SHELL MYANMAR ENERGY PTE LTD

ANDAMAN SEA BLOCK MD-5 EXPLORATION SURVEY PROGRAMME

INITIAL ENVIRONMENTAL EXAMINATION (IEE)

FEBRUARY 2017
Update of July 2016 version

Report completed by IEM and Jacobs

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No. 99C-1, U Aung Kane Lane
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Yangon, Myanmar

Ministry of Natural Resources and Environmental Conservation
Office No.(53), Ottrathiri Township
Nay Pyi Taw, Myanmar

Attn: Director General
Environmental Conservation Department

20 February 2016

Reference: SM 0717

Re: Initial Environmental Examination (IEE) Report in respect of the Offshore Exploration Survey Programme for Offshore Deepwater Block MD-05, and the associated Environmental and Social Management Plan (ESMP).

Dear Sir,

We refer to the captioned IEE, which was prepared and finalized on behalf of Shell Myanmar Energy Pte Limited (SMEPL) by our specialist consultants JACOBS with support from International Environmental Management (IEM) and local specialists Environmental Quality Management (EQM) Myanmar in accordance with the Environmental Conservation Law (2012), Rules (2014) and the EIA Procedures and under the guidance of the Ministry of Natural Resources and Environmental Conservation. The IEE Report and the associated ESMP were formally submitted to Myanmar Oil and Gas Enterprise (MOGE) on 16th July 2015.

SMEPL has provided all of the technical input relating to the details of the proposed activities in Block MD-05 to the consultants for the IEE. The proposed activities include a 3 dimensional seismic survey programme to be executed under a contract with Polarcus as well as a controlled source electromagnetic (CSEM) survey (not yet contracted), and in this context SMEPL can:

a. Endorse and confirm to Ministry of Natural Resources and Environmental Conservation the accuracy and completeness of the IEE;

b. Confirm and undertake to Ministry of Natural Resources and Environmental Conservation that the IEE has been prepared in compliance with applicable Environmental Conservation Law, Rules and EIA Procedures; and

c. Confirm and undertake to Ministry of Natural Resources and Environmental Conservation that SMEPL and their Survey Contractors during the execution of the Project will at all times comply fully with: the commitments, mitigation measures and plans set out in the ESMP contained in the IEE.

The undersigned is authorised to issue this Letter of Endorsement on behalf of SMEPL.

Your faithfully,

Name: John D Field
Title: Venture Lead
Shell Myanmar Energy Pte Ltd

၁ အနှစ်ချုပ်

၁.၁. မိတ်ဆက်

အက်ဒမန်ပင်လယ် အတွင်းရှိ ကမ်းလွန်လိုင်စင် MD-5 လုပ်ကွက်ဧရိယာအတွင်း ပြုလုပ်ဆောင်ရွက်မည့် လုပ်ငန်းဆောင်ရွက်မှုများနှင့်စပ်လျဉ်း၍ အကျိုးသက်ရောက်မှုတိုင်းတာထားသောပင်လယ်ကြမ်းပြင်မြေတိုင်းအစီရင်ခံစာကို ရေးသားပြုစုထားပါသည်။ ယင်းလုပ်ကွက် သည် ပုံ ၁.၁ တွင်ဖော်ပြထားသည့်အတိုင်း မြန်မာ့ကမ်းလွန်ရေနက်ပိုင်းတွင်တည်ရှိပါသည်။

၂၀၁၅ ခုနှစ် ဖေဖော်ဝါရီလ ၅ရက်နေ့တွင် Shell Myanmar Energy Pte Ltd (ဤအစီရင်ခံစာတွင် ယင်းအမည်ကို Shell ဟုသုံးနှုန်းသွားမည်) နှင့် ၎င်း၏ စီးပွားဖက်ကုမ္ပဏီဖြစ်သော Mitsui Oil Exploration Co. Ltd. Group (MOECO) တို့နှင့် ပြည်ထောင်စုသမ္မတမြန်မာနိုင်ငံတော် မြန်မာ့ရေနံနှင့်သဘာဝဓာတ်ငွေ့လုပ်ငန်း (MOGE) တို့အကြားချုပ်ဆိုသော ရေနက်ကမ်းလွန်ရှိ လုပ်ကွက် AD-9, AD-11 နှင့် MD-5 တို့အတွက် ရေနံရှာဖွေရေးနှင့် တူးဖော်ထုတ်လုပ်ရေးဆိုင်ရာ ပူးပေါင်းစာချုပ် (PSC) များကိုချုပ်ဆိုခဲ့ပါသည်။ ယင်းသို့ချုပ်ဆိုခြင်းက မြန်မာနိုင်ငံတွင် Shell Group ပြန်လည်ရောက်ရှိလာပြီး ရေနံနှင့် သဘာဝဓာတ်ငွေ့တူးဖော်ထုတ်လုပ်ရေး ပြန်လည်လုပ်ကိုင်မှုအား ထင်ရှားစေသည်။

အထက်ပါ PSC စာချုပ်များတွင် ပါဝင်သည့် တူးဖော်ရှာဖွေထုတ်လုပ်မှုများကို ဆောင်ရွက်ရမည့် Shell သည် ယင်းစာချုပ်များ အရ လုပ်ကွက်အတွင်း ရေနံနှင့် သဘာဝဓာတ်ငွေ့တူးဖော်မှုများကို ဆောင်ရွက်ရမည်ဖြစ်သည်။ ထို့ကြောင့် MOGE ၊ Shell ၊ MOECO တို့၏ကိုယ်စား Shell က လုပ်ကွက် MD-5 အတွင်းတွင် တူးဖော်ရေးဆိုင်ရာဆန်းစစ်လေ့လာမှုတစ်ရပ်ကို ဆောင်ရွက်ရန်အတွက် အဆိုပြုပါသည်။ လုပ်ကွက် MD-5 ၏ ဧရိယာအကျယ်အဝန်းမှာ ၂၄၅၂ စတုရန်းမိုင် သို့မဟုတ် ၆၃၅၀.၆၅ (၆၅ စတုရန်းကီလိုမီတာ) စတုရန်းကီလိုမီတာ အကျယ်အဝန်းရှိပါသည်။ လုပ်ကွက်၏ အရှေ့ဘက်နယ်နိမိတ်မှာ တနင်္သာရီတိုင်းဒေသကြီး၊ မြိတ်ခရိုင်၊ ကျွန်းစုမြို့အနောက်ဘက် ကမ်းရိုးတန်းမှ ၂၃၀ ကီလိုမီတာနီးပါး နှင့် မြန်မာ့ကမ်းရိုးတန်းပေါ်ရှိ တနင်္သာရီတိုင်း၊ မြိတ်ခရိုင်၊ ကျွန်းစုမြို့နယ်ရှိ Great Western Torres ကျွန်းအနောက်ဘက် ၁၂၀ ကီလိုမီတာနီးပါးအကွာအဝေး အသီးသီးစီတို့တွင်ရှိသည်။

