers) also towed by the same vessel. Those electric pulses are then recorded in a laboratory located in the vessel. In 3D seismic surveys, multiple hydrophone streamers are towed behind the survey vessel, generally together with dual sources.

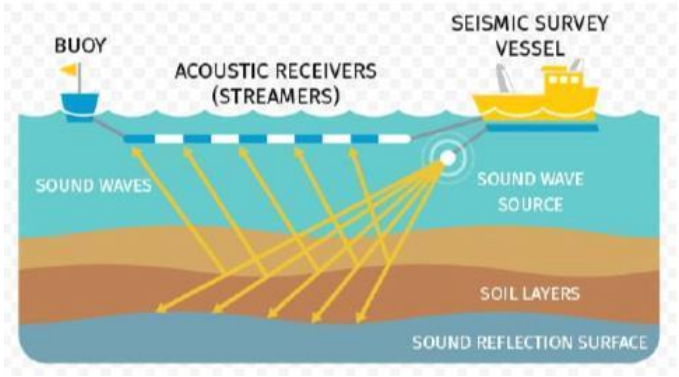


Figure 1-2 Marine seismic data acquisition methodology

A 3D survey data is normally acquired as shown in Figure 1-2, with a 'racetrack' pattern being employed to reduce the time necessary to turn the vessel while allowing adjacent lines to be recorded with the data in the same direction. This minimizes processing artifacts, which could adversely affect the data interpretation. In general, the survey area is broken down into areas in which swathes of lines are completed in phases.

Note: The seismic vessel will need to manoeuvre outside of the M5-M6 blocks in order to turn around onto the next track. While the seismic vessel carries out its turn outside the blocks, no airgun will be in activity.

(The Company has not yet selected the geophysical contractor that will carry out the operation; therefore, the description of the seismic equipment below is based on a generic pattern.)

An offshore seismic campaign uses the following devices:

- Seismic sources will be generated by airguns, which are using compressed air to generate underwater waves which reflect more or less quickly depending on the geological strata encountered beneath the sea bed. When an electrical pulse activates the seismic source, pressurized air bubbles are discharged into the surrounding water. This process is very rapid, taking only a few seconds to reload. The acoustic units operate to high acoustic frequencies, 10 to 100 khertz, with a maximum output of approximately 254 dB re 1 µPa at 1 m. (that is to say the sound power at 1 m of the source).

Figure 1-3 Typical seismic source

During each transit, a seismic shot is executed approximately every 10 seconds.

- Seismic receiver cables (« seismic streamers »), towed by the survey vessel, contain regularly spaced receivers called hydrophones, which capture the echoes reflected by the underlying lithological contrasts. Ten 8 km-length solid or semi-solid streamers will be towed in order to record reflected acoustic signals. The echoes recorded are collected as an analogic signal, converted to digital format and relayed to computers on-board the vessel. At the end of the survey, seismic raw data are transferred to onshore processing centers, and then interpreted by geophysicists. The results are calibrated with other data (such as rock samples, regional well/drilling results and known geology) to bild a detailed geological image of the area (3D component) and understand how the Yadana-Sein reservoirs are behaving (4D component).

Figure 1-4 Typical seismic receiver cable

- The survey will used a slanted streamer configiguration, whereby, instead of lying on the sea surface, the streamer gradually goes deeper into the water column. This helps calculate the effect ghost signals due to reflection of the seismic waves on the sea surface and hence eliminate them to obtain a better geological picture of the subsurface.
- In plane view, the configuration of the streamers is optimized by spreading them out with paravanes (known as birds in the seismic industry). An example of the fan shooting geometry for the streamers is shown in Figure 1-5.

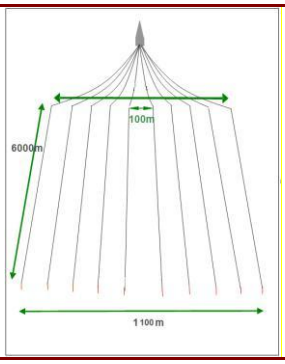


Figure 1-5 Fan mode geometry

A 2D seismic survey alternative would follow the same process, except it would use only one source and only one streamer, but he resulting level of detail collected would be much lower.

1.2.2 Logistic aspects of the seismic campaign

A specific marine streamer vessel is required to perform such a kind of operation. The contractor is not selected yet. Figure 1-6 provides photographs of a marine streamer vessel similar to the one which will be used for the present exploration program. The 3D seismic vessel required to complete this survey will accommodate a maximum crew of 70 people on board.

Typical 3D exploration surveys also mobilize one supply vessel, with a crew of 20, and several chase boats. The chase boats will accompany the main vessel to monitor the survey zone and to provide any emergency assistance required.

The only expected onshore activities proposed for this seismic survey will be associated with the support vessel, which may use the port of Yangon to re-supply the seismic vessel with food and fuel. The main survey vessel will be bunkered (refuelled) at sea in the 3D seismic area if necessary, however in general these seismic surveys vessels are designed for their self-sufficiency over long durations and it is assumed that no crew change will be effected.

Figure 1-6 Photograph of marine streamer vessel

Source: Total E&P

1.2.3 Inventory of waste, discharges and emissions

The first category is related to seismic acquisition survey activities:

- **Underwater noise** generated by the seismic source arrays (firing of air guns through the survey area), ambient noise impacts may occur during seismic activities; however, they will be on a short term and at a small scale.

The second category is related to the activities of the vessels:

- **Physical disturbance:** the vessels may interfere with the main shipping route and/or with commercial fishing. In addition, collision with marine mammals and specifically protected species might occur.
- **Atmospheric emissions:** atmospheric emissions from offshore exploration survey are primarily due to vessel diesel engines. GHG generated by the Project was estimated at 13,403 tons eqCO_2.
- **Wastewater:** wastewaters are generally associated with domestic and sanitary wastewaters (black and grey waters) as well as bilge and deck waters. For the project, the volume of domestic and sanitary wastewaters has been estimated at 2,331 $m^{3;}$ the volume of deck and bilge waters was estimated at 170 m^3 for the total duration of the Project. These water streams will be managed by the water storage and treatment devices on board, in compliance with the MARPOL Convention.

- **Solid waste:** ship activities produce hazardous waste and non-hazardous waste. A seismic survey only produces waste similar to those generated by a commercial ship of the same size. About 42 m^3 of domestic waste were estimated and approximately 390 tons of hazardous and non-hazardous waste might be produced during the seismic activities on the exploration program of the YWB block.
- **Odor and light:** potential impact from extraneous light is expected to be minor. No particular olfactory emission is expected during the seismic operation.
- **Accidental release:** unexpected leak from survey vessel fuel tanks.

The onshore waste disposal locations identified by TEPM is Thaketa (Myanmar).

1.3 DESCRIPTION OF THE EXISTING ENVIRONMENT

1.3.1 Physical environment

1.3.1.1 Atmospheric environment

Myanmar has a hot and humid climate dominated by monsoon pattern. Its climate can be described as tropical monsoon characterized by strong monsoon influences, a considerable amount of sun, a high rate of rainfall (coastal regions receiving over 5,000 mm of rain annually) and high humidity. Temperature in the country varies from 19°C to 38°C and humidity from 66 % to 83 %. During the forecasted period of the M5-M6 seismic survey project (April and October to March/April), little precipitation is anticipated, and would mostly occur in October.

Air quality on M5-M6 is may be affected locally by the Yadana and Sein gas operations and by shipping but is not expected to be an area of concern due to the size of the blocks. Air quality may be of concern in the port of Yangon, from where the supply vessel will be operating.

Air quality sensitivity ranks as very low.

1.3.1.1 Offshore sediment

Due to the proximity of the survey area to the Ayeryawady river delta that lies only 35 km further North, high fine sedimentation rates are expected to occur, which leads to rapid renewal of the tiop layer.

Offshore sediment sensitivity ranks as low.

1.3.1.1 Water quality

The water depth in the project area ranges from 10 to over 2,000 m, with most of the M5-M6 blocks located at a depth of around 100 m. The northern two-thirds of the blocks are affected by the inputs from the Ayeyarwady.

Water column sensitivity ranks as low.

1.3.2 Biological environment

1.3.2.1 Planktonic communities

Although the region presents a low abundance of crab larvae, planktonic shrimps and larvaceans, a rich abundance of zooplankton groups (including calanoid copepods, poecilostamatoid copepods and arrow worms) was observed during previous environmental baseline surveys carried out in the southern part of Myanmar waters. Until recently, plankton was considered to be a very low area of concern for seismic surveys, but recent findings may modify this line of thought.

Plankton sensitivity ranks as low.

1.3.2.2 *Fish*

Through the influence of the seasonal variations imposed by the monsoon systems, the pelagic fish community appears to be widespread with a common distribution. This community contains a wide variety species which are observed across the entire Indian Ocean.

Fish species sensitivity ranks as low.

1.3.2.3 *Marine mammals*

Among the 29 marine mammal species recorded by the IUCN with different levels of vulnerability in Andaman Sea, 21 may be encountered within the project area.

- 2 species are endangered (EN) facing very high risk of extinction in the wild: the Blue Whale (*Balaenoptera musculus*) and the Fin Whale (*Balaenoptera physalus*) ;
- 1 species is classified as vulnerable (VU) facing high risk of extinction in the wild: the Sperm Whale (*Physeter macrocephalus*).

Marine mammal sensitivity ranks as high.

1.3.2.4 *Turtles*

Some beaches on the Myanmar coastline were identified as nesting sites for five protected turtle species: **Olive Ridley Turtle**, **Loggerhead Turtle**, **Green Turtle, Hawksbill Turtle** and **Leather Back Turtle**.

These species are internationally protected and listed as vulnerable or endangered on the IUCN red list. The project area may be on a migration path for turtles that reach Myanmar beaches during the nesting period from the end of September to March, with a peak in January-February. Most observations of turtles are typically within 15 km of mainland shores in protected shallow marine waters (22-25 m), some distance from the project area. Nevertheless, some species may be encountered in the area to be explored as they are migratory species.

Turtle sensitivity ranks as high.

1.3.2.5 *Marine birds*

A total of 20 seabird species are currently identified by the IUCN in Myanmar waters. Amongst these species, 4 species are identified as near threatened and 16 species are recorded as least concern.

Marine birds sensitivity ranks as low.

1.3.2.1 *Benthic communities*

Most of the project is located on the continental shelf, within the direct area of influence of the Ayeyarwady delta. The associated benthic communities are therefore assumed to be fairly resilient to disturbance, but they do paly an important role in the food web.

The sensitivity of benthic communities (other than coral) ranks as low.

1.3.2.1 *Mangroves*

Mangroves constitute an important ecosystem that plays a role, among others, as a nursery for juvenile fish. The mangroves of the Ayeryawady delta have suffered a lot from conversion to agriculture and other human activities. Nevertheless, they are located at least 35 km from the project area.

Mangrove sensitivity ranks as low.

1.3.2.1 *Coral reef ecosystems*

A coral reef fringes Preparis island in the SW part of the survey zone, which lays outside of the area of influence of sediment and freshwater from the Ayeyarwady delta. Other reefs may be expected on shallow grounds along the line that extends the Rakine Mountains towards Preparis and the Coco Islands. Moreover many mobile reef species, including fish, are unlikely to leave the reef even if they are distrurbed.

The sensitivity of coral reef ecosystems ranks as high.

1.3.2.1 *Sensitive and protected areas*

The closest protected areas with a formal status are islands located close to the mainland, some 35 km north of the project. Preparis Island, although fairly pristine and surrounded by a coarl reef does not have a special protected status.

Sensitive and protected area sensitivity ranks as low.

1.3.3 Socioeconomic environment

1.3.3.1 *Fisheries*

The Project is located in the offshore fishery area, which represents more than 480,000 square kilometers and is only used by 2,000 domestic licensed vessels. However, interactions with fishermen are expected to be low due to the small number of fishermen authorized to fish in the offshore fishery area (2,000, against 30,000 in the inshore fishery area), the location of the block, out of identified fishing grounds, and a recent ban on foreign fishing in Myanmar waters that further reduces the likelihood to encounter fishermen (apart from illegal fishermen). Fishing is important economically and is already affected by overexploitation (and presumably by loss of mangrove nursery areas).

Fishing activity sensitivity ranks as medium.

1.3.3.1 *Marine traffic*

The Project area is located across the shipping lane from Yangon to Cape of Good Hope, which passes close to the Yadana / Sein fields and half of the length of this lane across the block is also used by offshore support vessels. The block is also cut across by the lane from Bengladesh to Singapore (Malacca Strait), and the lane from Singapore to NE India cuts across the SW corner of the block. Due to the presence of Preparis Island on M5-M6, vessels may need to anticipate in order to pass on the correct side of the island, depending on the location of the survey vessel.

Commercial ships are expected in the Project area.

Marine traffic sensitivity ranks as medium.

1.4 ENVIRONMENTAL AND SOCIAL IMPACT OF THE PROPOSED PROJECT

The assessment was conducted in three distinct stages:

- Identification of the impact source from the project description, and of the environment sensitivity from the description of its initial status;
- Estimation of the potential impact of each source of impact on each sensitive environmental component ;
- Identification of mitigation measures to reduce and control the potential impact and estimation of the residual impact once these measures are implemented.

The study showed that the main impacts on the environment and on the socioeconomic context are:

- The noise generated by marine seismic activities (airguns) may have consequences on the behavior of some species of on marine mammals, turtles and fish;
- There is a risk of direct contact with coral reefs, particularly due to shallow bottoms and the use of a slanted streamer area that extends into the water column;
- The presence of the survey fleet will affect fishing and commercial shipping.

The table below shows all the project residual impacts, i-e once the compensatory or mitigation measures are implemented. There are 7 impacts considered as « negligible » and 2 as « minor ».

1.4.1 Environmental impacts and associated measures

Table 0.2 Synthesis of potential impact : physical and natural components

Description of residual impacts	Residual impact (R)
Air quality	
Air emissions resulting from the seismic campaign are not a problem specific to seismic surveys: they are similar to those of any other merchant ship of a same size. Nevertheless, the supply vessel makes regular port calls at Yangon, where air quality is a growing issue and greenjhouse warming and ocean acidification are global problems that also affect Myanmar. The main vessel will have a Ship Energy Efficiency Management Plan and low-sulphur (less than 0.5%mass) fuel will be used	Negligible
Offshore sediments	
The project is mostly located in a delta environment where sedimentation rates are naturaly high, so minor sediment remobilization is not an issue. A no waste overboard will be implemented (with the possible exception with fiood waste to be treated as per MARPOL (ground before discharge).	Negligible
Water column	
The project will implement a zero discharge policy, with a relaxation for deck waters for the lesser vessels.. No bunkering, sewage or waste transfer is to occur during hours of darkness. A spill response procedure will extend SOPEPs to cover petty spills during bunkering.	Negligible
Planktonic communities	
Impacts on planktons are generally restricted to around 5 meters around the seismic source, but seismic operation impacts on these organisms were considered as statistically insignificant, although this traditional view is being challenged: this is an emerging topic. All other sources of impacts are eliminated by the zero discharge policy and spill prevention measures (no transfers in hours of darkness).	Negligible

Marine mammals	
Though marine mammals are sensitive to underwater noise, specific surveillance should significantly reduce geophysical survey impacts on cetaceans, including the risk of physical injuries, behavior disturbance (diving and breathing patterns, vocalization), migration disturbance, social behavior change. The soft start of seismic shooting will give cetaceans time to leave the study area. At night, observations will be maintained through the use of infra-red/light amplification systems and/or passive acoustic monitoring equipment (PAM). Two marine mammal observers will be needed to maintain a correct level of MMO availability throughout the duration of the campaigns.	Moderate

Turtles	
The turtle surveillance by MMO should significantly reduce geophysical survey impacts on turtles, including the risk of physical injuries, the disturbance of their behavior (especially during nesting and migration periods, etc.). The soft start procedure will give turtles time to leave the study area before the beginning of seismic shooting. In addition, the use of turtle fiendly tail buoys will avoid turtle mutilation and death caused by tail buoy towed tied at the end of the streamers; moreover, use of a slanted streamer configuration, whereby the streamers do not run along the sea surface is expected to reduice this risk.	Medium

Pelagic fish	
Adult fish: adult fishes (including threatened species identified by the IUCN) are likely to be present in the project area, but avoidance behavior generally observed in response to seismic acquisition activities contributes to prevent possible damages caused on these populations. In addition, the progressive start of the activities will give fish time to leave momentarily the area. The impact is therefore considered as minor to negligible.	Negligible
Juvenile fish: The seismic survey may cause short term disturbance to reproduction patterns of certain fish species which form concentrated breeding aggregations. Sesimic sound waves may damage larvae, but only at a very short range from the airguns, and this mortality is negligible compared to the enormous natural mortality of fish larvae.	Negligible

Birds	
It is unlikely that birds dive near the ship if food sources (fish, food waste) are kept away. In addition, even in an accidental situation, a seismic survey does not entail a risk of major heavy oil spill (no oil production during this geophysics study) that could harm marine birds. As a consequence, the impact should be anecdotal.	Negligible

Benthic communities (other than coral)	
A zero discharge will be applied.and. No impact is expected on the benthic communities (beyond acoustic damage to larval stages that fall within naural mortality rates).	Negligible

Mangroves	
The mangroves along the Ayeyarwady delta certainly play an important role as a fish nursery, and they have been severly impacted by conversion to agricultureal land/shrimp farming. However, these ecosystems lie at least 35 km from the project area, and any spills related to bunkering are unlikely to reach them.	Negligible

Coral reef ecosystems	
Coral reefs occur around Preparis Island and most probably on shallow bottoms between that Island and the coast, in areas where the influence from delta sedimentation is not excessive. Sensitive mobile organisms that inhabit reefs (essentially fish) may not flee away from acoustic impacts as readily as pelagic species. Moreover, there is some concern that the slanted streamer configuration, beneath the sea surface, may actually hit a reef and most coral species are highly sensitive to direct contact. Continuous echo-sounding will be performed to avoid such impacts..	Moderate

Sensitive an d protected areas	
Like for mangroves, the nearest officially protected areas are probably out of reach of any project impacts. The geostrategically located Preparis Island is not officially designated as a protected area but it is reasonably pristine and surrounded by a coral reef.	Minor

The main mitigation measures proposed are as follows, and are strongly based on the UK JNCC Guidelines, which are usually used as good practices references worldwide).

- Establishment of a shutdown zone, with a radius of 500 m (distance to be refined once the airgun characteristics are known)
- Establishment of an observation zone (**radius of 3 km**) from the center of the seismic source array. Within this area, continuous visual monitoring will be undertaken by two Marine Mammal Observers (MMO) working in shifts, one of whom is fully qualified on the seismic survey vessel, including continuous monitoring during a period of at least 60 minutes prior to airgun start-up (applicable to deep waters).
- During the pre-shooting watch, the seismic survey will be stopped if a marine mammal is observed within this area. If a marine mammal enters the zone after operations have started, no mitigation actions are recommended by the JNCC.
- 1 observer on each of the 2 support vessels in addition to the MMO on seismic vessel. The observers will be members of the crew of each vessel trained by the MMO before the beginning of the survey. The Observers will be in charge of reporting any marine mammals approaching the area.
- Establishment of a delay period of 20 minutes before the start-up (including soft start) after the last sighting of a marine mammal within the shutdown zone. Passive Acoustic Monitoring (PAM) will complement visual observation (with adapted devices that enable to detect animals when they vocalize, even when they dive for a long time) during night time and when visibility is too low to enable visual observations.
- Implementation of a soft-start procedure. Prior to acquiring data on each seismic line and after each break in operations, power will increase slowly in the seismic array over a period of at least 20 minutes (no longer than 40 minutes) to allow sensitive marine fauna to leave/avoid the area.

An exclusion zone with a radius equivalent to that for high frequency cetaceans will be applied to turles. Moreover, tail buoys tied to streamers will be equipped with a protection system on their propellers in order to prevent turtles from being injured.

Figure 1-7 illustrates the shut-down and observations zones proposed for the project to mitigate the impact on marine fauna.

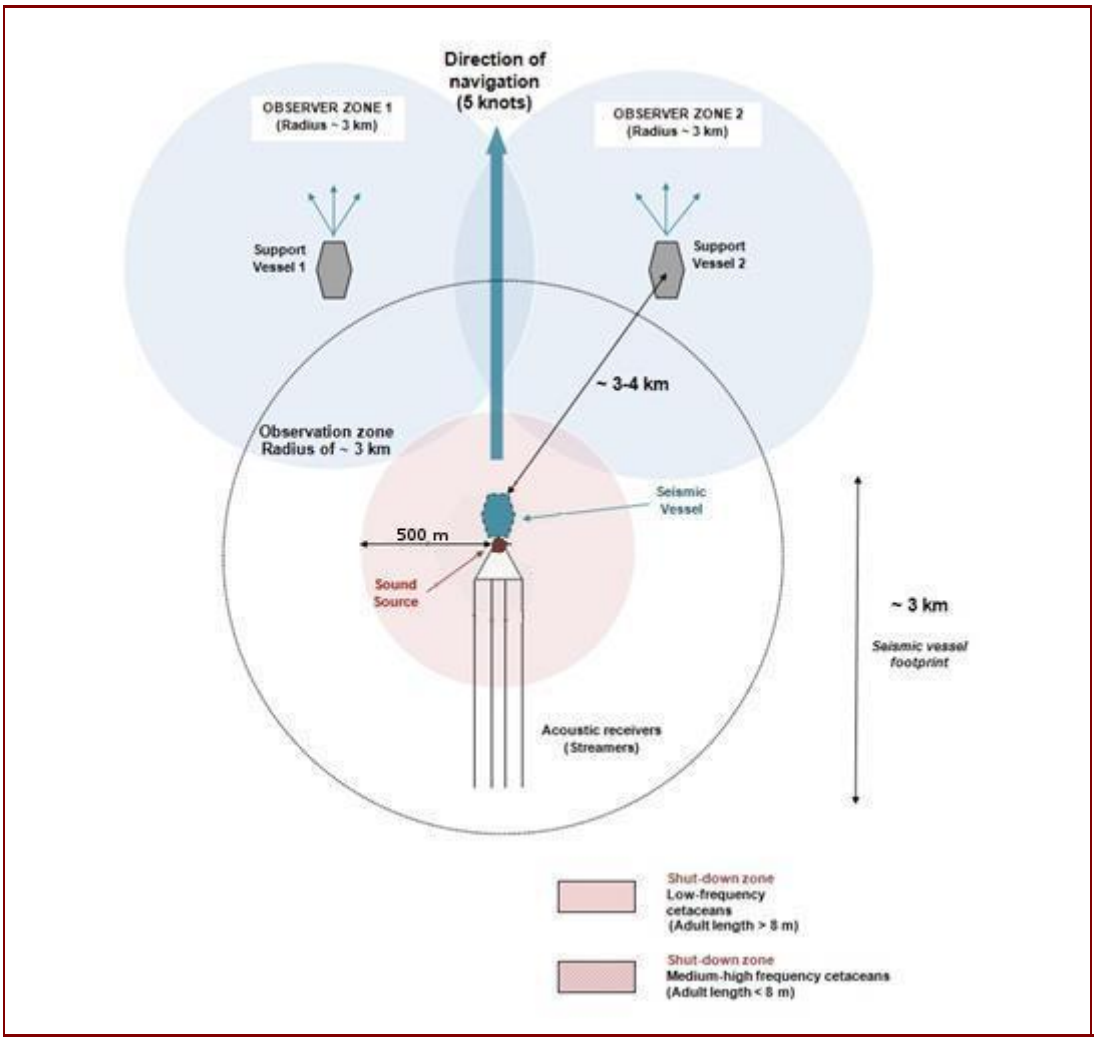


Figure 1-7 Diagram of proposed shut-down and observation zones for M5-M6 seismic survey

1.4.2 Socioeconomic impacts and associated measures

Table 0.3 Synthesis of potential impact : human component

Description of residual impacts	Residual impact (R)
Marine traffic	
Prior to the operation, it will be necessary to inform contractor's employees during HSE or Project inductions about the risks related to the presence of fishermen or commercial ships in the Project area and the mitigation measures planned. Furthermore, communication with Myanmar marine authorities (MPA, DMA, Myanmar Navy and coastguards) and the issuance of a notice to mariners about the seismic operation by marine authorities will be needed. Due to seismic vessel movement (approximately 5 knots), occupation of a same area will last only a few hours. Equipment of the seismic vessels with loud speakers to communicate with boats not equipped with radio will minimize the risk of collision with others ships present in the area. If the ship pursues its approach and does not respond to calls, chase vessels should make physical approach to inform the captain Preparis Island creates an obstacle for N-S traffic, which may warrant special anticipation to ensure that traffic choses to pass it on theeasiest side.	Minor
Fishing	
The project area encroaches on the offshore fishing zone. The fishing activity will be affected by seismic activities, mainly because of the presence of the survey vessel (for a short time at the same place), but also because of the procedures aiming at driving fish back from the main ship (soft start). Prior to the activity, flyers on the seismic campaign in Burmese and Thai languages will be prepared. A scouting survey enabling to assess the fishery activity at the seismic area, should be conducted before the seismic survey starts. The position of the ship and prospected areas will be notified at any time to the marine authorities and main fishery stakeholders (DoF and MFF) during the survey, in order to minimize the obstacle to maritime activities. Boats are not really deviated from their fishing area due to the seismic vessel movement. Furthermore, chase vessels are used to monitor the presence of ships using radar or visual observation, and establish radio or loud speaker communication with the ship operator to inform him about the operation area and the need to reroute their boat. Chase boats will also be used in case of need to contact fishing. Warning times of up to 45 days are requested from the fishing community, due to among others to the presence of long-term nets.	Minor

This initial environmental examination showed that there might be interactions between the project development and fishing activities. In order to avoid this impact, a communication plan with Maritime Authorities will be implemented to inform fishing boats of the seismic vessel position and of the safety distance that must be respected around it. Support ships will be used to communicate with fishing boats located around the main boat during operations.

1.5 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

The Environmental and Social Management Plan ensures that all identified mitigation measures in the IEE are implemented, in an appropriate planning.

It is built around the following components, which all appear in the Commitments Register:

- Marine mammal observation and related procedures for operating the airguns, which are essentially based on a soft-start procedure and delaying the start of firing until no mammals are within a 500 m exclusion zone. This procedure also benefits to sea turtles.
    - Observations will include two Marine Mammal Observers, one of whom is fully trained, in addition to the observers on the auxiliary vessels. Thuis will help alleviate the effects of the long duration of the seismic campaign.
    - Infra-red/night vision or passive acoustic monitoring (PAM) will be used at night;
    - Observations will include one month before the start of the seismic campaign, and one month after it (lilmited to the portion of the block between Yadana field and Yangon), so as to be in a better position to assess the impact of the survey.
- Virtually continuous echo sounding, which will decrease the risk of damage to coral reefs by the slanted array streamers;
- Coordination with maritime and fisheries stakeholders, so as to disrupt the least possibly the fishing and commercial shipping activites;
- Rules for safe bunkering of fuel at sea (e.g. not at night and not upstream of a reef);
- Application of best maritime practice to the main survey vessel, and more generally the whole fleet, such as:
    - Full compliance with MARPOL regulations, SOLAS and AIS regulations, Ballast water management plan, Ship Energy Efficiency Management Plan, etc..
    - Use of low-sulphur fuel (less than 0.5%$_{mass}$ of S)
    - No waste/effluent overboard policy and application of a waste management plan. (Wastes generated will be the same as for ordinary shipping, with the exception of a slightly higher content of electronics waste).
- The monitoring component is based on the:
    - The observations and logs of the Marine Mammals Observers.
    - Permanent checking that all other controls are always in place (e.g. correct fuel is being used, discharges overboard are not possible etc.).
- Auditing will come on top of the monitoring and will at least include checking the final destination of some of the waste streams).

The finalisation of the practical plans will occur as soon as the contractor has been identified, since the process requires interfacing TEPM procedures with the existing ones of the contractor. The final structure shall include the following elements:

- Health, Safety and Environment policy;
- Organization, resources and documentation;
- Hazard identification and risk management;
- Work procedures, change management and response in case of emergency situation;

- Operation monitoring system: reporting, and research on corrective actions;
- Waste management plan;
- Discharge management plan;
- Training program;
- Environment monitoring plan ;
- Socioeconomic program, including relationship with community, and navigation plan;
- …

SECTION 2. INTRODUCTION

2.1 CONTEXT

Myanmar is one of the world's oldest oil producers, exporting its first barrel in 1853. Rangoon Oil Company, the first foreign oil company to drill in the country, was created in 1871. Between 1886 and 1963, the country's oil industry was dominated by Burmah Oil Company (BOC), which discovered the Yenangyaung field in 1887 and the Chauk field in 1902. Both are still in production.

Currently, in the offshore, Total E&P Myanmar, Petronas Carigali Myanmar, Daewoo, PTT-EP, China National Offshore Oil Corporation, China National Petrochemical Corporation, Essar, GAIL, Malaysia's Rimbunam, India's ONGC, Silver Wave Energy, Australia's Danford Equities and Russia's Sun Itera Oil & Gas are exploring and/or developing 31 blocks.

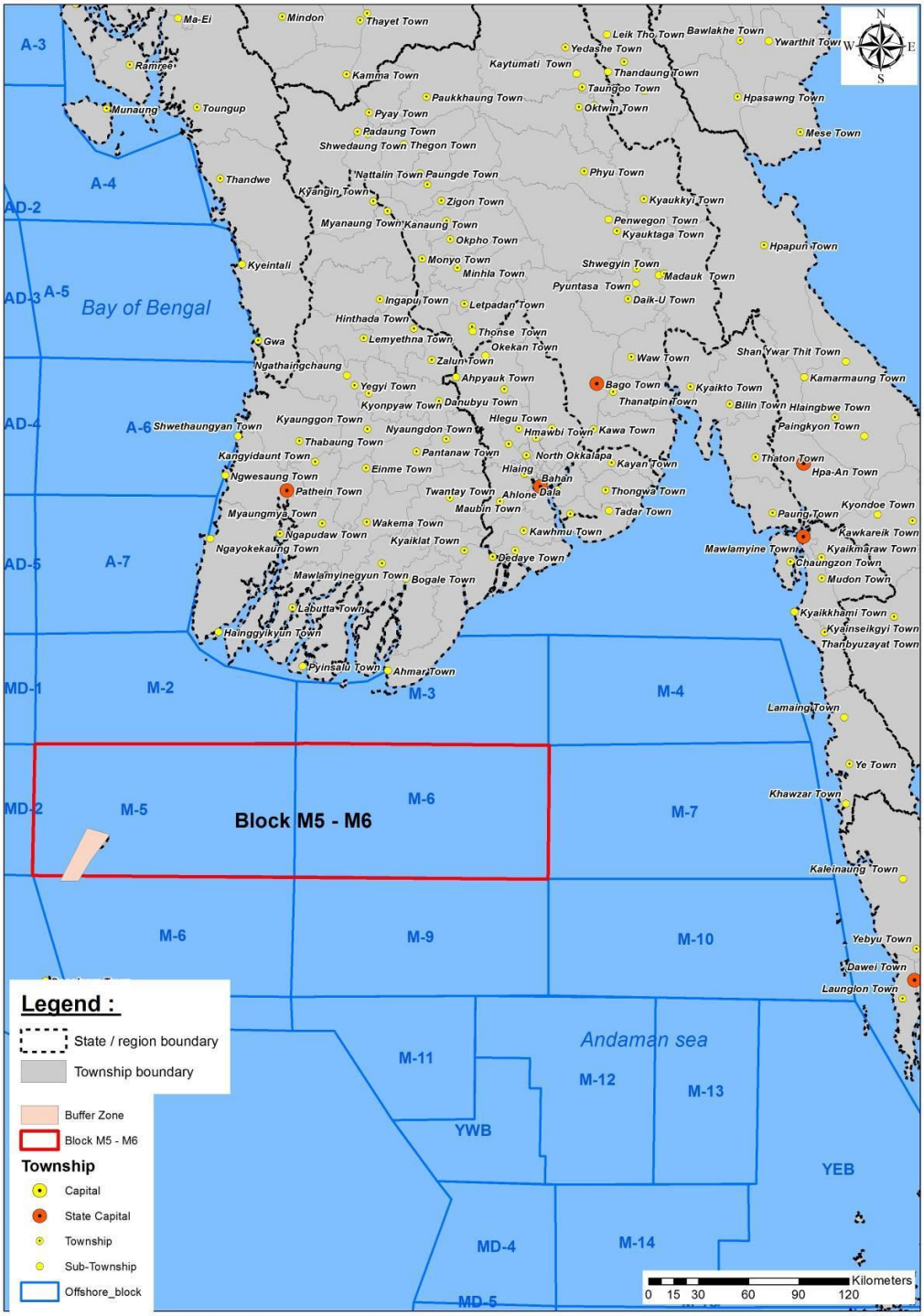
Total E&P Myanmar plans to complete a seismic campaign, object of the present Initial Environmental Examination. The entire seismic survey will be subdivided into three parts. 3D seismic campaigns will start in late April 2018 in Yadana-Sein before the monsoon, with an estimated duration of one month. It will be followed by a 7 month duration 3D seismic survey within M6 block in late 2018. The remaining acquisition campaign over M5 block will start late 2019 after the monsoon for an estimated duration of six months.

Figure 2-1 Tentative schedule of the seismic campaign

SOURCE: Total E&P MYANMAR

The seismic campaign will be split into three consecutive phases and the entire survey will be undertaken within the M5-M6 blocks perimeter.

The three 3D seismic survey will nominally cover 24541 km^2, i.e. the full footprint of blocks M5 and M6, minus any buffer zones such as Preparis Island.



Source : Myanmar Information Management Unit (MIMU)

Figure 2-2 Myanmar Offshore Blocks

2.2 PROJECT LOCATION

The seismic surveys will be located about 33 km south of the Myanmar coast, within the M5 and M6 blocks, in the Andaman Sea. The water depth in the area of prospect ranges from 20 m to 200 m.

The coordinates of the Project area are given in the table below and cover the entire M5 and M6 blocks limits. The Yadana Sein shooting footprint is included within the M5-M6 bloc perimeter.

Table 2-1 Coordinates of M5-M6 survey area (UTM WGS 84 Zone 46 north)

Description	Easting (X)	Northing (Y)
NW corner	534076.91 m E	1703471.77 m N
NE corner	198346.17 m E	1703011.52 m N
SW corner	532546.48 m E	1625462.43 m N
SE corner	195000.64 m E	1622063.06 m N

SOURCE: Total E&P MYANMAR

2.3 OBJECTIVES OF THE IEE (INITIAL ENVIRONMENTAL EVALUATION)

An Initial Environmental Evaluation is a report comprising an assessment of a proposed project that is prepared to aid environmental Authorities in determining whether the project affects the environment or existing socio-economic activities, and in deciding whether the project should be allowed or not. The form, content and structure of the report shall be in accordance with the Myanmar regulation (EIA Procedure), Total E&P Myanmar guidelines and international best practice, and include the Environmental Management Plan (EMP).

Box 1. ***Content of IEE Report***

The proposed IEE will comprise the following parts:

a) ***Project description in reasonable detail together with overview and layout maps;***

b) ***Identification of the Project Proponent including the identification of the owners, directors (if any) and day to day management and officers of the Project Proponent;***

c) ***Identification of the IEE experts, including which expert is responsible for which part of the IEE Report;***

d) ***Description of the surrounding environmental conditions of the Project;***

e) ***Identification and assessment of potential Adverse Impacts;***

f) ***Results of the public consultation / public participation process and the Total E&P Myanmar's written response to comments received during that process;***

g) ***The environmental protection measures of the Project;***

h) ***The conclusion of the IEE;***

i) ***The EMP; and***

j) ***The persons, organizations and budgets needed for implementation of the EMP.***

SECTION 3. DESCRIPTION OF THE PROJECT

3.1 SEISMIC SURVEY DESCRIPTION

The M5-M6 survey area is located about 35 km south of the Myanmar coast and its NW corner is located 163 km due South of Yangon, in Andaman Sea. Most of the area lies in the southwestern corner of the Andaman Sea, whereas the area West of Preparais Island is probably best considered as a part of the Bay of Bengal. The entire seismic campaign is subdivided into three 3D seismic surveys which will cover virtually the whole of the footrpints of blocks M5 and M6, with the exception of Preparis Island and a buffer zone around it. Within most of the project area, the bathymetry ranges from 50 to 100 m, but a small area no deeper than 10m occurs along the Great Coco Island / Preparis Island / Cape Negrais alignement, and oceanic depths of over 2000 m occur at the very SW corner of the survey area.

The project is planned to begin in late April 2018 for the central portion (Yadana-Sein fields already under production), before the monsoon, with an estimated duration of one month, followed by a period of approximately six months in late 2018 for the offshore block M5. The remaining acquisition campaign over the offshore block M6 start end 2019 after the monsoon for an estimated duration of six months.

The location of the Project area is shown on Figure 2-2.

3.1.1 General description of marine seismic surveys

Seismic surveys are carried out to allow the mapping of the subsurface geological formations and the identification of potential hydrocarbon deposits.

Marine seismic campaigns use a combination of air guns or water guns towed astern a marine seismic vessel to produce seismic pulses below the water level. These pulses generate acoustic energy rays which are propagated towards the ocean floor. These waves are reflected back to the water surface by the different geological formations in the earth's crust and are detected and recorded over a predetermined time period by underwater microphones (hydrophones). The data recorded is stored for later analysis and the generation of seismic data profiles which can be interrogated to determine the presence of potential hydrocarbon reserves.

An example of the marine seismic data acquisition technique is given Figure 3-1, with an aerial view of a seismic vessel in operation.

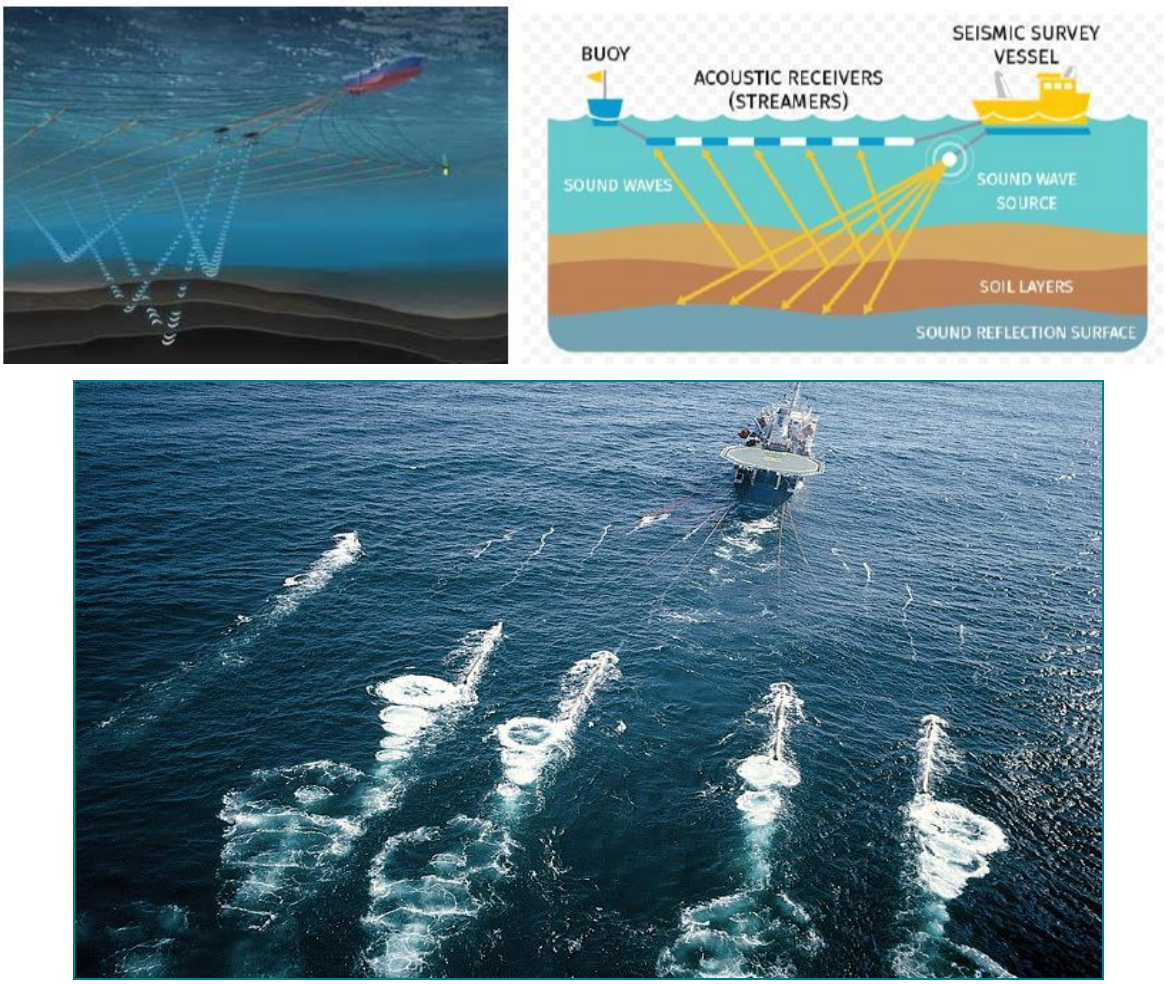


Figure 3-1 Technique and example of data acquisition during a marine seismic survey

SOURCE: TOTAL

3.1.2 Description of 3D seismic surveys

In 3D surveys several hydrophone streamers are towed behind the survey vessel, together with generally dual sources. This technique is the one proposed for the exploration of the M5-M6 3D seismic survey.

Since seismic waves travel along expanding spherical wave fronts they have surface area. A truly representative image of the subsurface is only obtained when the entire wave field is sampled. A 3D seismic survey is more capable of accurately imaging reflected waves because it utilizes multiple points of observation. Multi streamer or multi source surveys allow for a range of different angles (azimuth) and distances (offset) to be sampled resulting in a volume, or cube, of seismic data.

This allows for a more detailed and accurate delineation of the boundaries and extent of the subsurface geological structures. Potential oil and gas reservoirs can be imaged in three dimensions allowing interpreters to view the data in cross-sections along 360° of azimuth, in depth slices parallel to the ground

surface, and along planes that cut arbitrarily through the data volume. Information such as faulting and fracturing, bedding plane direction, the presence of pore fluids, complex geologic structure and detailed stratigraphy are now commonly interpreted from 3D seismic data sets.

A 3D survey data is normally acquired using a pattern as shown in Figure 3-2, which is called a 'racetrack' pattern. This is employed to reduce the time necessary to turn the vessel also around while allowing adjacent lines to be recorded with the data in the same direction. This minimizes processing artifacts, which could adversely affect the interpretation of the data. In general, the survey area is broken into areas in which swathes of lines are completed in phases. The distance between adjacent tracks is 450 m, i.e. slightly less than half the width of the hydrophone array.

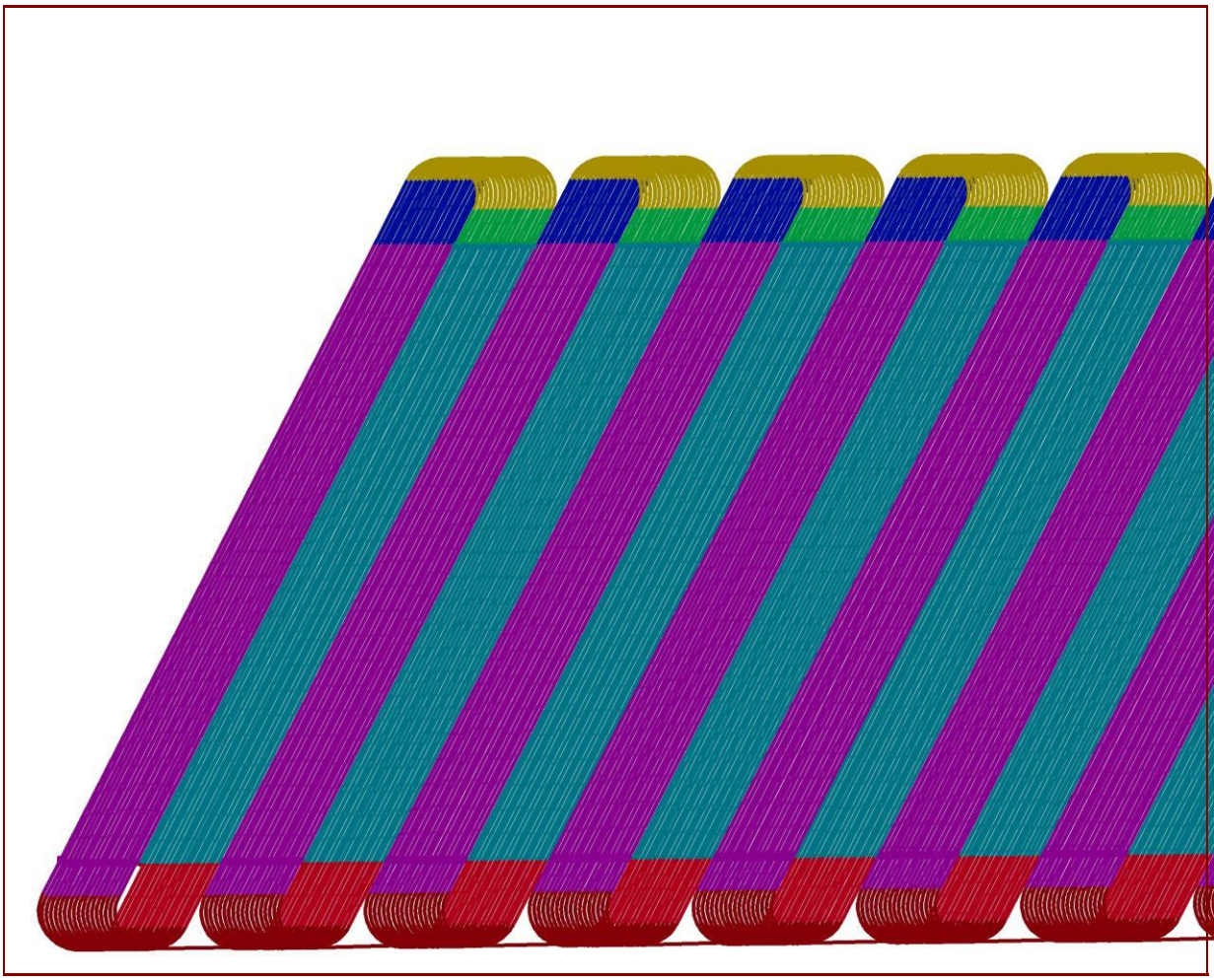


Figure 3-2 Typical racetrack shooting pattern for 3D seismic survey

SOURCE: Total EXPLORATION & PRODUCTION

The seismic acquisition will take place over M5-M6 blocks (entire footprint). While the seismic vessel carries out its turn outside the shooting tracks, no airgun will be in activity.

A special refinement of the project is that the Broadseis (slanted cable) technique will be used. This system places the various hydrophones at different depths (instead of just below the surface in a standard configuration). Figure 3-3 shows the configuration of a typical Broadseis streamer (stremer vessel on the left of the figure), with successive hydrophones placed deeper and deeper, as far as 50m deep if water depth allows, until the end of the streamer is supported by a tail buoy on the surface. The advantage of

this technique is that it is possible to calculate and eliminate the ghost echos due to sound wave reflections on the sea / air interface, resulting in a much broader range of sound frequencies that can be used for analyzing the geological features. Consequently, the resulting image of the geology is more detailed.

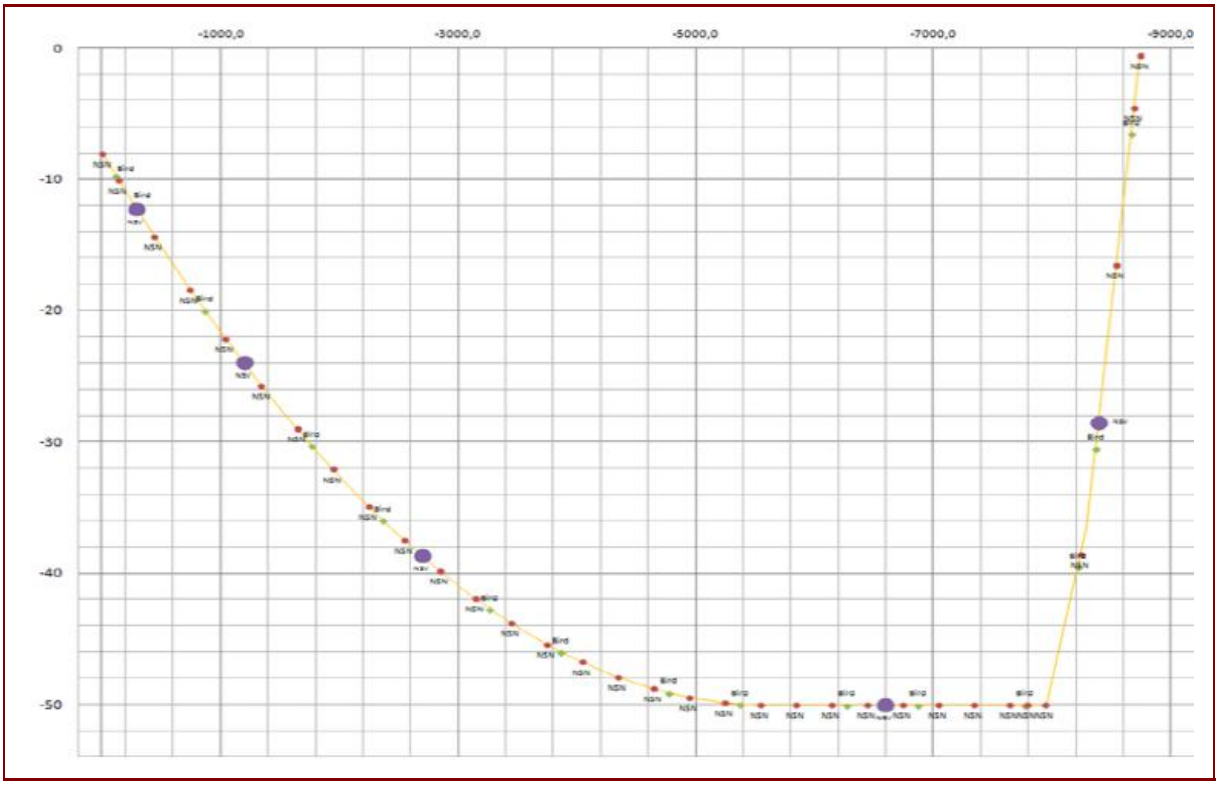


Figure 3-3 Typical streamer profile for the slanted array technique

SOURCE: TOTAL

3.1.3 M5-M6 Blocks

The M5-M6 survey is located about 35 km south of the Myanmar coast. Very few vintage 2D lines were acquired in the area during the 70s. These old data were completed by TEPM in 2012 with a 4D seismic survey over Badamyar-Yadana and Sein locations and in april/may 2016, during a 2D seismic covering approximately 2,000km of seismic lines.

The water depth ranges mostly from 20 m to around 200 m, with possibly some shallow grounds at around -10m lined up with Coco and Preparis Islands, and oceanic depths of -2000 m reached on the very NW corner of the survey area. The survey area of the M5-M6 blocks will be approximately 24541 km2.

The targeted structure is the Miocene carbonate platform. The aim of such an acquisition will be the detection of structural traps within the Plio-Pleistocene sequence. It is therefore essential to obtain a good structural image with a clear delineation of potential reservoirs.

The environments within the M5-M6 block is described in details in the section 5 “Description of the Environment”

3.2 SEISMIC ACQUISITION EQUIPMENT

A seismic survey system is mainly composed of the following equipment:

- Seismic vessel and support vessels;
- Seismic sources (airguns);
- Seismic receiver cables (streamers).

The survey is completed in three steps: (i) deployment of the streamers (ii) initialization of the airgun firing sequence and carrying out of the seismic survey and (iii) recovery of the streamers.

3.2.1 Master seismic vessel and chase/support vessels

The marine streamer vessel will be manned by up to 70 personnel and the support vessels manned by up to 20 persons maximum each. There will be up to two supply vessels in charge of the refueling of the seismic vessel, and the transportation to/from onshore of some goods, technical equipment needed by the main vessel, waste, etc. Three to five chase boats will be in charge of maritime safety and monitoring. A second source vessel will be required for a limited scope around the existing Yadana and Sein platforms, in order to achieve the required geometries betweent the sources and the streamers in this area that requires complex racetrack patterns for avoiding the installations.

The vessels are equipped with accommodation and supplies' quarters. The marine streamer vessel is equipped with a helipad for MEDEVAC and/or emergency only. Crew changes will be made thanks to support vessels. The vessels are equipped with modern navigation equipment including radar, sonar, current meter, speed log, communication equipment and propulsion systems as well as independent energy production capabilities. An echosounder will be also used virtually continuopusly for in order to check that there are no underwater obstacles; this is particularly important because of the slanted cable technique that will be used.

The survey vessel has an instrument room where the main seismic instrumentation is housed, including navigation and seismic source control equipment.

The back deck serves the purpose of storing, retrieving and deploying seismic equipment. The energy source equipment (air guns) is generally located here as well as the air feed from seismic vessel compressors. The towing equipment is located here as well allowing for an accurate positioning behind the vessel and various operating conditions.

A compressor room contains the compressor engines and the compressors that supply high pressure air to the seismic sources. The compressor allows the continuous firing of seismic sources typically every ten seconds during data acquisition (12 to 24 hours/day).

Figure 3-4 provides a photograph of a marine streamer vessel as an example (marine streamer used for the previous seismic survey on block M5-M6). A technical description of a typical marine streamer is provided in Appendix H.

The vessels will follow the MARPOL guidelines.

Figure 3-4 Photograph of the marine streamer vessel

SOURCE: Total EXPLORATION & PRODUCTION

The logicstics base for the operation will most likely be Thaketa (Yangon).

General characteristics of the vessels to be used for the campaign are presented in the below table (see Table 3-1).

Table 3-1 Characteristics of vessels for the seismic campaign – generic characteristics

General information of the seismic vessel	
Length	> 100 m
Fuel consumption	45 m^3/day
Crew	60 - 70
Survey speed	4.5 knot
Turning speed	4.3 knot
Normal turn radius on operation	Max 5 km
Water ballast	750 m^{3*}
Fresh water capacity	285 m^{3}*
Sewage	no onboard sewage treatment plant
General information of the supply and chase vessels	
Fuel consumption	25 m^3/day per vessel
Crew	Maximum 20 persons per vessel
Working speed	Maximum 11 knots
Chasing speed	Maximum 4,5 knots

SOURCE: Total EXPLORATION & PRODUCTION - * CHARACTERISTICS TAKEN FROM THE VOYAGER EXPLORER VESSEL

The supply vessel and the two chase boats are also not defined yet; therefore, generic characteristics are given on Table 3-1. Figure 3-5 provides photographs of typical marine support/supply vessels.

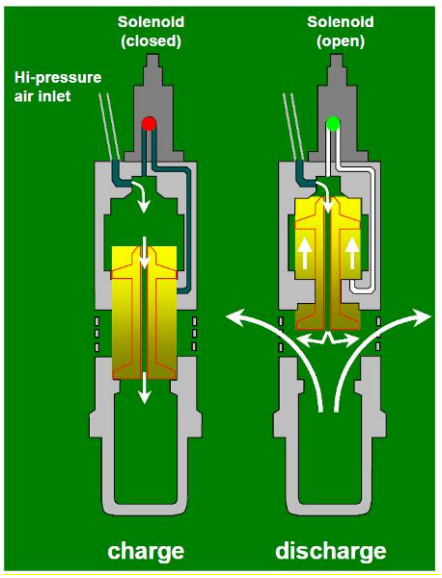
Figure 3-5 Photographs of support vessel (on the left) and chase vessels (on the right)

SOURCE: Total EXPLORATION & PRODUCTION

3.2.2 Seismic source for seismic survey

The seismic source for this project will be generated using airguns which emit pressurized bubbles to create powerful sound waves.

The air gun is composed of two high pressure air chambers; an upper control chamber and a discharge chamber (refer to Figure 3-6). A compressor situated on the seismic vessel supplies high pressure air (typical source pressure: 2000 psi) to the upper control chamber via an air hose which feeds into the lower firing chamber via an orifice in the shank of the shuttle. The airgun is actuated by sending an electrical pulse to the solenoid valve which opens and allows the high pressure air to flow to the underside of the piston. The high pressure air is then discharged into the surrounding water through the airgun ports. The air from these ports forms a bubble which oscillates according to the operating pressure, the water depth and the temperature and volume of air vented into the water. The shuttle is forced back into its original position by the high pressure air in the control chamber so that once the discharge chamber is recharged the airgun is ready for firing. This process is very rapid, taking only a few seconds to recharge.



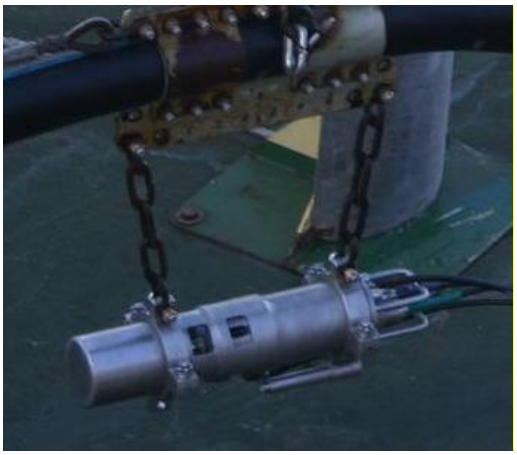


Figure 3-6 Typical air gun mechanics and example of typical air gun

Airguns are operated in groups (or sub-arrays) which are suspended from flotation devices to maintain the specified operating depths behind the marine vessel. The effect of having several airguns operating simultaneously as a series of sub-arrays (gun array) is to attenuate the emitted sound level by the oscillation of the bubbles to obtain the shortest acoustic signal possible.

Airguns are capable of providing information about geological structures until 10 km below the sea floor.

For this project, two seismic sources will operate in “flip-flop” mode (i.e alternatively). Each source will be composed of two sub-arrays of 12 airguns that will be operating at an air pressure of 2000 psi. The total volume of the source arrays anticipated reaches 2,340 cubic inches. During each transit, a seismic shot is executed approximately every 12.5 m.

The characteristics of the seismic sources are summarized in Table 3-2.

Table 3-2 Characteristics of airguns

Number of sources	2
Source Centre Separation	25 m
Shot interval per Source	12,5 m flip-flop
Operating Air Pressure	2,000 psi
Nominal source volume	~ 2,340 cu inch
Cross-line separation between sub-arrays	7 m
Source Depth	5 m
Vessel speed during seismic acquisition	4.5 knot

SOURCE: *Total EXPLORATION & PRODUCTION*

The figure below shows the configuration of gun arrays.

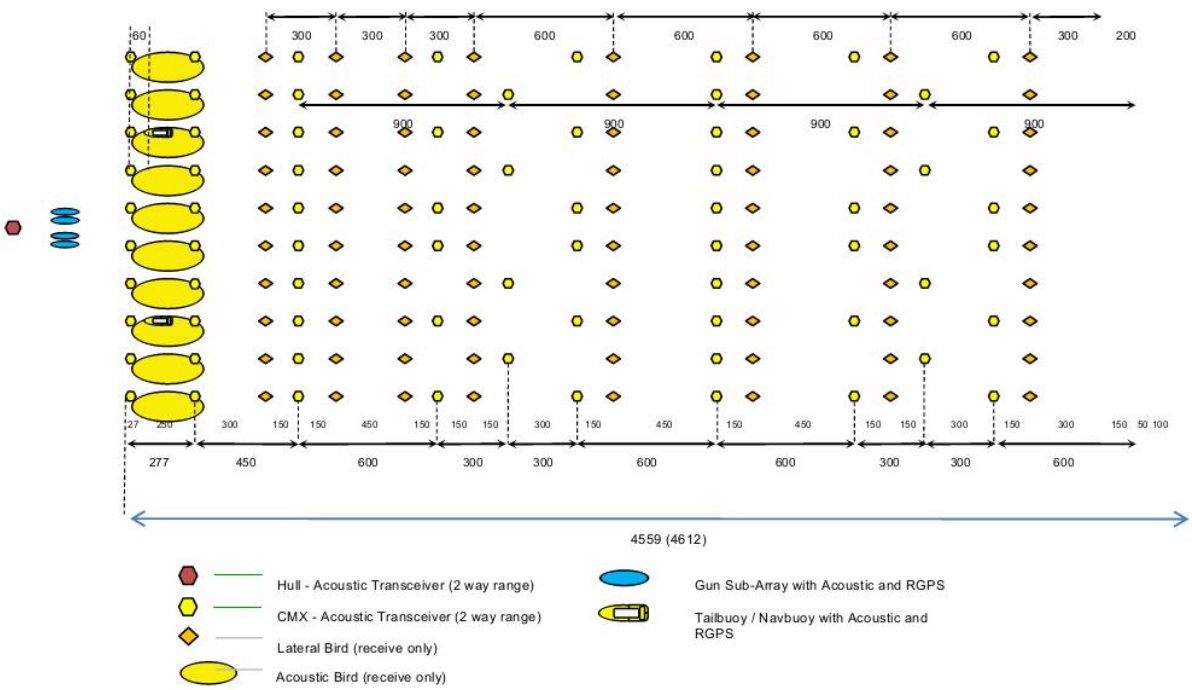


Figure 3-7 Gun array layout

SOURCE: Total EXPLORATION & PRODUCTION

3.2.2.1 *Principles of underwater acoustics*

Sound in the ocean travels as vibrations of water molecules that exert push-pull pressure on objects in their path. The properties of these vibrations are important in determining the impact on receivers:

- The frequency or rate of oscillation is measured in cycles per second or hertz (Hz). Ultrasonic frequencies are too high to be heard by humans (>20,000 Hz) but may be heard by some animals such as dolphins and bats. Infrasound is too low to be heard (<20 Hz) but can be heard by baleen whales (Richardson *et al.*, 1995).
- The wavelength is the length of the sound oscillation.

Sound pressure expressed in pressure units, microPascal (μPa), is the parameter measured by most instruments.

Acoustic intensity is the acoustic power per unit area in the direction of propagation (units: watts/m^2). The intensity, power and energy of an acoustic wave are proportional to the average of the pressure squared (mean square pressure).

The human ear responds in a logarithmic fashion to increases in sound intensity, therefore this scale has been adopted to reflect this response. The decibel scale is a logarithmic scale used to measure the intensity (power) of sound. It is defined as:

- **$dB = 10 \log10(I/I_0)$**, where I_0 is a reference intensity.

However sound measuring devices usually respond to sound pressure (P) and the intensity of sound varies as the square of the pressure. Consequently, the level of sound intensity can be rewritten as:

- **$dB = 20 \log10(P/P_0)$**, where P_0 is a reference pressure.

The reference pressure (P_0) is chosen to indicate the limit of human hearing and is:

- 20 µPa in air;
- 1 µPa in water.

The logarithmic decibel scale allows a large range of values to be represented by smaller numbers. For example a doubling of the pressure represents approximately 3dB.

In water, the acoustic signals emitted by airguns generally have a sinusoidal form constituted by a peak and dip in pressure. The intensity is usually expressed in dB re 1 µPa-m, which represents the sound power at 1m of the source.

Figure 3-8 illustrates the waveform of an airgun which is a typical pulsed output. The sound can be characterized by the following parameters of the Sound Power Level (SPL):

- Peak-to-peak (P-P) or Zero-to-peak pressure (0-P) (dB re 1 µPa-m): this considers the change in amplitude (pressure) of a sound wave, being respectively the maximum pressure of the rising part of the wave and the sum of the pressure of first peak plus the absolute value of the first trough.
- RMS (Root Mean Square) (dB re 1 µPa-rms): measures the total sound intensity, and then, divides it by the length of the signal. In other words, it expresses the average peak pressure over the duration of the sound pulse. Acoustic power, intensity and energy are proportional to the mean squared pressure.
- SEL (Sound Exposure level): measures the energy of a signal split up into one second. It involves a correction of the mean square calculation to account for the difficulty in determining signal duration. Behavioral response may be correlated with SEL, in particular for single pulse (SELop) and multi pulse (SELmp) sources. In the case of multiple pulse sources, like seismic sources (one pulse per 5 seconds), SELmp is the sum of the energy during the supposed contact between de sources and the receiver.
- The noise level at a given frequency: usually the frequency at which the transmitted sound power is a maximum. In this case, the unit is "maximum amplitude" a µPa in dB/Hz.

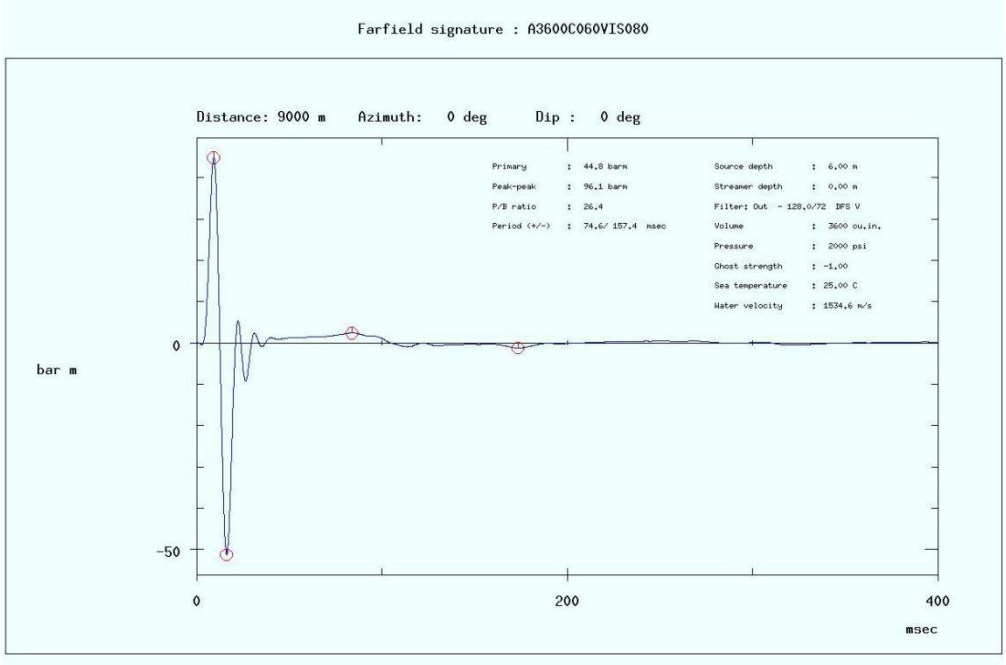


Figure 3-8 Typical pulsed sound from an air gun array

SOURCE: Total EXPLORATION & PRODUCTION

Generally used by biologists, the parameter dB-RMS (but not only) will be used in this report. Furthermore, these measures will be applied for the protection of aquatic species during this study.

*3.2.2.2 **Acoustics of seismic source***

It is assumed that the characteristics of the specific source signature of M5-M6 project are as follows:

- **Intensity**: characteristics are summarized in Table 3-3.

Table 3-3 Characteristics of source signature intensity	
Initial positive peak (0-P)	33.7 bar.m
Primary peak to peak (P-P)	67.4 bar.m
SPL (0-P)	251 dB re 1 µPa-m[1]
SPL (P-P)	257 dB re 1 µPa-m[1]
SPL RMS (20 ms)	248 dB re 1 µPa-m[1]
SELop (one pulse)	231 dB re 1 µPa2-s[1]
SELmp	259 dB re 1 µPa2-s[1]

Note 1: dB at 1 metre

- **Frequency**: Spectrum bandwidth at - 6 dB is [7 Hz - 100 Hz]. Figure 3-9 presents a typical source bands present in the airgun source spectrum. Note that typical source output of approximately 210 dB relative to 1 uPa/Hz at 1 metre, which is in the order of 40 bars of pressure (0-P).

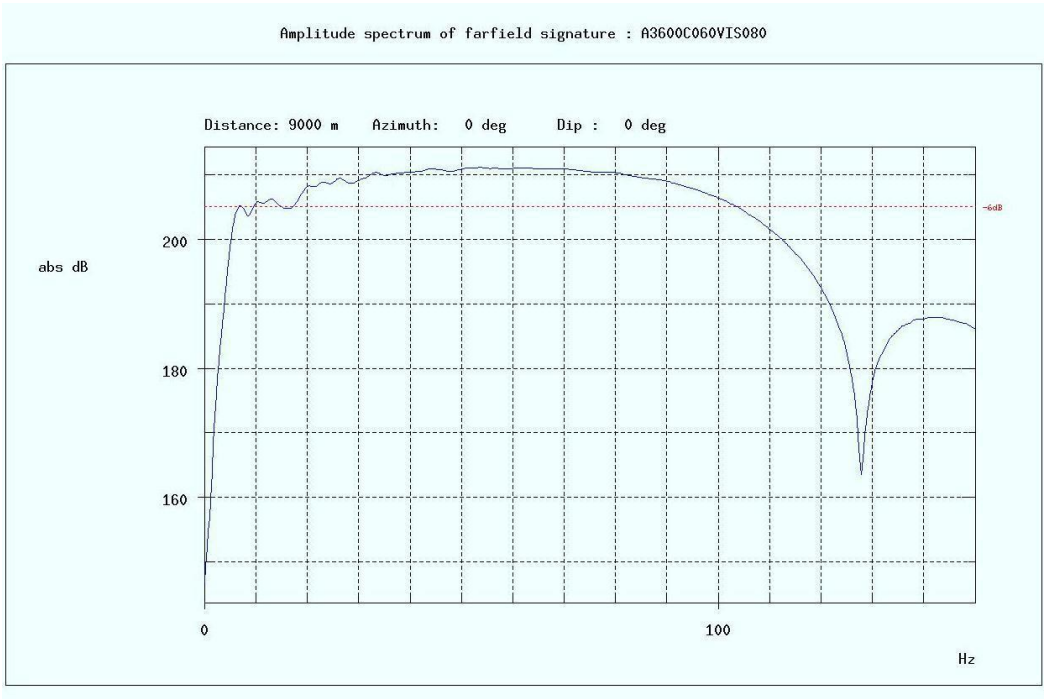


Figure 3-9 Acoustic spectrum in water

3.2.2.3 *Acoustics attenuation in water and sound spreading*

When sound propagates in seawater, the sound intensity reduces with the distance R from the source. This is due to (i) the absorption of sound energy by water and (ii) energy loss from sound spreading with increasing distance from the source.

- Sound energy absorption in water: has been quantified by numerous studies as approximately 0.005 dB/km for low frequency sounds such as those of the seismic source. This attenuation is thus considered to be negligible.
- Sound spreading losses: result from the diminution of intensity with distance from the source, as the total amount of acoustic energy remains the same as it spreads out. This sound attenuation or transmission loss (TL) is defined as :

TL=n Log R in dB re 1 µPa.

The value n is a specific variable to denote the characteristics of the attenuation depending on the type of spreading and the site specific conditions.

Cylindrical and spherical spreading are two simple approximations used to describe how sound level decreases as a sound wave propagates away from a source. Spherical spreading describes the reduction in level when a sound wave propagates away from a source uniformly in all directions, such as for a sound source at mid-depth in the ocean.

Beyond some range, the sound will hit the sea surface or bottom. This can be represented by cylindrical spreading in a zone with upper and lower boundaries. The assumption is adopted that sound is distributed uniformly over the surface of a cylinder having a radius equal to the range r and a height H equal to the depth of the ocean.

The concepts of spherical and cylindrical spreading are shown in Figure 3-10.

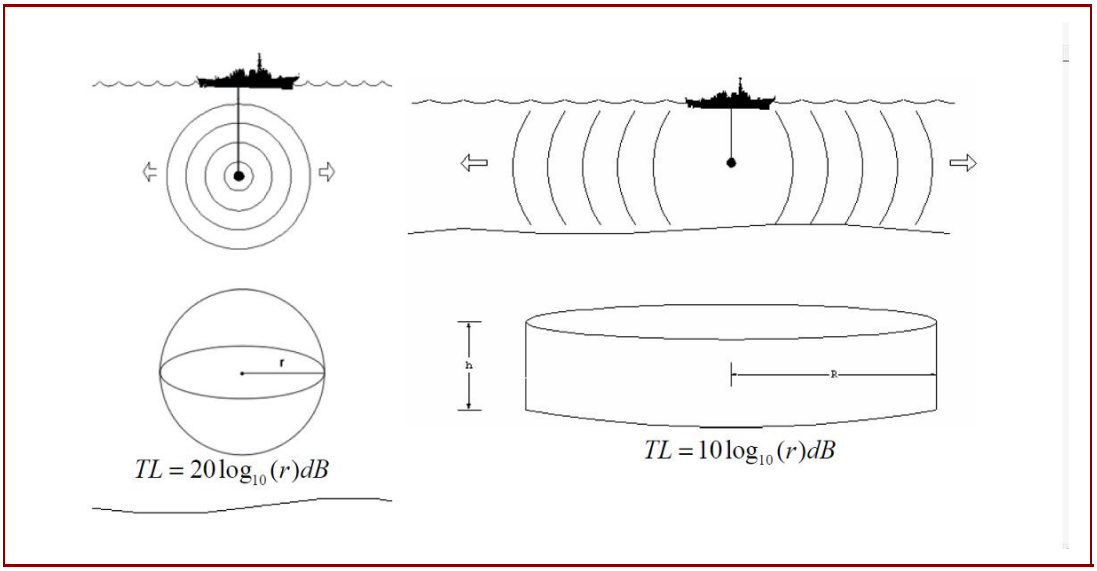


Figure 3-10 Concept of spherical and cylindrical spreading

SOURCE: IFREMER

The theoretical value of n is 20 for spherical attenuation and 10 for cylindrical attenuation. In field, n values are demonstrated to be superior to theoretical values, in particular for cylindrical attenuation. These differences depend mainly (i) of sound absorption by sea water for medium frequencies (spherical/cylindrical attenuation) and (ii) by the absorption of the sound by the bottom of the sea and the water/air mirror at sea surface. For the calculation of the exclusion zone, N has been taken as a fixed value (i.e calculations have been made with N=20 (Cf. Figure 3-10).

The sound pulses for the scenario with n=20 usually decrease to levels in the order of 190 re 1 µPa-m within 1 km of the source and approximately 185 dB re 1 µPa-m within 2 km (Acoustic Ecology Institute, 2005).

The sound power emitted from the 2 airguns array is spread over about 260 m^2. Within a radius of fifty meters from the airguns, the sound pressure level is significantly lower than that predicted by a point source representing the total power emitted by the airgun array. Thus, model noise predictions are only valid at distances exceeding 100 meters from the center of the airgun array.

The sound waves produced by a typical seismic source, such as airguns, usually have a moderately strong directivity component (refer to Figure 3-11). Thus perceived sound power levels can fluctuate significantly at locations situated at a fixed radius from the source with different vertical angles.

Airguns are designed to transmit the maximum power towards the seafloor using low frequencies of between 5 to 100 Hz with the result that source signals are much lower near the surface than on the vertical axis. For frequencies exceeding 100 Hz, the directional component of directivity varies, but is particularly focused.

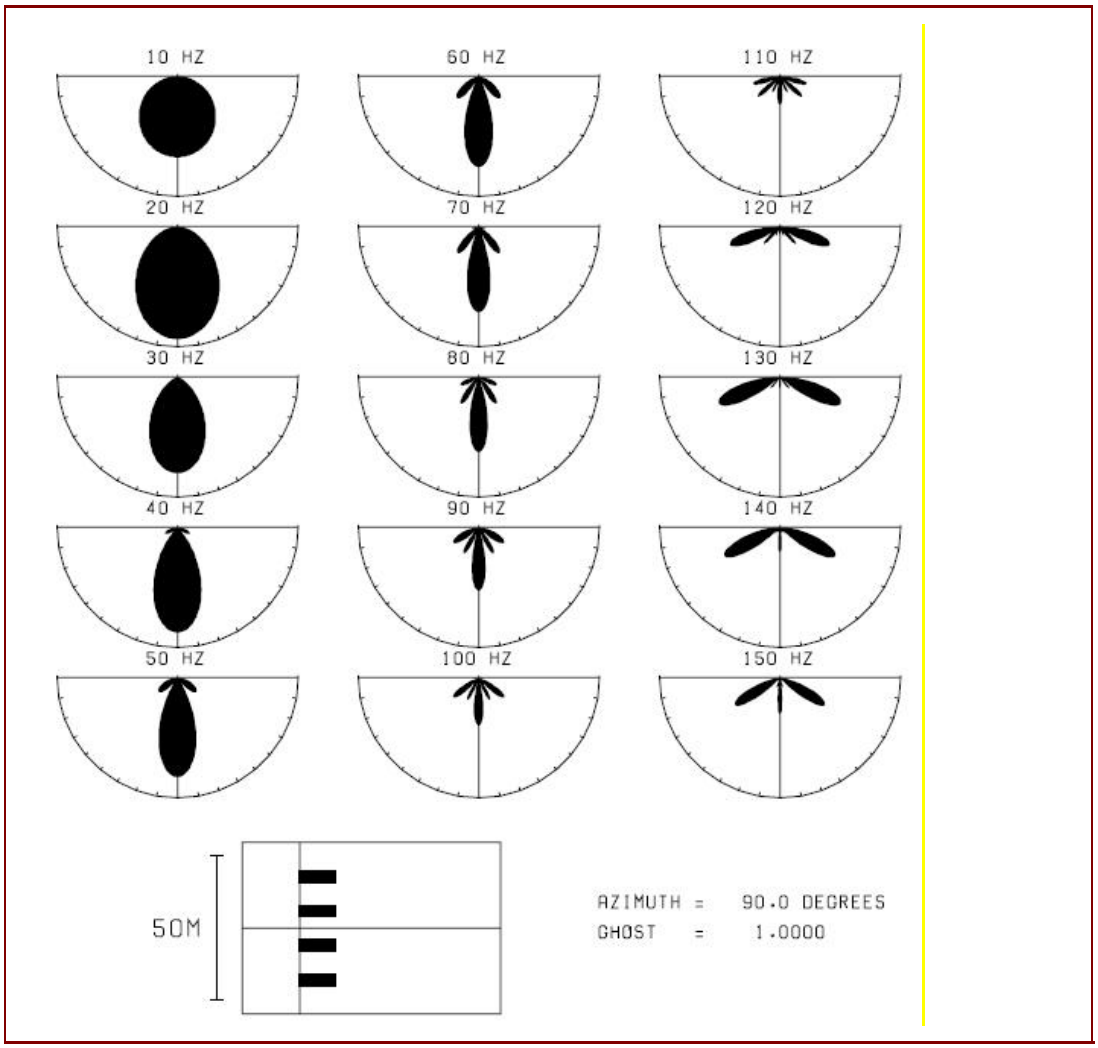


Figure 3-11 Graphical representation of airgun array acoustical spectrum in water

3.2.3 Streamers

The seismic receiver cables or streamers comprise an array of marine receivers which are towed by the marine vessel. Streamers consist of long net-like bands with marine receivers evenly spaced along their lengths, which listen for seismic echoes caused by the firing of the airguns. The marine receivers are composed of piezoelectric hydrophones, which respond to changes in water pressure and measure the acceleration of the medium as a seismic wave passes through it. The echoes recorded by the hydrophones are collected into an analogue signal, converted to digital format and relayed to the computers on the vessel.

Table 3-4 Characteristics of the streamers

Streamer length	8 000 m
Number of Streamers	10
Streamer separation	100 m

SOURCE: Total EXPLORATION & PRODUCTION

Figure 3-12 Typical seismic receiver cable

The streamer cables are sometimes filled with electrical isolating fluid, with a specific gravity of less than one, to make the streamers neutrally buoyant. Historically, this fluid has been organic compound such as kerosene since it would evaporate in the event of leak. More recently synthetic fluids tend to be more commonly used. The last generation of streamers, solid section streamers, constructed of extruded foam minimized or remove the requirement for buoyancy fluid. These materials are more robust and resistant and do not leak when damaged. Another recent variation of this equipment is the gel filled cables.

The present project will use solid streamers or oil-filled semi solid streamers.

*3.2.3.1 **Vessel steering and positioning***

The configuration of the streamers for optimal surface coverage has been determined and constitutes fan shooting mode. This will be tested during the mobilization phase of operations.

An example of the fan shooting geometry for the streamers is shown in figure below.

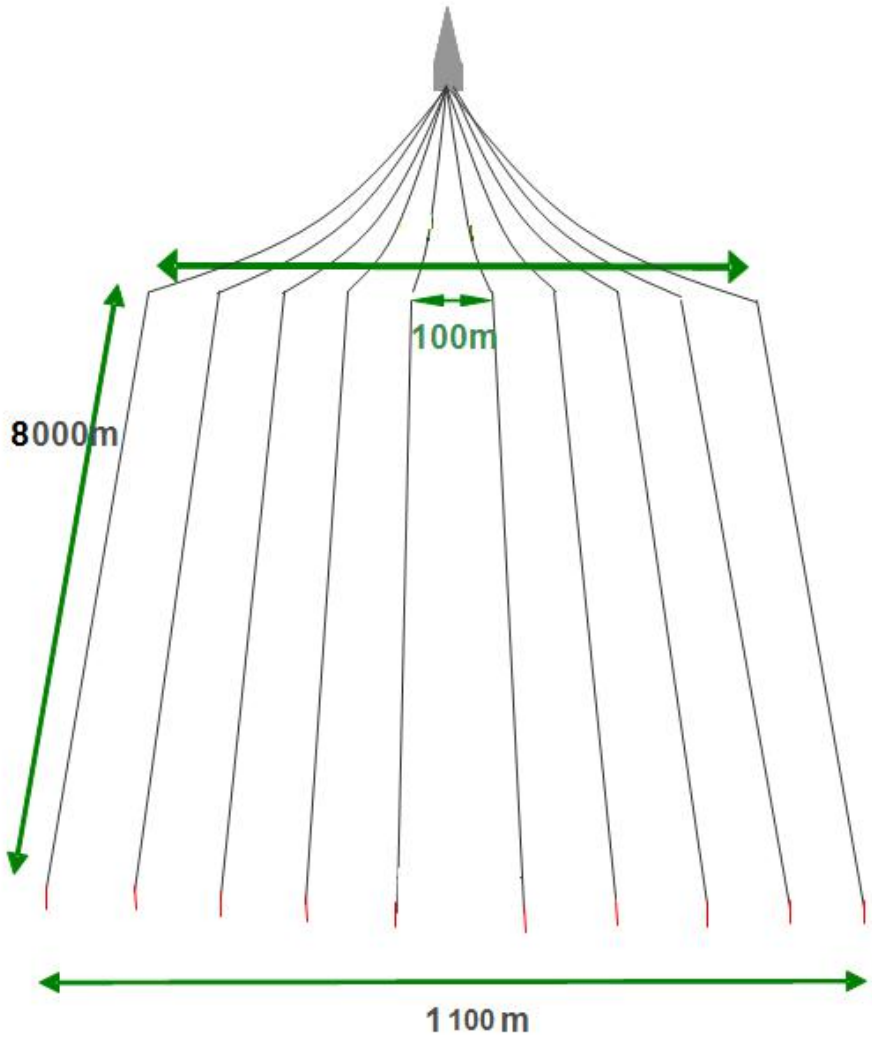


Figure 3-13 Fan mode geometry

Steering pieces of equipment are of two types: depth control units and bird and lateral control birds. The accuracy of such system is typically +/- 1m. The wings of the bird are electronically control to pivot in response to the hydrostatic pressure measured by a pressure transducer. As the streamer is weighted to be neutrally buoyant, the birds are used to counteract depth variation in the streamers introduced by vessel pitching moments in heavy weather or when different currents are experience, with corresponding fluctuation in density and/or temperatures.