တင်ပြထားသော ပင်လယ်ကြမ်းပြင်မြေတိုင်းအစီအစဉ်တွင် ၂၀၁၅ ခုနှစ် အထောက်အကူပြုရေယာဉ်ငယ်၏ အကူအညီဖြင့် ရေနံရှာဖွေရေးသင်္ဘော တစ်စီးမှ ဆောင်ရွက်မည့် မြေတိုင်းလုပ်ငန်းပါဝင်မည်ဖြစ်ပြီး ယင်းမြေတိုင်းလုပ်ငန်းအား ၂၀၁၅ ခုနှစ် စတုတ္ထသုံးလပတ်ကာလ မှ ၂၀၁၆ ခုနှစ် စတုတ္ထသုံးလပတ်ကာလအထိဆောင်ရွက်ရန် စီစဉ်သတ်မှတ်ပြီးဖြစ်သည်။ မြေတိုင်းလုပ်ငန်းစဉ်သည် ပြင်းထန်သော ရာသီဥတုတွင် လုပ်ဆောင်နိုင်ခြင်းမရှိသဖြင့် ရာသီဥတု နှစ်ခုကျော်အောင် လေ့လာဆောင်ရွက်ခဲ့ရပါသည်။ လုပ်ကွက် MD-5 အတွက်ဆောင်ရွက်သော မြေတိုင်းလုပ်ငန်းတွင် ၂၆၈၀ စတုရန်းကီလိုမီတာ (၃၅၀၀ စတုရန်းကီလိုမီတာအထိ) နီးပါးရှိသော သုံးဖက်မြင် (3D) ပုံ ကမ်းလွန်ငလျင်ကြောအချက်အလက်များထက်ကျော်လွန်စွာ ရရှိသည့်အပြင် ရည်မှန်းထားသည့်အတိုင်း (၃၈၅ စတုရန်း ကီလိုမီတာခန့်ရှိသော) Controlled Source Electro-Magnetic (CSEM) မြေတိုင်းလုပ်ငန်းငယ်တစ်ခုကိုပါ ဆောင်ရွက်နိုင်ခဲ့သည်။ သုံးဖက်မြင် (3D) ပုံ မရသေးသည့်ကာလအထိ CSEM မြေတိုင်းလုပ်ငန်း၏ အတိုင်းအတာကို အသေးစိတ်သတ်မှတ်၍ မရနိုင်သေးသော်လည်း ၎င်း၏ လွှမ်းခြုံမှုဧရိယာမှာ သုံးဖက်မြင် (3D) ထက် သိသာစွာပိုမိုသေးငယ်မည်ဖြစ်ပါသည်။

Jacobs Group Pty Limited ၊ International Environmental Management Co. Ltd. (IEM) နှင့် Enviromental Quality Management Co. Ltd. (EQM) တို့အား လုပ်ကွက် MD-5 စီမံကိန်းအတွက် သဘာဝပတ်ဝန်းကျင်ဆိုင်ရာကနဦးလေ့လာဆန်းစစ် မှု (IEE) ကိုဆောင်ရွက်ဖို့ရန်နှင့် တစ်ပါတည်းဖြစ်သော သဘာဝပတ်ကျင်းစီမံခန့်ခွဲမှုစီမံကိန်းတစ်ခုကို ဖော်ဆောင်ရန် Shell နှင့် စာချုပ်ချုပ်ဆိုပြီးဖြစ်သည်။

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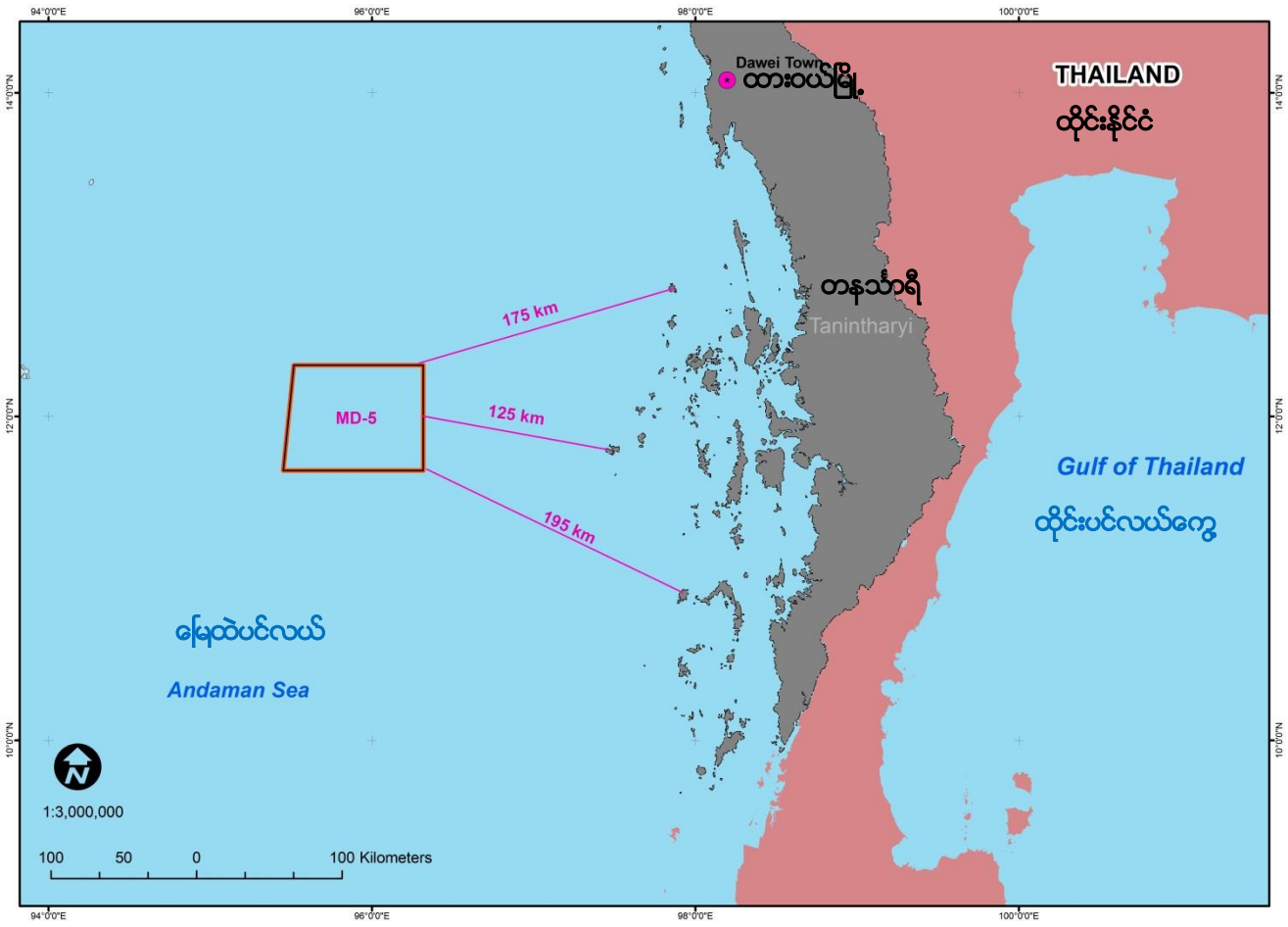


ပုံ ၁-၂ . လုပ်ကွက် MD-5 စီမံကိန်းတည်နေရာ

၁.၂ စီမံကိန်းဆိုင်ရာအသေးစိတ်အချက်အလက်များ

၁.၂.၁ သုံးသပ်ချက်

ဤရေနံရှာဖွေခြင်းလုပ်ငန်း၏ ရည်ရွယ်ချက်မှာ ပင်လယ်ကြမ်းပြင်အောက်ရှိ ဘူမိဗေဒအနေအထားများကို မြေပုံရေးဆွဲရန်၊ ဟိုက်ဒရိုကာဗွန်ရပ်ည့ွန်းများတည်ရှိနေနိုင်သည့်အလားအလာများကို ဆုံးဖြတ်ရာတွင်အထောက်အကူဖြစ်စေရန် ဖြစ်ပါသည်။ ငလျင်ကြောဆိုင်ရာသုံးဖက်မြင်ရေနံရှာဖွေခြင်း၏ နယ်နိမိတ်အကျယ်အဝန်းမှာ ၂၆၈၀ စတုရန်းမီတာ ကျော် (၃၅၀၀ စတုရန်းမီတာအထိ) ကျယ်ဝန်းပြီး CSEM ရေနံရှာဖွေခြင်းနှင့်တို့သည် လုပ်ကွက် MD-5 အတွက် PSC စာချုပ်အရ လိုအပ်သောရေနံရှာဖွေခြင်းလုပ်ငန်းရပ်များထဲတွင်ပါဝင်ပါသည်။ ရေနံရှာဖွေခြင်းလုပ်ငန်းရပ်များ ကို ရေအနက် ၂၁၀၀ မီတာ မှ ၂၆၀၀ မီတာအတွင်းတွင် ဆောင်ရွက်သွားမည်ဖြစ်ပါသည်။

3Dပုံရေအောက်ငလျင်မြေတိုင်းခြင်းကို ၂၀၁၅ ခုနှစ် နိဝင်ဘာလ သို့မဟုတ် ယင်းကာလလွန်ပြီး မကြာသောကာလတွင် စတင်ဆောင်ရွက်ရန် စီစဉ်ထားပါသည်။ ယင်း 3D ရေနံရှာဖွေခြင်းပုံပါကနဦးဒေတာ အချက်အလက်များကိုအသုံးချပြီး သတ်မှတ်ထားသော နေရာများကို အထူးပြုလေ့လာမည့် CSEM ရေနံရှာဖွေခြင်းလုပ်ငန်းရပ်များကို ၂၀၁၆ ခုနှစ်၏ တတိယသုံးလပတ် သို့မဟုတ် နောက်ဆုံးသုံးလပတ်အတွင်း ဆောင်ရွက်မည်ဖြစ်သည်။

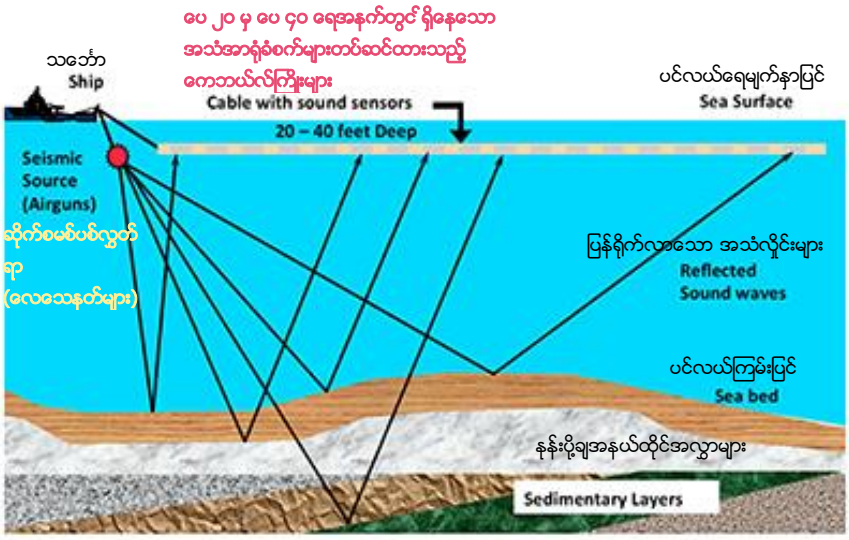
၁.၂.၂ 3D ရေနံရှာဖွေခြင်း

ရေနံရှာဖွေခြင်းလုပ်ငန်းစဉ်သည် ရေနံနှင့်သဘာဝဓာတ်ငွေတူးဖော်ရေးလုပ်ငန်းအတွက် မဖြစ်မနေလုပ်ဆောင်ရမည့် လုပ်ငန်းရပ်ဖြစ်ပါသည်။ရေအောက်ရေနံကြောလေ့လာတိုင်းတာရာတွင် အသံစွမ်းအင်ဆိုင်ရာသိပ္ပံပညာရပ်နှင့် ငလျင်ဗေဒ ပညာရပ်တို့ကို အသုံးချပြီး ပင်လယ်ရေအောက်ကြမ်းပြင်ရှိ ဘူမိဗေဒဆိုင်ရာဖွဲ့စည်းတည်ဆောက်ပုံများကို တိုင်းတာမြေပုံဆွဲသားခြင်းဖြစ်သည်။ စက်ကရိယာများကို ရေပေါ်တွင်ဆွဲသွားကာ အသံလှိုင်းများကို ရေအောက်သို့ဆက်တိုက်ပစ်လွှတ်ပါမည်။ ယင်းအသံလှိုင်းများက ရေထုကိုထိုးဖောက်ဖြတ်သန်းပြီး ပင်လယ်ကြမ်းပြင်ထဲသို့ ဝင်ရောက်သွားပါမည်။ ထို့နောက် ပြန်တက်လာသော အသံလှိုင်းများကို ဖမ်းယူသည့်စက် (Receivers) များဖြင့် ပြန်လည်ဖမ်းယူကာ ပြန်တက်လာသော လှိုင်းတစ်ခုချင်းစီ၏ အားနှင့် ပြန်တက်လာချိန်တို့ကို တိုင်းတာယူပါမည်။

ပြန်တက်လာသောလှိုင်းများကို ပေါင်းစည်းပြီး အီလက်ထရွန်နစ်နည်းပညာသုံးကာ အဓိပ္ပာယ်ဖွင့်ယူပါမည်။ ယင်းအချက်အလက်များမှတဆင့် ပင်လယ်ကြမ်းပြင်အောက်ရှိ ရေနံနှင့် သဘာဝဓာတ်ငွေ့အရိုင်းများခိုအောင်းနေနိုင်သည့် မြေသားထုများ၏ ဇောက်အနက် ၊ အနေအထား နှင့် ပုံပန်းသဏ္ဌာန်များဆိုင်ရာ အချက်အလက်များကို ရယူပါသည်။