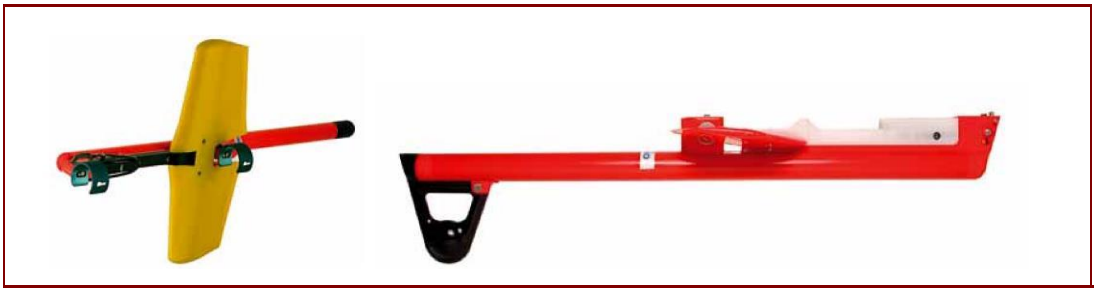


Figure 3-14 Birds

SOURCE: OGP, 2011

3.2.3.2 *Ancillary equipment and onshore support*

Support vessels for this project will include up to two supply vessels, and 3 to 5 chase boats which will accompany the seismic vessel (cf. § 3.2.1). Chase boats will be used for maritime safety and monitoring whereas supply vessel for refueling the seismic vessel and the transportation to/from onshore of some goods, technical equipment, waste, etc.

Thus, the only expected onshore activities proposed for this seismic survey will be associated with the support vessel, which may visit the port of Yangon to re-supply the seismic vessel with food and fuel. The main survey vessel will be bunkered (refueled) at sea in the 3D seismic area if necessary, however in general these marine vessels are selected for their self-sufficiency over long durations and it is assumed no crew changes will be effected.

The seismic fleet will be tracked using an online satellite positioning system (Orca Integrated Navigation System, SATPOS system or equivalent).

3.2.3.3 *Positioning systems*

Tail buoys will be used to position 2 independent dual frequency Differential Global Positioning (DGPS) systems. Calibration and validation of the positioning systems will be undertaken as part of the mobilization phase. These DGPS will record pitch, roll and heave at around 1 minute intervals; the height will be corrected from this data and these results will be GPS time stamped.

3.2.3.4 *Additional equipment*

It is critically important for the success of a seismic survey to know with accuracy the location of sources and receivers. To achieve this, compasses which measure the deviation of the streamer relative to the magnetic North, are commonly placed every 300 m on the streamer. Acoustic ranging units are used to provide additional positional information. These are attached to the hull of the vessel, the source floats, the streamers themselves and the tailbuoys.

Sea water temperature and salinity measurements shall be performed on regular basis throughout the survey and a current meter shall be available on-board the seismic vessel.

3.3 TIMING OF ACTIVITY

The seismic campaign is planned to begin on April 2018 with the arrival of the seismic fleet on M5-M6 block. Then, the seismic acquisition will last one month followed by late 2018 for M6 East, after the monsoon, for a duration of approximately seven months. The remaining proposed acquisition campaign over M5 block will start end 2019 after the monsoon for an estimated duration of six months.

The project schedule is presented in the below figure.

Figure 3-15 3D seismic surveys schedule

SOURCE: Total E&P MYANMAR

3.4 LEGAL/POLICY CONTROL SUMMARY

The Myanmar government has been involved in a significant number of investments regarding strategic planning reforms of environmental management policy. Myanmar has joined a number of international and regional agreements and treaties such as ASEAN (Association of South-East Asian Nations) and is in the process of enhancing its national environmental laws.

The present IEE has been developed according to Myanmar's Environmental Conservation Law (promulgated in 2012), the EIA procedure (promugalted in 2015) and Total E&P Myanmar requirements.

This section focuses on synthetic tables with the relevant regulation applied in the case of M5-M6 seismic project, followed by a description of the environmental institutional organization in Myanmar.

3.4.1 International agreements and conventions

Main international agreement and conventions signed by Myanmar and in line with the project activities are given in the table below.

Table 3-5 International agreements and convention in line with the project

International conventions and protocols	Adherence of Myanmar in
Stockholm Convention on Persistent Organic Pollutants (POPs)	2011 International environmental treaty, signed in 2001 and effective from May 2004, that aims to eliminate or restrict the production and use of persistent organic pollutants (POPs)
Memorandum of Understanding on the Conservation and Management of Dugongs (*dugong dugon*) and their Habitats throughout their Range	2007 Aims to promote internationally coordinated actions to ensure the long-term survival of dugongs and their seagrass habitats throughout their extensive range
International Plant Protection Convention (1952)	2006 Multilateral treaty overseen by the Food and Agriculture organization that aims to secure coordinated and effective actions to prevent and to control the introduction and spread of pests of plants and plant products

Table 3-5 International agreements and convention in line with the project	
International conventions and protocols	Adherence of Myanmar in
RAMSAR Convention	2005 International treaty for the conservation and sustainable utilization of wetlands recognizing the fundamental ecological functions of wetlands and their economic, cultural, scientific and recreational value
Agreement on the Establishment of the ASEAN Centre for Biodiversity	2005 An ASEAN Centre for Biodiversity (ACB) is established. The Centre shall have its seat in the Republic of the Philippines. The centre purpose is to “facilitate cooperation and coordination among the members of ASEAN, and with relevant national governments, regional and international organisations, on the conservation and sustainable use of biological diversity and the fair and equitable sharing of benefits arising from the use of such biodiversity in the ASEAN region”
Memorandum of Understanding concerning Conservation and Management of marine turtles and their habitats of the Indian Ocean and South East Asia	2001 Intergovernmental agreement that aims to protect, conserve, replenish and recover sea turtles and their habitats in the Indian Ocean and South-East Asian region, working in partnership with other relevant actors and organizations
Cartagena Protocol on Biosafety, Cartagena	2000 Is an international agreement on biosafety, as a supplement to the Convention on Biological Diversity. The Biosafety Protocol seeks to protect biological diversity from the potential risks posed by genetically modified organisms resulting from modern biotechnology
Asia Least Cost Greenhouse Gas Abatement Strategy (ALGAS)	1998 A project developed by the Asian Development Bank which drew up a least-cost greenhouse gas abatement strategy for Asia. 12 countries participated including Myanmar. Its objectives included the development of national/regional capacities for the preparation of GHG inventories, the identification of GHG abatement options, and the preparation of a portfolio of abatement projects for each country
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	1997 Multilateral treaty to protect endangered plants and animals ensuring that the international trade in specimens of wild animals and plants does not threatens the survival of the species in the wild and it accords varying degrees of protection to more than 35000 species

Table 3-5 International agreements and convention in line with the project	
International conventions and protocols	Adherence of Myanmar in
International Tropical Timber Agreement (ITTA), Geneva	1994 Multilateral agreement to provide an effective framework for consultation, international cooperation and the development of timber economy policies, to contribute to the process of sustainable development, to promote the expansion and diversification of international trade in tropical timber from sustainable sources, to improve forest management and the efficiency of wood utilisation, to provide members with new financial resources and to encourage information-sharing on the international timber market
Convention for the Protection of the World Cultural and Natural Heritage	1994 Each state party of the convention recognized that the duty of “ensuring the identification, protection, conservation, presentation and transmission to future generations of the cultural and natural heritage situated on its territory, belongs primarily to that State. It will dall it can to this end, to the utmost of its own resources and, where appropriate, with any international assistance and co-operation, in particular, financial, artistic, scientific and technical, which it may be able to obtain”
Convention on Biological Diversity, Rio de Janeiro	1992 Multilateral treaty aiming to develop national strategies for the conservation and sustainable use of biological diversity. It is seen as the key document regarding sustainable development
United Nations Framework Convention on Climate Change (UNFCCC)	1992 International environmental treaty negotiated at the United Nations Conference on Environment and Development (UNCED), informally known as the Earth Summit, held in Rio de Janeiro, 1992. The objective of the treaty is to "stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system". Myanmar ratified in 1994
London Amendment to the Montreal Protocol, London 1990	1990 To reinforce the measures laid down in the 1987 Montreal Protocol by extending its scope to new substances and establishing financial mechanisms

Table 3-5 International agreements and convention in line with the project	
International conventions and protocols	Adherence of Myanmar in
Montreal Protocol on Substances that Deplete the Ozone Layer	1989 International treaty designed to protect the ozone layer by phasing out the production of numerous substances that are responsible for the ozone depletion. The treaty is structured around several groups of halogenated hydrocarbons that have been shown to play a role in ozone depletion. All of these ozone depleting substances contain either chlorine or bromine. For each group, the treaty provides a timetable on which the production of those substances must be phased out and eventually eliminated.
Vienna Convention for the Protection of the Ozone Layer	1988 Multilateral Environmental Agreement agreed upon the Vienna Conference in 1985 which acts as a framework for the international efforts to protect the ozone layer
International Convention on the Prevention of Pollution from Ships, 1973 as modified by the protocol of 1978 (MARPOL 73/78)	1988 International convention designed to minimize sea pollution and to preserve the marine environment from the contamination by oil and other harmful substances and accidental discharges of such substances. Myanmar has only ratified annex I/II. Nevertheless, recommendation of annex IV and V were also considered
International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978 (STCW)	1988 This convention concerns the project particularly by its 2010 amendment which asks for new requirements for marine environment awareness training and training in leadership and teamwork; and new training guidance for personnel operating Dynamic Positioning Systems.
RIPAM or COLREG Convention 72 “collision regulation 72”	1987 The International Regulations for Preventing Collisions at Sea 1972 (Colregs) are published by the International Maritime Organization (IMO) and set out, among other things, the "rules of the road" or navigation rules to be followed by ships and other vessels at sea to prevent collisions between two or more vessels

Table 3-5 International agreements and convention in line with the project	
International conventions and protocols	Adherence of Myanmar in
SOLAS convention (Safety Of Life At Sea)	1987 International maritime safety treaty. It ensures that ships flagged by signatory States comply with minimum safety standards in construction, equipment and operation.
United Nations Convention on Law of the Sea (UNCLOS)	1986 International agreement which defines the rights and responsibilities of nations with respect to their use of the world's oceans, establishing guidelines for businesses, the environment, and the management of marine natural resources.
ASEAN Agreement on the Conservation of Nature and Natural Resources, Kuala Lumpur	1985 "(1) The Contracting Parties, within the framework of their respective national laws, undertake to adopt singly, or where necessary and appropriate through concerted action, the measures necessary to maintain essential ecological process and life-support systems, to preserve genetic diversity, and to ensure the sustainable utilization of harvested natural resources under their jurisdiction in accordance with scientific principles and with a view to attaining the goal of sustainable development. (2) To this end they shall develop national conservation strategies, and shall co-ordinate such strategies within the framework of a conservation strategy for the Region"
Convention on Wetlands of International Importance (RAMSAR), Iran	1971 International treaty for the conservation and sustainable utilization of wetlands. In Myanmar this treaty entered into force in 2005

Table 3-5 International agreements and convention in line with the project	
International conventions and protocols	Adherence of Myanmar in
Plant Protection Agreement for the Southeast Asia and the Pacific Region, Rome	1956 The Contracting Governments established a regional committee, to be known as the Plant Protection Committee for the South East Asia and Pacific Region to: a) the determination of procedures and arrangements necessary for the implementation of this Agreement and the making of recommendations to the Contracting Governments accordingly; b) the review of reports submitted by the Contracting Governments of progress in the implementation of this Agreement; c) the consideration of problems requiring co-operation on a regional basis and of measures for mutual assistance
Convention on the International Maritime Organization	1948 Establishment of the International Maritime Organization (IMO) by the State Parties. Myanmar acceptance in 1951

3.4.2 Myanmar environmental legislation in line with the Project

The below table synthetizes Myanmar's Environmental Legislation that is applicable to the offshore seismic project, in M5 – M6 Block.

Table 3-6 Myanmar environmental legislation in line with the project

Myanmar Investment Commission, Notification No.80/2016	This notification lines up the requirements for an ESIA with the main regulations, instead of listing specific activities (i.e. it abolishes the Myanmar Investment Commission, Notification No.50/2014 which becomes obsolete in face of the new legislation).
Environmental Impact Assessment Procedure (MOECAF (now MONREC) – Notification No. 616/2015)	The Environmental Impact Assessment (EIA) Procedure specifies the type and scope of environmental assessment required for all investment projects that could cause environmental and social harm (i.e. IEE or EIA). This procedure gives the methodology and requirements to undertake an EIA, according to the project.
National Environmental Quality (Emission) Guidelines 2015	These national Environmental Quality (Emission) Guidelines (hereafter referred to as Guidelines) provide the basis for regulation and control of noise and vibration, air emissions, and liquid discharges from various sources in order to prevent pollution for purposes or protection of human and ecosystem health.
Myanmar Environmental Conservation Rules (5th June 2014)	These place responsibility on the Government to establish and adopt the necessary programmes for the conservation and enhancement of environment, protection, control and reduction of pollution in environment, and conservation. An environment management fund has been created. Apart from state budget and other donations, polluters and people which obtain benefit from the natural environment service system will have to compensate their action through the fund. The Ministry may determine conditions for hazardous waste treatment, treatment of effluent, storage and transport of hazardous products, constraint of production to protect the environment. The Rules reinforce the obligation for project developers to submit an EIA or an IEE. The ministry will publish a list of the categories of plan, business or activity which shall carry out EIA or IEE. EIA shall be conducted by a qualified third person or organization accepted by the Ministry. Sets out the process to obtain prior permission for certain categories of project.

Table 3-6 Myanmar environmental legislation in line with the project	
Myanmar Port Authority Law (2015)	"Any person who by himself or another so casts or throws any ballast or rubbish or any such other thing or so discharges any oil or water mixed with oil, or the master of any vessel from which the same is so cast, thrown or discharged, shall be punishable with fine not exceeding fifty thousand kyats, and shall pay any reasonable expenses which may be incurred in removing the same".
Myanmar Investment Rules (2013)	The Myanmar foreign investment rules contain several elements dealing with environmental protection, including: Art. 33. Proposals for economic activities that are considered capital intensive by the Commission, and that are prescribed to undergo environmental impact assessment by the Ministry of Environmental Protection and Forestry have to be submitted along with Environmental and Social Impact Assessment. Art. 54. The promoter or investor shall: (a) comply with Environmental Protection Law in dealing with environmental protection matters related to the business; Art. 123. If it is scrutinized and found out that the investor has carried out business that causes environmental pollution or has not taken action to minimize environmental pollution at the land for which he is entitled to lease or use, or if it is scrutinized and found that the work carries out causes nuisance to the persons who reside around such place due to noise or by culture and if relevant persons officially object, the Commission may terminate the lease or tendering right to use after making necessary inquiry. Art. 125. The investor, for operating any business, does not have the right to lease and develop the following lands: (a) religious lands; (b) cultural heritage and natural heritage regions designated by relevant Ministries; (c) lands restricted for Union defence and security; (d) lands under litigation; (e) lands restricted by the State from time to time; (f) lands where exists place or building which may cause situations such as impact on public environment noise, pollution, impact on culture within urban residential area due to the business of the investor

Table 3-6 Myanmar environmental legislation in line with the project	
Myanmar Investment Commission, Notification No.1/2013	This notification defines which activities are prohibited or restricted for foreign investors. Exploration, drilling and production of oil and gas are allowed but require an Environmental and Social Impact Assessment that demonstrates to the Ministry in charge of the environment that it can be done safely.
Prevention of Hazard from Chemical and Related Substances Law (26th August 2013)	The project owner will abide the provisions of section 15, 16, 17, 22, 27 and 30 of said law, stating obligations related to chemicals and related substances: registration, training, instructions to abide by, mitigation measures, compensation for damages.
National Biodiversity Strategy and Action Plan (2012)	Established under Article 6 of the United Nations Convention on Biological Diversity in which each member country needs to develop its own National Biodiversity Strategy and Action Plan (NBSAP) to integrate conservation and the sustainable use of biodiversity. In order to fulfil this commitment to the Convention, Myanmar conducted a project entitled National Biodiversity Strategy and Action Plan in Myanmar (NBSAP Myanmar). The NBSAP acts as the major guiding document for planning biodiversity conservation in the country, following its goal to provide a strategic planning framework for the effective and efficient conservation and management of biodiversity and natural resources based on greater transparency, accountability and equity On 3rd May of 2012, the Government of the Republic of the Union of Myanmar adopted the Myanmar NBSAP by its Government Meeting No. 16/2012. The NBSAP is intended to provide a comprehensive framework for planning biodiversity conservation, management and utilization in a sustainable manner, as well as to ensure the long term survival of Myanmar's rich biodiversity.

Table 3-6 Myanmar environmental legislation in line with the project	
The Environmental Conservation Law (30th March, 2012)	The objective of this Law is to implement Myanmar's National Environmental Policy, enabling the basic principles and to give guidance for systematic integration of environmental conservation matters in the sustainable development process. The 7th article confers the following powers and functions to the Ministry: • To set environmental quality standards • To prescribe emission standards • To formulate EIA and SIA systems • To ensure the polluter pays principle • To issue rules, regulations and by-laws as may be necessary with the approval of the Union Government
Conservation of Water Resources and Rivers Rules (2012)	Chapter 3 on Prevention of water pollution and Environmental Conservation in its Para (7C) mentions the wastewater produced from any factories and industries nearby the rivers, channels and ports should be treated before discharge. Monitoring is required. Para (8E) states that everyone must take preventive measures in accordance with international standards in order to prevent the leakage/discharge of waste water and sewage into the rivers. Para (9) states that cost for pollution abatement is supported by the polluter
Myanmar Investment Law (2012)	This Law provides elements on foreign investments in Myanmar. Art. 17: The duties of the investor are as follows: (f) making no alteration of topography or elevation of the land obviously on which he is entitled to lease or use without the approval of the Commission; (h) not to cause environmental pollution or damage in accord with existing laws in respect of investment business.
Settlement of Labor Dispute Law (2012)	The Pyidaungsu Hluttaw hereby enacts this Law for safeguarding the right of workers or having good relationship between employer and workers and making peaceful workplace or obtaining the rights fairly, rightfully and quickly by settling the dispute of employer and worker justly.

Table 3-6 Myanmar environmental legislation in line with the project	
The State Supplementary Appropriation Law (2009)	This Law is concerned with sanctioned allotment and administration of supplementary expenditures and taking of loans for the respective persons mentioned in this law.
The Law Amending the Protection and Preservation of Cultural Heritage Regions Law (2009)	This Amendment is concerned with revising fines for failure to abide by this law. To implement the protection and preservation policy with respect to perpetuation of cultural heritage that has existed for many years; to protect and preserve the cultural heritage regions and the cultural heritage.
National Sustainable Development Strategy (2009)	This strategy concerns the sustainable management of natural resources, integrated economic development, and sustainable social development.
Constitution of the Republic of the Union of Myanmar (2008)	The national constitution states that: Art. 45: The Union shall protect and conserve natural environment. Art 390: Every citizen has the duty to assist the Union in carrying out the following matters: (a) preservation and safeguarding of cultural heritage; (b) environmental conservation; (c) striving for development of human resources; (d) protection and preservation of public property.
Law Amending the Ports Act (2008)	11. Sub-section 2 of section 21 of the Ports Act shall be substituted as follows: "(2) Any person who by himself or another so casts or throws any ballast or rubbish or any such other thing or so discharges any oil or water mixed with oil, or the master of any vessel from which the same is so cast, thrown or discharged, shall be punishable with fine not exceeding fifty thousand kyats, and shall pay any reasonable expenses which may be incurred in removing the same".
Law Amending the Territorial Sea and Maritime Zone Law (2008)	After clause 3 of the annex to the Territorial Sea and Maritime Zone Law, clause 4 and clause 5 have been inserted with new Coordinates which have no impact on the offshore Yadana Sein M5-M6 Blocks (and mostly confined to areas adjacent to Bangladesh).

Table 3-6 Myanmar environmental legislation in line with the project	
Conservation of Water Resources and Rivers Law (2006)	Section 6 outlines prohibitions for the following activities: "No person shall anchor the vessels where vessels are prohibited from anchoring in the rivers and creeks. No person shall dispose of engine oil, chemical, poisonous material and other materials which may cause environmental damage, or dispose of explosives from the bank or from a vessel which is plying, vessel which has berthed, anchored, stranded or sunk. No one shall dispose of any substance into the river-creek that may cause damage to waterway or change of watercourse from the bank or vessel." The aims of this Law are as follows: to conserve and protect the water resources and river systems for beneficial utilization by the public; to smooth and enhance safety of waterways navigation along rivers and creeks; to contribute to the development of State economy through improving water resources and river systems; to protect environmental impact. The empowerment of this Law is provided to the Ministry of Transport for controlling navigation of vessels in the rivers and creeks as well as communicating with local and foreign government and organizations for conservation of water resources, rivers and creeks. Also, to carry out conservation works for water resources, rivers and creeks, in accordance with the relevant international conventions, regional agreements and bilateral agreements for environmental conservation.
Rules on protection of wildlife and protected area conservation law (2003)	Rules created to establish a procedural framework for the 1994 Protection of Flora and Fauna, and Protected Area Conservation Law. It includes rules for licence to Hunt Animals; for Fishing in Reserved Forests Wild Life Sanctuaries; for Restricting Imports and Exports of Animals; rules as to Rewards, Appointment of Game Wardens and General Powers and Penalties.

Table 3-6 Myanmar environmental legislation in line with the project	
The Protection of Wildlife and Wild Plant and Conservation of Natural Areas Law (8th, June, 1994) & The Protection of Wildlife and Wild Plant and Conservation of Natural Areas Rule (2002)	The objectives of this Law are as follows:- (a) to implement the Government policy for wildlife protection; (b) to implement the Government policy for natural areas conservation; (c) to carry out in accordance with the International Conventions acceded by the State in respect of the protection and conservation of wildlife, ecosystems and migratory birds; (d) to protect endangered species of wildlife and their natural habitats; (e) to contribute for the development of research on natural science; (f) to protect wildlife by the establishment of zoological gardens and botanical gardens.
Kyoto Protocol to the Convention on Climate Change, Kyoto (1997)	13/8/2003 (Accession) The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change, which commits its Parties by setting internationally binding emission reduction targets.
Myanmar Agenda 21 (1997)	The Myanmar Agenda 21 makes recommendations for the drafting and promulgation of a framework law which can further promote the integration of environmental and developmental concerns in the decision-making processes of the country. The Myanmar Agenda 21 contains guidelines to address the following issues: increasing energy and material efficiency in production processes; reducing wastes from production and promoting recycling; promoting use of new and renewable sources of energy; using environmentally sound technologies for sustainable production; reducing wasteful consumption; increasing awareness for sustainable consumption.

Table 3-6 Myanmar environmental legislation in line with the project	
National Environment Policy (1994)	The National Environment Policy is reproduced below: "To establish sound environment policies, utilisation of water, land, forests, mineral, marine resources and other natural resources in order to conserve the environment and prevent its degradation, the Government of the Union of Myanmar hereby adopts the following policy: The wealth of the nation is its people, its cultural heritage, its environment and its natural resources. The objective of Myanmar's environmental policy is aimed at achieving harmony and balance between these through the integration of environmental considerations into the development process to enhance the quality of the life of all its citizens. Every nation has the sovereign right to utilise its natural resources in accordance with its environmental policies; but great care must be taken not to exceed its jurisdiction or infringe upon the interests of other nations. It is the responsibility of the State and every citizen to preserve its natural resources in the interests of present and future generations. Environmental protection should always be the primary objective in seeking development."
The Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law (1994)	Its objective is to implement a Government policy for wildlife protection and natural areas conservation; to "carry out in accordance to international conventions acceded by the State in respect of the protection and conservation of wildlife, ecosystems and migratory birds"; to protect endangered species and their habitats and establishing zoological and botanical gardens and "to contribute for the development of research and natural science". Of relevance the statement in Chapter 11 which outlines the penalties for whoever causes "water and air pollution, causing damage to a water-course or putting poison in the water in a natural area", and possesses or disposes of pollutants or mineral pollutants in a natural area.
Union of Myanmar Marine Fisheries Law (25 April 1990, amended 1993)	The relevance of this law to the offshore component of the Yadana Sein M5-M6 Blocks project is that it places restriction on pollution: "No person shall dispose of living aquatic creatures or any material into the Myanmar Marine Fisheries Waters to cause pollution of water or to harass fishes and other marine organisms."

Table 3-6 Myanmar environmental legislation in line with the project	
The Myanmar Insurance Law (July, 1993)	The objectives of this law: to overcome financial difficulties by effecting mutual agreement of insurance against social and economic losses which the people may encounter, due to common perils, to promote the habit of savings individually by effecting life assurance, thus contributing to the accumulation of resource, of the State to win the trust and confidence of the people in the insurance system by providing effective insurance safeguards which may become necessary in view of the social and economic developments.
The Forest Law (1992)	Government policy regarding forest management and usage. Chapter IV, regarding management of forest land states that whoever, within a forest land and forest covered land at the disposal Government is desirous of carrying out any development work or economic scheme shall obtain the prior approval of the Forestry Ministry. The text has been completed by Rules and Policy in 1995.
The Law relating to Aquaculture (1989)	This law gives the regulatory settings concerning Aquaculture: Lease or Licence, Duties and Fees, etc.
The Law Relating to the Fishing Rights of Foreign Fishing Vessels (1989) & Law Amending the Law Relating to the Fishing Rights of Foreign Fishing Vessels – 1993	The Law is divided into 11 Chapters: Title and Definition (I); Payment of Duties and Fees (II); Duties and Rights of Entrepreneurs (permissions for foreign fishermen) (III); Duties and Powers of the Director-general (IV); Duties and Powers of Inspectors (enforcement measures) (V); Duties of the Master (VI); Invalidity of Licence (VII); Appeals (VIII); Prohibitions (IX); Offences and Penalties (X); Miscellaneous (XI).
Territorial Sea and Maritime Zones law (1977)	The Union of Myanmar has exclusive jurisdiction for the construction, maintenance or operation of offshore terminals and exclusive jurisdiction to preserve and protect the marine environment, and to prevent and control marine pollution.
Public Health Law (1972)	Section 9 of this law empowers the Government to carry out measures relating to environmental health, such as garbage disposal, use of water for drinking and other purposes, radioactivity, protection of air from pollution, sanitation works and food and drug safety. However, detailed provisions do not exist to ensure more effective and comprehensive regulation of these areas

Table 3-6 Myanmar environmental legislation in line with the project	
Penal Code (1 May 1961, and extended to public health law in 1972)	The penal code is mainly concerned with public health; it is considered an offence to "voluntarily corrupt or foul the water of any public spring or reservoir so as to render it less fit for the purpose for which it is ordinarily used", or to pollute the atmosphere arising from smoke, fumes, noxious odours, dust particles, noise and radioactive substances. The only control of water pollution in the country is through guidelines issued in June 1994 by the Myanmar Investment Commission. These guidelines require that new projects, from both foreign and private investments, have waste water treatment plants or systems.
The Petroleum Act (1934)	This act covers control (licensing requirements, and container requirements) and testing of petroleum in order to improve safety.
The Oilfields Act (1918)	This Act provides clarification on activities within the oil and gas industry and provides the Government with the power to define and alter limits of any notified oilfield. In addition, the Government can make rules for regulating all matters connected with many operations related to the extraction of oil and/or gas. The Act also provides guidance and issues such as preventing oil and gas wastes, reporting of fires, accidents and other occurrences and regulating the collection and disposal of both oil and gas.

The project owner and its contractor will also have to comply with the following laws:

- The protection of rights of National Races Law, 2015 Section 5
- The Prevention and Control of Communicable Diseases Law, 1995
- The Control of Smoking and Consumption of Tobacco Product Law, 2006
- The Myanmar Fire Force Law, 2015 (section 25)
- The Protection and Preservation of Ancient Monument Law,2015
- Myanmar Investment Law, 2016 - 51 (b)(c)(d), 65 (g) (i) (j) (k) (l)(m)(o)(p) (q)
- The Development of Employees and Expertise (Skill), 2013 (Section 5,14,30
- The Factories Act, 1951 (Before notification that this project is oilfield issued by MOEE)
- The Welfare of Labors of Oilfield Act, 1951 (After notification)
- The Workmen Compensation Act, 1951
- Labor Organization Law, 2012
- Minimums Wages Law, 2013
- Payment of Wages Law, 2015 (3,4,8, 7(ii), 9, 10 (a) to (e)
- Social Security Law, 2012- 11, 16(a), 48(a), 51(a) (b), 54
- Leaves and Holidays Act, 1951
- The Explosive Act
- The Explosive Substances Act
- The Import and Export Law, 2012 (Section 7)

3.4.3 Environmental and social impact assessment legislation

The 7th Article of the Environmental Conservation Law (2012) includes the requirement to:
"Formulate systems for conducting Environmental Impact Assessments and Social Impact Assessments"
The strategic purpose is to assess if a proposed project may cause a significant impact on the environment. The Ministry may, with the approval of Government, require their prior authorization for projects which are considered potentially damaging to environmental quality.
On the basis of this Law, Environmental Conservation Rules were issued on June 5th 2014 (see Table above). Stemming from these Rules is the need to develop Environmental Impact Assessment Procedures. The establishment of the Procedures, which determine among other issues will define the need for a project to submit an Initial Environmental Examination (IEE) or EIA, are at the time of compiling this report on their 6th iterative draft and consultation, and are not yet issued or yet effective.
Item 21 will deal with Offshore Oil and Gas Development and currently cites as Guidance the IFC Offshore Oil and Gas Development Guidelines, and therefore these are referenced later in this chapter (See Section 3.4.4).

3.4.4 International guidelines and standards used for this IEE

Table 3-7 International guidelines and standards used for this IEE

Standards/Guidelines	Aim/Goal
World Health Organization (WHO) standards and guidelines	Gives guidelines value for ambient air quality regarding emission of SO_2, NO_2, Particulate matter (PM10 and PM2.5), O_3
the IFC Environmental Health and Safety Guidelines (2007) and IFC Environmental Health and Safety Guidelines – Offshore Oil and Gas Developments (2007)	Potential environmental issues associated with offshore oil and gas development projects include the following: • Air emissions (especially from seismic operations). Recommended measures to reduce the risk: o Significant (>100,000 tons CO2 equivalent per year) greenhouse gas (GHG) emissions from all facilities and offshore support activities should be quantified annually. o All reasonable attempts should be made to maximize energy efficiency and operation of vessels for lowest energy use. During equipment selection, air emission specifications should be considered. o Methods for controlling and reducing fugitive emissions should be considered and implemented in the design, operation, and maintenance of offshore vessels. Leak detection and repair programs should be implemented. • Noise (especially from seismic operations). Recommended measures to reduce the risk of noise impact on marine species include: o Identifying areas sensitive for marine life; o Planning seismic surveys to avoid sensitive times of the year; o Identifying fishing areas and reducing disturbance by planning seismic surveys at less productive times of the year, where possible; o Maximize the efficiency of the seismic surveys to reduce operation

	times; ○ If sensitive species are anticipated in the area, monitor their presence before the onset of noise creating activities, and throughout the seismic program or construction. In areas where significant impacts to sensitive species are anticipated, experienced observers should be used; ○ When marine mammals are observed congregating close to the area of planned activities, seismic start-up or construction should begin at least 500 meters away; ○ If marine mammals are sighted within 500 meters of the proposed seismic array or construction area, start-up of seismic activities or construction should be postponed until they have moved away, allowing adequate time after the last sighting; ○ Soft-start procedures, also called ramp-up or slow build up, should be used in areas of known marine mammal activity. This involves a gradual increase in sound pressure to full operational levels; ○ The lowest practicable power levels should be used throughout the seismic surveys, and their use should be documented; ○ Methods to reduce and/or baffle unnecessary high frequency noise produced by air guns or other acoustic energy sources should be used, where possible. • Emergency Preparedness and Response Plan: ○ Spill prevention and control plan as part of the Emergency Preparedness and Response Plan ○ The company must have the funds available to implement the spill control plan, including equipment, budget and insurance. This plan should include details of response procedures in case of emergencies such as spills and leaks, including: ▪ Inspection program implementation to ensure infrastructure integrity ▪ Preparation of standard operating procedures for appropriate containers and transfer operations ▪ Hazardous material location ▪ Documentation of specific PPE needs and operator training ▪ Documentation of availability of spill response equipment and lists of external resources ▪ Description of response activities including notification procedures (internal and external) ▪ Decision process for severity and action assessment. The results of this plan will be reported annually and the plan updated regularly in response to the outcomes reported.
MARPOL (Annex I, IV and V) (activities carried out at sea)	Annex I: Any discharge into the sea of oil or oily mixtures from ships is prohibited except if the following conditions are satisfied for vessels ≥400 gross tons and <400 gross tons:

	• Proceeding en route; and • Oil content less than 15 parts per million; and Oil discharge monitoring and control system and oil filtering equipment to be operating Any discharge into the sea of oil or oily mixtures from ships is prohibited except if the following conditions are satisfied for vessels <400 gross tons: • Oil and all oily mixtures retain on-board for on shore disposal OR • Proceeding en route; and • Has in operation equipment of a design approved by the administration that ensures oil content less than 15 parts per million Annex IV provides information concerning sewage treatment/discharge conditions. Annex V provides information concerning garbage treatment/discharge conditions, including comminute or ground food wastes

JNCC standards	Standard for the protection of marine mammals against important underwater acoustic waves, particularly due to seismic survey. Gives procedures such as prewatching, soft start, etc. in order to prevent potential damages on cetaceans.
IAGC Recommended Mitigation Measures For Cetaceans during Geophysical Operations (June 2011)	Identifies and recommends mitigation measures to be used for cetaceans (whales, dolphins and porpoises) only during geophysical operations. Gives procedures such as pre-watching, soft start, etc. in order to prevent potential damages on cetaceans.
Joint OGP/IAGC position paper Seismic Surveys & Marine Mammals (2004)	A paper that provides a joint vision of the exploration and production (E&P) activity with regards to their impacts on the marine fauna.
International Petroleum Industry Environment and Conservation Association (IPIECA) the Oil and Gas Industry: Operating in Sensitive Environments (2003)	IPIECA is a voluntary non-profit organization whose membership includes both petroleum companies and associations at the national, regional or international levels. It addresses global environmental and social issues related to the petroleum industry: oil spill preparedness and response, global climate change, biodiversity, social responsibility, fuel quality and vehicle emissions, and human health. IPIECA also helps members identify new global issues and assesses their potential impact on the oil industry. The Association represents the views of its members in public forums and provides an interface between the petroleum industry and the United Nations Agencies. IPIECA's goals are to promote good practices and industry consensus through arranging international workshops, publishing authoritative reports, providing a channel of communication with the UN, providing a forum for open dialogue, facilitating stakeholder engagement, promoting partnerships.
(OGP) Environmental management in oil and gas exploration and production (1997)	The OGP is the worldwide association of Oil and Gas Companies involved in exploration and production. The members include private and state-owned oil and gas companies, national associations and petroleum institutes. OGP represent their members before international regulatory bodies, and has observer status as a non-governmental organisation, with global and regional regulatory bodies that have an interest in marine environment protection.
OGP Waste Management Guidelines (1993)	Provides an insight to the oil exploration and production processes and to waste management methods. Appendix 3 provides a waste management planning worksheet and Appendix 5 and 6 a specific waste information and waste management options.
International Cable Protection Committee (ICPC) Procedure to be Followed Whilst Offshore Seismic Survey Work is undertaken in the Vicinity of Active Submarine Cable Systems (ICPC Recommendation No.8)	This document recommends procedures to be followed whilst offshore seismic survey work is undertaken in the vicinity of active submarine cable systems where these are installed in water depths of 200 m or less.

3.4.5 Institutional organisation

3.4.5.1 Institutional Environmental Governance

The National Commission for Environmental Affairs (NCEA) was formed in 1990 by Myanmar's Ministry of Foreign Affairs (MFA) to act as a central management agency for environmental matters. This agency is divided into four sub-committees:

- Conservation of Natural Resources;
- Control of Pollution;

- Research, Information and Education; and
- International Cooperation.

The NCEA has a Chairman, a Secretary and a Joint Secretary. All three representatives are simultaneously senior officials in the MFA, the NCEA Chairman also being the Minister of Foreign Affairs.

The ministerial departments relevant to the Block M15 project are:

- Ministry of Development and Planning;
- Ministry of Energy;
- Ministry of Industry;
- Ministry of Labour;
- Ministry of Environmental Conservation and Forestry; and
- Ministry of Transport.

In 1994, the NCEA formulated the National Environment Policy (NEP) which represents Myanmar's fundamental policy on environmental protection. The NCEA also assists the ministerial departments in drafting environmental legislation and published the Myanmar Agenda 21 in 1997 which sets out programmes for sustainable consumption and environmental conservation works. The Myanmar Agenda 21 calls for the integrated management of natural resources and provides a blueprint for achieving sustainable development.

The NCEA was replaced in April 2011 by the National Environmental Conservation Committee (NECC) as the central organisation for the national environmental management in Myanmar.

The Ministry of Environmental Conservation and Forestry (MOECAF) replaced the Ministry of Forestry in September 2011 as the focal agency for environmental management. The MOECAF is now replaced by The Ministry Of Natural Resources and Environmental Conservation (MONREC).

The Environmental Conservation Department (ECD) sits under MONREC and is responsible for the implementation of national environmental conservation policy.

*3.4.5.1 **Environmental conservation department***

The Environmental Conservation Department, one of the six departments under the Ministry of Environmental Conservation and Forestry is responsible for implementing National Environmental Policy, strategy, framework, planning and action plan for the integration of environmental consideration into in the national sustainable development process. ECD also manages natural resources conservation and sustainable utilization, the pollution control on water, air and land for the sustainable environment. It cooperates with other government organizations, civil society, private sectors and international organizations concerning with environmental management.

The ECD manages natural resources conservation and sustainable utilization, pollution control of water, air and land for the sustainable environment. It cooperates with other government organizations, civil society, private sector and international organizations concerned with environmental management. ECD is currently engaged in:

- The development of further legislation;
- The coordination of environmental conservation activities;
- Developing plans for climate change mitigation and adaptation; combating desertification; and ozone layer protection;
- Providing national reporting in line with international agreements.

A major recent legislative development is the Myanmar Environmental Conservation Law (30th March, 2012), comprising 14 Chapters and 42 Articles, and implementing the Myanmar National Environmental Policy of 1994.

An Environmental Conservation Committee has been formed with the duty of enacting and guiding further environmental legislation.

3.5 EMISSIONS INVENTORY

This chapter provides a brief description of the types of emissions and associated rejects generally associated with marine seismic campaigns.

The most significant impacts are associated with the underwater noise produced during the functioning of airguns. Other emissions and discharges to be analysed include emissions to air and sea and waste to be conveyed onshore.

3.5.1 Acoustic emissions

Acoustic emissions are generally associated with seismic survey airguns and propeller noise located aboard with the seismic vessel, as well as support vessels and helicopters if they are used.

This is particularly aggravated due to the different frequencies generated by these different elements (propeller, engines, etc.) and the impacts of water attenuation, the low frequencies and the susceptibilities of marine species to low frequencies.

The effects of the low range acoustic emissions of seismic survey airguns on marine life are the subject of a complex assessment process. The impacts are related to the number of exposures, level of exposure and the noise type, be it single pulse, multiple pulse or continuous noise.

Ambient acoustic emissions are also associated with the operation of support vessels (and helicopters, if used). However, the acoustic impacts associated with engine noise are negligible compared to airgun noise impacts, and uUnder normal operating conditions, the emissions of the support vessels would be confined to within a short distance of the ships. For example, McCauley (1998) measured underwater broadband noise of approximately 182dB re 1µPa from a rig support vessel holding station in the Timor Sea. This is about 50 dB lower than typical airgun noises. Emissions associated with helicopters are expected to be more significant, but due to the infrequence of helicopter presence (if any), these impacts are expected to be of short duration.

3.5.2 Atmospheric emissions

Atmospheric emissions are generally associated with diesel engine combustion and energy generation. The main sources of atmospheric emission are the following:

- Vessels diesel engine combustion;
- Note that helicopters will only be used for MEDEVAC and are not taken into account; Crew turn-over carried out by boat.

Hypotheses taken are given in the table below. It is inspired considering previous similar seismic campaigns.

Table 3-8 Hypotheses		
Seismic vessel consumption	45 m^3/day	Source: Total E&P Myanmar
Consumption supply vessel/chase boat	25 m^3/day	Source: Total E&P Myanmar
Duration of the project	409 days	Source: Total E&P Myanmar
Oil density	0.85 t/m^3	Internet data

Estimations of atmospheric emissions were undertaken by multiplying diesel consumption and emission factors for relevant atmospheric components.

Table 2 9 Calculation of atmospheric emissions		
Gas produced during the activity	Emission Factor (t/t)*	Total emission (tons)
CO_2	3.2000	244 746
CO	0.0021	161
NO_X	0.0094	719
N_2O	0.0002	15
SO_2	0.0010	76
CH_4	0.0001	7.6
VOC	0.0019	145

*METHODS FOR ESTIMATING ATMOSPHERIC EMISSIONS FROM E&P OPERATIONS, PAM POPE, ANDY SHAH, OIL INDUSTRY INTERNATIONAL EXPLORATION & PRODUCTION E&P FORUM, 1994; ADJUSTED FOR SO_2 BASED ON THE ASSUMPTION OF 0.5 %MASS OF S IN FUEL

(1) GHG emissions correspond to the sum of CO_2, N_2O and CH_4 emissions each multiplied by the corresponding Global Warming Potential factor.

In conclusion, the overall GHG production of the seismic campaign should range approximately **249 648 tonnes of CO_2eq.**

3.5.3 Discharges

Discharges are generally associated with wastewater and bilge water. These waste streams are usually collected in the water storage areas on the survey and support/chase vessels. The water storage areas generally incorporate domestic and sanitary wastewater; and deck and bilge water. These effluents will be stored on vessels before being discharged into the sea.

3.5.3.1 Domestic and sanitary wastewater

Domestic and sanitary waste will be generated as a result of the human presence on the survey vessels. The calculations for the vessels (survey and chase) are summarised in the table below.

The wastewater will be treated and monitored before discharge into the surrounding environment.

Table 2 10 Volumes domestic and sanitary wastewater

Waste stream	Quantity (m^3)	Assumption for estimation
Black water (m^3) (sewage water coming from the toilets)	6,442	Based on **210** crew members (70 persons on seismic boats and 140 in total for the 7 supply vessel/chase boat) and the flow rate determined by the US Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) for EIA in the Gulf of Mexico (**75 L/person/day for black water** and **110 L/person/day for grey water**). The seismic project duration is 409 days.
Grey water (m^3) (All domestic water with the exception of the flush toilet)	9,448	

*3.5.3.2 **Deck and bilge water***

The deck water comprises rainwater and deck washing water of the seismic vessel. The run-off water is collected by an open drain system.

The deck area free space comprises an area of about 100 metres by 25 metres (assumption) and all water falling within this area will be contained in isolated drainage systems depending on the potential for contamination. Annual rainfall in the project area is in the order of 5 450 mm/year. However, considering that the seismic survey will take place in the last quarter 2017 as currently planned, the bridge water releases are almost zero because these months are very low rainfall (~ 2mm/month in average for end of the year).

The bilge water means accumulated water in the ship holds and containing infiltration water, oil residues or any other product that would have been stored.

In order to minimize the waste associated with oils in bilge and deck water, no water will be discharged without prior on-board treatment. These wastewater releases comply with the Myanmar regulations and MARPOL 73/78. The table below summarizes the deck and bilge water production assumptions.

Table 3-9 Summary of deck and bilge water

Waste stream	Quantity (m^3)	Assumption for estimation
Deck water	4743	Area of Seismic vessel = 100 × 25 m2 and of support vessel = 50 x 15 7 support vessels/chase boat Rainfall patterns taken from Pyapon. 7 support vessel/chase boat The seismic campaign duration is anticipated to last 1 month in April,+ 7 months post-monsoon + 6 months post-monsoon.for 409 days.
Bilge water	5 800	53.2m^3/month Based on the experiences of full fold 4D seismic survey M5-M6 (Polarcus DMCC Total Yadana Draft 1 report)

3.5.4 Hazardous and non hazardous waste

A variety of non-hazardous solid waste will be generated such as glass, paper, plastic and wood. Much of this is associated with galley and food services operations and with operational supplies such as shipping pallets, containers and protective coverings. No solid waste will be intentionally disposed of into the marine environment. All solid wastes are collected and shipped to shore.
Milled food waste (i.e. < 25 mm diameter) will be discharged at the seismic location in compliance with MARPOL regulations. Hazardous wastes from lubricants, filters, chemical containers, used equipment, will be stored and consolidated for onshore disposal.

Table 3-10 Estimated wastes and emissions from seismic activities

Waste stream	Quantity (t)	Assumption for estimation
Hazardous wastes	90	Estimate based on waste records database from previous similar operations, for Block 17, Angola. Waste generated is based on ships utilized during the installation phase activities which will have a similar waste production schedule as the current project: **10 tons of hazardous waste/ship/year** and **434 tons non-hazardous waste/ship/years**. The seismic duration is 409 days in total; 1 seismic vessel and up to 7 support vessels forecasted.
Non-hazardous wastes	3891	
Putrcescible	29	Considering data from different seismic survey studies conducted by Artelia with a daily rate of 0,34 kg/day/person

The onshore waste disposal location identified by TEPM is Thaketa.

3.6 IMPACT PRODUCING FACTORS

Based on the project description, impact-producing factors identified can be divided into two different categories.

1) The first category is related to 3D seismic acquisition activities:

- **Underwater noise** generated by the seismic sources (discharge of airguns through the survey area).

2) The second category is related to the activities of the vessels:

- **Physical presence:** the vessels may interfere with shipping activities; and/or with commercial fishing. In addition, collision with marine mammals and other protected marine species (such as turtles and whale sharks) can occur.
- **Atmospheric emissions:** emissions primarily from fuel combustion on the survey and support/chase vessels.
- **Discharge to sea and solid wastes:** sewage, grey water and food waste discharge, impact to the marine environment from incorrect handling and disposal of chemicals, solid and hazardous wastes.
- **Generation of light:** generation of artificial light aboard the vessels is necessary for safety reasons; however it can attract marine fauna close to the vessels, and have an impact on local communities if the activity is taking place close to the coast.
- **Accidental releases:** spills of MGO during at-sea bunkering, or resulting from vessel collisions.

SECTION 4. PROJECT PROPONENT DETAILS

4.1 TOTAL E&P MYANMAR AND CONTACT PERSON

The operator of the project is Total E&P Myanmar. Total E&P Myanmar is present in Myanmar since 1992. Total currently operates the Yadana gas field with a 31.2% interest with a Production Sharing Contract signed with Myanma Oil and Gas Enterprise (MOGE). MOGE, created in 1963, is responsible for general oil and gas exploration and production in Myanmar, as well as domestic gas transmission through a 1,200-mile onshore pipeline network.

Commercial production began in 2000 with an expected field life of 30 years. With the Yadana project, Total has employed 2,500 people during the construction phase and currently employs 800 for the operating phase; 95% of the company's workforce consist of Myanmar nationals.

The following table presents the latest local seismic project performed by Total E&P Myanmar.

Table 4-1 Local Total E&P Myanmar recent experience in seismic acquisition

Year	Type	Characteristic
2008	Exploration survey – Arakan - Bangladesh	
2012	4D development survey	Yadana Field
2013	Exploration survey	Andaman – shallow water- 2090 km^2
2014	Exploration survey	Andaman – shallow water- 3150 km^2
2016	2D Exploration survey	Andaman – Deep offshore – 2,000km
2018	**3D exploration survey**	Blocks M5-M6, including Yadana Sein object of the present IEE

Table 4-2 Detailed Information about Project Proponent

Proponent name	Jean Paul Thiriet
Citizenship	France
Passport number	09AF56771
Address in Myanmar	No. 5, Sacred Tooth Relic Lake Avenue, Punn Pin Gone Quarter No.5, Mayangone Township, Yangon, The Republic of the Union of Myanmar. Tel. 95 (1) 650 977, 650 989, 660 466

	Fax. 95 (1) 650 478, 650 479
Phone number	Tel. : +(65) 6879 7900 Mobile: +(65) 9235 7786

Table 4-3 Detailed Information about Project Proponent Organization

Name of Principle Organization	Total EP Myanmar
Type of Business	Oil and Gas
Main Company Address	No. 5, Sacred Tooth Relic Lake Avenue, Punn Pin Gone Quarter No.5, Mayangone Township, Yangon, The Republic of the Union of Myanmar. Tel. 95 (1) 650 977, 650 989, 660 466 Fax. 95 (1) 650 478, 650 479

TEPM is committed to Corporate Social Responsibility as a core policy embedded in its operations. It prescribes Ethics, HSE, Code of Conduct and VPSHR principles to all stakeholders, while maintaining one of the most advanced human resources policy in Myanmar. As part of its commitment towards Myanmar and its local communities, TEPM has implemented since 1995 major Socio-Economic Programs in the pipeline area to improve Health, Education, Access to Energy, skills of local community, Micro Finance, etc… Such programs benefit to 33 villages and around 38 000 people and have become along the years a world class reference in term of CSR and an asset for Myanmar. TEPM also develops nationwide CSR programs and is actively involved in the EITI process.

4.2 INSTITUTIONAL FRAMEWORK OF THE PROJECT PROPONENT

The TEPM's organisation chart for this seismic survey is as presented in the following figure.

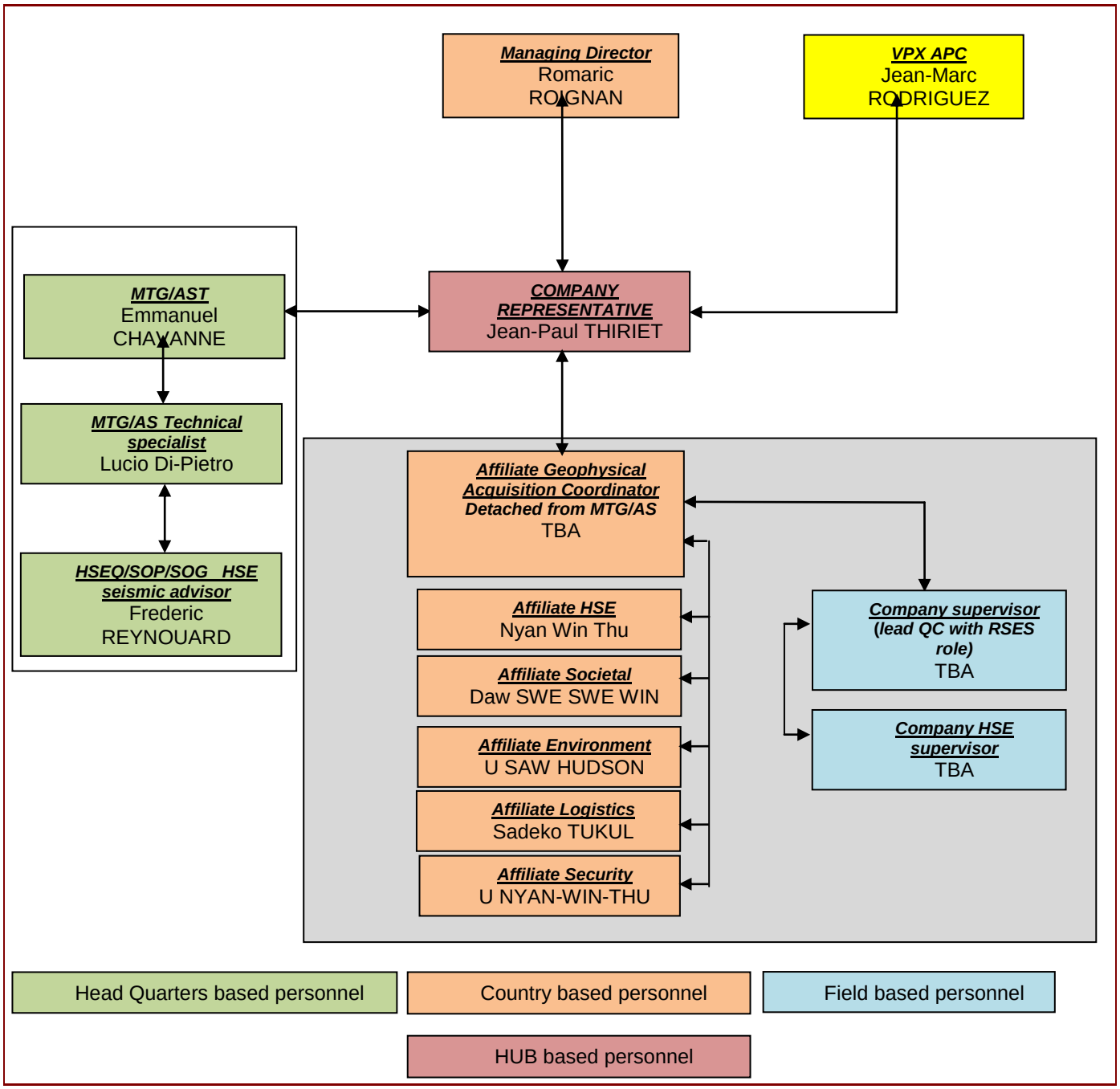


Figure 4-1 TEPM's Organisation chart during seismic operation

SECTION 5. INFORMATION ON EXPERTS

Artelia operates a branch office in Yangon since October 2012 and has already performed offshore environmental monitoring and six ESIAs' for Total Exploration &Production Myanmar. An environmental engineer from the Risk, Society & Environment department is now based in Yangon, which will facilitate data collection and local coordination. This gives to Artelia a good understanding of the local context and requirements, as well as an access to some existing data describing the offshore environment in Myanmar.

Artelia's experts have a good knowledge of seismic survey environmental & social issues: the project team includes an environmental engineer trained to MMO standards in the UK (JNCC) and a social specialist experienced in the management of offshore seismic campaign in Asia.

Table 4 1 Presentation of the team of experts

Name	Specific knowledge / skills	In charge of
Jordan PEYET	Environmental engineer	**Section 1,2,3,4** **Section 5:** 5.1 to 5.5 **Section 6 6.**1 to 6.4, 6.7 **Section 8** **Section9** **Section 10:** 10.1-10.7
Anne-Charlotte DUFAURE	Environmental engineer, Marine Mammal Observer accredited JNCC	
Coralie GRIELL	Social impact management specialist	**Section5:** 5.6 **Section6:** 6.5 and 6.6 **Section 7** **Section 8:** 8.2 **Section 10:** 10.8
Charles BOUHELIER	Environmental engineer, based in Yangon	Responsible of the data collection Meeting with the identified stakeholders
Christophe DERRIEN	Senior HSE engineer	Technical peer review, QA/QC

CVs of experts, explaining their backgrounds and fields of expertise, are available in APPENDIX A

SECTION 6. DESCRIPTION OF THE ENVIRONMENT

Note: The M5 – M6 blocks 3D seismic survey will be referred as "the Project" in the following sub-sections

6.1 INTRODUCTION

This section provides a description of the environmental conditions of the areas of proposed wells, which are located in the vicinity of M5 and M6 Blocks within the maritime jurisdiction of the Union of Myanmar (offshore) and coastal areas from the southern part of the Union of Myanmar (Irrawaddy Delta).

It is important to note that several Environmental Baseline surveys (EBS) were conducted in the Yadana field and Sein field located at ~7 km to the southeast of the M6 Block, namely:

- November 1994 – EBS on the Yadana field including the first marine survey around Yadana platforms area and pipeline route (Iare & Fugro, 1995);
- December 2003 – EBS of Sein field before construction of WP3 extension (Creocean, 2004a). EMS of Yadana field after Phase 1 of Yadana development (April 1997) (Creocean, 2004b);
- November 2010 – EBS of Yadana and Sein fields revisiting some of the sampling stations that were surveyed in 2003 surveys (Sogreah Magelis, 2011);
- December 2013 – EBS of Badamyar development in Block M5 centred over the proposed Wellhead Platform 4 (Fugro, 2013).

In particular, the EBS study carried out in 2013 by Fugro involved several in-situ physico-chemical measurements and laboratory analyses. Biological and chemical analyses were also carried out on both seawater (2 sampled stations) and sediment (10 sampled stations) located within the proposed well head, WP4 pipeline route and LCP-WP4 platforms locations. The study also provided a comparison of its results and the results from the previous environmental studies carried out in the Badamyar field mentioned above.

These previous EBS surveys carried out in adjacent areas of the M6 Block were used as reference and/or guidance for this study. To complement these studies, the 'Marine mammal observation report' performed on the M05/M06 3AA-3CA during the 3D seismic survey has also been used to update the environmental area of the project and its surroundings (CapFish, 2012) (Gardline, MMO report, 2014).

6.2 PHYSICAL ENVIRONMENT

The proposed Project area is located offshore Myanmar, on the Irrawaddy delta continental shelf in the northern part of the Andaman Sea. The area encompasses the Gulf of Martaban in the north-east, while the main body of the Bay of Bengal lies to the west.

The Andaman Sea is separated from the rest of the Bay of Bengal by the Andaman and Nicobar Islands. The water depth reaches several thousand metres, forming the Andaman Trench, before gradual sloping up to the coast of Myanmar.

The region receives considerable riverine input from the basin of the Irrawaddy, as well as from smaller rivers along the coast.

6.2.1 Geology and Geomorphology

The prospected area is located on the Ayeyarwady continental shelf in the northern Adaman Sea at the border with the Bay of Bengal and the Gulf of Martaban. Its geology is characterized by silts and clays for upper layers due to the important sediment deposition coming from Irrawaddy River (e.g., annual load of about 265.10^6 metric tons of silty clay).

Contribution from the Irrawaddy River constitutes 86% of the central trough's sediment, the difference being foraminiferal carbonate. Areal patterns of sediment indicate that transport of Irrawaddy sediment into the basin is related to bottom topography.

In general, the sub-sea geology is simple and contains no major structural features, like faulting and anticline/syncline systems.

Results from the Badamyar field development EBS report (Fugro, 2013) showed that in M5 Block sediment appeared to get finer with depth; a common pattern caused by weaker currents in deeper waters allowing a higher proportion of fine-grained particles to settle out of suspension. Although the survey area was dominated by fine-grained sediment, described as mud, one station located at 5 km north-west of Block M5 had a greater dominance of sand particles compared to the other mud dominated stations. It is therefore expected that the same type of sediment pattern from the adjacent Block M5 can be found on Block M6 as well.

In conclusion, both M5 and M6 blocks are located on the continental shelf with no specific anomalies recorded during previous Badamyar EBS. Thus, the vicinity of the seismic exploration area has the same geology and seabed features and properties.

6.2.2 Oceanography

*6.2.2.1 **Bathymetry***

Figure 6-1 shows the The vast majority of the project area is located on the continental shelf, i.e. where the water depth is less than 200 m. The continental shelf in the region South of the Ayeryawady delta is approximately 200 km wide, i.e. wider than the exploration blocks. The southern haldf of the survey area seems to display more varied bathymetry than the northern half, and presents both depressions below 150 m and mounds that may be as shallow as 10 m or less.

At the longitude of Preparis, the shelf is replaced by a fairly steep continental slope and depths in the NW corner of the survey area exceed 2000 m. This continental slope can be takent as marking the transition from the Andaman Sea to the Bay of Bengal. Preparis Island itself is located along an axis that extends the Rakhine Mountains past Cape Negrais towards the Andaman and Nicobar Islands. The shallowest points in the survey area (shallower than 10 m) also seem to be concentrated along that axis.

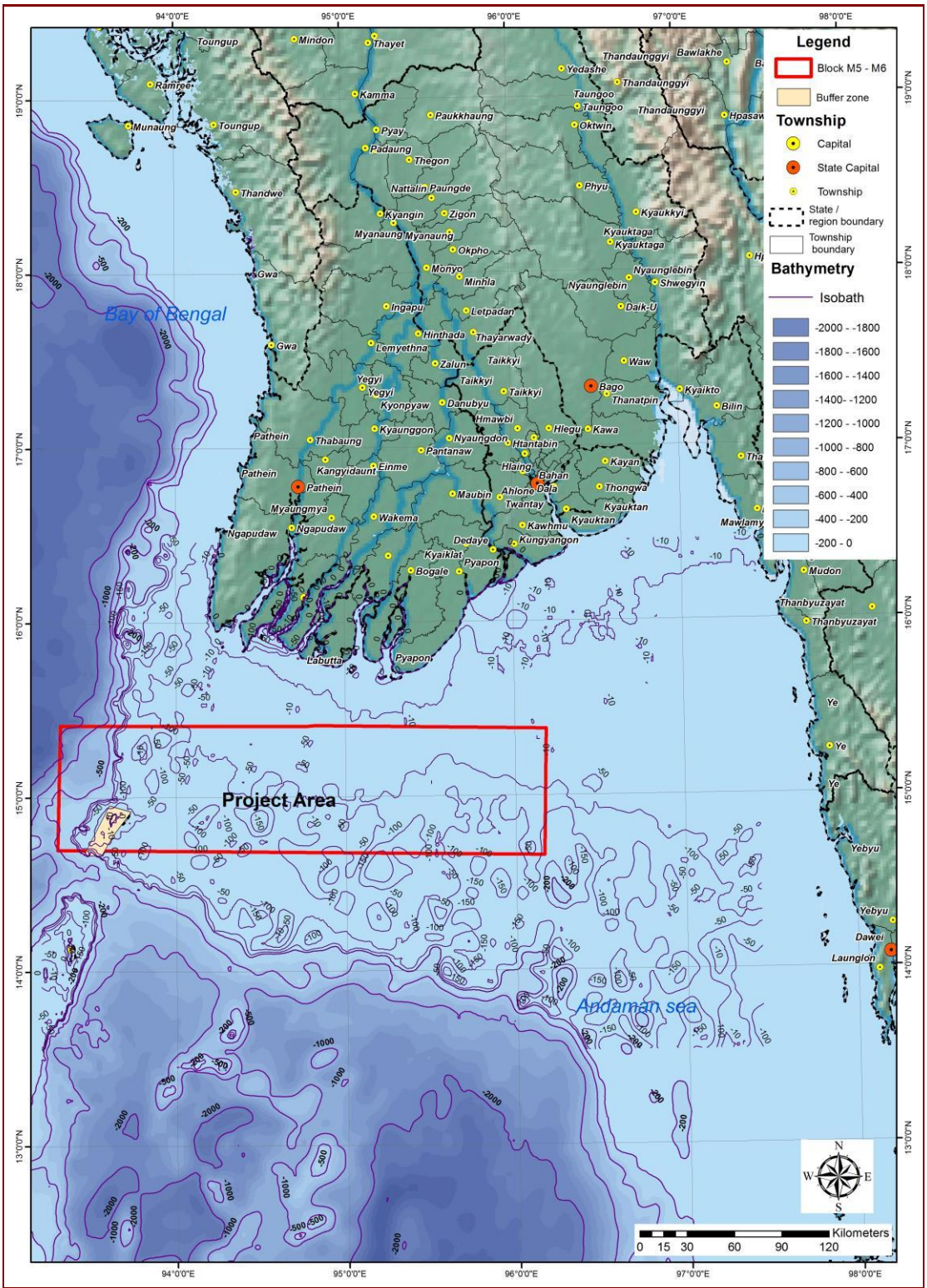


Figure 6-1 Bathymetry of the Project site (depth in meters) (*Source: GEBCO, 2014)*

6.2.2.2 *Submarine topography*

The seafloor topography around the project area is about 1.5-2°, dipping southeast. Frequent small dewatering features/pockmarks are seen over the site. No sonar contact is visible, as well as no obstructions/geo-hazards are detected.

In addition, the seabed morphology displays several active normal faults.

6.2.2.3 *Currents*

Surface currents in Myanmar are strongly dominated by the monsoon winds. Mean speeds are of around 0.4 m/s with possible peaks approaching 2.0 m/s due to the relatively steady monsoon winds (EMS of Yadana and Sein fields, Sogreah Magelis, 2011). These currents decrease rapidly with depth below the surface (mean speeds 0.15 m/s near the bottom).

The following figure (Figure 6-2) presents the typical seasonal current trajectories observed in Burmese waters, and around the Ayeyarwady delta in particular. Since the proposed 3D seismic campaign will possibly be carried out b after the monsoon 2018, between November 2018 and March 2019. During the Northeast monsoon, a clockwise direction of currents is expected.

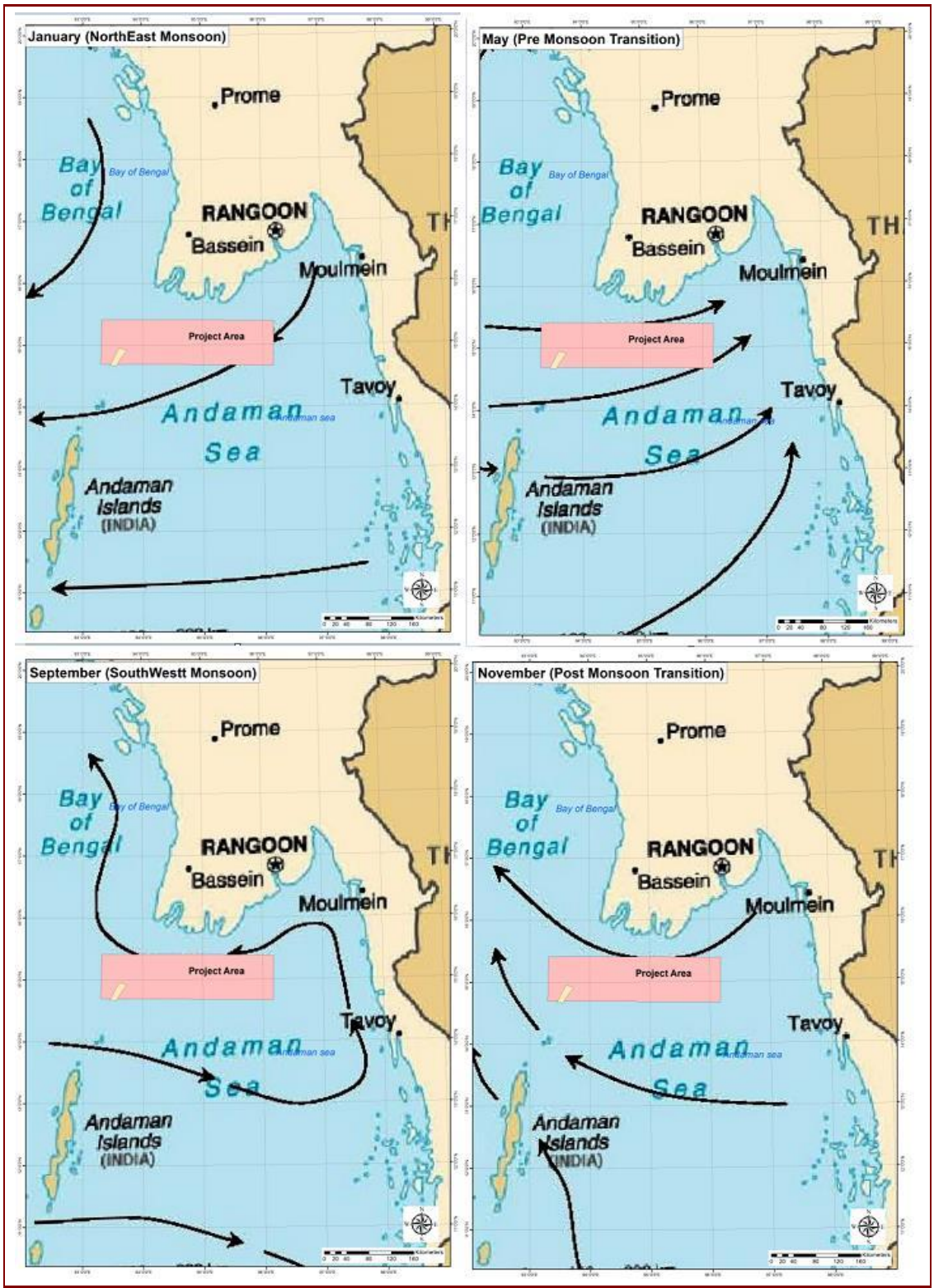


Figure 6-2 Vector Mean Currents in the Eastern Bay of Bengal (*Source: EMS of Yadana and Sein fields, Sogreah Magelis, 2011)*

6.2.2.4 *Tides and waves*

Throughout the study area, tides are predominantly semi-diurnal (EMS of Yadana and Sein fields, Sogreah Magelis, 2011). Off the coast of Myanmar, the spring tide range is approximately 2-2.5 m, increasing north-east of the Irrawaddy delta to about 6 m at the head of the Golf of Martaban.

The movement of swell in the region is related to the dominant monsoon wind. The area from the Ganga (Ganges) estuary to the Gulf of Martaban, including the Andaman Islands, has a generally moderate swell from the south-west though this becomes heavy during the Southwest monsoon. Turbulent seas are encountered from time to time, associated with squalls.

6.2.3 **Climate**

Myanmar's climate can be described as tropical monsoon characterized by strong monsoon influences, a considerable amount of sun, a high rate of rainfall (coastal regions receiving over 5,000 mm of rain annually) and high humidity. Temperature in the country varies from 19°C to 38°C and humidity from 66% to 83%.

Two monsoon systems influence the area to create four seasons in the Andaman Sea:

- Northeast monsoon: December to March, cool season (winter);
- Pre-monsoon transition: April to May, hot season (spring);
- Southwest monsoon: June to September, rainy season (summer);
- Post-monsoon transition: October and November (autumn).

The country receives practically all its rainfall between mid-May and October, when the sun's rays strike directly above the equator and the land mass of Asia is heated more than the Indian Ocean. This draws moist hot air from over the ocean onto the land, bringing the rains of the Southwest Monsoon season. Mean annual rainfall is the lowest in the Central Dry Zone (500-1,000 mm per year) increases in the eastern and northern hilly regions and is the highest in the southern and Rakhine coastal regions (2,500–5,500 mm) (Egashira, K.; Ave A.T., 2006). The project area is impacted by abundant rainfall during the wet season, with frequent thunderstorms. However, during the period of the drilling campaign (early of 2016), which shall happen during the northeast monsoon season, fine cool weather with very little rainfall are expected.

The main differences in the humidity values occur during the seasonal changes from the moist equatorial air of the Southwest Monsoon to the dry continental winter monsoon. In the project area, the northeast monsoon generates high moisture levels over the south and south-west part of the area. The highest relative humidity in the study area occurs in mid-summer, reaching an average of 82%.

Winds in Northern Andaman Sea are generally gently to moderate. The strongest winds mainly occur during the Pre-monsoon Transition (April) and the Southwest Monsoon (summer period) and are southwest orientated. The winds are then moderate changing to north-easterly during the Post-monsoon Transition (November) and north-westerly during the Northeast Monsoon (January).The wind regime in the vicinity of the project area is gentle to moderate, with 50% of the winds throughout the year exceeding 4.5 m/s and 10% exceeding 8.5 m/s (EMS of Yadana and Sein fields, Sogreah Magelis, 2011). Wind direction during January is generally from the South – Southeast quadrant.

Tornadoes recorded in the area are considered small scale and while very destructive, they are rare in the study area during the expected period of the seismic campaign. Waterspouts are more common, and their destructive path is more limited. They occur throughout the wider region, mainly in the south.

Air quality conditions within the project area are anticipated to be good due to its offshore location (approx. 70 km south of the Myanmar coast). Air quality within the project area is not identified as a specific issue.

6.2.4 Water quality

This section is based on the results from the Environmental Baseline Survey conducted by Fugro in December 2013 within the Yadana gas field complex, Block M5 of the Andaman Sea. The survey was undertaken to determine the physic-chemical and biological conditions of the water column prior to site development. The survey area covered 4 km x 6 km centre over the proposed Wellhead Platform 4. Since Block M5 is adjacent to Block M6, this survey provides the most representative up-to date for water quality of the Block M6 and hence it represents for the vicinity of the proposed seismic campaign area which is located within Block M5 and M6.

Water column profiles of temperature, salinity, pH, dissolved oxygen and turbidity showed an upper mixed layer between the surface and around 25 m depth, a stratified layer between around 25 m and 35 m, and a bottom mixed layer between approximately 35 m and the seabed.

Water column within the project area is characterized by:

- Surface average water temperature around 28.7°C, with a thermocline identified at 25– 35 m depth;
- Surface water salinity around 30 PSU, which decrease at 33 near the bottom with the same trend as the temperature profile (influenced by thermocline);
- Low turbidity, which increases with depth;
- Surface water generally saturated in oxygen (100%) with dissolved oxygen, which drops to 33% between 35m and the seabed (hypothoxic values);
- Uniform pH profile between the sea surface and 25m depth, where the pH was 8.4. Like the temperature profile (influenced by thermocline), a decrease in pH was observed between 25 m and 35 m, dropping from 8.3 to 8.1;
- Concentration of total suspended solids were below the limit of detection (<5.0 mg/l^{-1}) in all samples;
- Concentrations of nitrite and phosphate were below the detection limits (<0.01 mg/l^{-1});
- Chlorophyll and pheopigment were below the limit of detection (<1.5 $\mu g/l^{-1}$);
- Although concentration of hydrocarbons were below detection limits (<0.1 mg/l^{-1}), the presence of anthropogenically derived oil, such as lubricating or fuel oil, have been observed within block M5. Contamination was suggested to be a small scale input, possibly derived from passing ships;
- All heavy and trace metals were recorded at low concentrations.
- Nutrients and chlorophyll levels were low and comparable to nearby survey results.

The water column is likely to have a low turbidity, a high dissolved oxygen concentration and a moderate salinity.

6.2.5 Sediment quality

Based on results from the Fugro EBS 2013 of Block M5 and due to the overall geological and oceaanographic context, it is currently assumed that the sediment type and quality in Block M6 will be similar.

Sediment characteristics observed during Fugro EBS 2013 showed:

- Most sediment consists of fine particles (<63 µm), with the proportion of fines ranging between 60.23% and 90.26%;
- High water content in sediment samples, due to the high fine fraction content with high capacity to retain water;

- Similar to previous survey data, organic content was quite high in the whole area, which is typical for such marine sediment (high fine fraction);
- Although higher moisture contents were recorded in Yadana field EBS (1994) where the mean was 94.1%, the moisture content within the Badamyar sediment varied between 32.3% and 49.7%;
- Negative redox potentials were recorded in most of the marine sediments;
- Phosphorus concentration was low to medium, high concentration of nitrogen has been observed on sediment samples;
- Total Petroleum Hydrocarbon concentration were all below detection limit;
- Heavy metal, nickel and vanadium were below US EPA maximum limit;
- Barium was higher than USEPA average level but not over the maximum range indicated in USEPA; stations near well platforms (WP1, WP2) revealed higher concentration than others.

Overall, the M5 sediments were relatively uncontaminated, with a Total Petroleum Hydrocarbon concentration below detection limit, as with most of heavy metals (aluminum, cadmium, lead, zinc and mercury).

6.2.6 Vulnerability to natural disaster

The Union of Myanmar is exposed to multiple natural hazards including cyclones, earthquakes, floods and fire and it has been periodically hit by natural disasters. According to the United Nations Office for the Coordination of Humanitarian Affairs (OCHA), the tropical storm season in Myanmar occurs from May to November, with a peak of risk in October.

The M6 Block area is considered to be potentially exposed to multiple natural hazards; being the tropical storm the most relevant (OCHA, 2013). The most risky season occurs from May to November, with a higher risk in October.

Since the 3D seismic campaign will take place between November and April in the year, it is not likely that the project will be at risk of tropical storms or cyclones during this period.

6.3 BIOLOGICAL ENVIRONMENT

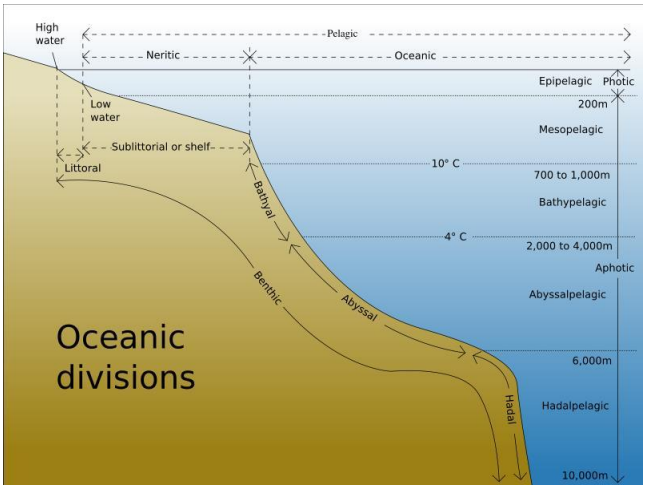


Figure 6-3 Oceanic divisions

The 3D seismic surveys will take place offshore Myanmar on the Irrawaddy delta continental shelf within the epipelagic zone (shallow waters <200 m depth) (see Figure 6-3). The epipelagic zone is the closest to the surface extending to a depth of 200 m and contains both phytoplankton and zooplankton communities that can support larger organisms like marine mammals and some types of fish, as local fauna typical of shallow tropical waters.

The previous EBS surveys carried out in the M5 Block, adjacent areas of the M6 Block, along with the M5-M6 3AA-3CA 2D seismic survey study, were used as reference and/or guidance for this study for the present Project.

The following section identifies the main group of marine species that may potentially occur within the project area and their main characteristics (IUCN Red List category, population trend, habitat, habits, feeding regime, sensitivity, etc.).

6.3.1 Marine fauna

6.3.1.1 Plankton

Studies on plankton in the Andaman Sea were performed in 2007 under the Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation study: “The Ecosystem -Based Fishery Management in the Bay of Bengal” which is a collaborative survey project of the BIMSTEC member countries. The study included plankton sampling carried out on board of M/V SEAFDEC at 24 stations during November 2007 in order to determine the composition, abundance and distribution of phyto and zooplankton in specific areas and obtain conclusions about its fertility as a new fishery ground. The study area was divided into three areas: area A or the Northern Bay of Bengal close to Bangladesh, area B on the western side of the Bay close to India and area C in the Andaman sea (Sopana Booonyapiwat, Md. Nasiruddin Sada, Jay Kishore Mandal, Manas Kumar Sinha, 2007).

An ecosystem survey was conducted during one month from 13 November / to 18 December 2013 in Myanmar. This survey was conducted by Dr. Fridtjof Nansen Research vessel, after a request from Department of Fisheries to FAO following consultations between the Norwegian Agency for Development Cooperation (Norad), the Bay of Bengal Marge Marine Ecosystem (BoBLME) project and the Department of Fisheries (DoF) of Myanmar. This survey was planned as a baseline-study of the shelf and upper slope within Myanmar EEZ, to assess the abundance of demersal and pelagic fish resources, as well as carry out investigations on biodiversity, zoo- and phytoplankton and the physical environment (Krakstad, et al., 2013).

In order to research on the Plankton, a total of 38 environmental stations were executed during the entire cruise along The Rakhine coastal zone, the Deltaic cost and The Tanintharyi coast.

Phytoplankton

In 2007 survey, a total of 58 genera with 135 species of phytoplankton were identified from the samples collected in the surface layer. The identified phytoplankton consisted of 2 genera with 2 species of cyanobacteria, 36 genera with 78 species of diatoms, 19 genera with 53 species of dinoflagellates and 1 genus with 1 species of silicoflagellate.

According to the results of 2007 survey, the species of *Oscillatoria erythraea* and *Proboscia alata* occurred as dominant species distributed in all areas of the study, being the former the most dominant species in the areas close to M6 Block.

From the results of R/V Dr. Fridtjof Nansen’s 2013 research, in total of 194 taxons was identified to species or to the nearest possible phylogenetic group. The average number of species per station was 44 ± 12 (SD) ranging from 22-72. The most common taxonomic groups were Fam. Chaetocerotaceae (represented with 23 different species), Fam. Ceratiaceae (represented with 22 different species) and Fam. Protoperidinaeae (represented with 15 different species).

The most common species found in R/V Dr. Fridtjof Nansen's survey were: *Oscillatoria sp, Ceratium fura, Ceratium, Rhizosolenia, Thalassionema nitzschioides, Chaetoceros, Chaetoceros lorenzianus, Hemiaulus sinensis,* and *Ornithocercus magnificus*. It was observed that the total number of 43-55 phytoplankton species was found in the area which is near to the proposed project site (Figure 6-4).

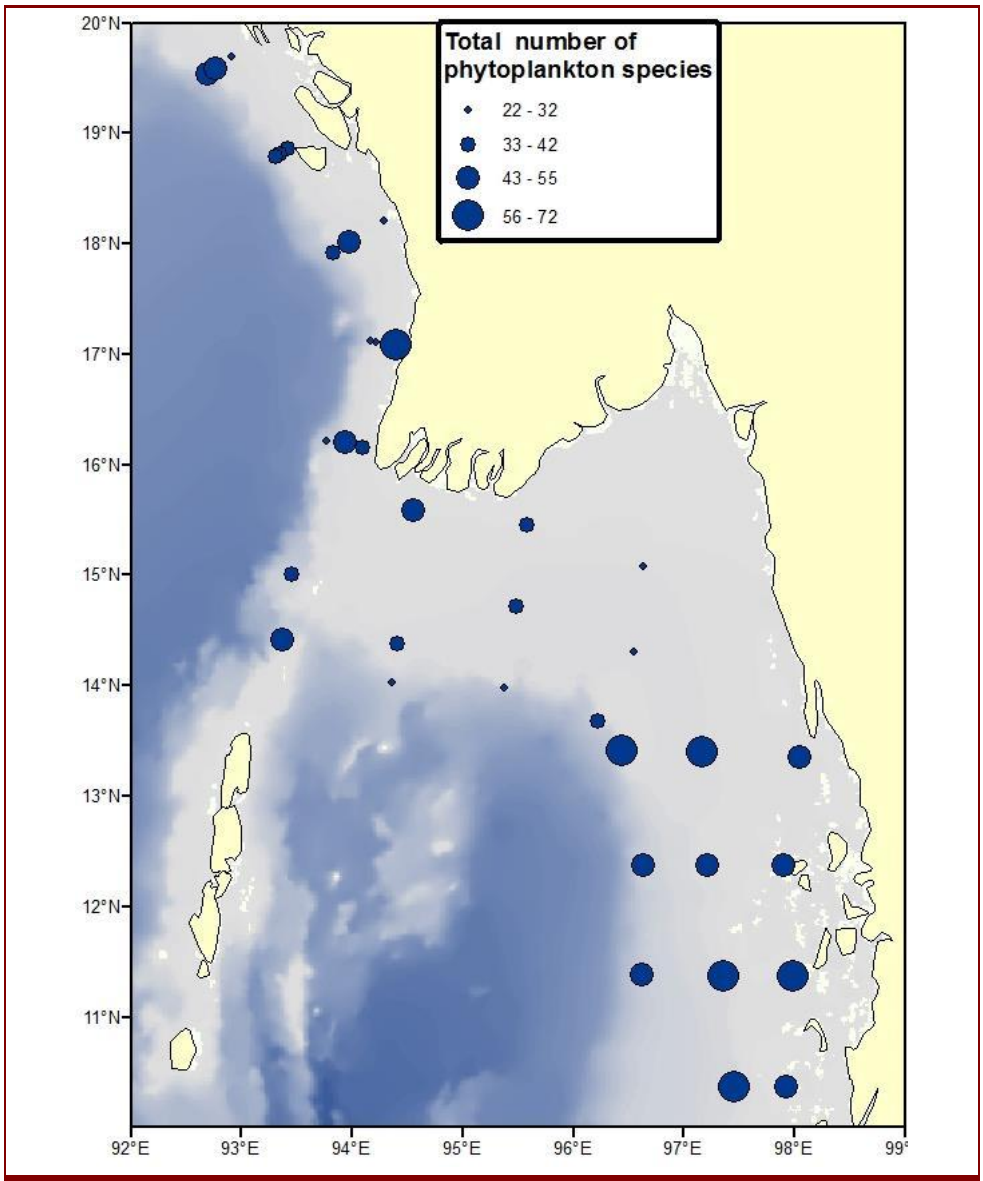


Figure 6-4 Phytoplankton species diversity at environmental stations along the Myanmar coast, November 2013

Source: Cruise report "Dr. Fridtjof Nanseen", Myanmar Ecosystem Survey, 2013

It was also possible to observe that the Andaman sea is very productive with high phytoplankton densities during the Northeast monsoon (November).