ပင်လယ်ရေအောက်ရေနံရှာဖွေခြင်းလုပ်ငန်းရပ်များလုပ်ဆောင်နိုင်ရန်အတွက် ပုံမှန်အားဖြင့် ၇၅ မိတာမှ ၉၀ မိတာ အရှည်ရှိသည့် အထူးသင်္ဘောများအပြင် မြေတိုင်းအင်ဂျင်နီယာများ နှင့် ပညာရှင်များ၊ သင်္ဘောသားအဖွဲ့တစ်ဖွဲ့လိုအပ်ပါသည်။ ရေနံ ရှာဖွေခြင်းလုပ်ငန်းဆောင်ရွက်နေစဉ်ကာလအတွင်း ရေနံရှာဖွေရေးရေယာဉ်သည် ကြိုတင်သတ်မှတ်ထားသော ရှာဖွေရေး လမ်းကြောင်းအတိုင်းမောင်းနှင်ကာ အသံလှိုင်းများကို ပစ်လွှတ်လွှင့်ထုတ်ရန်အတွက် ရေအောက်စက်ကိရိယာ (လေသေနတ်များ ပါသည့် အဆိုင်းများ) များ၊ ရေအောက်တွင် အသံလှိုင်းများ၏ အကွာအဝေးနှင့် ဦးတည်ရာကိုတိုင်းတာသည့်ဟိုက်ဒရိုဖုန်းများ တပ်ဆင်ထားသည့် Streamer ဟုခေါ်သော ကေဘယ်ကြိုးအရှည်အချို့ကို ရေယာဉ်၏နောက်တွင် ကပ်လျက်ချိတ်ဆွဲသွားရသည်။Seismic Streamer ကြိုးများ၏ အရှည်မှာ ပုံမှန်အားဖြင့် ၆ ကီလိုမီတာမှ ၁၀ ကီလိုမီတာရှည်သော်လည်း အချို့အခြေအနေများတွင် ၄ ကီလိုမီတာအထိ တိုနိုင်သည့်အပြင် ၁၆ ကီလိုမီတာအထိလည်း အရှည်ထားနိုင်သည်။

ဒေတာအချက်အလက်များစုဆောင်ပြီးသည်နှင့် ပင်လယ်ကြမ်းပြင်အောက်ဘူမိအလွှာကို ကွန်ပျူတာဖြင့်ပြုလုပ်ထားသော မြေပုံထွက်လာသည်။ 3D ဒေတာများအား အဓိပ္ပာယ်ဖွင့်ပုံဖော်လိုက်သောအခါ ယင်းဘူမိအလွှာ၏ အသွင်အပြင်များကို ပြသထားသည့် အသေးစိတ်ပုံကိုရရှိပါသည်။ (ပုံ၁-၂ ကိုကြည့်ပါ။)



ရေနံရှာဖွေခြင်းသရုပ်ဖော်ပုံ

http://www.energytomorrow.org/, 2015မှရယူထားသည်။

CSEM ရေနံရှာဖွေခြင်းလုပ်ငန်းဆောင်ရွက်ခြင်း

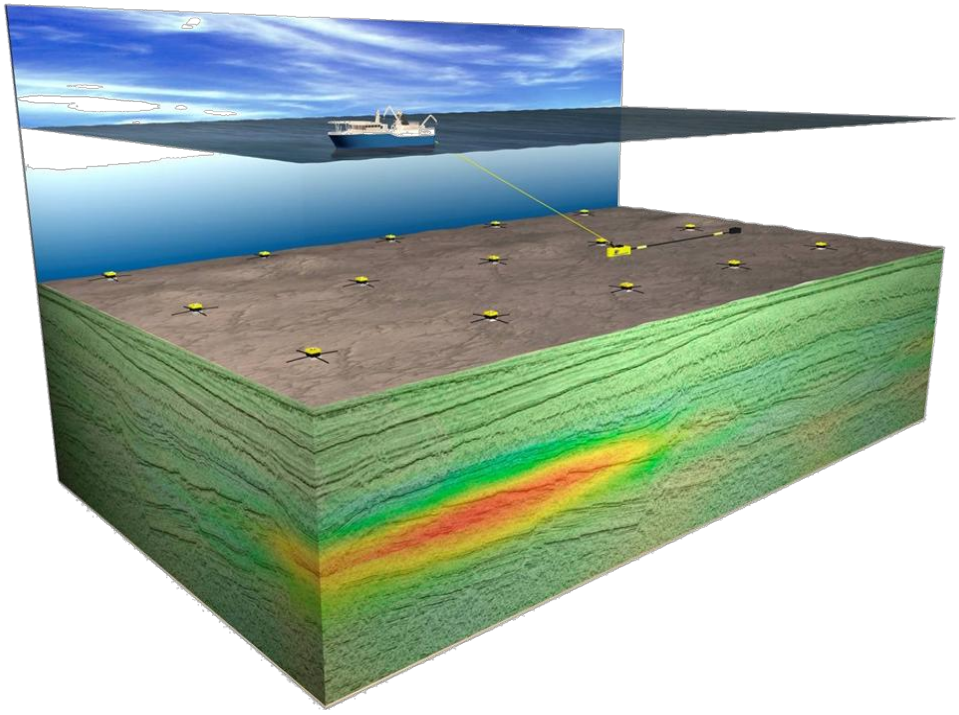
3D ရေနံရှာဖွေခြင်းဆောင်ရွက်ပြီးသည့်အခါတွင်ရရှိလာသည့်ဒေတာများကို ကနဦးအသုံးချပြီးသည့်နောက် Shell သည် CSEM နည်းပညာဖြင့်မြေတိုင်းခြင်းလုပ်ငန်းကို အသံလှိုင်းဖြင့်မြေတိုင်းလုပ်ငန်း ဆောင်ရွက်ချိန်က သတ်မှတ်ထားခဲ့သည့် နေရာများတွင် ဆောင်ရွက်ရသည်။ CSEMစနစ်ဖြင့် မြေတိုင်းလျှပ်စစ်ဒက်ခံနိုင်အားကွဲပြားမှုကိုအသုံးပြုပြီး မြေအောက်ရေနှင့် ဟိုက်ဒရိုကာဗွန်သိုက်များကို ရှာဖွေဖော်ထုတ်ရသည်။CSEM စနစ်ကို ရိုးရိုး 3D Seismic မြေတိုင်းခြင်းမှ ရရှိသော ဒေတာများဖြင့် ပေါင်းစပ်အသုံးပြုသောအခါတွင် MD-5 ရှိ အခြား ဘူမိဗေဒတည်နေရာများတွင် ခိုအောင်းနေနိုင်သော ဟိုက်ဒရိုကာဗွန်သိုက်များကို ဖော်ထုတ်နိုင်စွမ်းမှာ ပိုမိုမြင့်မားလာလေ့ရှိသည်။

ရေနံရှာဖွေခြင်းလုပ်ငန်းစဉ်အတွင်း လျှပ်စစ်သံလိုက်ချောင်းတစ်ချောင်းကို ရေပြင်ညီအနေအထားဖြင့် ပင်လယ်ကြမ်းပြင်အထက် မီတာ (၃၀) အကွာအဝေးတွင်ဆွဲသွားရသည်။ ယင်းသံလိုက်ချောင်းမှတဆင့် အထူးဒီဇိုင်းဖော်ထားသည့် ကြိမ်နှုန်းနိမ့်လျှပ်စစ်သံလိုက်လှိုင်းများကို မြေအောက်လွှာထဲသို့ လွှင့်ထုတ်သည်။ အမျိုးမျိုးသော ကျောက်သားလွှာများ၊ ရေနှင့် ဟိုက်ဒရိုကာဗွန်အမျိုးအစားများက ယင်းတို့ကိုဖြတ်သန်းသွားသော လျှပ်စစ်သံလိုက်စက်ကွင်းများ၏ ဂုဏ်သတ္တိကို ပြောင်းလဲစေသည်။ လျှပ်စစ်သံလိုက်စွမ်းအင်သည် လျှပ်ကူးသတ္တိရှိသော နန်းများထဲတွင် လျှင်မြန်စွာ အားယုတ်လျော့သွားသော်လည်း လျှပ်စီးဒဏ်ကို ပိုခံနိုင်သည့် အလွှာများဖြစ်သည့် ဟိုက်ဒရိုကာဗွန်သိုက်များထဲတွင် ပြင်းအားယုတ်လျော့မှုနည်းပါးကာ ပိုမို၍ လျင်မြန်စွာ ပျံ့နှံ့သည်ကိုတွေ့ရသည်။