Zooplankton

According to M/V SEAFDEC 2007 survey, the zooplankton community consisted of 205 species, widely distributed in groups of copepods (the most significant group both in terms of species number and

abundance with 119 species), protozoan zooplankton, arrow worms, larvaceans, cnidarians, ostracods and thaliaceans.

Results for the sampling station located in the southern coast of Myanmar (closest to the M6 Block even if at 500 km south) also indicated a rich abundance of zooplankton groups, including calanoid copepods, poecilostomatoid copepods and arrow worms, whereas the region presented a lower abundance of crab larvae, planktonic shrimps and larvaceans.

In addition, numerous species of hydromedusae occured in the region, including ubiquitous species such as *Liriope tetraphylla*, species shared with the Arabian Sea such as *Pandeopsis sutigera*, as well as deep water and even Antarctic species.

Regarding the overall results from R/V Dr. Fridtjof Nansen's survey 2013, the analysis from the WP2 net indicated the presence of 204 different zooplankton taxa determined to genus or species level. The average number of species found per station was 47±15 (SD) ranging from 23-104 species. The phylogenetic groups represented by the largest species diversity were: Fam. Sagittidae (represented with 14 different species), Class Polychaetae (represented by 12 species), Fam. Paracalidae (represented with 10 different species) and Fam. Pontillidae (represented with 9 different species).

The species most commonly found in the samples from the WP2 net were: *Eucalanus subcrassus* and *Eucalanus crassus* but also: *Acartia erythraea, Atlanta, Undinula vulgaris, Paracalanus aculeatus, Oncaea venusta, Cresis clava* and *Oikopeura cophocerca* (Krakstad, et al., 2013). Figure 6-5 illustrates the biomass of zooplankton collected with WP2-net along the cruise lines.

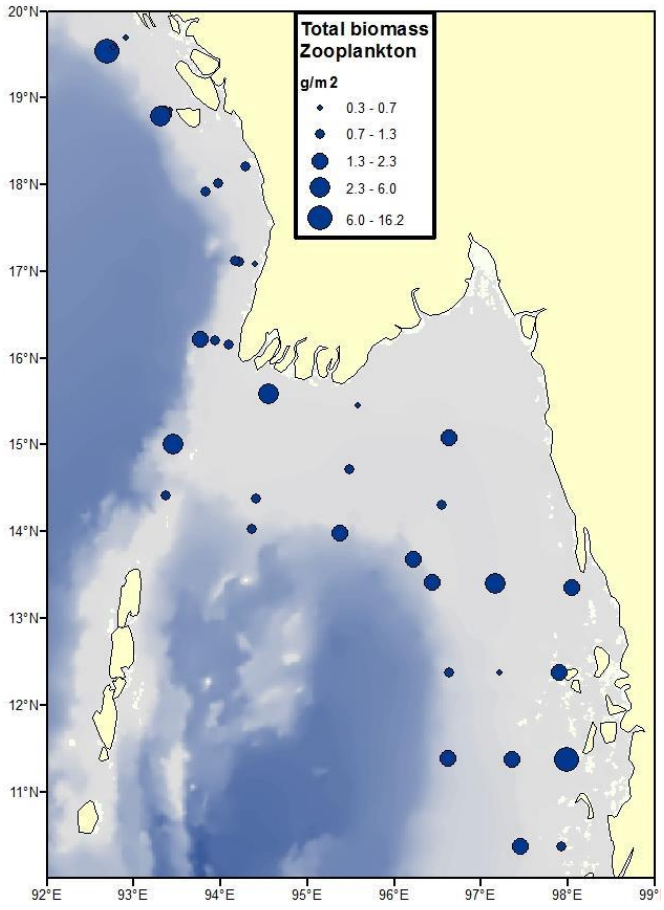


Figure 6-5 Biomass zooplankton (dry-weight g/mm^2) collected with WP2 net along the cruise lines November-December 2013

Source: Cruise report "Dr. Fridtjof Nanseen", Myanmar Ecosystem Survey, 2013

*6.3.1.2 **Benthic communities***

A quantitative assessment concerning the benthic macro-invertebrate community structure and distribution in the Irrawaddy continental shelf of the Andaman Sea has been performed through sampling of 46 stations distributed along the area at a depth range of 20 to 1000 m (Ansari, Z.A.; Furtado, R.; Badesab, S.; Mehta, P; Thwin, S., 2012).

The study showed a large variation in the distribution of benthic fauna density influenced by the river runoffs which bring major changes in sediment granulometry and consequently affect the distribution of this type of fauna in the region. Additionally, the study also concluded that in this area the faunal composition differs according to the depth and to the type of sediment (macrobenthic density and biomass was maximum in sandy sediment and minimum in clayey silt).

A total of 27 taxonomic groups were recorded and among them the dominant phyla were foraminiferans, polychaeta, nematode, crustacea, mollusca, echinodermata and coelentrata.

About 24 taxa were recorded from 20-50 m depth while the intermediate depth of 51-100 m had the maximum taxa (27) and in the deepest zone (201-1000 m) there were only 11 taxa recorded.

Forams were abundant in shallow regions (20-50 m) while the polychaete showed no preference to water depth and were recorded regularly with high prevalence in all the locations. Among crustaceans the amphipods, copepods, ostracods and macruran crabs were represented at different depth. Between 500m and 1000m depth, Polychaeta represented 52.7%, Crustacea 27.8%, Mollusca 6.9%, Echinodermata 0% and others 12.6%.

The trend in the abundance of fauna reported in this study supports the hypothesis that the quantity and species diversity of macro-benthos are higher in near shore than in offshore areas with exception of specialized ecosystems.

The Yadana and SEIN field EBS (2010) in adjacent areas of M6 Block found Crustacea to be the most abundant group in terms of abundance (74.8%) whilst Annelida made up just 14.7% of the total abundance. On the other hand, sediments from the SEIN field were dominated by Annelida (48%) in terms of abundance (Fugro, 2013).

The EBS on M5 Block by Fugro in 2013 also reported Annelida as the most abundant group (59.2%). Crustacea and Mollusca represented 21.1% and 12.6% of the abundance respectively, while members of the Echinodermata made up just 0.32% of the total abundance (Fugro, 2013).

The broad faunal community on M5 Block was found to be diverse and non-dominated with a large number of taxa occurring in relatively low abundances. A multivariate analysis demonstrated that at least part of the macro-fauna dataset variability could be explained by the variability in the sediment composition.

Taking into account the former studies in adjacent areas, as well as the water depth and sediments found at the M6 Block, it is possible to conclude that a significant abundance and diversity of the benthic community is likely expected in the area.

*6.3.1.3 **Pelagic Fish communities***

The pelagic system of the Andaman Sea is in general related to the considerable seasonal variations imposed by the monsoon systems. This seasonal variability, combined with reduced salinity (compared to oceanic water) due to riverine inputs, gives this community a distinctive character. Strong correlations are observed between temperature, phosphate concentration, primary production, copepod density and fish larvae density during both monsoons in the pelagic community of the Bay of Bengal as a whole, including the Andaman Sea.

The pelagic fish community is widespread and relatively eclectic in its distribution and include a wide variety of jacks, tunnys, barracudas, flying

fish, sharks and rays. Some predatory species may also be associated with reefs from time to time (e.g. barracudas and certain shark species), where prey are most abundant. This community contains some noteworthy species such as the rare whale shark (*Rhyncodon typus* – vulnerable).

The pelagic fish community is represented by the following classes of vertebrates:

- Agnatha (jawless, finless fish), i.e. Hagfish, Lamprey;
- Chondrichthyes (cartilaginous fish), i.e. Sharks, Rays;
- Osteichthyes (bony fish), i.e. Herring, Cod, Halibut, Tuna, Salmon.

A total of 37 pelagic fish species were identified with different levels of vulnerability:

- 2 species are critically endangered (CR), facing an extremely high risk of extinction in the wild;
- 15 species are endangered (EN), facing very high risk of extinction in the wild;
- 30 are classified as vulnerable (VU), facing high risk of extinction in the wild.

Acoustic distribution and abundance was estimated for two species groups, Pelagic 1 and Pelagic 2, during the 2013 survey. The Pelagic 1 group of species consists of pelagic fish of the Clupeidae and Engraulididae families, while the Pelagic 2 species belong to the Carangidae, Scombridae, Barracuda and Hairtails families (Krakstad, et al., 2013).

It was observed that low densities of Pelagic 1 were found in Deltaic cost and the distribution was generally found at longer distance from the coast. A total acoustic abundance index of 18,000 tonnes of fish was estimated based on a set (average) total length of 10 cm. The most common Clupeid species found in the region was the Sardinella *Sardinella gibbosa*, the Anchovy *Stolephorus indicus*, and the *Ilisha melastoma* (Krakstad, et al., 2013).

The distribution of Pelagic 2 species was found in low density over most of the Deltaic area. A total acoustic abundance index of 34,000 tonnes of fish was estimated based on a set (average) total length of 10 cm. The most common Pelagic 2 species found in the region were the shortfin scad *Decapturus macrosoma*, the Torpedo scad *Megalaspis cordyla*, and the hairtail *Lepturacanthus savala* (Krakstad, et al., 2013).

All species may potentially be found in the project area.

6.3.1.4 ***Commercially Important Fish Species***

The marine fishery comprises coastal and inshore fisheries, and offshore or deep-sea fisheries. Surveys carried out for the Department of Fisheries to determine the relative abundance and size composition of commercially important species indicate that some commercially important species inhabit Myanmar offshore waters, including the Swordfish (*Xiphiasgladius*), YellowfinTuna (*Thunnusalbacares*), Striped marlin (*Tetrapturusaudax*) and Sailfish (*Istiophorusplatypus*). Additionally, the BigeyeThresher (*Alopiaspelagicus*), Whit-tipped shark (*Carcharhinuslongimanus*), Escolar (*Lepidocybium flavobrunneum*), Pelagic stingray (*Dasyatissp*) and Snake mackerel (*Gympylussurpens*) can also be found as by-catch.

From the past surveys performed, the swordfish is the most dominant species in Myanmar offshore waters and it can be considered as one of the commercial fished for future offshore fisheries.

6.3.1.5 ***Marine Mammals***

Two major groups of marine mammals occur in Myanmar's waters; namely sirenians and cetaceans. The sirenians are represented by a single species, the dugong (*Dugon dugon*). The Cetaceans are organized into two groups - the ondotocetes or toothed whales, and the mysticetes, or the baleen whales:

- **Toothed whales (Ondotocetes)** include all whales that have teeth such as the killer whale, sperm whale and pilot whale and all dolphins and porpoises. In total, there are 73 species. The teeth in these animals vary in shape and number.

- **Baleen whales (Mysticetes)** do not have teeth but baleen plates which are made from a substance similar to keratin. These plates hang from the upper jaw and have frayed edges which the whale uses to sieve out plankton and fish after it has taken a mouthful of water.

A total of 29 marine mammal species are documented by the IUCN as being present in Myanmar waters, with different levels of vulnerability:

- 2 species are endangered (EN) facing very high risk of extinction in the wild: the Blue Whale (*Balaenoptera musculus*) and the Fin Whale (*Balaenoptera physalus*);
- 4 species are classified as vulnerable (VU) facing high risk of extinction in the wild: the Indo-Pacific Finless Porpoise (*Neophocaena phocaenoides*), the Irrawaddy Dolphin (*Orcaella brevirostris*), the Sperm Whale (*Physeter macrocephalus*) and the Dugong (*Dugong dugon*). The Dugongs are rare and are mostly found west of the Irrawaddy Delta and north of the main coastline.
- 1 species is near threatened (NT): the Indo-pacific Hump-backed Dolphin (*Sousa chinensis*).

Two species of marine mammals typical of coastal areas (shallow water, delta, rivers) in the Andaman Sea can possibly be found within the project area. These include:

- Irrawaddy dolphin (*Orcaella brevirostris*) (VU);
- Striped dolphin (*Stenella coeruleoalba*) (LC).

Some 31 sightings of marine mammals have been recorded during the 3AA-3CA 3D seismic survey on M5-M6 blocks that was conducted from February, 5th of 2014 to May 7th of 2014, for a total survey effort of 98 hours and 34 minutes. Many of the sightings occurred when the air-gun was not firing. These species are hopefully still active in the project area; they are :

- Sperm Whale (VU): a group of ten adults and two juveniles was sighted 200 m away from the survey vessel.
- Pygmy Killer Whale (data deficient – no status): a group comprising 40 pygmy killer whales was sighted 1,500 m away from the vessel.
- Melon-headed whale (LC): a group of approximately 20 individuals including four calves and two juveniles were sighted 400 m away from the vessel.
- Spinner Dolphin (data deficient – no status): a group of 60 spinner dolphins was sighted 500 m away from the vessel.
- Dwarf Spinner Dolphin (not assessed): a group comprising 20 probable dwarf spinner dlophins were encountered 1,000 m away from the ship.
- Pantropical Spotted Dolphin (LC): two groups of 25 and 80 pantropical spotted dolphins were seen.
- Unidentified dolphin species: four different groups of unidentified dolphin species were sighted. One of the groups, with approximately 100 unidentified dolphins, was sighted 3,000 m away from the vessel.

*6.3.1.6 **Marine reptiles***

A total of 16 marine reptile species are documented by the IUCN as being present in Myanmar coastal waters from which turtles represent the most threatened group.

Marine turtles

Marine turtles are one of the internationally listed aquatic endangered species for long term protection and conservation. Nesting of turtles is observed around the Andaman Sea, Gulf of Mottama (Gulf of Mattaban), Thamihla Island and Bay of Bengal. Currently in Myanmar, the Department of Fisheries has recorded at least 35 nesting sites in areas along the coastal region. Among those, six are closely conserved through monitoring and surveillance of turtle landing sites, clutches and numbers of hatchlings able to return to the sea.

Five species are commonly seen nesting regularly in Myanmar. They are olive ridley (VU), loggerhead (VU), green (EN), hawksbill (CR) and leatherback (VU) turtles. However, loggerhead and leatherback turtles are assumed to be almost extinct in Myanmar.

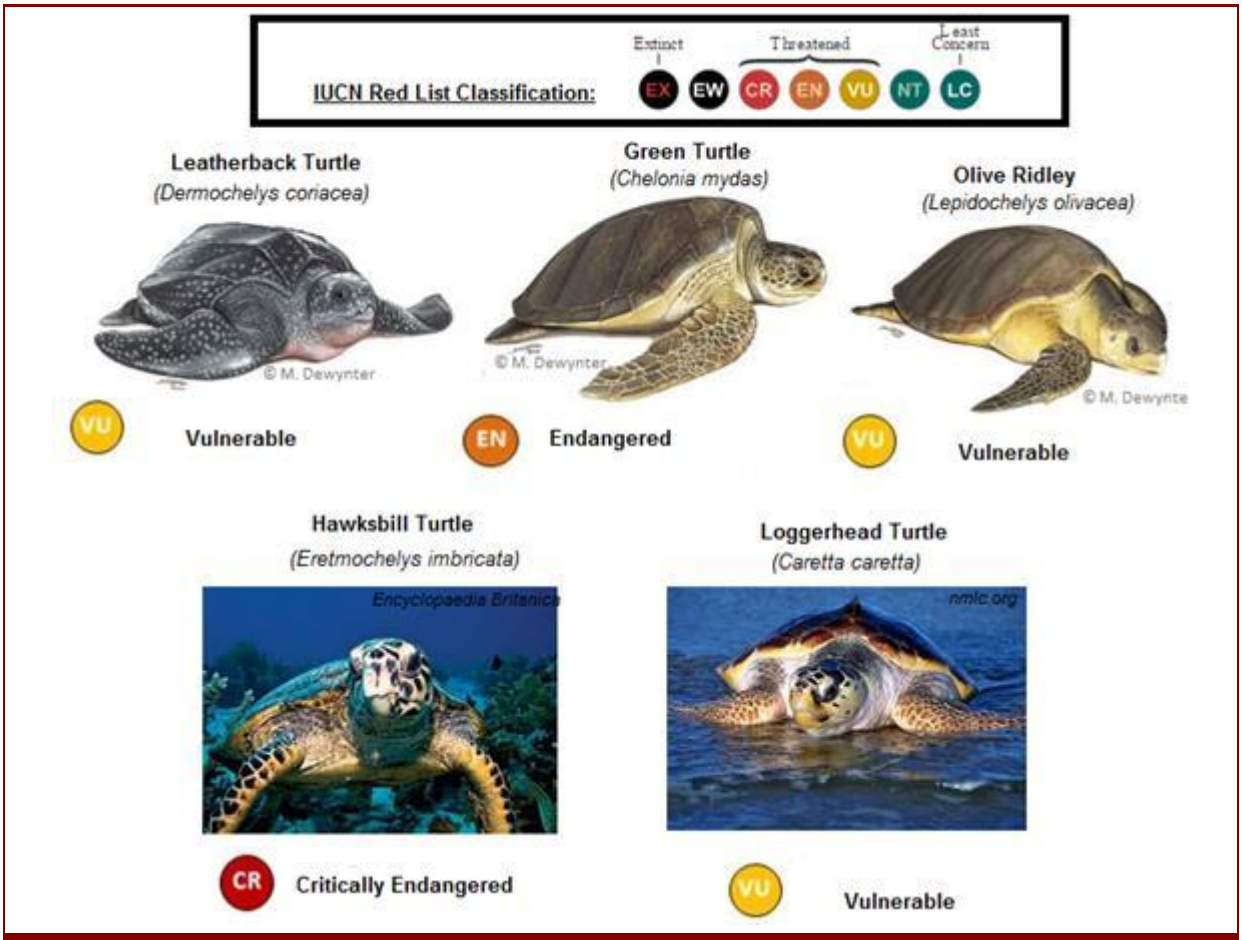


Figure 6-6 Marine turtles present in Myanmar waters

The table below shows the geographical distribution of marine turtle species in Myanmar.

Table 6-1: Distribution of marine turtles in Myanmar

Location/Habitat	Leatherback	Loggerhead	Green	Hawksbill	Olive ridley
Location					
Rakhine	*	*	*	*	*
Ayeyarwady	*		*	*	*
Yangon	*		*	*	*
Mon			*		*
Tanintharyi	*		*	*	*
Habitat					
Marine	*	*	*	*	*
Coastal	*	*	*	*	*

Source: Kyoto University Research Information Repository, 2012 Interaction between Fishing Activities and Marine Turtles in Myanmar, W IN / habitat: IUCN red List 2014

During the 3AA-3CA 3D seismic survey on M5-M6 blocks, a green turtle was sighted surfacing 200 m away from the vessel, and a single dead olive ridley turtle was encountered. Moreover, two unidentified turtle were also sighted 200 m away from the vessel.

All the marine turtles species recorded in Myanmar may occur in the M5-M6 Block during migratory movements to and from nesting beaches along the coast with exception of the Loggerhead turtle. Preparis Island was documented in 1911 as harbouring numerous green turtles (IUCN Red Data Book,1982) but more recent information is poorly documented; the 2004 earthquake raised the level of the island by 30 to 40 cm, and it is not clear whether this affected the nesting potential of the island, since a step could act as an obstruction to the movement of turtles on land.

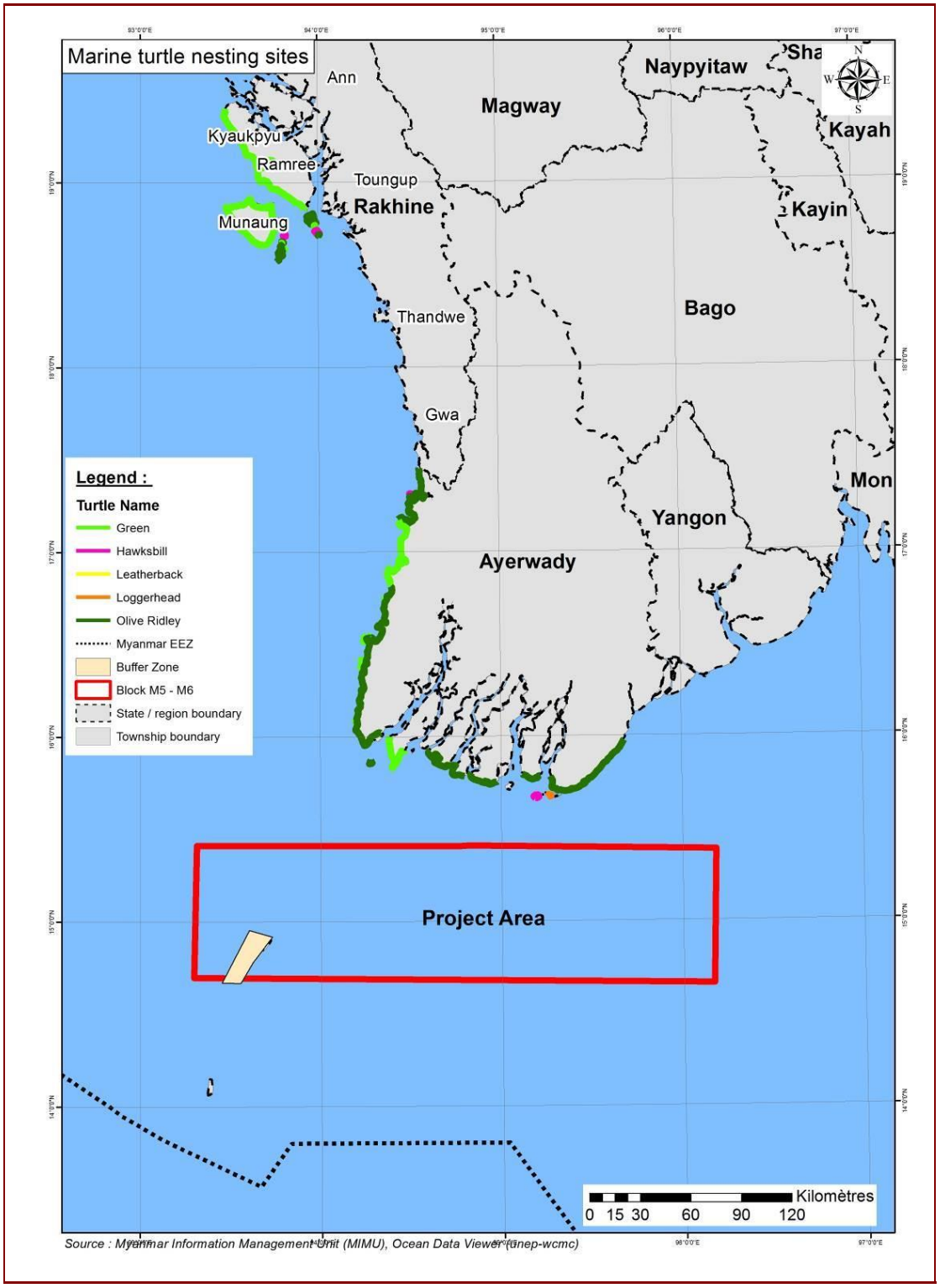


Figure 6-7 Key biodiversity areas for marine and freshwater turtle species

SOURCE: MYANMAR MARINE BIODIVERSITY ATLAS. 2016

Sea snake

Regarding sea snakes, all the species identified by the IUCN in Myanmar coastal waters have been identified as being of 'least concern'.

Saltwater crocdile

In addition to sea turtles and snakes, the saltwater crocodile (*Crocodilus porosus*) has been recorded in swampy coastal areas throughout the region, as well as occasionally being observed in the open sea. This species is listed by the IUCN as least concern, and it is not considered significant in the context of the proposed Block seismic project.

6.3.1.7 ***Seabirds***

Seabirds are commonly seen over the open ocean thousands of kilometres from the nearest land, but all birds come ashore to raise their young. Many seabirds are excellent swimmers and divers, including such distantly related types of birds as grebes, loons, ducks, auks, cormorants, penguins, and diving petrels. Most of these seabirds have webbed or lobed toes that act as paddles, which they use to propel themselves underwater. Others, including auks and penguins, use their wings to propel themselves through the water. Swimming sea birds have broad, raft like bodies that provide stability. They have dense feather coverings that hold pockets of air for warmth, but they can compress the air out of these pockets to reduce buoyancy when diving.

A survey conducted in 2006 in the mouth of Yangon River and Ayeyarwaddy (Irrawaddy) delta to record the diversity and determine the number of waterbird species present in the Southern part of Myanmar identified one seabird species that was most frequently recorded namely the Great Frigatebird *Fregata minor* and two coastal threatened species: Spotted Greenshank *Tringa guttifer* (Endangered), and Lesser Adjutant-Stork *Leptoptilos javanicus* (Vulnerable).

A total of 1,088 species of birds are currently identified as ocurring in Myanmar; from which 5 are endemic species, 2 are introduced species and 54 are globally threatned species[1].

The threatened seabird species typically found in Myanmar marine waters are listed in the hereafter table with their respective IUCN Red List category. Twenty threatened seabird species are identified in Myanmar's marine waters. Amongst these species, one species is identified as vulnerable (VU), five species as near threatened (NT) and thirteen species as least concern (LC) on the IUCN Red List.

Table 6-2: Seabird species recorded in Myanmar

Order	Family	Species	Common name	IUCN red list	Typical habitat
CICONIIFORMES	CICONIIDAE	*Ciconia episcopus*	Woolly-necked Stork	VU	Frequents coastal mudflats or coral reefs, mangrove swamps and estuaries
PELECANIFORMES	ANHINGIDAE	*Anhinga melanogaster*	African Darter, Darter, Oriental Darter	NT	Common in south Myanmar/ wetlands/marin e
CORACIIFORMES	ALCEDINIDAE	Pelargopsis amauroptera	Brown-winged Kingfisher	NT	Coast/ fairly common to

[1]http://avibase.bsc-eoc.org/

					locally common resident in the south-west and Tenasserim
CHARADRIIFORMES	BURHINIDAE	*Esacus giganteus*	Beach Stone-curlew, Beach Thick-knee	NT	Islands off peninsular/ coastal
CHARADRIIFORMES	SCOLOPACIDAE	*Limosa limosa*	Black-tailed Godwit	NT	Marine
CHARADRIIFORMES	SCOLOPACIDAE	*Calidrisruficollis*	Red-necked Stint, Rufous-necked Stint	NT	Terrestrial/marine
GRUIFORMES	RALLIDAE	*Fulica atra*	Common Coot, Coot, Eurasian Coot, European Coot	LC	Marine/coastal
ANSERIFORMES	ANATIDAE	*Anas querquedula*	Garganey	LC	Highly migratory/coastal saltmarshes
ANSERIFORMES	ANATIDAE	*Anser albifrons*	Greater White-fronted Goose, White-fronted Goose	LC	Fully migratory/shrub by tundra on the coast
CHARADRIIFORMES	LARIDAE	*Larus ichthyaetus*	Great Black-headed Gull, Pallas's Gull	LC	Fully migratory/coastal
CHARADRIIFORMES	CHARADRIIDAE	*Charadrius leschenaultii*	Greater Sand Plover, Greater Sand-Plover, Large Sand Dotterel	LC	Fully migratory/near the coast
CHARADRIIFORMES	SCOLOPACIDAE	*Tringa nebularia*	Common Greenshank, Greenshank	LC	Marine wetlands/estuaries
CHARADRIIFORMES	SCOLOPACIDAE	*Actitis hypoleucos*	Common Sandpiper	LC	Full migrant/coastal shores/ estuaries
CHARADRIIFORMES	SCOLOPACIDAE	*Calidris ferruginea*	Curlew Sandpiper	LC	Full migrant /estuaries
CHARADRIIFORMES	CHARADRIIDAE	*Charadrius alexandrinus*	Kentish Plover, Snowy Plover	LC	Fully migratory /predominantly coastal
CHARADRIIFORMES	SCOLOPACIDAE	*Arenaria interpres*	Ruddy Turnstone, Turnstone	LC	Fully migratory/species is mainly coastal/ estuaries
CHARADRIIFORMES	SCOLOPACIDAE	*Calidris temminckii*	Temminck's Stint	LC	Full migrant/coastal inlets/avoids extremely cold conditions and exposed coasts
CHARADRIIFORMES	SCOLOPACIDAE	*Xenus cinereus*	Terek Sandpiper	LC	Full migrant/inhabits tropical coasts, especially open intertidal

					estuaries
CICONIIFORMES	ARDEIDAE	*Mesophoyx intermedia*	Intermediate Egret, Yellow-billed Egret	LC	Marine/coastal

Note: IUCN Red List - Status: Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC), Data Deficient (DD). (Last accessed: 09/12/2017)

Taking into account the typical habitat of these seabirds, seven species could potentially occur within the M5-M6 Block: four of these are listed as Least Concern species (Common Coot, *Fulica atra*; Common Greenshank, *Tringa nebularia*; Intermediate Egret/Yellow-billed Egret, *Mesophoyx intermedia*) and four are listed as Near Threatened (Red-necked Stint, *Calidris ruficollis*, African Darter, *Anhinga melanogaster*; Beach stone-curlew, *Esacus giganteus*; and the Black-tailed Godwit *Limosa limosa*).

6.3.1.8 ***Fauna observed within the study zone***

Fauna observations have been conducted within the M5-M6 block during two campaigns, the first conducted between Novembre and December 2012 (CapFish, 2012) and a second between February and May 2014 (Gardline, 2014).

Marine mammals

No cetaceans were sighted during the survey conducted by CapFish (CapFish, 2012).

Turtles

An adult Loggerhead turtle (*Caretta caretta*) was sighted on 20th November 2012 approximatly 2 000 m ahead of the vessel (CapFish, 2012).

Fish

Fish activity has been observed, especially small fishes which appeared to be large shoals of macquerels hunting bait fish (possibly sardine or anchovy). Bait fish activity was confirmed by seabirds (generally terns) swooping down to the water for feeding (Cap Fish, 2012).

Seabirds

Three different bird species were recorded during the entire survey period of which one species was positively identified. A total of 72 bird counts were performed, accumulating to 359.87 hours of bird observations, during which only 414 birds were counted (Cap Fish, 2012).

Species	Common Name	No. of Sightings	Total Bird Count	Maximum during Single Count
Pelagodroma Marina	White-faced Storm petrel	1	1	1
Sternidae spp.	Terns (unidentified)	15	408	150
	Egret (unidentified)	5	5	1
Total			**414**	

Fauna observations from the Capfish (2012) and Gardline (2014) studies recorded no marine mammals, only one turtle and three different speices of birds, correlated with the fish acitivty within their survey zone. These observation show that the study zone does not present a high density of sensitive species.

6.3.2 **Coastal habitat**

Myanmar supports some of the most extensive and least disturbed coastal marine ecosystems in mainland Southeast Asia. An extensive coastline accommodates half a million hectares of brackish and freshwater swampland that supports essential ecological functions and habitats as spawning, nursery and feeding grounds for aquatic organism like fish, prawns and other aquatic fauna and flora of economic importance (UNEP; MOECAF; GEF, 2011).

6.3.2.1 *Irrawaddy River and Delta*

The Irrawaddy River is located in regional Myanmar and originates from the confluence of the Mali and Nmai Rivers. Both rivers find their sources in the Himalaya glaciers located north of Myanmar. The catchment area is located in the northern part of Myanmar and has an area of 404,100km^2. The river originates in the north-south trending Tebasserun-Shon fold belt. From its headwaters, the river flows generally southwards for 1,295 km; near the town of Henzada it branches into several tributaries, forming an extensive delta and empties into the Andaman Sea.

The delta system of the Irrawaddy River extends in a great alluvial fan from the limit of tidal influence near Myanaung (18°15'N) to the Bay of Bengal and Andaman Sea, 290 km to the south. This alluvial plain is bounded to the west by the southern Arakan Yoma range and to the east by the Pegu Yoma. The city of Yangon, situated on the southernmost spur of the Pegu Yoma, lies at the SE edge of the delta. The entire area is overlain by a thick layer of recent alluvium displaced by the Irrawaddy.

Three main types of soil have developed: meadow gley clay soils, meadow swampy soils and saline gley soils. The flow in the Irrawaddy is at its lowest in February and March and there is a sharp rise in level in April-May as a result of melting snow in the upper catchment, and a further steep rise in May-June with the onset of the monsoon. The maximum flow occurs in July or August. Most waterways are natural water courses, and there is no extensive system of dredged canals, the only major canal being the Twante canal which links Rangoon with the western part of the delta.

The upper and central portions of the delta are almost entirely under cultivation, principally used for rice crops. Until about 1850, much of this region comprised a complex of permanent and seasonal lakes, swamps and marshes, and vast areas of seasonally inundated plains and swamp forest. However, following the rush of settlers from Upper to Lower Burma in the late 19th Century, the construction of embankments and reclamation of land for agriculture has kept pace with the increase in population. The system of embankments provides a unique example of partial flood protection. The major dykes form horseshoes around the areas between the main rivers, with the downstream ends left open. In the event of extreme flooding, the lower parts act as flood basins, thus slightly reducing the flood peak. The old embankments have been maintained, and projects are contemplated to extend the system even further. Despite these reclamation schemes, there still remain large tracts of land that are deeply flooded during the monsoon and retain water even during the dry season. In addition, there are numerous permanent oxbow lakes and associated marshes, particularly along the Irrawaddy between Myanaung and Henzada, along the Myitmaka, and along the upper Bassein and Daga rivers.

The lower third of the delta, stretching 130 km from east to west, is completely flat with no local relief. About 520,000 ha of land are below the high spring tide level and subject to tidal inundation. Much of this area is covered by mangrove forest, and cultivation is limited to the higher areas of ground. Sandy ridges, such as old beaches and sand banks, provide refuges for wildlife during the highest tides. Although the mangrove vegetation has been exploited for a very long time, there are some relatively intact stands remaining. The area is dissected into a number of islands and peninsulas by a series of large, southerly flowing rivers and a complex of smaller, interconnecting water courses, all of which are at least intermittently saline due to tidal intrusion.

Drainage is directly into the Bay of Bengal through nine major river mouths, the Bassein, Thetkethaung, Ywe, Pyamalaw, Irrawaddy, Bogale, Pyapon, China Bakir and Yagon. These rivers carry a heavy silt load, and their waters are very turbid. The delta is actively accreting seawards, and as a result the sea is very shallow for some distance out to sea. Water depths are less than 5.5m across the whole coastline fronting the delta and up to 28 km offshore in the east. The present rate of advance of the delta is estimated at 5-6 km per 100 years, equivalent to about 1,000 ha per year. Several small islands, some of which are visible only at low tide, have developed offshore.

There are no marine protected areas in the Irrawaddy delta. However, protection is required for mangroves, turtles, estuarine crocodiles and waterfowl and three sites were proposed as wildlife sanctuaries: Meinmahla Kyun, Kadonlay Kyun and Letkokken Islands. All of these areas are small estuarine islands, surrounded by shallow water comprising mudflats and mangroves frequented by crocodiles.

The Irrawaddy Delta is one of the most densely populated parts in the country. Virtually all land not designated as Reserved Forest has been converted to intensive agriculture particularly for rice cultivation. Rivers are used for artisanal and commercial fishing.

The Irrawaddy is one of the most heavily silted rivers in the world, not only because of deforestation and significant erosion in the watershed, but also due to a long history of intensive agriculture along the river banks. Virtually all land outside the Reserved Forests has already been converted into agricultural land, and the mangrove forests within the Reserved Forests are now disappearing at a rapid rate. Large parts of the Kyagan Kwinbauk, Kakayen and Pyinland Reserved Forests have already been deforested and converted into agricultural land.

The populations of Estuarine Crocodile *Crocodylus porosus*, sea turtles and River Terrapin *Batagur baska* have been drastically reduced by commercial exploitation and are now seriously threatened. The crocodile population continues to be exploited by the People's Pearl and Fisheries Corporation, which removed an average of 465 hatchlings per year during the period 1978-83 for rearing at a crocodile farm in Rangoon. Other threats to the remaining crocodiles include habitat destruction, collection of eggs for food, hunting of adults and juveniles, and entanglement in fishing nets. The number of sea-turtle eggs collected annually in the Irrawaddy Delta declined from 1,500,000 in 1911 to an average of 400,000 during the period 1978/79 to 1981/82. This decline in egg harvests has been reflected in a decline in adult turtles and the abandonment of some former nesting beaches. Mature turtles are taken by fishermen and caught by trawlers in their nets throughout the delta, and Hawksbill Turtles *Eretmochelys imbricata* are hunted for their "tortoise shell". At the turn of the century, approximately 70,000 eggs of the River Terrapin Batagur baska were collected annually in the delta. Although the species is now on the verge of extinction in the delta, the adult terrapins and their eggs continue to be taken wherever they are found.

The project area is located at ~30 km offshore the mouth of the Irrawaddy Delta.

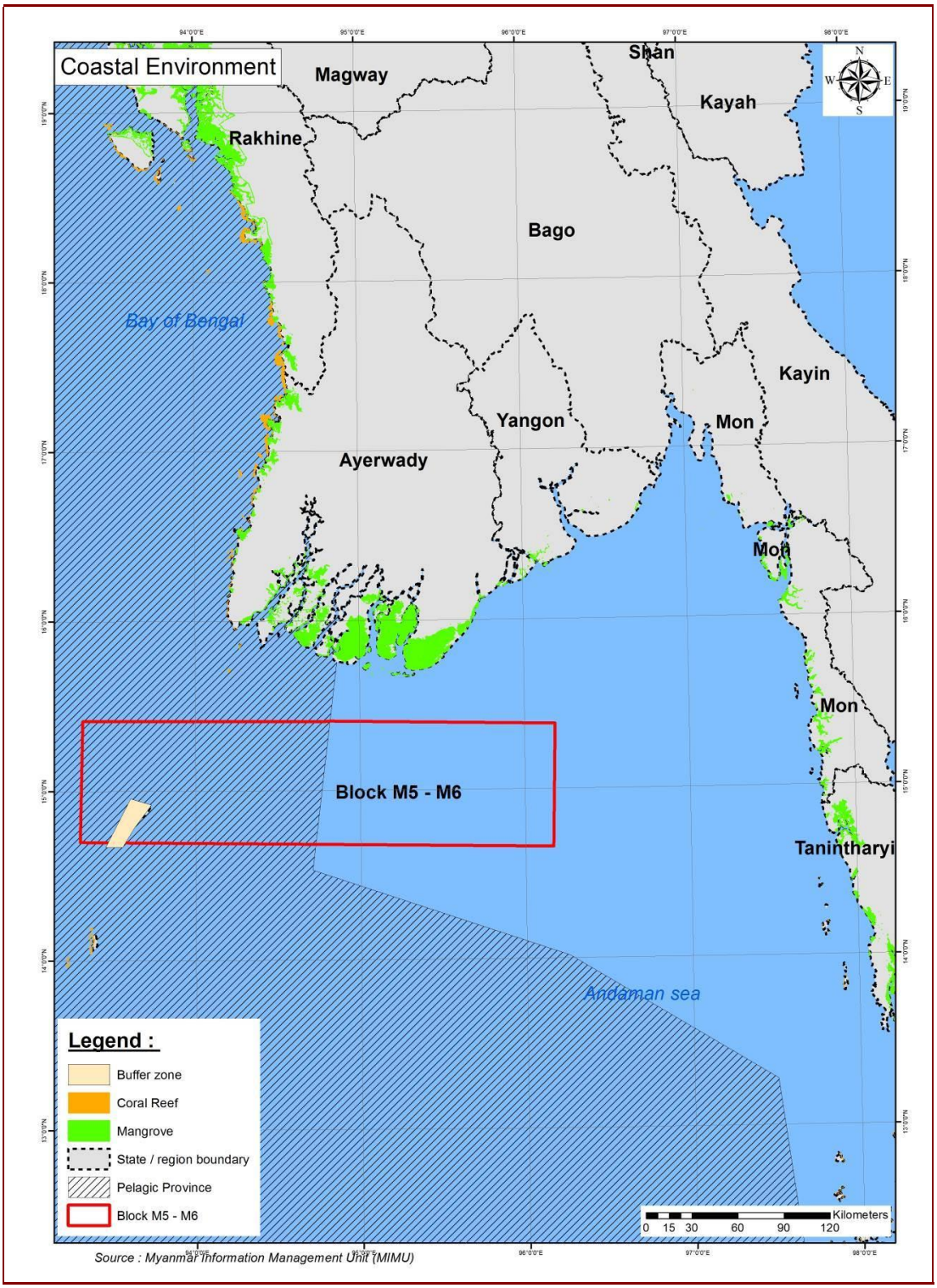


Figure 6-8 Location of mangrove

SOURCE: MYANMAR MARINE BIODIVERSITY ATLAS. 2016

6.3.2.2 *Coastal habitat*

The habitats in coastal areas of Myanmar consist of mangroves, coral reefs, seagrass beds, evergreen forest, wetlands and various types of agricultural land.

Mangroves

With the exception of agriculture, mangrove ecosystems contribute to maintain biological resources which are not only significant for the conservation of biological diversity but also of direct economic significance to Myanmar.

Mangroves are found in all regions of Myanmar but the Irrawaddy delta area has the most extensive mangrove habitats in the country. Other mangrove habitats are found along the sheltered coasts in the Rakhine and Tanintharyi regions. The original surface area covered by mangrove forest in Myanmar was 320,106 ha in early 1900.

According to the National Report of Myanmar on Sustainable Management of the Bay of Bengal Large Marine Ecosystem (2003), as many as 24 species of mangrove trees have been recorded along the Myanmar coastline. Species identified include Rhizophora, Sonneratia, Avicennia, Bruguiera and *Xylocarpus spp* which are dominant, the first one being used to call mangrove area i.e Rhizophora forest (Department of Fisheries Myanmar, 2003).

Mangroves along the Myanmar's coast are of great importance to the local population; they are particularly used as a source of firewood and charcoal for cooking, wood for construction and fisheries.

The nearest mangrove areas are located at ~35 km from the seismic campaign area on the SE part of the mouth of the Irrawaddy Delta.

Seagrass

Seagrass are submerged flowering plants found mostly along the coastline. Healthy seagrass protect the shore, promote biodiversity, store carbon, cycle nutrients and help support numerous industries (e.g. fishing, tourism). Seagrass plays an important role in the life cycles of a number of important species in Myanmar, such as dugongs, marine turtles, etc. Seagrass occur generally in shallow water (as they require light for photosynthesis) providing habitats and food for numerous species.

There is little information on the status of seagrass resources in Myanmar. Based on the data prepared by Soe-htun in 2001, Myanmar has nine species of seagrass belonging to five genera from two families. These are *Cymodocea rotundata, C. serrulata, Halodule pinifolia, H. uninervis, Syringodium isotoefolium, Enhalus acoroides, Halophila beccarii, H. decipiens, H. ovalis*. Among these species, *Cymodocea rotundata*, *C. serrulata* and *Enhalus acoroides* are dominant in the seagrass beds (U. Soe-htun et al, 2001).

However, these species are found mainly in the Rakhine and Tanintharyi coastal regions. No seagrass are present in the Irrawaddy Delta and Gulf of Martaban coastal region where water turbidity is very high because of the enormous sediment discharges from upstream watersheds (UNEP; MOECAF; GEF, 2011)

Seaweed

Myanmar being a tropical country has a rich and varied seaweed flora. Although the Burmese have for many years eaten several of the seaweeds as vegetables and used them as a source of agar extraction, there is little recognition of their importance as part of the marine environment. Therefore, there is currently not much information available on the subject.

Myanmar, located in the tropics, has a rich and varied seaweed flora. Although the Burmese have for many years eaten several seaweeds as vegetables and used them as a source of agar extraction, there is little recognition of their importance as part of the marine environment. Therefore, there is currently not much information available on the subject.

According to the National Report of Myanmar on Sustainable Management of the Bay of Bengal Large Marine Ecosystem, a number of the 122 genera and 307 species of seaweeds from Myanmar have been reported and (Department of Fisheries Myanmar, 2003).

From visual observations and studies, the following seaweed genera have been identified for their economic potential:

- Chlorophyta: *Ulva, Enteromopha, Monostroma, Caulerpa, Codium*.
- Phaeophyta: *Padina, Dictyota, Spathoglossum, Chnoospora, Rosenvingea, Hormophysa, Turbinaria, Sargassum*.
- Rhodophyta: *Porphyra, Gelidiella, Halymenia, Solieria, Catenella, Hypnea, Gracilaria, Laurencia, Acanthophora*.

Among these species, *Sargassum* and *Hypnea* are the most abundant in Myanmar. The standing stock of *Sargassum* is estimated at 2,500 tonnes dry weight and 1,500mt dry weight for *Hypnea*. *Sargassum* beds formed along the Tanintharyi coastal region provide good habitats, refuges and spawning grounds for commercially important fishery resources.

6.3.2.3 ***Coastal Fauna***

Coral Reefs

Coral reefs are one of the world's most diverse natural ecosystems and provide a wide variety of food and habitat for a great number of species such as plants, fish and other living creatures. Globally, there are about 600,000 km^2 of coral reef (0.9% are located in Myanmar); more than half of this area occurs in the Indian Ocean.

As Myanmar is located in a tropical region, a large number of coral species occur across the coastal waters of the country. However, reports on Myanmar coral is scarce mainly due to the limited funds and tools essential to assess the current the status of its species and populations. There are however settlements of fishing villages in some islands, where fishermen are dependent on coral-associated invertebrates. Coral reefs itself are a resource of immense importance for the local population as they provide food from reef fish, recreation for tourists, etc.

A total of 51 coral species have been identified in Myanmar by the DOF but systematic assessment is still needed to map out the status of coral reef diversity and their trend in the seascape (UNEP; MOECAF; GEF, 2011): among anthozoan coral polyps, 51 species belonging to 20 families and 30 genera along Rakhine coast, 3 species belonging to 2 families and 2 genera from Delta areas and 93 species belonging to 21 families and 47 genera from Tanintharyi coast have been recorded by Aung Kyi (1982), San San Win (1993), Mya Than Tun (2000) and Mya Than Tun and Tint Tun (2002). (Bay of Bengal Large Marine Ecosystem Project, 2012)

Coral Reef formation in the Irrawaddy coastal zone is restricted to the Thamihla Kyun, Coco and Preparis islands which lie far outside the zone of influence of river runoff.

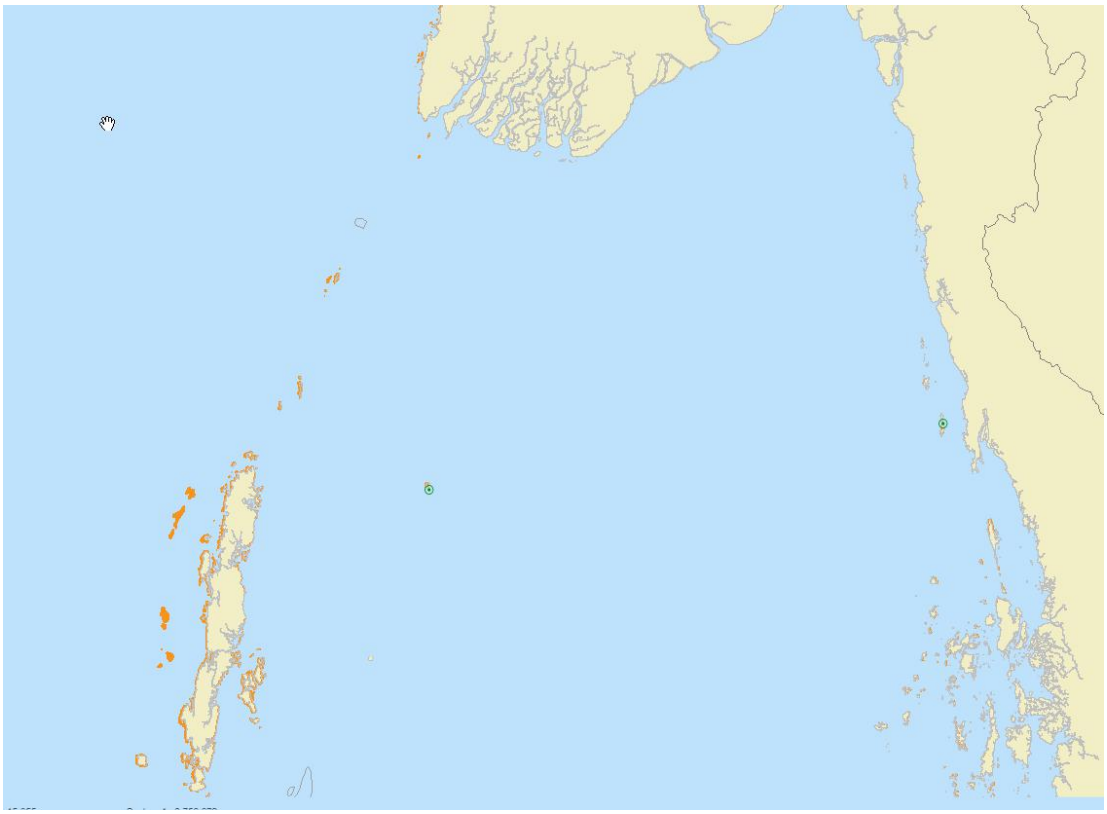


Figure 6-9 Coral reefs identified in the region

SOURCE: REEFBASE

The seismic project area includes Preparis island and lies 60 km North of Great Coco Island, and 49 km South of Thamihla Kyun Island.

Please refer to **Section 6.3.3** for more details on these species.

6.3.3 Sensitive and Protected Areas

Myanmar possesses significant levels of coastal biological diversity, such as:

- Marine biodiversity in the coastal areas;
- Coastal and inland mangroves;
- Tropical evergreen forests;
- Moist deciduous, dry deciduous forests.

With a coastline of 2,278 km, several large estuarine and delta systems, and numerous offshore islands, Myanmar possesses a considerable diversity of coastal wetland habitats, including coral reefs, sandy beaches and mudflats. Several major rivers including the Ganges in the north and Irrawaddy, Sittang and Salween in the Gulf of Martaban have created soft shores where mangroves develop extensively.

A protected area is an area of sea and/or land especially dedicated to the protection and maintenance of biological diversity and managed through legal or other effective means.

The main sensitive protected marine areas located at the mouth of the Irrawaddy Delta and in the proximity of theM5-M6 Block project area are:

- Meinmahla Kyun (designated 1993) and Kadonlay Kyun Islands: official wildlife sanctuaries for the protection of turtles, crocodiles and shorebirds. These areas are located at ~40km and ~35km north, respectively, of the proposed seismic investigation area.
- Thamihla Kyun known as Diamond Island (designated in 1970): a wildlife sanctuary encompassing marine areas and coral reefs that are sensitive. This area is located at ~70km northwest of the proposed seismic investigation area.

6.3.3.1 ***Meinmahla Kyun Island***

The southern tip of this island is located 50 km form the northern edge of the project area.

An estuarine island in the delta of the Irrawaddy River, almost entirely comprised of alluvial deposits from the Bogale River. The island is flat, with low cliffs to the south and west dropping to a narrow sandy beach. Numerous creeks and channels intersect the island which also features sand dunes and mudflats. The sea throughout the entire area is highly turbid and very shallow, being no deeper than 5.5m up to 28km offshore. The tidal range is 2.0-2.5 m. The Island is a wetland classified as a mangrove ecosystem reserve and wildlife sanctuary. The reserve is occupies an area of 52.79 square miles (~137 km²) and was established in 1986.

An estimated 2,600 estuarine crocodiles *(Crocodylus porosus)* inhabit the island, representing about two-thirds of the entire population in the eastern delta. Other wildlife includes *Panthera tigris, P. pardus, Cuon alpinus, Lutra sp* and *Elephas maximus*. The island is likely to be of considerable importance for both resident and migratory waterfowl, but almost no information is available. Species observed on the Island incude 250 *Egretta spp* and one *Leptoptilos dubius* in late 1982. It has a total of 29 mangrove tree species (Istituto OIKOS and BANCA, 2011).

Land use includes intensive fishing in the creeks but there is no resident population on the island, only temporary camps are established by fishermen. According to FAO, there is some illegal logging on the island, and the waterways are heavily fished (Istituto OIKOS and BANCA, 2011).

6.3.3.2 ***Kadonlay Kyun Island***

Situated at ~10 km off the coast of the Irrawaddy Delta, opposite the mouth of the Bogale River, Delta Forest Division is a low, flat island, formed exclusively of silt deposits from the Bogale River. It comprises grassy areas and sand dunes bordered by broad sandy beaches and mudflats with some mangrove forest. The surrounding sea is very shallow, hampering access to the island.

The Island is an important nesting site for sea turtles, which lay approximately 1,000 nests each year. According to local information, the turtles are mostly Loggerheads (*Careta careta*), but considerable confusion has arisen over identification, and it is now thought that the majority are Olive Ridleys (*Lepidochelys olivacea*). A few Green Turtles Chelonia mydas appear each year, and a single Leatherback (*Dermochelys coriacea*) nests every two or three years. In addition, the island may still support a very small number of River Terrapins *Batagur baska*. Some migratory shorebirds have also been observed on the island in November/December. Sea turtle eggs are collected by the Kadonkani Cooperative, which stations keepers on the island during the main turtle nesting season from September to February. Otherwise the island is uninhabited and difficult to approach due to the extreme shallowness of the surrounding waters (Istituto OIKOS and BANCA, 2011).

Researchs performed in 1983 by Salters reported that an average of 122,000 turtle eggs was collected each year during the period 1978-82. Sustained harvesting of turtle eggs at this level has almost certainly been the main cause for the decline in the number of eggs available for collection, probably mirroring a decline in the number of breeding adult turtles. Fishing nets and baited lines also contribute to turtle mortality. Excessive harvesting of the eggs of the River Terrapin has resulted in the near extermination of the species (Istituto OIKOS and BANCA, 2011).

6.3.3.3 *Thamihla Kyun Wildlife Sanctuary*

Thamihla Kyun lies 50 km from the northern edge of the project.

It is a small, offshore island to the west of the Irrawaddy Delta, measuring about 1,100m by 730m. The topography is undulating, with low cliffs to the south and west dropping to narrow, sandy beaches. Much of the island is pock-marked with bomb craters. With the exception of the north, the island is surrounded by a rocky reef, about 270m in width, comprising sandstone and shale. There are three small freshwater reservoirs on the island, the largest covering approximately 0.6 ha.

Sandy beaches are backed by typical beach vegetation with *Hibiscus sp, Terminalia catappa, Casuarina equisetifolia* and *Cocos nucifera*. The sheltered northern part of the island has good cover of Bombax malabaricum, Ficus spp. Lagerstroemia macrocarpa, Xylia dolabriformis, Terminalia belerica and Lannea grandis. Evergreen shrubs and bamboo constitute a fairly dense understorey. The southern part of the island is more exposed, and supports a poorer cover with patches of open grassland and bare rock interspersed with evergreen thickets.

Formerly a major green and Olive Ridley turtle nesting site where an extension was recommended to create a marine reserve. Harvesting of sea turtle eggs and fishing are the main land use. There is no resident local population on the island. The People's Pearl and Fisheries Corporation maintains a representative and a small number of labourers, and a policeman and forest guard are resident. In 1983, there was a temporary military garrison on the island. The island has a sheltered anchorage of some 3-5m in depth (Istituto OIKOS and BANCA, 2011).

Sea turtles are seriously threatened by the intensive egg-collecting and offshore trawling activities of the People's Pearl and Fisheries Corporation. Between 1.5 and two million eggs were harvested annually at the beginning of this century. By 1980, this harvest had fallen to an average of 150,000 eggs per year. The People's Pearl and Fisheries Corporation is still permitted to collect nearly all the turtle eggs, whilst its trawling operations offshore are thought to be responsible for about 100 turtle deaths each year (Istituto OIKOS and BANCA, 2011).

6.3.3.4 *Offshore Islands*

The following offshore islands are the closest islands in terms of location with regards to the proposed 3D seismic campaign:

- Preparis Island (14°52'28"N 93°37'36"E) lies within the footprint of the 3D seismic survey area. It is an island 7 km long and 1.8 km wide covered with dense forest; Coral reef formations are known to exist around the island. The island is part of a line that connects the Rakhine mountains with the Andaman Islands chain.
- The Coco Islands are a pair of strategically important islands located in the eastern Indian Ocean and politically administered by Myanmar under Yangon Division. Geographically, they are part of the Rakhine mountains / Andaman Islands lineament and are separated from the North Andaman Island (India) by the 20 km wide Coco Channel.
    - The main island, Great Coco Island (14°07′00″N 93°22′03″E), is approximately 10 km long and 2 km wide. Many green turtles nest on the beaches of the Great Coco Island. A series of research programs on marine turtle conservation have been conducted by Burma's Department of Fisheries. Data collection on tissue samples of green turtles for population genetic and tagging studies was conducted at Great Coco Island from March to April 2006. Prior to this, Great Coco Island had never been surveyed for marine turtle conservation by the Department of Fisheries due to its remote location. The survey found an estimated 150 sea turtles nesting and between 90,000 and 100,000 hatchlings and juveniles.
    - Little Coco Island lies 15 km to the southwest from the Great Coco Island. It is approximately 5km long and 1km wide. It is located 74 km from the SW corner of the proposed seismic investigation area.

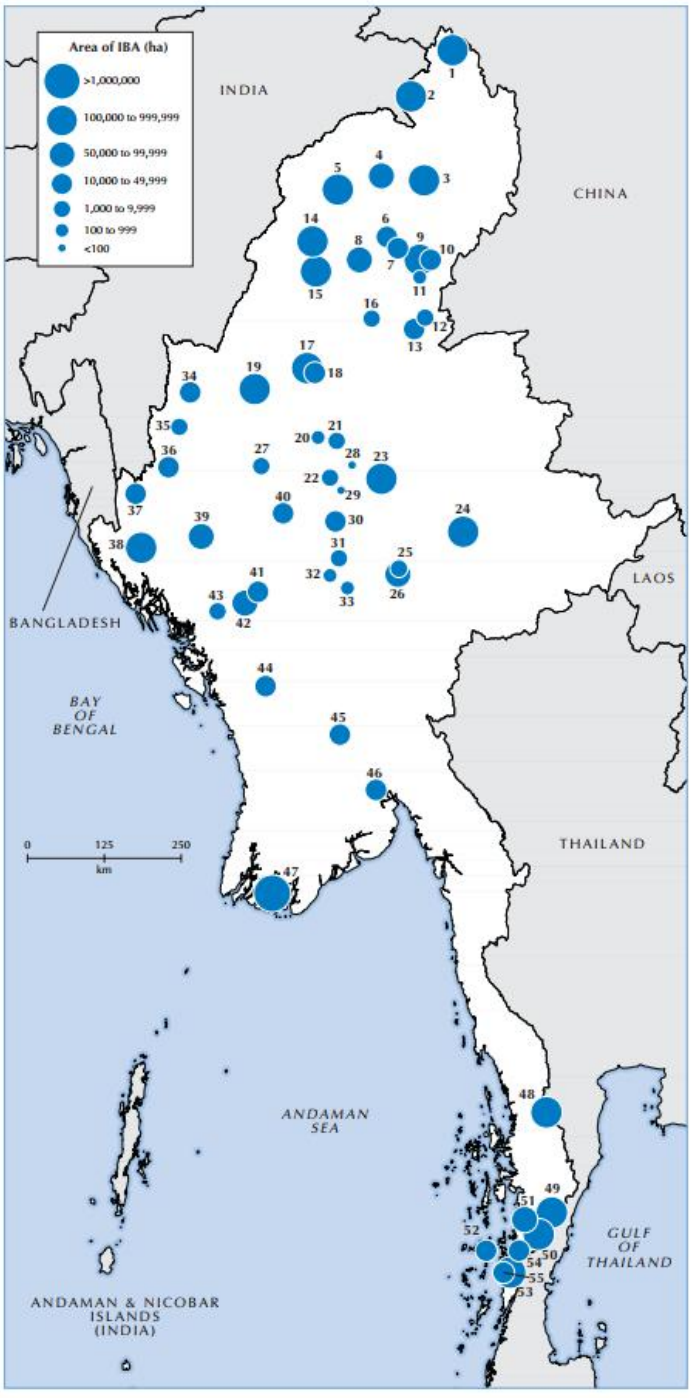
- Narcondam Island is a small (3 km*4 km) volcanic island located in the Andaman Sea. This island is part of the Indian Union territory of Andaman and Nicobar Islands. It is located at ~150 km south of the proposed seismic investigation area.

6.3.3.5 International Protected Sites

The Ramsar Convention identified one site in Myanmar – Moyingyi wetland wildlife sanctuary in the Bago region. A state-owned area comprising floodplain and a storage reservoir that is important for flood control. Originally constructed as a reservoir to provide water to the Bago-Sittaung canal (linking the Bago and Sittaung rivers) for transport of timber by boat, the site now functions as a source of fresh water for downstream areas where rice cultivation takes place. It floods in the wet season (May-October) and from October to March hosts over 20,000 migratory waterbirds. These include the globally threatened Baer's Pochard Aythya baeri, Sarus Crane Grus antigone and Greater Spotted Eagle Aquila clanga, as well as >1% of the regional population of the Northern Pintail Anas acuta. The communities use the site for fishing, grazing, duck-rearing and some rice-growing; and there is a small tourist facility to accommodate birdwatchers[2]. This site is not considered to be affected by the seismic campaign project.

Additionally, 57 Important Bird areas are identified in Myanmar from which the most relevant for the M5-M6 blocks is considered to be the Ayeyarwady Delta (including Meinmahla Kyun Island). This area includes 4 threatened species of birds (1 of leact concern - Ruddy Shelduck *Tadorna ferruginea*, 2 vulnerable - Lesser Adjutant *Leptoptilos javanicus* and Sarus Crane *Antigone antigone* and 1 critically endangered - Spoon-billed Sandpiper *Calidris pygmaea*)[3]. This area is located at ~50 km from the project area.

[2] http://www.ramsar.org/wetland/myanmar
[3] http://www.birdlife.org/datazone/sitefactsheet.php?id=16306



47 Ayeyarwaddy Delta Partially protected A1 A4i,iii

Admin region Ayeyarwaddy **Coordinates** 16°10'N 95°14'E **Altitude** 0–5 m **Area** 1,100,000 ha

Habitats Artificial landscapes (terrestrial); Wetlands

Threatened species *Leptoptilos javanicus, Grus antigone, Eurynorhynchus pygmeus* **Congregatory waterbirds** *Tadorna ferruginea*

Figure 6-10: Myanmar Important Bird Areas (IBAs)

SOURCE: BIRDLIFE

6.3.3.6 *Indo-Burma Hotspot*

The Indo-Burma Hotspot is a biodiversity hotspot which comprises all non-marine parts of Cambodia, Lao PDR, Myanmar, Thailand and Vietnam, plus parts of southern China. With its high levels of plant and animal endemism, and limited remaining natural habitat, Indo-Burma ranks among the top 10 biodiversity hotspots for irreplaceability and the top five for threat. Indo-Burma holds more people than any other hotspot, and its remaining natural ecosystems, already greatly reduced in extent, are subject to intense and growing pressure from habitat loss, degradation and fragmentation, and over-exploitation of natural resources (CEPF, October 2012).

6.4 SOCIO-ECONOMIC ENVIRONMENT

As shown on Figure 6-1Figure 6-13, the project area is located 35 km from the coastal mainland, close to the Ayeyarwady region; in an offshore zone, with typical water depths of around 100 m, but which actually range from the 0-10 (Preparis island and a few shallow bottoms) down to over 2000 m (Western edge of the blocks). The project is not expected to have significant interactions with the on-shore human environment in Myanmar, apart from offshore marine activities such as fishing and goods transportation. Likelihoods that coastal human activities (small-scale fishing, aquaculture or tourism) are impacted by the project are limited, except in case of accidents or emergencies.

Therefore, emphasis is made here on marine economic activities (for example, commercial sea navigation and fishing) and of the socio-economic conditions of coastal communities living in the Ayeyarwady region, which is the closest to the project area.

6.4.1 Administrative Organization

The Union of Myanmar is administratively divided into seven states, seven regions (called divisions prior to 2010), six self-administered zones and one self-administered division. These administrations are each headed by a Chief Minister, appointed by the President of the Union and chosen among the region and state Hluttaws (regional parliaments made up of elected civilian and representatives of the armed forces). The Chief Minister is assisted in his missions by a cabinet of ministers that he appoints himself, and that is responsible for various sectorial policies at the regional level (such as forestry and mines, agriculture and livestock, etc.).

States and regions are sub-divided into 67 districts and 325 townships, further divided into wards and village tracts (groups of villages). Districts and townships are headed by administrators appointed by the government and coming from the General Administration Department (GAD) of the Ministry of Home Affairs. Village tract administrators, who used to be centrally-appointed, are now directly elected by citizens since the Ward and Village Tract Administration Law has been passed in 2012.

6.4.2 Study area

Ayeyarwady region is composed of five districts: Hinthada, Maubin and Myaungmya which don't have a connection to the Andaman Sea, and Pathein, Labutta and Pyapon which are bordered by it. The region is further subdivided into 26 townships and 29 cities, 219 wards, 1,912 village groups and 11,651 villages. Pathein is the state capital, where all the major government institutions are based.

The project area is located offshore three coastal districts and five townships that are presented in the figure below (Figure 6-11).

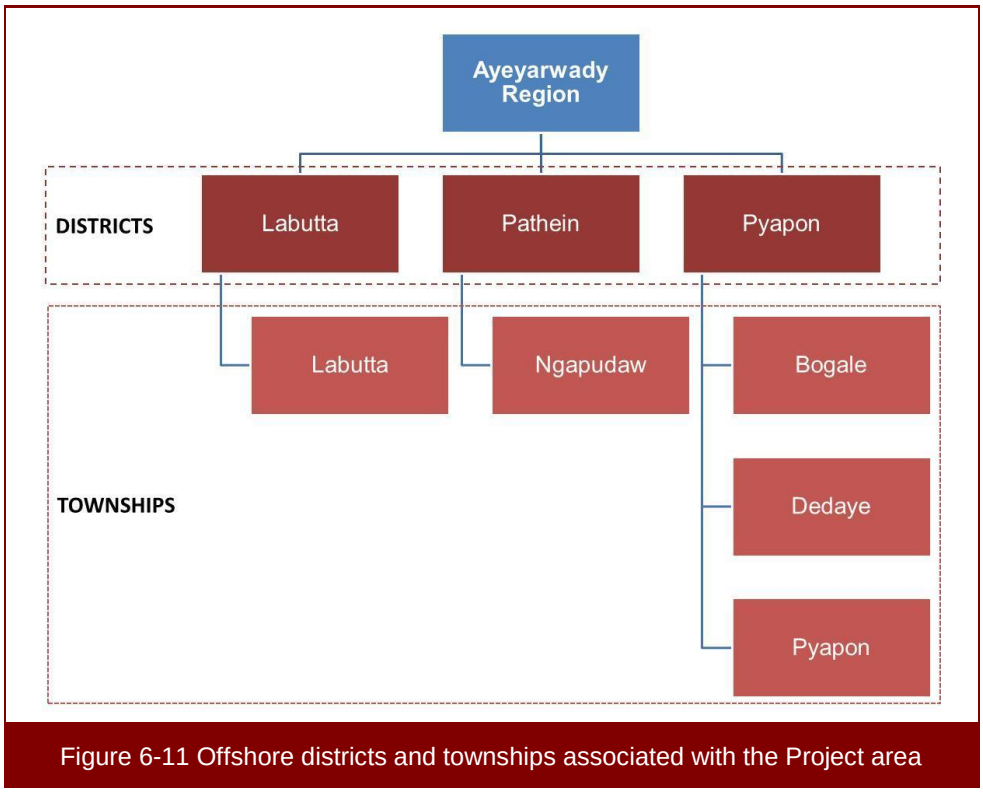


Figure 6-11 Offshore districts and townships associated with the Project area

Figure 6-12below shows the main towns including Bogale, Dedaye, Labutta, Pathein, Pyapon located inside the Delta area; small towns (Ahmar, Pyinsalu, Hainggikyun) and village-tracts border the coast.

6.4.3 Governance

According to the new Constitution of 2008, and the changes to the country administrative and electoral systems, the public policies set up by the government moves towards good governance, public services delivery and citizen participation through decentralization reforms and the delegation of resources and responsibilities to the local governance systems (state, region, township and village administrations)[4]. The government indeed passed several policies in order to devolve fiscal, political and administrative power to these administrations: in 2012, it revised the Village Tract Administration Law, which increased local democracy through the direct election of the village tract administrator by the village inhabitants; on the same year, it introduced the Framework on Economic and Social Reform (FESR), which underlines the development of laws and regulations to organize the decentralization process[5].

In Ayeyarwady region, the most important stakeholder in the public authority is the Chief Minister who was appointed by the central government in 2011. He is followed in importance by the districts and townships administrators. At the village tract level, authority is shared between administrators, directly elected by villagers, and informal leaders usually represented by elders. Village collective organizations, such as community-based associations or cooperatives, remain limited despite the on-going decentralization process[6]. However, traditional forms of social cohesion have been reported to prevail in the Ayeyarwady Delta villages. Local communities have strong capacities for collective problem-solving and decision-making, and are able to collaborate with each other to achieve village development goals. Mutual aid and

[4] NIXON Hamish *et al.*, *State and Region Government in Myanmar*, September 2013, 96 p.

[5] Asia Foundation, *State and Region Government in Myanmar*, September 2013

[6] SHIGETOMI Shinichi, OKAMOTO Ikuko, *Local Societies and Rural Development, Self-organization and Participatory Development in Asia*, Institute of Developing Economies, JETRO 2014

reciprocity between members of a community encountering economic or social difficulties prevail and act as safety nets in a region where state support remains low and where no public social security systems that would support disadvantaged people exists yet[7].

6.4.4 Population and Demography

6.4.4.1 Demography

The Ministry of Immigration and Population conducted Myanmar's population last census in March and April 2014 (for the first time in 30 years[8]); results are expected in May 2015. Published provisional results[9] show that the country total population is composed of 51.4 million people[10], with an annual population growth rate of 1% as of 2012. Household composition ranges from 4.1 to 5.1 members in the different states of the Union, with an average of 4.4 household members.

Ayeyarwady region is the second most populated region in the country after Yangon, and contains 6,175,123 inhabitants representing 12% of the national population[11]. Its inhabitants mostly live in a rural environment (85%) and inhabits dry thatch roofed houses. The population density is one of the highest of the country, with 176 inhabitants per km² (just below Yangon at 723 and Mandalay at 206). Pathein district contains 26% of the region population, while Labutta is the lowest populated district with 10% of the regional population.

The main population figures for the districts and townships closest to the project area are presented in Figure 6-12 below. The figures in blue represent the district population, while the red figures represent the townships population.

[7] Tripartite Core Group, *Post Nargis Joint Assessment*, July 2008

[8] The last census was conducted in 1983.

[9] Department of Population, Ministry of Immigration and Population, *Population and Housing Census of Myanmar, 2014, Provisional Results, Census Report Volume I*, August 2014

[10] This figure encompasses the 1,206,353 persons estimated not to have been counted in the census in parts of the states of Rakhine, Kachin and Kayin for various reasons.

[11] These figures include the 1,090,000 persons not counted during the 2014 national census.

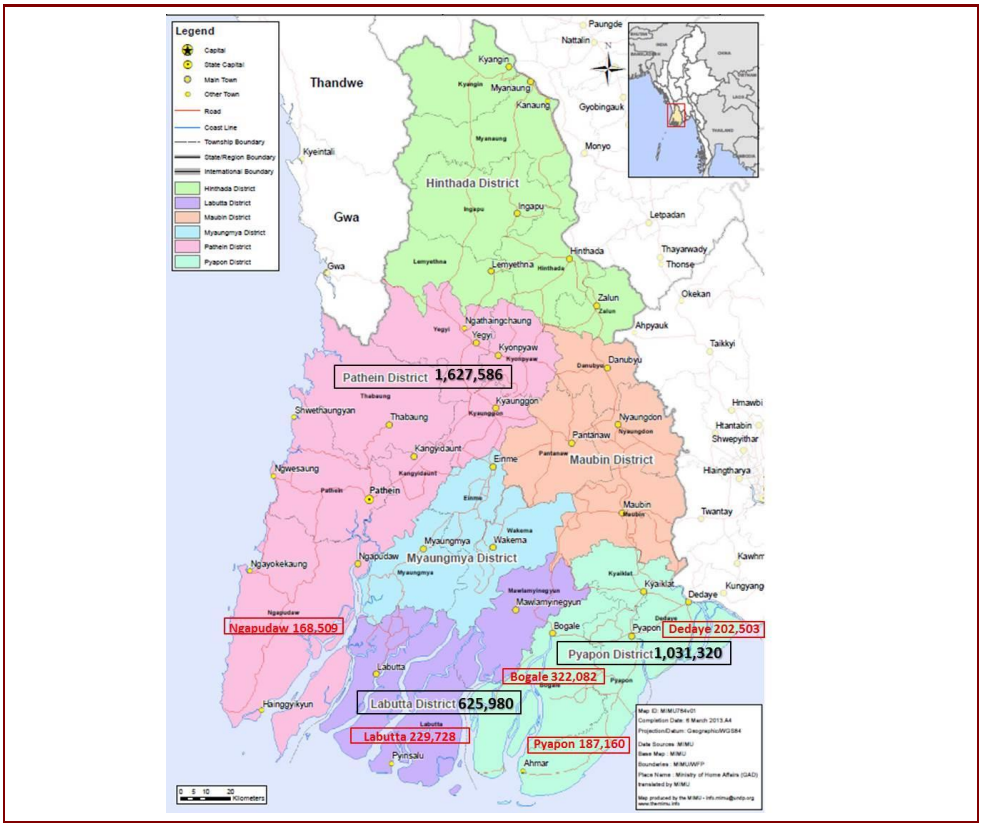


Figure 6-12 Population figures in the townships and districts close to the 3D seismic campaign area

(Source: Myanmar Information Myanmar Unit (MIMU))

6.4.4.2 *Ethnicity and Religion*

Myanmar is an ethnically diverse nation with 135 distinct ethnic groups officially recognized by the government, each having a particular history, culture and language.

The Bamar (also called Burman) are the dominant ethnic group in the country. They are 29 million people (representing 69% of the population according to the 1983 census) and inhabit mostly the central and upper plains of the country.

They are the most important ethnic group in Ayeyarwady region. Karen people also inhabit the region (they live in the central part of the Delta) as well as Rakhine people who live along the West coast. Small numbers of Buddhist Mon and Indian Muslims also live in the Ayeyarwady. Historically these ethnic groups have lived together peacefully, and while some villages are ethnically segregated, others are a mix of several ethnic groups.

6.4.5 Human Development and Access to Basic Services

Myanmar indicators on human development and access to basic social services have improved over the last years, but remain low according to international standards. The country Human Development Index of 0.524 ranks it 150 out of 187 countries (2013), and is below the regional average of 0.703. 25.6% of its population lives below the national poverty line and has limited access to health, education, energy, water, or transportation infrastructures. Myanmar also manages growing inequalities among states/regions, and

between urban and rural areas that are differently underserved in basic services and have therefore different levels of human development.

The current situation in Ayeyarwady mirrors these increasing inequalities. While the region is one of the most populated in the country, it has a poverty rate higher than the national average, with 32% of the population living below the poverty line. This makes Ayeyarwady the 4th poorest region of the country.

These high poverty levels can be partly attributed to the high exposure of the Delta to natural disasters, in particular cyclones, tsunamis and floods. Indeed, due to its geomorphological conditions, especially its low land elevation (on average 0 to 5 meters above sea level), the region and its inhabitants are very vulnerable to sea-related catastrophes that can destroy houses, crops and agricultural or fishing equipment.

6.4.5.1 Effects of Cyclone Nargis on Human Development in the Delta

The Nargis Cyclone that hit Ayeyarwady and other parts regions of the country on May 2008 was the most devastating natural disaster in the country's history. It largely contributed to impoverish the Delta inhabitants and damaged their living conditions. The cyclone caused numerous fatalities and extensive damages to private properties, houses, crops, production equipment such as agricultural tools and fishing boats, as well as rural sources of livelihood. It also destroyed public infrastructures such as schools, health centres, roads and electricity and water networks. Six years after, although state programs and numerous interventions from national and international NGOs were implemented in the region to help rebuild infrastructure and assist people in recovering their sources of livelihoods, the living conditions of the Delta inhabitants remain affected by the cyclone as recovery has not yet been fully achieved.

6.4.5.2 Health and Education

There have been recent improvements in access to healthcare in the country since its opening to international health organizations and NGOs. For instance, 81% of the population now lives within walking distance of a hospital or a health centre. Besides, health expenditures by the Ministry of Health have more than doubled between 2007 and 2012.

However, recent health indicators are still low. Life expectancy reaches 65.7 in 2012, far below regional neighbours, and Myanmar has the highest crude mortality rate of all Asia-Pacific countries (9 per 1,000 people). Maternal and child health are a major issue, along with HIV/AIDS, malaria and tuberculosis, which causes substantial mortality and morbidity. In 2012, HIV/AIDS prevalence rate represented 0.6% of the population. Malaria incidence was measured at 2,743 cases for 100,000 people, while tuberculosis prevalence was estimated to 489 cases for 100,000 people[12].

On-going health issues in Myanmar are the major consequence of past low government expenditures on health sector (2% of the Gross Domestic Product), low availability of medical care professionals and the poor condition or absence of health facilities.

In Ayeyarwady, latest health indicators in terms of nutrition, maternal and child health or immunization coverage and HIV/AIDS do not reflect anymore the negative consequences of Nargis cyclone. Although damages to health facilities, loss of health personnel and overcrowded, unsanitary camps for Internally-Displaced People caused a surge in communicable diseases and a deterioration of health conditions of people affected by the cyclone, numerous intervention from national and international health partners enabled to progressively restore the health system in the region. A 2010 UNDP survey showed that Ayeyarwady health indicators were better than in the least served states such as Rakhine or Chin, and close to and sometimes above national average. Thus, 85.7% of the population in Ayeyarwady region has access to healthcare, above national average.

Government investment in primary education is more important than in the health sector, a fact demonstrated by good indicators in terms of literacy rate (90% of adults are literate) and net primary school

[12] World Health Organization, *Myanmar Health Profile 2012*

enrolment (88%). However, net secondary school enrolment is low compared to other regional neighbours (53% of the children attend secondary school, against 79% in Thailand and 76% in Indonesia)[13].

In Ayeyarwady region, the literacy rate is higher than the national average with 94.7% of the population. Access to education indicators are close to national average, with 87.5% of children enrolled in primary school, and 51% completing this level (against 54% at national level)[14].

6.4.5.3 Water, Sanitation and Energy

Myanmar has abundant freshwater resources, and access to water is good at the national level with 69.4% of the population having access to drinkable water source in 2010. Though there is varying access to water between urban and rural populations, (81.4% against 65.2%), strong regional discrepancies are observed. In Ayeyarwady, access to drinking water is problematic with 44.6% of the population without freshwater access, the lowest figure in the country. The use of improved sanitation is better, with 82.4% of the regional population having access to it, above the national average.

Access to connected electricity in Myanmar stands at around 48.8% in 2010, though there are significant variations among the states. Ayeyarwady is among the least connected; 29.7% of the population. Most of the households therefore rely on other sources of energy for lighting and cooking.

6.4.5.4 Human Development Activities in Ayeyarwady region

Six years after Cyclone Nargis, international humanitarian assistance in the form of direct relief and reconstruction activities has ended in the region. NGOs now focus on traditional development work with 19,290 projects in Ayeyarwady registered as of November 2014 by the Myanmar Information Management Unit (MIMU) an organization that gathers and regularly updates all the data on national and international NGOs action in the country. NGOs such as Mercy Corps, MERLIN, World Vision, Action Aid, Médecins du Monde mainly work on health, support to agricultural and non-agricultural livelihoods, education and disaster risk reduction.

6.4.6 Economic Activities in the Ayeyarwady Region

Agriculture and fisheries are the two main economic activities in the Ayeyarwady Delta, due to the combination of fertile soils and a large and rich riverine ecosystem. Prior to Cyclone Nargis, 50 to 60 % of the population was engaged in agricultural activities, mostly dedicated to rice crop cultivation. The rest was engaged either in the fishery sector, or as agricultural workers, with a smaller proportion of traders and businesses. Aquaculture, cattle breeding and salt production are other economic activities. Although Cyclone Nargis impacted agriculture and fishing activities directly, destroying tools and equipment, most of the people in the Delta have now restored their sources of livelihoods six years after. However, the lack of tools and equipment, poor farming or fishing techniques and low quality inputs are still important constraint to the improvement of agricultural and fishery productivity in the Delta[15].

Since the project is located in the offshore area, the economic activities likely to be affected are limited to fishing, commercial shipping and oil and gas exploration and production. The analysis provided below therefore focuses on these three sectors.

6.4.6.1 Fisheries Sector

Myanmar has a coastline of 2,280 km, a marine area of 486,000 km^2, and an inland water area totalling 124,280 km^2. The potential for development of both inland and marine fisheries is therefore substantial.

[13] UNICEF statistics on Myanmar
[14] UNICEF, *A Snapshot of Child Well-being in Ayeyarwady Region*, 2013
[15] Driel, W.F. van & T. A. Nauta, *Vulnerability and Resilience Assessment of the Ayeyarwady Delta in Myanmar, Scoping phase*, Bay of Bengal Large Marine Ecosystem (BOBLME) Project, Global Water Partnership (GWP) and Delta Alliance, Delft-Wageningen, The Netherlands, 2013

This sector already represents the fourth most important export earning sector and generates along with livestock 9.9% of the GDP[16]. It employs almost 8 million people, a third of them active fishermen[17], which represents 15% of the total country population. Moreover, as in many Asian countries, fish and other products are important for the Myanmar diet. In 2002, per capita consumption of fish amounted to 21kg/year and constituted 60 to 70% of the total protein intake for the population[18].

The Ayeyarwady region has an important coastline and an extensive riverine network. Fisheries are therefore a vital economic activity, the second most important after agriculture. This sector is divided between freshwater (aquaculture, open fisheries, leasable resources) and marine fisheries. An overview of the fishery sector at the national level is provided in the next sections, followed by a focus on marine fishery in the Ayeyarwady region.

Laws, Regulations and Implementing Agencies

Six laws are the basis for inland and marine fishery organization, management and control by the different government agencies in charge of this sector. They are listed below:

- Law Relating to the Fishing Rights of Foreign Fishing Vessels – 1989;
- Law relating to Aquaculture – 1989;
- Myanmar Marine Fisheries Law – 1990;
- Freshwater Fisheries Law – 1991;
- Law Amending the Myanmar Marine Fisheries Law – 1993; and
- Law Amending the Law Relating to the Fishing Rights of Foreign Fishing Vessels – 1993.

The Myanmar fisheries sector is managed by the Ministry of Livestock, Fisheries and Rural Development, and more particularly by the Department of Fisheries (DoF), which takes care of both inland and marine fisheries. The main mission of the DoF is to develop and implement sectorial policies aiming at promoting sustainable fishing practices and ensuring the preservation of marine resources. The DoF develops conservation efforts, promotes research and surveys on the current condition of marine resources in partnership with intergovernmental agencies, maintains statistics on fisheries, and supervises the fishery sector through delivery of licenses to national fishing vessels.

Marine Fisheries

Marine fisheries are organized under the Marine Fisheries Law, which classifies this sector into the inshore and offshore categories. Their main characteristics are detailed below:

- **Inshore (or coastal) fishery**: covers an area up to 10 nautical miles from the shore on the Ayeyarwady coadt. Boats entering this category should not be equipped with engine having more than 12 horsepower and length of the boat is limited to 30 feet.
- **Offshore fishery**: covers the outer area of the inshore fishery zone up to the EEZ border. Boats should have more than 12 horsepower engine, and can use bottom trawl, purse seine, surrounding nets, drift nets and long lines19.

On this map, the inshore fishery zone is represented in deep blue and borders the coast, while the offshore zone spans from the inshore borders up to the EEZ borders, at water depths varying from 0 to over 200 meters. For licensing purposes, the Department of Fisheries divided the offshore zone into 140 fishing grounds of 30X30 nautical miles block, using latitude and longitude lines. It also designated four fishing areas, namely Rakhine (40 blocks), Ayeyarwady (44 blocks), Mon (14 blocks) and Taninthary (52 blocks).

[16] According to the Institute of Marine Research figures, available at [http://www.imr.no/forskning/utviklingssamarbeid/surveys/myanmar_2013/en]
[17] Bay of Bengal Large Marine Ecosystem – BOBLME
[18] Pe Myint, *National Report of Myanmar on the Sustainable Management of The Bay of Bengal Large Marine Ecosystem*, BOBLME, GCP/RAS/179/WBG, 2004
[19] FAO, *The State of World Fisheries and Aquaculture, Opportunities and Challenges*, 2014

As seen on this map, the project area is located in the Ayeyarwady offshore fishing zone, in water depths of ~114 m.

Marine Fishery License System

The national fishing license system is divided into two categories based on the fishing zones:

- **Inshore fishery zone license:** the General Administration Department (GAD) is in charge of inshore fishing boats' inspection. The Department of Fisheries proceeds with the issuance of fishing licenses upon recommendation of the GAD.
- **Offshore fishery zone license:** the Department of Marine Administration (DMA) takes care of inspection and registration of the offshore fishing boats. Fishing licenses are delivered by the DoF only when the DMA has issued its approval.

The Myanmar Fisheries Law encourages foreign fishing activity with the granting of fishing rights to foreign companies, but limits their activity to the EEZ and forbids it in the territorial sea.

In April 2014, the Government of Myanmar suspended the granting of fishing rights and licensing for foreign vessels until further notice. This ban is justified by alleged fish resources depletion, due to overfishing and the use of destructive fishing gears by foreign companies whose activity has intensified over the last five years. It was welcomed by national fishing associations, as it was expected for a long time[20].

Illegal, Unreported and Unregulated Fishing

Myanmar law is repressive against illegal, unreported and unregulated fishing. It bans all fishing gears that are destructive to the environment and fisheries resources, including pair trawl, electric fishing, fishing using poisons, chemicals, explosives, purse seine net less than 3,5 inches mesh size and trawl net cod-end mesh size less than 2 inches[21]. Trawl use is also forbidden in the inshore fishery zone. Several institutions are involved in fighting illegal fishing under the coordination of the Myanmar Navy: the Coast guards, the Department of Fisheries, the Myanmar Customs Department and the Myanmar Police Force.

Despite these measures, illegal fishing is commonly practiced in Myanmar waters, especially by neighbouring Thai vessels in the Andaman Sea.

Marine resources: Surveys and Estimates

Myanmar fishery institutions do not have recent and reliable data on the extent of their marine resources stocks and the current size and composition of marine catches. They rely on past surveys to draw estimations on fish stocks, and these surveys often make different estimations: according to the Institute of Marine Research (a Norwegian research institution), fish stocks range between 1.3 and 1.8 million metric ton (mmt): 1 mmt for pelagic fish, and 0.8mmt for demersal fish, respectively. But for the government of Myanmar, the potential maximum sustainable yield (MSY) of Myanmar waters is about 1.05 mmt per year (0.5 mmt of pelagic fish and 0.55 mmt of demersal fish)[22].

The fishery policy is therefore build on inadequate data on marine resources, which often prompts declarations by various stakeholders on drastic depletion of stocks and overfishing both for the offshore and inshore fisheries.

Under the management of the Department of Fisheries, a large marine ecosystem survey was recently conducted in the frame of the EAF-Nansen project and the BOBLME[23]. This survey is expected to produce comprehensive and reliable data on marine ecosystems and resources, and will enable Myanmar fisheries

[20] The Irrawady, *Burma Bans Foreign Fishing Boats From Its Waters*, April 3, 2014

[21] *KYA Kyaw, Dr., SEAFDEC, Countries profile of Myanmar Addressing the IUU Fishing in the Southeast Asian Region, 2010*

[22] *Tony J Pitcher, An Estimation of Compliance of the Fisheries of Myanmar with Article 7 (Fisheries Management) of the UN Code of Conduct for Responsible Fishing, 2007*

[23] *The EAF-Nansen project, launched in 2006, is a multi-stakeholder project funded by the Norwegian Agency for Development Cooperation and managed by the FAO in partnership with the Institute of Marine Research (IMR). Its objective is to strengthen the knowledge base on fisheries and implement an ecosystem approach to marine fisheries in developing countries. The project conducts activities in the Bay of Bengal and in Myanmar, among other countries. More information at: [http://www.eaf-nansen.org/nansen/organization/17910/en]*

institutions to draft a sustainable fisheries policy preserving marine resources while allowing for the commercial fishery sector to prosper.

Main Characteristics of the Marine Fishery Sector

Fishing Grounds

Several commercially important species were identified during previous surveys as having a high potential for the offshore fisheries development. These species are mainly pelagic fishes, such as swordfish (*xiphias gladius*), deep-sea lobster and deep-sea shrimp, yellow fin tuna (*thunnus albacares*), striped marlin (*tetrapturus audax*) and sailfish (*istiophorus platypus*)[24].

Fishing fleets and techniques

The latest estimates on the country total fishing fleet set the number of vessels at around 30,800 in 2011, among which half of it are non-motorized boats, and 1,600 trawlers[25].

Myanmar fishery sector is mostly developed in the artisanal, small-scale inshore fishery zone, with 27,751 inshore fishing vessels registered by the DoF in 2012, a decrease compared to the 29,371 vessels the previous year. Among these, 55% are powered vessels, and the rest are non-motorized boats. They usually operate close to the coast, in waters less than 50m depth, due to a lack of technology, suitable fishing gears and equipment to process fisheries resources information (such as GPS or satellite devices).

The offshore fishery zone is the domain of large companies, national and international, and of fishermen having the capital to buy equipment with the capacity to fish in high water depth. Around 2,450 national vessels were engaged in offshore fisheries in 2012. Additionally, 132 foreign vessels were reported having licenses to conduct offshore fishery before the ban[26].

Thailand is an important actor of the foreign fishery sector in the country, with several Thai companies having fishing rights. Other companies from countries like Singapore, Japan, China or South Korea also participate in Myanmar fisheries.

Fleets operating offshore (encompassing foreign fishing vessels) mainly use active fishing gears, with trawling, driftnet and purse seine being the most commonly used. Static fishing techniques, fish traps or stow nets, are also used but less commonly in the offshore fishery zone.

Fish Catches and Exports

Myanmar is an important contributor to the regional fishery sector along with India. In terms of volume, total catches for all sectors (aquaculture, inland and marine capture fisheries) amounted to 4,464,419 tonnes in 2012. Among these, inland waters fisheries accounted for 1,246,460 tonnes and aquaculture for 0,885 tonnes.

The marine capture fisheries represented half of the total production, with 2,332,790 tonnes of catches in 2012, an increase of 7.5% from the previous year, and from 121% between 2003 and 2012. However, this figure is underestimated as it doesn't take into account the production loss caused by illegal fishing, and by the landing of catches to foreign ports. Indeed, for fishing performed by foreign vessels, landing sites are usually not located in Myanmar but, according to the size of catches, to Phuket in Thailand, Penang in Malaysia or even in Japan. Foreign fleets have the modern equipment and powerful engines enabling them to easily transport their catch to international ports in a short time. These catches are therefore not reported in the country statistics. Furthermore, the general composition of the marine catches landed in the country is also not known precisely[27]. This lack of data prevents the country to identify overfishing by species, and therefore to adopt a sustainable fishery policy.

[24] *Julius Kyaw, Department of Fisheries, Present Status of Off-shore Fishery Resources and Information on Tuna Fishery in Myanmar, Special Meeting on Improvement of Tuna Information and Data Collection in the Southeast Asia7-9 September, 2011. Songkhla Province, Thailand.*

[25] Bay of Bengal Large Marine Ecosystem Project (BOBLME), *Transboundary Diagnostic Analaysis vol. 2*, 2012.

[26] According to the Institute of Marine Research figures, available at: [http://www.imr.no/forskning/utviklingssamarbeid/surveys/myanmar_2013/en].

Main landing sites and wholesale fish markets are around Yangon, at Pazuntaung Nyaungdan and Annawa, with a fish market at San Pya in Alone township. Other major landing sites are found along the coast, at Thandwe, Mawlamyine, Myeik and Kawthoung cities.

The best quality catches are exported to neighbouring countries. Global marine products exports in 2013 amounted to 376,845 tons, generating revenues of USD 650 million. Excluding shrimps, fish products represented 70% of these exports (266,464 tons), and USD 380 million of revenues. During 2014 fiscal year, a decrease in fishery export was observed with only USD 550 million of revenues against the target set by the Myanmar government for marine products exports of USD 700 million.

For low quality catches, they are processed in Myanmar in the form of fish paste or fish meal for the chicken industry, or used fresh or chilled for direct consumption, with some fish being frozen or cured.

Marine Fishery in Ayeyarwady region

The geomorphology of the Ayeyarwady Delta coastal front is characterized by a very flat land, low water depths (5 meters on average going up to 28 kilometres from the coastline) and shallow and brackish waters where fishing activities are performed targeting coastal and offshore marine areas. The active fishing technique mainly used in the area is the drift net, with 401 boats using this type of gear registered by the Department of Fisheries in 2013. No other types of fishing vessels were registered by the DoF as operating in the area.

However, TEPM's fishery monitoring system for M05-M06 Block indicates that other techniques are used in the area, such as purse seine net vessels, squid fishing vessels and trawlers. Passive fishing gears have been located as well, mainly fixed fishing nets marked by buoys at the surface, bamboo sticks with nets and fishtrap vessels installing static fish traps. Ports of origin of the fishermen operating at M5-M6 block are in Haing Gyi Island, Bogale, Pyapon and Yangon.

Interactions between the Fishery Sector and the Project

The Project area is located in the offshore fishery zone of the Ayeyarwady region. It is relatively close to the shoreline and at water depths of 114 m. Given these parameters, there is a probability that large, industrial fishing fleets legally operate targeting mainly pelagic fish (a probability confirmed by Total E&P Myanmar through its monitoring of fishing activities in M5-M6 in the frame of the Yadana project). It is also possible to find foreign fishing fleet (mostly Thai) operating illegally since the recent ban forbids legal foreign fishing. Besides, small-scale fishermen that occasionally venture far away from the coast could be encountered, although this likelihood is much more limited.

6.4.6.2 Marine Traffic

The project area is not located on any major international or regional shipping lane. Marine traffic density offshore Ayeyarwady is limited to boats navigating between the Port of Yangon and a regional shipping lane connecting Bangladesh to Thailand.

6.4.6.3 Port Infrastructure

Port infrastructures in the Ayeyarwady Region are limited to the inland port of Pathein, which borders a tributary of the Ayeyarwady River. This port, although remote from the coast, is the second most important port of the Delta area after the port of Yangon. It is equipped with 10 jetties but its capacity to welcome large ships such as cargoes or other commercial vessels is limited by a water depth of 4.5 meter. This port is therefore not frequently used by regional or international vessels.

The most important port close to the project area is Yangon Port, the first international port of Myanmar. It has an annual traffic of more than 2,000 vessels and 600,000 tons of goods transited there in 2013[28]. Following the fast pace of economic development in the country, marine traffic has increased over the last years, causing regular congestion at the port. This trend is likely to continue in the future if additional infrastructures are not developed.

[28] Interview with the Myanmar Port Authority.

Yangon Port is placed under the management of the Myanmar Port Authority. This division of the Ministry of Transport also controls eight major ports along the coast (four on the west coast and four on the south-east coast). These ports receive international ships, but still have inadequate infrastructures and lack mechanised facilities that could increase their capacities. Consequently, Myanmar's government actively supports private companies who wish to invest in the development of new port infrastructure. One project in particular is underway 25km south of Yangon: the Myanmar International Terminals Thilawa (MITT). This is a deep sea multi-purpose container port complementing the infrastructures of the Port of Yangon. It is operated by a private foreign company, Hutchison Port Holdings. Construction works will start in June 2015 according to the Myanmar Port Authority.

6.4.6.4 Offshore Oil and Gas Operations

Myanmar offshore oil and gas resources represent an important potential of growth for the country's economy, attracting interest from the national and international oil and gas industry. In 2012, 34% of the Foreign Direct Investments in the country were directed at oil and gas exploration and production[29].

In a move to boost this sector, the Ministry of Energy recently concluded the "Myanmar Offshore Blocks Bidding Round 2013", awarding 20 offshore blocks to international companies[30]. Ten deep-water blocks and ten shallow-water blocks located in the Andaman Sea and the Bay of Bengal were attributed to oil majors and independent companies, such as Statoil, Eni, Shell, Total, ConocoPhillips, BG Group, and Woodside Energy.

Apart from M5 Block already operated by Total, two blocks neighbouring M06 (M3 and M9) were attributed before this bidding round and are operated by the Thai company Petroleum Authority of Thailand Exploration and Production (PTTEP). Two other blocks were attributed during the 2013 bidding round: M4 to Oil India Limited, and M7 to ROC Oil Company Limited.

6.4.7 Stakeholder Identification

Due to the fast pace of economic development in Myanmar, the use of marine space by multiple users will increase rapidly, along with pressures on the marine ecosystems and on the individuals and companies that benefit from its resources or are engaged in its protection.

Besides oil and gas operators, other users having interests in the marine spaces of Myanmar have therefore to be identified in the context of this Project, as they can either influence it or be impacted by it. These stakeholders are listed below, covering public authorities, private sector, and intergovernmental and non-governmental organizations involved in the regulation, use or protection of Myanmar marine areas and their ecosystems.

A comprehensive identification of stakeholders will allow to build an efficient stakeholder engagement plan. This plan will determine the appropriate audience for the public consultations, whose objectives are to gather stakeholders' perception on the project's impacts identified and the mitigation measures prepared in this report.

6.4.7.1 Ministries

Ministry of Energy (MoE): MoE is in charge of developing the oil and gas resources in the country. It provides offshore and onshore blocks through bidding rounds to national and international companies for the purpose of exploration and/or exploitation.

Ministry of Environment Conservation and Forestry (MOECAF): MOECAF is in charge of developing the country environmental policy, in particular in the fields of water and marine resources conservation. It is also responsible for introducing a new environmental permitting system, which is in process of creation.

[29] John Buchanan, Tom Kramer, Kevin Woods, *Developing Disparity - Regional Investment in Burma's Borderlands*, Transnational Institute (TNI), Burma Center Netherlands (BCN), Amsterdam, February 2013

[30] Offshore Energy Today, *Myanmar awards new offshore blocks*, March 26, 2014.

Ministry of Livestock, Fisheries and Rural Development (MLFRD): MLFRD is in charge of developing, implementing and monitoring the country policies in the field of livestock, fishery and rural development, to ensure food security is achieved in the country, and prevent infectious diseases development that could endanger the national production.

- Department of Fisheries (DoF): Under the MLFRD, the DoF main mission is to guarantee the preservation of fish resources in order to ensure the sustainability of the fishery sector. The DoF develops conservation efforts, promotes research and surveys on the current condition of marine resources in partnership with intergovernmental agencies, maintains statistics on fisheries, and supervises the fishery sector through the delivery of licenses to fishing vessels.
- DoF has regional offices at the township level: these offices are responsible to handle the licensing system and taxes collection at the local level.

Ministry of Transport (MoT): MoT is responsible for the organization of the country's transport infrastructures, from air to marine transportation.

- Department of Marine Administration (DMA): DMA is placed under the management of the Ministry of Transport. It is responsible for the marine traffic safety (conformity of ships to national safety standards, improvement of rescue operations at sea) and human resources development in the maritime sector. It is in charge of the offshore fishing vessels inspection to determine if they meet safety standards, prior to the delivery of fishing licenses by the DoF.
- Myanmar Port Authority (MPA): MPA is a government agency under the Ministry of Transport, founded in 1989 and located in Yangon. It is responsible for the regulation and administration of 8 coastal ports. It is also in charge of developing and improving the port infrastructures, notably through the development of Special Economic Zones and their associated ports.

Myanmar Navy: Naval branch of the armed forces of Myanmar with 19,000 staff. The Myanmar Navy currently operates more than 122 vessels, and increased its activities over the last years to improve defence of its territorial waters in particular against illegal fishing. The Navy is also responsible for securing Myanmar waters from illegal fishing activities and human trafficking, which they do through patrolling.

6.4.7.2 Universities and Research Institutes

University of Mawlamyine (Mon State): it is one of the few universities in the country to offer a specialized degree in marine science, from Bachelor, Master to PhDs. It also has a Marine Science Laboratory in the coastal town of Setse, about 60km south of Mawlamyine city. A total of 900 students are registered across the various classes available.

Institute of Fisheries Technology: Public institution established in Yangon in 1983 under the management of the Department of Fisheries. It provides training to fishermen on fishing techniques, fishing gears and fish processing, among others. Training courses can vary, from basic fishing technology to fish processing supervision.

6.4.7.3 Public Enterprises

Myanmar Oil and Gas Enterprise (MOGE): MOGE is Myanmar oil and gas state-owned enterprise. Established in 1983, it is an operator in oil and gas exploration and production as well as domestic gas transport through pipeline networks. It is also partner of joint-ventures with foreign oil and gas companies such as Total, Chevron, etc.

6.4.7.4 Regional Authorities

The Chief Minister, district and township administrators represent the highest levels of authority in the region of Ayeyarwady.

6.4.7.5 *Business Associations*

Union of Myanmar Federation of Chambers of Commerce and Industry (UMFCCI): UMFCCI is the largest not-for-profit business federation of the country. Its functions include human resources development and training, commercial courses, management and accounting, providing trade information and participation in international trade fairs. Almost every economic sector has its own federation under the umbrella of the UMFCCI. This is the case for the fishing industry, represented by the MFF.

Myanmar Fishery Federation (MFF): Non-profit association founded in 1989 with the objective to encourage and promote fishing and fishery industries of Myanmar, through cooperation, training and knowledge sharing with other actors of the national fishery sector. The MFF counts 9 functional associations, and 13 regional fisheries associations under its umbrella. It has an important role in advocacy and opinion-making by regularly intervening in Myanmar media on issues of overfishing and depletion of the country marine resources.

Myanmar Marine Fisheries Association: Member of the MFF along with eight other associations.

Myanmar Fishery Products Processors and Exporters Association (MFPPEA): Professional association in charge of supporting and promoting the processing and exporting companies in Myanmar.

6.4.7.6 *Oil and Gas Companies*

Directly surrounding the project area, several companies were awarded interests in inshore and offshore blocks, and their operations have either not started, or are at the exploration or exploitation stage.

PTTEP: Thai oil and gas company, operator of two blocks bordering M6: M3 block (in exploration phase) and M9 block which with M11 makes up the Zawtika project, composed of three gas fields (Zawtika, Kakonna and Gawthaka) that started to produce in March 2014.

Oil India Limited: Indian oil and Gas Company.

ROC Oil Company Limited: Australian independent upstream oil and gas company operating in China, South East Asia and Australia.

6.4.7.7 *Intergovernmental Organizations*

Intergovernmental organizations involved in the protection of marine spaces and/or the promotion of sustainable fisheries at the Southeast Asia regional level are numerous. They are particularly active in Myanmar, where the fishery sector is threatened by marine resources depletion.

Asia Pacific Fishery Commission (APFIC): APFIC is a regional fishery body established by the FAO at the request of its members in 1948 during the organization of the Indo-Pacific Fisheries Council. Its Secretariat is provided and supported by the FAO. Its role is to promote full and proper utilization of living aquatic resources, by the development and management of fishing, processing and marketing activities. APFIC also aims at improving knowledge sharing, training and promotion of best practices in the fishery sector to encourage sustainable fisheries, in collaboration with other regional entities and the national fishery institutions of its members.

ASEAN Sectorial Working Group on Fisheries (ASWGFi): Under the leadership of the ASEAN, ASWGFi is a regional working group gathering fisheries specialists during regular consultative forums which address issues such as registration of fishing vessels, census of marine resources, etc. Overall, the working group objective is to provide inputs for the creation of a common sustainable regional fishery policy among the ASEAN countries.

South East Asian Fisheries Development Centre (SEAFDEC): SEAFDEC mission is to develop and manage the fisheries potential of the region, supporting the rational utilization of the resources through transfer of new technologies, research and information dissemination activities. SEAFDEC comprises 11 member countries: Brunei Darussalam, Cambodia, Indonesia, Japan, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam. Its central office is located in Thailand. The Marine

Fisheries Research Department and the Marine Fishery Resources Development and Management Department are the two bodies working on assessing Myanmar marine resources and estimating potential for development of the fishery sector. The organization has also concluded an agreement with the ASEAN leading to the creation of a Fisheries Consultative Group.

Bay of Bengal Large Marine Ecosystem Project (BOBLME): BOBLME is a regional project whose objectives are to develop a coordinated policy on the management and protection of marine resources and environment in the large ecosystem of the Bay of Bengal. Its overall goal is to improve livelihoods of coastal communities depending on the BOB resources. Funded by international donors (Global Environmental Facility, Norway, Swedish Internal Development Agency), the project is piloted by the FAO in cooperation with respective Marine and/or Fisheries Ministries in each member country (Maldives, India, Sri Lanka, Bangladesh, Myanmar, Thailand, Indonesia and Malaysia).

6.4.7.8 International Non-Governmental Organizations (INGOs)

The presence of international NGOs in the country has increased over the last 5 years due to the political opening which allows them to open branches and lead projects in various sectors, from community development projects aiming at reducing poverty to environment conservation initiatives targeting inland and marine ecosystems. These INGOs are listed below.

Fauna & Flora International (FFI): FFI works in Myanmar on various biodiversity and conservation projects. It currently leads a capacity-building program for marine conservation. Started in 2012, this program aims at identifying marine areas that should be protected, and support the management of already established protected areas. In partnership with **Biodiversity and Nature Conservation Association** (BANCA), a Myanmar national NGO, and the Forestry and Fisheries Departments, activities will consist in trainings on marine survey methods, community-based fisheries and marine protected areas establishment and management. One of the pilot areas for these activities is the Myeik archipelago off Thanintharyi State.

WWF: WWF has been very active in the greater Mekong region over the last decades, and has just recently opened an office in Myanmar. Its aim is to support Myanmar's development ambitions with a focus on spatial planning and biodiversity conservation in parallel with ecosystem services protection and sustainable livelihoods.

Wildlife Conservation Society: International organization based in the USA, it is involved in the conservation of species with more than 500 projects in 60 countries. It started to operate in Myanmar in 1993, becoming the first international conservation organization to initiate a long-term program in the country. Their activities range from biological surveys, wildlife species population monitoring, to aid in the establishment of protected areas.

Human Rights Watch: Human Rights Watch regularly conduct human rights assessments in oil and gas projects, focusing on the pipelines connecting the offshore fields and the receiving countries than on offshore oil and gas platforms.

6.4.7.9 National Non-Governmental Organizations (NGOs)

The economic strategy implemented by the government has succeeded in attracting international investors interests in various business sectors. Industrial developments are significant but increasingly threatening ecosystems. To face these new environmental challenges, several national NGOs have been created over the last years to preserve and protect the wide range of Myanmar natural ecosystems.

Myanmar Environmental Rehabilitation-conservation Network (MERN): MERN is a network of 20 local environmental NGOs created in 2009. It works for environmental rehabilitation and conservation activities in support of local communities, to help them improve their sources of livelihoods and food security.

Biodiversity and Nature Conservation Association (BANCA): BANCA is a national NGO registered since 2004 whose objectives are to support conservation of nature, biodiversity through advocacy, research, networking and capacity-building programs. It works with the FFI on a marine conservation

project. It also worked on projects focusing on inland ecosystems with other international NGOs such as Birdlife International, the Royal Society for the Protection of Birds, Care, Arcona Cambridge, etc.

Marine Science Association, Myanmar (MSAM): MSAM is a national NGO whose objectives are to take part in the sustainable development activities in Myanmar using its marine science expertise to conduct marine and coastal research, conservation and development, and to raise awareness on marine environment preservation.

Community Development Association (CDA): CDA is a registered non-profit, local non-government humanitarian organization established in Myanmar. Its mandates are to implement community developmental elementary interventions with effective involvement of existing support services and technical assistance. The Community Development Association has worked on various humanitarian assistance programs and has collaborated with Total E&P Myanmar.

Friends of Wildlife Myanmar: Run by a former forestry official and based in Yangon, Friends of Wildlife provides education and technical assistance to help local communities shift from slash-and-burn agriculture, hunting, and illegal logging to sustainable agriculture. It is also involved in sustainable fishery management promotion.

Burma Environmental Working Group (BEWG): BEWG gather Myanmar ethnic environmental and social organizations, providing a forum for member organizations to collaborate on research, reporting, advocacy campaigns, capacity-building initiatives and policy formulation.

*6.4.7.10 **Media***

Eleven Myanmar: Part of the Eleven Media Group funded in 2000, it has 5 weekly publications among which one is in English, and employs 250 staff. Number of published copies is 450,000 in 2012.

The Myanmar Times: This newspaper has two versions, one in Burmese and one in English. It employs more than 300 employees and has a circulation of around 25,000 copies.

The Irrawaddy Magazine: News magazine founded in 1992 by Burmese exiles living in Thailand. It is unaffiliated politically but supportive of democratic movements, and publishes news in English and in Burmese.

socio-economic conditions of coastal communities living in the four states where the ports are located (**Ayeyarwady, Yangon, Mon and Thanintharyi**) is also provided in the sections below. Bago State is not included in this study as no major port where fishermen could land their catch is located on its coast.

6.4.8 Coastal socio-economic environment

*6.4.8.1 **Administrative organization and sociodemographic characteristics***

Administrative organization and governance

The Union of Myanmar is administratively divided into 7 States and 7 Regions. Each of them is headed by a Chief Minister who is appointed by the President, chosen among the regional and state legislature representatives. These States and Regions are divided into 63 Districts and a total of 324 Townships, further divided into wards and village tracts.

Six states have connections to the sea. Rakhine State borders the Bay of Bengal, while Yangon, Bago, Mon and Thanintharyi States border the Andaman Sea. Ayeyarwady State shares border with the two marine spaces. Figure 6-13 shows the location of these states as well as the M5-M6 block. The closest state to the project location is **Ayeyarwady.**

Figure 6-13 Map of Myanmar States and Regions

Prior to 2008, the government system in Myanmar was highly centralized, with limited transfer of authority to subnational governance institutions. The central government held most of the powers and responsibilities and monopolized financial resources. It controlled the states and regions, integrated in the government structure, with the main consequence that regional and local authorities enjoyed limited roles and responsibilities.

In the frame of the new Constitution of 2008, and the renewal of the country administrative and election systems, the Government of Myanmar has expressed its will to improve good governance and public services delivery, in particular through the delegation of resources and responsibilities to local governance systems that are the States, regions and the Township administrations[31]. The United Nations Development Programme (UNDP) has partnered with the government to support these efforts: they initiated a local governance mapping that will be completed in November 2014 with the publication of reports on the "State of Local Governance" in each State that composes the Union of Myanmar. These reports will give an overview of the current local governance system in the states of Ayeyarwady, Yangon, Mon and Thanintharyi, enabling to identify important regional and local stakeholders that should be integrated in the stakeholder engagement plan.

However, until decentralization reforms are finally achieved, power is centralized at Nay Pyi Taw, and the main political and administrative authorities involved in the regulation of oil and gas activities and environment protection remain the government and its ministries.

Demography

The Ministry of Immigration and Population conducted the last Myanmar's population census in March April 2014 (for the first time in 30 years[32]), which results are expected to be released in May 2015.

Published preliminary results show that the country total population is composed of 51.4 million people, with an annual population growth rate of 1% as of 2012. Household composition ranges from 4.1 to 5.1 members in the different states of the Union, with an average of 4.4 household members.

Demographic data for each State of the study area are presented in Table 6-3. These data indicate that Yangon and Ayeyarwaddy are the most populated states, while Thanintharyi State is the lowest. Coastal states are mostly composed of people living in rural areas, except for Yangon where 70% of the population is urban.

Table 6-3 Demographic data of the states in the study area

Ayeyarwady	6,175,123	12%	85.9%
Yangon	7,355,075	14.3%	29.9%
Mon	2,050,282	4%	72.2%
Thanintharyi	1,406,434	2.7%	74%
Total	16,986,914	33%	NA

In several coastal towns, demographic data were available and are presented in the Table 6-4. Apart from Yangon and Pyapon, coastal towns are relatively small in size, with less than 300 000 inhabitants.

[31] Hamish Nixon *et al.*, *State and Region Govnerment in Myanmar*, September 2013, 96 p.
[32] The last census was conducted in 1983.

Table 6-4 Population at the coastal towns/ports in the study area

Pathein	286,684
Pyapon	1,031,320
Yangon	5,209,541
Mawlamyine	288,120
Dawei	125,239
Myeik	284,037
Kawthoung	116,722

Census estimates also show that the population density in Myanmar is 76 persons per square kilometer. In coastal states, the most densely populated state is Yangon, followed by Ayeyarwady, Mon and Thanintharyi, the least populated state of the study area with only 32 persons per square kilometer. Figure 6-14 shows the differences of population density among the 17 states of Myanmar.

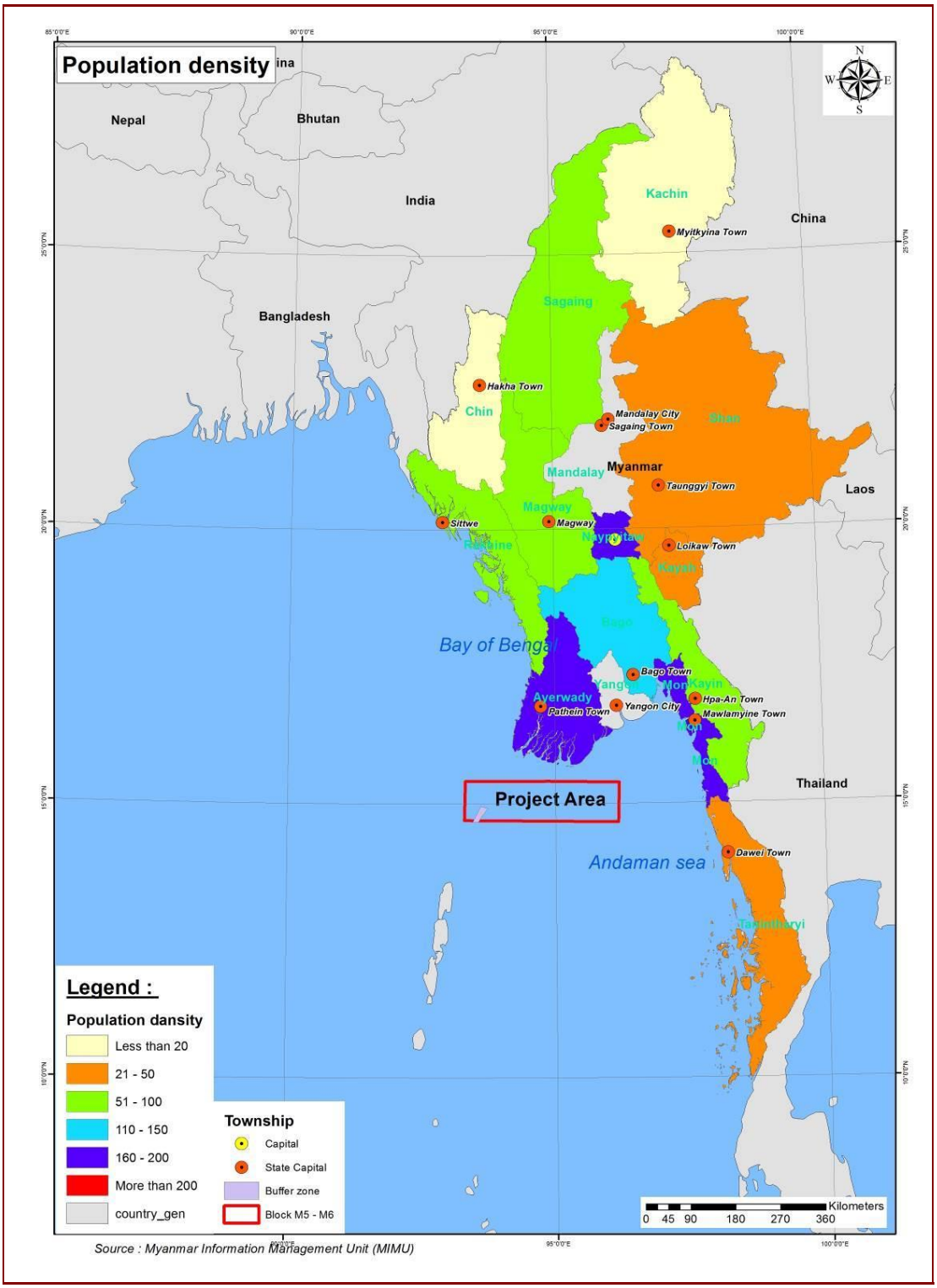


Figure 6-14 Population density by state

SOURCE: MYANMAR CENSUS 2014, MINISTRY OF IMMIGRATION AND POPULATION

Ethnicity

Myanmar is an ethnically diverse nation with more than a hundred distinct ethnic groups officially recognized by the Burmese government, each having a particular history, culture and language.

At the study area, coastal states are mostly inhabited by Bamar people (Ayeyarwady, Yangon and Tanintharyi states) while Mon State is populated by the Mon ethnic group. Figure 6-15 shows in more detail the ethnic distribution in the country and coastal states.

The Bamar are the dominant ethnic group in the country. They are 29 million people and inhabit mostly the central and upper plains of the country. This people from Sino-tibetan descent migrated from Yunnan, China, and settled in central Myanmar, progressively becoming the country prevailing group.

The Mon represents 8 million people, accounting for 15.6% of the total population. They are with the Pyu ethnic group the initial inhabitants of Myanmar Ayeyarwady valley, prior to the arrival of the Bamar people. They have been long time rulers over lower Myanmar, and supposedly brought Buddhism in the country. They have cultural particularities distinguishing them from the other ethnic groups of Myanmar, in the fields of language, arts (music, dances), clothes and architecture. However, their culture tends to fade away and assimilate with the Bamar culture, except in rural areas where Mon tradition still prevails.

South-east of the Project area, on the archipelago of Mergui in Thanintharyi State, live the Moken. They are a people referred to as sea gypsies, a denomination designating nomadic people living on the sea in several parts of Southeast Asia, such as Thailand, Malaysia, Philippines and Indonesia. In Myanmar, Moken people live essentially from sea-based sources of livelihoods, inhabiting their boat which is also their house. They are mobile by nature, but were progressively settled down in coastal villages, ending their migration-based living-patterns.

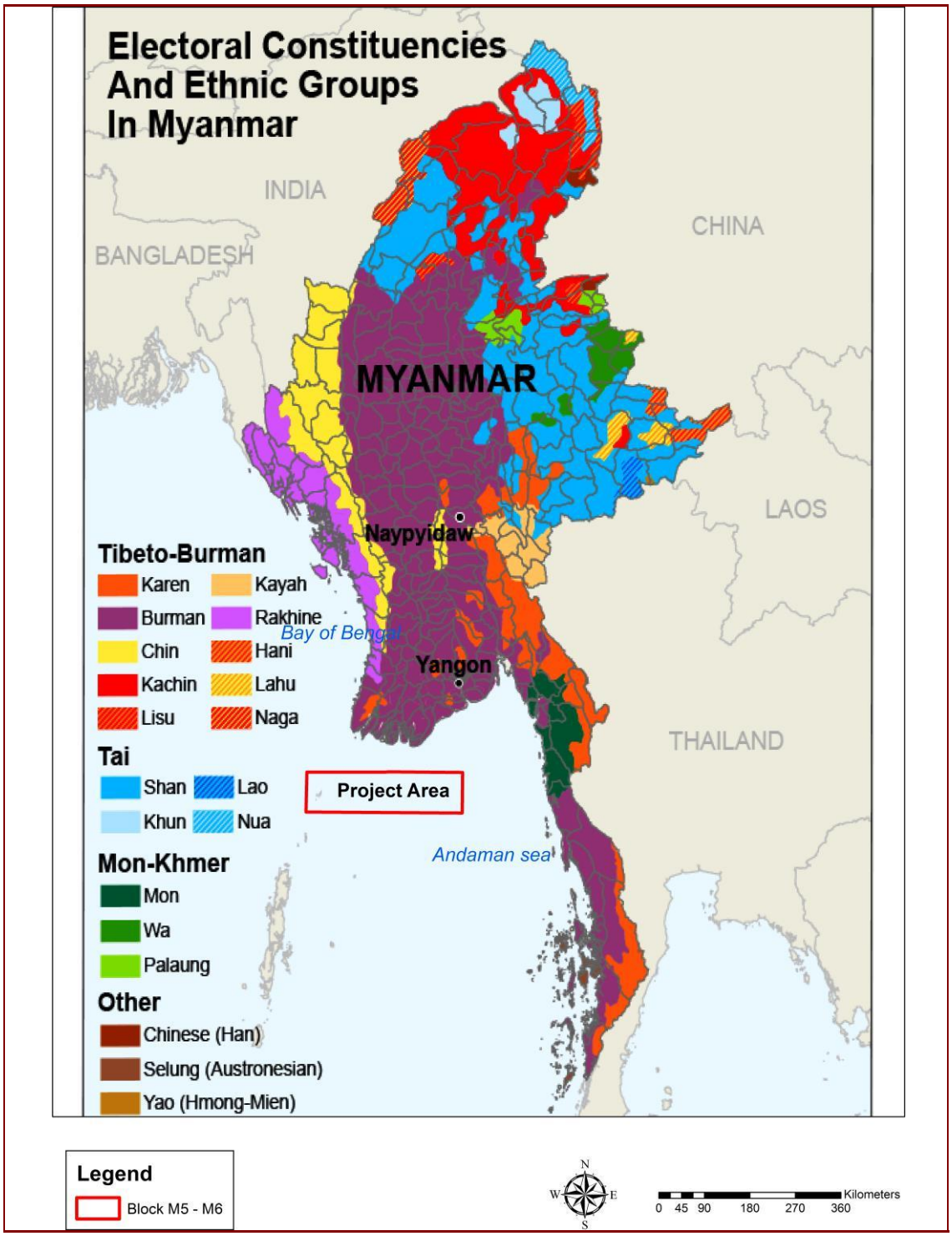


Figure 6-15 Ethnic groups distribution

SOURCE: THE NEW YORK TIMES, JUNE 30TH 2012, AVAILABLE AT [HTTP://WWW.NYTIMES.COM/IMAGEPAGES/2012/03/30/OPINION/30SELWAYMAP.HTML?REF=OPINION]

Gender role

Myanmar used to be a matriarchal society, where women enjoyed independency, political power and rights over economic resources, despite Buddhism stereotypes on gender roles. The British rule and the subsequent establishment of a male military state relegated women's rights behind those of men, the society accepting male rights prevalence as the norm.

Today, this heritage still delineates strong social roles between the two sexes. Despite a school enrolment being almost at parity between boys and girls, urban women increasing contribution to the household revenues, and despite sharing the same legal rights as those of men, gender equality is far from being achieved in the country[33]. On the contrary, it varies greatly based on the living environment (urban or rural) and the ethnic group belonging. Women still have a lower adult literacy rate as percentage of men's and lower estimated incomes. Their role in the political sphere remains very limited, with only 5.7% of women holding seats at the Pyithu Hluttaw (lower house) of the national Union Parliament[34].

Although their social and political roles are still unequal to those of men, the contribution of women to economic activities in the country is high, with 75% of the total female population being economically active according to the International Labour Office (ILO). Women in the country are mostly engaged in the agricultural sector, especially in rural areas.

Religion

The main religion in Myanmar is Theravada Buddhism, practiced by around 90% of the population. Theravada Buddhism is the dominant religion for the Bamar, Shan, Arakanese and Mon ethnic groups. Other religions in the country are Islam and Christianity: Christianity is mostly present in the Kachin ethnic group, Chin and Naga; Islam is mostly practiced in Rakhine State by the Rohingya minority as well as in the south and center of the country (Yangon, Ayeyarwady, Magwe, and Mandalay). Other minorities practice their traditional religions, which is the case of the Chinese and some ethnic groups in the highland regions who practice animist believes.

Although the Constitution recognises freedom of religion, recent conflicts have opposed Buddhists and Muslims, undermining political stability in the country. Violent clashes started in 2013 in the city of Meiktila between Buddhist and Muslims groups, and led to a series of anti-Muslim riots throughout the country over the year. The support offered by a minority of the Buddhist clergy to anti-Muslim movements continued to fuel the conflicts, and recent clashes have occurred in July 2014[35].

However, no religious tensions have been observed in the coastal states of the study area, as they remain concentrated in the central part of the country.

6.4.8.2 ***Access to social services and infrastructure in the coastal areas***

The country's indicators on human development and access to basic social services have improved over the last years, but remain low according to international standards. Thus, Myanmar Human Development Index of 0.524 in 2013 ranks it 150 out of 187 countries, and is below the regional average of 0.703. Besides, 25.6% of its population lives below the national poverty line and has limited access to health, education, energy, water, or transportation infrastructures. The country also faces growing structural inequalities between states/regions, and urban/rural areas that are differently underserved in basic services and have therefore different levels of human development.

Health and education

With a life expectancy of 65.7 years in 2012, and the highest crude mortality rate of all Asia-Pacific countries (9 per 1000 people), health indicators in Myanmar reflect years of neglect and are distressing for a country that only recently opened to international health organizations assessments and interventions.

There have been an improvement in access to healthcare, with 81% of the population living in walking distance from a hospital (including township hospitals, public specialized hospitals and station hospitals) or health centre (including rural health centres, sub-rural health centres, maternal and child health centres). Besides, health expenditures by the Ministry of Health have more than doubled between 2007 and 2012.

[33] Than Than New, *Gendered Spaces: Women in Burmese Society*, Transformations, No. 6, February 2003.
[34] Global Justice Center, *The Gender Gap and Women's Political Power in Myanmar*, May 2013.
[35] HUME Tim, *Curfew imposed after deadly clashes between Buddhists, Muslims in Myanmar*, CNN, 6th July 2014.

However, basic health concerns continue to undermine the country human development. Maternal and child health is a major issue, along with HIV/AIDS, malaria and tuberculosis, which causes substantial mortality and morbidity. In 2012, HIV/AIDS prevalence rate represented 0.6% of the population. Malaria incidence was assessed at 2,743 cases for 100 000 people, while tuberculosis prevalence was estimated to 489 cases for 100 000 people[36].

Ongoing health issues in Myanmar are the major consequence of low government expenditures on health sector (2% of the GDP), low availability of medical care professionals and the poor condition or absence of health facilities. On average, Myanmar has only 1 physician per 2,188 people and 1 hospital bed per 1,667 people.

In the study area, Ayeyarwady and Mon states are disadvantaged compared to Yangon and Thanintahryi in terms of doctors' distribution. Besides, Nargis cyclone in 2008 considerably decreased access to healthcare in Ayeyarwady State. Six years after, despite NGOs active role in post-disaster restoration, populations living in this State remain particularly vulnerable.

Government investment in primary education is more important than in the health sector, which is displayed by high indicators in the terms of literacy rate (93% of adults are literate) and gross primary school enrollment (114%). However, gross secondary school enrollment is low as compared to other regional neihgbours (50% of the children attend secondary school)[37].

Access to energy, water and sanitation

According to the International Energy Agency (IEA), Myanmar is in a condition of energy poverty. Its average electrification rate was about 28% in 2012. Urban areas have a better access than rural ones. Thus, Yangon City has the highest electrification rate (72%), followed by Nay Pyi Taw (65%), Kayar (42%), and Mandalay (35%), while rural areas are poorly electrified, with an average rural electrification rate of 16%.

Myanmar enjoys abundant water resources, and access to water is good at the national level with 70% of the population having access to drinkable water source in 2010. Access to improved water sources is higher in urban areas where 94.8% of people benefit from these sources, than in rural ones with 81.1% having access to them. Regional discrepancies are also observed, and states in the study have unequal access (44.6% in Ayeyarwady, 76.7% in Yangon). In terms of improved sanitation facilities, 79% of the population has access to it, over 80% in the coastal area (including Ayeyarwady). This is the result of large investments in the sector from government and external sources, which have allowed tackling this issue efficiently.

6.4.9 Marine socio-economic environment

Myanmar economic development has accelerated over the last years, influenced by the democratization process initiated by the regime in 2010. Myanmar authorities have thus recently refurbished their laws and regulations to improve the ability of the domestic market to welcome foreign investments. They notably revised the 1988 Foreign Investment Law in 2012, to facilitate international companies' investments in the country's economy. Positive effects were felt rapidly, with an increase of foreign direct investment from USD 1.9 billion in 2012 to USD 2.7 billion in 2013, mostly in the energy, garment industry, information technologies and food and beverages. According to the World Bank, economic growth reached 6.5% in 2013, on the rise from 5.9% in 2012. The government notable efforts to improve the business environment and stakeholders' interests in its market succeeded, and numerous foreign companies are now willing to invest in the country's economy.

Like for other sectors, marine economic activities represent a high potential of economic growth. Part of the Myanmar maritime space, they are regulated by the **United Nations Convention on the Law of the Sea (UNCLOS)**. This convention governs the States' rights and responsibilities related to the oceans and their resources. It establishes categories spatially demarcated such as the territorial waters, the contiguous zone and the Exclusive Economic Zone (EEZ). Each category represents rights and obligations for the

[36] World Health Organization, *Myanmar Health Profile 2012.*
[37] UNICEF statistics on Myanmar.

signatory state: for instance, the EEZ status recognizes the right of a State to explore and exploit the ocean's resources[38], but requires this State to guarantee free passage of foreign ships in its waters.

Myanmar is signatory State of this convention, and translated it in its Territorial Sea and Maritime Zones Law in 1977. The country already actively exploits its marine oil and gas resources, supported by several foreign companies. In parallel, the government sees an important potential of growth in the marine fishery sector. These sectors, along with the commercial shipping, use the same environment and their interests will probably overlap over the coming years, creating interactions and potential conflicts among them that need to be anticipated and whenever possible prevented.

6.4.9.1 Offshore oil and gas sector

Myanmar promising offshore oil and gas resources represent an important potential of growth for the country's economy, attracting interest from the national and international oil and gas industry. In 2012, 34% of the Foreign Direct Investments in the country were directed at oil and gas exploration and production[39].

In a move to boost the increase of oil and gas activity in the country, the Ministry of Energy recently concluded the Myanmar Offshore Blocks Bidding Round 2013, attributing 20 offshore blocks to international companies[40]. Ten deep-water blocks and ten shallow-water blocks were attributed to oil majors and independent companies, such as Statoil, Eni, Shell, Total, ConocoPhillips, BG Group, and Woodside Energy.

The M5-M6 block was awarded to Total E&P Myanmar, and other neighboring blocks were attributed to various companies, such as to Eni (block MD2). They can be localized in Figure 2-2 and are for most of them in production:

- The Yetagun field in M12, M13 and M14 produces since 2000 and is operated by a local subsidiary of Malaysian company Petronas.
- The Zawtika, Kakonna and Gawthaka fields, located in blocks M9 and M11, started to produce in March 2014, and are operated by the Thai company Petroleum Authority of Thailand Exploration and Production International (PTTEP International).
- Several other blocks are at the stage of 2-D or 3-D seismic campaigns.

This surge in offshore exploitation of oil and gas resources causes an increase in operational activities in the Andaman Sea, which could lead to **negative cumulative impacts on the fishery sector and global marine traffic in the region**.

6.4.9.2 Marine fishery sector

Myanmar has a coastline of 2,280 kilometers, a marine water area of 486,000 square kilometers, and an inland water area of 124,280 square kilometers[41]. Generally, Myanmar fisheries are divided into two sub-sectors:

- **Inland fisheries**, covering freshwater fisheries and aquaculture;
- **Marine fisheries**, covering inshore and offshore fisheries.

The potential for development of fisheries in the country is considerable. This sector as a whole already represents the **fourth most important export earning sector** and generate with livestock **9.9% of the GDP**[42]. It employs an estimated number of **7,977,000** persons, among which 3,269,000 are active

[38] UNITED NATIONS, *The United Nations Convention on the Law of the Sea (A historical perspective)*, 1998, available at [http://www.un.org/Depts/los/convention_agreements/convention_historical_perspective.htm#Exclusive Economic Zone]
[39] OECD.
[40] Offshore Energy Today, *Myanmar awards new offshore blocks*, March 26, 2014.

[41] Pe Myint, National Report of Myanmar on the Sustainable Management of The Bay of Bengal Large Marine Ecosystem, BOBLME, GCP/RAS/179/WBG, 2004

[42] According to the Institute of Marine Research figures, available at [http://www.imr.no/forskning/utviklingssamarbeid/surveys/myanmar_2013/en]

fishermen[43]. This represents 15% of the total country population, highlighting the evident importance of this sector for the economy. Besides, like in many Asian countries, fish and other products are important for the Myanmar people diet and for food security. In 2002, per capita consumption of fish amounted to 21.04 kg/yr and constituted 60 to 70% of the total protein intake for the population[44].

The M5-M6 seismic project area is located in the marine fishery zone, more particularly in the offshore fishery zone as displayed on Figure 6-16.

Laws and regulations

Myanmar fishery sector was previously regulated by the Fisheries Act of 1905. Laws were upgraded in the 1990s to support the development of this sector, encompassing new topics such as artisanal and foreign fishing. Today, six laws are the basis for inland and marine fishery organization, management and control by the different government agencies in charge of this sector. These laws are listed below:

- Law Relating to the Fishing Rights of Foreign Fishing Vessels - 1989
- Law relating to Aquaculture - 1989
- Myanmar Marine Fisheries Law - 1990
- Freshwater Fisheries Law - 1991
- Law Amending the Myanmar Marine Fisheries Law - 1993
- Law Amending the Law Relating to the Fishing Rights of Foreign Fishing Vessels - 1993

Myanmar fishery sector is managed by the Ministry of Livestock, Fisheries and Rural Development, and more particularly by the Department of Fisheries (DoF), which takes care of both inland and marine fisheries. The most important mission of the DoF is to develop and implement sectorial policies aiming at promoting sustainable fishing practices and ensuring the preservation of marine resources. The DoF develops conservation efforts, promotes research and surveys on the current condition of marine resources in partnership with intergovernmental agencies, maintains statistics on fisheries, and supervises the fishery sector through delivery of licenses to national fishing vessels.

Marine fishery zones

Myanmar fishery zones are organized under the Marine Fisheries Law of 1990, which classifies the fishery sector into the inshore and offshore categories. Their main characteristics are detailed below:

- **Inshore (or coastal) fishery**: covers an area up to 5 miles from the shore for the Rakhine coast, and 10 nautical miles from the shore on the Ayeyarwady and Tanintharyi coasts. Boats entering this category should not be equipped with engine having more than 12 horsepower and length of the boat is limited to 30 feet.
- **Offshore fishery**: covers the outer area of the inshore fishery zone up to the EEZ border. Boats should have more than 12HP engine, and can use bottom trawl, purse seine, surrounding nets, drift nets and long lines[45].

As seen on Figure 6-16, the inshore zone is represented in deep blue and borders the coast, while the offshore zone spans from the inshore borders up to the EEZ borders, at water depths varying from 0 to over 200 meters. For administrative purposed, the Department of Fisheries has divided the offshore zone into 140 fishing grounds of 30×30 nautical miles block, using latitude and longitude lines. It has also designated 4 fishing areas, namely Rakhine (40 blocks), Ayeyarwady (44 blocks), Mon (14 blocks) and Taninthary (52 blocks). The Project area is entirely located in the offshore fishing zone.

[43] Bay of Bengal Large Marine Ecosystem - BOBLME

[44] Pe Myint, National Report of Myanmar on the Sustainable Management of The Bay of Bengal Large Marine Ecosystem, BOBLME, GCP/RAS/179/WBG, 2004

[45] FAO, *The State of World Fisheries and Aquaculture, Opportunities and Challenges*, 2014

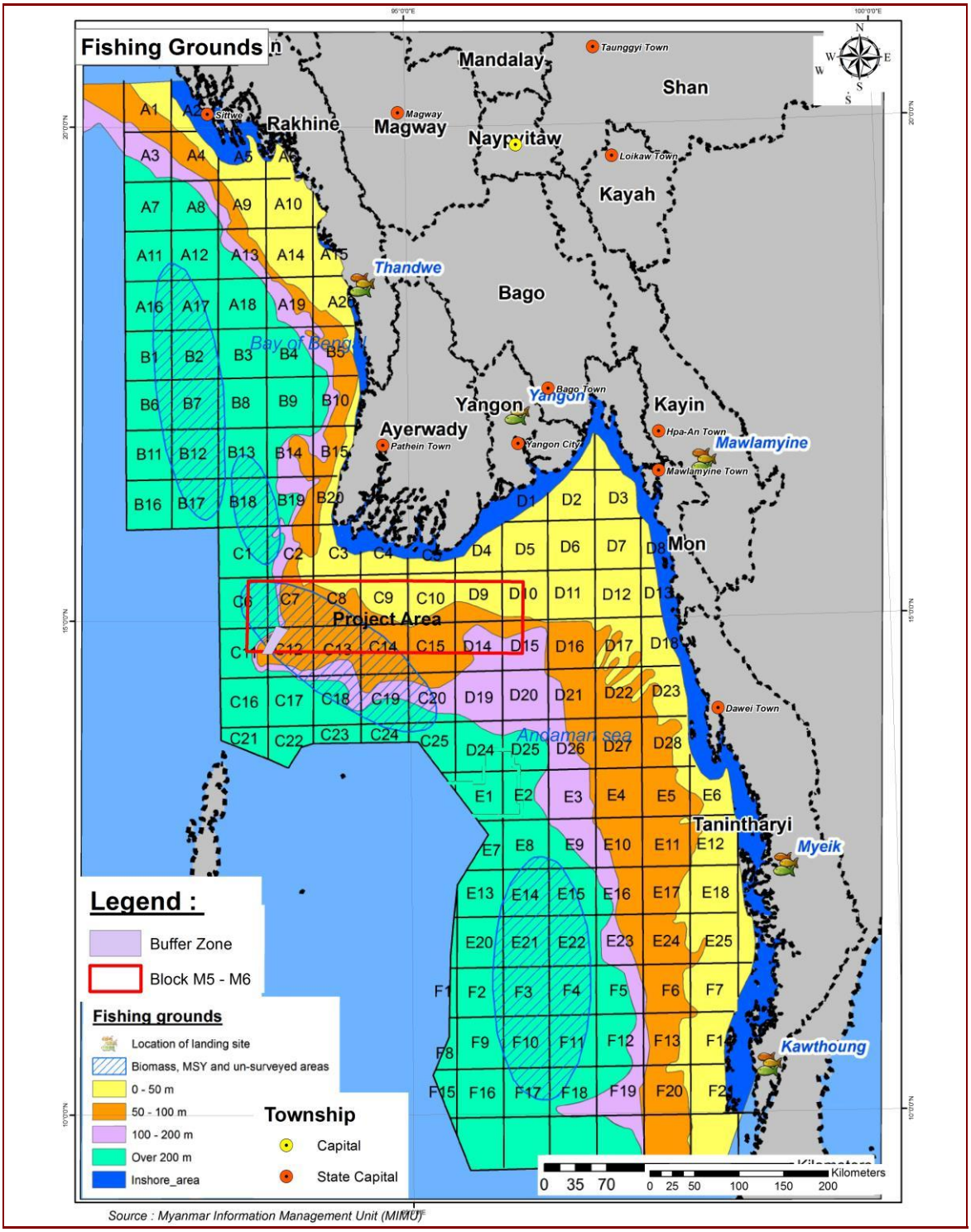


Figure 6-16 Myanmar fishing zones as defined by Marine Fisheries law

SOURCE: MYANMAR DEPARTMENT OF FISHERIES

Marine fishery licensing system

The fishing vessel licensing system in Myanmar is framed by the Marine Fisheries Law and based on the nationality of the license requester. The national license system is divided into two sub-categories based on the fishing zones:

- **Inshore fishery zone license:** the General Administration Department (GAD) is in charge of inshore fishing boats' inspection. The Department of Fisheries proceeds with the issuance of fishing licenses upon recommendation of the GAD.
- **Offshore fishery zone license:** the Department of Marine Administration (DMA) takes care of inspection and registration of the offshore fishing boats. Fishing licenses are delivered by the DoF only when DMA has issued its approval.

The Myanmar Fisheries Law encourages foreign fishing activity with the granting of fishing rights to foreign companies, but limits their activity to the EEZ. It is only under exceptional circumstances and expresses agreement of the related government agencies that foreign fishing vessels can conduct fishing activities in the country territorial waters. Foreign fishing companies can acquire licenses to operate in the Burmese waters from the Department of Fisheries, in exchange of a fee and upon approval of the Ministry of Livestock and Fisheries. In order to encourage empowerment of national fishing fleets and development of national capacities in the fishery sector, DoF will also grant licenses to the foreign companies that have formed a joint-venture with a state enterprise or a Burmese business partner.

Marine resources: surveys and estimations

The Myanmar fishery institutions do not have recent and reliable data informing on the marine resources available in their waters, as well as the size and composition of marine catches. This lack of knowledge is due to years of isolation, a focus of the previous fishery policies on inland resources (especially aquaculture) and a lack of means (in terms of budget, human resources and competencies) from the government agencies for collecting information and building expertise.

Without this knowledge, it is difficult for the Ministry of Livestock, Fisheries and Rural Development and the Department of Fisheries to draft a sustainable fishery policy which would preserve fishery resources while allowing for the commercial fishery sector to prosper.

Myanmar is member of several inter-governmental organizations specialized in fishery at the regional scale, such as the Southeast Asian Fisheries Development Centre (SEAFDEC), the Asia-Pacific Fisheries Commission (APFIC), and the Bay of Bengal Large Marine Ecosystem Program (BOBLME). Trying to build knowledge on the state of marine resources and fisheries, these organizations conducted several surveys in Myanmar waters under the leadership of the Food and Agriculture Organization (FAO).

These surveys enabled to draw estimations on fish stocks, but their results vary. According to the Institute of Marine Resources, fish stocks range between **1.3 and 1.8 million metric ton (mmt): 1 mmt for pelagic fish, and 0.8 mmt for demersal fish, respectively**. But for the government of Myanmar, the potential maximum sustainable yield (MSY) of Myanmar waters is about 1.05 mmt per year (0.5 mmt of pelagic fish and 0.55 mmt of demersal fish)[46].

Conclusions of surveys conducted in 2004 and 2007 by the SEAFDEC on Myanmar marine fishery resources revealed that even if stocks were not known yet, Myanmar was rich in some commercially important big pelagic species such as sword fish (*xiphias gladius*), deep-sea lobster and deep-sea shrimp. Other commercially important species, such as yellowfin tuna (*thunnus albacares*), striped marlin (*tetrapturus audax*) and sailfish (*istiophorus platypus*) inhabit Myanmar offshore waters[47].

Recently, a **large marine ecosystem survey** was conducted in the frame of the EAF-Nansen project and the BOBLME[48]. Piloted by the Institute of Marine Research, a Norwegian organization appointed by the

[46] Tony J Pitcher, *An Estimation of Compliance of the Fisheries of Myanmar with Article 7 (Fisheries Management) of the UN Code of Conduct for Responsible Fishing*, 2007

[47] Julius Kyaw, Department of Fisheries, *Present Status of Off-shore Fishery Resources and Information on Tuna Fishery in Myanmar*, Special Meeting on Improvement of Tuna Information and Data Collection in the Southeast Asia7-9 September, 2011. Songkhla Province, Thailand

[48] The EAF-Nansen project, launched in 2006, is a multi-stakeholder project funded by the Norwegian Agency for Development Cooperation and managed by the FAO in partnership with the Institute of Marine Research (IMR). Its objective is to strengthen the knowledge base on

SEAFDEC, this study gathered a team of marine experts for a six-week field survey in November 2013, with the participation of the DoF. Due to large data the project has to process before being able to publish any report, it is unlikely that the results of the survey will be available by the end of the year, and therefore used in this study.

Waiting for these results, the data and information used by the Government to guide its decisions on fishery management are still out-of-date and inaccurate. Assertions are made by various stakeholders, such as the Myanmar Fishery Federation[49], on **severe depletion of stocks and overfishing both for the offshore and inshore fisheries**[50]. In the frame of the preparation of this IEE, discussions with NGOs specialized in marine ecosystem protection also tend to confirm this fact, despite a clear lack of data.

Fishing vessels and gears

Most recent estimates on the country total fishing fleet set the number of vessels at **around 30 800 in 2011**, among which half of it were non-motorized boats, and 1 600 were trawlers[51].

Myanmar fishery sector is mostly developed in the artisanal, small-scale inshore fishery zone (up to 10 miles from the coast), with **27 751 inshore fishing vessels** registered by the DoF in 2012, a decrease compared to the 29 371 vessels the previous year. Among these, 55% are powered vessels, and the rest are non-motorised boats. They usually operates in waters less than 50-meter depth, due to a lack of technology, suitable fishing gears and equipment to process fisheries resources information (such as GPS or satellite devices).

The offshore fishery zone is mostly the domain of **large national companies** and **foreign fishing vessels** that have powerful boats, and concluded fishing agreements with the Ministry of Livestock, Fisheries and Rural Development.

Around 2450 national vessels were engaged in offshore fisheries in 2012. Additionally, 132 foreign vessels were reported having licenses to conduct offshore fishery[52]. This number is in decrease compared to 2010 when 390 foreign fishing vessels had fishing licenses.

As presented in the Table 6-5 below, fleets operating offshore (encompassing foreign fishing vessels) mainly use active fishing gears, with trawling, driftnet and purse seine being the most commonly used. Static fishing techniques, fish traps or stow nets, are also used but less commonly in the offshore fishery zone.

fisheries and implement an ecosystem approach to marine fisheries in developing countries. The project conducts activities in the Bay of Bengal and in Myanmar, among other countries. More information at: [http://www.eaf-nansen.org/nansen/organization/17910/en]

[49] The Irrawady, *Burma Bans Foreign Fishing Boats from Its Waters*, April 3, 2014

[50] Source: UNDP, *Myanmar Agricultural Sector Review and Investment Strategy, Volume 2: Agricultural Sector Investment Strategy*, June 2004.

[51] BAY OF BENGAL LARGE MARINE ECOSYSTEM PROJECT (BOBLME), *Transboundary Diagnostic Analaysis vol. 2*, 2012.

[52] According to the Institute of Marine Research figures, available at [http://www.imr.no/forskning/utviklingssamarbeid/surveys/myanmar_2013/en].

Table 6-5 Number of fishing vessels engaged in offshore fishery, 2013[53]

Type of gear	Under 24 meters length	Above 24 meters length	Total
Trawl	638	462	1100
Purse seine	157	101	258
Stow net	450	97	547
Drift net (gil net)	258	2	260
Long line	37	-	37
Squid cast net	300	-	300
Fish trap	94	2	96
Total	1934	664	2598
Total	1934	664	2598

Thailand is an important actor of the foreign fishery sector in the country, and several Thai companies have fishing rights (in 2013, 60 licensed foreign vessels were reported to belong to two Thai companies). Thai fishing in Myanmar waters is a recent activity, started in the late 1990s when the two countries concluded joint venture agreements allowing Thai fleets to operate in the Myanmar EEZ legally. Other companies from countries like Singapore, Japan, China or South Korea also have a role in Myanmar fisheries.

Myanmar law is repressive against **illegal, unreported and unregulated fishing**. It bans all fishing gears that are destructive to the environment and fisheries resources, including pair trawl, electric fishing, fishing using poisons, chemicals, explosives, purse seine net less than 3,5 inches mesh size and trawl net cod-end mesh size less than 2 inches[54]. Trawl use is also forbidden in the inshore fishery zone. Several institutions are involved in battling illegal fishing under the coordination of the Myanmar Navy: the Coast guards, the Department of Fisheries, the Myanmar Customs Department and the Myanmar Police Force.

However, despite these measures **illegal fishing is commonly practiced in Myanmar waters, especially by neighboring Thai vessels**, because of an inability from Thai authorities to control their fleet in their territorial waters[55]. Clashes have as a consequence regularly happened between Myanmar and Thailand over this issue. Violent actions in July 2014 saw the drowning of a Thai trawler caught performing illegal fishing by a Myanmar Navy patrol boat[56]. This series of events, coupled with nationalist pressures from fishery stakeholders, such as the Myanmar Fisheries Federation, contributed to a recent decision to ban foreign fishing taken by Myanmar.

Indeed, in April 2014, the Government of Myanmar decided the **suspension of fishing rights and licensing for foreign vessels until further notice**. This ban is justified by alleged fish resources depletion, due to overfishing and the use of destructive fishing gears by foreign companies whose activity

[53] APFIC (Khin Maung Aye & Win Ko Ko), *Regional Expert Workshop on Topical Trawl Fishery Management,* 30 September – 4 October 2013, Phuket, Thailand.
[54] KYA Kyaw, Dr., SEAFDEC, *Countries profile of Myanmar Addressing the IUU Fishing in the Southeast Asian Region,* 2010
[55] MORGAN Gary R, STAPLES Derek J. (2006), *The History of Industrial Marine Fisheries in Southeast Asia*, Asia-Pacific Fishery Commission, FAO Regional Office for Asia and the Pacific. APFIC ad hoc publication
[56] CHUENNIRAN Achdataya, *Myanmar Sinks Thai Trawler*, Bangkok Post, 11 July 2014, available at [http://www.bangkokpost.com/news/local/420067/myanmar-sinks-thai-trawler]

has intensified over the last five years. It was welcomed by national fishing associations, since it was expected for a long time[57].

Fishing grounds, fish catches and exports

Commercially interesting species identified for the offshore fisheries, as described in the section on Marine resources: surveys and estimations, are **pelagic fish species, with the tuna being in a privileged position for industrial development**. Figure 6-16 shows the tuna fishing grounds (in blue circles on the map). No data are available on fishing grounds for other groups of species.

Myanmar is an important contributor to the regional fishery sector along with India. In terms of volume, total catches for all sectors (aquaculture, inland and marine capture fisheries) amounted to 4,464,419 tons in 2012. Among these, inland waters fisheries accounted for 1,246,460 tons and aquaculture for 0,885 tons.

The marine capture fisheries represented half of the total production, with 2,332,790 tons of catches in 2012, an increase of 7.5% from the previous year, and from 121% between 2003 and 2012. However, this figure is underestimated as it doesn't take into account the production loss caused by illegal fishing, and by the landing of catches to foreign ports. Indeed, for fishing performed by foreign vessels, landing sites are usually not located in Myanmar but, according to the size of catches, to Phuket in Thailand, Penang in Malaysia or even in Japan. Foreign fleets have the modern equipment and powerful engines enabling them to easily transport their catch to international ports in a short time. These catches are therefore not reported in the country statistics.

Besides, the general composition of the marine catches landed in the country is also not known precisely[58]. This lack of data prevents the country to identify overfishing by species, and therefore to adopt a sustainable fishery policy.

Main landing sites and wholesale fish markets are around Yangon, at Pazuntaung Nyaungdan and Annawa, with a fish market at San Pya in Alone township. Other major landing sites are found along the coast, at Thandwe, Mawlamyine, Myeik and Kawthoung cities. Capture fish landing there is sold through an auction system.

In terms of export, the best quality catches are exported to neighboring countries. 116 fishery processing factories are registered in Myanmar, and most of them export fish to the Chinese market. Only 20 of these factories have licenses to export to EU and United States markets. A recent project from the United Nations Industrial Development Organization will help upgrade eight other factories, increasing their standards to allow exports to these high profitability markets[59]. However, exports to Europe and United States markets remain limited at the time being.

Global marine products exports in 2013 amounted to 376,845 tons, generating revenues of USD 650 million. Excluding shrimps, **fish products represented 70% of these exports (266,464 tons)**, and USD 380 million of revenues. During 2014 fiscal year, a decrease in fishery export was observed with only USD 550 million of revenues against the target set by the Myanmar government for marine products exports of USD 700 million. According to the Myanmar Fishery Products Processors and Exporters Association (MFPPEA), this decrease is mainly caused by a lack of competency in the fishery sector, preventing it to compete on international markets.

In regards to low quality catches, they are processed in Myanmar in the form of fish paste or fish meal for the chicken industry, or used fresh or chilled for direct consumption, with some fish being frozen or cured.

Focus on the area of operations

The marine fishing areas of Myanmar are divide into three main zones: Rakhine (Bay of Bengal), Taintharyi (Andaman Sea) and Ayeyarwady (at the junction between the two), where the project is located. Table 6-6 shows the catch per unit effort for demersal fish during fishing trials by the research vessel Dr Fridtjof Nansen for two periods: 1979/1980 and 2013 (BOBLME, 2014). The catch per unit effort is minimal in the

[57] The Irrawady, *Burma Bans Foreign Fishing Boats From Its Waters*, April 3, 2014

[59] ELEVEN MYANMAR, *UNIDO to Upgrade Myanmar's Fish Factories*, 11 April 2014, available at [http://www.elevenmyanmar.com/index.php?option=com_content&view=article&id=5731:unido-to-upgrade-myanmar-s-fish-factories&catid=33:business&Itemid=356]

Ayeyarwady region, which is surprising since the Ayeryawady delta would be expected to increase productivity due to the nutrient influx: overfishing related to the greater population density in this region is expected to occur. Overfishing is clearly apparent when comparing the two periods, with a more than three-fold drop in catch per unit effort in Ayeyarwady.

Table 6-6 Catch rates for demersals as measured by RV Dr Fridtjof Nansen

Area	Catch per unit effort (kg/hr)	
	1979-1980	2013
Rakhine	609	225
Ayeyarwady	415	126
Tanintharyi	894	154
Average	639	168

Few fishing boats operating in Myanmar waters, or fish traps installed, are equipped with vessel monitoring system enabling to localize their area of activity. Therefore, it is not possible to prove with firm evidence that the Project area is popular with fishermen.

Figure 6-17 Offshore fishing vessels

SOURCE: HTTP://WWW.BOBLME.ORG

The Myanmar offshore fishing boats tend to be quite small and have limited engine capacity, they therefore tend to fish relatively close to the land and are reported seldom to go in waters deeper than 50 m (BOBLME 2014). Due to fishing pressure, it is expected that many vessels would go as far out as they can to increase their chances of catching fish, this means that manty vessels would be expected up to the 50 m depth line, which covers the northern third of blocks M5-M6 (yellow area on Figure 6-16). This tends to be confirmed by occasional sightings of fishing vessels in the vicinity of the Yadana field. Incidentally, a cursory glance at salinity maps would iindicate that this limit corresponds roughly with the limit of the area of influence of freshwater from the delta.

6.4.9.3 ***Port infrastructures and marine traffic***

Port infrastructures

The Port of Yangon is the first international port of Myanmar. It has an annual traffic of more than 2,000 vessels, and 600,000 tons of goods transited there in 2013[60]. Following the fast pace of economic development in the country, marine traffic has increased over the last years, causing regular congestion at the port. This trend that is likely to continue in the future if additional infrastructures are not developed.

Yangon Port is placed under the management of the Myanmar Port Authority. This division of the Ministry of Transport also controls eight major ports along the coast (four on the west coast and four on the south-east coast). These ports receive international ships, but still have inadequate infrastructures and lack mechanised facilities that could increase their capacities. As shown in Figure 6-18, the main ports bordering the Project area are located in Pathein (Ayeyarwady State), Mawlamyine (Mon State), and in Dawei, Myeik and Kawthaung (Tanintharyi State).

Lacking the capacities and resources to develop its port infrastructures, Myanmar's government supports private companies who wish to invest in this sector. Two projects are on the way, financed by foreign enterprises.

- Located 25 km south of Yangon, the Myanmar International Terminals Thilawa (MITT) is a deep sea multi-purpose container port complementing the infrastructures of the Port of Yangon. It is operated by a private foreign company, Hutchison Port Holdings. Construction works will start in June 2015 according to the Myanmar Port Authority.
- In the coastal city of Dawei, the development of a large deep-sea port has been planned for several years. This project is managed by the Dawei SEZ Development Co, a Thai-Burma consortium in charge of developing the port and a large Special Economic Zone. This deep-sea port will benefit from domestic commercial traffic, but will also profit Thailand, who has had a significant increase in its business relationships with Myanmar over the last years. India could also take the advantage of this port as an alternative sea route to Southeast Asia, reducing its dependency from the congested Strait of Malacca.

[60] Interview with the Myanma Port Authority

Figure 6-18 Location of ports in Myanmar

SOURCE: HTTP://WWW.MYANMARPORTDEVELOPMENT.COM/ABOUT-THE-CONFERENCE.PHP

Marine traffic

Marine traffic in Myanmar waters (Figure 6-19) is limited to domestic traffic and the passage of its EEZ by ships traveling regionally.

Traffic from the port of Yangon branches into three main directions:

- a domestic shipping lane connects Yangon and the port of Kawthong in the south-east coast of Thanintharyi state. A lack of mechanized and modern port infrastructures and the limited economic activity that characterize Myanmar explain this low intensity opf the maritime traffic;
- the main branch leads South towards Singapore and beyond the Malacca Strait (the Malacca Strait is one of the busiest shipping lanes in the world with an annual passage of more than 60,000 vessels);
- another branch heads SW towards the Cape of Good Hope and passes just South of the Yadana – Sein fields and Preparis Island, but nevertheless virtually cuts diagonally across the project area.

Regionally, commercial shipping lanes that do not stop in Myanmar ports also cut across the Myanmar Exclusive Economic Zone and leave from India and Bangladesh coastal ports (Paradip, Calcutta and Chittagong) to the Malacca strait via the north of the Andaman and Nicobar islands. The main branch of traffic betwenn Singapore and Chittagong cuts across the western part of the project area, slightly East of Preparis Island, whereas the branches between Singapore and India only just about touch the very southwestern corner of the project area.

Other features that show up well on Figure 6-19 are (i) the oil ang gas fields (Yadana / Badamya / Sein at 15°N 95°E in the centre of the project area, Zawtika at 14°N 96°E, and Yetagun at 13°N 97°E) because standby vessels and supplies generate a lot of GPS positions whilst remaining static, and (ii) racetrack patterns that look very much like seismic survey vessel activity around 13°30'N 95°30'E and 16°30'N 93°E. Interstingly, at first look these race tracks patterns, despite their extent, do not seem to unduly affect the main shipping lanes that cut right across them.

Thus, the seismic campaign is likely to temporarily increase the marine traffic in the area, and operational ships may encounter commercial ships during the Project implementation.

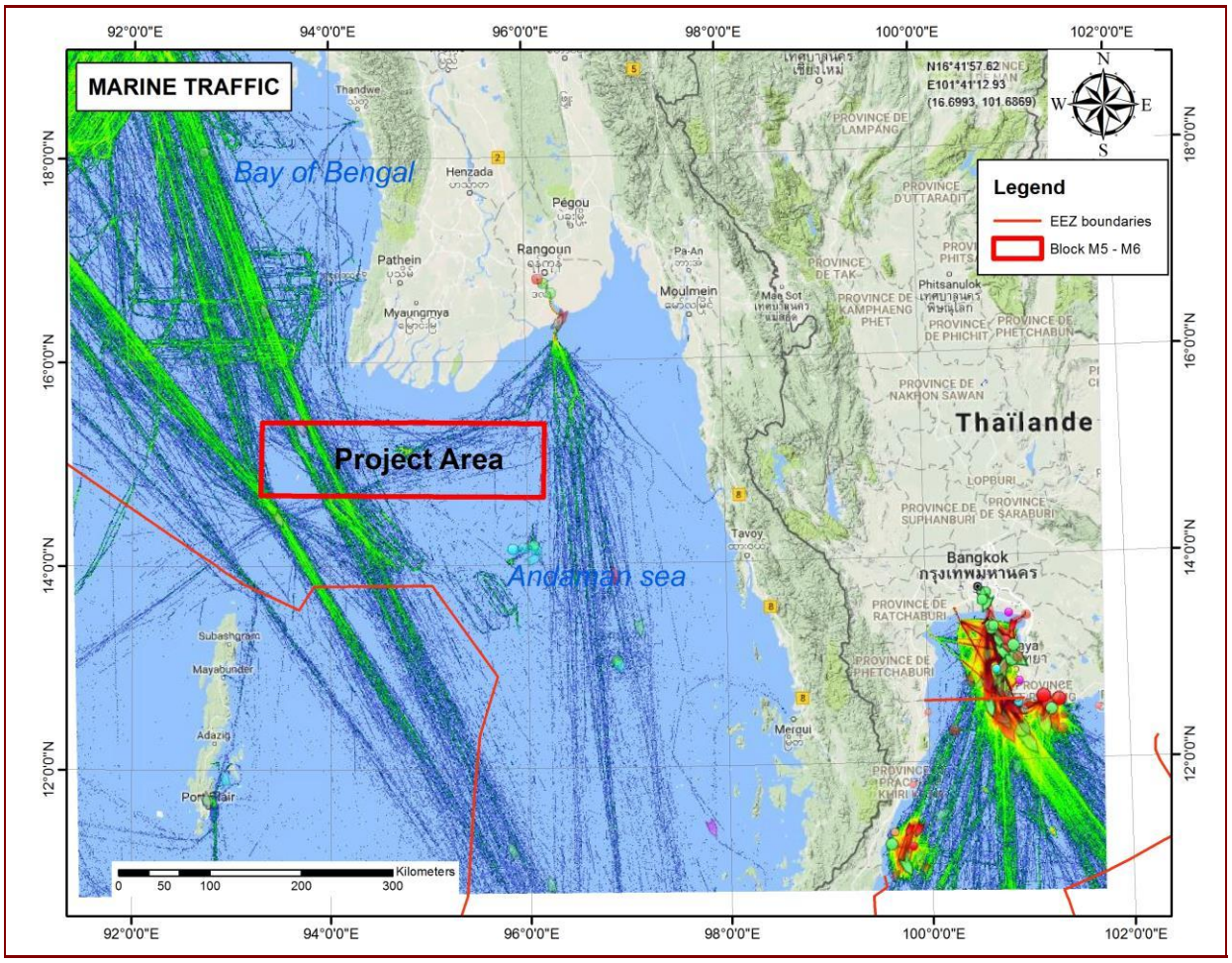


Figure 6-19 Regional maritime routes and traffic density

SOURCE: MARINETRAFFIC.COM, DATA PRESENTED IS AGGREGATION OF DATA FROM THE LAST AUTUMN 2017

6.4.10 Stakeholder identification

The marine space off Myanmar coast has long been the preferred area of oil and gas companies. However, the government wishes to diversify its economy particularly through the fishery industry development. With several port upgrades and new infrastructure developments, it also aims at increasing its commercial exchanges with foreign countries using marine transportation means. Accordingly, the use of marine space by multiple actors is bound to increase, along with pressures on the marine ecosystems and on the individuals and companies that benefit from its resources or are engaged in its protection.

Besides oil and gas operators, other actors having interests in the marine spaces of Myanmar have therefore to be identified in the frame of this Project, as they can either influence it or be impacted by it. These stakeholders are listed below, covering the public authorities, private sector, and intergovernmental and non-governmental organizations involved in the regulation, use or protection of Myanmar marine areas and their ecosystems.

A comprehensive identification of stakeholders will allow to build an efficient stakeholder engagement plan, presented in SECTION 8 of this report. This plan will indeed identify the right audience for the public

consultations that will aim at gathering stakeholders' perception on the impacts identified and the mitigation measures prepared in this report.

6.4.10.1 ***Public authorities***

Public authorities grant the authorizations and permits needed by Total E & P Myanmar to perform the seismic campaign on M5-M6 block. They also regulate the use of marine areas between various stakeholders, from commercial vessels to fishermen.

Ministries

- **Ministry of Energy (MoE):** MoE is in charge of developing the oil and gas resources in the country. It provides offshore and onshore blocks through bidding rounds to national and international companies for the purpose of exploration and/or exploitation.
- **Ministry of Natural Resources and Environmental Conservation (MONREC, ex-MOECAF):** MONREC is in charge of developing the country environmental policy, in particular in the fields of water and marine resources conservation. It is also responsible for introducing a new environmental permitting system, which is in process of creation.
- **Ministry of Livestock, Fisheries and Rural Development (MLFRD):** MLFRD is in charge of developing, implementing and monitoring the country policies in the field of livestock, fishery and rural development, to ensure food security is achieved in the country, and prevent infectious diseases development that could endanger the national production.
    - **Department of Fisheries (DoF):** Under the MLFRD, the DoF main mission is to guarantee the preservation of fish resources in order to ensure the sustainability of the fishery sector. The DoF develops conservation efforts, promotes research and surveys on the current condition of marine resources in partnership with intergovernmental agencies, maintains statistics on fisheries, and supervises the fishery sector through the delivery of licenses to fishing vessels.
- **Ministry of Transport (MoT)**: MoT is responsible for the organization of the country's transport infrastructures, from air to marine transportation.
    - **Department of Marine Administration (DMA):** DMA is placed under the management of the Ministry of Transport. It is responsible for the marine traffic safety (conformity of ships to national safety standards, improvement of rescue operations at sea) and human resources development in the maritime sector. It is in charge of the offshore fishing vessels inspection to determine if they meet safety standards, prior to the delivery of fishing licenses by the DoF.
    - **Myanma Port Authority (MPA):** MPA is a government agency under the Ministry of Transport, founded in 1989 and located in Yangon. It is responsible for the regulation and administration of 8 coastal ports, among which Yangon Port. It is also in charge of developing and improving the port infrastructures, notably through the development of Special Economic Zones and their associated ports.
- **Myanmar Navy:** Naval branch of the armed forces of Myanmar with 19,000 staff. The Myanmar Navy currently operates more than 122 vessels, and increased its activities over the last years to improve defence of its territorial waters in particular against illegal fishing.

Universities and research institutes

- **University of Mawlamyine (Mon State):** it is one of the few universities in the country to offer a specialized degree in marine science, from Bachelor, Master to PhDs. It also has a Marine Science Laboratory in the coastal town of Setse, about 60 km south of Mawlamyine city. 900 students are registered across the various classes available.
- **Institute of Fisheries Technology:** Public institution established in Yangon in 1983 under the management of the Department of Fisheries. It provides training to fishermen on fishing techniques,

fishing gears and fish processing, among others. Training courses can vary, from basic fishing technology to fish processing supervision.

Public enterprises

Myanmar Oil and Gas Enterprise (MOGE): MOGE is Myanmar oil and gas state-owned enterprise. Established in 1983, it is an operator in oil and gas exploration and production as well as domestic gas transport through pipeline networks. It is also partner of joint-ventures with foreign oil and gas companies such as Total, Chevron, etc.

6.4.10.2 Business associations

- **Union of Myanmar Federation of Chambers of Commerce and Industry (UMFCCI):** UMFCCI is the largest not-for-profit business federation of the country. Its functions include human resources development and training, commercial courses, management and accounting, providing trade information and participation in international trade fairs. Almost every economic sector has its own federation under the umbrella of the UMFCCI. This is the case for the fishing industry, represented by the MFF.
- **Myanmar Fishery Federation (MFF):** Non-profit association founded in 1989 with the objective to encourage and promote fishing and fishery industries of Myanmar, through cooperation, training and knowledge sharing with other actors of the national fishery sector. The MFF counts 9 functional associations, and 13 regional fisheries associations under its umbrella. It has an important role in advocacy and opinion-making by regularly intervening in Myanmar media on issues of overfishing and depletion of the country marine resources.
- **Myanmar Marine Fisheries Association:** Member of the MFF along with 8 other associations.
- **Myanmar Fishery Products Processors and Exporters Association (MFPPEA):** Professional association in charge of supporting and promoting the processing and exporting companies in Myanmar.