ပင်လယ်ကြမ်းပြင်ပေါ်ရှိ လျှပ်စစ်ကွန်ရက်အတွင်းရှိ Receivers များက ပင်လယ်ရေနှင့် ပင်လယ်အောက်ကြမ်းပြင်ထဲတွင် စိမ့်ဝင်စီးကူးပျံ့နှံ့နေသော စွမ်းအင်ကို တိုင်းတာပြီး (ပုံ ၁-၃ ကိုကြည့်ပါ) အထက်ပါအတိုင်း လျှပ်စစ်သံလိုက်စက်ကွင်းများ၏ ဂုဏ်သတ္တိပြောင်းလဲမှုများကို မှတ်တမ်းတင်ကြသည်။

ရေပေါ်တွင်ပေါလောပေါ်နေသော လျှပ်စစ်စွမ်းအင်အရင်းအမြစ်က လျှပ်စစ်သံလိုက်ချောင်းကို စွမ်းအင်ပေးသည် ။ ပေးပုံမှာ လျှပ်စစ်အရင်းအမြစ်ကိုသွယ်တန်းထားသော ကေဘယ်ကြိုးတစ်လျှောက်တွင် အင်တာနာ နှစ်ချောင်းကို မီတာ ၅၀ မှ ၃၀၀ အကြားအကွာအဝေးတွင် တပ်ဆင်ထားသည်။ ရေနံရှာဖွေရေးရေယာဉ်က ယင်းလျှပ်စစ်အရင်းအမြစ်ရှိရာဆီသို့ သွယ်တန်းထားသည့် ကြိုးတန်းမှ တဆင့် လျှပ်စစ်ဓာတ်အားကို ပို့လွှတ်ပေးသည်။ ထုတ်လွှတ်လိုက်သော လျှပ်စစ်သံလိုက်လှိုင်းများမှာ အလွန်အားနည်းပါသည်။ အင်တာနာများမှ ၄ မီတာ အကွာနီးပါးရှိလျှပ်စစ်သံလိုက်စွမ်းအင်မှာ ကမ္ဘာမြေကြီး၏ လျှပ်စစ်သံလိုက်စက်ကွင်းနှင့် ညီမျှသော ပြင်းအားသာရှိသည်။

ရေအောက်ကြမ်းပြင်ရှိ Receiver များမှာ တပ်ဆင်ရလွယ်ကူသော အရှင်များဖြစ်ပြီး ကွန်ကရစ်ကျောက်ဆူးများဖြင့်လည်း ချိတ်ဆက်ထားသည်။ ယင်း Receiver တစ်ခုချင်းစီ၏ အောက်ခြေအကျယ်မှာ ၁ စတုရန်းမီတာနီးပါးခန့်ရှိသည်။ ရေနံရှာဖွေရေးလုပ်ငန်း ပြီးဆုံးသည်နှင့် Receiver များကို ကျောက်ဆူးများမှ ဖြုတ်ပြီး ရေပေါ်သို့ဆယ်တင်ရသည်။ ကြမ်းပြင်တွင်ထားခဲ့သော ကျောက်ဆူးများမှာ ၆ လ နှင့် ၈ လအကြာတွင် တစစီပျက်စီးသွားမည်ဖြစ်သည်။



ပုံ ၁-၃ CSEM မြေတိုင်းနည်းပညာအားသရုပ်ဖော်ထားပုံ

http://www.emgs.com/, 2015 မှ ပုံကို ရယူထားခြင်းဖြစ်သည်။

၁.၂.၄ လုပ်သားအင်အား

ရေနံရှာဖွေခြင်းလုပ်ငန်းတွင် တာဝန်ထမ်းဆောင်မည့် လုပ်သား ၁၁၀ ဦးအထိခန့်ထားရန် ခန့်မှန်း ထားသည်။ ယင်းလုပ်သားများထဲတွင် ရေနံရှာဖွေခြင်းလုပ်ငန်းဆောင်ရွက်မည့် ရေယာဉ်တွင် ဝန်ထမ်း ၆၀ ဦးလိုအပ်ပြီး ထောက်ပံ့ရေးရေယာဉ်များနှင့် အကူရေယာဉ်များအတွက် ဝန်ထမ်းအင်အား ၄၈ ဦးလိုအပ်သည့်အပြင် ကမ်းရိုးတန်းပင်မစခန်းတွင် တာဝန်ထမ်းဆောင်ရန် ဝန်ထမ်း (၂) ဦးလိုအပ်ကာ ခန့်မှန်းလုပ်ငန်းကြာမြင့်ချိန် ရက်ပေါင်း ၆၀ နီးပါးကြာမြင့်မည်။

CSEM ရေနံရှာဖွေခြင်းလုပ်ငန်းဆောင်ရွက်ရန်အတွက် ဝန်ထမ်း ၅၂ ဦးခန့်ထားရမည်။ CSEM ရေနံရှာဖွေခြင်းဆောင်ရွက်မည့် ရေယာဉ်ပေါ်တွင် ၄၂ ဦးခန့်ထားမည်ဖြစ်ပြီး ထောက်ပံ့ရေးရေယာဉ်တစ်စင်းတွင် (လိုအပ်ပါက) ၈ ဦးနှင့် ကမ်းရိုးတန်းပင်မစခန်းတွင် (၂) ဦး ထပ်မံခန့်ထားမည် ဖြစ်သည်။ လုပ်ငန်းကြာမြင့်ချိန် မှာ ခန့်မှန်း (၆၀) ရက်ကြာမြင့်မည်။

၁.၂.၅ သယ်ယူပို့ဆောင်ရေး

မြေတိုင်းရေယာဉ်များကို စက်ံပူ သို့မဟုတ် ရန်ကုန်အပြည်အပြည်ဆိုင်ရာဆိပ်ကမ်းတစ်ခုမှ စတင်ထွက်ခွာမည် ဖြစ်သည်။ မြေတိုင်းရေယာဉ်များပေါ်တွင် လိုအပ်သည့်ပစ္စည်းများအား အပြည့်အစုံတင်ဆောင်သွားမည်ဖြစ်ပြီး အထောက်အပံ့ပစ္စည်းတစ်စုံတစ်ရာ လိုအပ်ပါက ထောက်ပံ့ရေးရေယာဉ်ဖြင့် ထိုင်းနိုင်ငံ ရနောင်ဆိပ်ကမ်း သို့မဟုတ် ရန်ကုန် ဆိပ်ကမ်း မှတဆင့် လိုအပ်သည့်အချိန်တွင် သယ်ပို့ပေးသွားမည်။ မြေတိုင်းရေယာဉ်များကို လောင်စာဆီဖြည့်တင်းခြင်းအား လိုအပ်လာပါက ထောက်ပံ့ရေးရေယာဉ်ကို အသုံးပြုဆောင်ရွက်သွားမည်ဖြစ်သည်။