6.4.10.3 Oil and gas companies

Following an active development policy by the Myanmar authorities, the blocks around the project have all been allocated. The neighbouring operators are:

- **Eni**: Italian oil and gas company, on block MD2 west of the project area.
- **PVEP**: Vietnamese oil and gas Company, on block M2, north of the M5 part of the project area
- **Berlanga**: a Dutch company, on block M8, south of the M5 part of the project area
- **PTTEP**, a Thai oil and gas company, on blocks M3 and M9, to the north and south of the M6 portion of the project area, respectively
- **Tap Oil**, an Australian oil and gas company, on block M7, east of the project area.

6.4.10.4 International organizations

Food and Agriculture Organization (FAO): FAO has a representation office in Myanmar since 1978, and is involved in a wide range of activities to support sectoral development, in particular fisheries, focusing mostly on aquaculture and coastal fisheries as a support to artisanal fishing communities.

6.4.10.5 Intergovernmental organizations

Intergovernmental organizations involved in the protection of marine spaces and/or the promotion of sustainable fisheries at the Southeast Asia regional level are numerous. They are particularly active in Myanmar, where the fishery sector is threatened by marine resources depletion.

- **Asia Pacific Fishery Commission (APFIC):** APFIC is a regional fishery body established by the FAO at the request of its members in 1948 during the organization of the Indo-Pacific Fisheries

Council. Its Secretariat is provided and supported by the FAO. Its role is to promote full and proper utilization of living aquatic resources, by the development and management of fishing, processing and marketing activities. APFIC also aims at improving knowledge sharing, training and promotion of best practices in the fishery sector to encourage sustainable fisheries, in collaboration with other regional entities and the national fishery institutions of its members.

- **ASEAN Sectoral Working Group on Fisheries (ASWGFi):** Under the leadership of the ASEAN, ASWGFi is a regional working group gathering fisheries specialists during regular consultative forums which address issues such as registration of fishing vessels, census of marine resources, etc. Overall, the working group objective is to provide inputs for the creation of a common sustainable regional fishery policy among the ASEAN countries.
- **South East Asian Fisheries Development Center (SEAFDEC):** SEAFDEC mission is to develop and manage the fisheries potential of the region, supporting the rational utilization of the resources through transfer of new technologies, research and information dissemination activities. SEAFDEC comprises 11 member countries: Brunei Darussalam, Cambodia, Indonesia, Japan, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam. Its central office is located in Thailand. The Marine Fisheries Research Department and the Marine Fishery Resources Development and Management Department are the two bodies working on assessing Myanmar marine resources and estimating potential for development of the fishery sector. The organization has also concluded an agreement with the ASEAN leading to the creation of a Fisheries Consultative Group.
- **Bay of Bengal Large Marine Ecosystem Project (BOBLME):** BOBLME is a regional project whose objectives are to develop a coordinated policy on the management and protection of marine resources and environment in the large ecosystem of the Bay of Bengal. Its overall goal is to improve livelihoods of coastal communities depending on the BOB resources. Funded by international donors (Global Environmental Facility, Norway, Swedish Internal Development Agency), the project is piloted by the FAO in cooperation with respective Marine and/or Fisheries Ministries in each member country (Maldives, India, Sri Lanka, Bangladesh, Myanmar, Thailand, Indonesia and Malaysia).

6.4.10.6 International Non Governmental Organizations

The presence of international NGOs in the country has increased over the last 5 years due to a political opening which allows them to open branches and lead projects in various sectors, from community development projects aiming at reducing poverty to environment conservation initiatives targeting inland and marine ecosystems.

- **Fauna & Flora International (FFI):** FFI works in Myanmar on various biodiversity and conservation projects. It currently leads a capacity-building program for marine conservation. Started in 2012, this program aims at identifying marine areas that should be protected, and support the management of already established protected areas. In partnership with **Biodiversity and Nature Conservation Association (**BANCA), a Myanmar national NGO, and the Forestry and Fisheries Departments, activities will consist in trainings on marine survey methods, community-based fisheries and marine protected areas establishment and management. One of the pilot areas for these activities is the Myeik archipelago off Thanintharyi State.
- **WWF:** WWF has been very active in the greater Mekong region over the last decades, and has just recently opened an office in Myanmar. Its aim is to support Myanmar's development ambitions with a focus on spatial planning and biodiversity conservation in parallel with ecosystem services protection and sustainable livelihoods.
- **Wildlife Conservation Society:** International organization based in the USA, it is involved in the conservation of species with more than 500 projects in 60 countries. It started to operate in Myanmar in 1993, becoming the first international conservation organization to initiate a long-term program in the country. Their activities range from biological surveys, wildlife species population monitoring, to aid in the establishment of protected areas.

- **Human Rights Watch:** Human Rights Watch regularly conduct human rights assessments in oil and gas projects, focusing on the pipelines connecting the offshore fields and the receiving countries than on offshore oil and gas platforms.

6.4.10.7 National Non Governmental Organizations

The economic strategy implemented by the government has succeeded in attracting international investors interests in various business sectors. Industrial developments are significant, increasingly threatening ecosystems that were preserved by years of isolation. To face these new environmental challenges, several national NGOs have been created over the last years to preserve and protect the wide range of natural ecosystems.

- **Myanmar Environmental Rehabilitation-conservation Network (MERN):** MERN is a network of 20 local environmental NGOs created in 2009. It works for environmental rehabilitation and conservation activities in support of local communities, to help them improve their sources of livelihoods and food security. It has in particular a coastal livelihood and environmental restoration program in the state of Rakhine.
- **Biodiversity and Nature Conservation Association (BANCA):** BANCA is a national NGO registered since 2004 whose objectives are to support conservation of nature, biodiversity through advocacy, research, networking and capacity-building programs. It works with the FFI on a marine conservation project. It also worked on projects focusing on inland ecosystems with other international NGOs such as Birdlife International, the Royal Society for the Protection of Birds, Care, Arcona Cambridge, etc.
- **Marine Science Association, Myanmar (MSAM):** MSAM is a national NGO whose objectives are to take part in the sustainable development activities in Myanmar using its marine science expertise to conduct marine and coastal research, conservation and development, and to raise awareness on marine environment preservation.
- **Community Development Association (CDA):** CDA is a registered non-profit, local non-government humanitarian organization established in Myanmar. Its mandates are to implement community developmental elementary interventions with effective involvement of existing support services and technical assistance. The Community Development Association has worked on various humanitarian assistance programs and has collaborated with Total E&P Myanmar.
- **Friends of Wildlife Myanmar**: Run by a former forestry official and based in Yangon, Friends of Wildlife provides education and technical assistance to help local communities shift from slash-and-burn agriculture, hunting, and illegal logging to sustainable agriculture. It is also involved in sustainable fishery management promotion.
- **Burma Environmental Working Group (BEWG)**: BEWG gather Myanmar ethnic environmental and social organizations, providing a forum for member organizations to collaborate on research, reporting, advocacy campaigns, capacity-building initiatives and policy formulation.

6.4.10.8 Media

- **Eleven Myanmar:** Part of the Eleven Media Group funded in 2000, it has 5 weekly publications among which one is in English, and employs 250 staffs. Number of published copies is 450,000 in 2012.
- **The Myanmar Times:** This newspaper has two versions, one in Burmese and one in English. It counts more than 300 employees and has a circulation of around 25,000 copies.
- **The Irrawaddy Magazine:** Newsmagazine founded in 1992 by Burmese exiles living in Thailand. It is unaffiliated politically but supportive of democratic movements, and publishes news in English and in Burmese.

6.4.11 Total E&P Myanmar CSR Programs

Total E&P Myanmar has operated the Yadana gas field since 1998, in a consortium with Chevron (28.26%), Petroleum Authority of Thailand Exploration & Production (25.5%) and Myanma Oil and Gas Enterprise (15%).

Since 1995, it has implemented several socio-economic development programs at the onshore pipeline area, located in Thanintharyi State. In 1998, it extended its programs outside its operation areas to the national scale, focusing on public health and social welfare.

Within the onshore pipeline area, community development projects cover 33 villages representing 38 000 people. Major projects are detailed below:

- Health (eye and dental care, medical staff training, provision of material and infrastructures);
- Education (provision of infrastructures, scholarship and tuition program);
- Community development and humanitarian assistance (flood relief assistance, road safety campaigns);
- Microfinance (Village Bank Committees, capacity-building);
- Support to agricultural activities and veterinary services (rubber, cocoa and paddy farmers, financial and technical trainings for farmers, support to the creation of local farmers associations, animal vaccination campaigns, etc.);
- Infrastructures (roads, bridges, schools, health centers, water network, etc.);
- Solar energy (launching of Total corporate TATS program);
- Good stakeholder relations (communication with regional authorities, grievance mechanism).
- Orphanages;
- Blindness prevention program;
- Integrated HIV Care program;
- Support to Government doctors training;
- Supports to Associate Medicale Franco–Asiatique (AMFA);
- Supports to community in neighborhood;
- “On Job training” facilities to CVT students (Center for Vocational Training);
- Collaboration with Government Technical High School (Dawei).

The 4th phase of the CSR program started in 2016 and will cover the 2016-2020 period with several programs implemented in 2016 which are listed below:

- Preventive health in 6 pilot villages, preparation of preventive health campaigns;
- Established 3 pig breeder famrs;
- Implementation of 2 village run tree nurseries for future seedings distributions;
- Community training center and school based programs (sport & education) initiated in 3 high schools;
- High loan pilot project initiated, introduction of new loan product for vocational training clients.

6.5 SYNTHESIS OF ENVIRONMENTAL SENSITIVITY

The sensitivity of the receiving environment (Se) is integrated into the following impact assessment by determining a sensitivity score. The notion of sensitivity takes into consideration numerous factors including: marine traffic frequencies, biodiversity, presence of protected or rare species, economic importance, capacity to recover and also the percentage of the ecosystem or resource affected compared with regional, national and international ecosystems and resources.

The sensitivity is scored on a scale of 1 to 4, where 1 represents low sensitivity and 4 high sensitivity. The scoring is established qualitatively. General principles for defining the sensitivity value are provided in the following General principles for sensitivity scoring (Se)Table 6-7;

Table 6-7 General principles for sensitivity scoring (Se)

Score	Guide[1]
1	**Very low:** The affected area of the project (or the impact extent) includes a low number of populations, animal or plant species or ecosystems or resources.
2	**Low:** The affected area of the project (or the impact extent) includes a minor or moderate number of human populations, animal or plant species or includes unprotected ecosystems or local resources.
3	**Medium:** The affected area of the project (or the impact extent) includes a significant number of human populations, animal or plant species or includes sensitive or locally protected ecosystems or resources of regional importance.
4	**High:** The affected area of the project (or the impact extent) includes a significant proportion of sensitive human population, sensitive/protected animal or plant species or ecosystems, or includes very sensitive areas or national or global resources.

Note 1: In this table "resources" does not refer to those of the oil and gas field.

The sensitivity of the receiving environment is a significant factor in the determination of environmental consequence and it has been analysed with regards to the analysis provided in the previous chapters of Part § SECTION 6. The sensitivities of each environmental component of M5-M6 Block 3D seismic survey campaign can be summarised as follows Table 6-8.

Table 6-8Synthesis of the sensitivity within the project area

Environmental component		Sensitivity of the environmental component	Score
Physical parameter	Atmospheric environment	The sensitivity of the atmospheric environment to changes in atmospheric emission concentrations in the magnitudes predicted as part of the exploration project is expected to be fairly low due to the other similar industrial activities currently undertaken in the adjacent areas.	1
	Offshore sediments	Offshore sediments consist of high proportions of silt and clay, with high nutrient contents and organics. This indicates a soil environment in generally good condition, with chemical and physical characteristics which would be reasonably sensible to changes in physical composition as a result of seabed disturbance.	2
	Water quality	Water quality in the region of the project area is considered to be good, with acceptable chemical water quality characteristics. Although anthropogenic pollution has been recorded in surrounding blocks, the presence of pollution on Block M5-M6 is not known.	2

Table 6-8Synthesis of the sensitivity within the project area			
Environmental component		Sensitivity of the environmental component	Score
Biological Environment	Plankton	The Andaman sea is very productive with high phytoplankton densities during the Northeast monsoon (November). *Oscillatoria erythraea* and *Proboscia alata* are the dominant species. A rich abundance of zooplankton groups, including calanoid copepods, poecilostomatoid copepods and arrow worms is found present in the project area.	2
	Pelagic Fish	The pelagic fish community is widespread and relatively eclectic in its distribution. A wide variety of jacks, tunnys, barracudas, flying fish, sharks and rays are included in this community that extends across the entire Indian Ocean. A total of 37 pelagic fish species were identified by the IUCN as threatened with different levels of vulnerability in Andaman Sea and Bay of Bengal.	2
	Marine mammals (cetacean/sirenian)	A total of 29 marine mammal species are present in Myanmar according to the IUCN with different levels of vulnerability: • 2 species are endangered (EN) facing very high risk of extinction in the wild: the Blue Whale (Balaenoptera musculus) and the Fin Whale (Balaenoptera physalus); • 4 species are classified as vulnerable (VU) facing high risk of extinction in the wild: the Indo-Pacific Finless Porpoise (Neophocaena phocaenoides), the Irrawaddy Dolphin (Orcaella brevirostris), the Sperm Whale (Physeter macrocephalus) and the Dugong (Dugong dugon). The Dugongs are rare and are mostly found west of the Irrawaddy Delta and further north of the main coastline. • 1 species is near threatened (NT): the Indo-pacific Hump-backed Dolphin (*Sousa chinensis*). Two species of marine mammals typical of coastal areas of the Andaman Sea can possibly be found within the M05-M06 Block. These include: • Irrawaddy dolphin (*Orcaella brevirostris*) (Vulnerable); • Striped dolphin (*Stenella coeruleoalba*) (Least Concern). A total of 10 species are likely to be found within the project area.	3
	Marine turtles	Amongst the turtle species present in Myanmar, 5 species breed regularly on Myanmar's beaches, including the Olive Ridley Turtle Lepoidochelys olivacea (vulnerable), the loggerhead Caretta caretta (endangered), the Green Turtle Chelonia mydas (endangered), the Hawksbill Turtle Eretmochelys imbricata (critically endangered), and Leather Back Turtle Dermochelys coriacea (critically endangered). Most observations of turtles are typically within 15 kilometers of mainland shores in protected, relatively shallow marine waters (22-55 m). However, all the marine turtles species recorded in Myanmar may occur in the M5-M6 Block during migratory movements to and from nesting beaches along the coast with exception of the Loggerhead turtle.	3

Table 6-8Synthesis of the sensitivity within the project area			
Environmental component		Sensitivity of the environmental component	Score
	Seabirds	A total of 20 threatened seabird species are currently identified by the IUCN in Myanmar waters. Amongst these species, 4 species are identified as near threatened and 16 species are recorded as least concern. Taking into account the typical habitat of these seabirds, seven species could potentially occur within the project area.	2
	Benthic communities	Benthic communities (other than coral) are likely to be well presented in terms of species and abundance within the project area.	2
	Mangroves	Mangroves along the Myanmar coast are of great importance. The nearest mangrove areas are located in the Ayeyarwady delta 35 km from the 3D seismic campaign area. They are under pressure from conversion to agriculture.	2
	Coral Reefs	Coral Reef formations in the Irrawaddy coastal zone is restricted to the Coco and Preparis islands which lie outside the zone of influence of river runoff; undocumented reefs may also occur on shallow borttoms lined up with these islands. Preparis Island lies within the study area and Great Coco lies 63 km South of it.	3
	Sensitive and protected areas	There are three sensitive areas located in the proximity of the M05-M06 block, which reflect the original mangrove of the delta: Meinmahla Kyun island, KaingThaung and Diamond Island, which lie respectively 55 km, 35 km and 52 km north of the project area. Myanmar has one identified Ramsar site which is not considered to be affected by the project and 1 Important Bird Area (the Irrawaddy Delta), which is very unlikely to be affected by the project. Preparis island is difficult to access and acts as a border outpost making it fairly pristine, but it does not benefit from a protected status.	2
Societal Offshore environment	Fishing (industrial fishing)	The Project area is located in the offshore fishery zone of the Ayeyarwady region. It is relatively close to the shoreline and at water depths of around 100 m, and is mostly within the area of influence of the nutrient influx from the rivers. Given these parameters, there is a probability that large, industrial fishing fleets legally operate targeting mainly pelagic fish (a probability confirmed by Total E&P Myanmar through its monitoring of fishing activities in M5-M6 for the Yadana project). It is also possible to find foreign fishing fleets (mostly Thai) operating illegally since the recent ban forbids legal foreign fishing. Besides, small-scale fishermen that occasionally venture far away from the coast could be encountered, although this likelihood is much more limited.	3
	Marine traffic	The project is located across the marine routes from Singapore to Bengladesh and from Yangon to the Cape of Good Hope. Additionally, TEPM vessels supporting the Yadana and Sein fields are also active in the survey area.	2

SECTION 7. ENVIRONMENTAL AND SOCIAL IMPACT OF THE PROJECT

7.1 METHODOLOGY

The methodology to assess the environmental impacts is based on Total E&P's specification GS EP ENV 120. This embodies a systematic approach derived from those of the World Bank and the Standard ISO 14001.

The first stage involves establishing the impact factors from the seismic operations based on the project description (see conclusion of SECTION 3), then estimating the environmental sensitivity from the description of the initial or baseline state (see § 6.5).
The second stage involves estimating the potential impact of each impact factor on each sensitive environmental component. This approach is, above all, qualitative and based on the opinions of experts. The results are presented in the matrix of potential impacts in § 7.3 displaying the issues in a quick, global way. The environmentally sensitive elements are shown in the matrix rows and the impact factors in the columns.
The third stage involves drawing up measures for reducing, and compensating for, the potential impacts, then estimating the residual impact of all the impact factors on each environmentally sensitive component. The same assessment system as that applied to the potential impacts is implemented; the impact reduction measures enable its intensity to be modified.

7.2 RATING POTENTIAL AND RESIDUAL IMPACTS

The impact severity (S) is rated by considering the impact intensity (I) and the sensitivity of the receiving environment (Se) based on the table below (Table 7-1).

Table 7-1 Rating impact severity

Severity S = I x Se	Sensitivity of the affected environment (Se)				
		1	2	3	4
Intensity (I)	0	0	0	0	0
	1	1	2	3	4
	2	2	4	6	8
	3	3	6	9	12
	4	4	8	12	16

Positive impact
P

NO IMPACT	
NEGLIGIBLE	MODERATE
MINOR	MAJOR

The environmental sensitivity is assessed in §6.5 6.5 au-dessus

The impact intensity (I) is estimated by an expert based on the environment presented in the table below (Table 7-2).

Table 7-2 Impact intensity

Intensity (I)	Level
MAJOR: Long-term impact (more than 10 years), widespread and slightly reversible or irreversible. Significant consumption of raw materials, water, energy and fuel resulting in shortages on a regional scale. Numerous non-conformities with respect to national regulations and international standards. Air pollution, water contamination, coastal pollution by toxic or non-biodegradable products and/or hazardous substances having a potentially negative impact on human health, including serious injury or death. High ambient noise level affecting health. High underwater noise level resulting in damage and injuries on protected species. Significant production of waste, which is neither sorted nor treated.	4
MODERATE: Medium-term impacts (4 to 10 years), fairly widespread or widespread and reversible. Significant consumption of raw materials, water, energy and fuel resulting in shortages on a regional scale. Air pollution, water contamination, coastal pollution by toxic or slightly biodegradable products and/or hazardous substances having a chronic effect on human health after long-term exposure. Significant production of sorted waste. Ambient noise level slightly higher than legal threshold. Moderate underwater noise level resulting in behavioural changes/stress on protected species.	3
MINOR: Short-term impact (less than 4 years), fairly widespread and reversible. Significant consumption of raw materials, water, energy and fuel on a local scale with possible conflicts. Level of air, water, and coastal pollution detectable, but below thresholds known to have an effect on human health. Acceptable noise level below the thresholds known to have no effect on human health. Minor impacts on protected species. Low waste production and waste sorted and treated by specialized companies.	2
NEGLIGIBLE: Short-term impact (less than 4 years), not widespread and reversible. Low consumption of raw materials with negligible water and energy consumption. Waste effluents released into water, air and soil/ground at near-natural concentrations. Noise level similar to background noise level. No release of hazardous or special waste. Negligible change in the ecosystems and/or landscape. Negligible impacts on protected species.	1
NILL	0

Interpretation of the impact severity can be qualitatively assessed using Table 7-3.

Table 7-3 Impact severity

Environment	Major	Moderate	Minor
Physical and natural environment	Long-term (>10 years) and general changes in characteristics of habitat/ecosystem and its ecological functions. The habitat/ecosystem cannot return to its original state. Sufficient disturbance of a bio-geographical portion of a species population to cause a decrease in its abundance, distribution or size of gene pool, such that the population of the species and other associated species cannot naturally return to the original level. Loss or major modification of an internationally designated site, for which the key characteristics will be fundamentally changed. Injury or death of a species (numerous individuals) classified as "critically endangered" by the IUCN, such that its regional and/or international population is threatened. Incident requiring mobilization of equipment and an international response team.	Changes in characteristics of habitat and ecosystem or its ecological functions, which can return to their initial state within 5-10 years. Sufficient disturbance of a bio-geographical portion of a species population to cause a decrease in its abundance, distribution or size of gene pool, such that the population of the species and other associated species will return to their original level only after several years. Loss or major modification of a locally designated site, for which the key characteristics will be fundamentally changed Injury or death of a species (one or several individuals) classified as "critically endangered" by the IUCN. The mortality rate remains negligible compared with the local population. Incident requiring mobilization of a national or company response resource. Major change in the appearance and sensitivity of a rare or unique landscape recognised locally.	Reduction of the integrity of a habitat and ecosystem, which will nevertheless return to its initial state in 2-5 years with minimum intervention. Disturbance of a bio-geographical population or species individuals resulting in a decline in abundance or distribution of one or several generations, but which does not adversely affect the integrity of other associated species. Injury or death of a species (one or several individuals) classified as "vulnerable" by the IUCN. Mortality rate remains negligible compared with the local population. Incident on site requiring mobilization of equipment and a response team. Development will not affect the key characteristics contributing to the distinctive nature and/or value of the landscape.

Environment	Major	Moderate	Minor
Human environment	Major disruption to fishing activities causing a loss to fishermen revenues and affecting the whole industry, from fishing, processing up to exporting. Major change in maritime traffic through sensitive areas (e.g. international traffic lanes).	Medium and temporary disruption to fishing activities with possible loss of equipment and restriction of access to fishing grounds for fishermen. Increase/change in maritime traffic through sensitive areas (e.g. international traffic lanes).	Minor and temporary disruption to fishing activities with possibility for fishermen to use other fishing areas during the operation. Minor increase/change in marine traffic through sensitive areas (e.g. national traffic lanes).

7.3 IMPACT SCREENING

7.3.1 Environmental and social risks

A summary of the key sources of environmental/social risks for the proposed activity include:

- Emission of underwater seismic pulses;
- Physical presence of vessels and gear on the surface and in the water column (footprint),
- Light emission from survey, support and chase vessels;
- Loss of streamers and associated equipment;
- Atmospheric emissions from vessels;
- Discharge of ballast water and vessel biological fouling (biofouling);
- Routine discharge of wastewater and waste to the ocean from survey, support and chase vessels;
- Accidental discharge of hydrocarbons and chemicals to the ocean from survey, support and chase vessels.

7.3.2 Environmental and social impacts

A summary of the potential environmental/social impacts associated with the sources of risk listed above include:

- Disturbance to marine fauna including cetaceans, whale sharks, turtles, fish and plankton because of underwater noise generated;
- Disturbance to the seabed and benthic habitats and communities;
- Reduced air quality from atmospheric emissions as a result of engine operation and use of internal combustion engines;
- Introduction of invasive marine species as a result of ballast water discharge and vessel biological fouling;
- Marine pollution from routine discharges including sewage water, bilge water and other solid wastes;

- Marine pollution from accidental discharges including hydrocarbon spills and hazardous materials; and
- Indirect employment;
- Disturbance to fishing industry activities and to marine traffic, particularly around Yadana platforms;
- Disturbance to social and community values due to potential interactions with local fishermen;
- Interactions with other oil and gas exploration activities;
- Collision with marine fauna.

7.3.3 Leopold matrix

The Leopold matrix hereafter gives an overview of potential impacts of the seismic project within the M5-M6 Blocks, that is to say, rate of impacts before implementing proposed mitigation measures.

Potential Impact Matrix

Severity (S) = Intensity (I) x Sensibility (Se

No impact

1-2 : Negligible

3-4 : Minor

5-9 : Moderate

>9 : Major

Se : Environmental sensitivity (1 to 4)
S : Severity = Se x I
I : Impact intensity : Negative - 0 to 4

Environment		Underwater noise from airgun	Physical presence on surface and in water column	Physical contact with coral and other sensitive species and habitats	Spills (particularly during bunkering)	Misc. stray emissions from shipping: atmospheric pollutants, non-seismic noise, light, biological dispersal, discharges and waste
Physical environment	Atmospheric environment	0	0	0	0	0
	Offshore sediments	0	0	2 2 1	2 2 1	2 2 1
	Water quality	0	0	0	2 4 2	2 4 2
Biological environment	Plankton	2 4 2	0	0	2 2 1	2 4 2
	Pelagic fish	2 2 1	2 2 1	0	2 4 2	2 4 2
	Marine mammals	3 12 4	3 6 2	0	3 6 2	3 6 2
	Marine turtles	3 12 4	3 6 2	3 6 2	3 6 2	3 6 2
	Seabirds	2 4 2	0	0	2 4 2	2 4 2
	Benthic communities (other than coral)	0	0	2 2 1	2 2 1	2 4 2
	Mangroves	0	0	0	2 4 2	2 4 2
	Coral reef ecosystems	3 6 2	0	3 12 4	3 6 2	3 6 2
	Sensitive and protected areas	0	0	0	2 4 2	2 4 2
Societal offshore environment	Offshore fisheries	3 6 2	3 6 2	0	3 3 1	3 6 2
	Marine traffic	0	3 9 3	0	0	0

Figure 7-1 Matrix of potential impacts

Residual Impact Matrix

Severity (S) = Intensity (I) x Sensibility (Se

No impact
1-2 : Negligible
3-4 : Minor
5-9 : Moderate
>9 : Major

Se : Environmental sensitivity (1 t
S : Severity = Se x I
Impact intensity : Negative - 0 to 4

Environment		Underwater noise from airgun	Physical presence on surface and in water column	Physical contact with coral and other sensitive species and habitats	Spills (particularly during bunkering)	Misc. stray emissions from shipping: atmospheric pollutants, non-seismic noise, light, biological dispersal, discharges and waste
Physical environment	Atmospheric environment	0	0	0	0	0
	Offshore sediments	0	0	2 2 1	2 2 1	2 2 1
	Water quality	0	0	0	2 2 1	2 2 1
Biological environment	Plankton	2 4 2	0	0	2 2 1	2 2 1
	Pelagic fish	2 2 1	2 2 1	0	2 2 1	2 2 1
	Marine mammals	3 6 2	3 6 2	0	3 3 1	3 3 1
	Marine turtles	3 9 3	3 6 2	3 3 1	3 3 1	3 3 1
	Seabirds	2 4 2	0	0	2 4 2	2 4 2
	Benthic communities (other than coral)	0	0	2 2 1	2 2 1	2 2 1
	Mangroves	0	0	0	2 2 1	2 2
	Coral reef ecosystems	3 6 2	0	3 3 1	3 3 1	3 3 1
	Sensitive and protected areas	0	0	0	2 4 2	2 4 2
Societal offshore environment	Offshore fisheries	3 3 1	3 3 1	0	3 3 1	3 3 1
	Marine traffic	0	3 3 1	0	0	0

Figure 7-2 Matrix of residual impacts

7.4 SPECIFIC IMPACT ON MARINE MAMMALS, TURTLES & FISH

Potential specific impacts generated by the seismic survey are linked to:

- Underwater acoustic emissions caused by the use of airguns and, to a lesser extent, by the functioning of vessel's motors;
- Use of tail buoys propellers which may mutilate sea turtles.

Figure below synthetizes the main direct/indirect impacts caused by the functioning of airguns during the seismic campaign.

7.4.1 Underwater acoustic emissions

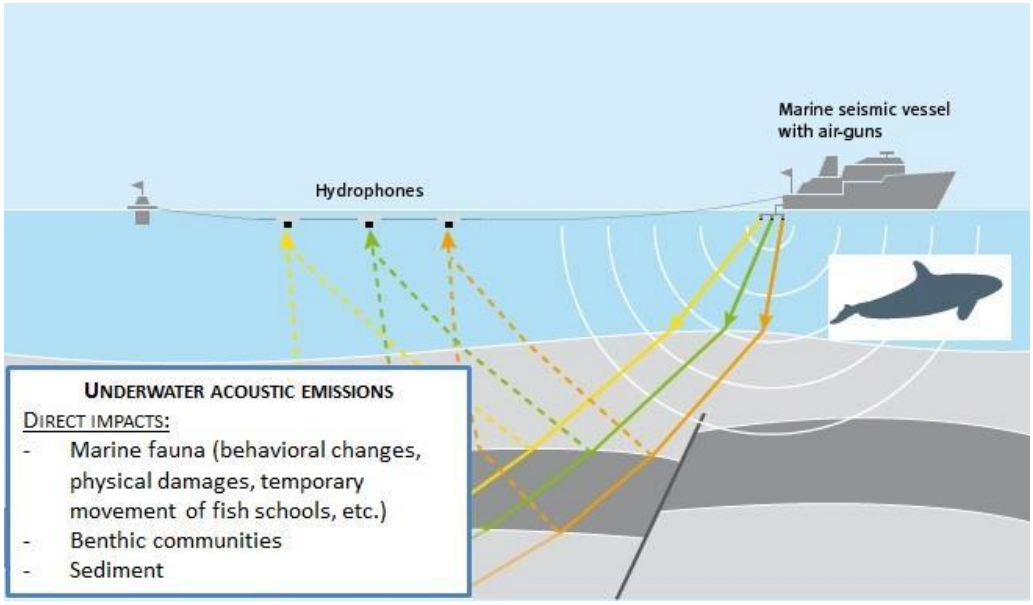


Figure 7-3 Listing of directs/indirect impacts caused by underwater acoustic emissions

The main noise sources associated with the seismic survey activities are a result of the airgun operations of the seismic vessel, which produce high energy, low frequency sound transmission to characterize the ocean's geological features and is directed towards the seabed. These sounds are often described in terms of their intensity (expressed in decibels, dB), frequency and duration (e.g., continuous or impulsive). Sound levels from seismic activities vary from project to project but usually the pressure from airguns typically ranges from 2000 to 5000 psi. In terms of decibels this can exceed 230 dB but most of this energy is centered at low frequency typically below 300 Hz (e.g. from **7 to 104 Hz** on the pevious TEPM campaign, on block YWB). Because low frequency sound is transmitted through water over greater distances than high frequencies, seismic airguns can be heard several kilometres away from the source sometimes as much as 200 km away. Theoretical source levels during the YWB survey was approximately **251 dB re 1 µPa-m-1 (RMS).** It should be noted that the use of slanted arrays optimizes the the amount of information that can be collected for the same power.

These elevated noise sources are considered likely to have an impact on marine mammals hearing and also on the animals' physiology and behaviour. Marine mammals produce sounds to serve predominantly social function, including reproduction and maintaining contact, but they may also play some role in spatial orientation. Some whales, dolphins and porpoise produce specialized clicks used in biosonar

(echolocation) systems for prey detection and navigation, especially in the darkness. This intense sound hits an object such as a fish and an echo is created. The animal picks up these echoes in special tissues in its lower jaw, which are then passed on to the ear. The echolocation clicks can be very intense such as the bottlenose dolphins and sperm whales echo locating up to 220 dB re 1 µPa.

It is worth noting however that at any point in the water column, natural sound levels will be elevated as a result of medium pressure (being 20 µPa for air as opposed to 1 µPa for water). Figure 7-4 presents the relation and extent of underwater sounds and compares them to threshold levels for the responses of marine mammals (Richardson *et al* 1995).

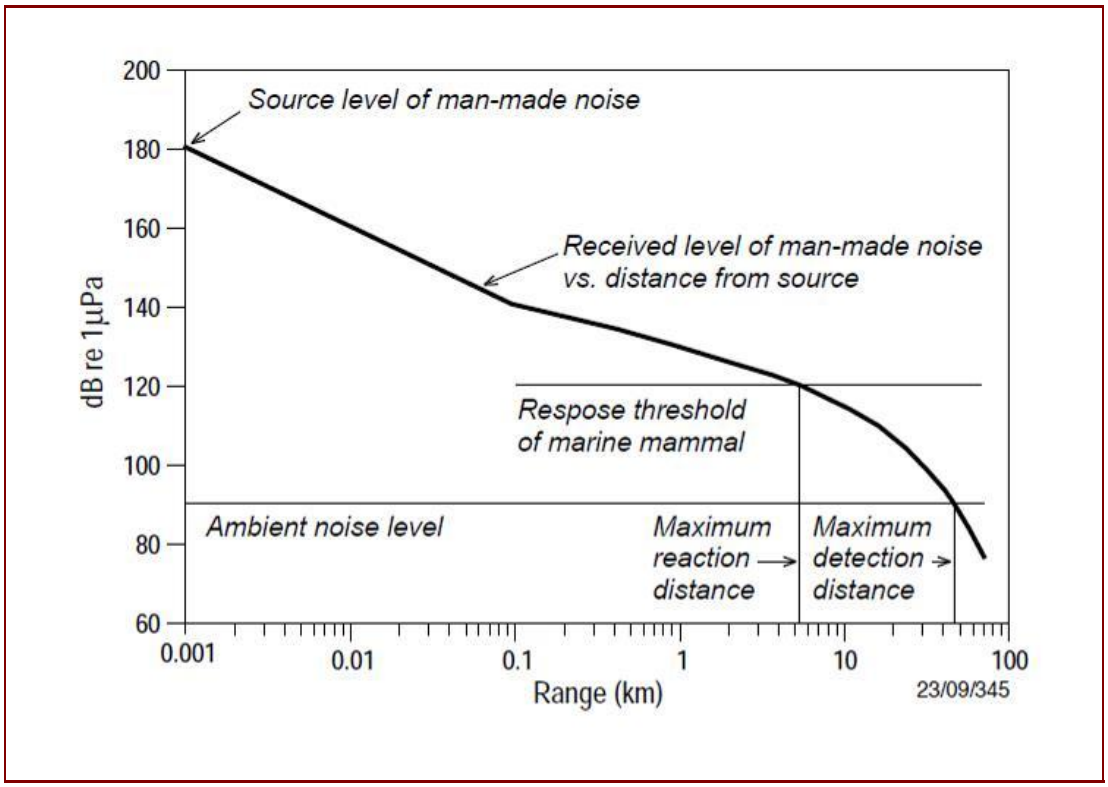


Figure 7-4 Theoretical interrelationships of the source level and marine mammal response

SOURCE: RICHARDSON ET AL. 1995

Response thresholds of marine mammals are well above ambient noise level and are estimated by Richardson *et al* at 120 dB re 1µPa for a distance between 5 and 6 km from the source (180 dB re 1 µPa). The detection distance from the source level created compared to sea ambient noise level is estimated between 40 and 50 km from the source. These figures may vary according to local climate conditions and bathymetry.

7.4.2 Potential impact on marine fauna

As shown in § 7.4.1 , the frequency range of seismic signals coincides with the audiogram of many marine species and may therefore interfere with their normal behaviour.

Disturbance of marine organisms by sound emissions can generally be classified as physical or behavioural. It has been argued that the auditory system of marine mammals is sensitive to physical damage from sound pressure. Thus, mitigation measures have been developed with the aim of preventing

from auditory damage against different forms of physical impacts (e.g. tissue damage) and behavioural disturbance (interfere with orientation, communication, feeding or migrating processes).

The potential major acoustic impacts of anthropogenic noise sources on marine fauna include:

- **Death or physical injury** as a result of exposure to excessive underwater noise such as air gun fire. These incidents **are rare and are limited to an exposure range of several meters to a few hundred meters from the source**. Temporary or permanent hearing losses are the most common injuries to mammals, even at low exposure levels for particularly sensitive species. Other observed responses include increased stress levels which may result in the compromise of immune, cardiovascular or reproductive systems of the animal. Changes in diving behaviour and respiration rates have also been noted.
- **Minor to severe behavioural changes** as a result of exposure to anthropogenic noise. Noise exposure can also affect reproduction rates of marine species by causing interference with migratory routes, places of habitat, calving, reproduction and nurturing behaviour as a result of modification of routines to avoid noise exposure. These consequences are highly temporally dependent and can have significant impacts on species survival and abundance.
- **Masking of critical sounds** such as those used for navigation, communication, detection of prey, fleeing from predators and potential mates (reproduction).
- **Indirect effects**, such as changes in the abundance or behaviour of prey animals.

In consideration of these potential consequences it is necessary to determine the acoustic impacts and significance to marine fauna during the seismic acquisition survey.

Further effects of nearby airgun operations on marine species have been the subject of numerous literature studies. Available research generally indicates that among the key elements of the ecosystem, including invertebrates, fish, marine mammals and sea turtles, physiological and behavioural effects vary greatly from one species to another and depend on the exposure level, i.e. the distance from the source.
The main marine species living within the project area include (see § 6.3):

- Phytoplankton (see. § 7.5.1);
- Benthic community (see. § 7.5.1);
- Pelagic fish;
- Marine reptiles (turtles);
- Marine mammals.

A brief description of the main effects on Fish, turtles, marine mammals for exposure levels are presented in the sub-sections below.

7.4.2.1 Fish species

Seismic surveys can have an impact on individual fish, fish populations and fisheries, either directly through harmful physiological effects or behavioral effects. Many fish species display a general ‘alarm’ response of increased speed at 156 - 161 dB re 1 µPa rms, which is included in the disturbance avoidance range of baleen whales (see Figure 7-4).

Fish eggs, larvae and fry: the physiological effects will mainly affect younger stages of fish life such as eggs, larvae and fry. These are stages in fish development where the organisms have limited ability to escape from their habitual areas in the event of various influences. (DNV Energy, 2007).

Adult fish: For later life stages and for adult fish, the behavioral effects are considered most important. This can mean that fish are scared away from fishing banks and areas. It can thus be of indirect but significant importance for the fisheries due to reduced abundance of fish to catch and thus smaller

catches. Some findings by McCauley *et al.* (2003) also indicated harmful effects on the part of adult fish. Serious injuries were proven in hearing sensor cells.
Another issue is potential disturbances that spawning fish may be exposed to in spawning areas and during concentrated spawning journeys to the spawning grounds. This can change the areas that are used for spawning, and possibly the timing of the spawning, so that spawning conditions become less favorable. This could at worst reduce the total annual reproduction.

7.4.2.2 ***Potential impacts on turtles***

Turtles are highly migratory marine species which mainly live within 15 km of the shore. Turtles often occur on Myanmar's beaches and surrounding islands such as Diamonds Island. Kaing-Thaung Island and Taung-Ka-Done Island respectively host the nesting olive ridley turtle and loggerhead turtle.

Figure 7-5 Picture of a green sea turtle

Sea turtles use a wide range of broadly separated localities and habitats during their lifetimes (for review see Hirth 1997). Upon attaining sexual maturity green turtles commence breeding migrations between foraging grounds and nesting areas that are undertaken every few years (Hirth 1997). Migrations are carried out by both males and females and may traverse oceanic zones, often spanning thousands of kilometers (Carr 1986, Mortimer and Portier 1989).

Green turtles are known to currently lay eggs on Great Coco Island and on Diamond Island. They were also documented by the IUCN in 1984 as being very abundant on Preparis Island in 1911. Preparis Island was raised by 30-40 cm during the 2004 earthquake and it is not clear how this affected the island's value as a nesting area. However, due to the lack of information on the distribution of turtles in sea waters of Myanmar and their migration route, other species may also be present.

Despite being listed as endangered or critically endangered by the IUCN, marine turtle species are included only in the Brazilian (IBAMA 2005) and Canadian (DFO 2005) mitigation guidelines and there has been no airgun-related research on free-ranging turtles. Controlled exposure experiments on captive turtles found an increase in swim speed and erratic behaviour indicative of avoidance, at received airgun sound levels of 166–176 dB re 1 µPa (rms) (O'Hara & Wilcox 1990; McCauley *et al.* 2000). Their behaviour becomes more agitated when noise levels reach 175 dB re 1 µPa (rms).

The limited available data on marine turtle hearing suggest highest auditory sensitivity at frequencies of 250–700 Hz, and some sensitivity to frequencies at least as low as 60 Hz (Ridgway *et al.* 1969; O'Hara & Wilcox, 1990; Moein-Bartol *et al.* 1999), overlapping with the higher frequencies produced by airguns.

While there has recently been an increased interest in sea turtles because of the endangered or threatened status of some species, relatively little is known about the sensitivity of these species to sound. As a measure of precaution, given the limited knowledge on the sensitivity of sea turtles to sound and given the endangered status of a number of sea turtles, the fisheries and Oceans Department of Canada concluded that sea turtles should have the benefit of the same mitigation measures as marine mammals.

Based on studies that have been conducted to date (DFO, 2004), it is considered unlikely that sea turtles are more sensitive to seismic operations than cetaceans or some fish. Therefore, mitigation measures designed to reduce risk or severity of exposure of cetaceans to seismic sounds may be informative about measures to reduce risk or severity of exposure of sea turtles to seismic sounds. However sea turtles are harder to detect both visually and acoustically than are many species of cetaceans, so mitigation strategies based on sightings or acoustic detection of turtles, are expected to be less effective for turtles than for cetaceans.

Because turtles need to surface for breathing, they are known to get mutilated by the propellers of the tail buoys that end the streamers; the issue is common enough for turtle-friendly tail bouys to have been developed. In the present campaign a slanted array configuration will be used whereby the streamers do not float along the surface; this is expected to reduce the probability of turtles being pulled into contact with the tail buoys.

7.4.2.3 ***Potential impact on marine mammal species***

The study area is likely to be frequented by many species of marine mammal, in particular cetaceans, which are highly sensitive to the acoustic waves generated during seismic campaigns. Cetaceans are particularly susceptible to alterations in the acoustic environment as their sensory response system includes not only the ear but also the lower jaw and potentially the skin.

Two major groups of marine mammals occur in the waters off Myanmar; namely sirenians (dugong) and cetaceans organized into two groups the ondotocetes - toothed whales (killer whales, sperm whales, pilot whales and all dolphins and porpoises) and the mysticetes - baleen whales. Dugongs tend to be coastal, and are often associated with seagrass beds that do not occur in the survey area; they are therefore not expected to occur.

A total of 29 marine mammals species have been identified in section 6.3.1.5 to potentially occur within the survey area, including dolphins, porpoise, toothed whales and baleen whales.

Dolphins & porpoises

The dolphins and porpoises (ondocete cetaceans) produce sounds across some of the widest frequency bands that have been observed in animals. Their social sounds are generally in range audible to humans, from a few hundreds of Hz to several tens of kHz, but specialized clicks used in biosonar (echolocation) systems for prey detection and navigation extend well above 100 kHz (Southall *et al.* 2007).

Controlled studies on dolphins in tanks confirm that sensory reception is broadband (up to about 120-130 kHz) with a maximum sensitivity of between 5 and 100 kHz. The threshold of hearing is estimated at around 35-50 dB re 1m Pa at 1m for small and medium-sized odontocetes.

Striped dolphin (*Stenella coeruleoalba*), adopt avoidance behaviour when noise levels reach 150 - 160 dB re 1 µPa rms (McCauley *et al*, 2000).

Exposure to sufficiently high levels of noise can cause an upward shift in the threshold of hearing. These can be temporary threshold shifts (TTS) the severity of which is dependent on the level of sound and how long the exposure to this sound lasts. Bottlenose dolphins exposed to a single one second pulse of strong sound (192-201 dB) experienced mild TTS (Schlundt *et al*., 1999) However, hearing thresholds shifts were recoverable 12 hours after the last exposure. The TTS thresholds have not been quantified for repeated sounds such as seismic pulses.

Whales

Little practical information is available regarding the sensory responses of whales; however empirical studies indicate an aural sensitivity centered around the low and mid frequency ranges (1-20 kHz). The hearing threshold would be higher compared to dolphins, approximately 40-70 dB re 1m Pa at 1m relative to the much higher background noise in this spectrum range.

The large whales (mysticeste cetaceans) generally produced low-frequency sounds in the tens of Hz to the several kHz band, with a few signals extending above 10 kHz (Southall *et al*. 2007).

Physical damage includes tissues damage and hemorrhaging. There is some evidence that loud levels of sound can cause direct damage to the auditory apparatus. For eg. ear damage was reported during humpback whale post-mortem examinations from two individuals dead in the vicinity of Trinity Bay, NE Newfoundland, where industrial noises underwater drilling, blasting and dredging occurred at high sound levels, mainly between 20 – 400 Hz (Lien *et al*. 1995).

Concern has been expressed for deep diving species whose diving patterns may be disrupted by high levels of sound. These animals will be on a strict energy budget during deep dives and if startled may not have enough oxygen stored to flee from the noise source. Rapid swimming to the surface caused by startling the animals may also results in bends – a condition in which gas bubbles form in the blood and tissues as a result of surfacing too fast. Gas bubbles have been found in the tissues of cetaceans, in particular the liver, from animals that stranded after exposure to military sonar.

Figure 7-6 indicates the increased sensitivity of baleen whales (or cetaceans) to underwater airgun noise levels. Considering the maximum threshold for marine mammals and the sound power level of a typical airgun (ranging from 220 to 250 dB re 1 µPa), is it likely that the signal will be perceived by most types of marine organisms present in the area. For this reason the impacts on cetaceans will be considered in particular for this assessment, to indicate the worst-case scenarios of potential noise impacts on marine mammals in the area.

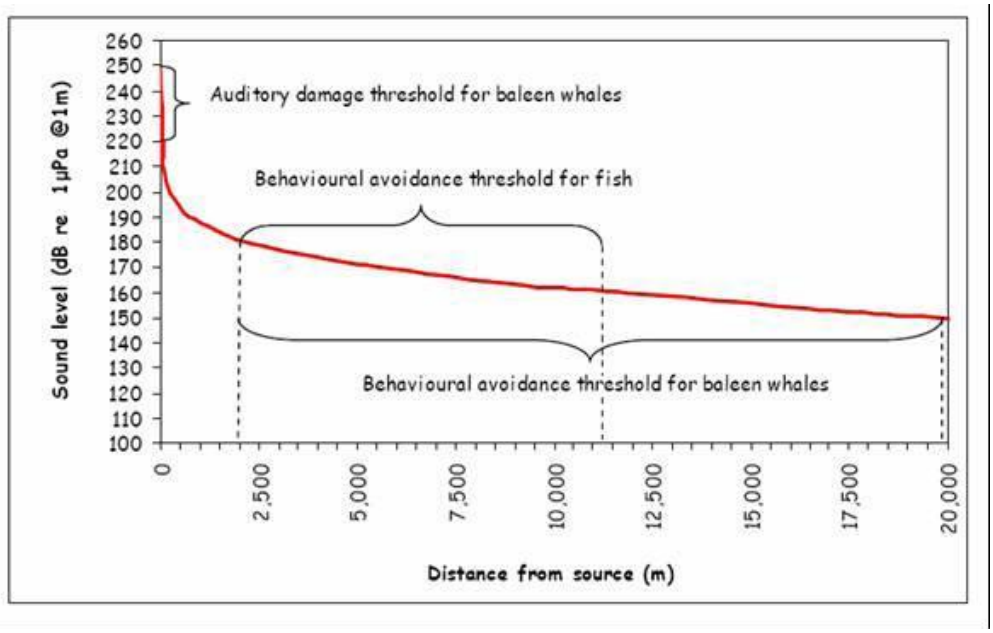


Figure 7-6 Impacts of underwater sound levels on marine mammals generated by typical airguns

7.4.3 Conclusion of specific impacts on marine mammals, turtles and fish

Table 7-4 below synthetises potential impacts on marine mammals, turtles and fishs, mitigation measures proposed (they are detailed on SECTION 9) and assessment of residual impacts after implementing mitigation measures.

Table 7-4 Impacts and mitigations on marine mammals, turtle and fish

IMPACT PRODUCING FACTOR AND POTENTIAL IMPACT	MITIGATION MEASURES	ENVIRONMENTAL CONSEQUENCES	RESIDUAL IMPACT RANKING
Impacts on adult fish			
Use of airguns I = 2 Se = 2 Seismic surveys may affect fish that possess a swim bladder and whose audible frequency range and threshold levels overlap with the frequency range of airguns. The potential effects at different distances from typical airgun are as follows: - Physical damage to fish hearing organs and swim bladder at very close distance (max. :20 m from the air gun); - Startle response at 20 – 500 m of the air gun; - Alarm response at distance of 500 m to 1 km - Subtle changes in behaviour within 10 km. As a general statement, fish have a good hearing at low frequencies, and are probably able to hear seismic sound sources at large distances (up to several kilometers). These effects of air guns will however, vary with the fish size and species.	A soft-start procedure will be implemented. Prior to acquiring data from each seismic line and after each break in operations, power will be built up slowly in the seismic array over a period of at least 20 minutes and no longer than 40 minutes.	A number of 37 threatened species are known to occur within the Andaman sea. However, the pelagic fish community is widespread and relatively eclectic in its distribution. Although fish are likely to be present in the vicinity of the seismic area during the airgun operations, it is considered that adult fish exhibit avoidance behaviour in response to noise. In other words, they will leave the vicinity with the approach of the seismic vessels or during the progressive slow build up of power. Therefore, adult fishes may effectively evading potential damage. Due to the confirmed presence of fish within the project area, including sensitive pelagic fish, the effect is therefore considered as minor to negligible.	I = 1 Se = 2 **Minor to negligible** If a soft-start procedure is implemented

IMPACT PRODUCING FACTOR AND POTENTIAL IMPACT	MITIGATION MEASURES	ENVIRONMENTAL CONSEQUENCES	RESIDUAL IMPACT RANKING
Impacts on juvenile fish			
Use of airguns I = 2 Se = 2 Noise emissions may cause short-term disturbance to reproduction patterns of certain fish species, which form few, concentrated breeding aggregations. However, in order to have a detectable effect on reproduction, the seismic survey would need to be performed close to the breeding sites over a sustained period while the fish was spawning (Swan, Neff, Young, 1994).	No mitigation measures identified.	Of the studies that report the physiological and behavioral effects of sound exposure from airguns on fish eggs and larvae, most of them confirm that sound levels greater than 230 - 240 dB peak-to-peak re 1 µPa are required to generate physical injury. Consequently, juvenile fish located at a distance of several meters from the airgun will be subjected to physical injury. Natural mortality rates for juvenile fish are high (5 to 15% per day for most species at this life stage), therefore it is considered that the direct mortality effects of the seismic survey would lead to neither statistically significant nor measurable impacts to fish recruitment at the population level. Considering the high natural rate of mortality of juvenile fish and also their widespread and relatively eclectic distribution amongst seawaters, few individuals will be affected. The impacts are considered to be temporary and negligible.	I= 2 Se = 2 **Minor**
Impacts on marine mammals (cetaceans)			
Use of airguns I = 4 Se = 4 3D seismic surveys may have detectable effects on marine mammals though mortality is unlikely. Information on breeding, calving and migratory routes of cetaceans in the offshore region of Myanmar is limited. Generally, marine mammals are sensitive to high frequency components of the seismic shots, low frequencies are not audible. The possible effects of seismic sound exposure on marine mammals are:	- Establishment of a shutdown zone with a **radius of 500 m as recommended per JNCC when insufficient information is available).** This radius is to be confirmed by calculations once the exact characteristics of the airgun are known (e.g. on previous campaigns, 2,800 m were required for low frequency cetaceans (i.e adult length > 8 m) and **800 m** for medium/high frequency cetaceans (i.e adult length < 8 m). - During the pre-shooting watch, the seismic survey will be stopped if a marine mammal is observed within this area. If a marine mammal enters the zone after operations have started, no mitigation actions are recommended by the JNCC. - Establishment of an observation zone (**radius of 3 km**) from the center of the seismic source array. Within this area, continuous visual	M5-M6 block zone is not known to be a feeding or a breeding/nursery area. However, a number of cetaceans may occur within the project location during the programmed seismic activities. The presence of two MMOs onboard the main survey vessel and the soft-start procedure should ensure that any cetaceans in the vicinity can leave the area before the beginning of the survey. These measures are absolutely necessary.	I=2 Se = 4 **Moderate** MMO presence on-board the seismic vessel and a procedure to monitor cetacean presence is to be implemented

IMPACT PRODUCING FACTOR AND POTENTIAL IMPACT	MITIGATION MEASURES	ENVIRONMENTAL CONSEQUENCES	RESIDUAL IMPACT RANKING
- Displacement from feeding grounds, resting areas, breeding areas and/or migratory diversion. - Change in dive and respiratory patterns causing interference with feeding and incurring increased energetic needs. - Changes in social behaviour. - Change of vocalization patterns - Reduced communication capabilities. Moreover, high energy of low frequencies could result in a loss of hearing sensitivity which could be temporary or permanent, depending on the species and the sound intensity.	monitoring will be undertaken by a qualified Marine Mammal Observer (MMO) on the seismic survey vessel, including continuous monitoring during a period of at least 60 minutes prior to airgun start-up (applicable to deep waters). Due to the duration of the campaign**, two MMO**s are required on the vessel, one of whom will be fully qualified. - 1 **observer** on each of the 2 support vessels in addition to the MMO on seismic vessel. The observers will be members of the crew of each vessel trained by the MMO before the beginning of the survey. The observers will be in charge of reporting any marine mammals approaching the area (see Figure 9-2). - In order to assess the impact of the campaign, MMO observations will include 1 month before the seismic shooting and one month after it. - Establishment of a **delay period** of 20 minutes before the start-up (including soft start) after the last sighting of a marine mammal within the shutdown zone. - Passive Acoustic Monitoring (**PAM**) or **infra-red** or **night vision** equipment will complement visual observation during night time and low visibility operations. - Implementation of a **soft-start** procedure. Prior to acquiring data on each seismic line and after each break in operations, power will be built up slowly in the seismic array over a period of at least 20 minutes (no longer than 40 minutes).		

IMPACT PRODUCING FACTOR AND POTENTIAL IMPACT	MITIGATION MEASURES	ENVIRONMENTAL CONSEQUENCES	RESIDUAL IMPACT RANKING
Impacts on sea turtles			
Use of airguns I = 4 Se = 4 Behavioural changes in response to underwater noise has been reported for some sea turtles, however, no conclusive evidence of pathological pattern is identified. High noise level may cause: - Disturbance to mating and nesting behaviour; - Disturbance to turtles mechanism for orientation (navigation) and affecting migration pattern; - Increased swimming speed; - Increased activity; - Change in swimming direction; - Avoidance. Possible physical mutilations of sea turtles with tail buoy propellers or streamers.	- The towed seismic propellers will be equipped with guards to prevent catching turtles. - Regular cleaning of streamers to prevent turtles being attracted to the food sources that become attached to the streamers. - Establishment of a shutdown zone which is the same as for medium/high frequency marine mammals. - Ramp up approach (soft start) to enable turtles to escape the area of greatest impact. - See also controls and mitigations for the cetaceans above.	Sea turtles migrate to and from Myanmar beaches during the nesting season which is from September to March (with a peak in January-February). Typical behavior of turtles observed in the world is an arrival on beaches in September – November, lay hutches for a few weeks (3 to 4) and return to sea. The hatching occurs approximately 2 months later and can occur at the latest in May. The seismic activities will be carried out in an area known to harbor at least green turtles. It will be performed during periods that will overlap the nesting season (i.e. November to March (i.e mainly during the nesting season). The presence of the MMO onboard the vessel and the soft start procedures should reduce the risk for sea turtles of being affected by the activities. The impact on marine turtles is therefore considered as minor.	I=2 Se = 4 **Minor** A MMO on-board the seismic vessel and a procedure to monitor sea turtles presence will be implemented
Impacts on marine fauna in general (including marine mammals, turtles and fish)			
Accidental releases (Hydrocarbon spill) I = 2 Se = 2-3 **Moderate** Oil spill occurring during bunkering or a collision with another vessel. The amounts are limited to the fuel for the vessels, no other hydrocarbons are transported. The greatest risk comes from bunkering at sea.	Strict bunkering procedures to be applied: bunkering during daytime and not upstream from coral reefs. Bridge manned permanently. Modern navigation equipment to indicate the approach of other vessels complete by surroundings surveillance by chase boats; SOPEP plans required by MARPOL to be completed with ability to deal with a small spill during bunkering. Training of teams to ensure proper response to spills.	Given the low probability of an oil spill and the mean amount of fuel that could be spilled during the most likely scenarios (one hoseful during refuelling), this impact can be considered as minor if te mitigation measures are adhered to.	I=1 Se = 3 **Minor**

7.4.4 Additional information

The probability of a collision is low. In the case of collision, the volume of oil discharges into the sea will be limited to the volume on the two boats involved in the collision (fuel capacity for 1 vessel: ca .6,500 m^3) as **seismic exploration does not include extraction of hydrocarbons** from the ground (contrary to certain types of drilling).

The United-States BSEE statistician (Bureau of Safety and Environmental Enforcement) provides general statistics and summaries of OCS (Outer Continental Shelf) incidents reported by year. Some case of spillage and collisions were recorded by BSEE between 2007 and 2012 in the Gulf of Mexico Region and the Pacific Region.

Table 7-5 OCS collisions/spillage (2007-2012)

Type	2007	2008	2009	2010	2011	2012
Number of spills > 50 Barrels						
Crude Oil & Natural Gas Condensate	1	19	4	2	1	1
Synthetic-Based Fluids	2	2	4	2	2	3
Chemicals, e.g., Zinc, Bromide, Glycol, Methanol	1	12	3	1	0	4
Total for the year	4	**33**	**11**	**5**	**3**	**8**
Collisions						
Total for the year	21	22	29	8	14	7

SOURCE: BSEE DATABASE AS OF JANUARY 2013

The various fluid spillages are specific to exploration or production drilling activities and cannot be bound to seismic operation. Between 2007 and 2012, 28 hydrocarbons spillages were recorded by BSEE. They are all recorded during drilling or production activities. **No spills were recorded during seismic activities. Collisions represent less than 2 % of the totality of incident**. The main types of incidents reported are injuries (47%) and varied incident (26%).

7.5 OTHER ENVIRONMENTAL AND SOCIAL IMPACTS

7.5.1 Potential impact of airguns on benthic community, plankton and seabirds

Recent scientific investigations have found that different marine species have different acoustic response thresholds to nearby airgun activities. The sound exposure levels for of some plankton like fish larvae are summarized in Table 7-6.

Table 7-6 Observed pathological effects associated with seismic noise

Species	Source	Level (dB at 1 m re 1 µpa)	Distance From Source (m)	Exposure Level (dB re 1 µpa)	Observed Effect	Reference
Fish and plankton						
Cod (adults)	Single air guns and arrays, 1,000-20,000 cm^3	220-240 (estimated)	0.5	226-246	Haemorrhaging and eye damage	Kosheleva, 1992
			1.0	220-240	No harmful effects	

Species	Source	Level (dB at 1 m re 1 µpa)	Distance From Source (m)	Exposure Level (dB re 1 µpa)	Observed Effect	Reference
Cod (adults)	Electrically generated signal in laboratory conditions	Not stated	Not stated	192-198	Transient shunning, no subsequent mortalities	Hastlings, 1990
Cod (larvae 5 days)	Single air gun	250	1	250	Delamination of the retina	Matishov, 1992
Snapper (adult)	Single air gun	220	<15 m at closest	Not stated	Damage to otoliths	McCauley *et al.*, 2003
Cod (larvae 2-110 days)	Single air gun	222	1	222	No injuries detected	Dalen and Knulsen, 1987
			10	202	No injuries detected	
Fish eggs Anchovy	Single air gun	230 (estimated)	1	230	7.8% of eggs injured relative to control	Kostyvchenko, 1973
			10	210	No injuries detected	
Fish eggs Red Mullet			1	230	No injuries detected	
			10	210	No injuries detected	
Rainbow trout	Single air gun	229	150	160	No injuries detected	Thomson, 2002
Not reported	Single air gun	230	0.6 to 1.5	234	Lethal effect	Falk and Lawrence, 1973
			1 to 2	226	10 to 20% showed signs of swim bladder damage	
Dungeness Crab	Seven air gun array	244 (estimated)	1	233.5	No significant difference in survival rate relative to controls	Pearson *et al.,* 1994
			3	230.9		
			10	222.5		
Snow Crab	Seven air gun array		50	197 to 225	No significant difference between exposed and unexposed crab	Christian *et al*., 2003
Benthic species						
Mussel	Single air gun	223 (estimated)	0.5	229	No detectable effect, all three groups continued to function normally after airgun exposure. Monitoring over next 30 days revealed no adverse effects.	Kosheleva, 1992
Periwinkles						
Crabs						
Sea Urchin	Single air gun	223 (estimated)	2	217	15% of spines fell off	Malishov, 1992

Based on current information, the following impacts have been assessed for plankton, benthic community and pelagic fish.

7.5.1.1 ***Benthic organisms***

Benthic organisms that could be potentially affected by the project live permanently on or in the substrate bottom of the seabed. The communities present are of course expected to vary from one part of the project to another, due to the wide range of depths (10 to 2300 m) and exposure to sediment from the Ayeryawadt delta. From the available literature, little research has been conducted on the effect of seismic surveys on zooplankton and other small organisms (DNV, 2007). However, according to Table 7-6, no effects were detected after airgun exposure (Kosheleva, 1992). Only physiological effects were detected on sea urchins with loss of 15% of spines (Malishov, 1992).
In the USA, Pearson *et al.* (1994) conducted experiments with air guns (seven guns with a total chamber volume of 13.8 liters) on early life stages of Dungeness crabs. A survival reduction of less than 10% was observed for the larvae at any specific stage, i.e. at the stage for the second ecdysis. There were no other effects. Christian *et al.* (2003) conducted similar experiments on snow crabs. Their egg development stages exhibited definite developmental differences between the control groups and the test groups for eggs exposed at a distance of 2 m from a single, small air gun of 0.7 liter. Both the test and control groups were examined over a 12-week incubation period in the laboratory. Other than this, there was no indication of immediate or delayed mortality or other effects (DNV, 2007).

7.5.1.2 ***Plankton***

The available data on the effects of seismic noise on plankton species are quite variable and may differ from a species to another. Some research studies on the potential effects on plankton organisms from the extensive seismic activity in the North Sea, have shown no significant harmful effects for experiments with Gammarus locusta and shellfish at distances of 0.5 m and greater from a single air gun with a chamber volume of 3 liters (DNV, 2007). Other results from Thomson *et al.* (2000) show that the exposure to acoustic sources located within 5 metres lead to the deaths of entire populations of phytoplankton and zooplankton, the principle food source for baleen whales.

A study conducted in Tasmania in 2015 and published in 2017 by McCauley *et al.* exposed in real conditions plankton to airgun shoots. The results showed that 58% of taxa abundance was reduced by more than 50% after air gun exposure with statistically significant lower zooplankton abundance after air gun exposure. All krill larvae found in all exposed samples were dead at all range groups following the air gun pass. The 'copepods dead' category was dominated by the smaller copepod species (*Acartia tranteri*, *Oithona* spp.). Previous attempts to quantify ecological scale impacts on planktonic larvae from seismic surveys used modelling scenarios with impact ranges of < 10 m and suggested insignificant impacts compared with the naturally high turnover of plankton. The impact range observed here, at the maximum range sampled of 1–1.2 km, is more than two orders of magnitude higher than what was assumed in these modelling studies. The impacts seen here were taxon, range and time-dependent, and the scale of the impacts exceeded that of sampling in terms of both time (1.2 h) and range. Building on top of these results, a modeling study led in 2017 by Richardson *et al.* for CSIRO Oceans applied the death rates from the McCauley *et al* (2017) study and found that seismic activities had a substantial impact on zooplankton populations on a local scale within or close to the survey area, with a maximum decline of 22% in zooplankton populations in the survey area, 14% within 15 km of the survey area. However, on a regional scale the impacts were minimal: 2% within 150 km. This study underlies also the importance of currents in the impact significance. Simulations with no ocean circulation showed a much greater impact of seismic activities on zooplankton biomass.

However in the case of the present seismic campaign, the duration and the scale of the operations which cover two adjacent blocks, the impact on the planktonic communities might be more important than the findings from the cited publication. Thus, McCauley *et al* (2017) insists on the fact that phytoplankton and their grazers (zooplankton) underpin ocean productivity, therefore significant impacts on plankton by anthropogenic sources have wide ranging implications for ocean ecosystem structure and health. In addition, a significant component of zooplankton communities comprises the larval stages of many commercial fisheries species. Healthy populations of fish, top predators and marine mammals are not possible without viable planktonic productivity.

7.5.2 Conclusion of underwater noise impacts on other marine fauna

The table below summarizes the potential impacts on benthic communities, plankton and seabirds. Mitigation measures are proposed and the residual impacts are after mitigation measures implementation.

Table 7-7 Impacts and mitigations from underwater noise on other marine fauna

IMPACT PRODUCING FACTOR AND POTENTIAL IMPACT	MITIGATION MEASURES	ENVIRONMENTAL CONSEQUENCES	RESIDUAL IMPACT RANKING
Impacts on benthic communities			
Use of airguns I = 1 Se = 2 Re-suspension of superficial sediment is a known effect caused by bubble pulse train effect.	No mitigation measures identified.	As a general statement, significant disturbance to the seabed or impacts to the associated benthic community from airgun operations are observed in water depth < 50 m (Fisheries and Ocean Canada, 2004). Benthic communities of M5-M6 study area are poorly known but due to the delta context, they are likely to be adapted to high sedimentation rates.	I=1 Se = 2 **Negligible**
Use of airguns I = 1 Se = 1 Physical and behavioral disturbance of seismic sound.	No mitigation measures identified.	Data are generally insufficient to evaluate the potential damage to eggs and larvae of fish and shellfish (or other planktonic organisms) that might be caused by seismic sound under field operating conditions. However, as the organism located in the sediment will in the vast majority of cases be at a minimum distance of 35-50 meters to the source, no detectible effect are expected for the plankton, eggs, larvae of fish and invertebrates. The impact on benthic communities should be negligible.	I=1 Se = 2 **Negligible**
Impacts on Plankton communities			

Use of airguns I = 2 Se = 2 Within the water column, at close range (2m – 5 m) of a firing airgun, mortality may be observed for plankton (including larvae of benthic species) unable to flee from the sound source. Most frequent and serious injuries would be limited to 5 m of the airgun source. (Fisheries and oceans Canada, 2004).	No mitigation measures identified.	Little research has been conducted regarding potential effects of seismic surveys on plankton organisms: this is an emerging topic. Even if the Andaman sea has a rich abundance of zooplankton groups, including calanoid copepods and poecilostomatoid copepods and arrow worms, natural mortality rates are high and natural annual fluctuations in population densities is large (due to oceanographic and climatic variations). Direct mortality from airgun fire is not expected to cause a measurable effect as the study area is in open water.	I=1 Se =2 **Minor**
Impacts on seabirds			
Use of airguns I = 2 Se = 2 Seismic sound would only cause potential impacts if birds are diving in close proximity to the airguns i.e. less than 5 meters (Swan, Neff, Young, 1994). Even if it's unlikely, birds could dive into seawater near the airguns if a school of fish is close to the surface.	Do not discharge ground food waste overboard during shooting periods in daytime if this attracts birds. If needed, consider taking action on airgun firing when retrieving fishing nets entagled in the streamers.	Seabirds of the Bay of Bengal large marine ecosystem (which includes the whole of the project area) are not very abundant and poorly known, but a recent study suggests that pelagic seabirds (including threatened terns) are more diverse than visitng/moigrating species. Acoustic damage to birds could be experienced if a bird dives in close proximity to the airgun array (i.e. within 5 m of the array). It is not considered likely that birds will be in the water close to the airgun array once it is operating. In addition, as the array is towed directly behind the survey vessel there will be a bird free corridor. The vessel may disturb the birds present within the project area (e.g present/living on platforms, boats, migrating, etc.). Although the birds may avoid the area as the array passes, they should be already beyond any harmful range (Macduff-Duncan & Davies, 1995). Harmful effects on birds are expected to be limited or unlikely, therefore the impact will be negligible.	I=1 S = 2 **Negligible**

Impacts on marine reptiles			
Use of airguns I = 1 Se = 1 Saltwater crocodiles are not documented as being particularly sensitive to sound or affected by seismic surveys	No mitigation measures identified.	The survey area presents crocodile populations to the North (Meinmahla Kyun) and South of it (Myeik archipelago). Saltwater crocodiles are capable of using long ranging sea currents for dispersal.	I=1 S = 1 **Negligible**

7.5.3 Other environmental impacts

Potential others environmental impacts generated by the seismic survey are linked to:

- Atmospheric emissions caused by the combustion of fuel (seismic vessel and chase/supply boats);
- Discharge of liquid wastes (bilge water, sanitary and domestic water);
- Generation of solid wastes (food wastes, hazardous and non hazardous wastes);
- Ambient noise and light;
- Accidental releases (not in normal operations).

The figure below list the potential impacts expected without environmental management measures put in place.

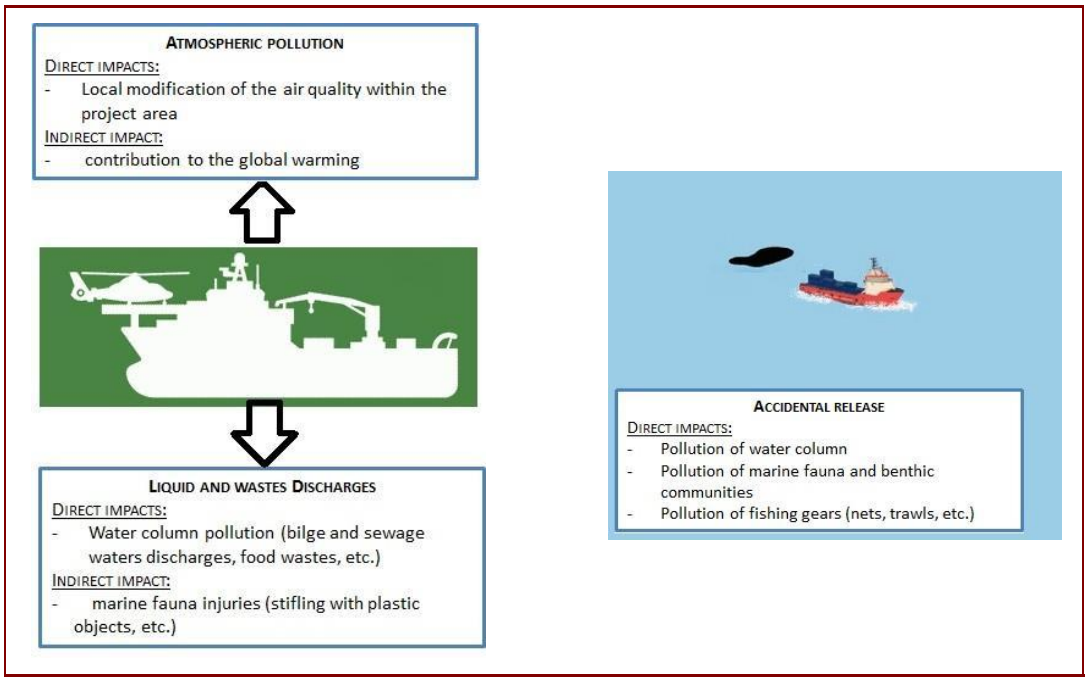


Figure 7-7 Listing of directs/indirect impacts cause by discharges into the environment

Table below synthetizes other environmental impacts identified and associated mitigation measures proposed concerning the M5-M6 3D seismic project of Total E&P Myanmar.

Table 7-8 Impacts and mitigations concerning other aspects (mostly relating to shipping)

IMPACT PRODUCING FACTOR AND POTENTIAL IMPACT	MITIGATION MEASURES	ENVIRONMENTAL CONSEQUENCES	RESIDUAL IMPACT RANKING
Atmospheric Emissions			
Main vessels diesel combustion I = 2 Se = 2 **Minor**	- Use low sulphur fuel, with a Sulphur content (0.5%) less thant the current maximum IMO sulphur content cap of 3,5%; - Use the best available technology to reduce the duration of the campaign; - Perform regular maintenance of engines and power generation; - Implement a Ship Energy Efficiency Management Plan.	The issue is mainly in terms of its contribution to worldwide emissions (Greenhouse Warming, Ocean acidification). Using low Sulphur fuel helps Myanmar prepare for the 2020/2025 IMO cap on sulkphur and reduce air pollution in Yangon. This is particularly important for the supply vessel that will make multiple port calls.	I=1 Se=2 **Negligible**
Discharge to sea and solid waste			
Discharge of: **-liquid sanitary and domestic Waste** **-bilge and deck waters** I = 2 Se = 2 **Minor** Produced by vessels during the entire seismic survey. Pollution of water column; Attraction of animals. The estimated amounts of sanitary wastes (including black and grey waters) are estimated at 15 890 m^3 for the duration of the survey. Estimation of bilge water: 5800 m^3	All effluents of seismic vessel and supply boats will be clearly identified, collected and sent to shore for treatment. Bilge and deck water will be collected through an oil separator to achieve MARPOL specification: hydrocarbons in water discharges cannot exceed 15 ppm.	Proper onshore treatment of wastewater helps contribute to improve the capacity of the port facilities to treat waste and therefore have wider ranging implications than just limited to the scale of the project.	I=1 Se=2 **Negligible** When <15ppm hydrocarbons present in discharged wastewaters
Chemical product spillage from streamer damage I = 1 Se = 2 **Negligible** Pollution of water column Intoxication for animals When a streamer gets	- Choice of seismic streamer (solid or semli-solid) limits the risk of leaking any liquids; - Continuous assessment program to assure the good working condition of the equipment; - The presence of surface components such as the tailing buoy will be materialized with radar reflectors and night lighting; - Navigation equipment for signaling the approach of other vessels; - Continuous monitoring of the seawater column with a precision hydrographic	Assuming that any fluid is only slightly toxic and not bio accumulative, it is likely that the spill will biodegrade gradually and will not cause measurable effect on the marine environment.	I=1 Se = 1 **Negligible**

damaged through snagging or due to a vessel ignoring recommendations, ,buoyancy fluid may be lost to sea. Estimated quantity: 10m^3.	echosounder to ensure that no obstacles will snag the streamers; - Training teams to ensure proper response to spills. - Seismic survey has no specific needs of chemicals; therefore, no huge quantity of chemicals is expected to be used onboard.		
Generation of ambient noise and light			
Generation of ambient noise and light I = 1 Se = 2 **Negligible** (Biological/human disturbance) If the boat lighting is directed towards water, it could attract wildlife close to the seismic vessel.	- Restrict lighting to what is necessary and avoid illuminating water surface. Unnecessary noise will be avoided by maintaing vessel engines in good condition. These issues are expected to be covered in the Ship Energy Efficiency Management Plan.	Working with reputable contractors minimizes the risk of stray emissions becoming a concern.	I=1 Se = 3 **Negligible**
Generation of solid hazardous and non hazardous wastes			
Discharge of food wastes I = 2 Se = 2 **Minor** Discharges from main (seismic vessel) and ancillary vessels. Presence of personnel will lead to food waste production, which if they are thrown overboard, will attract schools of fish to the surface near the boat. Fish presences leads to the presence of predators (mammals, birds).	- All waste apart from food waste to be brought to shore. Food waste will be ground onboard before being discharged to sea. They will be quickly dispersed and will provide a source of food for fish. There will be no visual trace to the surface of water. They have to be ground in compliance with MARPOL: crushed < 25mm and discharged more than 3 miles away from the shore. - Discharge of food waste will occur at night or outside of shooting periods.	Milled and ground food waste that is discharged into the sea will be rapidly dispersed and will provide a food source for fish. There will be no visual traces on the sea surface.	I=1 Se = 2 **Negligible**
Generation of hazardous and non-hazardous wastes I = 2 Se = 2 **Minor to moderate** The project will generate some waste related to the vessels, together with some some streamer and electronic waste. Estimation (for the complete fleet):	- All waste will be collected, sorted and disposed in accordance with the Waste Management Plan applicable during the seismic campaign: all waste shall be sent to shore for processing by approved companies - The crew will be trained to use the waste management procedure. - An Environmental Monitoring Plan and a Waste Management Plan will be implemented Some of the companies taking the waste will be audited, including the one in charge of electronic waste.	If well implemented, mitigation measures will remove the impact and reinforce sound waste management channels in the country.	I=1 Se = 2 **Negligible**

Hazardous wastes:9t Non hazardous wastes: 3891t			

7.5.4 Other socio-economic impacts

Figure below synthetizes the main direct/indirect impacts caused by the physical presence of seismic equipment and vessels during the M5-M6 3D seismic campaign.

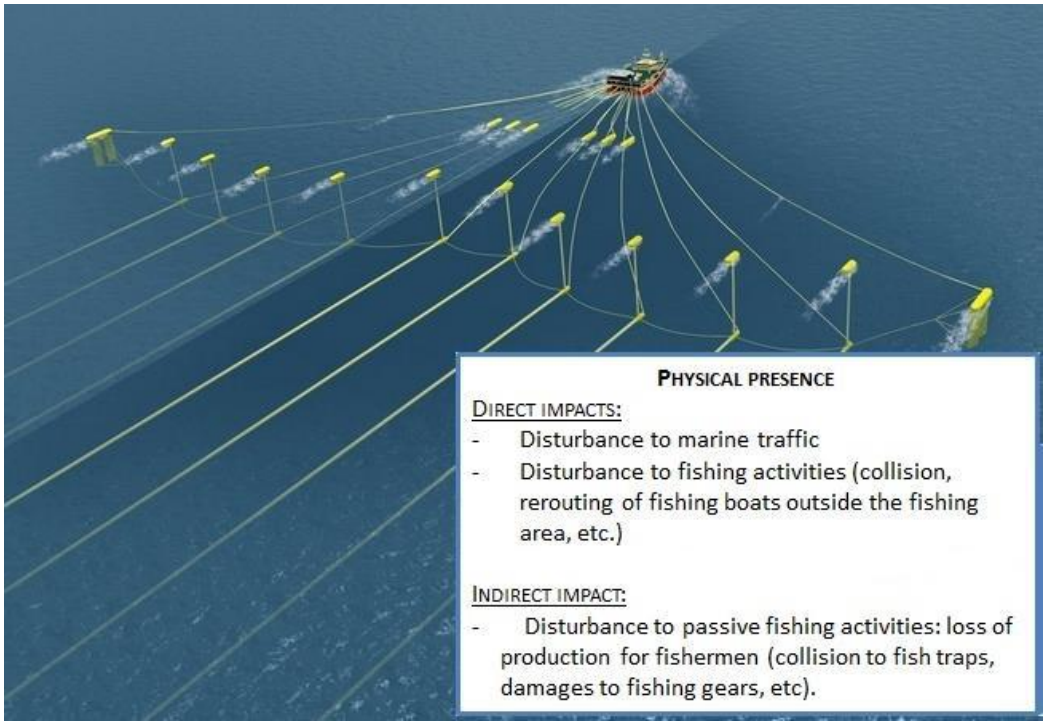


Figure 7-8 Example of direct and indirect impacts caused by the physical presence of the seismic equipment

As shown in the analysis of sensitive components, the only two social components that will be impacted by the project are the commercial marine traffic (including for serving the Yadana and Sein fields) and the offshore fishery sector.

7.5.4.1 Disturbances to marine traffic

During a seismic campaign, disturbances to commercial marine traffic are caused by the physical presence and movements of the survey vessel and the chase/supply boats. Indeed, their presence can cause collision with all kinds of ships, including commercial ships. Unlike for fixed facilities, there are no requirements for a formal safety zone to be established around seismic vessels.

Aside from applying the general maritime rules (in order to avoid collision between vessels), navigation restrictions will have to be implemented. Ships have to be excluded from the operational area of the seismic survey in order to limit the risks. This exclusion may cause a rerouting of the vessels that usually cross the seismic survey area to reach their port of destination.

7.5.4.2 *Disturbance to fishing activities*

As detailed in the part 7.4 , seismic operations can have direct impacts on fish populations evolving at the seismic location during the shooting. The underwater acoustic sound produced by airguns can affect fish and fish banks behaviors, causing them to either move down to the sea bottom or leave the seismic location temporarily. However, several studies proved that this impact's effect on socio-economic activities cannot be assessed. A report, produced for the Norwegian Oil Industry Association in 2003 and gathering results of seismic impacts assessments on fish and fisheries concludes that although behavioral changes of fish are confirmed by scientific studies, there are no effects of seismic surveys on long term catch rates or on the size of fish stocks in general[61], as opposed to fishermen's general belief that seismic activities interfere with fisheries in a negative way. A more recent study commissioned by the Norwegian Petroleum Directorate and conducted by the Institute of Marine Research in 2009, confirmed that the sound produced by a 3D seismic survey performed in the Nordland temporarily influenced either positively or negatively the fish catches based on the type of species (it was observed that there were increases in fish catches for some endemic species, and reductions of catches for others[62].)

Another impact of seismic surveys on fisheries is the general disturbance to fishing activities induced by the physical presence of boats and cables, which can cause a loss of equipment or production for fishermen as described below:

- Seismic vessels can collide with fishing boats;
- Active fishing gears in the form of nets stretching behind fishing boats can be damaged by the seismic vessels or the streamers;
- Passive fishing gears in the form of static fish traps or fish aggregating devices installed in the sea and marked by a buoy (or even unmarked) can also be damaged by vessel movements.

For safety reasons, and to avoid loss of seismic material during the survey performance, fishermen must be kept out from the operational area. This can cause a perturbation of their daily activities and a possible loss of production if they cannot perform fishing in another area.

The table below synthetises the potential socio-economic impacts, the mitigation measures proposed and the assessment of residual impacts after implementation of the mitigation measures.

Table 7-9 Socioeconomic impacts of M5-M6 Seismic Project

IMPACT PRODUCING FACTOR AND POTENTIAL IMPACT	MITIGATION MEASURES	SOCIAL CONSEQUENCES	RESIDUAL IMPACT RANKING
Disturbance to marine traffic			
Physical presence **Disturbance to marine traffic** I = 3 Se =3 **Moderate**	**Prior to the start of the seismic survey:** Information to the contractor's employees during HSE or Project inductions about the risks related to the presence of fishermen or commercial ships at the Project area and the mitigation measures planned; Communication and coordination with	Rerouting of vessels will lead to slight delays in transportation.	I=1 Se = 3 **Minor**

[61] GAUSLAND Ingebret, *Seismic Surveys Impacts on Fish and Fisheries, Report for Norwegian Oil Industry Association*, March 2003.
[62] http://www.imr.no/forskning/prosjekter/seismikk_gav_bade_okte_og_reduserte_fiskefangster/en.