မြေတိုင်းရေယာဉ်ပေါ်ရှိ ဝန်ထမ်းများ တာဝန်ချိန်လဲလှယ်ခြင်းကို ၅ ပတ်တစ်ကြိမ် ပုံမှန်ဆောင်ရွက်မည်။ တာဝန်လဲရာတွင် ရနောင် သို့မဟုတ် ရန်ကုန်ဆိပ်ကမ်းမှတဆင့် ထောက်ပံ့ရေးရေယာဉ်များကို အသုံးပြုပြီး လွှဲပြောင်းလဲလှယ်ပေးသွားမည်။

ကျန်းမာရေးအရေးပေါ်ကိစ္စပေါ်ပေါက်ပါက ရေနံရှာဖွေရေးရေယာဉ်ပေါ်တွင် ဆေးပစ္စည်းအပြည့်အစုံရှိသော ဆေးခန်းနှင့် ဆေးဘက်ဆိုင်ရာအရာရှိတစ်ဦးထားရှိပေးထားသည်။ ကျန်းမာရေးထိခိုက်သူများအားကမ်းပေါ် ပြန်လည်ပို့ဆောင်ရေး အပါအဝင် အရေးပေါ်ကျန်းမာရေးစောင့်ရှောက်မှုအစီအစဉ်အား စာချုပ်ချုပ် ဆိုသူနှင့် Shell ဘက်မှ မြေတိုင်းလုပ်ငန်း မစတင်မီကတည်းက စီစဉ်ထားရှိပေးမည်ဖြစ်သည်။

၁.၂.၆ ကမ်းရိုးတန်း ပင်မစခန်း/ ဆိပ်ကမ်း

စာချုပ်ချုပ်ဆိုသူသည် ရေနံရှာဖွေခြင်းလုပ်ငန်းဆောင်ရွက်နေစဉ်ကာလတစ်လျှောက်လုံး ကမ်းရိုးတန်းပင်မစခန်းတွင် အရာရှိ ၁ ဦး သို့မဟုတ် ၂ ဦးကို ခန့်အပ်တာဝန်ပေးထားနိုင်ဖွယ်ရှိသည်။ ကမ်းရိုးတန်းပင်မစခန်း၏ တည်နေရာကို မရွေးချယ်ရသေးသော်လည်း ရနောင် သို့မဟုတ် ရန်ကုန်တွင် ဖြစ်နိုင်သည်။

၁.၂.၇ ထုတ်လွှတ်မှုများ၊ စွန့်ပစ်ပစ္စည်းများ နှင့် အညစ်အကြေးစွန့်ထုတ်မှုများ

၁.၂.၇.၁ လေထုတ်လွှတ်မှုများ

လေထုတ်လွှတ်မှုဖြစ်စဉ်များ မြေတိုင်းရေယာဉ်များလုပ်ငန်းဆောင်ရွက်နေစဉ်ကာလတွင် ပေါ်ပေါက်နေမည်ဖြစ်ပြီး အထူးသဖြင့် အင်ဂျင်အတွင်း ဟိုက်ဒရိုကာဗွန်လောင်စာများ လောင်ကျွမ်းမှုကြောင့် ထွက်ပေါ်ခြင်းဖြစ်သည်။ ထုတ်လွှတ်လိုက်သော လေထဲတွင် လေထုကိုညစ်ညမ်းစေမည့် ဓာတ်ငွေ့များဖြစ်သည့် ကာဗွန်မိုနောက်ဆိုဒ် (CO) ၊ ကာဗွန်ဒိုင်အောက်ဆိုဒ် (CO_2) ၊ နိုက်ထရိုဂျင်ဒိုင်အောက်ဆိုဒ် (NO_2) ၊ ဆာလဖာဒိုင်အောက်ဆိုဒ် (SO_2) ၊ ဓာတ်ငွေ့များပါဝင်နေသည်။ လောင်ကျွမ်းမှုဖြစ်စဉ်မှ ထွက်ပေါ်လာသော CO_2 သည် ဖန်လုံအိမ်အာနိသင်ဖြစ်စေသည့် ဓာတ်ငွေ့ဖြစ်ပြီး ရာသီဥတုပြောင်းလဲမှု များကို ဖြစ်ပေါ်စေသည့် ဓာတ်ငွေ့အဖြစ် သတ်မှတ်ထားသည်။ ရေနံရှာဖွေခြင်းနှင့် CSEM နည်းပညာသုံး ရေနံရှာဖွေရေးတွင် စုစုပေါင်း ဖန်လုံအိမ်ဓာတ်ငွေ့ သို့မဟုတ် CO_2 ဓာတ်ငွေ့ထုတ်လွှတ်မှုပမာဏမှာ ၁၉၆၁၉ တန်ခန့်ရှိမည်ဟု ခန့်မှန်းရသည်။ ယင်းပမာဏသည် မြန်မာတစ်နိုင်ငံလုံးမှ ဖန်လုံအိမ်ဓာတ်ငွေ့ သို့မဟုတ် CO_2 ထုတ်လွှတ်မှုပမာဏ၏ ၀.၀၁ % ခန့်နှင့် ညီမျှပါသည်။

၁.၂.၇.၂ မိလ္လာရေဆိုး

ရေနံရှာဖွေရေးရေယာဉ်များ လုပ်ငန်းဆောင်ရွက်ရာတွင် ခဲရောင် နှင့် အနက်ရောင်ရေများအဖြစ် ရေဆိုးများ စွန့်ထုတ်ရမည်ဖြစ်သည်။ ရေနံရှာဖွေခြင်းလုပ်ငန်းစဉ်တစ်လျှောက် လုပ်သားအများဆုံး ၁၀၈ ဦးနှင့် ရက်ပေါင်း ၆၀ကြာ လုပ်ငန်းဆောင်ရွက်ရာတွင် စုစုပေါင်းထွက်ရှိမည့် ရေဆိုးပမာဏမှာ အနက်ရောင်ရေဆိုး ၄၉၀ ကုဗမီတာခန့် နှင့် ခဲရောင် ရေဆိုး ၇၂၀ ကုဗမီတာ ရှိပါသည်။ CSEM နည်းပညာသုံးမြေတိုင်းစီမံကိန်းမှ လုပ်သားအင်အား အများအဆုံး ၅၀ ဦးဖြင့် ရက်ပေါင်း ၆၀ လုပ်ငန်းဆောင်ရွက်ရာတွင် ထွက်ရှိမည့် ရေဆိုးပမာဏမှာ အနက်ရောင်ရေဆိုး ၂၃၀ ကုဗမီတာနီးပါးနှင့် ခဲရောင် ရေဆိုး ၃၃၀ ကုဗမီတာခန့်နီးပါးတို့ထွက်ရှိပါ မည်။ ပင်လယ်ထဲသို့ ရေနံရှာဖွေခြင်းလုပ်ငန်းမှထွက်ရှိသော ရေဆိုးများကို စွန့်ပစ်သည့်အခါတိုင်းတွင် MARPOL73/78 (Annex IV) ဆိုင်ရာ သတ်မှတ်ချက်များနှင့်အညီ အနီးဆုံးကမ်းရိုးတန်းနှင့် ရေမိုင် ၁၂ မိုင်ကျော်ဝေးကွာသောရေပြင်တွင်သာ စွန့်ပစ်ပါမည်။