	Myanmar marine authorities (Myanma Port Authority (MPA), Department of Marine Administration (DMA), Myanmar Navy and coastguards) about the seismic location, schedule and duration; Issuance of notices to mariners about the seismic operation by marine authorities; Note that vessels may need to anticipate which side of Preparis island they have to sail. Equipment of the seismic vessels with loud speakers to communicate with boats not equipped with radio. **During the seismic survey:** Fully comply with navigation marks, AIS identification etc. Weekly communication with marine authorities on operations (date, position, issues, etc.); Chase vessels to monitor the presence of ships using radar or visual observation, and establish radio or loud speaker communication with the ship operator to inform him about the operation area and the need to reroute their boat; If the ship pursues its approach and does not respond to calls, chase vessels should make physical approach to inform the captain.		
Disturbance to fishing activity			
Physical presence **Disturbance to fishing activities** I = 2 Se = 3 **Moderate**	**Prior to the start of the seismic survey:** Communication and coordination with marine authorities and main fishery stakeholders (DoF and MFF) about the seismic location, schedule and duration; Preparation of flyers on the seismic campaign in Burmese and Thai language; Recruitment of a Fisheries Liaison Officer able to speak Burmese and Thai languages that will participate to the survey and handle encounters with both Burmese and Thai fishermen, solving any issues that could arise between these fishermen and the project; A scouting survey enabling to assess the fishery activity at the seismic area (localize fishermen and interview them to determine their origin, spot and count the fish traps installed in the area) should be conducted before the seismic	Fishermen will have to adapt the planning of their activities to avoid the seismic survey vessel. There is special concern for nets that are deployed for long term usage.	I=1 Se = 3 **Minor**

	survey starts. **During the seismic survey:** Chase vessels to monitor the presence of ships using radar or visual observation, and establish radio or loud speaker communication with the ship operator to inform him about the operation area and the need to reroute their boat; If the ship pursues its approach and do not respond to calls, chase vessels should make physical approach to inform the captain.		

It is very unlikely that the project will create any jobs opportunity, this social impact is therefore neutral.

7.6 CUMULATIVE IMPACT ASSESSMENT

7.6.1 General issues

The environmental impacts associated with a project may be accumulated or intensified when considered in the context of existing operations in the area. The cumulative impacts on different environmental indicators may vary depending on the scale, intensity, and proximity of multiple operations, as well as the interactions of environmental ecosystems affected.

This assessment allows the consideration of deviations from baseline environmental conditions as a result of simultaneous marine activities, current and future, and accounts for the seeming insignificance of a single activity which may trigger, aggravate or in some other way worsen the impacts of a project when considered in collaboration with another.

The evaluation of cumulative impacts associated with seismic activities is extremely complex due to the transient nature of airgun fire, the continual displacement of the source and other diverse operational and environmental interactions.

In order to account for the complexity of cumulative impacts, this assessment was conducted in four phases:

- Identification of environmental components which may be significantly adversely affected by the project;
- Identification of projects or activities (mainly future) which may have a negative impact on the environmental components identified above;
- Determination of the sensitivity of environmental components to cumulative impacts (be they over a short- or long-term period) when considered in parallel with other projects or activities identified in the area;
- Determination of significance of cumulative impacts on the environmental components after consideration of proposed mitigation measures.

The potential impacts associated with the marine M5-M6 3D seismic survey are considered in the context of other existing marine operations in the potentially affected area in the sections below.

7.6.2 Potential environmental impacts associated with seismic activities

The impact assessment indicated that the environmental components susceptible to be the most affected by the M5-M6 3D seismic activities are the:

- Acoustic environment and response mechanisms of marine mammals;
- And to a lesser extent, socio-economic environment as a result of disturbance to fishing and shipping traffic routes.

The cumulative effects on marine mammals and fishing/shipping traffic routes may appear if they are affected by other actions at the same time and in the same area.

It is possible that an operator from a nearby block shoot its seismic survey simultaneously with Total E&P Myanmar M5-M6 3D seismic project.

Environmental cumulative impacts are anticipated due to the significative increase of anthropogenic underwater sound generated by both seismic surveys which could have an impact on the marine fauna in general.

The logarithmic definition of the decibel scale implies that an increase of 10 times in the scale of sound pressure expressed in Pascal corresponds to a 20dB increase in the pressure level.

Table 7-10 Increase of sound pressure level (SPL) corresponding to an increase of pressure

Increase of sound pressure	Increase of sound pressure level
1 x	+ 0dB
2 x	+ 6 dB
10 x	+ 20 dB
100 x	+ 40 dB
1000 x	+ 60 dB
10000 x	+ 80 dB

SOURCE: LABORATORY OF APPLIED BIOACOUSTICS (LAB) BEST PRACTICES IN MANAGEMENT, ASSESSMENT AND CONTROL OF UNDERWATER NOISE POLLUTION, 30 JUNE, 2009

The other solution already studied by Total E&P Myanmar could be to merge its seismic programs with those of its neighbors in order to avoid cumulative impacts. The advantages of this solution are:

- Avoid cumulative impacts of anthropogenic underwater sound generated by the projects;
- Share the cost of mobilisation of the seismic vessel and seismic equipment;
- Avoid possible interference of received signals coming from the different airguns used for the two seismic campaigns.

The main issue lies in the organisation of this campaign for the companies. Nevertheless, even if the footprint of the project is enlarged (which induces a longer duration of seismic acquisition), the cumulative impact is reduced since the airguns will not work at the same time, i.e. the acoustic impact will not be increased but will just last longer.

In conclusion, this option should be preferred if technical conditions allow it.

7.6.3 Interactions between neighboring blocks

Cumulative impacts are of particular concern because several offshore blocks have recently been awarded and as most of their operators are going through an exploration stage in 2017-2018. There is therefore cause for concern that cumulative impacts could occur as a result of multiple surveys occurring simultaneously over adjacent blocks.

The survey area covers 24,541 km^2, which is a large area, and is treated as a single entity using a single seismic vessel (the use of an auxiliary source vessel is limited to the region around the Yadana and Sein platforms in order to achieve the required geometries. This usage of a single seismic vessel minimizes the cumulative impacts that could occur if seismic surveys occur simultaneous ly in neighbouring areas.

7.6.4 Interactions between successive seismic acquisitions on 4D campaigns

Cumulative impacts could occur as a result of successive acquisition campaigns for performing 4D seismic surveys of reservoirs that are under production. However, 4D seismic surveys started less than ten years ago and acquisitions are not performed every year; consequently there seems to be little feedback information on how cumulative impacts behave. The lifespan of a small marine mammal such as a porpoise (8 to 10 years) is longer than the time between successive campaigns for a 4D survey. Therefore, it is expected that some marine mammals would remember previous campaigns, but it is not clear how that would affect the impacts.

SECTION 8. PUBLIC CONSULTATION & INFORMATION DISCLOSURE

As part of the IEE study, Artelia organized three meetings:

- A scoping meeting with the MMF in September 2017
- A public consultation in Pathein
- A public consultation in Pyapon, with media presence

The first objective was to collect up-to-date and precise information on the current socio-economic conditions in the Project area. The second objective was to present the project to the stakeholders, to collect their opinions and views, and to discuss the potential environmental and social impacts and possible mitigation measures.

8.1 INDIVIDUAL STAKEHOLDER MEETINGS

A meeting was held with MFF on Sept. 20th 2017, in order to ensure that concerns of the fishery sector are fully taken into account.

Action by	Discussion
MFF	Suggestion: MFF is organizing a large meeting every two weeks and Total could attend the next one in order to present the project.
ART	What are your concerns and comments about the project?
MFF	It is important to inform the inshore fishermen, it can be done through the Ayerwaddy regional fisheries federation and there are also departments of fisheries in Labutta and Pyapon Townships. A mariner notice needs to be issued.
ART	Some representatives of MFF and local fishermen attended Pyapon and Pathein meetings. Mariner notice will be definitely disclosed and some people ask to announce 45 days before the project.
MFF	You need to explain the project to local fisheries and to comply with the rules in the mariner notice so that it won't make any disturbance in the work, from both sides. In the past, as it was well explained and instructed step by step, there was no problem with seismic surveys although there are many fisheries in delta region. Fishermen are concerned that it may affect the fishes when sound is emitted by air pressure.
MFF	Is there any difference between dynamite explosion and air pressure explosion?
ART/ TOTAL	2000 psi is usually used for seismic source. Dynamite directly kills the fishes and corals. In seismic procedure, there is soft start stage in which the fishes are given time to escape.
MFF	There is a paper done by New Zealand and Australian scientists saying that seismic survey deadly damages the phytoplankton and zooplankton. How do you think about that?
ART	We, environmentalists collect and use all the available studies and make own interpretation according to the condition of the project. We will consider all the newest studies.
TOTAL	Artelia already took note the advice of marine science professors on this issue. Then Artelia will suggest how to reduce the impact in their report.
MFF	It would be the best if fishermen from Hainggyi, Pyinsalu and Pyapon where offshore fishing like trawling is most common are warned before the start of the operation in

	order to avoid any danger.
TOTAL	Near the start of operation, Total will send the letter to Myanmar Fisheries Federation and Total requests MFF to issue the necessary instructions to the subordinates.
MFF	It is important to inform MFF about 2 weeks before the operation starts.
ART	As fishermen requested, they should be warned 45 days in advance to make sure they have enough time.
MFF	It would be better if the exact time of operation is issued. There are a lot of fishing activities in Ayerwaddy region including both inshore and offshore.
MFF	In Tanintharyi region, there were some conflicts between inshore fishermen and Oil & Gas company over the damage to resources. The company later returned the blocks.
MFF	I am concerned that there might be a disturbance with fishing boats during seismic survey.
TOTAL	There will be a liaison officer from MOGE on seismic vessel to deal with them in Myanmar language in case there is an issue.
TOTAL	Could you explain about the current situation of fisheries in Myanmar? Is it developing or not?
MFF	There are two parts in fishery including shrimp; fishing and livestock. Regarding the fishing, there were many fishes as the number of fishing vessels is low in the past time. But in these days, as there are more fishing vessels and foreign ones are allowed, the resources are much more fewer than before. Only 30% left. Now we are depending on livestock. There are also some issues concerning livestock. As mentioned in the rules and regulations of ministry, farm cannot be used in other purpose otherwise permit is needed. But in the era of previous governments, as they encouraged fishery and shrimp fishery, the farming area is over 400,000acres while only 100,000acres were allowed. It means that other 300,000acres are illegal. We can't move forward. MFF has plan to form a public company to focus on shrimp farming cooperating with Yangon regional government and we are trying to export to international market. We will continue to have an agreement starting from this year.
ART	In your opinion, why the number of fishes is largely decreasing over the past years?
MFF	Because of overfishing and using the illegal fishing gears or discarded fishing gears with small nets. These bad practices are called Illegal Unreported and Unregulated (IUU) fishing. It is practiced for both inshore and offshore fishing.
ART	Do you think there will be some measures implemented by the government to reduce illegal fishing?
MFF	Department of Fisheries is concerned about that. But they don't have enough power to manage as it also depends on the other agency like Myanmar navy.
MFF	The surveys of RV Dr. Fridtjof Nansen vessel from Norway in 1979-1980 and in 2013-2015 showed a 90% drops in 30year for some offshore fish livestock.

Figure 8-1 Meeting at MFF regarding the M5 & M6 blocks 3D Seismic Survey (20-9-2017)

8.2 PATHEIN PUBLIC CONSULTATIONS

The public consultation was organised on the 25th of Aug 2017 in Pathein.

Twenty six persons participated to the meeting. The complete list of participants is provided in the table below. The original list of attendees is available in APPENDIX D .

Table 8-1 List of Participants attending the Public Consultation in Pathein, August 25th 2017

No	Name	Position	Department
1.	U Zaw Win	Assistance Director	ECD
2.	U Kyaw Kyaw Oo	A.D	ECD
3.	Daw Mo Mo	DSO	ECD
4.	Daw Khin Thindar Win	SK-4	ECD
5.	U Myint Swe	Department of Fisheries	Department of Fisheries
6.	U Sone Mine	Deputy Director	Department of Fisheries
7.	Daw Khin Mar Thi	Assistant Port Officer	Myanmar Port Authority
8.	U Ohn Maung	Secretary	Department of Fisheries
9.	U Kyaw Myint Aung	Shrimp Industry Association	Ayarwaddy Region

10.	U Ba Hein	Minister (Agriculture)	Ayawaddy Region
11.	U Naing Linn Htut	Central Executive Committee	MATA
12.	U Naing Gyi	Representative of MATA	MATA
13.	U Aung Bo Bo Htet	Representative of MATA	MATA
14.	U Soe Hlaing Oo	88 Generation (Nyein Pwint)	Pathein
15.	U Win Zaw Htun	Assistance Director	Regional
16.	U Myint Htay	Fututun Green	-
17.	U Aung Myo Khaing	PPMFW Party	-
18.	Doctor U Kan Myint	PPMFW Party	-
19.	Ko Moe	MATA (SC)	-
20.	Dr. Cherry Aung	Professor/ Head	Department of Marine Science
21.	Daw Ei Mon Aung	A/L	Department of Marine Science
22.	Dr.Nyut Sandar Aung	A/L	Department of Marine Science
23.	U Soe Thein	Fisheries Officer	Department of Fisheries, Pathein
24.	U Thaung Tin	Township Officer	MRCS
25.	U Maung Moe Tun	-	Oil work
26.	Ko Thiha Ye Htut	Volunteer	MATA (Ayarwaddy)

The meeting consisted in a presentation of the project displayed by Total Exploration and Production Myanmar, followed by questions and answers. The questions raised and answers provided to them, are summed up in the Table 8-2 below. The discussions focused on CSR programmes relating to the pipeline that crosses the region (which is not related to TEPM), on the need for good coordination between the project and the fisheries sector and on benefits of the project to better understanding benthic communities of the delta.

Table 8-2 Summary of questions and answers

No.	Question and recommendation	Answer
1.	• To develop coastal region and farming and animal husbandry. • To carry out implementation without damaging mangrove. • To carry out CSR program and to mitigate impacts in the region	**Answer by TEPM:** Any projecs can have environment and social impacts. But our practices are to make sure the mitigation measures are applied as much as possible, so as to maximize all positive impacts.

Table 8-2 Summary of questions and answers

No.	Question and recommendation	Answer
2.	• I did not find the CSR program for Ayawaddy although Yadana project is working in Ayawaddy Region with its pipeline and gas is produced from Ayeyarwaddy waters. • So, did you have CSR program for using resources in this region?	**Answer by TEPM:** In Ayeyarwaddy region, the pipeline is installed under water. So this could not impact the social environment. The onshore portion of the pipe requires a good neighborhood with communities that is why Socio Eco activities are chosen to be done there. Woodside and MPRL operating for A6 block in Ayeyarwaddy region are carrying out CSR programs. Total is 40% share holder of this block. In case CSR programs are to be promoted, regional government will be consulted.
3.	Concerning the (MOGE) Gas Pipeline, this pipeline is now located on the ground in our region. So this can impact our region. Moreover it passes through creek so this is a disturbance to the navigation. And I found other Oil and Gas projects were using resource of our region, but they did not do specific social development for our region. So I would like to request your orgaanization to support our regional development. What can MOGE do for our region? Have you assessed impacts of the project on the fishermen? If you don't have a program, do you plan CSR and impacts mitigation in the future?	**Answer by TEPM:** Regarding the onshore domestic pipeline through Daw Nyein, this was built and is being operated by MOGE, not TEPM. So MOGE representative will answer your question. However, as a partner of MOGE, TEPM can address/refer your concerns to MOGE. **Answer by MOGE Rep:** The domestic gas pipeline is installed to generate electricity for our country. If possible, please be careful and avoid going near the pipeline. Ministry is planning solutions about this. Gas pipeline is supporting the public and this is onshore facility. MOGE is doing the maintenance section by section. We will report to concerned department about this case. They will continue implement by checking.
4.	M5, M6 blocks are located within the fishery zone. But I have not found development. So I would like to ask you: • How to integrate and negotiate with Myanmar Fisheries Federation? • How to carry on reducing the impact on environment during seismic survey?	**Answer by TEPM** We have discussed with MD of Dept of Fishery in Naypyidaw and U Han Tun of MFF about this in the past project. We will seek suggestion and advices from these organizations. Fishing blocks and M5/M6 project activities will be discussed in following presentation slides.

Table 8-2 Summary of questions and answers

No.	Question and recommendation	Answer
5.	How much net profit of your enterprise is used in CSR programs? Regarding EITI procedure, it is made with Multi-stake Holder Group (MSG) which is integrated with civil society organization, company and government. Which civil society organization is cooperating with your company? And is this organization in Ayawaddy region? I have information that extractive industries have a "development fund' to support education, social and health. Do you have any connection on to this investment?	**Answer by TEPM** Our CSR budget does not go with % of profit or whatsoever. It is planned annually. Our practices involve agreement of partners, including MOGE, community meetings and internal assessments. We are used to communicating the impacts/outcomes of our activities that reflect "how we use" rather than "how much we spend" so it is difficult to state the CSR budget to be exact % of income. Regarding EITI involvement, you can refer to CSR annual report 2016. MATA is one of the organizations in MSG and it is collaborating with TEPM rep so we would like to invite MATA rep to answer this. Concerning socio-economics, we will make integration with permission of government.
6.	How many cubic feet/ cubic meter of extraction within 20 years? Seismic survey could impact on the environment in our region. I think that MOGE or government should have to give compensation for impacts. Do you have planning or agreement for compensating in our region due to seismic survey? I would like to recommend, this region should have an organization which consists civil society, national party and government's representatives after reviewing seismic survey.	**Answer by TEPM** Our CSR budget does not go with % of profit or whatsoever. It is planned annually. Our practices involve agreement of partners, including MOGE, community meetings and internal assessments. Any project/activity can produce impacts. But this can be avoided by discussing and finding ways in advance, like this meeting. In case of grievance, TEPM has a grievance procedure where anybody can address his/her grievance in accordance with this procedure. Steps range from verbal resolution to compensation. There will be a person (MOGE rep) on board in case fishermen need to address their concerns.

Table 8-2 Summary of questions and answers

No.	Question and recommendation	Answer
7.	During the seismic survey, fishermen will suspend their work. So this can impact on their economics. Is there a pre-engagement and agreement with regional people and how do you communicate with them? EITI procedure should also be implemented with one organization which consists of regional group, company, CSO of EITI.	**Answer by TEPM** The seismic boat will move from one place to another. Fishermen will not necessarily need to stop fishing. The area is only 3 miles x 6 miles around the boat. When the boat moves on, they can continue fishing. All communication means with fishermen will be ensured prior to the commencement of the project activity. There will be another round of public meeting to detail this. (EITI issues was explained by MATA rep)
8.	Welcome for all investments. Ayawaddy region has a lot of resources and suffered environmental disaster because of usage of extraction. According to law and rules, please be carried out without damage on regional people.	
9.	The seismic survey is located within the fisheries zone. So you need to meet Myanmar Fishery Federation and Department of Fisheries. The location including from Phyar Pon to Kyeik Hton. So you need to discuss each department of fisheries and need to inform the schedule of seismic survey.	**Answer by TEPM** Our project will start April, 2018. Now we are making the public consultation to get the recommendations and record from all the concerned stakeholders. We have a meeting in Phyarpon Township on 31 August, 2018. Fishermen and department of fisheries will attend this public consultation.

Table 8-2 Summary of questions and answers

No.	Question and recommendation	Answer
10.	Regarding seismic survey, firstly I want to say about oil leakage. It can impact on benthic communities. Some of benthic communities are human food. So I would like to request to make testing about benthic communities. I would like to share my experience. In 2002, we made seismic survey and benthic survey along Rakhine, Ayawaddy and Tanintharyi coastal by cooperating with Department of Marine Science and India Organization. We found many benthic communities in M5, M6 blocks and new species were found in Ayarwaddy. We assume that population of fish in Adaman sea are maintained by benthic communities. Benthic community is food for fish: phytoplankton and zooplankton. So this location is the source of food. Seismic waves can impact fish and oil leakage can impact benthic communities. So I would like to request to support assessment of Ayarwaddy region and to help for the protection of benthic communities.	**Answer by TEPM** We have an oil spill contingency plan and implement the project according to International best practices with regard to oil spill. We will make sure that there will be no oil spill from the vessels. As we are fully in compliance with international and national regulations, we only make a contract to those contractors who have the same Health Safety and Environmental standards as us. Regarding benthic survey, we make Environmental monitoring survey every five years. In order to monitor the environment impact caused by the operational activities like drilling performed environmental monitoring surveys in 2003 and 2010 sending benthic samples to an accredited laboratory overseas. We made one in 2010 with Artelia. We can disclose these environmental baseline study reports for your research works. We also have environmental records like numbers of days without oil pollution. These data are recorded monthly and sent to Head Quarters annually.
11.	The duration of seismic survey is about six months. How do you plan for the people who are working in this region (offshore) during seismic survey?	**Answer by TEPM** The seismic survey is not continuously working for six months. We will conduct one time in April for one month. And then next shooting will be in November after the monsoon period. This is not a continuous process. One/Two week before the seismic survey, we will dispatch the pamphlets regarding the seismic campaign. After the seismic survey, fishermen can re-enter the area for fishing. Moreover we will make public consultation in Phyarpon to discuss with fishermen.



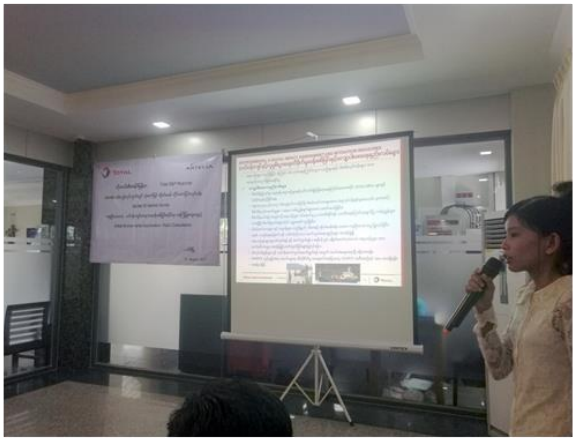



Figure 8-2 M5 & M6 blocks 3D Seismic Survey IEE- Public Consultation Meeting in Pathein (25-8-2017)

8.3 PYAPON PUBLIC CONSULTATION

The public consultation was organised on the 31st of August 2017 in a government building in Pyapon. Thirty three persons attended the meeting, coming from local public administrations, from the media and from the local fishery sector. The full list of participants is provided below. The original list of attendees is available in APPENDIX C .

Table 8-3 List of Participants attending the Public Consultation in Pyapon, August 31st 2017

No	Name	Position	Department
1.	U Soe Myint	Police Chief (Pyapon)	Pyapon Police Station
2.	Daw Khin Ma Ma Mu	Chief Officer	Labour and Immigration Department
3.	U Win Naing	Assistant Director	District General Administrative Department
4.	U Htay Sae	Assistant Director	District Fire Department
5.	U Tin Maung Maung	District Director	District Department of Fisheries
6.	U Kyaw Naing	_	NLD
7.	U Tin Aung Win	_	NLD
8.	U Thein Linn	_	NLD
9.	U Win Myint	Deputy Chief Officer	District General Administrative Department
10.	U Zaw Win	Guard District Chief	Red Cross
11.	Daw War War Thein	Chief Officer	Department of Fisheries (Pyapon)
12.	Daw Mar Mar Lwin	Chief Officer	Department of Infromation and communication
13.	U Thein Zaw	Deputy Chief Officer	Labour and Immigration Department
14.	U Kyaw Soe	Police Chief of District	District Polic Station
15.	U Thant	Fisherman	Near Shore Fisheries
16.	U Aye Soe	Administrator	N/M
17.	U Naing Win	Administrator	Dedalu Village
18.	U Shwe Pau	Administrator	Daw Nyein Village
19.	U Aung Toe	Fisherman	England Fishery Net
20.	U Kyaw Aye	Chairman	Inshore/ offshore Fisheries
21.	U Min Kyae	Businessman	Tiger Fisheries Association
22.	Thuzar Nwe	Reporter	MDN (Pyapon)
23.	Kyaw Soe Moe	Reporter	Up to Date (Pyapon)
24.	Ko Aye Nay Tun	Township Executive	_
25.	Ko Than Soe	Township Executive	_
26.	U Tun Tun Win	Township Secretary	USDP
27.	U Paw Lwin	Township EC	USDP
28.	U Zin Shein	Town's Elder	Pyapon Township
29.	U Zaya Ohn	Township Administrator	Pyapon Township
30.	U Aung Win Naing	_	Department of Information and communication
31.	U Myo San Soe	Media	Public Pen
32.	U Moe Kyaw Aung	_	Chaung Wa-Dedalu
33.	Ko Kyaw Thet	_	Chaung Wa-Dedalu

The meeting consisted in a presentation of the project displayed by Total Exploration and Production Myanmar, followed by questions and answers. The questions raised and answers provided to them, are summed up in Table 8-4. Concerns expressed showed that fishermen needed a long period of warning to anticipate the campaign, e.g. due to nets being deployed for long term fishing; the issue of CSR programs was also raised.

Table 8-4 Summary of questions and answers in Pyapon

No	Questions	Answers
1.	How large is the project area of M5-M6 blocks? As these blocks are parts of fishery zone, could you give me the location of project area to avoid any disturbance?	**By TEPM,** Notice for Yadana project including location (latitude, longitude) will be disclosed in the newspapers two weeks before the beginning of the project.
2.	We will end fishing in April. But we will restart it within 180 days of project period.	**By TEPM,** Our project will start on April, 2018. We will reveal the description of project (size & location etc.) before April. Next period will start before November 2018. So we will be back to distribute brochures of the project to fishermen in Pyapon in October 2018.
3.	Our fishing nets are laying down in the sea for long term fishing. And we pay tax for it. But if we have to move our fishing area, how TEPM will consider and take responsibility about this impact on fishermen? If you could adjust schedule, it could mitigate this impact.	**By TEPM,** This is noted and will consider your problem. There is a complaint system: If you assume that you are affected by the project, you can complain to our organization. I will give you detail information about this system. Fisheries liaison officer from MOGE will also be on ship to deal with fishermen.
4.	The proposed project location and fishing zone are in same area and there are around 37 fish species that are usually caught by trawl nets. We don't catch mammals and big fishes. Regarding Passive Acoustic Monitoring (PAM), Artelia Myanmar presented that sound power will be emitted by controlling. But we don't know how sound is emitted in the sea? I found many dead fish species in the sea. Firstly mammals should be frightened to go away before soft start procedure of PAM. I think this action could mitigate the impact on mammals.	**By Artelia Myanmar,** Regarding the dead mammals, this is indeeed a concerning issue, that we discussed with Marine Science Department of Myeik University. According to the discussion, dead mammals could be caused by seismic survey but there are also other different reasons. There were already dead mammals found in Myanmar before Oil & Gas activities, because of ships or other reasons. A scientific study is needed to know the exact cause of death. However, frequent dead mamals might be an indicator of a sensitive environment.

Table 8-4 Summary of questions and answers in Pyapon

No	Questions	Answers
5.	Please announce 45 days before the survey. As inshore fisheries could be affected, please take responsibility for local people according to environmental conservation law and international standard guidelines. How about CSR program for our region?	**By TEPM,** Fisheries liaison officer from MOGE will also be on ship to discuss with fishermen. If you would like to know more information about CSR program and environmental conservation plan, a public representative could propose to our organization from representative village office.
6.	There is an onshore domestic pipeline in Daw Nyein village to generate electricity. In 2016, Daw Nyein gas pipeline was carried out in our region but there was no solution for the impact on local people. So this activity should be revealed.	**By MOGE,** Daw Nyein pipe line is installed to generate electricity for our country and it is national project. Regarding CSR, MOGE is now implementing in respective regions. So this activity will be in your region soon.
7.	There should be more transparency in CSR programs for Daw Nyein village. Gas is produced in our region but now we are depending on candle light.	**By MOGE,** At MOGE, there is annual meeting with respective oil fields and regions for CSR programs. In this meeting, we evaluate and prioritize which region is more important to support depending on country's budget. **By TEPM,** Regarding the onshore domestic pipeline through Daw Nyein, it was built and is being operated by MOGE, not TEPM. So MOGE will also carry out CSR program.

Table 8-4 Summary of questions and answers in Pyapon

No	Questions	Answers
8.	In 2016 and 2017, fishes were dead because of waste water from oil and gas. In this case, I mean not only Total E&P Myanmar but also other oil and gas companies. Now there are just over 90 species left comparing to 600 species that inhabited in Myanmar. Number of fish species are lower and lower. I have a doubt, it is caused by wastes or acoustic waves or leakage of the gas pipeline.	**By TEPM,** Waste productions of Yadana project have been carried out with the waste management plan according to international standards and guideline. We don't discharge in the sea. Any waste on the ship is carried to Tharketa workshop. There is waste management plan and we have also audited to review our working system. Regarding leakage, we are always reviewing gas pipeline. If it happens, not only the country but also our organization could be affected. There is a sensor system that can indicate where leakage occurs. So we assure that leakage is unlikely to happen. Regarding the environment, our company has been awarded certificate of ISO 14001 since 2005. There is annual audit and certificate is updated once per three years.
9.	This project is to improve our country but please make sure it won't damage our small business and everyone.	**By TEPM,** There is a complaint system: If you assume that you are affected by the project, you could complain to our organization. Fisheries liaison officer from MOGE will also be on ship to deal with fishermen.
10.	The major occupation of our region is fishery. So fishermen are prime concern. I invited participants from townships to villages. Our objective is to disclose all the information about project. Thanks for explaining and presentation about the project. Request • To meet with us before starting the project, April-2018. • To adjust schedule between project schedule and working time of fishermen.	**By TEPM,** We are so glad to meet with all. We invited all participants according to ECD's suggestion, and we will come back. The objective of the public consultation is to listen to your suggestions and requirements and to discuss with all.

Some pictures of the meeting are provided below.

Figure 8-3 M5 & M6 Blocks 3D Seismic Survey IEE- Public Consultation Meeting in Pyapon (31-8-2017)

8.4 MEDIA COVERAGE

Media representatives attended the meeting in Pyapon and disclosed relevant news on a media website, as shown in thefollwoing figure.

Figure 8-4 Media website covering the Pyapon public consutation from 31/08/2017

SECTION 9. MITIGATION MEASURES FOR THE PROJECT

This section gives details on mitigation measures associated with potential underwater acoustic impacts of the M5-M6 3D seismic project on marine mammals, turtles and fish.
Mitigations measures associated with other environmental and social potential impacts of the project have already been developed in § 7.5 .
At the end of this section, a commitment register will detail roles and responsibilities for each of the mitigation measures proposed in this IEE.

9.1 SPECIFIC MITIGATION MEASURES FOR MARINE MAMMALS, TURTLES AND FISHES

9.1.1.1 Mitigation actions and procedures

The methods recommended by the IAGC (International Association of Geophysical Organisation) and the JNCC (Joint Nature Conservation Committee, UK) to minimize the disturbance of marine mammals during the course of marine seismic activities will be implemented. The protocol will be adapted to account for the zones of exclusion deemed necessary for the project (i.e. 500 m). Marine mammal observers will accompany the vessel during the life of operations to ensure compliance with the intervention protocols.

A brief description of how the shutdown distances have been calculated and mitigation measures to be implemented are presented in § 9.1.1.2 9.1.1.2 . Additional mitigation measures to ensure the protection of marine mammals, fish and turtles are described on § 9.1.1.3 .

9.1.1.2 Temporary and permanent threshold criteria for cetaceans- calculation of shutdown areas

National Marine Fisheries Services Criteria

The United States oif America's National Marine Fisheries Services (NMFS) proposes the adoption of physiological change thresholds by the definition of TTS ('Temporary Threshold Shift') and PTS ('Permanent Threshold Shift') criteria.

The TTS and PTS respectively define the upper exposure limit for the temporary and permanent loss of hearing ability.

These thresholds do not take into account either the exposure duration, which is implicitly considered as very short, or the level of loss, implicitly regarded as disability.

The NMFS proposes the adoption of thresholds for marine mammals based on a conservative approach using the results of TTS studies of many marine mammal species. This value defines the spatial limit (or exclusion zone) of seismic activities in order to comply with the following values:

- 180 dB re µPa (RMS) for cetaceans;
- 190 dB re µPa (RMS) for pinnipeds (not expected in the study area).

The NMFS also provides a criteria of "behavioural discomfort" of 160 dB re µPa (RMS) for all cetaceans species.

The exclusion zone is then determined by the characteristics of the source and depth of the zone.

Marine Animal Noise Exposure Criteria

A more recent and highly regarded study was conducted by Southall *et al.* (2007), which proposed criteria for injury for marine mammal groups and sound types. Noise exposure criteria for auditory injury have been based in the publication on exposures inducing PTS-onset i.e 40 dB-TTS.

Definition:

PTS-onset is an irreversible elevation of the hearing threshold (i.e loss in sensitivity) at a specific frequency. PTS is presumed to be likely if the threshold is over 40 dB above TTS. Noise-inducted PTS represents tissue injury, whereas TTS does not.

TTS-onset has been defined as being a temporary elevation of a hearing threshold by 6 dB (Southall *and al*). TTS involves reduced hearing sensitivity following exposure, it results primarily from the fatigue (as opposed to loss) of cochlear hair cells and is by definition reversible.

Criteria for injury were derived from measured or assumed TTS-onset thresholds for each marine mammal group plus TTS growth rate estimates. Available data for 2 mid-frequency cetacean species are used as a basis for estimating PTS-onset thresholds for all cetaceans.

The PTS-onset thresholds are used to define exclusion zones. This study was developed on the basis of an extensive industry related bibliography and considers many factors in the development of criteria:

- **The designation of sound response frequency weightings** depending on mammal type, being mammals sensitive to low, mid and high frequency acoustic sources. These mammal types have been designated with a specific weighting curve to represent their sonar response, ie to modify the sonar signal to represent the noise level perceived by the mammal. For instance, mammals with sensitivity to high frequency sounds (eg dolphins and porpoises) will be much less affected by low frequency airgun emissions than baleen whales, which are sensitive to low frequency sounds.

As such, each mammal type (of low, mid and high frequency sensitivities) has been designated with a specific weighting curve to represent sonar response, being Mlf, Mmf and Mhf respectively (refer to Figure 9-1). Thus, in the frequency range of 7 – 104 Hz of airgun firing, weightings of -2 and -15 dB respectively were adopted for mammals sensitive to low and middle frequencies in order to modify the emitted sound level to represent the perceived noise levels for marine mammals sensitive to low and middle frequencies.

- **Signal type, being single pulse, multi pulse and continuous.** The seismic survey will be characterized by multiple pulses sound of 20 ms duration repeated every 10-15 seconds.
- **Indicator types, being the SPLo-p and the SEL**. The sound energy level describes the energy sum of each signal pulse. For a doubling in pulse (i.e. doubling of energy) the SEL doubles by 3 dB. The strictest indicator will be used to define the exclusion zone. For the calculation of the SEL, an exposure duration of **120 minutes** has been adopted, a conservative assumption of the time required for the acoustic source to move away from the static cetacean or vice versa. Assuming a streamer vessel speed of **9 km/h,** this would signify a significant reduction in received sound levels over the period calculated.

The sound response frequency weightings for different mammal species are shown in Figure 9-1 and values of PTS-onset are presented as an extract in Table 9-1).

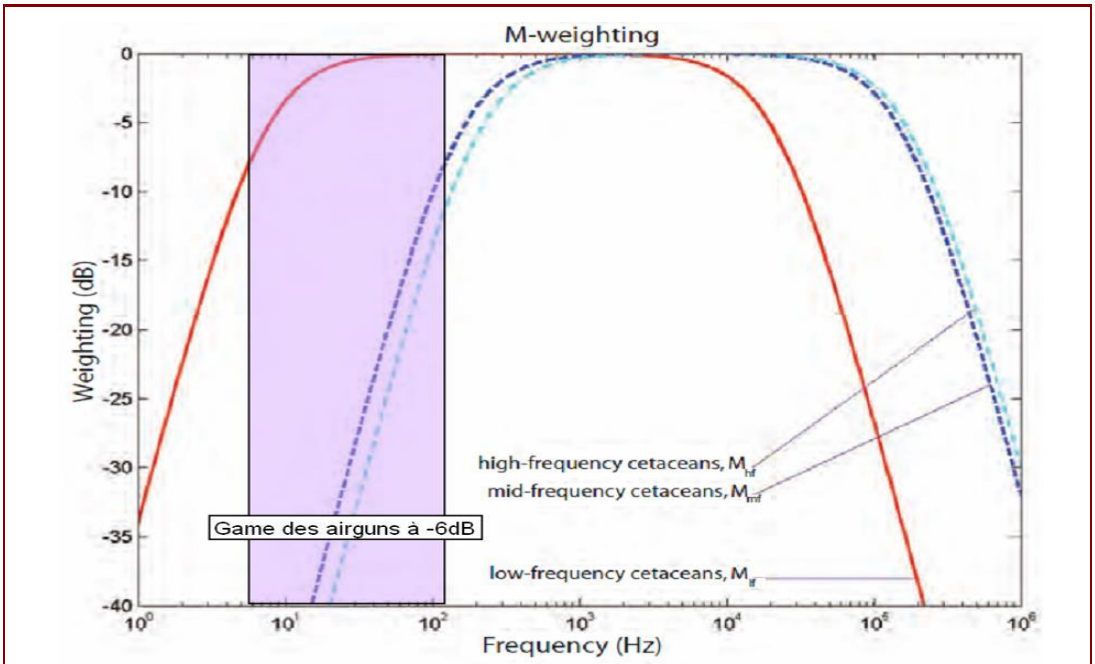


Figure 9-1 M-Weighting curve (Southall *et al.*, 2007)

Table 9-1 Proposed injury criteria (Southall *et al.*, 2007)

Table 3. Proposed injury criteria for individual marine mammals exposed to "discrete" noise events (either single or multiple exposures within a 24-h period; see Chapter 2)

	Sound type		
Marine mammal group	Single pulses	Multiple pulses	Nonpulses
Low-frequency cetaceans	Cell 1	Cell 2	Cell 3
Sound pressure level	230 dB re: 1 μPa (peak) (flat)	230 dB re: 1 μPa (peak) (flat)	230 dB re: 1 μPa (peak) (flat)
Sound exposure level	198 dB re: 1 μPa²-s (M_{lf})	198 dB re: 1 μPa²-s (M_{lf})	215 dB re: 1 μPa²-s (M_{lf})
Mid-frequency cetaceans	Cell 4	Cell 5	Cell 6
Sound pressure level	230 dB re: 1 μPa (peak) (flat)	230 dB re: 1 μPa (peak) (flat)	230 dB re: 1 μPa (peak) (flat)
Sound exposure level	198 dB re: 1 μPa²-s (M_{mf})	198 dB re: 1 μPa²-s (M_{mf})	215 dB re: 1 μPa²-s (M_{mf})
High-frequency cetaceans	Cell 7	Cell 8	Cell 9
Sound pressure level	230 dB re: 1 μPa (peak) (flat)	230 dB re: 1 μPa (peak) (flat)	230 dB re: 1 μPa (peak) (flat)
Sound exposure level	198 dB re: 1 μPa²-s (M_{hf})	198 dB re: 1 μPa²-s (M_{hf})	215 dB re: 1 μPa²-s (M_{hf})
Pinnipeds (in water)	Cell 10	Cell 11	Cell 12
Sound pressure level	218 dB re: 1 μPa (peak) (flat)	218 dB re: 1 μPa (peak) (flat)	218 dB re: 1 μPa (peak) (flat)
Sound exposure level	186 dB re: 1 μPa²-s (M_{pw})	186 dB re: 1 μPa²-s (M_{pw})	203 dB re: 1 μPa²-s (M_{pw})
Pinnipeds (in air)	Cell 13	Cell 14	Cell 15
Sound pressure level	149 dB re: 20 μPa (peak) (flat)	149 dB re: 20 μPa (peak) (flat)	149 dB re: 20 μPa (peak) (flat)
Sound exposure level	144 dB re: (20 μPa)²-s (M_{pa})	144 dB re: (20 μPa)²-s (M_{pa})	144.5 dB re: (20 μPa)²-s (M_{pa})

Note: All criteria in the "Sound pressure level" lines are based on the peak pressure known or assumed to elicit TTS-onset, plus 6 dB. Criteria in the "Sound exposure level" lines are based on the SEL eliciting TTS-onset plus (1) 15 dB for any type of marine mammal exposed to single or multiple pulses, (2) 20 dB for cetaceans or pinnipeds in water exposed to nonpulses, or (3) 13.5 dB for pinnipeds in air exposed to nonpulses. See text for details and derivation.

Project specific criteria

At the time of submission of the present IEE, the exact caracteristics of the sound source are not known, as it partly depends upon whom is awarded the contract. Under these circumstances the JNCC guidelines recommend applying a fixed 500 m radius exclusion zone around the source. Nevertheless, the following section indicates the type of calculations that is normally performed when source characteristics are known (the values may be higher than those applicable to the present project).

Taking into account injury criteria, transmission loss and directivity of the sound source the calculated distances to TTS and PTS thresholds for cetaceans are provided in the Table 9-2. These calculations have been performed assuming appropriate transmission loss corresponding to n=20.

The determination of protection zones corresponding to the threshold of discomfort 180 dB µPa-1m (SPL-RMS) defined by the US authorities (NMFS) for marine mammals gives very different protection perimeters for epipelagic species, mesopelagic and bathypelagic.

Table 9-2 Calculated distances to TTS and PTS thresholds for cetaceans

Distances R in m corresponding to different criteria for acoustic source considered For seismic source of airgun 254 dB 0-P µPa -1m						
Criteria			In the vertical to the bottom, in axis of maximum transmission	Take into account of directivity according to reference (3) for seismic source of 257 dB 0-P µPa-1m at different depth		
			Att=N LogR N adjusted to 20 by reference (3)	Epipelagic 0-200m	Mesopelagic 200-1000 m	Bathypelagic more than 1000 m
NMFS (1)	TTS for cetacean	180 dB re 1 µPa (SPL rms)	Profondeur max 2000	600	1,350	1,700
	Airgun behavioural disturbance criterion for cetaceans	160 dB re 1 µPa (SPL rms)	Profondeur max 2000	1,750	4,500	6,600
Southall criteria for cetacean (2)	TTS - multi pulse sources	224 dB re 1 µPa (SPL o-p)	< 100	< 100	< 100	< 100
	PTS - multi pulse sources	230 dB re 1 µPa (SPL o-p)	< 100	< 100	< 100	< 100
	TTS - multi pulse sources (weighted Mlf approx -2dB)	183 dB re 1 µPa^2 (SEL multiples impulsions)	Profondeur max 2000	900	2,100	**2,800**
	PTS - multi pulse sources (weighted Mlf approx -2dB)	198 dB re 1 µPa^2 (SEL multiples impulsions)	0	350	650	650
	TTS - multi pulse sources (weighted Mmf approx -15dB))	183 dB re 1 µPa^2 (SEL multiples impulsions)	0	400	800	**800**
	PTS - multi pulse sources (weighted Mmf approx -15dB)	198 dB re 1 µPa^2 (SEL multiples impulsions)	350	< 100	< 100	< 100

Considered results for the definition of radius exclusion area.

Table notes:

(1) NMFS (US National Marine Fisheries Service), February 2006. "Small takes on marine mammals incidental to specified activities: low energy seismic survey on the Louisville Ridge, Southwest Pacific Ocean". Federal registers vol. 71. Perry. S.L. Demaster, D.P. & Silber, G.K. 1999. The Humpback Whale. Marine Fisheries Review. 6191: 24-37.

(2) Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations, Supported through Joint Sponsorship by the European Association for Aquatic Mammals, the Alliance of Marine Mammal Parks and Aquariums, and the International Marine Animal Trainer's Association, Southall et al, 2007
(3) Risks analysis of marine mammals with the used of acoustic methods in oceanography, IFREMER, 2007.
SPL Sound Pressure Level, SEL Sound Exposure Level calculated using reference (2)
MIf weighting for low frequency sensitive cetacean (-2 dB) et Mmf/hf weighting for medium and high frequency sensitive cetacean (-15 dB) see reference (2)
PTS Permanent Threshold Shift, TTS Temporary Threshold Shift

For the purposes of this assessment, the thresholds defined by Southall *et al* (2007) have been adopted as they consider the specific characteristic and behavioural responses of the different species of cetaceans. Thus the thresholds developed provide stricter and more conservative limits concerning behavioural responses and not permanent or fatality levels.

The results determined in Table 9-2 indicate the distance to exposure to noise levels representing the PTS (the level of physical disturbance) for multipulse sources.

From calculation, the adopted shut-down zone (or exclusion zone/mitigation zone) for marine mammals are as follows:

- **2,800 m for cetaceans sensitive to low frequencies** (e.g whales species), which are likely to be animals with a size greater than 8 meters in length (up to 33 m);
- **800 m for cetaceans sensitive to middle/high frequency** (e.g dolphins, porpoises and some whales species), which are likely to be animals with size ranging from 1 to 8 meters in length. The only exception is the Sperm Whale measuring between 16 – 20 m in length.

Table 9-3 presents a proposed shut-down zones (or mitigation zones) for marine mammal species supposed to occur within the project area according to their frequency range sensitivity, IUCN status and average size of adult individuals. Further descriptions of marine mammals are presented in SECTION 6.

The observation zone of the MMO during the 3D seismic acquisition survey will be approximately of 3000 metres. Adoption of this observation zone will allow a buffer time for the observation team before their eventual encroachment of the exclusion zone limit, permitting determination of species, identification of applicable exclusion zone and subsequent responses from the seismic source crews.

The maintenance of the observation zone will be undertaken by the deployment of at least two support vessels being located 3-4 km ahead the seismic vessel with radio communication capabilities will supplement the visual monitoring of MMOs.

Figure 9-2 illustrates the proposed shut-down and observations zones proposed for the project to mitigate the impact on marine mammals and also on marine traffic.

Table 9-3 Proposed exclusion for marine mammals occurring in Myanmar waters (using generic data for illustration purposes only)

Common name	Species	IUCN status	Freq. sensitivity (Low, Medium, High)	Proposed shut-down zone (m)	Adult size in length (m)	Potentially present within the project area
Common Minke Whale	Balaenoptera acutorostrata	LC	LFC	2,800 m	7 – 10	x
Bryde's Whale	Balaenoptera edeni	DD	LFC	2,800 m	12 - 15	x
Blue Whale	Balaenoptera musculus	EN	LFC	2,800 m	27 - 33	x

Fin Whale	Balaenoptera physalus	EN	LFC	2,800 m	19 - 26	x
Risso's Dolphin	Grampus griseus	LC	MFC	800 m	< 4	x
Indo-pacific Beaked Whale	Indopacetus pacificus	DD	MFC	800 m	7 - 8	X
Humpback Whale	Megaptera novaeangliae	LC	LFC	2,800 m	12 - 16	x migratory
Blainville's Beaked Whale	Mesoplodon densirostris	DD	MFC	800 m	4 - 5	x
Indo-Pacific Finless Porpoise	Neophocaena phocaenoides	VU	MFC	800 m	< 2	x
Sperm Whale, Cachelot	Physeter macrocephalus	VU	MFC	800 m	16 - 20	x
False Killer Whale	Pseudorca crassidens	DD	MFC	800 m	< 5	x
Pantropical Spotted Dolphin	Stenella attenuata	LC	MFC	800 m	< 3	x
Rough-toothed Dolphin	Steno bredanensis	LC	MFC	800 m	< 3	x
Common Bottlenose Dolphin	Tursiops truncatus	LC	MFC	800 m	< 4	x

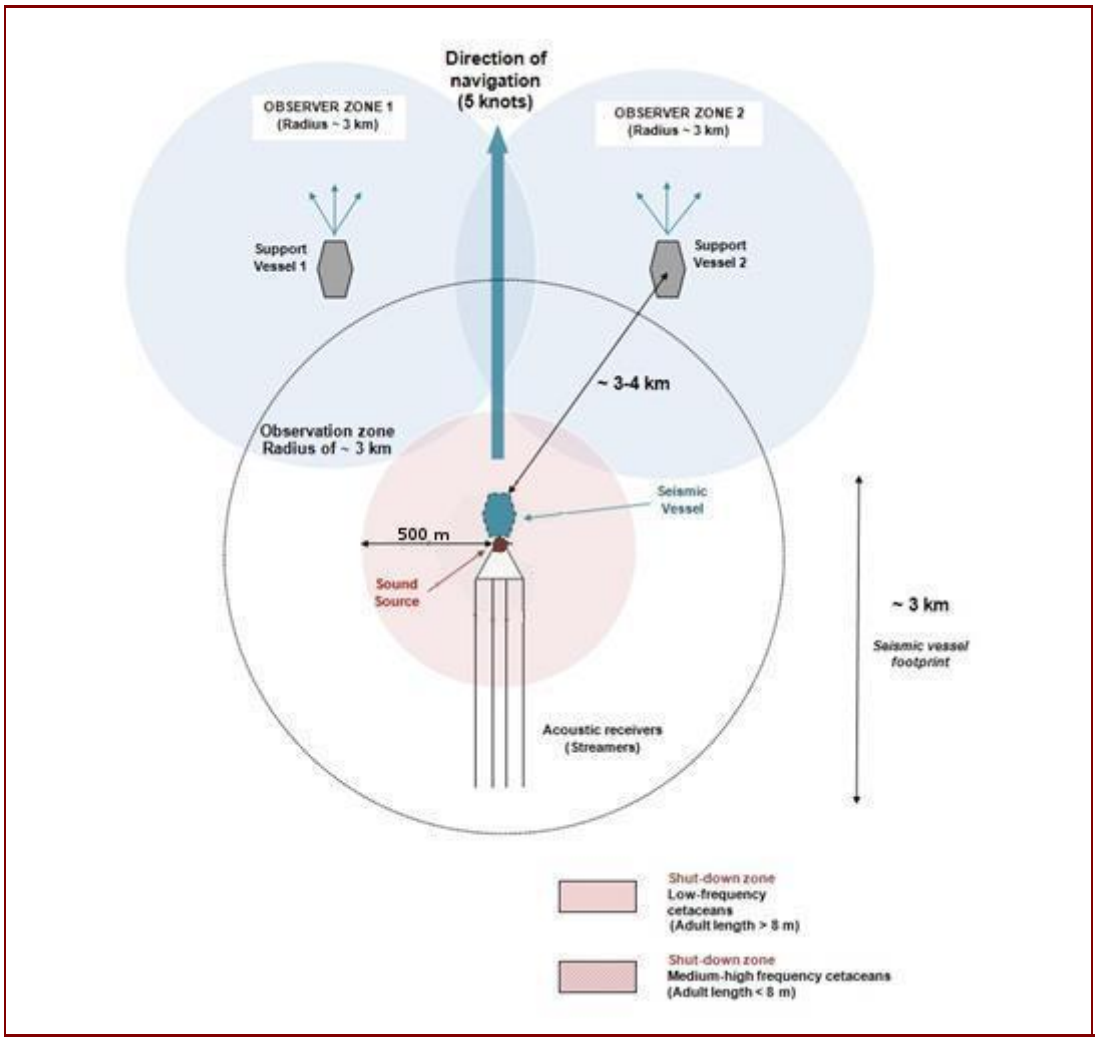


Figure 9-2 Diagram of proposed shut-down and observation zones for M5-M6 Block seismic survey

Pre-shooting search

The pre-shooting search should normally be conducted over a period of 60 minutes before commencement of any use of the airguns (the M5-M6 blocks are situated in deepwater >200m depth). The MMO should make a visual assessment to determine if any marine mammals are within the mitigation/exclusion zone (i.e 500 m of the centre of the airgun array).

If PAM is used in conjunction with visual monitoring, the PAM operator should ensure the system is deployed and being monitored for vocalisations during each designated pre-shooting period.

Delay if marine mammals are detected within the mitigation zone

Mitigation actions are taken by either the MMO or the PAM; if present, in case of the following scenario:

- If marine mammals are detected by the MMO within the mitigation zone of the center of the airgun array during the pre-shooting search, the soft-start of the seismic sources should be delayed until

their passage, or the transit of the vessel, results in the marine mammals being more than 500 meters away from the source.

Irrespecive of whether it is the vessel or the mammal that moves away, there should be a 20 minute delay from the time of the last sighting within the mitigation zone of the source to the commencement of the soft-start, in order to ensure that the animals have left the area.

If PAM is used, it is the responsibility of the PAM operatives to assess any acoustic detection and determine if there are likely to be marine mammals within the mitigation zone. If the PAM operatives consider marine mammals are present within that range then the start of the operation should be delayed as outlined above.

If marine mammals are detected within the mitigation zone whilst the airguns are firing, either during the soft-start procedure or whilst at full power, there is no requirement to stop firing the airguns.

Soft start procedure (ramp-ups)

The soft-start is defined as the time that airguns commence shooting till the time that full operational power is obtained. Soft-start procedures are based on precautionary practice of starting the sound source at low levels and then building these levels up gradually. The goal of a soft start is to give sufficient warning to marine mammals in the vicinity of the survey area of the increasing noise in their environment. The idea is to provide these animals with adequate time to move away from the survey area before the sound sources achieve the full energy output.

Soft starts involve using the equipment that produces the sound source during operations. Soft start procedures are carried out during seismic surveys by first firing the smallest volume airgun and then adding successively larger volume airguns to the firing pattern with each step. It is recommended that soft starts for seismic surveys **should last at least 20 minutes and last no longer than 40 minutes**.

A soft-start procedure is required every time the airguns are used or if there is any break in airgun activity day or night exceeding 10 minutes.

Soft start procedures on seismic surveys vessels are often automated on-board vessels to ensure consistency. An example of this is shown below.

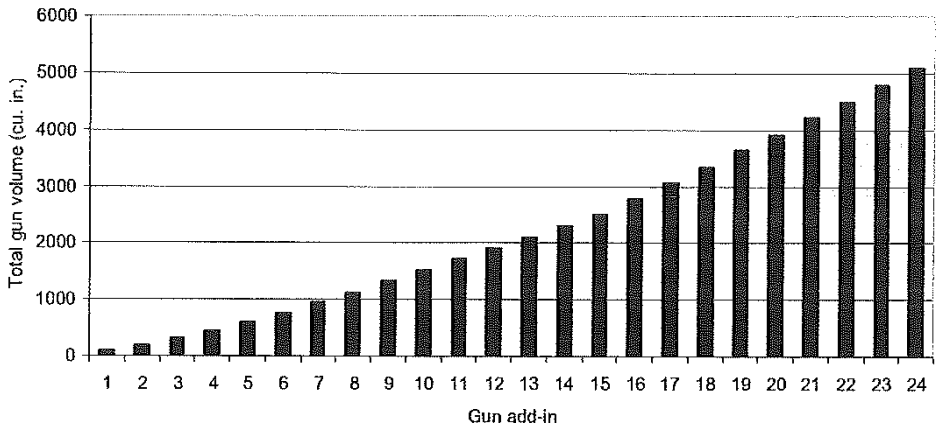


Figure 9-3 Soft start

JNCC guidelines (2017) provide clarification when a soft-start is required during airgun testing. Airgun testing may be required before a survey commences, or to test damaged or misfiring guns following

repair, or to trial new arrays. Individual airguns, or the whole array may need testing, and the airguns may be tested at varying power levels. The following guidance is provided to clarify when a soft-start is required:

- If the intention is to test all airguns at full power then a 20 minute soft-start is required.
- If the intention is to test a single airgun on low power then a soft-start is not required.
- If the intention is to test a single airgun, or a number of guns on high power, the airgun or airguns should be fired at lower power first, and the power then increased to the level of the required test; this should be carried out over a time period proportional to the number of guns being tested and ideally not exceed 20 minutes in duration.

MMOs should maintain a watch as outlined in the pre-shooting search guidance (see below the visual observation guidance) before any instances of gun testing.

JNCC guidelines provide the operators with the following recommendations (JNCC, 2017):

- To minimise additional noise in the marine environment, a soft-start (from commencement of soft-start to commencement of the line) should not be significantly longer than 20 minutes (for example, soft-starts greater than 40 minutes are considered to be excessive, and an explanation should be provided within the MMO report).
- Where possible, soft-starts should be planned so that they commence within daylight hours.
- Once the soft-start has been performed and the airguns are at full power the survey line should start immediately. Operators should avoid unnecessary firing at full power before commencement of the line.
- If, for any reason, firing of the airguns has stopped and not restarted for at least 10 minutes, then a pre-shooting search and 20 minute soft-start should be carried out (the requirement for a pre-shooting search only applies if there was no MMO on duty and observing at this time, and if the break in firing occurred during the hours of daylight). After any unplanned break in firing for less than 10 minutes the MMO should make a visual assessment for marine mammals (not a pre-shooting search) within 500 metres of the centre of the airgun array. If a marine mammal is detected whilst the airguns are not firing the MMO should advise to delay commencement, as per the pre-shooting search, delay and soft start instructions above. If no marine mammals are present then they can advise to commence firing the airguns.
- When time-sharing, where two or more vessels are operating in adjacent areas and take turns to shoot to avoid causing seismic interference with each other, the soft-start and delay procedures for each vessel should be communicated to, and applied on, all the vessels involved in the surveying.

Line change

Seismic data is usually collected along predetermined survey lines. Line change is the term used to describe the activity of turning the vessel at the end of one line prior to commencement of the next line. Depending upon the type of seismic survey being undertaken, the time for a line change can vary. Line changes are not necessary for all types of seismic surveys, for example, in certain regional surveys where there is a significant distance between the lines, and for VSP operations.

The guidance relating to line change depends upon the airgun volume. The exact caracteristics of the airguns used for the M5-M6 blocks seismic survey are not known at the time of writing up the present IEE. However, based on the size ofr airguns used on previous campaigns by TEPM, the corresponding guidance from JNCC is expected to be as below:

If the line change time is expected to be greater than 40 minutes, airgun firing should be terminated at the end of the line and a full 20 minute soft-start undertaken before the next line.

A pre-shooting search should also be undertaken during the scheduled line change, and the soft-start delayed if marine mammals are seen within the exclusion zone.

Depending upon the duration of the line turns and the nature of seismic survey it may be necessary to vary the soft-start procedures. If this recommended protocol cannot be achieved using the above methods, the operator should propose alternative methods.

Undershoot operations

During an undershoot operation, one vessel is employed to tow the seismic source and a second vessel used to tow the hydrophone array, although the main vessel will still tow the hydrophone array.

The MMO may be too far away from the airguns to effectively monitor the mitigation zone, and it is therefore recommended to place the MMO on the source vessel. If this is not possible, for example for logistical reasons, or the health and safety implications of transferring personnel from one vessel to another, the application should explain that the recommended procedure cannot be followed in the application for the survey.

In all cases, the pre-shooting search and soft-start procedures should still be followed prior to undertaking an undershoot operation.

9.1.1.3 ***Marine mammal survey techniques***

The marine mammal observer (MMO) must first be able to detect marine mammals. This is done by visual and passive acoustic monitoring.

Visual monitoring

At least 60 minutes prior to any use of seismic sources, the operator and observers will attentively perform a visual check from a high and adapted vantage point, to check the presence marine mammals within the observation zone.

Visual monitoring involves sighting marine mammals as they break the surface of the water or pass by very close underneath the surface. There are several reasons why a marine mammal will come to the surface, which are to breathe air, roll backs and tail flukes, feed, socialize, rest and to increase speed of travelling (porpoising).

During the visual monitoring, the MMO will be looking for various cues in order to determine the presence of marine mammals in the area depending on their behavior at the surface. Sighting cues can also help in the identification of animals to the group level and in some cases to the species level.

A local marine mammal expert will be involved in this surveillance and observation process. The expert will be independent and selected for his/her regional marine knowledge, if possible. At the end of the campaign all parties will submit a summary report of all sightings.

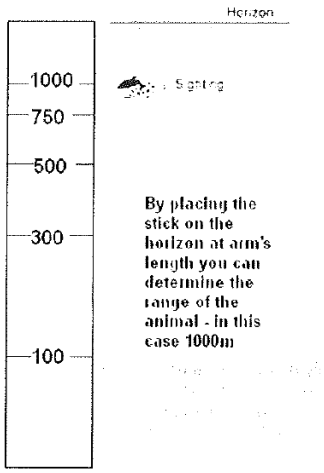
The observation zone comprises a radius of 3 km approximately, and a qualified MMO will undertake continuous visual monitoring within this area, including continuous monitoring over a period of at least 60 minutes prior to the airgun start-up.

The maintenance of the observation zone will be undertaken by the deployment of at least two support vessels being located 3-4 km ahead the seismic vessel with radio communication capabilities. They will supplement the visual monitoring of MMOs (see Figure 9-4).

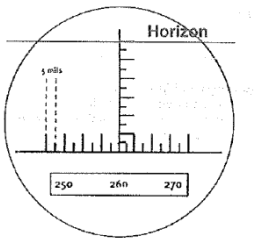
Figure 9-4 Example of observation of marine mammals

MMOs use different means to determine range at sea, as for example binoculars with reticules or making a range stick (see Figure 9-5). Both of these methods use the horizon and calculations of observer height above sea level to determine range to the animal. These methods are fairly accurate as long as there is not too much swell and that the horizon is visible.

Binoculars



Binoculars



Sighting

Figure 9-5 Example of observation techniques for marine mammals

SOURCE: JNCC

Over a few years, there has been increasing interest in using infra-red and night-vision (light amplification) technologies for observing marine mammals. These techniques, particularly infra-red do have some limitations, e.g. infra-red vision becomes quickly limited as soon as white horses appear on the wave crests, and the more sophisticated instruments require complex cooling systems for the optics and have a limited lifespan. Nevertheless, these technologies provide at least a partial answer to night observation when PAM cannot be deployed.

Passive acoustic monitoring

Standard visual observation is an ineffective mitigation tool during periods of darkness or poor visibility (such as fog), or during periods when the sea state is not conducive to visual mitigation, as it will not be possible to detect marine mammals in the vicinity of airgun sources. Under such conditions, PAM is currently considered to be the best available observation technique that can be used to detect marine mammals.

Passive acoustic monitoring may be a requirement for surveys that are conducted in particularly sensitive areas or for certain species, such as sperm whales. It is also helpful in detecting harbor porpoises within the 500 metres mitigation zone, although the systems have their limitations and can only be used to detect vocalising species of marine mammals.

Submerged cetacean are much more risk than those on the surface. According the JNCC, this makes it particularly important to use a hydrophone whenever possible to detect vocally active animals that may be invisible from the surface. The PAM system is therefore ideally used in conjunction with visual monitoring, to provide effective 24 hours observation of cetaceans.

- **PAM equipment – frequency range**

PAM systems consist of hydrophones that are deployed into the water column, and the detected sounds are processed using specialized software. The equipment involves towing long lengths of cable (200-300 m) which ensures that the hydrophones elements are away from the engines. This system usually contains filters to eliminate some of the engine noise.

Current equipment for electronic detection of cetaceans can detect 5 to 8 times more cetaceans than previously (Gillespie & Chappell, 1998). Electronic detection systems passively record all frequencies up to 140 kHz (the waves used for seismic reach 200 kHz). Software will be used to assess frequencies anomalies corresponding to the potential presence of sound emitting marine mammals.

- **Conditions of use of PAM and limitations**

The advantages that PAM has over visual monitoring are:

- Acoustic detection of cetaceans is less affected by weather conditions;
- Acoustic detection range for many species superior than visual detection;
- Acoustic detection can be made of animals below the surface (as long as they are vocalizing) and therefore increases the likelihood of detecting deep diving species,
- Acoustic monitoring can be conducted 24 hrs a day;
- A complete and permanent record can be made of acoustic monitoring cues.

However, PAM does have the following limitations:

- Current PAM systems do not give accurate estimates of range. The accuracy can be estimated at +/-300 meters which means animals detected and calculated to be within 500 meters from the source could, in reality, be 500 + 300 = 800 meters, but their detection would still lead to a delay in the soft-start. Although, at present it is not possible to express the range accuracy of most PAM systems in numerical terms.
- PAM systems do not have a reliable range determination facility or can only calculate the range for some species. For e.g baleen whales vocalize at frequencies

which are very difficult to detect using current PAM systems, whereas harbor porpoises utilize high frequencies (130 kHz) and thus have a very short acoustic detection range;

In such cases, the detection of a confirmed cetacean vocalization should still be used to initiate postponement of the soft-start if the PAM operator is able to make a judgment about the range of the animals from the airgun source, because of their experience gained in differentiating between distant and close vocalizations. In the absence of PAM systems capable of range determination, this expert judgment will constitute the basis for deciding whether an area is free from cetaceans prior to the soft-start.

- Animals do not vocalize all of the time and may pass by undetected;
- Interference with other maritime anthropogenic sound, such as boat nearby, engines, etc…

This last example serves to illustrate that it is in the operator's best interests to use the most accurate system available and to check with the PAM provider if the frequency range covered are adapted to local marine mammals.

Requirements for MMOs and PAMs

The M5-M6 blocks are located off the coast of Myanmar in the northern part of the Andaman Sea. The seismic campaign will be conducted within area located between latitudes 14ºN and 15ºN, therefore the expected duration of daylight is over 12 hours per day from lmid-March to mid-September, and between 10 and 12 hours the other half of the year.

Considering JNCC guidelines, the size of the bloack and duration of the campaigns, and the sensitivity of potential marine mammals that may occur within the project area:

- Two full-time MMOs (one of whom should be fully trained) should be appointed for the purpose of monitoring the implementation of the guidelines and undertaking visual observations to detect marine mammals and turles during periods of seismic activity. Additionally, an observer role will be needed on the auxiliary vessels.
- Either one PAM system should be used to supplement visual observations, or light amplification or infra-red means of observation should be available to extend the feasibility of observing marine mammals during dusk / night-time hours.

9.2 COMMITMENT REGISTER WITH RESPONSIBILITIES

The impact mitigation measures regarding the seismic survey activities have been outlined in SECTION 9 and in paragraph 7.5 and are listed in the commitment register below.

Table 9-4 Commitment register

Impacts	Mitigation measures	Type / Responsibility	Cost
Impact of noise on marine mammals, sea turtles and fish	Reevaluate the appropriate **radii** to use for low frequency and high-frequency ceteaceans (instead of the default 500 m) value, once the airgun characteristics are known.	TEPM	No specific cost allocated
	Mobilise **two Marine Mammal Observers** on the streamer vessel, one of whom is fully trained, in addition to the multi-role observers on the auxiliary vessels, in order to address the long duratuion of the campaign.	Seismic contractor via EMP	360 000 USD (30 man months (2 × 14 + 2) @ 400 USD/day)
	Infrared/night-vision of Passive Acoustic Monitoring to be implemented in order to allow observations during **night time**.	Seismic contractor via EMP	No specific cost allocated
	Extend periods of marine mammal observations to include one month before start of the overall seismic campaign and one month after the campaign, for impact evaluation purposes. This may be done using a single observer (with appropriate equipment), using vessels of opportunity (scouting or support vessels for Yadana /Sein.	Seismic contractor via EMP	No specific cost allocated
	Observation zone will be enforced by the deployment of a series of marine vessels with radio communication capabilities. It is recommended that observers could be embarked on the **support vessels** to complement the visual monitoring of the main MMO. This is especially relevant during undershooting operations.	Seismic contractor via EMP	No specific cost allocated
	Pre-shooting visual monitoring by MMOs on the vessel for at least 60 minutes prior to airgun firing to check for marine mammal presence in exclusion zone. This should be undertaken between line changes.	Seismic contractor via EMP	No specific cost allocated
	Implementation of **soft start procedures**, over a period of at least 20 minutes to allow marine mammals the time to leave the survey area including a mitigation air gun. This should be undertaken between line changes in the event the change time exceeds 20 minutes.	Seismic contractor via EMP	No specific cost allocated
	Prior to the commencement of seismic firing, if marine mammals are identified in the exclusion zone, the soft start procedure should be delayed until all mammals have left the **exclusion zone**. The soft start procedure should be initiated 20 minutes after the last sighting of the animal in the exclusion zone.	Seismic contractor via EMP	No specific cost allocated
	Streamers to be of a solid or semi-solid type.	Seismic contractor	No specific cost allocated
	Best Available Technology to **optimize duration** of activities.	Seismic contractor	Already integrated in design phase

Table 9-4 Commitment register

Impacts	Mitigation measures	Type / Responsibility	Cost
	Food waste not to be discharged overboard (as per MARPOL) when shooting is ongoing if this appears to attract fish / birds..	Seismic contractor	No specific cost allocated
Damage due to physical contact	**Permanent watch** to be kept on the bridge and full compliance with SOLAS and other maritime regulations for all the vessels.	Seismic contractor	No specific cost allocated
	Continuous sounding in shallow waters to prevent damage to coral reefs by streamers.	Seismic contractor	No specific cost allocated
	Anchoring prohibited on coral reefs (use of dynamic positioning vessels).	Seismic contractor	No specific cost allocated
	Turtle-friendly tail bouys to be used.	Seismic contractor	No specific cost allocated
Standard maritime impacts	Use **low-sulphur fuel** (less than 0.5%$_{mass}$), in exceedance of current IMO sulphur cap.	Seismic contractor	Overhead of low-sulphur fuel compared to current IMO cap.
	Implement a **Ship Energy Efficiency Management Plan** for at least the main vessels. Unnecessary / ineffective lighting to be avoided.	Seismic contractor	Integrated in the constractor prerequisite
	Implement **Ballast Water Management Plans**, as per IMO regulations.	Seismic contractor	Integrated in the constractor prerequisite
	Implement a **no solid/liquid waste to sea discharge policy**, covering all solid waste (with the possible exception of food waste if MARPOL is followed) and liquid wastes (blckack, grey, deck and bilge waters) for all vessels. All waste to be brought onshore. Some relaxation for deck waters of auxiliary vessels may be considered.	Seismic contractor	Integrated in the constractor prerequisite
	Implement a **Waste Management Plan**, including appropriate reporting mechanisms for the treatment of wastes.	Seismic contractor	No specific cost allocated
Spills	Implement a **bunkering procedure** that prohibits bunkering during dark /dusk hours and upstream of coral reefs. (This also applies to sewage and waste transfers).	Seismic contractor	No specific cost allocated
	SOPEPs to be extended with a **spill procedure** for spills at sea during bunkering.	Seismic contractor	No specific cost allocated
Disturbance to fisheries and marine traffic	Information to the **contractor's employees** during HSE or Project Inductions about the risks related to the presence of fishermen or commercial ships in the Project area and the mitigation measures planned.	Total E&P Myanmar/ Seismic contractor via ESMP	No specific cost allocated
	Communication and coordination with Myanmar **marine authorities** (MPA, DMA, Myanmar Navy and coastguards) and main fishery stakeholders (DoF and MFF) about the seismic survey location, schedule and duration (before, during and after seismic survey).	Seismic contractor	No specific cost allocated

Table 9-4 Commitment register

Impacts	Mitigation measures	Type / Responsibility	Cost
	Preparation of **flyers** on the seismic campaign in Burmese and Thai language.	Total E&P Myanmar via ESMP	No specific cost allocated
	Recruitment **of a Fisheries Liaison Officer** able to speak Burmese and Thai that will participate to the survey and handle encounters with Thai fishermen, solving any issues that could arise between these fishermen and the project.	Seismic contractor	409 000 USD (daily rate 350 USD for a month)
	Organise issuance of a **notice to mariners** about the seismic operation with the assistance of marine authorities, and communication with fisheries stakeholders with plenty of time to get organized (45 days).	Total E&P Myanmar/ Seismic contractor	No specific cost allocated
	Weekly communication with marine authorities on operations (date, position, issues, etc.).	Seismic contractor	No specific cost allocated
	Equipment of the seismic vessels with **loud speakers** to communicate with boats not equipped with radio.	Seismic contractor	Integrated in HSE management of contractor
	Perform a **scouting survey** enabling to assess the fishery activity at the seismic area (localize fishermen and interview them to determine their origin, spot and count the fish traps installed in the area) should be conducted before the seismic starts even if there is a low probability of encounters with fishermen and of the presence of fish traps	Total E&P Myanmar/ Seismic contractor via ESMP	360 000 USD (1 chase boat, daily rate 4000 USD for a month each campaign)
	Use of **chase vessels** to monitor the presence of ships using radar or visual observation and keep them out of the seismic area.	Seismic contractor	No specific cost allocated
	Modern **navigation equipment** to indicate the approach of other vessels complete by surroundings surveillance by chase boats.	Seismic contractor	Integrated in the contractor prerequisite
	Full compliance of vessels with SOLAS requirements and **AIS** identification rules.	Seismic contractor	Integrated in the contractor prerequisite
General (control)	Perform regular **checks/monitoring** of the whole fleet (physical and/or documentary) to check that all measures in the present commitments register are appliced.	Seismic contractor	Integrated in the contractor prerequisite
	Perform two **audits**, (in addition to normal RSES control), one per main campaign season, to ensure that contractor and subcontractors (including some of the waste recipients, in particular for electronic waste), are in line with the present Commitments Register.	TEPM	8000 USD for HSE audit (1 Auditor, 2 days rate including travel expenses)

SECTION 10. CONCLUSION

The Total E&P Myanmar Project consists of a 3D seismic acquisition with a full fold area of 24,541 km^2 in blocks M5 and M6, including the Yadana and Sein fields, the closest part to the mainland being situated approx. 35 km from the shore. The project is planned to occur in three steps: one month in April 2018, i.e. just before the 2018 monsoon for the Yadana – Sein fields (central part), 7 months after the 2018 monsoon for the western part (M6) and 6 months after the 2019 monsoon for the eastern part (M5).

The principle of seismic acquisition is to use compressed air to generate underwater waves which reflect more or less quickly depending on the geological strata encountered beneath the sea. Processing of the reflected waves allows identifying potential sources of hydrocarbons in the subsoil. The characteristics of the sources are not known at the time of writing the present IEE. Ten 8km-length streamers of a solid or oil-filled semi-solid type will be towed in order to record reflected acoustic signals. Typical source pressure levels (SPL, 0-P) for such a campaign are of the order of 250 dB $1\mu Pa.m^{-1}$.

The seismic vessel will be supported by chase boats to identify any possible embarrassment to the seismic survey (such as floating objects, for example). One supply vessel will be used for logistical needs, especially bunkering. Up to seven vessels will support the main survey vessel.

GHG generated by the Project has been estimated at 249648 tons $eqCO_2$. Volumes of domestic and sanitary wastewater were estimated at 15890 m^3. Deck and bilge waters were estimated at 10543 m^3 for the total duration of the Project, and hazardous and non hazardous waste at 4010 tons.

During the pre-monsoon period (first phase of the campaign) currents are expected to flow eastwards, whereas during the post-monsoon period (second and third phases) currents will essentially flow westawards.

The project area is located almost entirely on the continental shelf apart for the westernmost portion, West of Preparis Island, which extends down the continental slope to the ocean bottom at depths exceeding 2000 m. The nearest coastline on the mainland is the southern tip of the Ayeryawady delta which lies 35 km from the edge of the block. The northern two thirds of the study area are under direct influence of the Ayeyarwady delta and present strong chlorophyll a concentrations; fine sediments are expected. Many of the 29 marine mammals registered by the IUCN as bein g present in Myanmar's waters are present in the block, as shown during previous surveys. Sea turtles are very likely to be encountered, particularly the green turtle. Some 37 species of fish are taken in the region.

The study area belongs to the offshore fishing area. It lies across the shipping lane from Yangon to the Cape of Good Hope, the lane from Bengladesh to Singapore and the SW corner is on the lane from Singapore to northern India.

The description of the environment has shown that cetaceans, turtles and coral reefs (the latter in case of physical contact) are the most sensitive components of the natural environment, whereas fishing and have shipping will also need to be addressed.

The main potential impacts of the project identified in this IEE are underwater noise generated by airguns on marine mammals and turtles. Other potential impacts identified are damage to coral by the slanted streamer configuration, and disruption to fisheries and shipping due to the size of the streamer array (1× 8 km). Additionnaly, general maritime impacts will result from using the project fleet (air emisisons, waste, biodispersion, discharges, stray light etc.), but they are expected to be of no more consequence than ordinary shipping, the main difference being the increased risk of petty spills due to bunkering at sea.

Mitigation measures focus on observing marine mammals to adapt the airgun starting time, as per UK JNCC recommendations. Two main observers will be needed due to the duration of the campaign. Virtually permanent will limit collision of streamers with reefs. Disruptions to fisheries and shipping will be avoided by tightly coordinating with maritime authorities and stakeholders, and will include initial scouting to avoid collision with fixed fishing gear. Finally, ordinary martitime impacts of the survey fleet will be

controlled by leveraging on all existing MARPOL and IMO regulations and expecting strict compliance from the operator, for whom following these points is a requirement in the selection process); additionally, low-sulphur fuel will also be used. The measures are recapitulated in a Commtiment Register, which also indicates the areas of responsibility of the various parties.

The corresponding Environmental and Social Management Plan is indicated in the SECTION 11, with more detailed components in the appendices.

SECTION 11. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

11.1 INTRODUCTION

The present Environmental and Social Management Plan (ESMP) and its specific procedures will be completed by Total E&P Myanmar and all relevant contractors for the seismic activities.

This section briefly describes the Environmental and Social Management Plan (EMSP) relevant to the Total E&P Myanmar seismic acquisition project that will be prepared by Total E&P Myanmar and the seismic contractor, in accordance with the Environmental Management System and relevant (Health, Safety and Environment (HSE) specifications. It also incorporates the principles outlined in internal documents such as the General Specifications **GS-EP-ENV 001** (Environmental Requirements for Project Design and E&P Activities), **GS-EP-ENV-120** (Environmental Impact Assessment of E&P activities), and **GS-EP-SDV 102** (Social Impact Assessment) issued by the Exploration & Production branch of TOTAL group.

In compliance with these guidelines, this ESMP will include the following Management Plan:

- Waste Management Plan;
- Oil Spill Contingency Plan (SOPEP);
- Environmental Monitoring Program;
- Training Program;
- Environmental Audit Program;
- Social Management Plan, if relevant.

In practice, TEPM works with reputable contractors who are expected to already have their own internal company and vessel specific Environmental and Social management systems already in place. Therefore finalization of an ESMP proceeds through the following steps:

- Incorporation of Environmental and Social expectations into the bidding documents and taking into account of these expectations during the contractor selection process;
- Comparison between TEPM expectations and how they are actually answered by the contractor ESMP and management system; establishment of a bridging document for interfacing between the TEPM and contractor ESMP and completion of any gaps with project –specific procedures.

11.2 ROLES AND RESPONSIBILITIES

Environmental management will be supervised on board by a Company man representing Total E&P Myanmar. He will act as the RSES (Responsible Safety and Environment on Site) and will be nominated by TEPM General Manager.
The RSES works in collaboration with the HSE coordinator from the contracted company that carries out the campaign. He directly report to the TEPM Seismic Operation Superintendent and to the Geosciences Manager for all aspects of HSE.

11.2.1 RSES

His role consists in:

- Ensuring the implementation of risk reduction and control of impacts procedures;
- Checking compatibility and coordinating simultaneous activities;
- Imposing additional more complete risk reduction measures if the situation requires it;
- Supporting emergency situations control.

11.2.2 Geophysical contractor role and responsibilities

The ESMP for the exploration campaign will be prepared by the seismic contractor, in accordance with the requirements of Myanmar and TEPM regulations.
Particular attention falls on the following aspects:

- Communication on the ESMP key points;
- Sharing of information;
- Specific training;
- Method to assess and monitor environmental and social performance during operations;
- Sound functioning of all ship related mitigation plans (Ship Energy Efficiency Management Plan, Ballast Water Management Plan, Waste and discharge management, SOPEP etc.)

The seismic contractor will designate an **HSE coordinator** within his teams. He/she will be in charge of all the environmental and social aspect; he/she will work in collaboration with the RSES. He/she will also be in charge of daily HSE organization and the implementation of the daily reporting to TEPM.

The HSE coordinator will:

- directly monitor all ship-related aspects (as opposed to seismic-related) by e.g. checking that sea valves are closed and/or scealed, being present during bunkering operations and similar physical and/or documentary verifications;
- facilitate integration of the MMOs into the ship's operations.

11.3 ENVIRONMENTAL MONITORING PROGRAM

11.3.1 Guiding principles

The main goals of the EMoP are as follows:

- Manage and minimise the acoustic impacts to marine fauna via the implementation of appropriate management and monitoring procedures;
- Check the overall effectiveness of design and operational procedures in protecting the environment;
- Comply with regulations, standards, compliance programmes;
- Detect sudden environmental changes;
- Measure physical disturbance and subsequent recovery following the end of operations;
- Assess impact and recovery following accidents and incidents;
- Confirm that environmental equipment and procedures are effective and suitable; and
- Compare observed impacts with those predicted in the IEE.

11.3.2 Overview

The table below summarizes the points that will be monitored. The main monitoring concerns the observations on marine mammals: this covers the major impacts and is the only one that can be realistically performed on the environment. Observation periods will be extended before and after the campaigns so as to allow comparison during shooting and outside of shooting. All other monitoring focuses on the source side of the impacts, to check that the operations do not generate harmful aspects. Observations will be recorded in log books, and consolidated as part of the HSE reporting.

Table 11-1 Seismic survey monitoring program

	Monitoring requirement		
	Impact factor	Parameter / characteristics	Timeframe / Monitoring frequency
1	Acoustic noise from airgun	Presence of marine mammals (and turles)	Before a campaign: for a duration of one month During a campaign: prior ot starting the airgun + substabncial percentage of time at other periods After a campaign: for a duration of one month
2	Transfers at sea (bunkering, sanitary sewage, waste…)	Observations at sea and on deck	During each transfer operation
3	Contact of streamers with coral (and nets etc.)	Observations from the bridge and on deck	Whenever in shallow waters(depth < 10 m): HSE presence on the bridge or other location that facilitates situation awareness

			Whenever streamers are pulled on deck
4	Ordinary martitime impacts • atmospheric emisisons, • non-seismic noise, • stray light, • biological dispersal • discharges • waste	Adherence with the various plans (Ship Energey Efficieny Management Plan, Balast Water Management Plan, Waste Management Plan etc.)	Ongoing on the streamer vessel: checks above and below deck (e.g. checking valve positions/seals, discussion with crew memebers…) At least weekly HSE contact with each of the auxiliary vessels.
			Two audits for the whole project: including documentary evidence (e.g. proof of purchase low-sulphur fuel etc.) and physical investigations (e.g. checking that waste final destination – particularly for e-waste, which is the only stream specific to a seismic survey)

The main concerns of this EMoP are the main impact of the survey, i.e. acoustic impacts of seismic activities on marine fauna, and the implementation of adequate monitoring procedures to minimize potential risks by the implementation of a **marine mammal observation program**, which also benefits to turles. It ties in directly into the control of the airgun.

11.3.3 Marine mammals observation

A Marine Mammal Observer (MMO) program will be implemented according to best practice in the oil and gas industry during survey operations. Two Marine Mammal Observerq (MMO), including one who is fully qualified) will be located on-board (one in the survey vessel and two others observers trained will be in the support vessels upstream the seismic vessel) and will monitor the presence of marine life within the 500 m radius zone.
The monitoring procedure set up by Total E&P Myanmar will be developed on the basis of the recommendations of the United Kingdom Joint Nature Conservation Committee (JNCC), whose rules are commonlyu used in the industry, and taking into account specific technical and biological research on the subject used in this IEE.
In addition to the logbooks of the marine mammal observers sightings and observation efforts, an environmental monitoring register will also list all other observations relating to marine fauna (fish, turtles, birds, etc.).

11.3.3.1 MMO capabilities

The nominated MMO should be suitably qualified with:

- Specific knowledge of identification of main species of marine mammals, sharks, marine birds and marine turtles;
- Knowledge of good practices for MMO surveys in oil and gas activities;
- General knowledge of marine mammal behaviour;
- General knowledge of marine mammal and turtle sensitivity to sound;
- General knowledge of the Environmental Management System of Total E&P Myanmar and other HSE procedures.

The implementation of this MMO program as a sustainable development strategy may present an opportunity to develop new proficiencies and capacities to transfer this knowledge from Total E&P Myanmar to local government agencies.
In this capacity, the observation reports of marine mammals may be sent to the associations and the scientific community which might be interested.

11.3.3.2 ***Procedures***

The observers - The observers must be able to carry out the task of detecting, tracking and identifying marine organisms. However, it is preferable that other workers involved in the survey and present on board each source vessel have some understanding of the process in order to support the implementation and the coordination of the observation procedure.
The observer is to be located on an observational platform (the height depends on the vessel) and should be in direct communication with the MMO, party chief and if necessary client representative of the seismic survey.
The observation - The activities of the MMO should occur throughout the day, from the departure of the vessels, so that the MMOs gain experience and increase identification capacities.
Equipment for marine mammal observation should include marine binoculars, camera, laptop and identification keys of marine mammals.
Before the start of seismic survey activities, the MMO/observers must observe the horizon within a radius of 3km the source vessels to ensure the absence of marine mammals within the 500 m radius. If a marine mammal is sighted in the shutdown zone before the start of the shooting, the observer must delay the seismic activity until the marine mammal has left the shutdown zone. The observation will continue until the marine mammal is outside the established zone perimeter.