၁.၂.၇.၃ ရေထုတ်စနစ်/ရေယာဉ်ဝမ်းဗိုက်ဘေးမှထုတ်သောရေ

သင်္ဘောမှထုတ်သောရေများတွင် ရေနံရှာဖွေခြင်းလုပ်ငန်းဆောင်ရွက်နေသော ရေယာဉ်များနှင့် ထောက်ပံ့ရေးရေယာဉ်များ၏ သင်္ဘော ဝမ်းစာရေနှင့် ကုန်းပတ်ပေါ်မှစီးကျသောရေများပါဝင်ပြီး ဆီနှင့် ချောဆီများရောနှောပါဝင်နေလေ့ရှိသည်။ ယင်းသို့ထွက်ရှိလာသောရေများကို စုဆောင်းပြီး ရေနှင့်ဆီကို ခွဲခြားသည့်စက်ဖြင့် ရေယာဉ်တိုင်းတွင် သန့်စင်မှုလုပ်ပါမည်။ ယင်းစက်များဖြင့် ရေနှင့်ဆီကိုခွဲထုတ်ကာ သန့်စင်ပြီးရေကိုသာသင်္ဘောပေါ်မှ စွန့်ပစ်ပါမည်။ သင်္ဘော၏ ရေထုတ်ပိုက်မှကျလာသောရေများမှာ MARPOL73/78 (Annex I) ဆိုင်ရာ သတ်မှတ်ချက်များကိုက်ညီမှုရှိပါမည်။ ယင်းသို့ပြုလုပ်ခြင်းဖြင့် ပင်လယ်သမုဒ္ဒရာရေညစ်ညမ်းခြင်းကိုထိန်းညှိကာကွယ်နိုင်ပြီး သင်္ဘောများမှထွက်ရှိသောစွန့်ထုတ်ရေများ(အားမစွန့်ထုတ်ခင် လောင်စာဆီရောနှောပါဝင်သောပမာဏ ၁၅ ppm ထက်လျော့နည်းအောင်အထိ) ထိန်းချုပ်ကန့်သတ်ပြီးဖြစ်သည်။

၁.၂.၇.၄ စွန့်ပစ်အဖတ်များ

ကမ်းလွန်ရေနံရှာဖွေခြင်းလုပ်ငန်းများတွင် ပုံမှန်အားဖြင့် ရိုးရိုးသာမန်ရေယာဉ်သင်္ဘောများ စွန့်ပစ်သည်ထက် ပိုမိုသော အညစ်အကြေးပမာဏထွက်ရှိလေ့မရှိပါ။ မြေတိုင်းလုပ်ငန်းနှစ်ရပ်ကြောင့် ထွက်ရှိလာသော အညစ်အကြေးများအားလုံး သန့်စင်ပြုပြင်ခြင်း၊ သယ်ပို့ခြင်း၊ စွန့်ပစ်ခြင်း သို့မဟုတ် ပြန်လည်အသုံးပြုခြင်းမပြုလုပ်မီ အမျိုးအစား အရင်ခွဲခြားပါမည်။ အညစ်အကြေးစွန့်ပစ်မှု အစီအစဉ်အား ရေနံရှာဖွေခြင်းလုပ်ငန်းဆောင်ရွက်သူ(ကန်ထရိုက်တာ)၏ သဘာဝပတ်ဝန်းကျင် စီမံခန့်ခွဲမှုနှင့် လေးစားလိုက်နာမှုအစီအစဉ်တွင် ထည့်သွင်းဆောင်ရွက်သွားမည်။ လုပ်ငန်းဆောင်ရွက်နေသော ရေယာဉ်များတွင် အမှိုက်စွန့်ပစ်မှုအစီအစဉ်တစ်ခုကို နိုင်ငံတကာပင်လယ်ရေကြောင်းအဖွဲ့အစည်း (IMO) ၏ လမ်းညွှန်ချက်များနှင့်အညီ ထည့်သွင်းဆောင်ရွက်သွားမည်ဖြစ်သည်။

၁.၃ လက်ရှိသဘာဝပတ်ဝန်းကျင်နှင့်လူမှုရေးအခြေအနေများ

၁.၃.၁ ရုပ်သဘာဝပတ်ဝန်းကျင်

ဤစီမံကိန်း၏ လေ့လာရေးနယ်ပယ်ကို လုပ်ကွက် MD-5 တည်ရှိရာ တနင်္သာရီကမ်းရိုးတန်းဇုန် ကမ်းရိုးတန်းနှင့် ကမ်းလွန်ဒေသများတွင် အထူးပြုလုပ်ပါသည်။ တနင်္သာရီကမ်းရိုးတန်းဒေသသည် မြန်မာနိုင်ငံတွင် အရှည်လျားဆုံး ကမ်းရိုးတန်းဖြစ်ပြီး ကီလိုမီတာ ၁၂၀၀ခန့် ရှည်လျားပါသည်။ (Mergui ကျွန်းစုဟုလည်း ခေါ်သည့်) မြိတ်ကျွန်းစု သည်လည်း တနင်္သာရီတိုင်းကမ်းရိုးတန်းဒေသတွင် ပါဝင်ပြီး ကျွန်းပေါင်း (၈၀၀) ကျော်စုဝေးနေပါသည်။

မြေထဲပင်လယ်ထဲတွင် ပင်လယ်ရေသည် မြောက်အိန္ဒိယသမုဒ္ဒရာ၊ ဘင်္ဂလားပင်လယ်အော် မြန်မာနှင့် ထိုင်းနိုင်ငံကမ်းရိုးတန်းတစ်လျှောက် လည်ပတ်ရွှေ့လျားကာ ဖူးခတ်ကျွန်း၏ အနောက်တောင်ဘက်သို့ဆက်၍ အိန္ဒိယသမုဒ္ဒရာသို့ ပြန်လှည့်သွားသည်။ တောင်ပိုင်းပင်လယ်ရေထုသည် မလက္ကာရေလက်ကြားမှ စီးဝင်ကာ ဖူးခတ်ကျွန်းကမ်းရိုးတန်းအနောက်တောင်ဘက်သို့ မြောက်ယွန်းယွန်းဆက်စီးကာ မြောက်ပိုင်းရေထုနှင့်တွေ့ဆုံပြီး အိန္ဒိယသမုဒ္ဒရာသို့စီးသွားသည်။ သမုဒ္ဒရာဒီရေက တစ်နှစ် လျှင် (၂) ကြိမ်ပြောင်းလဲလေ့ရှိသည်။ နွေဦးရာသီနှင့် အစောပိုင်းနွေရာသီကာလတွင် လမ်းကြောင်းပုံစံတစ်မျိုးဖြင့်ဒီရေတက်ပြီး ကျန်ကာလများတွင် ပြောင်းပြန်ပုံစံဖြင့်တက်လေ့ရှိသည်။