Due to the potential severity of impacts on marine mammals, it is critical to incorporate the following components into seismic survey activities:

- Use of "soft-start" procedures especially during bad weather or during night;
- The constant watch for marine mammals before the start of activities;
- The delay between seismic observation and shooting in the event that marine mammals are located in the vicinity of the vessel;
- Use of vessel staff as supplementary marine mammal observers to support MMO (surveillance and communication purposes only).

The table below summarizes waiting time and specific mitigation measures proposed for Total E&P Myanmar seismic campaign.

Table 11-2 Synthesis of mitigation measures for underwater noise generated during seismic survey

Mitigation measures	Seismic campaign recommendation
Marine mammal monitoring requirement	Day: observer(s) required; Passive Acoustic Monitoring – PAM may be recommended;(1) Night: Passive Acoustic Monitoring – PAM (1), or alternatively infra-red/light amplification equipment.
Duration of pre-operations monitoring period	60 minutes (1)

Shutdown zone (or « mitigation zone » or « exclusion zone »)	500 m
Length of soft start	At least 20 minutes and no longer than 40 minutes (1)
Delay of soft start after last detection of marine mammal in mitigation zone	20 minutes (1)

Sources:

(1) Good practice recommended by English governmental organization - Joint Nature Conservation Committee' (JNCC);

11.3.3.3 ***Reports***

Daily reports will be completed in accordance with JNCC (2017) guidelines.
A marine mammal observation monitoring form will be available to the MMO for inclusion in an observational report. The observations regarding marine mammals, sea turtles and birds are required by the JNCC (2017) include:

- Location (latitude and longitude), distance from vessel;
- Identification and determination of species, sex and size;
- The behaviour of animals for each consecutive observation;
- Meteorological data (weather conditions, state of the sea, winds) and coverage should be recorded during each period.

The monitoring form will generally comprise tables such as those presented below.
The contractor shall take into account any survey-related recommendations made during the monitoring. All observations of marine mammals and/or turtles shall be recorded in a log book and appropriate action taken in compliance with the specific instructions defined by Total E&P Myanmar.

Table 11-3 MMO Monitoring Form: Location and effort

Date	MMO Initial	Observation time		Vessel Position (Lat/Long)		Wind (Direction & Speed)		Wave height (m)	Visibility
		Start							
		End							

Table 11-4 MMO MMO Monitoring Form: Record of operations

Date	Initials MMO	Start MM observation	End MM observation	Duration of Marine Mammal Watch	Shoot Duration while Marine mammals visible	Start/End Position	Sea state G = glassy S = slight C= choppy	Swell O=low (<2 m) M=medium (2 - 4 m) L=large (> 4 m)	Visibility P=poor (< 1 km) M=moderate (1-5 Km) G=good (> 5 km)

Table 11-5 MMO Monitoring Form: Record of sighting

Date:		Time (GMT):
How did this sighting occur? While you were keeping a continuous watch for marine mammals. Spotted incidentally by you or someone else. Other (please specify) :		
Ship:		Observer:
Ship's position (latitude and longitude):		Water depth (meters):
Species:		Certainty of identification *Definite / probable / possible*
Total number:		Number of adults: Number of juveniles:
Description (include features such as overall size; shape of head; color and pattern; size, shape and position of dorsal fin; height, direction and shape of blow hole):		Photograph or video taken *Yes / No*
		Direction of travel of animals in relation to ship (draw arrow):
Behaviour:		Direction of travel of mammals (compass points):
Activity of ship:	Air-gun *Yes / No*	Closest distance of mammals from vessel (meters):
Video, photographic and sound file reference:		

Following the survey, the Marine Mammal Observer report will be provided to MOECAF by TEPM.

11.3.3.4 ***Support vessels to supplement MMOs***

The observation zone of the MMO during the 3D seismic acquisition survey will be 500 mm. Adoption of this observation zone will allow a buffer time for the observation team before their possible encroachment of the exclusion zone limit, permitting determination of species, identification of applicable exclusion zone and subsequent responses from the seismic source crews.
The maintenance of the observation zone will be undertaken by the deployment of at least two support vessels being located ~4 km ahead the seismic vessel with radio communication capabilities will supplement the visual monitoring of MMO.
Figure 9-2 illustrates the proposed shut-down and observations zones proposed for the project to mitigate the impact on marine mammals and also on marine traffic.
Prior the beginning of the seismic survey, a crew member of each support vessel will be chosen to be trained by the principal MMO in order to understand the mitigations actions. The training session will explain the main marine mammal sensitivity to seismic sound and will define the reporting procedure if a marine mammal is sighted within the observation zone of the support vessel observer.

11.4 TRAINING PROGRAM

Conscientious planning and good project design are not sufficient to ensure right environmental and social management if the staff on board does not apply environmental good practices. A training program for staff about respect of the various environmental procedures will be prepared by the contractor in charge of the seismic campaign and will be submitted to Total E&P for approval. It will be consistent with the significant environmental aspects and impacts associated with the proposed exploration activities. The training will take place on board, with the assistance of HSE supervisor.
The training sessions may take the form of toolbox and will broach the following topics:

- Environmental policy;

- Waste management procedures;
- Discharges (air and liquids) management;
- Dangerous chemicals management, including SOPEP implementation in case of accidental spillage;
- Regulatory and socio-economic aspect management;
- Identification and treatment of non-compliance, etc.

11.5 WASTE MANAGEMENT PLAN

The objectives of the Waste Management Plan (WMP) are to provide a framework to ensure that the disposal of produced waste is performed under conditions that prevent significant impacts on the environment. WMP will include the list of produced waste, the classification, sorting and recording system until final disposal in compliance with local and international regulation.
The WMP will provide rules to collect, sort, classify, store and transport waste to a suitable disposal area.
The main objectives of the WMP are to:

- Minimize the generation of waste material by judicious use of raw materials and reuse or recycling of materials, when feasible;
- Treat or dispose waste with a minimum impact on the surrounding environment, and;
- Enhance awareness of the staff on-site about proper waste management procedures.

The WMP prepared by geophysical contractor will be approved by Total E&P Myanmar. Particular attention falls on the respect of national regulation and MARPOL.
The Garbage Management Plan is requested by the MARPOL Convention.

An example of Garbage Management Plan is presented in APPENDIX E . It has been provided by Total, it concerned a previous seismic project performed for TEPM. This Garbage Management Plan states:

"In following this procedure we ensure our vessel follows the requirements of MARPOL 73/78 and amendments and 'Our Commitment to the Environment' to prevent:

- ***Mishandling of shipboard garbage which could,***
  - ***o cause unsanitary conditions,***
  - ***o spread disease***
  - ***o attract rodent / insect infestation***
- ***Mishandling of shipboard garbage which could cause further damage / burdenthe ecosystem and environment in which we live.***

The contractor accepts the responsibility for tracking our generated waste through to its final destination."

11.5.1 WMP key points

11.5.1.1 Waste classification

Waste is classified into two main groups according to danger criteria: hazardous waste and non-hazardous waste. Non-hazardous waste are household waste and similar from industrial activity. Hazardous waste are waste creating nuisance due to flammability, reactivity, corrosiveness, toxicity to humans and the environment, and requiring careful and controlled disposal.
Note that seismic survey does not generate specific waste: generated waste (hazardous and non-hazardous) is similar to those of a merchant ship of similar size.

Table 11-6 Waste streams to be encountered during Total E&P Myanmar operations

Non-hazardous wastes	Hazardous wastes
Scrap metal, wood, paper, cardboard, etc. (combustible and incombustible). General packaging materials. Domestic waste.	Chemical residues, paints, spent oils. Contaminated packaging materials. Special maintenance waste, batteries, filters and other. Medical waste, etc. Combustion residues. Cartridges from photocopiers or printers, etc.

*11.5.1.2 **Waste identification, quantification and monitoring***

An inventory of generated waste shall be kept updated. In order to obtain an effective waste monitoring, the following actions shall be carried out:

- Label waste containers;
- Estimate the tonnage of each waste collected into each type of containers;
- Control subcontractor in charge of waste handling, transport and disposal. Thus, the final destination of each category of waste will be verified and validated by Total E&P Myanmar.

Registers will be used to record and track all waste generated by the vessel. Waste transfer and treatment will be monitored until final disposal.
As per MARPOL Convention, the vessel will maintain a garbage record book onboard.
The boat should be equipped with a scale to weight the waste in order to ensure a proper reporting to TEPM.

*11.5.1.3 **Waste collection***

All waste must be collected and disposed of in appropriate bins / skips / containers. The waste collection principles include:

- Incompatible / inter-reacting products should not be mixed (e.g. spent oils and waste paints) under any circumstances.
- Personnel will be trained in waste sorting and collection (adapted to position and to waste generated).

In line with Total E&P Myanmar standards the following typical waste segregation scheme will be implemented:

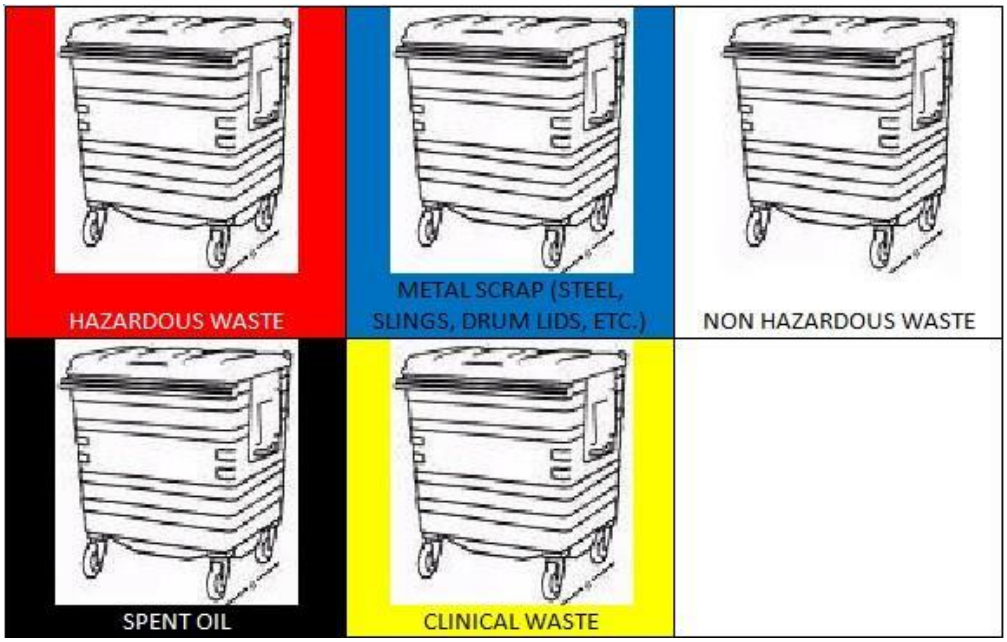


Figure 11-1 Waste segregation scheme

SOURCE: Total E&P MYANMAR

11.5.1.4 *Waste treatment and disposal*

If relevant, means of transportation must be adapted to the transported waste type. All hazardous waste transfer must comply with Myanmar's regulation or IMO if not existing. To ensure traceability of waste treatment, a monitoring register will be established by the operator, describing the types of waste, quantity, storage location and the treatment sector used.

A report will be submitted to the RSES, according to the required frequency (weekly). It will contain waste produced types and quantities, disposal method for each type of waste and costs. In accordance with regulation 9 of annex V of the International Convention of Pollution from ships, 1973, as modified by the Protocol of 1978 (MARPOL) a record is to be kept of each discharge operation or completed incineration. This includes discharges to the sea, to reception facilities or to other ships.

The onshore waste disposal location identified by TEPM is Thaketa (Myanmar).

11.6 SOCIAL MANAGEMENT PLAN

11.6.1 Stakeholder engagement plan

Total E&P Myanmar has a stakeholder engagement plan. The purpose of this plan is to create an open and transparent dialogue and minimize any adverse impact of the project on these stakeholders. Total E&P Myanmar shall update this plan, integrating any stakeholders that may be identified during the project implementation but were not identified previously.
The specific objectives and actions this plan are to:

- Establish appropriate communication channels with authorities (MoE, MONREC, MPA, DMA etc.) and other stakeholders relevant to the Project (such as those having commercial or environmental interests in marine areas like the MFF) prior to the beginning of the operation;
- Maintain a positive relationship based on dialogue and transparency with all these stakeholders;
- Prior to the beginning of the seismic campaign, inform them about the exact seismic location, schedule and duration through e-mails, phone calls or personal meetings;
- Inform them during the seismic campaign and once it is completed about major socio-economic issues encountered, if any;
- Apply the existing grievance mechanism (procedure 3-PR-CSR-007 see APPENDIX I)
- Record, report and solve grievances made by stakeholders related to any impact or incident occurring during the performance of the operations;
- Offer to share valuable information acquired during the seismic (such as results of bathymetry data) with stakeholders who might have an interest in having them (NGOs involved in marine ecosystem protection, fishermen, government agency, etc.);

For the purpose of guaranteeing smooth operations and minimizing issues that could rise from encounters with fishermen or commercial ships at the Project location, additional measures will be implemented by Total E&P Myanmar and the Contractor:

- Total E&P Myanmar shall update as required the Job Description of the Fisheries Liaison Officer and request he provides Total E&P Myanmar with regular (daily or weekly) reports;
- Total E&P Myanmar shall adapt as required existing leaflets in Burmese and Thai languages explaining the seismic survey and its main hazards for fishermen, and the contractor shall distribute it to all fishermen encountered in the area during the Project implementation and prior scouting survey;
- Total E&P Myanmar will remind the contractor's employees during HSE or Project Inductions about the risks related to the presence of fishermen or commercial ships at the Project area and the mitigation measures planned to limit these risks;
- The Contractor shall recruit a Fisheries Liaison Officer speaking Burmese and Thai language. This Officer will stay on board during the operation in order to handle any issue that may arise with fishermen in the area, whether they are from Burmese or Thai nationality;

11.6.2 Marine traffic safety plan

Safety of marine users that may be affected by Total E&P Myanmar seismic operations shall be guaranteed by the application at all times of international marine safety standards established by the International Maritime Organization (IMO) and in particular the **International Convention for the Safety of Life at Sea** (**SOLAS**). Total corporate marine safety policy shall also be applied by the seismic contractor.

Additional measures will be implemented by the contractor to limit the risks of vessel collisions, covering:

- Abide by speed limits and other special cautions where they apply (e.g. close to the Yadana and Sein Platforms);
- Check that all navigation identification marks, including AIS identification and frequency of AIS messages comply with maritime regulations;
- Equip the seismic vessels with loud speakers to communicate with boats not equipped with radio;
- Weekly communication with marine authorities on operations (date, position, issues, etc.);
- Procedures to be implemented in case of an accident where another marine user is affected (fishermen, cargoes, tankers, etc.).

11.7 OIL SPILL CONTINGENCY PLAN (SOPEP)

The contractor will submit to Total E&P Myanmar a plan for approval which includes procedures for the control of oil and chemicals spills.
For vessels over 400 gross tons, a plan for spills on deck already exists under the name **SOPEP: Ship Offshore Pollution Emergency Plan,** in accordance with MARPOL. All Oil Spill Prevention measures that are listed in existing procedures are to be followed at any time to avoid Oil Spills. Particular attention is to be paid to the Oil Spill prevention measures mentioned in the procedures for refueling at sea. If an oil spill does occur, the approved SOPEP plan is to be followed and the reporting of any oil spill, regardless of quantity, is to be communicated to Total E&P Myanmar.
Minor spills will be managed by cleaning instructions and absorbent products utilization to contain any accidental spillage (oil / chemicals). An extension to the standard SOPEP will address petty spills at sea that may occur during bunkering.

An example of Oil Spill Procedure is presented in APPENDIX F . It has been provided by Total, it concerned a previous seismic project performed for TEPM.

11.8 EMERGENCY RESPONSE: CYCLONE AND TSUNAMI RESPONSE MEASURES

Tropical cyclones have the potential to cause damage to survey equipment, present a risk to the safety and health of survey personnel and have the potential to cause spills of hazardous materials into the environment from damaged vessels. The survey on blocks M5-M6 will include a period before the monsoon in 2018, and post-monsoon periods in 2018-2019 and 2019-3020 (see 3.3). These periods overlap with the two cyclone seasons in Myanmar, which last from mid-April to mid-May (pre-monsoon season) and from October to November (post-monsoon season)[63].

The seismic contractor has developed and implemented an “Extreme Weather Procedure” for all seismic surveys utilising its vessels. This procedure will be applied during the M5-M6 blocks seismic survey. During the survey, the procedure will be implemented in the event of an approaching cyclone. If a cyclone appears to be forming within the region of the survey, support and chase vessels will depart from the M5-M6 block location for safer waters. Depending on the situation, the survey vessel may also retrieve the towed seismic equipment (airgun arrays, vanes, streamers, tail buoys etc.) and in a worst case scenario proceed to the nearest port away from the expected track of the approaching cyclone.

An example of’ “Extreme Weather Procedure, which has been developed for TEPM and approved by TEPM on a previous project is available in APPENDIX G .

Tsunamis represent a threat to vessels on the continental shelf, due to the amplification of tsunami waves when they reach shallow waters. Moreover, the continental slope on the western part of the survey corresponds to a well-known active fault area in the deep ocean. As the tsunami reaches the coastline, the wave energy is compressed into a much shorter distance creating destructive, live-threatening waves.

11.9 ENVIRONMENTAL AUDIT PROGRAM

An Environmental audit program will be written in compliance with Total E&P Myanmar and will include:

- Identification of deviations from regulatory standards and contractual requirements identified;

[63] http://www.dmh.gov.mm/disaster-risk-reduction accessed Oct. 2017

- Evaluation of the various plans implementation efficiency, devices and mitigation measures identified in this study;

The Total E&P Myanmar Supervisor, with the seismic contractor HSE coordinator, will be responsible for the implementation of internal environmental audits on environmental good practices. He will be responsible for preparing environmental reports to the authorities, if any.
Audits will be provided during the various exploration phases:

- Before starting operation, an HSE marine seismic operation specialist mandated by Total E&P Myanmar will carry out an audit on the contracted vessels. This audit enables the specialist to review environmental procedure at the beginning of the project. The HSE specialist will be accompanied by the HSE coordinator and the quality controller (Total E&P Myanmar) in charge of the technical supervision of the seismic acquisition.
- Regular audits (monthly for example) will be conducted by the HSE supervisor to ensure that the monitoring, control and intervention on board are in agreement with the recommendations of the ESMP.

Total E&P will inform the authoritiesif an incident is observed.

SECTION 12. RESPONSIBLE PERSONS & COSTS FOR ESMP IMPLEMENTATION

The commitment register developed in Table 9-4 list the comprehensive measures proposed in this IEE and give the responsible for each measure to be monitored. When possible, an estimation of the cost/measure has been given.

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13.1.4 Convention

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13.2 SOCIO-ECONOMIC REFERENCES

13.2.1 Webistes

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US Energy Information Administration website: http://www.eia.doe.gov/

United Nations Environment Programme (UNEP) – World Conservation Monitoring Centre website: http://www.unep-wcmcg/

13.2.2 Socio-economic articles

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13.2.3 Reports

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Hume Tim, 6 July 2014, Curfew imposed after deadly clashes between Buddhists, Muslims in Myanmar, CNN

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Staples D., 2009, Status and potential of offshore resources in South and Southeast Asia. Asia-Pacific Fishery Commission, FAO Regional Office for Asia and the Pacific

UNFPA, June 2010, Report on Situation Analysis of Population and Development, Reproductive Health and Gender in Myanmar

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UNDP, 2013, Annual Report 2013, Myanmar

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13.3 CONVENTION

UNITED NATIONS, The United Nations Convention on the Law of the Sea (A historical perspective), 1998, available at [http://www.un.org/Depts/los/convention_agreements/convention_historical_perspective.htm#Exclusive Economic Zone]

SECTION 14. APPENDICES

APPENDIX A CV of Experts

Christophe DERRIEN

HSE Project Director
Water & Environment | Risk, Society and Environment department (RSE)

Date of Birth : 20/05/1973
Nationality : French
Education and Training:

- MSC in Industrial Risks & Environment at the University of Lyon
- BSC in Environmental Engineering at the University of Lyon (with Honors)
- Helicopter Underwater Escape Training (HUET) valid until October 2013
- Occupational Risk Prevention and Safety (INRS)
- Safety Management / ISRS (DNV)
- Environmental expert in chemical industries (UIC)
- HAZOP reviews (ARTHUR D. LITTLE)
- Environment and Quality internal Audit – ISO 14001 (APAVE)
- Safety Engineering (ENSPM FI)

Languages : French (mother tongue), English (fluent), and Italian (intermediate)
Start date in Artelia group : 2008

CAREER SUMMARY | SKILLS

- HSE management of industrial projects
- HSE management : contingency plans, crisis management, management systems and audits (SGS SEVESO 2 ; ISO 14001, OHSAS 18001 ; ISRS ; MASE ; ILO OHS 2001)
- Risk and industrial environment assessment (technological risk assessments, environmental impact assessments, pipeline assessment, permitting)
- Industrial risk analysis (APR, HAZID, AMDEC, …)
- Occupational safety
- Training sessions design and delivery, University teaching

PROFESSIONAL EXPERIENCE

ENVIRONMENTAL,SOCIAL & RISKS ASSESSMENT

2015-2017
MALI

KENIE hydropower project (dam)
Environmental & Social Impact Assessment, Environmental & Social Management Plan, Resettlement Action Plan according to IFC Performance Standards
Client : IFC and Eranove (JV: Kénié Energie Renouvelable)
Position : Project Director – Budget : 1, 000, 000 euros

2016
CHAD

Djermaya Solar Plant project
Environmental & Social Impact Assessment, Environmental & Social Management Plan, Livelyhood Restoration Plan, according to IFC Performance Standards and local regulation
Client : Aldwych International / JCM Capital / Smart Energy
Position : Project Director

2015-2016 ALGERIA	**AIN TSILA Development** Environmental & Social Impact Assessment, Environmental & Social Management Plan, according to Algerian regulation and taking into account IFC Performance Standards **Client : Groupement Isarene (SONATRACH / PETROCELTIC)** Position : Project Director
2014-2016 BULGARIA	**Offshore oil exploration program on block Khan Asparuh project (drilling, deep offshore)** Environmental & Social Impact Assessment, oil spill contingency plan **Client : TOTAL E&P Bulgaria ;** Position : Project Director
2014-2015 UGANDA	**Buliisa onshore Oil Development Project** Health & Social baseline survey **Client : TOTAL E&P Uganda ;** Position : Project Director
2014 MAURITANIA	**Offshore oil exploration program on block C9 project (drilling, deep offshore)** Environmental & Social Impact Assessment **Client : TOTAL E&P Mauritania ;** Position : Project Director
2013 ALGERIA	**GPL pumping station ELR-1, Hassi Messaoud** Environmental and societal impact assessment, technological risk assessment (including HAZID and Fire & Explosion Risk Analysis) **Client : ABB Spa Process & Automation for SONATRACH TRC ;** Position : Project director
2012-2014 CONGO	**Moho Nord Project : submarine wells, FPU, TLP, integration N'Kossa, integration to Djeno terminal** Environmental and societal impact assessment, health risk assessment **Client : TOTAL E&P Congo ;** Position : Project director
2013 ALGERIA	**Seismic campaign, exploration drilling, Hassi-Bir-Rekaiz block** Environmental and societal impact assessment **Client : PTTEP ;** Position : Project director
2013 ALGERIA	**Rhourde-Er-Rouni block** Environmental baseline study, environmental liabilities study **Client : CEPSA ;** Position : Project director
2013 MAURITANIA	**Emergency Plan Development, & large scale exercise** **Client : TOTAL EP MAURITANIE ;** Position : Project director
2012-2015 CAMEROON	**Cameroon LNG project** Environmental and social impact assessment (LNG plant, Offshore feed pipelines network), environmental and social management plan, offshore environmental, baseline survey, public consultations, biodiversity action plan, … **Client : GDF Suez ;** Position : Project director
2012 MAURITANIA	**Offshore oil exploration program on block C9 project (seismic, bathymetry, coring)** Environmental & Social Baseline Survey **Client : TOTAL E&P Mauritania ;** Position : Project Director
2012 FRANCE	**Ocean Thermal Energy Conversion Project** Preliminary safety report on a SEVESO offshore platform using ammonia **Client : DCNS** Position : Industrial risk expert

2012 BRUNEI DARUSSALAM	**ML South project : platform well construction, drilling, sea line installation, and extension of the onshore gas treatment plant** Environmental & Social Baseline Survey **Client : TOTAL E&P Borneo ;** Position : Project Director
2012 DRC	**Maluku Special Economic Zone project** Environmental & Social Baseline Survey, resettlement Action Plan (IFC standards and RDC regulations) **Client : World Bank / IFC ;** Position : Project Director
2011-2012 ALGERIA	**GALSI Project : natural gas compression facility and underwater gas export pipeline Algeria-Sardinia-Italy** Risk assessment, Site Contingency Plan, Atex survey, lightning assessment, environmental impact assessment, Environmental Management Plan **Client: GALSI : SONATRACH – EDISON – ENEL ; Position : Project Director**
2011 CHINA	**Modified starch synthesis workshop** Risk assessment, HAZID **Client: ROQUETTE ; Position : Project Director**
2011 ALGERIA	**Rhourde Nouss Gas Treatment Facility** Risk assessment of the 4th compression train **Client: JGC / SONATRACH ; Position : Project Director**
2010-2011 BAHREÏN	**TATWEER project** Production water treatment : HAZID, Fire Risk Review, HAZOP **Client: VEOLIA WATER SOLUTIONS OIL & GAS ; Position : Project Director**
2010 ALGERIA	**Gassi Touil Production Center (CPF)** Risk assessment ; **Client: JGC / SONATRACH** ; Position : Project Director
2009-2010 ALGERIA	**Guellala and Haoud Berkaoui Production Center Revamping (CPF)** Risk assessment ; Client: ABB / SONATRACH ; Position : Project Director
2009 ALGERIA	**LPG-LDHP project in Hassi-Messaoud** Environmental Impact Assessment **Client: SAIPEM /SONATRACH ; Position : Project Director**
2009 ALGERIA	**GNL-3Z project** Liquefaction, storage and offsite train at Arzew Risk assessment and Environmental Impact Assessment **Client: SAIPEM-SNAMPROGETTI / SONATRACH ; Position : Project Director**
2009 CONGO	**HMC permit** Offshore seismic survey on HMC permit **Client: TOTAL E&P CONGO ; Position : Project Director**
2008 ANGOLA	**FPSO Dalia** Environmental assessment on FPSO Dalia loading buoy incident **Client: TOTAL E&P ANGOLA ; Position : Project Director**
2009-2010 ANGOLA	**FPSO CLOV project** Environmental Impact Assessment **Client: TOTAL E&P ANGOLA / CLOV PROJECT ; Position : Project Director**
2009 France	**Risk analysis of an industrial waste grouping facility** **Client: SITA SUEZ ; Position : Project Director**

2009-2010
CONGO

Liambou industrial waste management facility
Detailed design, contractors selection, Risk assessment, ESIA peer review
Client: TOTAL E&P CONGO ; Position : Project Director

2013
CYPRUS

Offshore seismic campaign (block 11)
Environmental and societal impact assessment
Client : TOTAL E&P CYPRUS ; Position : Project director

CRISIS MANAGEMENT EXERCISES, EMERGENCY RESPONSE PLANS & SITE CONTINGENCY PLAN PREPARATION

2007-2016
ALGERIA

Groupement TFT, Gas Treatment Facility
7 Large Scale Exercises
Client: Groupement TFT (SONATRACH – TOTAL – REPSOL) ; Position : Project Director

2012
ALGERIA

Groupement TFT, Gas Treatment Facility
Site Contingency Plan review according to new ARH framework
Client: Groupement TFT (SONATRACH – TOTAL – REPSOL) ; Position : Project Director

SINCE 2006
WORLDWIDE

Emergency Management Cell training and organization of emergency simulation exercises
Indonesia, USA, Russia (5 missions), Italy (5 missions), Algeria (2 missions), Congo (2 missions), Gabon (4 missions), Yemen, France (3 missions), Nigeria (2 missions), Angola (3 missions), Mauritania (3 missions), Malaysia, Brunei, Qatar (2 missions), etc.
Client: TOTAL E&P ; Position : Project Director

2014
BULGARIA

Offshore oil exploration program on block Khan Asparuh project (drilling, deep offshore)
Oil Spill Contingency Plan
Client : TOTAL E&P Bulgaria ; Position : Project Director

2011-2012
FRANCE AND EUROP

HSE Regulatory context study of the exploration-production of shale gas and intranet tool development:
Client: Confidential ; Position : Project Director

2011
FRANCE

Risk Management Training to French site directors
Client: NEXANS ; Position : Trainer

2011
ALGERIA

Rhourde Nouss Gas treatment facility
Site Contingency Plan of the gas treatment facility
Client: JGC / SONATRACH ; Position : Project Director

2011-2012
FRANCE

Rewriting of the methodological guide for oil spill contingency plans
Client: TOTAL/DGEP/HSE/ENV ; Position : Project Director

2009
MALAYSIA

Affiliate Emergency Plan Development
Client: TOTAL E&P Malaysia ; Position : Project Director

2009
ALGERIA

Site Contingency Plan of the Gas Turbine Plant at the port in Alger
Client: GENERAL ELECTRIC / SONELGAZ
Position: Project Director

2009
ALGERIA

Site Contingency Plan of the Gas Turbine Plant in Annaba
Client: GENERAL ELECTRIC / SONELGAZ
Position : Project Director

INDUSTRIAL RISKS ASSESSMENT (ENVIRONMENT & SAFETY) – JANUARY 2000 TO JULY 2008

FRANCE

Port-la-Nouvelle Oil Terminal
Major risks assessment, pipeline and sea line risk assessments
Client: TOTAL RM ; Position : Project Manager

FRANCE	**Ajaccio Oil Terminal** Major risks assessment, safety engineering, pipeline risk and environmental impact assessment **Client: TOTAL RM ; Position : Project Manager**
FRANCE	**Nantes Oil Terminal** Risk assessment **Client: TOTAL RM ; Position : Project Manager**
FRANCE	**Cournon-d'Auvergne Oil Terminal** Environmental impact assessment, ICPE regulatory report **Client: TOTAL RM ; Position : Project Manager**
FRANCE	**Risk assessment of the perchloric acid production facilities** **Client: ATOFINA ; Position : Project Manager**
FRANCE	**Risk assessment of the ammonia unloading and storage facilities** **Client: ATOFINA ; Position : Project Manager**
FRANCE	**Safety report and Onsite risk assessment, HAZID review** **Client: TOTAL ACS ; Position : Project Manager**
FRANCE	**Risk assessment of butadiene and styrene polymerization unit, HAZID review** **Client: MICHELIN ; Position : Project Manager**
FRANCE	**Grandpuit Refinery** Toxic dispersion modelling, risk analysis (UFIP methodology) of alkylation facilities, safety report ; **Client: TOTAL RM ; Position : Project Manager**
FRANCE	**KETEC Pediatric project, HAZOP review** **Client: SANOFI ; Position : scribe**
FRANCE	**SEVESO Permit** Industrial risks assessment (environment and safety) **Client: RHODIA ; Position : Project Manager**
FRANCE	**Brest port silos** AMDEC, Risk assessment **Client: CCI de Brest** Position : Project Manager

EMERGENCY MANAGEMENT : TRAINING SESSIONS AND CRISIS MANAGEMENT EXERCISES – JANUARY 2000 TO JULY 2008

GABON, ITALY, RUSSIA, FRANCE	**Client: TOTAL EXPLORATION PRODUCTION** Position : Project Manager
FRANCE	**Client: BASF AGRO *(agro-chemistry)*** Position : Project Manager
FRANCE	**Client: TOTAL ACS *(special fuels and additives)*** Position : Project Manager
FRANCE	**Client: DISTILLERIES RYSSEN *(alcohol distillation)*** Position : Trainer

FRANCE Pipeline contingency plan of the Montoir plant in Bretagne
Client: DIESTER INDUSTRIE ATLANTIQUE
Position : Project Manager

FRANCE Contingency plan of the slopes treatment plant of the Port of Brest
Client: CCI BREST ; Position : Project Manager

FRANCE Contingency plan of the distillation units, the tank farm, and the off-site facilities
Client: DISTILLERIES RYSSEN ; Position : Project Manager

FRANCE Contingency plan of the pipeline of Ajaccio terminal
Client: TOTAL RM *(oil storage)*
Position : Project Manager

HSE MANAGEMENT SYSTEMS & AUDITS

FRANCE **Assistance to the implementation of Safety Management Systems complying with the MASE standard in more than 200 critical contractors, design of a specific web site dedicated to the project**
Client: LAFARGE Ciments
Position : Project Manager

WORLD **Preparation of the corporate environmental audit questionnaire (French & English)**
Client: ERAMET
Position : Project Manager

FRANCE **Implementation of a Security Management System (following Seveso regulation)**
Client: DISTILLERIES RYSSEN
Position : Project Manager

FRANCE **Oil Terminal, special fuels, additives and specialised chemistry**
Implementation of a SMS (following Seveso regulation and ISRS standard)
Client: TOTAL ACS
Position : Project Manager

FRANCE **Implementation of a EMS following ISO 14001 standard**
Client: HOUGHTON
Position : Project Manager

FRANCE **4 regulatory compliance audits on Gravelines and Genay plants**
Client: BASF
Position : Project Manager

FRANCE **2 EMS ISO 14001 audits on Tavaux plant**
Client: SOLVAY
Position : Project Manager

FRANCE **ICPE regulatory compliance audit**
Client: MICHELIN
Position : Project Manager

FRANCE **6 ISO 14001 audits, 1 OHSAS 18001 audit, 1 occupational safety audit**
Client: ALSTOM Transport
Position : Project Manager

FRANCE	**EMS ISO 14001 audit** **Client: ALSTOM T&D** Position : Project Manager
FRANCE	**Fire protection audit** **Client: ATMEL** Position : HSE engineer
FRANCE	**Safety management system audit** **Client: SOLLAC** Position : HSE engineer
FRANCE	**3 EMS ISO 14001 and regulatory compliance audits** **Client: HOUGHTON SA** Position : Project Manager
FRANCE	**EMS ISO 14001 audit and EMS internal audit training** **Client: SYGMAKALON** Position : Project Manager
1997 FRANCE	**Implementation of an Environmental Management System, HSE training for operators & engineers, HSE audits, Regulation follow-up** **Client: Elf Antar France – Port Pétrolier de Givors ; Position : HSE engineer**

SAFETY ENGINEERING

2006 UNITED ARAB EMIRATES	**Management of the Central Complex firewater network optimization project, off-shore technical audit; technical specification and bid follow-up for a breathing "cascade system"** **Client: TOTAL ABK ; Position : HSE engineer**
2002 FRANCE	**HSE assistance on « Special Fuels » project design reviews** **Client: TOTAL ACS ; Position : HSE engineer**
2004 FRANCE	**Safety Concept** **Client: SHELL / BUREAU VERITAS ; Position : HSE engineer**
2000 FRANCE	**HSE general safety and environmental concept, fire protection engineering safety audit** **Client: ATMEL ; Position : HSE engineer**
2002 FRANCE	**Project management and safety engineering on petrochemical semi-industrial facilities** **Client: MICHELIN ; Position : HSE engineer**

TRAINING DESIGN AND DELIVERY

- Crisis managfement: Total, Nexans
- MASE standard: LIOYD's REGISTER, FLOWTECH
- OHSAS 18001 : THALES
- HSE Management : TOTAL, ERAMET, HOUGHTON
- Trainers instruction : TOTAL
- Chemical risks : ALSTOM
- ISO 14001 internal audit : HOUGHTON, SYGMAKALON
- UNIVERSITY LYON I : in charge of teaching : French safety and environmental regulations (ICPE), Occupational and Industrial safety regulations, risk assessment, seminar management

RISK ASSESSMENT, SAFETY ENGINEERING

1998 IRAN	**Consequence analysis, fire and gas safety** **Client: TOTAL SOUTH PARS ; Position : HSE engineer**
1999 POLAND	HAZOP reviews **Client: PETROCHEMIA REFINERY ; Position : HSE engineer**
1998 EGYPT	**Environmental impact assessment review** **Client: MIDOR ; Position : HSE engineer**
1999 QATAR	**HAZOP reviews, reliability analysis on instrumentation, fire and gas protection** **Client: QATAR VINYL COMPANY ; Position : HSE engineer**

PROFESSIONAL MEMBERSHIP

Member of the French Association of oil & gas engineers and technicians (AFTP)
Member of the International Association of Impact Assessment

PUBLICATIONS

Guide of biotechnologies for the environment in Rhône-Alpes, Groupement d'intérêt scientifique Biotechnologies, Environnement et Développement, Chambre de commerce et d'industrie, Direction de l'industrie, 1996 (ISBN 978-2-900539-90-3).

EMPLOYMENT RECORD

2005-2008	**ODZ CONSULTANTS** (Lyon, HSE consulting for process industry, assignments in France and overseas) Operations Manager, project engineer: Management of 28 engineers and technicians, technical coordination and HSE consulting
2003-2005	**ODZ CONSULTANTS** (Lyon, HSE consulting for process industry, assignments in France and overseas) Business development Manager, project engineer : Marketing and sales management, Development of new services, assessment projects and HSE consulting
2000-2003	**ODZ CONSULTANTS** (Lyon, HSE consulting for process industry, assignments in France and overseas) HSE engineer, head of environmental consulting team : major hazards assessments, HSE management, HSE training, Safety engineering
1998-1999	**TECHNIP** (France and Italy, engineering for O&G industry) HSE engineer : process safety, Fire & Gas protection, accident modeling
1997	**ELF ANTAR France** (PPG, currently TOTAL ACS) HSE engineer, HSE System Management

Armeline Dimier

Stakeholder Relationship and Social Impact Consultant
Water & Environment | RSE

Date of birth: December 12th 1985
Nationality: French
Education:
- Master II in Geopolitics and International Relations, International Trade, International Law, Humanitarian Rights, Development Issues, Institut d'Etudes politiques de Toulouse, 2008
- Political Sciences Diploma (equivalent to a Master level), Politics and International Relations, Geopolitics, Institut d'Etudes Politiques de Grenoble and Sussex University in Brighton, 2007

Professional trainings:
- *Societal Management in Oil and Gas Operations*, Total, February 2011
- *Management of the relationships between NGOs and corporations*, WWF Training Center, Paris, 2010

Languages: French (mother tongue), English (bilingual), Indonesian (bilingual), German (academic)
Date of employment in Artelia: July 2014

CAREER SUMMARY | SKILLS

5-year experience in the field of corporate CSR strategy development in the oil & gas world, covering stakeholder mapping, consultation and engagement; social impact assessment, social management plan implementation and follow-up, community grievance management, and tools development.

- **Stakeholder mapping, consultation and engagement:** mapping of stakeholders from the business, authorities and civil society groups based on their interests and expectations, stakeholders' priority ranking, development of consultation tools (interview questionnaire and guidelines), realization of consultations, development of engagement action plans in line with operational priorities.

- **Social impact assessments and Social Management Plan implementation and follow-up:** contribution to the realization of ESBS (Environmental and Social Baseline Assessment) and ESIA (Environmental and Social Impact Assessment) as well as Indonesian environmental and social studies (UKL-UPL and RKL-RPL), covering consultant identification, briefing, field survey preparation, quality control, and final hand-over. Development, implementation and follow-up of Social Management Plan.

- **Community grievance management:** development of claim registration database and claim handling procedure.

- **Tools development:** integration of social data into GIS system, installation of societal management software (MOST).

PROFESSIONAL EXPERIENCE

2016
CHAD

Environmental and social impact assessment for a solar power plant in Chad
Objective : To conduct an Environmental and social impact assessment and a livelihood restoration plan
Missions :
- Documentary review of the local socio-economic environment
- Description of the socio-economic elements and sensitivities in the study area
- Analysis of the stakeholders' expectations and concerns
- Social impact assessment
- Development of appropriate mitigation measures and of a social management plan
- Development of a livelihood restoration plan

Client : Djermaya Solar
Fonction : Societal consultant

2016
CAMEROON

Environmental and social management plan for Nachtigal hydropower project in Cameroon
Objective : To Update the social section within the preliminary ESMP (2011) in order to take into account several additional studies after the environmental and social impact assessment.
Missions :
- Reviewing the existing documentation, of the additional studies (Social influx management plan, health plan, resettlement action plan, local economy development plan, etc.) and of the consultation documents (DCE)
- Listing the avoiding, reduction and compensatory measures for social impacts
- Comparing the proposed measures to the IFC standards
- Integrating relevant measures and detailing some aspects in a detailed and operational ESMP

Client : EDF
Fonction : Societal consultant

2016
ALBANIA

Corporate Environmental And Social Assessment of KESH (Albanian hydropower national company)
Objective : To assess KESH overall social performance compared to the EBRD's performance requirements (PR).
Missions :
- Analyze the social impacts and risks generated by KESH and its activities
- Review all the risk managements procedures implemented by KESH and study their compliance with the EBRD's performance requirements.
- Within an environmental and social action plan, recommend actions so that KESH complies with the EBRD's PR.
- Identify KESH stakeholders and develop a stakeholder management plan.

Client : European Bank for Reconstruction and Development (EBRD)
Fonction : Societal consultant

2015-2016
MALI

Environmental and social impact assessment and resettlement action plan for Kenié hydropower project near Bamako
Objective: development of an environmental and social impact assessment and a resettlement action plan
Missions:
- Coordination of the teams in charge of producing the socio-economic baseline study, the stakeholder engagement plan and the RAP, and contributions to studies
- Identifying social impacts, management measures and developing an Environmental and Social Management Plan (ESMP).

Client: Kenié Energie Renouvelable (KER)
Position held: Societal consultant

2015
TUNISIA

Complementary social studies for a 225 kV power lines project carried out by the STEG (*Société Tunisienne de l'Electricité et du Gaz*)

Objective: complete the existing impact studies to comply with the project's donor standards.

Missions:

- Assessment of STEG procedures in terms of information, social impact management and compensation of the people affected by the power lines
- Gap analysis between these procedures and EBRD requirements and proposal for measures included in a framework for land acquisition and compensation plan
- Stakeholders mapping and development of a stakeholder engagement plan (SEP).

Client: European Bank for Reconstruction and Development (EBRD)

Position held: Societal consultant

2015
UGANDA

Social and health baseline study for an oil project in Buliisa district

Objective: social, economic, cultural and health baseline study of Buliisa district where a major oil project will be developed soon.

Missions:

- Exhaustive documentary review regarding socio-economic context
- Mapping of local, regional and national stakeholders
- Field data collection (20 days): participatory mapping of villages, household surveys, focus groups, consultations of the major stakeholders, etc.
- Detailed analysis of the socioeconomic characteristics of Buliisa district
- Study focused on livestock breeding: their economic importance for households, production system, actors, value chain, markets, etc.

Client: Total E&P Uganda

Position held: Societal consultant

2014 – 2015
CAMEROON

Environmental and societal impact assessment for a natural gas liquefaction plant project to the south of Kribi

Objective: to assess the project's societal aspects on local communities affected by the project.

Missions:

- Documentary review regarding the socio-economic context
- Stakeholders mapping
- Field data collection: household surveys, discussion groups, major stakeholder consultations of the major stakeholders, etc.
- Analysis of the key socioeconomic characteristics
- Analysis of expectations and concerns of the populations affected by the project and of the stakeholders
- Gap analysis between the resettlement action plan developed by the Cameroonian authorities for the industrial and port infrastructures in the vicinity of the project and what was really implemented
- Potential societal impact assessment
- Development of mitigation measure and social management plan

Client: GDF SUEZ

Position held: Societal impact specialist

2014 MYANMAR

Environmental and Social Impact Assessment for the Offshore Seismic Acquisition Campaign on block M6 off Ayeyarwaddy River delta

Objective: to assess the project's societal aspects on fishing activities and marine transport

Missions:

- Coordination of the Artelia team in Myanmar
- Desk review of existing data and literature on the socio-economic context
- Description of key socio-economic characteristics in the study area
- Stakeholder mapping (business, authorities, civil society)
- Analysis of stakeholders' expectations and concerns
- Social impacts assessment
- Development of appropriate mitigation measures and of the social management plan

Client: Total E&P Myanmar

Position held: Societal impact specialist

2014 MYANMAR

Environmental and Social Impact Assessment for the Offshore Seismic Acquisition Campaign on the Block YWB off Thanintharyi state

Objective: to assess the project's societal aspects on fishing activities and marine transport

Missions:

- Coordination of the Artelia team in Myanmar
- Desk review of existing data and literature on the socio-economic context
- Description of key socio-economic characteristics in the study area
- Stakeholder mapping (business, authorities, civil society)
- Analysis of stakeholders' expectations and concerns
- Social impacts assessment
- Development of appropriate mitigation measures and of the social management plan

Client: Total E&P Myanmar

Position held: Societal impact specialist

2014 MYANMAR

Environmental and Social Impact Assessment for the Offshore Seismic Acquisition Campaign on the Block A-03 off Arakan region

Objective: to assess the project's societal aspects on fishing activities and marine transport

Missions:

- Coordination of the Artelia team in Myanmar
- Desk review of existing data and literature on the socio-economic context in which the project takes place
- Description of key socio-economic characteristics in the study area
- Stakeholder mapping (business, authorities, civil society)
- Analysis of stakeholders' expectations and concerns
- Assessment of social impacts
- Development of appropriate mitigation measures and of the social management plan

Client: Ophir Energy

Position held: Societal impact specialist

2014
SOUTH SUDAN

Environmental and Social Screening of 7 dam options for the Hydropower Expansion Plan and Regional Integration Plan of South Sudan into Regional Electricity Grid

Objective: classify the various dam projects according to the initial sensibility of the human context and expected extent of the environmental and social impacts in order to direct the authorities with the decision process towards options with the best environmental and social performance.

Missions:

- Identification and selection of an appropriate set of criteria for measuring the economic and social impacts (and performance) of each dam option
- Desk review of existing data and literature on each criteria identified in order to define current context and related sensitivities (example of criteria include land acquisition, physical displacement, health, food security, ethnic groups, public services, etc.)
- Assessment of potential impacts for each criteria and proposition of associated mitigation measures
- Ranking of impact importance for each criteria and each dam option
- Final assessment of all the criteria for each dam option, in order to identify the most performing option environmentally and socially

Client: Nile Equatorial Lakes Subsidiary Action Program

Position held: Social impact specialist

2014
BULGARIA

Preliminary Environmental and Social Impact Assessment for the offshore drilling of two exploration wells on Block 1-21 Han Asparuh

Objectives: to assess the project's societal aspects on fishing activities and marine transport

Missions:

- Coordination of the social impact assessment study realization with Artelia Bulgarian team
- Desk review of existing data and literature on the socio-economic context in which the project takes place
- Description of key socio-economic characteristics in the study area
- Stakeholder mapping (business, authorities, civil society)
- Analysis of stakeholders' expectations and concerns
- Assessment of social impacts
- Development of appropriate mitigation measures and of the social management plan

Client: Total E&P Bulgaria

Position held: Social impact specialist

2014
MAURITANIA

Environmental and Social Impact Assessment for the offshore drilling of one exploration well on Block C9

- Desk review of existing data and literature on the socio-economic context in which the project takes place
- Data collection of key socio-economic characteristics in the study area
- Stakeholder mapping and analysis of stakeholders' expectations and concerns
- Assessment of social impacts
- Development of appropriate mitigation measures and of the social management plan

Client: Total E&P Mauritanie

Position held: Social impact specialist

PUBLICATIONS

"*Re-engaging with Local Stakeholders in the Mature Oil and Gas Mahakam Block*", Technical paper presented during the Society of Petroleum Engineering (SPE) Conference on HSE in Long Beach, CA, on 20th March 2014

PROFESSIONAL EXPERIENCE

2014 - PRESENT

Consultant in societal studies, Artelia Eau & Environnement

- Social, economic, cultural and health baseline studies
- Environmental and societal impact assessment
- Societal benchmarking for projects to identify those with the best societal performance
- Stakeholder mapping
- Development of participatory tools for societal research (household surveys, discussion groups, participatory mapping, etc.)

2011 - 2014

Stakeholder Relationship and Social Impact Consultant, Total E&P Indonesie, Indonesia

- East Kalimantan District operations:

- Stakeholder mapping and implementation of a consultation plan (interviews with 45 local and regional stakeholders);
- Creation of a societal action plan, in line with company's requirements and stakeholders expectations in the fields of dialog, impact management, local content and community development projects;
- Technical assistance for environmental and social baseline and impact studies: preparation of field work/surveys with the consultants, quality control and improvement of studies for Total Head Office and the Indonesian Ministry of Environment;
- Improvement of internal societal procedures and standards in line with Head Office instructions: management of claim and grievances from local communities, mapping of social data using the company GIS
- Implementation of mitigation measures for social impacts generated by specific operations (drilling, rig movement, seismic acquisition, etc.).

- West Papua District operations: stakeholder mapping, consultation preparation, including training of the field survey team.

- *Mentawai District operations:* as a complementary study to the ESIA, stakeholder identification, mapping and ranking, Social Management Plan development and implementation, particularly related to control of contractors.

2010-2011

Societal Officer, Total Marketing France

- Organizing cooperation between Total entities that have operations or projects in the region;
- Preparing consultation of relevant external stakeholders, to identify how Total can contribute in achieving the region's priorities in terms of economic and social development.

FEB 2010 – NOV 2010

Societal Coordination Officer, Total Supply & Marketing - Africa/Middle East Division, France

- Realizing two annual surveys in the subsidiaries: AIDS Survey, aiming at assessing the progress of the policy of fight against AIDS and Societal Survey, aiming at collecting information on the CSR actions of the subsidiaries;
- Improving the health policy (fight against AIDS and malaria) through awareness-raising campaigns;
- Creating communication tools on the division CSR strategy, and particularly a brochure presenting the Division CSR strategy as well as subsidiaries projects in favor of social and economic local development.

SEPT 2008 – MAY 2009

Societal Coordination Officer, Total Supply & Marketing - Africa/Middle East Division, France

- Realizing two annual surveys in the subsidiaries: AIDS Survey, aiming at assessing the progress of the policy of fight against AIDS and Societal Survey, aiming at collecting information on the CSR actions of the subsidiaries;
- Improving the health policy (fight against AIDS and malaria) through awareness-raising campaigns;
- Organization of an annual internal sponsorship committee supporting initiatives from NGOs operating in our perimeter.

MAR 2008 – AUG 2008

Public Fundraising Officer, Planet Finance

- Monitoring of all the potential public donors and their related strategies/policies;
- Research of public fundings: identification of donors and of their call for proposals;
- Writing of proposals for big donors (EUROPEAID, USAID, IFC, Development Banks, etc);
- Project management (logical framework, budget...);
- Support to private fundraising team and contribution to the research of potential NGO and private companies partnerships.

Anne-Charlotte DUFAURE DECULTY

Project Manager
Water & Environment | Risks, Society and Environment Unit (RSE)

Date of birth : 08/11/1986
Nationality : French
Education : Water Engineer

- Master in Environmental Services Management and Engineering – 2012
- Polytech'Montpellier Engineering School - Water sciences and technologies – 2010
- University Diploma (2 years) in Life Science, major in marine biology – 2006

Languages: French (mother tongue), English, Spanish
Date of employment in Artelia: 01/03/12

CAREER SUMMARY | SKILLS

Marine Mammal Observer (JNCC agreement - 2013)

MISE Master – Management and engineering for environmental services

- Risk Management
- Territory and sustainable governance
- Performance monitoring and management
- Development strategy of range of services
- Thesis on Differentiated contract management

Engineering school: Water Sciences and Technologies

- Management and protection of the resource in water
- Hydraulics
- Hydrology
- Processes' Engineering and Water Treatment (sewage water/ drinking water)
- Hydrobiology
- Hydrogeology

Diploma of Life Sciences – Marine biology

- marine ecology
- coastal and benthic environment
- oceanology/ oceanography
- Plant and animal biology
- Biochemistry
- Joint approach of the littoral ecosystems
- Coral ecosystems

PROFESSIONAL EXPERIENCE

2017
MYANMAR

Coordination and technical monitoring for the production of an impact study on an activity zone development in Myanmar
Technical monitoring – critical review of the productions
Project coordination
Production of the impacts/measures section and environmental management plan
Client : KMA

Position held : Project manager

2017
FRANCE

Production of the impact study and coordination with the Client/subcontractor for a gas pipeline laying in Normandy
Production of the impacts/measures section, update of the baseline study and of the description of the project
Management and quality review of the subcontractors' production
Client : GRTgaz

Position held : Project engineer

2016
AUSTRALIA
NEW-CALEDONIA

Managing the Permitting section for the various stakeholders and developing the project description associated to dried residue storage
Managing the permitting section of the project between the engineering team based in Brsbane and VNC based in New-Caledonia as well as the various consulting firms working on the permitting.
Monitoring the contract and regulatory terms, monitoring deliverables, identification of issues to be taken into account in the detailed engineering, development of the description of the project for the ICPE file, identification of the studies to perform so that the file is approved, review of technical plans , identifying, collecting and transmission of input data to perform the various technical studies.
Client : HATCH

Position held : Project engineer

2014-2015
NEW-CALEDONIA

Coordination and development of ICPE regulation dossiers related to a mining project for tailing management
Development of a framework document defining the methodology to list and assess the impacts
Multicriteria analysis for the implementation of water treatment system
Critical result of inventories and recommendation for additional inventories
Performance of the impact study on the tailings site and associated installation and on the water treatment unit
Client : VALE NC

Position held : Project engineer

2014
MYANMAR

Initial Environmental Evaluation (IEE) regarding Block AD3 offshore seismic campaign
Performance of an environmental description, priliminary impact assessment regarding a 3D seismic acquisition in deepwater context.
Client :Ophir energy plc

Position held: environmental engineer

2014
MYANMAR

Initial Environmental Evaluation (IEE) regarding Block YWB seismic campaign
Performance of an environmental description, priliminary impact assessment regarding a 3D seismic acquisition in deepwater context.
Client :Total E&P Myanmar

Position held :environmental engineer

2014
MYANMAR

Environmental Impact Assessment for Badamyar field development and Offshore Yadana infrastructure replacement in Burmese waters
Environmental impact assessment for Badamyar offshore gas field development and the implementation of new oil facilities (jacket, pipeline, etc.)
Client : Total E&P Myanmar

Position held : Project engineer

2014
MYANMAR

Environmental Impact Assessment for an Offshore Seismic and Bathymetric Campaign (M5-M6 block) in Burmese waters
Environmental impact assessment for the performance of an offshore seismic and bathymetric campaign
Client : Total E&P Myanmar

Position held : Project engineer

2014
EUROPA ISLAND, FRANCE (TAAF)

Performance of a Notice of Impacts for an exclusive 5-year-license to hydrocarbon exploration projects
Achievement of an environmental and social impact assessment for offshore exploration projects
Client : SAPETRO JDN SAS

Position held : Project engineer

2014
BULGARIA

Impact Assessment for the drilling of an exploration well in the Black Sea
Achievement of the environmental and social impact assessment for an offshore exploration drilling
Client : Total E&P Bulgaria

Position held : Project engineer

2014
MAURITANIA

Impact Assessment for the drilling of an ultra deep water exploration well (block C9)
Achievement of the environmental and social impact assessment for an offshore exploration drilling
Client : Total E&P Mauritania

Position held : Project engineer

2014
ALGERIA

Environmental and social Impact Assessment for the construction and the operation of two combined cycle power plants (Jijel and Biskra)
Participation in the environmental and social impact assessments for the implementation of two power plants in two different environments (urban/desert).
Client : Hyundaï Engineering Co Ltd.

Position held : Project engineer

2014
ALGERIA

Environmental and social Impact Assessment for a power plant in a desert environment (El Borma, Ouargla)
Environmental and social impact assessment for the implementation of a new gas turbogenarator.
Client : General Electric (GE)

Position held : Project engineer

2014
MADAGASCAR

Environmental and social Impact Assessment for an offshore seismic acquisition project (block Amilobe) in Nosy Be
Environmental and social impact assessment for a seismic acquisition project in a very tourist area and with major environmental issues.
Client : Sterling Energy PLC

Position held : Project engineer

2014
FRANCE

Environmental Impact Assessment for reconstruction project of 30 manual dam of the Aisne and Meuse rivers
Participation to the creation of the water regulation file, the declaration of public utility and environmental impact assessment
Client: Vinci

Position held : Project engineer

2013
MYANMAR

Impact assessment on an offshore seismic campaign
Environmental impact assessment on YWB offshore block offshore blocks exploration project
Client : Total E&P Myanmar

Position held : Project manager

2013
CYPRUS

Environmental Impact Assessment for an Offshore Seismic Campaign in Cyprus waters
Participation to an environmental impact assessment for the performance of a seismic campaign
Client : Total E&P Cyprus

Position held : Project engineer

2013
EGYPT

Environmental Impact Assessment for the drilling of an exploration well in Egypt
Execution of the environmental impact assessment for the performance of an offshore exploration well
Client : Total E&P Egypt

Position held : Project engineer

2013
MADAGASCAR

Environmental and Social Impact Assessment concerning a seismic campaign in Madagascar
Execution of the impact assessment for a seismic campaign in 4 study area (North, West, and South) in Madagascar
Achieved 17 public consultations in Madagascar during 1 month; stakeholders: fishermen, mayors and regional representatives.

Client : TGS Nopec

Position held: Project engineer

2013
FRANCE

Environmental study concerning impacts of a wind farm decommissioning
Regulatory synthesis, impacts methodology development, impacts identification and proposition of mitigation measures.

Client : EDF

Position held: Project engineer

2013
ALGERIA

Environmental and Social Impact Assessment concerning the implementation of LPG pumping station with electric line, gas conduit and road
Execution of the impact assessment for the building of LPG pumping station

Client : ABB SpA

Position held: Project engineer

2012
FRANCE

Environmental Impact Assessment and Water Legislation Act in regards to dike in Manosque, France
Execution of the impact assessment and the Water Legislation Act for a dike rebuilding project close to an industrial zone.
Client : Manosque district

Position held: Project engineer

2012
FRANCE

Impact Survey for the drilling of an exploration well in Algeria
Execution of part of the environmental and societal impact assessment for the creation of an exploration well
Client : E On Ruhrgas

Position held : Project engineer

2012
MAURITANIA

Impact Assessment for drilling exploration wells in Mauritania
Realization of part of the ESIA for the construction of exploration wells
Client : Total E&P Mauritania

Position held : Project engineer

2012
FRANCE

Updating an impact statement for offshore seismic exploration
Updating an impact statement on a 3D seismic exploration at sea
Client : SAPETRO

Position held : Project engineer

2012
FRANCE

Impact survey for a gas compressor station
Assessment of the impact of the extension of a gas compressor station, Saint-Martin-de-Crau, in France
Client : GRT Gaz

Position held : Project engineer

2012
BURUNDI/RWANDA/
TANZANIA

Resumption of an impact assessment for a dam over water in Burundi / Rwanda / Tanzania - Rusumo Falls
The project initially planned involved a large-scale dam, the choice of the project has evolved into a dam over water, a full resumption of the impact study was conducted.
Client : NELSAP

Position held : Project engineer

2010
ALGERIA

Environmental and societal impact survey
Onshore gas and crude oil platform – Writing of the environmental and societal impact assessment report
Client : Bir Seba

Position held : Project engineer (internship)

EMPLOYMENT RECORD

04/10/10 – 31/12/11 FRANCE	**Veolia Water** **Project Manager for planning and reporting activity set up of two agencies** Project officer: set up activity reporting and planning tools. Change management – performance management
15/06/09 – 15/09/09 SCOTLAND	**Veolia Water** **Implementation of a thermophilic digester** Internship : transition from a mesophilic to a thermophilic digester; Polymer optimisation ; Energy balance
2006-2007 FRANCE	**JEPI : junior enterprise Polytech'Montpellier** **Biotic index (IBGN) survey** Technician: Quality control and assessment of river water. Identification of the biological criteria distinctive of the quality of water in a river.

Julien Aulner

Environmental engineer & QHSE manager
Water & Environment | Risk, Society and Environment Unit

Date of birth: June 17th, 1978
Nationality: French
Education:

- Engineer in Industrial System, Engineering College of Industrial System (ENGSI / INPL, Nancy)
  - Major in project management, QSE, production optimisation (SMED, 5S)
- Risk analysis (AMDEC, Mads MOSAR)

Languages: French, English (advanced level) and Spanish (intermediate level)
Date of employment in Artelia: 2009

CAREER SUMMARY | SKILLS

Julien Aulner is an EHS engineer who is specialised in environment, sustainable development and health and safety.

As an EHS Auditor, he was project leader of International EHS Audit Program for industry, EHS project review during plant construction, International Regulatory Update, Technologic and Natural Risks Assessment and QSE Management System. He's now very active in EIA coordination and realization.

As a Project Engineer he carries out soil baseline investigation, Sustainable Building Guidelines Manual and IPCC site closure. His duties as an executive manager involved the planning, quotation and management team.

Julien's previous experiences have enabled him to develop certain skills required in his field of work such as:

- Good project management skills
- Good interpersonal and leading skills since he was the team manager of a multicultural team
- Training of engineers in EHS
- Internal Audit and Quality Management

PROFESSIONAL EXPERIENCE

2017
IVORY COAST

Environmental and social impact assessment for a FSRU projet
Conduction of an ESIA for Abidjan regasification terminal project
Client : CI GNL

Position held : Study engineer

2017-2018
BURKINA FASO

HSE Audit – Construction site of a solar plant
Audit during the construction phase and operational phase of Zagtouli future solar plant as well as its ancillary facilities (transmission lines, transformer).
Client : SONABEL/ EU delegation in Burkina Faso

Position held : HSE Auditor

2016-2018
DRC

Environmental monitoring – Construction site of the second intake channel of Inga dams
Approval and update of the environmental management plan performed by the service provider in charge of the work site. Support to staff in charge of monitoring the Client work site in terms of HSE aspects. Production of HSE audits for the construction site during launch phase, construction phase and at the end including submitting a compliance action plan.
Client: SNEL

Position held: HSE auditor

2016
CHAD

Environmental and social impact assessment – Djermaya solar plant
Production of the ESIA for a 60 MW solar plant in Djermaya
Client : Consortium Djermaya Solar

Position held : Engineer

2016
DRC

Seismic post-operation survey in Albertine Graben Block III
Performance of seismic post-operation survey to assess the compliance of the environmental requirements outlined in the seismic contractor ESIA/ESMP.

Position held: HSE auditor

2016
ALGERIA

Environmental and social impact assessment for a pumpinig station project
Production of the ESIA for SP1/ROB1 pumping station project on Haoud El Hamra site
Client : CPECC

Position held: Study engineer, QA/QC

2016
ALGERIA

Environmental and social impact assessment for a field development
Production of the ESIA for Ain Tsila
Client : Groupement Isarene (Petroceltic, Enel, Sonatrach)

Position held: Study engineer, QA/QC

2015
BULGARIA

Update of the Environmental Impact Assessment and development of environmental plans
Update of the EIA for a drilling project in the black sea region.
Writing of the project waste management plan, chemical management plan, operational discharge management plan and environmental management plan according to Total standards
Client: Total E&P Bulgaria

Position held: Project manager – Study engineer

2015
FRANCE

Update of the IPPC ranking of the site – Orange – Data Center – Lyon
Update of the IPPC ranking of the site. Creation of the permitting folder for the new installations.
Client: Orange

Position held: Project manager – Study engineer

2014-2015
NEW-CALEDONIA

Coordination and development of the operating permitting folder related to a mining project for tailing management
Development of a framework document defining the methodology to list and assess the impacts
Multicriteria analysis for the implementation of a residue storage facility (project justification)
Critical review of FEL3 design documentation regarding environmental protection
Consolidation of a list of standards applicable to the project
Performance of the environmental impact study on the tailings site and associated installation
Client : VALE NC

Position held : Project engineer

2014
MYANMAR

Environmental Impact Assessment of a caustic soda plant
Environmental impact assessment of a plant producing caustic soda, bleaching powder, chlorinated acid and Polyaluminium chloride.
Client: PHUI – Ministry of Industry Myanmar

Position held: Project manager – Study engineer

2014
DRC

Environmental Audit of Perenco Installations in DRC
Performance of an environmental survey covering air, soil, aliments (fish, vegetables) surface water and ground water contamination. Definition of the investigation program, sampling, managing logistic of materials and samples, investigations, report and recommendations.
Client: Perenco

Position held: In charge of soil investigations and analysis

2014
MADAGASCAR

Update of the EIA for an offshore seismic acquisition
Update of the EIA of the Ambilobe offshore seismic survey project. Assistance during consultation meetings with local inhabitants and the administrations.
Client: Sterling Energy Plc

Position held: Project manager – Study engineer

2014
FRANCE

Environmental Impact assessment of a wind turbines park
EIA of a wind turbines project in the Meuse department
Client : Eole Res

Position held: Project manager

2014
FRANCE

Accreditation folder for PCB depollution
Performance of the accreditation folder for PCB decontamination activity using mobile units.
Client: Sea Marconi

Position held: Project manager – Study engineer

2013
MOROCCO

Update of the ESIA of a mining project
Update of the ESIA of Achmmach Tin mining project to the south of Meknès
Client: Kasbah Ressources

Position held: Study engineer

2013-14
MYANMAR

Impact assessment on an offshore field development
Environmental impact assessment on the Badamyar field development project
Client : Total E&P Myanmar

Position held : Project manager – Study engineer

2013
MYANMAR

Impact assessment on an offshore seismic campaign
Environmental impact assessment on M5-M6 offshore blocks exploration project
Client : Total E&P Myanmar

Position held : Project manager – Study engineer

2013 – ON-GOING
FRANCE

Impact assessment on a gas pipeline project
Initial diagnosis and impact study on a doubling of Macon pipe
Client : GRT Gaz

Position held : Study engineer

2013
FRANCE

Environmental due diligence – port facilities (bulk carrier)
Environmental due diligence on two bulk material unloading sites (coal)
Client : Royal Haskoning

Position held : Study engineer

2013
FRANCE

Due diligence – Ground-based solar farm projects payer
Performance of 9 due diligences on behalf of the projects
Client : Société Générale

Position held : Project manager – Study engineer

2013
ALGERIA

Environmental liabilities audit
Performance of an environmental liabilities audit including measures for air, soil and groundwater quality
Client : Cepsa

Position held : Study engineer - quality proofreader

2013
FRANCE

Update of the impact review
Update of the environmental impact review of Nord Cambrai permit following the DREAL North remarks
Client : BASGAS

Position held : Study engineer – Project manager

2013
ALGERIA

Environmental study on a paper factory
Performance of an impact assessment on a toilet paper factory in Sétif
Client : FADERCO

Position held : Study engineer

2013
ROMANIA

Due Diligence – Thermal power plant
Audit of an environmental due diligence as part of the renewal of the buying of two thermal power plants
Client : Dalkia Romania

Position held : Quality proofreader

2013
FRANCE

Declaration file
Regulatory file within the framework of the generating set renewal of Toison d'Or mall
Client : Espace Expansion

Position held : Study engineer and quality proofreader

2013
ALGERIA

Update of the EIA – seismic campaign and exploration drilling (Hassi Bir Rekaiz permit)
Update of the environmental assessment and of the environmental management plan
Client : PTTEP

Position held : Study engineer and quality proofreader

2013
MARTINIQUE

DDAE – Composting facility
Authorization file to operate from a composting platform, in Ducos, Martinique
Client : Terralys

Position held : Project manager and quality proofreader

2013
FRANCE

Oil exploration exclusive permit
2 environmental impact assessment notes
Client : ELIXIR

Position held : Project manager and quality proofreader

2012-2013
MADAGASCAR

EIA – Offshore 2D seismic campaign
Offshore seismic campaign on a 200 000 km area, in the North, South and West of Madagascar
Client : TGS

Position held : Study engineer and quality proofreader

2012
FRANCE

Documentary study (phase 1) and regularoty audit - Lacq
Regulatory audit and historical study within the framework of the production equipment sale of Lacq site in the South-West of France
Client : Total E&P

Position held : Study engineer and project manager

2012
FRANCE

ERIDAN pipeline project
EIA critical review, consideration of new regulations (December 2011 decree)
Client : GRT Gaz

Position held : Study engineer

2012
DRC

SEZ project in Maluku
Environmental Baseline Survey & EIA of an industrial park project in the Kinshasa region, in compliance with local regulations and IFC standards
Client : World Bank / IFC

Position held : Study engineer

2012
BRUNEI

Field development and expansion of onshore facilities
Environmental Baseline Survey & EIA of a project for offshore fields development and for the expansion of onshore gas processing facilities
Client : Total E&P Borneo

Position held : Field engineer and quality reviewer

2012
CAMEROON

Establishment of a gas liquefaction plant project
Environmental Baseline Survey & EIA of a project consisting in establishing a gas liquefaction plant in Cameroon
Client : GDF Suez

Position held : Project Quality Manager

2012 **Due Diligence – Road bypass project**
FRANCE Due Diligence of the bypass project in the city of Jargeau, including the creation of a bridge over the Loire (Natura 2000, UNESCO site…)
Client : SPIE Batignolles

Position held : Study engineer and quality reviewer

2012 **Natura 2000 impact package**
FRANCE Creation of the Natura 2000 impact package for Saint-Genix-sur-Guiers micro plant project
Client : Town of Saint-Genix-sur-Guiers

Position held : Study engineer and quality reviewer

2012 **Information package of a pyrogasification unit**
FRANCE Creation of an information package for an experimental pyrogasification unit. Meetings with the DREAL.
Client : SEA Marconi

Position held : Study engineer and quality reviewer

2012 **Natura 2000 impact package**
FRANCE Creation of the Natura 2000 impact package for Saint-Genix-sur-Guiers micro plant project
Client : Cityhall of Saint-Genix-sur-Guiers

Position held : Study engineer and quality reviewer

2012 **EIA and EMP for a seismic campaign**
MADAGASCAR Onshore seismic campaign on block 1101 in Ambilobe district
Client : EAX

Position held : Study engineer and quality reviewer

2012 **EIA and EMP for a seismic campaign and exploration drilling**
ALGERIA Exploration mission of Rhourde er Rouni II block
Client : CEPSA

Position held : Study engineer and quality reviewer

2012 **Due diligence for two photovoltaic projects**
FRANCE Environmental due diligence for two photovoltaic project (concentrated solar energy) in the Bouche-du-Rhône and Pyrénées-Orientales departments
Client : Deposit and Consignment Office

Position held : Study engineer

2011 **EBS, EIA and EMP of the Algerian part of the Galsi project**
ALGERIA Algeria to Italia via Sardinia gas pipeline – deepest planned pipeline in the world Including the compression station
Client : Galsi

Position held : Study engineer and quality reviewer

2011 **Authorization request folder for 3 windmill parks**
FRANCE Development of three authorization request folders for windmill parks in Zondrange, Morange et Vilpion
Client : Nordex France

Position held : Study engineer and project manager

2011
FRANCE

Update of the EIE for a small hydraulic power station
Update of the EIE for a micro-hydroelectric plant in Saint-Genix-sur-Guiers
Client : Town of Saint-Genix-sur-Guiers

Position held : Project manager and quality reviewer

2011
ALGERIA

GNL Project
EIA and EMP for a riprap operation of 2 sealines in Arzew
Client : SAIPEM

Position held : Project manager and quality reviewer

2011
MOROCCO

EBS of a future mining site in the field of the EIA preparation
Development of an environmental baseline survey for a future mining site (air and soil analysis, surface and underground water analysis).
Client : Kasbah Ressources

Position held : Field engineer

2011
FRANCE

Regulatory analysis of shale gas development and exploitation
Development of an internet presentation and research tools
Client : TGSE

Position held : Study engineer and quality reviewer

2011
FRANCE

Document review (phase 1) and regulatory audit for 4 oil and gas fields
Execution of regulatory audits and a historical study within the framework of the selling of 4 oil and gas fields in the South-West of France (La Grave, Vic Bilh, Pécorade and Arrance fields)
Client : Total E&P

Position held : Study engineer and project manager

2011
ALGERIA

Seismic campaign and exploration drilling for Rhourde Yakoub block
EIA and EMP for an exploration program (seismic and drilling)
Client : EON Ruhrgas

Position held : Study engineer and quality reviewer

2010-2012
FRANCE

Environmental Impact Assessment for a wind farm development project
Wind farm development project in Forez.
Assistance in the decision-making process of the wind farm establishment.
Subcontractor coordination (fauna and flora study, landscape study, acoustic measure campaign).
Client : ENR Forez

Position held : Project manager, quality reviewer and study engineer

2010
FRANCE

Environmental Impact Notice for 5 “shale gas” or “shale oil” permits in the eastern part of the Parisian basin
Development of 5 environmental notes
Client : BASGAS

Position held : Study engineer

2010
ALGERIA

Blocks 443a, 424a, 414ext et 415ext of Hassi Bir Rekaiz permit
Environmental Impact Assessment and Environmental Management Plan for a seismic campaign and an exploration drilling program
Client : PTTEP

Position held : Study engineer and quality reviewer

2010 FRANCE
EIA coordination for a photovoltaic project in the South of France
Environmental impact study supervision
Client : Photowatt

Position held : Project manager and quality reviewer

2010 ALGERIA
Ahnet permit
Environmental Impact Assessment and Environmental Management Plan
Client : Sogreah Algerie

Position held : Study engineer and quality reviewer

2010 FRANCE
Environmental impact updated in the context of offshore seismic survey
Update of an impact study, meeting with stakeholders, Natura 2000 impact assessment report
Client : Melrose Resources

Position held : Study engineer

2010 ALGERIA
Timimoun Block in Algeria
Societal and Environmental Impact Assessment for a seismic survey
Client : Total E&P

Position held : Study engineer

2010 ALGERIA
Project Bir Sebba field development, Touggourt
Environmental Impact Assessment and Environmental Management Plan
Client : Sogreah Algérie

Position held : Study engineer and quality reviewer

2010 ALGERIA
Gassi Touil site
EHS Audit protocol
Client : JGC

Position held : Study engineer

EMPLOYMENT RECORD

2005 – 2009
EHS auditor and project manager, BG Consulting Engineer
- EHS auditor (compliance / Due Diligence) – 60 sites audited world wild (Europe – China – Mexico – Marocco)
- Responsible for the QSE management system (ISO 9000 / 14000 OHSAS 18001)
- Project manager: green Plant project / Audit program (27 audits of waste management plan) / EHS regulatory Update
- Project Engineer: sustainable building guidelines manual, IPPC site closure folder, soil baseline investigation.

2003 – 2004
Project leader and treasurer, CU BI Production – Socio-cultural project – Morocco, Mauritania, Senegal
Subvention research (45 k€), administrative and logistics management, management of a 9-person team.

2002 – 2002
Professional training, Onyx Industries, Le Mans
- Administration manager : decontamination, cleaning, waste management
- Planning and budget follow-up
- Management of a team of 20 people
- Implementation of the ADR regulation

Charles Bouhelier

Project Manager / Environmental Engineer
Artelia Myanmar

Date of birth: 11/12/1985
Nationality: French
Education:
- Master's Degree - *Management and Environmental Services Engineering* – VEOLIA Campus, Universities of Marne-la-vallée and Cergy-Pontoise, ENPC - 2012
- Engineer's Degree - *Water & Environment* - Limoges (France) Engineering School "ENSIL" - 2009
- Technical University Diploma "*Physics measurements*" – University of Limoges - 2006

Languages: French (mother tongue), English (fluent), Burmese (notions)
Date of employment in Artelia: 2014

CAREER SUMMARY | SKILLS

Environmental Services

- Environmental Impact Assessment
- Quality/Health/Safety/Environment approach
- Territory and sustainable governance
- Renewable energies

Waste management

- Domestic and Industrial waste collection
- Waste treatment
- Recycling – Material recovery – Energy recovery

Water sciences and technologies

- Waste water treatment plant processes
- Management and protection of the resource in water

PROFESSIONAL EXPERIENCE

2017 MYANMAR	**EIA for an Onshore Drilling project** Environmental Impact Assessment for an Onshore Drilling in North Myanmar **Client: Pacific Hunt Energy** Position held: Project Manager, Environmental engineer
2017 MYANMAR	**EIA for an Onshore Drilling project** Environmental Impact Assessment for an Onshore Drilling in South Myanmar **Client: Confidential** Position held: Project Manager, Environmental engineer

2017
MYANMAR

EIA for an Offshore Drilling project
Environmental Impact Assessment for an Offshore Appraisal and Exploration Drilling in block M9
Client: PTTEPI

Position held: Project Manager, Environmental engineer

2017
MYANMAR

EIA for an Offshore Drilling project
Environmental Impact Assessment for an Offshore Exploration Drilling in block M11
Client: PTTEPI

Position held: Project Manager, Environmental engineer

2017
MYANMAR

EIA for an Industrial Park
Environmental Impact Assessment for an Industrial Park project near Yangon.
Client: Confidential

Position held: Project Manager, Environmental engineer

2017
MYANMAR

IEE for an offshore 3D seismic survey project
Initial Environmental Examination for an offshore 3D seismic campaign on block YWB.
Client: TOTAL E&P Myanmar

Position held: Project Manager - Environmental engineer – Local coordination - Stakeholders consultations (meetings with authorities and local stakeholders: fishermen, township administration, etc.)

2016
MYANMAR

EIA for an offshore drilling project
Environmental & Social Impact Assessment for an offshore exploratory drilling project.
Client: TOTAL E&P Myanmar

Position held: Environmental engineer – Local coordination - Stakeholders consultations (meetings with authorities and local stakeholders: fishermen, township administration, etc.)

2015
MYANMAR

Initial Environmental Examination for a seismic campaign project
Initial Environmental Examination for an offshore seismic campaign on block M-15.
Client: CFG Pte. Ltd.

Position held: Environmental engineer – Local coordination - Stakeholders consultations (meetings with authorities and local stakeholders: fishermen, township administration, etc.)

2015
MYANMAR

Preliminary EIA for 2 drilling campaign projects
Preliminary Environmental & Social Impact Assessment for an offshore exploratory drilling campaign on blocks M5-M6.
Client: TOTAL E&P Myanmar

Position held: Environmental engineer – Local coordination.

2014-2015
MYANMAR

Initial Environmental Examination for a 2D seismic campaign project
Initial Environmental Examination for an offshore seismic campaign on block YWB.
Client: TOTAL E&P Myanmar

Position held: Environmental engineer – Local coordination - Stakeholders consultations (meetings with authorities and local stakeholders: fishermen, township administration, etc.)

2014
MYANMAR

Initial Environmental Examination for a seismic campaign project
Initial Environmental Examination for an offshore seismic campaign on block AD-O3.
Client: OPHIR Energy

Position held: Environmental engineer – local coordination - Stakeholders consultations (meetings with authorities and local stakeholders: fishermen, township administration, etc.)

2014
MYANMAR

Environmental Impact Assessment for a caustic soda plant project
Environmental impact assessment of a plant producing caustic soda, bleaching powder, chlorinated acid and Polyaluminium chloride. Near Thaton in the Mon State.
Client: PHUI – Ministry of Industry Myanmar

Position held: Environmental engineer – Local coordination – Environmental & Social field survey (water and soil sampling, meetings with villagers)

EMPLOYMENT RECORD

2010 – 2014
FRANCE

Research manager, Veolia Environmental Services
Replying to the invitations to tender in the field of the waste management (collection, waste treatment, recycling, cleaning) in a strongly competitive area:
- Analysis of the context and the requirements
- Design and costs estimation of the services, redaction and summary of the technical documentations
- Organisation and communication with: field workers, clients, subcontractors
- Follow-up of the services on the field

2009
FRANCE

Environmental engineer, **EDF – Cruas Nuclear power plant**
Internship: Updating the Environmental Management System of the plant – Environmental impacts analysis (ISO 14001).

2008
THE NETHERLANDS

Laboratory worker, **WETSUS - Water research Institute**
Biological reactor monitoring*: nutrient recovery from black water (partial nitritation+ Anammox)* - Water treatment.

2006
FRANCE

Technician internship , **BODYCOTE HIT Ambazac**
Quality control laboratory in a thermal processing factory. Autonomy – Need to apply an organised process.

APPENDIX B HSE Charter of TEPM

TOTAL
COMMITTED TO BETTER ENERGY

HEALTH, SAFETY AND ENVIRONMENT POLICY

TOTAL E&P MYANMAR CONSIDERS HEALTH AND SAFETY, RESPECT FOR THE ENVIRONMENT, AND ENGAGEMENT WITH OUR STAKEHOLDERS AS PARAMOUNT PRIORITIES. WE ARE THEREFORE COMMITTED TO:

- **HEALTH AND SAFETY OF PERSONNEL.**
- **ENVIRONMENTAL PROTECTION.**
- **SECURITY AND ASSETS INTEGRITY.**
- **TRANSPARENCY AND DIALOGUE WITH AUTHORITIES, PARTNERS, AND STAKEHOLDERS.**

We comply with Myanmar, international, and industrial laws and regulations.

Our principles, responsibilities and commitments are set out in TOTAL 'Health, Safety, Environment, Quality' and 'Security' Charters, TOTAL 'Code of Conduct', HSE Policy of Exploration & Production and Total E&P Myanmar management system.

Total E&P Myanmar implements the guidelines of the Voluntary Principles on Security & Human Rights.

TO DEVELOP A STRONG HSE CULTURE, WE ARE DETERMINED TO FOSTER:

- Transparency and communication within the company and with the authorities, our partners, and our stakeholders.
- Management's leadership through exemplarity.
- Active supervision of all HSE matters.
- Commitment from all personnel to our 14 'HSE Management Principles' and 12 'Golden Rules'.
- Vigilance and professionalism of every one at all times.

IN ORDER TO ACHIEVE OUR STANDARDS WE SHALL, IN ALL OUR ACTIVITIES:

- Manage risks to personnel, environment and assets through appropriate risk assessments.
- Ensure effective preparedness for any emergency situation.
- Develop ambitious, measurable HSE objectives and indicators in order to improve our performances.
- Maintain a high level of reporting and analysis for every anomaly and incident that may happen, in order to implement corrective actions.
- Maintain and develop the competencies of our personnel through appropriate trainings.
- Continuously improve our management system through regular monitoring, audits and inspections, and ensure its implementation.
- Protect the environment (sea, land, forest, ecosystems...) in all our operations.
- Ensure that contractors and suppliers are able to conform to our policies and standards.
- Contribute to the economic and social development, and welfare of local communities, and of Myanmar.

I trust that each and every one of you will, in your daily activities, be conscious of your personal responsibilities in implementing a sound Health, Safety, and Environment policy, and behave in an exemplary manner at all times.

September 2014

Xavier Préel
General Manager

TOTAL E&P MYANMAR

ETHICS CHARTER

TOTAL IS COMMITTED TO GROWING ITS BUSINESS BASED ON SHARED VALUES AND COMMON PRINCIPLES THAT CLEARLY ASSERT ITS ETHICAL STANDARDS AND ACCOUNTABILITY FOR ALL ITS BUSINESSES.

IN PARTICULAR, TOTAL IS ACCOUNTABLE TO:

- Its shareholders, with the objective of striving to ensure a good return on their investment and providing them complete and transparent information on a regular basis.
- Its customers, with the commitment to supplying quality products and services in strict compliance with accepted safety and environmental standards.
- Its employees, with attention to their professional development and the promotion of health and safety in the workplace.
- Its suppliers and partners, in accordance with clear contract terms and conditions. The Group expects them to comply with the principles and behaviours described in its Code of Conduct.
- The civil society. Total contributes to the social and economic development of the countries in which it operates, in compliance with local legislation and regulation. It is committed to protecting the environment and respecting local cultures.

MORE GENERALLY, TOTAL STANDS FOR:

- The principles of the 1948 Universal Declaration of Human Rights.
- The principles of the International Labour Organization.
- The OECD guidelines for Multinational Enterprises.
- The Principles of the United Nations Global Compact.

TOTAL RESPECTS THE PRINCIPLES OF FREE COMPETITION AND REJECTS ANY FORM OF CORRUPTION.

IT DOES NOT INTERVENE IN THE POLITICAL PROCESSES OF THE COUNTRIES IN WHICH IT OPERATES.

IT IS ACTIVELY INVOLVED IN ENVIRONMENTAL STEWARDSHIP AS PART OF ITS CLEAR-CUT COMMITMENT TO SUSTAINABLE DEVELOPMENT.

Total expects the Group's employees to make a positive, contribution to the Group's ethics policy, which they carry out in the course of their daily routine. It therefore requires the Group's employees to adhere to the core values and principles expressed in the Code of Conduct. In particular, this involves:

- To strictly abide by all applicable legislation and regulation.
- To diligently apply the health, safety and environment rules.
- To build clear and honest relationships with customers, suppliers and associates.
- To ensure confidentiality of business information.
- To act with loyalty and integrity towards the Group by avoiding conflicts of interest and insider trading.
- To refrain from intervening in the political arena of the countries in which they have no civil rights.
- To contribute to a positive working team environment.

Christophe de Margerie
Chairman and CEO

APRIL 2011

SAFETY HEALTH ENVIRONMENT QUALITY CHARTER

Total has based its policy in matters pertaining to safety, health, environment and quality on the following ten principles:

ARTICLE 1
Total considers people safety and health protection, safety in regard to operations, respect for the environment, customer satisfaction and listening to stakeholders as paramount priorities.

ARTICLE 2
Total strives to comply with applicable laws and regulations wherever it conducts its business and supplements them, when appropriate, with its own specific requirements.

ARTICLE 3
Total promotes among its employees a shared culture whose core components are skills management, incident feedback, information and dialogue. This process is driven by the leadership and exemplary conduct of management.

ARTICLE 4
Total favors the selection of its industrial and business partners on the basis of their ability to comply with its policy on safety, health, environment and quality.

ARTICLE 5
Total implements, for all its operations, appropriate management policies regarding safety, health, environment and quality risks which are regularly assessed. No project development or product launch may be undertaken without a risk assessment covering the entire life of the project or product.

ARTICLE 6
Appropriate safety, health, environment and quality management systems for each business undergo regular assessment involving measurement of performance, setting milestones, formulating relevant action plans and instituting suitable control procedures.

ARTICLE 7
In order to respond effectively in the event of accidents, Total equips itself appropriately and establishes emergency procedures that are periodically reviewed and regularly tested during exercises.

ARTICLE 8
Each person, at all levels, must be conscious in his or her job of his or her personal responsibility, giving due consideration to the prevention of risks of accident, harm to health, environmental damage or adverse impacts on product and service quality. Vigilance and professionalism in these fields are important criteria in evaluating the performance of each member of personnel, in particular for those in positions of responsibility.

ARTICLE 9
In matters of safety, health, environment and quality, Total adopts a constructive attitude based on open dialogue with stakeholders and outside parties. Through its social commitment, It focuses on developing its activities in harmony with the neighbouring communities.

ARTICLE 10
Total monitors and controls the Group's energy consumption, greenhouse gas emissions, production of final waste and impact on biodiversity. The Group develops new processes, products and customer services in order to enhance energy efficiency and reduce environmental footprints. The Group is engaged in exploring for and developing additional energy resources. Total thus actively contributes to sustainable development.

Christophe de Margerie
Chairman and CEO

September 2009

TOTAL
COMMITTED TO BETTER ENERGY

CODE OF CONDUCT

TOTAL E&P MYANMAR IS COMMITTED TO INSTIL THE VALUES OF RESPECT, RESPONSIBILITY, AND EXEMPLARITY. THE FOLLOWING THREE 'PRIORITY BUSINESS PRINCIPLES' ARE EQUALLY CRITICAL TO TEPM SUCCESS AS A RESPONSIBLE COMPANY:

- **COMMITMENT TO HEALTH, SAFETY AND ENVIRONMENT.**
- **COMPLIANCE WITH THE HIGHEST INTEGRITY STANDARDS.**
- **RESPECT FOR HUMAN RIGHTS STANDARDS.**

We uphold and respect the highest applicable norms of international, local laws, and industry standards.

We apply a 'zero tolerance' compliance program designed to prevent and detect violations of applicable anti-trust, anti-fraud, anti-bribery, and anti-corruption laws.

We adhere to the 'Universal Declaration of Human Rights', support the United Nations Global Compact, and follow the 'United Nations guiding principles on Business and Human Rights', as well as the International Labor Organization standards. We also implement the 'Voluntary Principles for Security and Human Rights'.

We respect the environment, the cultural values, and the local communities of Myanmar. We do not intervene in the political processes of Myanmar.

Total E&P Myanmar code of conduct is a common reference document for all our managers and employees as well as for all our different stakeholders, including local authorities, local communities, partners, suppliers and contractors.

TOTAL E&P MYANMAR MANAGERS' RESPONSIBILITIES:

- Refer to the Code of Conduct with their team members, and make sure they understand it.
- Create a speak-up climate, prevent harassment, and provide fair remuneration and equitable treatment for their employees.
- Ensure that our business principles are implemented and respected.
- Behave in an exemplary manner.

TOTAL E&P MYANMAR EMPLOYEES SHALL INDIVIDUALLY ENSURE THAT THEY:

- Understand and respect the business principles contained in the 'Code of Conduct'.
- Declare any conflict of interest that may arise.
- Avoid insider trading, and ensure confidentiality of business information.

TOTAL E&P MYANMAR SUPPLIERS AND CONTRACTORS ARE EXPECTED TO:

- Apply equivalent standards to their employees and guarantee that their suppliers and subcontractors respect equivalent principles to those of Total E&P Myanmar.

TOTAL E&P MYANMAR PARTNER'S SHALL:

- Abide by our 'Code of Conduct'.

I trust that each and every one of you will act and behave in line with this Code of Conduct. If any concern rises related to its application, you can contact the Group Ethic Committee or TEPM Ethics coordinator.

September 2014

Xavier Préel
General Manager

TOTAL E&P MYANMAR

APPENDIX C Attendance sheet for the public consultation organized in Pyapon

ဌာနဆိုင်ရာ

အစည်းအဝေး - ကနဦးသဘာဝ ပတ်ဝန်းကျင်လေ့လာဆန်းစစ်ခြင်းဆိုင်ရာ အကြံပြုဆွေးနွေးပွဲ

နေရာ - ဖျာပုံ

အချိန် -

နေ့ရက် - ၃၁ ဩဂုတ်လ ၂၀၁၇

စဉ်	အမည်	ရာထူး/ အလုပ်အကိုင်	ဌာန	လက်မှတ်
၁	[illegible]	[illegible]	[illegible]	
၂	[illegible]	[illegible]	[illegible]	
၃	ဦးဝင်းနိုင်	[illegible]	[illegible]	
၄	ဦးရွှေဝေ	"	[illegible]	
၅	[illegible]	[illegible]	[illegible]	
၆	ဦးကျော်နိုင်	[illegible]	NLD	
၇	[illegible]	"	NLD	
၈	[illegible]	-	NLD	
၉	ဦးဝင်းမြင့်	[illegible]	[illegible]	
၁၀	[illegible]	[illegible]	[illegible]	

အစည်းအဝေး - ကနဦးသဘာဝ ပတ်ဝန်းကျင်လေ့လာဆန်းစစ်ခြင်းဆိုင်ရာ အကြံပြုဆွေးနွေးပွဲ

နေရာ - ဗျာပုံ

အချိန် -

နေ့ရက် - ၃၁ ဩဂုတ်လ ၂၀၁၇

စဉ်	အမည်	ရာထူး/ အလုပ်အကိုင်	ဌာန	လက်မှတ်
၁	[illegible]	[illegible]	[illegible]	[illegible]
၂	[illegible]	[illegible]	[illegible]	[illegible]
၃	[illegible]	[illegible]	[illegible]	[illegible]
၄	[illegible]	[illegible]	[illegible]	[illegible]
၅	[illegible]	[illegible]	[illegible]	[illegible]
၆	[illegible]	[illegible]		

အစည်းအဝေး - ကနဦးသဘာဝ ပတ်ဝန်းကျင်လေ့လာဆန်းစစ်ခြင်းဆိုင်ရာ အကြံပြုဆွေးနွေးပွဲ

နေရာ - ဖျာပုံ

အချိန် -

နေ့ရက် - ၃၁ ဩဂုတ်လ ၂၀၁၇

စဉ်	အမည်	ရာထူး/ အလုပ်အကိုင်	ဌာန	လက်မှတ်
1.	ဦးဘွေးရှိ	[illegible]		
2.	ဦး[illegible]	[illegible]		
3.	ဦး[illegible]	[illegible]		Shwe[illegible]
4.	ဦး[illegible]	[illegible]		
5	ဦး[illegible]	[illegible]		
6.	ဦး[illegible]	[illegible]		
7	သူရအောင် (ဖျာပုံ)	သတင်းထောက် (MDN)		
8.	ကျော်စိုးမိုး (ဖျာပုံ)	သတင်းထောက် Update.		
9	ကို[illegible]	[illegible]		
10	ကို[illegible]	"		

အစည်းအဝေး - ကနဦးသဘာဝ ပတ်ဝန်းကျင်လေ့လာဆန်းစစ်ခြင်းဆိုင်ရာ အကြံပြုဆွေးနွေးပွဲ

နေရာ - ဖျာပုံ

အချိန် -

နေ့ရက် - ၃၁ ဩဂုတ်လ ၂၀၁၇

စဉ်	အမည်	ရာထူး/ အလုပ်အကိုင်	ဌာန	လက်မှတ်
11	ဦးထွန်းအောင်ဝင်း	[illegible]	[illegible]	[illegible]
12	ဦး[illegible]	" EC	"	[illegible]
13	ဦး[illegible]	[illegible]		[illegible]
14	ဦးဝေယံထွန်း	မြို့နယ်အုပ်ချုပ်ရေးမှူး	ဖျာပုံမြို့နယ်	[illegible]
15	အောင်စံလွင်	[illegible]	[illegible]	[illegible]
16	မျိုးဇော်	မီဒီယာ	[illegible]	[illegible]
17	ဦးမိုးကျော်ဇော	[illegible]		[illegible]
18	ကိုကျော်သက်	[illegible]		[illegible]
19				

APPENDIX D Attendance sheet for the public consultation organized in Pathein

အစည်းအဝေး - ကနဦးသဘာဝ ပတ်ဝန်းကျင်လေ့လာဆန်းစစ်ခြင်းဆိုင်ရာ အကြံပြုဆွေးနွေးပွဲ

နေရာ - ပုသိမ်

အချိန် -

နေ့ရက် - ၂၅ ဩဂုတ်လ ၂၀၁၇

စဉ်	အမည်	ရာထူး/ အလုပ်အကိုင်	ဌာန	လက်မှတ်
၁။	ဦး[illegible]	ဒု/ည [illegible]	ECD	
၂.	ဦးကျော်ကျော်[illegible]	A.D	ECD	
၃.	ဒေါ်မိုမို	DSO	ECD	
၄	ဒေါ်[illegible]	SK-4	ECD	
၅	ဦး[illegible]	DOF	DOF	
၆	ဦး[illegible]	D-OF/ Deputy Director	D-O-F	
၇	ဒေါ်[illegible]	[illegible]	[illegible]	
၈	ဦးကျော်အောင်	[illegible]	[illegible]	
၉	ဦး[illegible]	[illegible]	[illegible]	
၁၀	[illegible]	[illegible]	〃	

အစည်းအဝေး - ကနဦးသဘာဝ ပတ်ဝန်းကျင်လေ့လာဆန်းစစ်ခြင်းဆိုင်ရာ အကြံပြုဆွေးနွေးပွဲ

နေရာ - ပုသိမ်

အချိန် -

နေ့ရက် - ၂၅ ဩဂုတ်လ ၂၀၁၇

စဉ်	အမည်	ရာထူး/ အလုပ်အကိုင်	ဌာန	လက်မှတ်
၁၁	ကိုနိုင်လင်းထွဋ်	MATA [illegible]	MATA	
၁၂	ဦးနိုင်ကြို	MATA, ကိုင်းကိုယ်စားလှယ်	"	
၁၃	ဦး[illegible]	"	"	
၁၄	ဦးခိုင်ကြည်ဦး	[illegible]	- ပုသိမ်	
၁၅	ဦးဝင်းဇော်ထွန်း	[illegible]	[illegible]	
၁၆	ဦးမောင်ရွှေ...	Futuwa Green	-	
၁၇	ဦးအောင်ကျော်နိုင်	PPMFW ပါဝင်		
၁၈	ဒေါက်တာဦး[illegible]	" "		
၁၉	ကိုစိုး	MATA (SC) [illegible]		
၂၀	Dr. Cherry Aung	Professor / Head	Department of Marine Science	

အစည်းအဝေး - ကနဦးသဘာဝ ပတ်ဝန်းကျင်လေ့လာဆန်းစစ်ခြင်းဆိုင်ရာ အကြံပြုဆွေးနွေးပွဲ

နေရာ - ပုသိမ်

အချိန် -

နေ့ရက် - ၂၅ ဩဂုတ်လ ၂၀၁၇

စဉ်	အမည်	ရာထူး/ အလုပ်အကိုင်	ဌာန	လက်မှတ်
21.	Daffi Mon Aung	All	Department of marine science	
22	Dr. Nyunt Sander Aung	A/L	Department of marine science	
23	U Soe Thein	Fisheries Officer	DOF, PaThein	
24	U THAUNG TIN	TOWNSHIP OFFICER	MRCS	
25.	U [illegible]		[illegible]	
26.	Ko Thi Ha Ye Htut	Volunteer	MATA (AYY)	

APPENDIX E Example of Garbage Management Plan

Garbage Management Plan Asima

Revision date: 21-Sep-14
Version: 12.0
Author: Tom Parker
Approver: Simon Hodgkinson

Authority

The Master has overall responsibility for ensuring compliance with this procedure. It is also the Master's responsibility to pass on information on local area regulations to onboard personnel and ensure compliance.

All crew shall be made aware of the regulations that discharge of all garbage into the sea is prohibited.

The Chief Officer is responsible for carrying out the plan and shall be assisted by the GPT (Green Protection Team) and departmental heads to ensure that the collection, separation and processing of garbage is efficient in all areas of the vessel and relevant procedures are carried out in accordance with the Garbage Management Plan.

EHSQ Significant Aspects

In following this procedure we ensure our vessel follows the requirements of MARPOL 73/78 and amendments and 'Our Commitment to the Environment' to prevent:

- Mishandling of shipboard garbage which could,
  - cause unsanitary conditions,
  - spread disease
  - attract rodent / insect infestation
- Mishandling of shipboard garbage which could cause further damage / burden the ecosystem and environment in which we live.
- Breach of the MARPOL Regulations, potentially threatening the company Explore Green agenda and Polarcus reputation.

Polarcus accepts the responsibility for tracking our generated waste through to its final destination.

Procedure Description

SECTION - A

1. Purpose

This procedure is written to give guidance to, and ensure uniformity in the implementation of the vessels Garbage Management Plan and to ensure compliance with the requirements of MARPOL 73/78 Annex V.

2. Scope

This procedure covers aspects of garbage collection, storing and disposal from vessels both at sea and whilst in port.

3. Management Commitments

Reference is made to Polarcus – Our Commitment to Environment.

4. Language

As required by the regulations this Garbage Management Plan is written in “English”, in the working language of the vessel.

5. Definitions

Cooking oil – any type of edible oil or animal fat used or intended to be used for the preparation or cooking of food, but does not include the food itself that is prepared using these oils.

Food wastes – any spoiled or unspoiled food substances and includes fruits, vegetables, dairy products, poultry, meat products and food scraps generated aboard ship.

GMP – Garbage Management Plan

GPT – Green Protection Team

Garbage – all kinds of food wastes, domestic wastes and operational wastes, all plastics, cargo residues, incinerator ashes, cooking oil, fishing gear, and animal carcasses generated during the normal operation of the ship and liable to be disposed of continuously or periodically except those substances which are defined or listed in other Annexes to the present Convention.

Incinerator ashes – ash and clinkers resulting from shipboard incinerators used for the incineration of garbage.

Operational wastes – all solid wastes (including slurries) not covered by other Annexes that are collected on board during normal maintenance or operations of a ship, or used for cargo stowage and handling. Operational wastes also includes cleaning agents and additives contained in cargo hold and external wash water. Operational wastes does not include grey water, bilge water, or other similar discharges essential to the operation of a ship, taking into account the guidelines developed by the Organization.

Plastic – a solid material which contains as an essential ingredient one or more high molecular mass polymers and which is formed (shaped) during either manufacture of the polymer or the fabrication into a finished product by heat and/or pressure. Plastics have material properties ranging from hard and brittle to soft and elastic. For the purposes of this annex, "all plastics" means all garbage that consists of or includes plastic in any form, including synthetic ropes, synthetic fishing nets, plastic garbage bags and incinerator ashes from plastic products.

Special area – a sea area where for recognized technical reasons in relation to its oceanographic and ecological condition and to the particular character of its traffic the adoption of special mandatory methods for the prevention of sea pollution by garbage is required.

For the purposes of Annex V the special areas are the Mediterranean Sea area, the Baltic Sea area, the Black Sea area, the Red Sea area, the Gulfs area, the North Sea area, the Antarctic area and the Wider Caribbean Region, including the Gulf of Mexico.

6. Actions

6.1 Collecting garbage

Garbage collection points should be at appropriate sites around the vessel with separation into the waste streams indicated in this document. Various bins distinguished by color and/or name are placed around the vessel. Garbage is sorted by different categories and type.

The following should be observed as a minimum:-

- Food waste shall be collected in designated bins with cover. Black bins
- Non combustibles – Plastics except food wrapping, Packaging Material, Metal, Glass etc. to be collected in designated bins for storage until discharging to an approved shore reception facility. Green bins
- Alkaline Batteries Grey Bin
- Combustible garbage i.e.; oily rags, shall be collected in fire proof designated bins. Red Steel Bins with cover.
- Lithium batteries when discharged are to be stored in special storage containers and returned to the manufacturer – Lithium batteries do not form part of the vessel waste stream.

6.2 Storing of garbage

Garbage shall be stored in suitable means in designated places on board, and be sorted at least as follows:

- Plastics and plastics mixed with non plastic garbage
- Metals, aerosol cans, cans of unusable paints, chemicals and other solvents
- Food waste including materials contaminated by such wastes
- Other garbage which can be incinerated paper, wood and food waste.
- Used lithium batteries (See procedure Lithium Battery Storage and Handling)

6.3 Onboard Processing of garbage

Garbage shall be stored in suitable means in designated places on board, and be sorted at least as follows:

Overboard – macerated food waste.

Incinerator – food waste, wood, paper, cardboard, plastic food wrapping (to reduce contamination), sludge.
Disposal Ashore – All other items.

Operation of the incinerator shall be limited to approved operators only and the list of approved operators shall be clearly displayed.

Incineration - Please note that MARPOL 73/78 Annex VI (Air Pollution) also prohibits the incineration on board ship of certain products, such as contaminated packaging materials and polychlorinated biphenyls (PCBs).

The use of the Incinerator onboard may at times be restricted due to national requirements which prohibit the use of shipboard incinerators. When operating from such countries all onboard incinerators must be tagged and locked out.

The disposal of incinerator ashes at sea is prohibited. Incinerator Ash shall be retained on board to be:

- Shipped via supply vessels ashore and then sent to an appropriate waste reception facility
- Landed ashore during port calls and sent to an appropriate waste reception facility.

6.4 Disposing of garbage according to Marpol 73/78 Annex V and in relation to Polarcus operations

MARPOL 73/78 Annex V indicates the legal minimum standard for disposal of garbage at sea. The company requirements or local regulations may indicate a higher standard.
The vessel will always operate to the highest standard or regulation in force.

Special note outside of Marpol 73/78 requirements: One must take into consideration food waste disposed of overboard will attract sharks, which may result in shark bites on the streamers.

Regulation 3 - General Prohibition on Discharge of Garbage into the Sea.
States the following:

- Discharge of all garbage into the sea is prohibited.

Regulation 4 - Discharge of Garbage Outside Special Areas
States the following:

Discharge of the following garbage into the sea outside special areas shall only be permitted while the ship is en route and as far as practicable from the nearest land, but in any case not less than:

- 3 nautical miles from the nearest land for food wastes which have been passed through a comminuter or grinder. Such comminuted or ground food wastes shall be capable of passing through a screen with openings no greater than 25 mm.
- 12 nautical miles from the nearest land for food wastes that have not been treated in accordance with subparagraph in bullet point above.
- When garbage is mixed with or contaminated by other substances prohibited from discharge or having different discharge requirements, the more stringent requirements shall apply.

Regulation 6 – Discharge of Garbage within Special Areas
States the following:

Discharge of the following garbage into the sea within special areas shall only be permitted while the ship is en route and as follows

- Discharge into the sea of food wastes as far as practicable from the nearest land, but not less than 12 nautical miles from the nearest land or the nearest ice shelf. Food wastes shall be comminuted or ground and shall be capable of passing through a screen with openings no greater than 25 mm. Food wastes shall not be contaminated by any other garbage type. Discharge of introduced avian products, including poultry and poultry parts, is not permitted in the Antarctic area unless it has been treated to be made sterile
- Cleaning agents or additives contained in deck and external surfaces wash water may be discharged into the sea, but only if these substances are not harmful to the marine environment, taking into account guidelines developed by the Organization

The following rules (in addition to the rules in paragraph 1 of this regulation) apply with respect to the Antarctic area.

- Each Party at whose ports ships depart en route to or arrive from the Antarctic area undertakes to ensure that as soon as practicable adequate facilities are provided for the reception of all garbage from all ships, without causing undue delay, and according to the needs of the ships using them.
- Each Party shall ensure that all ships entitled to fly its flag, before entering the Antarctic area, have sufficient capacity on board for the retention of all garbage, while operating in the area and have concluded arrangements to discharge such garbage at a reception facility after leaving the area.
- When garbage is mixed with or contaminated by other substances prohibited from discharge or having different discharge requirements, the more stringent requirements shall apply

Regulation 7 – Exceptions
States the following:

Regulations **3**, **4**, **5** and **6** of this Annex shall not apply to:

- The discharge of garbage from a ship necessary for the purpose of securing the safety of a ship and those on board or saving life at sea; or
- The accidental loss of garbage resulting from damage to a ship or its equipment, provided that all reasonable precautions have been taken before and after the occurrence of the damage, to prevent or minimize the accidental loss.

Exception of *en route*

- The *en route* requirements of regulations **4** and **6** shall not apply to the discharge of food wastes where it is clear the retention on board of these food wastes presents an imminent health risk to the people on board

7. Minimization efforts

Reference is made to - Procurement departments procedure where suppliers are asked to supply goods in Eco friendly packaging material to reduce pollution at source.

When goods are received in port they are unpacked while vessel is in port – time permitting so that packaging material etc. are not carried out to sea.

The company has made efforts to minimize waste through such endeavors as limiting the purchases of individual bottled waters and promoting the consumption of the vessel produced potable water. Bottled water is now supplied onboard as an emergency type supply versus the previous program of being the main source of drinking water. A reduction in approximately 500,000 plastic water bottles annually.

Environmental awareness of the crew is raised on the vessel during EHSQ meetings and encouraged to adhere to GMP. Company has a reward recognition program for crew member's effort to reduce garbage and suggesting new ideas for pollution prevention.

The Company focuses on the use of the most environmentally friendly products to reduce pollution and emissions and also the minimization of waste.

8. Training

The Company commitment towards Environmental responsibility will be communicated to the crew.

During the familiarization of the vessel a special mention is made of the Garbage Management Plan and an overview of the system given.
Personnel are informed about garbage segregation and correct disposal techniques for various types of garbage on board.

The vessel operates a "NOTHING OVERBOARD" policy in regards to waste other than the permissible wastes identified in MARPOL Regulations.

Placards are placed at various garbage collection locations and main areas of the vessel to further reinforce the GMP and raise awareness.

Crewmembers involved in the collection of garbage and disposal on board, will receive special instructions in sorting, handling and storage prior to disposal.

Oil pollution prevention drills are carried out at regular intervals.

Onboard training shall be carried out to ensure that all personnel are familiar with the requirements of the Garbage Management Plan. Training shall also be given to people requiring approval as operators of hazardous equipment (e.g. incinerator or comminuter/macerator) The Master will ensure that all personnel are compliant with local training requirements.

9. Garbage record book

A Bahamas approved Garbage Record Book shall be maintained on board.

The Garbage Record Book shall be used to record the following operations and be signed for on the date of the incineration or discharge by the officer in charge:

- Each discharge operation
- Each completed Incineration
- Accidental discharge as described in Marpol 73/78 Annex V, regulation 7
- The entry for each incineration or discharge shall include the following:
    - Date and time
    - Position of the ship
    - Description of the garbage
    - Estimated amount

SECTION – B

1. Vessels Particulars

Official/IMO Number:	9538127
Flag/Port of Registry:	Bahamas
Classification Society:	DNV
Call Sign:	C6XK6
Length (m):	92.0 m
Breadth (m):	21.0 m
Draft (m):	7.5 m
Gross Tonnage:	7894
Net Tonnage:	N.A
Deadweight:	N.A
Passengers:	N.A
Freeboard (m):	N.A

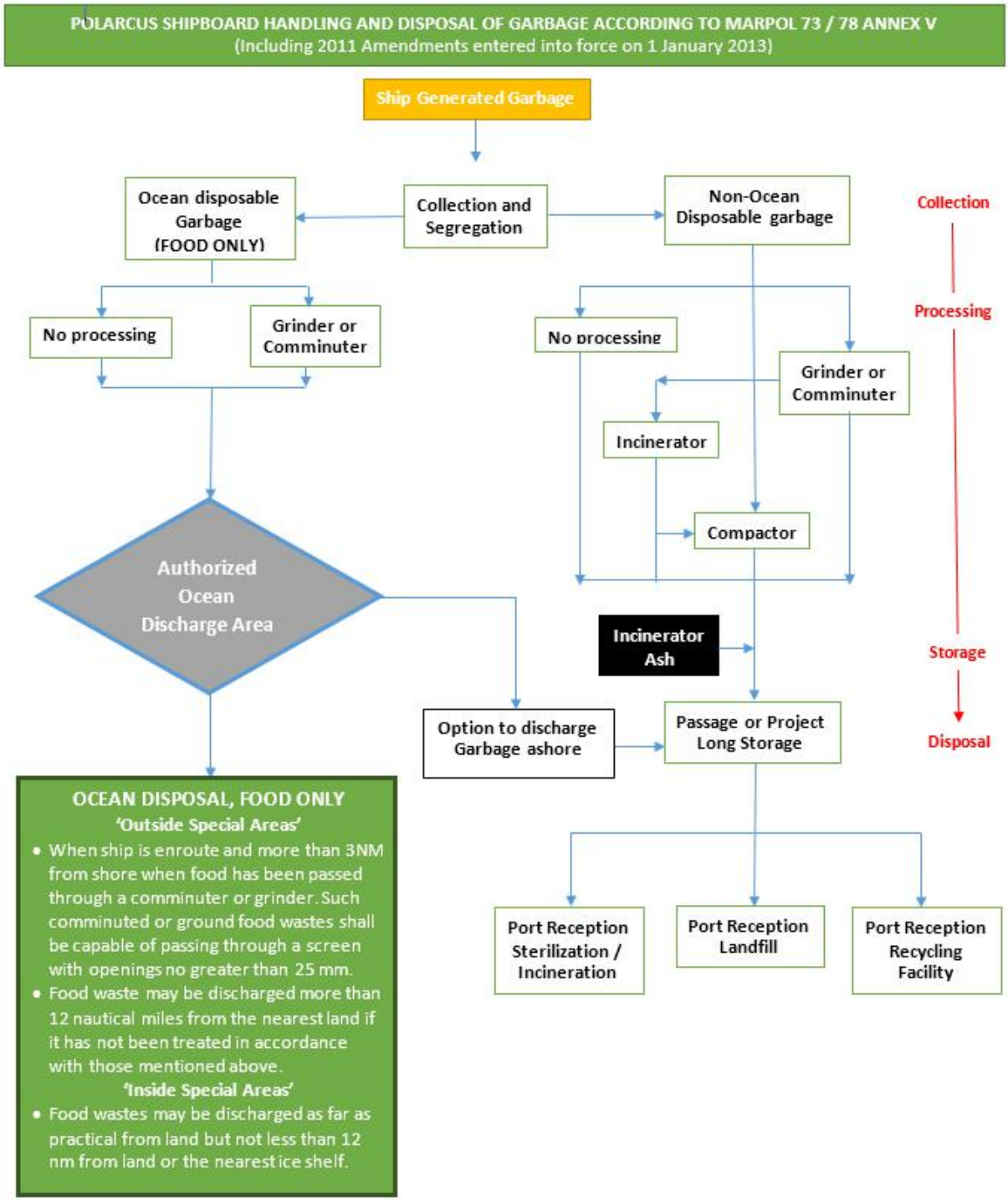
2. Garbage types and discharge provisions

Simplified overview of the discharge provisions of the **revised MARPOL Annex V (resolution MEPC.201(62))** which entered into force on 1 January 2013 **(**for the full text of the respective discharge requirements please refer to the text of the **revised MARPOL Annex V,** and for more detailed guidance please consult the **2012 Guidelines for the Implementation of MARPOL Annex V (resolution MEPC.219(63))**

Type of Garbage	Ships outside special areas	Ships within special areas	Offshore Platforms and all ships within 500m of such platforms
Food waste comminuted or ground	Discharge permitted ≥3 nm from the nearest land and en route	Discharge permitted ≥12 nm from the nearest land and en route	Discharge permitted ≥12 nm from the nearest land
Food waste not comminuted or ground	Discharge permitted ≥12 nm from the nearest land and en route	Discharge prohibited	Discharge prohibited
Cargo residues[1] not contained in wash water	Discharge permitted ≥12 nm from the nearest land and en route	Discharge prohibited	Discharge prohibited
Cargo residues[1] contained in wash water		Discharge only permitted in specific circumstances[2] and ≥12 nm from the nearest land and en route	Discharge prohibited
Cleaning agents and additives[1] contained in cargo hold wash water	Discharge permitted	Discharge only permitted in specific circumstances[2] and ≥12 nm from the nearest land and en route	Discharge prohibited
Cleaning agents and additives[1] contained in deck and external surfaces wash water		Discharge permitted	Discharge prohibited
Carcasses of animals carried on board as cargo and which died during the voyage	Discharge permitted as far from the nearest land as possible and en route	Discharge prohibited	Discharge prohibited
All other garbage including plastics, domestic wastes, cooking oil, incinerator ashes, operational wastes and fishing gear	Discharge prohibited	Discharge prohibited	Discharge prohibited
Mixed Garbage	When garbage is mixed with or contaminated by other substances prohibited from discharge or having different discharge requirements, the more stringent requirements shall apply.		

1. These substances must not be harmful to the marine environment.
2. According to regulation 6.1.2 of MARPOL Annex V, the discharge shall only be allowed if: (a) both the port of departure and the next port of destination are within the special area and the ship will not transit outside the special area between these ports (regulation 6.1.2.2); and (b) if no adequate reception facilities are available at those ports (regulation 6.1.2.3).

3. Schematic


POLARCUS SHIPBOARD HANDLING AND DISPOSAL OF GARBAGE ACCORDING TO MARPOL 73 / 78 ANNEX V
(Including 2011 Amendments entered into force on 1 January 2013)
Ship Generated Garbage
Collection and Segregation
Ocean disposable Garbage (FOOD ONLY)
Non-Ocean Disposable garbage
No processing
Grinder or Comminuter
No processing
Grinder or Comminuter
Incinerator
Compactor
Authorized Ocean Discharge Area
Incinerator Ash
Option to discharge Garbage ashore
Passage or Project Long Storage
Port Reception Sterilization / Incineration
Port Reception Landfill
Port Reception Recycling Facility
Collection
Processing
Storage
Disposal
OCEAN DISPOSAL, FOOD ONLY
'Outside Special Areas'
• When ship is enroute and more than 3NM from shore when food has been passed through a comminuter or grinder. Such comminuted or ground food wastes shall be capable of passing through a screen with openings no greater than 25 mm.
• Food waste may be discharged more than 12 nautical miles from the nearest land if it has not been treated in accordance with those mentioned above.
'Inside Special Areas'
• Food wastes may be discharged as far as practical from land but not less than 12 nm from land or the nearest ice shelf.

4. Effects of incineration

Typical examples	Special handling by Vessel personnel Before incineration	Incineration characteristics				Onboard Storage Space
		Combustibility	Reduction of Volume	Residual	Exhaust	
Paper packaging, food and beverage containers	Minor – easy to feed into hopper	High	Over 95%	Powder ash	Possibly smoky and not hazardous	Minimum
Fiber and paper board	Minor- reduce material to size for feed; minimum manual labor	High	Over 95%	Powder ash	Possibly smoky and not hazardous	Minimum
Plastic packaging, food and beverage containers,etc.	Minor- easy to feed into hopper	High	Over 95%	Powder ash	Possibly smoky and hazardous based on incinerator design	Minimum
Plastic sheeting, netting, rope and bulk material	Moderate manual labor time for size reduction	High	Over 95%	Powder ash	Possibly smoky and hazardous based on incinerator design	Minimum
Rubber hoses and bulk pieces	Major manual labor time for size reduction	High	Over 95%	Powder ash	Possibly smoky and hazardous based on incinerator design	Minimum
Metal food and beverage containers, etc.	Minor – easy to feed into hopper	Low	Less 10%	Slag	Possibly smoky and not hazardous	Moderate
Metal cargo, bulky containers, thick metal items	Major manual labor time for size reduction (not easily incinerated)	Very Low	Less 5%	Large metal fragments and slag	Possibly smoky and not hazardous	Maximum
Glass food and beverage containers, etc.	Minor – easy to feed into hopper	Low	Less 10%	Slag	Possibly smoky and not hazardous	Moderate
Wood, cargo containers and large wood scraps	Moderate manual labor time for size reduction	High	Over 95%	Powder ash	Possibly smoky and not hazardous	Minimum

References

MARPOL
Res MEPC.219(63) Guidelines for the Implementation of MARPOL Annex V
Res MEPC.201(62) Amendment to MARPOL 73/78 Annex V
Form of Garbage Record Book
Port & Flag State Inspections
DNV Environmental Clean Design
Lithium Battery Storage and Handling

Attachments

ASIMA Waste Management
International Pollution Regulations Placard
Record of Garbage Discharge
UMCC call Incinerator
Waste Compactor

Table of Amendments

Rev Date	Rev No.	Amendments
21-Sep-14	12	Updated EHSQ Significant Aspects – About generated waste.

APPENDIX F Example of Oil Spill Procedure

Oil Spill Procedure

Revision date: 08-Sep-14
Version: 8.0
Author: Tom Parker
Approver: Simon Hodgkinson

Authority

The Master has overall responsibility for the safety of the vessel and personnel.

The Chief Engineer is responsible for ensuring all spill recovery and containment equipment and stores held or controlled by the Engineering department are ready for use at all times (Including for use in cold weather conditions).

EHSQ Significant Aspects

In general, apart from small localized spills, such as those caused by failed deck fittings and/ or transfer incidents, it is highly unlikely for the crew to be directly involved in deploying heavy response gear (booms and skimmers) or implementing specialized tactics such as in-situ burning or dispersants.

Procedure Description

General

Those spills that that may occur at or near a company's own facilities as a consequence of its own activities are classed by the Petroleum Industry Environmental Conservation Association (IPIECA) as Tier 1 level spills.

All commercial ships are required to have a shipboard oil pollution emergency plan (SOPEP) to deal with Tier 1 level spills and details of plan requirements vary with the nation involved.

The more common sources of Tier 1 spills are those resulting from bunkering operations.

Tier 1 Spills

In the event of a Tier 1 spill or release, all oil spill response activities will be performed in accordance with the vessel's (MARPOL73/78 compliant) Shipboard Oil Pollution Emergency Plan (SOPEP).

SOPEP response activities are designed to ensure:

- Protection of life (vessel crew, public, etc.)
- Securing the safety of the vessel and protection of property
- Protection of the environment

Major Spills

Spills classified as Tier 2 or Tier 3 major spills will be subject to government direction and controls.

It is important to note that due to the limited quantities of oil and fuel carried onboard Polarcus vessels and accompanying support vessels (if any), Tier 3 spills are not possible.

Oil Pollution Prevention Team

Bunkering operations present the highest risk for a spill to occur. The shipboard Oil Pollution Prevention Team is responsible for both prevention and response activities, detailed instructions for the team are listed in the Vessel specific 'Shipboard Oil and Pollution Emergency Plan (SOPEP)'.

Reporting

Article 8 and Protocol I of MARPOL 73/78 require that the nearest coastal state should be notified of actual or probable discharges of oil to the sea. The intent of the requirement is to ensure that coastal states are informed without delay of any incident giving rise to pollution, or threat of pollution, of the marine environment, as well as the need for assistance and salvage measures, so that appropriate action may be taken.

The reporting to be followed by the master or other person in charge of the ship after an oil pollution incident is based on guidelines developed by the International Maritime Organization.*

If the ship is involved in a pollution incident reports must be made both to coastal state or port contacts, as appropriate, and to contacts representing interest in the ship.

The P. & I. underwriters' handbooks for pollution abatement, also current and valid Flag state rules and requirements give detailed information about international and national regulations in connection with oil release.

*"General principles for ship reporting system and ship reporting requirements, including Guidelines for reporting incidents involving dangerous goods, harmful substances and/or marine pollutants" adopted by the International Maritime Organization by resolution A.851(20).

Arctic Considerations

Responding to oil spills in remote areas such as the Arctic, often under extreme climate conditions, will always be a major challenge that is further complicated by the lack of any basic infrastructure.

Regional spill response organization and preparedness in the Arctic varies between the Arctic nations. Framework agreements are in place for cooperative measures in relation to pollution incidents involving oil.

Any Tier 2 or Tier 3 spill response in the Arctic will be regionally coordinated by the relevant national government agencies.

References

SOPEP
Vessel Incident Reporting Procedure

Attachments

Arctic Council National Contact List

Table of Amendments

Rev Date	Rev No.	Amendments
08-Sep-14	8	Changes made to “Authority” subheading

APPENDIX G Example of Extreme Weather Procedure

Extreme Weather Procedure

Revision date: 21-Jan-15
Version: 7.0
Author: Chris Griffin
Approver: Simon Hodgkinson

Authority

The Master of the vessel will take whatever action he feels necessary to prevent the vessel from navigating through extreme weather conditions. The Master is responsible for all actions taken.

The Party Manager is responsible for all seismic towed equipment and the decisions taken regarding it but this will never supersede the directions and decisions of the vessel Master when preparing for such extreme weather avoidance.

EHSQ Significant Aspects

In following this Procedure we can ensure our vessels are prepared for extreme weather conditions when they occur and are managed safely in a way to;

- Prevent fatalities, and life threatening injuries due to the hazards associated with extreme weather.
- Prevent damage to our vessels and equipment during the periods of extreme weather.

Procedure Description

Use the Extreme Weather Checklist for guidance

Weather Alert Levels

In determining a :

Green Alert: Hurricane, Typhoon or Cyclone confirmed, but more than **1000 nm** from location. No action necessary other than monitoring and plotting the storm movements.

Yellow Alert: Hurricane, Typhoon or Cyclone reported in or approaching location and at a distance of **800 - 1000nm**. Continue monitoring and plotting. Secure all loose items.

Orange Alert: Hurricane, Typhoon or Cyclone developing or entering within a radius of **800 nm** of location. Weather reports to be obtained at 3 hourly intervals. The vessel Master will prepare plans for evacuating the survey area.

Red Alert: Hurricane, Typhoon or Cyclone developing or entering within a radius of **500 nm** of location. The Master will advise Polarcus Management of the situation and the plan for evacuation. (Decision or time line to pick up gear should be agreed upon at this stage since further delay could cause problems).

Hurricane, Typhoon or Cyclone Evacuation

If the Hurricane, Typhoon or Cyclone enters within **300nm** of location, the vessel is to cease operations and prepare to leave area for shelter. If there are circumstances that may hamper evacuation, or the recovery of the seismic equipment, the evacuation should be initiated earlier. In such a situation, the Vessel Manager should be kept up to date with the position and status of the vessel.

When the Hurricane, Typhoon or Cyclone has passed, a status report of the vessel and crew is to be made.

Standing by for weather in the Project Area

If it is necessary to stand by during periods of extreme weather when the in-sea seismic equipment is deployed the Master will identify an area considered safe for the vessel and in-sea equipment.
This area shall be:

- Identified within 24 hours of arrival on project.
- Of adequate size for the vessel to maneuver freely in.
- In close proximity to the project.
- Free of surface and sub-sea obstructions which would potentially endanger the vessel or in-sea towed seismic equipment.
- Away from charted sea lanes with minimal or no shipping traffic.
- Of adequate water depth to provide sufficient clearance for the safety of the vessel and in-sea equipment while standing by and maneuvering during the periods of extreme weather.

References

EHSQ Project Plan

Attachments

Extreme Weather Checklist

Table of Amendments

Rev Date	Rev No.	Amendments
21-Jan-15	7.0	Reviewed with minor changes.

APPENDIX H Example of Equipment

Exhibit C

CONTRACTOR's PERSONNEL and EQUIPMENT

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Annexe 12	Positioning data quality control description and examples
Annexe 13	Source and receiver positioning detailed description
Annexe 14	CVs of key personnel
Annexe 15	Bathymetry processing description
Annexe 16	Quality control attribute database
Annexe 17	System timing

1 CONTRACTOR's PERSONNEL

The following positions marked as "(*)" are defined as CONTRACTOR'S KEY PERSONNEL.

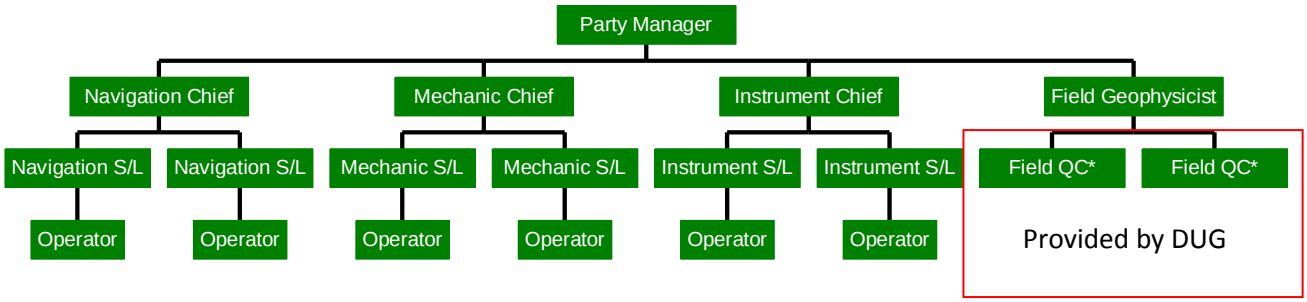
1.1. Seismic vessel(s) geophysical CONTRACTOR's PERSONNEL

Refer also to Exhibit A (Health, Safety and Environment general specifications) of CONTRACT for safety dedicated personnel, and to Annexe 17 of this Exhibit, containing the CVs of all key personnel (project manager, party manager, deputy party manager, department chiefs and senior personnel).
Project organisation chart during operation phase to be filled by CONTRACTOR following Annexe 21 template.
The following numbers relate only to the permanent staff positions excluding CONTRACTOR's specialists who may perform short time interventions.

POSITION	NUMBER
Party Manager (*)	1
Deputy Party Manager (*)	NA
Chief Observer (*)	1
Senior Observer or Shift Leader	2
Observer (1 per shift)	2
Chief Gun Mechanic	1
Gun Mechanic (2 per shift)	2

Chief Navigator (*)	2
Senior Navigator or Shift Leader	2
Navigator	2
Positioning Data Processing Analyst	Chief Navigator responsible
Chief Seismic Data QC and Processing Analyst or Field Geo (*)	1
Senior Seismic Data QC and Processing Analyst	2
Seismic Data Processing Analyst	2
HSE advisor (*)	1
Gravimetry / Magnetometry Data Acquisition Operator (*)	1

Seismic Crew Model

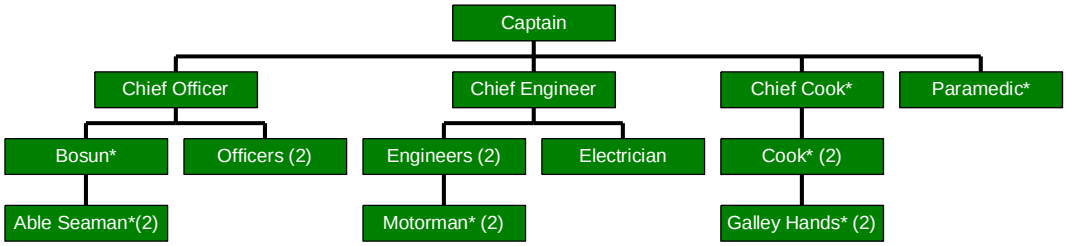


1.2. Seismic vessel(s) marine CONTRACTOR's PERSONNEL

POSITION	NUMBER
Captain (*)	1
	1
	2

	4
	1
	5
	4

Maritime Crew Model



1.3. Support vessel(s) marine CONTRACTOR's PERSONNEL

POSITION	NUMBER
Captain (*)	1
Mate	2
Engineer	3
Seamen	3

1.4. Onshore support CONTRACTOR's PERSONNEL

POSITION	NUMBER
Project Manager (*)	
Project Logistic Coordinator	

1.5. Additional and optional CONTRACTOR's PERSONNEL

1.5.1 Additional CONTRACTOR's PERSONNEL

POSITION	NUMBER
PAM	1
Marine Mammal Observer	1
Fishing Activity Representative	1

1.5.2 Optional CONTRACTOR's PERSONNEL

POSITION	NUMBER

2 Operational considerations

Average recording speed	4.0 – 4.5knots (depending on the sea currents and weather)
Maximum sea state for workboat streamer maintenance	Streamer work (in roller) <1.5m Streamer work (out of roller) <2m
Barnacle growing monitoring and barnacle cleaning methods	Streamer Tension will be utilized to monitor the growth of the barnacles in the streamer. Contractor will assure the clean of the streamer during deployment. Contractor will have standard regular cleaning to the insea equipment.
Will crew changes and resupply operations interrupt the survey?	Contractor will endeavour to keep in production during the crew-x or re-supply. Only for special circumstances (due to for HSE issue, will then Contractor to abort the production to be able to carry on the crew-x or re-supply.

3 Vessel(s)

Note: All vessels engaged by COMPANY for seismic operations must be registered in OVID (Offshore Vessel Information Database) of OCIMF (Oil Companies International Marine Forum). Acceptance of any vessel by COMPANY is dependent on an OVID inspection. The OVID inspection is the CONTRACTOR's responsibility.

3.1. Seismic vessel(s) main characteristics

Vessel name	M/V Polarcus Asima
Vessel owner	Polarcus Ltd. 5
Flag	Bahamas
Port of registry	Nassau
Registry number	9538127
Type	Seismic Vessel
Classification	DNV 1A1, SF, E0, DYNPOS-AUTR, CLEAN DESIGN, COMF-V (3), ICE-1A, WINTERIZED BASIC, NAUT-AW, HELDK, BWM-T
Year built and year rebuilt	2010
Length LOA/LBP	92 m
Breadth	21 m
Maximum draft of fully loaded vessel	7.5 m
Maximum draft of in-water equipment	Deployment dependant
Turning radius with specified streamer configuration	5600m – configuration dependant
Run in with specified streamer configuration	1.2 – 1.5 x Streamer Length
Estimated streamer deployment time	12 Streamers : 5 days
Estimated streamer recovery time	12 Streamers : 1.5 days
Cruising speed	12.0 Knots to 15.0 Knots
Average recording speed	4.4 - 4.6Knots (current dependant)
Endurance at sea	42 days – 44 days (configuration dependent)
Bunkering capability at sea	Yes
Accommodation	69, including 23 single cabins

Client's office description (size, equipment...)	Monitor, Desktop, Printer, Full modern facilities available

3.2. Seismic vessel(s) propulsion and power

Number and type of engines	4 x Wartsila 9L20 + 2 x Wartsila 9L26
Power of individual engine	12,900kW @ 1000 RPM
Number and type of propellers	2 x conventional CPP propellers at 3.75MW
Number of bow thrusters	1 x Brunvoll tunnel thruster at 1200kW 1 X 850 Kw retractable azimuth thruster

3.2.1 Seismic vessel(s) communications

Number and type of VHF units for marine communication	9 x Fixed (RT2048 & RT5022 and 9 Portable x Sailor Tron TR-20
Number and type of VHF units for helicopter communication	1 x ICOM ICA-200
Number and type of satellite communication links	INMARSAT-C w/EGC; INMARSAT-FLEET 77
Type of dedicated satellite data link	SpaceTrack 4000 stabilized VSAT system
Flow rate of the satellite data link	256Kb
Type of safety and distress watch receiver	Sailor CU5000
Type of helicopter homing beacon	Helibeacon, Model TS-1B

Refer also to Exhibit A (Health, Safety and Environment general specifications) of CONTRACT.

3.3. Seismic vessel(s) navigation

Number and type of radars	1 x Furuno FCR 28378 S-Band, 1 x ARPA Furuno FAR 2827 X- Band
Type and frequency of echo sounder	Atlas DESO 35 : 12 KHz , 33 KHz , 210 KHz
Depth range of the echo sounder	6000m at 12 KHz
Type of current meter	Nortek

Type of speed log	Furuno

3.4. Seismic vessel(s) helideck

Helideck landing capacity:

Helicopter maximum weight	(Sikorsky S-61N / S-92)
Helicopter maximum dimensions	(Sikorsky S-61N / S-92)

Refer also to Exhibit A (Health, Safety and Environment general specifications) of CONTRACT.

3.5. Seismic vessel(s) auxiliary boats

type of work boat(s)	1x Westplast WP950SW
Number and type of mob (man over board) boat(s)	1 Norsafe Magnum 750

3.6. Safety equipment

Refer to Exhibit A (Health, Safety and Environment general specifications) of CONTRACT.

3.7. Support vessel(s) main characteristics

Vessel name	TBC
Vessel owner	
Flag	
Port of registry	
Registry number	
Type	
Classification	
Year built and year rebuilt	
Length LOA/LBP	
Maximum draft	

Cruising speed	
Endurance at sea	
Accommodation	

3.8. Support vessel(s) propulsion and power

Number and type of engines	
Power of each individual engine	

3.9. Support vessel(s) communications

Number and type of VHF units :	
Number and type of satellite communication links	
Type of safety and distress watch receiver	

Refer also to Exhibit A (Health, Safety and Environment general specifications) of CONTRACT.

3.10. Support vessel(s) navigation

Number and type of radars	
Type and frequency of echo sounder	

In case of shallow water survey only:

Type of RGPS	

3.11. Support vessel safety equipment

Refer to Exhibit A (Health, Safety and Environment general specifications) of CONTRACT.

3.12. Pre-assessment of the vessel (documentation required)

1	Independent FMEA Study of complete unit including control, engineering and electrical subsystems Hard copy of FMEA (latest version) should be submitted along with description of action list closeout response. This will be reviewed in detail. As a minimum, the vessel FMEA must meet following standards: • DP Class :IMO 645 & IMCA standards • Redundancy Class : Redundancy notation <u>FMEA shall include failure mode proving analysis of:</u> • Engineering auxiliaries • Electrical HV including single worst case HV failure • Electrical MV • Electrical LV • UPS systems • Cooling systems (generation and thruster systems) • Control and Service Air systems • Fuel systems • Lube systems • Thruster failure modes • Thruster auxiliaries • DP Control systems if fitted • Motion reference sensors, wind sensors & gyrocompasses if fitted • Satellite based reference systems including diff link failure modes if fitted • Communications methods • alert systems • Alarm printing methods (both DP and vessel management systems)
2	FMEA Proving trials report As a minimum, the vessel FMEA Proving trials must meet IMCA standards and include cause and effect proving analysis of: • Engineering auxiliaries • Electrical HV including single worst case HV failure • Electrical MV • Electrical LV • UPS systems • Cooling systems (generation and thruster systems) • Control and Service Air systems • Fuel systems • Lube systems • Thruster failure modes • Thruster auxiliaries • DP Control systems if fitted • Motion reference sensors, wind sensors & gyrocompasses if fitted • Satellite based reference systems including diff link failure modes if fitted • Communications methods • alert systems • Alarm printing methods (both DP and vessel management systems)
3	Annual trials for previous years Annual trials shall include tests which prove the failure modes in the following systems: • Engineering auxiliaries • Electrical HV including single worst case HV failure
	• Electrical MV • Electrical LV • UPS systems • Cooling systems (generation and thruster systems) • Control and Service Air systems • Fuel systems • Lube systems • Thruster failure modes • Thruster auxiliaries • DP Control systems if fitted • Motion reference sensors, wind sensors & gyrocompasses if fitted • Satellite based reference systems including diff link failure modes if fitted • Communications methods • alert systems

4	Performance capability and performance study for downgraded situation : Working and Survival speed VS Seismic drag effect • Power available Vs Power needed for different configurations (See chart template Document) and different conditions (Normal and degraded) • Load shedding philosophy • Black-out test result at different configurations (Open and Close bus bar)
5	Propulsion Incident reports and changes made as a result of cause analysis • The report shall include a description of the reporting philosophy in place.
6	Additional documentation such as: • Vessel control management (Power and heading and interface between) • Operations manual and onboard training schedules • Deck and ECR Pre-Operations and Periodical checklists proposed • Maintenance schedules covering well program period for critical equipments (Critical equipment list to be included)
7	Key personnel information • Resume / CV of the key marine personnel • Outline of onboard vessel familiarization and specific training required for new key DP personnel (Deck and Engine personnel) • Training Matrix for all crew

3.13. Pre-assessment of the performance of the vessel

- Each case to be filled in the form
- Worst case failure is defined as critical situation where the propulsion is degraded and minimum speed shall be maintained in order to prevent streamers to sink.
- Normal situation is defined when 100% of the propulsion is available and standard acquisition speed is to be kept.
- For acquisition (streamers) vessels: ○ The streamers simulation report shall be provided in support to this filled form, ○ In case of potential change of the streamers configuration e.g. fan mode, back-up design, a similar pre-assessment shall be submitted together with the associated streamers simulation report.

Load analysis Template - Diesel Electric propulsion - 2 bus					
	Case N°			**Example**	Asima
	Description			12 streamers x 6kms x 100m separation	12x8kmx100m
1	**Normal Situation**	Minimum speed	Kts	5	4.5
2		Drag Value	Tons	69	83
3		**Corresponding Propulsion power needed**	**Kw**	**12000**	6050
4	**Worst Case failure**	Minimum speed	Kts	3	3.5
5		Drag Value	Tons	40	50
6		**Corresponding Propulsion power needed**	**Kw**	**7000**	4060

7	Power Production @ 80% Load	BUS 1	Kw	8000	5160
8		BUS 2	Kw	8000	5160
9	Power need (except Propulsion)	Hotel Loads BUS 1	Kw	500	800
10		Hotel Loads Bus 2	Kw	300	800
11		Auxiliaries and Seismic Equipment BUS 1	Kw	1000	250
12		Auxiliaries and Seismic Equipment BUS 2	Kw	300	250
13	Max Propulsion Power available =Power production - Power need	BUS1	Kw	6500	3750
14		BUS 2	Kw	7400	3750
15	**Balance and result Green - Satisfactory Red - Not satisfactory**	**Balance at Normal condition (Kw remaining)**	**Kw**	**1900**	1450
16		**Balance at Worst Case Failure Bus 1 off**	**Kw**	**-500**	-310
17		**Balance at Worst Case Failure Bus 2 off**	**Kw**	**400**	-310

4 Seismic source

4.1. Source characteristics

Type of seismic source	Bolt Gun
Number of sources	1 source
Volume of individual source	TBC
Number of sub-arrays per individual source	
Volume of individual sub-arrays	
Length of individual sub-array	
Width of individual sub-array	

Refer also to the following:

- Type, model and volume of individual guns described in Annexe 1 (Individual gun sub-array composition) of this Exhibit.

- Separation, location of individual guns, detailed geometry of clusters, locations of near-field hydrophones, depth sensors and positioning devices, etc... displayed in Fig. 1 (Seismic source geometry) and Fig. 2 (Individual sub-array geometry) of this Exhibit.
- Time display and amplitude spectrum of source signatures displayed in Fig. 3 (Source signature modelled with standard parameters) and Fig. 4 (Source signature modelled with SURVEY acquisition parameters) of this Exhibit. The standard parameters are defined as: 0-128 Hz bandwidth, 6 m source depth and 2000 psi operating pressure.
- Source directivity diagrams, in line and cross line displayed in Fig. 12 of this Exhibit.
- Dropout specifications for proposed source array displayed in Fig.13 of this Exhibit

4.2. Compressor, sensor and peripheral equipment characteristics

Number, type and capacity of each air compressors	3 x LMF; 1800 cfm each
Minimum refilling time with survey parameters	6.5 seconds (using two compressors for 4240in³ array)
Type and number of devices used to achieve source geometry (deflectors, booms, tie ropes, etc)	2 x Baro 46
Maximum distance between source outer gear and source centre	Sub array separation is 7m
Type of floats sustaining the sub-arrays	Flexible
Type, number and location of near-field hydrophones	AGH 7000, 1 per gun plate
Nearfield hydrophone signal real time display	Yes, available via Gunlink 4000
For multiple vessel operations, means to transmit nearfield signals to master vessel	N/A
Type, number and location of depth sensors (depth controller)	AGH 7000, 1 per gun plate
Type, number and location of air pressure sensors	AGH 7000, 1 per gun plate
Real time visualization of depth sensor values and air pressure sensor values	Yes, available via Gunlink 4000
Data recording of depth sensor and air pressure sensor values	Yes
Characteristics of firing control unit	GunLink 4000
Time delay between start of record and source blast	50ms
Source steering system description	Not available for this project

Refer also to Fig. 5 (Timing diagram of shooting and recording sequence) of this Exhibit.

4.3. Seismic source spare equipment

	Sufficient spares carried onboard to maintain source array and components

5 Seismic recording system

5.1. Seismic recorder characteristics

Type and model of seismic recording system	Sercel SEAL 24-Bit
Analog/digital conversion technology	24-bit Sigma/Delta Individual A/D converter per channel
Recording system overhead cycle time	O sec. 700ms overlap is theoretically possible but will result in a system alarm.
Available sampling rates	0.25ms, 0.5ms, 1 ms , 2 ms, 4 ms
Available low-cut filters	Analog 2 Hz + user selectable Digital in 0.1 Hz increments from 2 Hz to 15Hz, 12dB/octave
Available high-cut filters	0.8 FN (Linear or Minimum Phase)
Maximum number of channels	12 x 480
Dual recording	Yes
Recording format	SEGD
Recording media	IBM 3592

Refer also to Fig. 6 (Amplitude and Phase Spectrum of the seismic recorder filters) of this Exhibit:

5.2. Streamer characteristics

Type and model of streamer	Sentinel II Solid
Type and characteristics of skin	Polyurethane
Maximum available number of streamers in operation per vessel	12
Maximum number of channels available per streamer	480
Number of traces per section	96
Trace interval	12.5m
Trace length	12.5
Trace sensitivity	19.73 V/Bar
Number of sensors per trace	8
Type and location of built-in depth sensors (independent of depth controllers)	N/A
Maximum distance between built-in depth sensors	300m (in Digicourse 5011 birds)
Calibration mode of depth sensors	Manufacturer calibration
Type and location of waterbreak hydrophones	N/A

Location of communication coils for externally mounted equipment	24.2m and 124.2m from head of section
Maximum distance between depth controllers	300m
Calibration mode of depth controllers	Manufacturer calibration
Available calibrated streamer sections (age, number)	640 sections (12 x 8km) + spares. New in 2010
Minimum achievable in line distance source centre to near trace centre	~125m approx
Maximum achievable distance source centre to far trace centre	~6125m
Spare parts, contingency for replacement or repair	Minimum of 12 x 8100m + 10-20% spares carried onboard

Refer also to the following figures of this Exhibit:

- Fig. 7 (Vessel, source and streamer geometry) displaying the source and streamer offsets relative to the vessel
- Fig. 8 (Front streamer configuration) displaying the configuration of near-trace offsets, lead-ins, front end stretch sections, first active sections, deflecting devices, etc
- Fig. 9 (Tail streamer configuration) displaying the configuration of last active sections, tail stretch sections, tail-buoys, etc
- Fig. 10 (Streamer active section configuration) displaying the configuration of traces, waterbreak hydrophones if any, built-in depth sensors, depth controllers and sensors, acoustic units, digitising units, power supply units, compasses if any, etc
- Fig. 11 (Seismic trace configuration) displaying the location and weighting of hydrophones

Sensor (hydrophone and/or geophone) characteristics:

<table>
<tr><td>Type of hydrophone</td><td>Sercel Flexible Hydrophone</td></tr>
<tr><td>Hydrophone physical and mechanical characteristics (maximum pressure allowed, etc)</td><td>
<table>
<tr><th>Category</th><th>Performance</th></tr>
<tr><td>Operating temperature</td><td>–10°C to +50°C</td></tr>
<tr><td>Storage temperature</td><td>–40°C to +50°C</td></tr>
<tr><td>Survival depth</td><td>250 m</td></tr>
<tr><td>Capacitance change with temperature</td><td>0.5% per degree C</td></tr>
<tr><td>Sensitivity change vs. depth</td><td>less than 1 dB over operational depth</td></tr>
<tr><td>Sensitivity change vs. temperature</td><td>less than 1 dB over operational temperature</td></tr>
<tr><td>Acceleration sensitivity</td><td>less than –65 dB referenced to 1 V/g</td></tr>
<tr><td>Total harmonic distortion</td><td>less than –65 dB referenced to 1 V/µPa</td></tr>
<tr><td>Lowest mechanical resonance</td><td>2.5 kHz</td></tr>
<tr><td>Frequency response</td><td>±0.5 dB from 2 Hz to 500 Hz</td></tr>
<tr><td>Dow Corning 200(R) fluid volume</td><td>0.062 litre</td></tr>
</table>
</td></tr>
<tr><td>Hydrophone electronic characteristics</td><td>As Above</td></tr>
<tr><td>Hydrophone sensitivity</td><td>As Above</td></tr>
<tr><td>Type of geophone</td><td>N/A</td></tr>
<tr><td>Geophone physical and mechanical characteristics (maximum pressure allowed, etc)</td><td>N/A</td></tr>
<tr><td>Geophone electronic characteristics</td><td>N/A</td></tr>
<tr><td>Geophone sensitivity</td><td>N/A</td></tr>
</table>

Characteristics of special units located inside the active sections:

Power supply units	N/A
Digitising units	N/A

Characteristics of streamer modules:

Head and terminator modules	Head Auxiliary Unit and Head Auxiliary Power Unit (HAU and HAUP). Tail Auxiliary and Power Unit (TAPU)
Electronic and connector modules	Line Acquisition Unit Marine (LAUM)

5.3. Peripheral equipment characteristics

Type and mechanical characteristics of lead-in	Sercel Fibre Optic Armoured Tow Lead-in
Type and characteristics of depth controllers	ION DigiBird model 5011
Number, type and characteristics of streamer deflectors	2 x Mode 37
Maximum lateral distance streamer deflector to outer streamer	Partner Plase 800 Litre Partially solar powered
Type and characteristics of active tailbuoys	Sercel Fibre Optic Armoured Tow Lead-in
Steamer tension meter type, real time display and data recording	The streamer tension is logged by the first streamer module (HAU module) situated approximately 40m from the lead-in. There are two tension values logged by the HCU in 5 second intervals; peak value and average value. The values are available real time and history available through the Seal user interface. File is logged to disk so it can be exported as text file for further analyses.
Type and location of streamer steering devices, control software	DigiFIn , 200 m but Polarcus will confirm the final spread in combination with Total requirements

5.4. Seismic recording spare equipment

	Sufficient spares carried onboard to maintain recording equipment and components

6 Seismic data quality control

Main characteristics of the processing system installed onboard:

Type and model of workstation	3 x HP Z420 desktops 2 x High performance processing workstations 4 x 30" monitors for Real Time QC displays
Operating system	Linux
Main hardware characteristics	**Lustre File System** • Lustre is a high performance, clustered, highly-available global file system that is used by the largest supercomputers in the world. • Amalgamates the capacity and performance of an arbitrary number of storage servers (8 in the offered solution) into a single file system. • Capacity and bandwidth can be increased by adding more live servers, meaning there is no downtime to increase capacity or bandwidth. • Easy to manage and fault-resilient.
Seismic processing software	DUG Insite
Version number	4 - Developed and Tailored Exclusively for Polarcus onboard processsing
Main processing capabilities	**Compute Cluster** 20 nodes, each with: • 2 x Xeon Ivy Bridge • 4x Intel Phi Co-processors • 128 GB RAM Computing power onboard one vessel - 172 TFLOPS
Online seismic data capture	Yes, via Argus
Hard disk storage type and capacity	**Storage Cluster** 84 x 4TB drives, RAID 6, 1.4GB/s aggregate bandwidth

Refer also to Annexe 13 (Seismic data quality control description and examples) of this Exhibit.

7 Source and receiver positioning

Refer to annexe 16 (Source and receiver positioning detailed description) and annexe 14 (Positioning data quality control description and examples) of this Exhibit.

Annexe 16 will:

- detail the systems and processes used to: ○ calculate source and receiver positions within specifications ○ record source and receiver positions
  - ○ record raw positioning data
  - ○ ensure that source and receiver actual positions will match preplot positions within specifications
- list contractor proposed positioning specifications

8 DGPS

Refer to the following:

- Annexe 2 (DGPS description) of this Exhibit.
- Annexe 3 (DGPS reference and monitor station description) of this Exhibit, detailing name, description, co-ordinates, distance and azimuth from prospect of all DGPS monitor and reference stations.

8.1. Primary DGPS

8.1.1 DGPS characteristics

Name of system	Fugro HP
Type of system	DGPS
Manufacturer	Fugro
Contractor	Fugro

8.1.2 Vessel installation

Receiver type	Integrated L1/L2 Dual frequency GPS carrier phase correction data from Fugro's network of reference stations and completely independent from SkyFix-XP
Number of channels	NA
Firmware version	TBC
Computer	TBC
Software and version	TBC
Differential correction transmission	INMARSAT, RTCM SC104
Mobile operator	Polarcus
Spare parts, contingency for replacement or repair	20% spares carried onboard vessel

8.1.3 Shore installation

Shore support	Fugro	
DGPS monitor station	Globally Corrected	

DGPS network control centre	TBC	
For each reference station	N/A (Globally corrected)	
Name	N/A	
Receiver type	N/A	
Number of channels	N/A	
Firmware and version	N/A	
Computer	N/A	
Software and version	N/A	
Power supply	N/A	
Spare parts, contingency for replacement or repair	N/A	
(add rows as necessary)		

8.2. Secondary DGPS

8.2.1 DGPS characteristics

Name of system	Fugro G2 SkyFix G2	
Type of system	DGPS	
Manufacturer	Fugro	
Contractor	Fugro	

8.2.2 Vessel installation

Receiver type	Integrated L1/L2 dual GPS and GLONASS positioning system that is based on orbit and clock correction generated from Fugro's own expanded network of dual system reference stations	

Number of channels	NA	
Firmware version	TBC	
Computer	TBC	
Software and version	TBC	
Differential correction transmission	INMARSAT RTC< SC104	
Mobile operator	Polarcus	
Spare parts, contingency for replacement or repair	10-20% spares carried onboard vessel	

8.2.3 Shore installation

Shore support	Fugro
DGPS monitor station	Globally Corrected
DGPS network control centre	TBC
For each reference station	N/A (Globally corrected)
Name	N/A
Receiver type	N/A
Number of channels	N/A
Firmware and version	N/A
Computer	N/A
Software and version	N/A
Power supply	N/A

Spare parts, contingency for replacement or repair	N/A
(add rows as necessary)	

8.3. Tertiary DGPS

Article to be deleted, if necessary. **8.3.1 DGPS characteristics**

Name of system	
Type of system	
Manufacturer	
Contractor	

8.3.2 Vessel installation

Receiver type	
Number of channels	
Firmware version	
Computer	
Software and version	
Differential correction transmission	
Mobile operator	
Spare parts, contingency for replacement or repair	

8.3.3 Shore installation

Shore support	
DGPS monitor station	
DGPS network control centre	

For each reference station	
Name	
Receiver type	
Number of channels	
Firmware and version	
Computer	
Software and version	
Power supply	
Spare parts, contingency for replacement or repair	
(add rows as necessary)	

9 RGPS

Type and manufacturer	BuoyLink, SEAMAP LTD
Source(s)	1 per gun-string
Float(s) or front buoys	If requested
Tailbuoys	1 per tailbuoy
Software and version	TBC
Hardware	TBC
Telemetry link front (gun), float(s)	Radio
Telemetry link tailbuoys	Radio
Spare parts, contingency for replacement or repair	10% - 20% carried onboard

Refer also to annexe 4 (RGPS description) of this Exhibit.

10 Heading sensors

10.1. Gyro-compass

Type and manufacturer	Anschutz, Standard 22, 22 GG-R / GGM-R
Calibration equipment	TBC
Spare parts, contingency for replacement or repair	Backup Gyro

Refer to Annexe 7 (Gyro-compass description) of this Exhibit.

10.2. Back-up gyro-compass

Type and manufacturer	Anschutz, Standard 22, 22 GG-R / GGM-R
Calibration equipment	TBC
Spare parts, contingency for replacement or repair	Backup Gyro

10.3. GPS based heading and attitude sensor

Type and manufacturer	N/A
Software and version	
Hardware	
Calibration equipment	
Spare parts, contingency for replacement or repair	

Refer to Annexe 8 (GPS heading sensor description) of this Exhibit.

11 Streamer compasses

Type and manufacturer	ION 5011
Calibration method	Onboard Calibration
Spacing	Every 300m (minimum)
Number per streamer and distribution	Deployment dependant
Batteries	Lithium

Magnetic variation model	TBC
Spare parts, contingency for replacement or repair	10% - 20% carried onboard

Refer also to Annexe 9 (Streamer compass description) of this Exhibit.

12 Bathymetry

12.1. Echo sounder

Type and manufacturer	Kongsberg EA 600
Transducers, frequencies	12 KHz , 38 KHz , 200 KHz
Depth range	0 – 6000 m
Calibration equipment	TBC
Spare parts, contingency for replacement or repair	Min 20% spares carried onboard

Refer also to Annexe 10 (Echo sounder description) of this Exhibit.

12.2. Sea water speed of sound, temperature and salinity meter

Type and manufacturer	Valeport Midas SVX2
Depth range	1,2,4 or 8Hz
Calibration equipment	TBC
Spare parts, contingency for replacement or repair	10% - 20% spares carried onboard

Refer also to Annexe11 (sea water temperature and salinity meter description) of this Exhibit.

12.3. Bathymetry data processing

Refer to Annexe18 (bathymetry processing description) of this Exhibit. The annexe will describe:

- how the echosounder data is processed
- how the tide is measured or predicted and how it is used to correct the bathymetry data

13 Integrated navigation system

Refer to Annexe 12 (Integrated navigation system description) of this Exhibit.

13.1. Online integrated navigation system

Type and manufacturer	ION ORCA INS

Software and version	ORCA Ver 1.7.1
Hardware	Dell Servers (4 Orca severs) + 5 orca display servers and Bridge machine

13.2. Offline integrated navigation system

Type and manufacturer	ION Sprint
Software and version	Sprint Ver 4.3.8
Hardware	TBC
Network analysis software	Sprint

14 System timing

Refer to Annexe 20 (system timing) of this Exhibit. The annexe will describe the method and systems used to synchronise source, recording and positioning across all the seismic fleet and seismic systems.

15 Seismic processing equipment and software

Type and manufacturer	Linux
Characteristics	As below

Hard disk storage	System: DUG Insight 3 Linux CPU Available: 172 TFlops 20 nodes, each with: • x Xeon Ivy Bridge • 4x Intel Phi Co-processors • 128 GB RAM Operating System: Linux Tape Drives: 2 x IBM T1140 (E07) drives, 4TB max tape capacity with 3592 JC/JY tape cartridges 4 x IBM T1130 (E06) drives with T1120 (E05) emulation option – 500GB with 3592JA media. Available Disk Space: 84 x 4TB drives, RAID 6, 1.4GB/s aggregate bandwidth Monitors: 6 Spares Equipment: sufficient spares available Processing Software: Dug Insite 3
(add rows as necessary)	

16 Quality control attribute database

Refer also to Annexe19 (Quality control attribute database) of this Exhibit. The annexe will describe:

- typical list of attributes gathered by contractor
- format of attribute files
- software used to graph and map attributes

17 Gravimetry data acquisition equipment

Article to be deleted, if necessary.

Type and manufacturer	

Characteristics	
(add rows as necessary)	

18 Magnetometry data acquisition equipment

Article to be deleted, if necessary.

Type and manufacturer	
Characteristics	
(add rows as necessary)	

19 Additional and optional EQUIPMENT

Article to be deleted, if necessary.

19.1. Additional EQUIPMENT

Type and manufacturer	
Characteristics	
(add rows as necessary)	

19.2. Optional EQUIPMENT

Type and manufacturer	
Characteristics	
(add rows as necessary)	

Figures

Fig. 1 Seismic source configuration
Fig. 2 - Individual sub-Array configuration
Fig. 3 - Seismic Source Signature (modelled with standard parameters)
Fig. 4 - Seismic Source Signature (modelled with SURVEY parameters)

Annexes

APPENDIX I TEPM's Grievance Procedure

SCOPE SUMMARY:

This document sets an official channel for recording and processing grievances expressed by local community towards TEPM. It identifies the principal stakeholders, and describes the responsibilities of each and everyone.

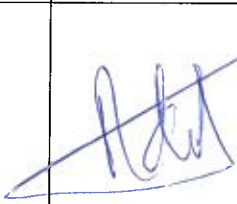
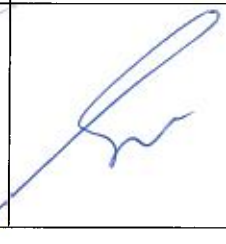
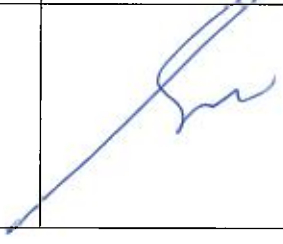
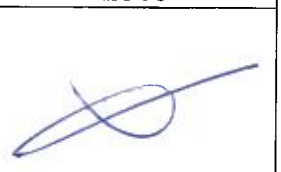
REVISION PURPOSE:

Revision Number	Purpose of update
03	Precise the difference between grievances and issues, modify the members of the grievance management board, functionality of mediation committee and small other modifications.

DOCUMENT DISTRIBUTION:

Original :	CSR
Copies to:	GM, DO, DOFM, DS, DA, OK, KPL, FI, National Program coordinator

APPROVAL:

	Prepared by:	Checked by:	Validated by:	Approved by:
Name	Marie-Alix du Laz	Swe Swe Win	Swe Swe Win	Xaviel Preel
Function	Kanbauk Program Leader	CSR Manager	CSR Manager	General Manager
Date	10 September 2015	10 September 2015	10 September 2015	10 September 2015
Signature				

PURPOSE AND SCOPE

In the course of its activities, TEPM is committed to establish and maintain a permanent dialogue with local communities, in order to build relationship of mutual trust.

The purpose of this grievance procedure is to establish a formal process allowing local communities to raise complaints related to the perceived impacts of TEPM activities, its contractors and/or their employees (behavior..) within the limits of Myanmar Laws and Regulations and these complaints to be addressed and resolved in a timely manner.

This procedure does not cover:

- Requests for local development project supports submitted by local communities, which are addressed by the CSR department;
- Grievances expressed by TEPM employees and related to their employment with the Company;
- Grievances expressed by TEPM contracted staff and related to their employer, which shall be addressed through discussion and negotiation with their employer;
- Grievances between third parties (between a villager and local authorities for instance);
- *Issues* (see definition below).

Using this grievance mechanism does not prevent the complainant to use other legal channels, like filing an official complaint against the company.

The Company may seek legal assistance in case an official complaint is filed in court, as well as for any serious incident reports related to the activities of the affiliate.

REFERENCE DOCUMENTS

CR EP HSE 130 – Integrating societal concerns into E&P activities
Code of Conduct
TEPM External Stakeholder Consultation Plan – Pipeline area

DEFINITIONS

A complainant is the issuer of a complaint. He/She is defined as a stakeholder, as far as he/she feels he/she is impacted by the activities of the company or/and its contractor or of its employees. The complainant can be an individual or a group of people.

A Grievance is defined as a statement made by an individual or a group of persons who feel he/they are facing a disturbance, regarded as ground for complaint, and request a corrective action. It is different from an *issue.*

Issue*: An issue is* defined as a concern raised by the local communities on a perceived negative impacts related/or supposed to be related to TEPM activities. Issues management is described in the stakeholder consultation plan. CSR Department will meet the concerned local community member(s) to solve the issue. If a solution cannot been found quickly and easily the issue will be upgraded to a grievance.

RESPONSIBILITIES

Community Liaison Officer (CLO)

TEPM Community Development Supervisor (in the pipeline area) / National Program Coordinator (in Yangon) within the CSR department acts as Community Liaison Officer (CLO). The CLO is one of the key contact points between the company and the villagers.
His/her responsibilities are the following:

- Conduct information campaigns about the grievance procedure, in a way easily understandable by local communities, and relevant to the local culture. He/she stresses that all information shared by the complainant shall remain confidential[1], unless the complainant authorizes them to be shared and states that the process is free of charge.
- Assist the stakeholders in the implementation of their complaints, illustrate (if needed) the object of the complaint by pictures,
- Record complaints in a database/software, keep a physical record and answer the complainant by acknowledging reception of the grievance.
- Propose a solution, in case the grievance can be solved by an immediate action
- Keep a high level of dialogue with the complainant till the resolution of the problem, and inform him/her of the ongoing actions.
- Prepare a yearly Grievances Analysis Report, analyzing the number of grievances and comparing the trends with the previous years.
- Inform MOGE Representative on a regular basis

[1] *Importance to keep all information confidential shall be stressed as a key feature of the procedure to the CLO, as well as to all stakeholders involved in the different steps described in this procedure.*

Grievance Management Board (GMB)

The Kanbauk Program Leader (KPL) and PLC Site Manager (in pipeline area) / The CSR Manager and HR and Admin. Manager (in Yangon) act jointly as the Grievance Management Board.
Responsibilities of the management board are the following:

- It meets with the stakeholders to investigate the case.
- It proposes a solution within two weeks following reception of the complaint.

Decisions of the GMB are made by discussing till reaching a satisfactory solution.

Grievance Management Internal Committee (GMIC)

In case of appeal of GMB decision by the complainant, a session of the Grievance Management Internal Committee is called by the General Manager within one month. The committee is composed of DG (chairman of the committee), CSR, DOFM, DS, DA, OK, FI, KPL, as well as representatives of the involved contractor in case the grievance is related to a contractor's activities.
Responsibilities of the committee are the following:

- To review the case
- To propose a solution.

Mediation Committee (MC)

In case of an appeal of GMIC's decision by the complainant, a Mediation Committee can be established within one month. Main responsibilities of the MC are to review the case and to propose a solution. Being opened to external stakeholders (community representatives, NGOs, ombudsman...) the Mediation Committee allows a consensual decision, likely to be acceptable by all stakeholders. Its members are designated, according to the case, among the stakeholders listed below but not limited to:

- Company representatives
- MOGE representative
- Contractor's representatives if needed
- The complainant, his/her representative, or representatives of concerned populations
- Representatives of the local authorities
- Representative from Village Communication Committee of the village where the grievance arises
- A mediator or an ombudsman[2]
- If needed, representatives of NGOs specialized in the topics discussed, as well as village patrons.

[2] *An Ombudsman/Ombudsperson assists with the fair and expeditious resolution of complaints in an impartial, confidential and independent manner. Ombudsman seeks informal resolutions to complaints using tools like mediation, negotiation and shuttle diplomacy. In some settings they conduct more formal investigations to determine whether a complaint is founded and may make recommendations to correct unfair situations, both in individual cases and to address systemic issues. In other settings Ombudsman help resolve complaints through advice, referral and discussion and by evaluating available options. Most ombudsman look for trends and patterns in complaints so they can identify and address potential systemic issues and seek system-wide improvements.*

GRIEVANCE PROCESS

The stakeholders involved in the process shall follow the steps described below:

- 1st step: Grievance can be expressed by complainants by different means, either by submitting a letter, either by informing orally TEPM staff. Any grievance expressed to any TEPM staff shall be reported without delay to CLO.

- 2nd step: In case a complaint is raised, CLO meets the complainant,
  - CLO asks the complainant to write down its complaint, offering its assistance if required[3].
  - In case the impact underlined is ascertained and can be solved by an immediate response, CLO implements the correction after expressing apologies from the Company. In this case, a complaint is opened, and immediately closed[4].
  - In case a complaint is not receivable (because motivated by reasons non acceptable, doubtful or unreliable), or when it is caused by a lack of information about the activities of the company, CLO explains his refusal and delivers explanations to the complainant[5]. It is important that reasons for not receiving the complaint get understood by the complainant, and that a delay is given to him in order to appeal this decision within 5 days.
  - In case a complaint is related to the activities of another company or a third party, CLO clarifies the fact with the complainant, and forward the grievance to the concerned company or a third party through KPL (and CSR in case of Yangon). Complainant shall be informed of the process and shall be encouraged to work directly with the company or a third party concerned[6].

- 3rd step: CLO records the complaint in the database/software and forwards it to the Grievance Management Board.

- 4th step: GMB meet (or designate someone to meet) with complainant and discuss thoroughly with him, in the spirit of finding a solution that would address his/her grievance. Then, GMB proposes a solution and expresses apologies from the Company If appropriate.

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[3] *In case the complainant doesn't know how to read and write, a person designated by the complainant checks the information described in the complaint. In order to formalize the document, a signature or any other distinguishing feature of the complainant (finger print, picture done during the complaint filling…) and of the person designated by the complainant shall be affixed on the document together with the signature of CD Supervisor.*

[4] *A case is closed when the Company has addressed the grievance, through the different means described in this procedure, with the intention of reaching an agreement with the complainant. In case the process is successful, closure is formalized by a document referring to the history of the case, where both parties acknowledge having reached an agreement satisfying them. In case the complainant does not accept any of the propositions made by the Company to address his/her grievance, closure is formalized through a document referring to the history of the case, where the complainant acknowledges having been proposed with solutions, but expresses not finding them satisfactory.*

[5] [6] *Even so, the complaint shall be recorded in the database, categorized as "issues"*

- 5th step:
  - If the solution proposed to the complainant by the GMB is accepted by the complainant, the case is closed.
  - If the solution is not accepted, GMB explains the next step to the complainant and request a session of the GMIC, which proposes solutions.
- 6th step: CLO presents to the complainant the solutions proposed by the GMIC.
- 7th step: In case the solution is not approved, GMIC calls for a session of the Mediation Committee.
- 8th step: CLO shares the conclusions of the Mediation Committee with the complainant.
- 9th step: The case is closed or go to legal proceeding.

Process and stakeholders of the grievance mechanism