တနင်္သာရီကမ်းရိုးတန်းနှင့် ထိုင်းနိုင်ငံအနောက်ဘက်ကမ်းရိုးတန်းတစ်လျှောက်တွင် တက်သောဒီရေမှာ တစ်ရက် နှစ်ကြိမ် ဖြစ်သည်။ နှစ်ကြိမ်စလုံးတွင် ဒီရေတက်ချိန်နှင့် ဒီရေအမြင့်တူညီလေ့မရှိပါ။ မြေထဲပင်လယ်၏ ပျမ်းမျှ အနက်မှာ မီတာ ၁၀၀၀ (ပေ၃၀၀၀) ခန့်ရှိသည်။ မြောက်ပိုင်းနှင့် အရှေ့ပိုင်းအစိတ်အပိုင်းများမှာ ဇရာဝတီမြစ်က ပို့ချသော နုန်းများကြောင့် မီတာ ၁၈၀ (၆၀၀ ပေ) ထက်အနက်ပိုတိမ်ပါသည်။ ယင်းမြစ်က မြန်မာနိုင်ငံ မြောက်ဖျားမှမြစ်ဖျားခံ၍ မြန်မာနိုင်ငံကို ဖြတ်သန်းစီးဆင်းကာ ပင်လယ်သို့စီးဝင်သော မြစ်ဖြစ်သည်။ အနောက်ပိုင်းနှင့် အလယ်ပိုင်းဒေသများမှာ မီတာ ၉၀၀ မှ မီတာ ၃၀၀၀ (ပေ ၃၀၀၀ မှ ပေ ၁၀,၀၀၀) အထိနက်ရှိုင်းသည်။ ပင်လယ်ပြင်၏ ၅ %သော အစိတ်ပိုင်းသည်သာ မီတာ ၃,၀၀၀ (ပေ ၁၀,၀၀၀) ထက်ပိုမိုနက်ရှိုင်းသည်။ အက်ဒမန်နီကိုဘာ တောင်ကြော၏ အရှေ့ဘက် ရှိ ပင်လယ်မျက်နှာပြင်အောက် ချိုင့်ဝှမ်းများ စုဝေးနေသောနေရာ တစ်ခုတွင် အနက်မှာ မီတာ ၄,၀၀၀ (ပေပေါင်း ၁၃,၂၀၀) နက်ရှိုင်းသည်။

အမျိုးအစားပေါင်းစုံကိုကိုယ်စားပြုသော ရေအရည်အသွေးဆိုင်ရာအချက်အလက်များအရ အက်ဒမန်ပင်လယ်ရေမျက်နှာပြင်၏ အပူချိန်မှာ ၂၉ မှ ၃၀ ဒီဂရီဆဲလ်စီးယပ်အတွင်းရှိသည်ဟုသိရသည်။ ၄င်းဒေသ၏ ပင်လယ်ရေမျက်နှာပြင်တွင် ဆားငန်နှုန်းနိမ့်ပြီး အပူချိန်မြင့်မားနေသည်ကို တွေ့ရှိရသည်။ ရေမျက်နှာပြင်၏ PH level မှာ ၈.၃၆ နှင့် ၈.၃၃ အကြားရှိသည်။ အောက်ဆီဂျင်ပျော်ဝင်နှုန်းမှာ ၃.၉၅ မှ ၄.၉၃ ml/l ဖြစ်သည်။ ယင်းဒေသရှိ Thermocline ရေအလွှာကို ရေအောက်အနက်ပေ ၃၀ မှ ၂၁၁ ပေအတွင်းတွင်တွေ့ရှိရပြီး ယင်းရေအလွှာတွင် ဆားငန်းနှုန်း၊ အောက်ဆီဂျင်ပျော်ဝင်နှုန်းနှင့် PH အနိမ့်အမြင့်နှုန်းတို့၏ လျင်မြန်စွာ ပြောင်းလဲမှုများ ပိုမိုတွေ့ရှိရကြောင်း လေ့လာသိရှိရသည်။ ယင်းထက်နက်သော အပိုင်းတွင် ဆားငန်နှုန်းနှင့် PH တို့ တည်ငြိမ်မှုရှိပြီး အောက်ဆီဂျင်ပျော်ဝင်နှုန်းမှာ ရေနက်လေလေ ပါဝင်နှုန်းအနည်းငယ်တိုးလာလေလေဖြစ်သည်။

၁.၃.၂ ဇီဝဗေဒပတ်ဝန်းကျင်

မြန်မာနိုင်ငံသည် ဇီဝဘူမိပထဝီအနေအထားဆိုင်ရာနယ်မြေ (၄) ခုပေါ်တွင် တည်ရှိနေသည်။ ယင်းတို့မှာ အာရှိတိုက်အခွဲဒေသ၊ ပလေအာ့တစ်ဗဟိုအာရှ၊ အင်ဒိုချိုင်းနား နှင့် မလေးရှား (ဆွန်ဒိုက်) တို့ဖြစ်ကြသည်။ အင်ဒိုချိုင်းနားနှင့် မလေးရှား(ဆွန်ဒိုက်) ဒေသတို့ကိုအရှေ့တောင်အာရှ သို့မဟုတ် အရှေ့တိုင်းဒေသဟု ရည်ညွှန်းခေါ်ဆိုကြသည်။ အပင်မျိုးကွဲမျိုးစုံနှင့် ဇီဝမျိုးကွဲမျိုးစုံတို့ ရှိနေသဖြင့် ယင်းသို့ ကျယ်ဝန်းကြီးမားလှသော ဒေသကြီးများတွင် ရောထွေးနေထိုင်ကျက်စားကြသည်။

BANCA (2011) အရ၊ နို့တိုက်တိရစ္ဆာန်မျိုးစိတ် ၂၅၀ ခန့်၊ ငှက်မျိုးစိတ် ၁,၀၀၀ ကျော်ခန့်၊ တွားသွားသတ္တဝါအမျိုးပေါင်း ၃၇၀ ၊ အပင်မျိုးစိတ် ၇,၀၀၀ တို့ မြန်မာနိုင်ငံတွင်ရှိနေကြောင်း မှတ်တမ်းတင်ထားသည်ဟု သိရှိရသည်။ ယင်းတို့ထဲမှ နို့တိုက်သတ္တဝါ မျိုးစိတ်၃၉ မျိုး၊ ငှက် ၄၅ မျိုး၊ တွားသွားသတ္တဝါ ၂၁ မျိုး၊ အပင်မျိုးစိတ် ၃၈ မျိုးတို့မှာ ကမ္ဘာတစ်ဝှမ်းတွင် မျိုးပြုန်းတော့မည့် အန္တရာယ်ကိုရင်ဆိုင်နေရသည် (NCEA, 2009) ဇီဝမျိုးကွဲများရှိရာအဓိကဒေသ (KBA) ၇၆ ခုကို ဖော်ထုတ်ထားပြီး ဖြစ်သည်။ ယင်းတို့အထဲမှ ၅၄ နေရာတို့ကို အရေးကြီးငှက်မျိုးစိတ်များရှိရာဒေသ (IBA) များအဖြစ်အသိအမှတ်ပြုထားသည် (BLI, 2005)။ ယခုအချိန်အထိ Ramsar Site တစ်ခုကိုသာ သတ်မှတ်ထားရသေးသည် (IBA တစ်ခု၏တည်နေရာနှင့် ထပ်တူကျနေသည်) ။ ထို့ပြင် နောက်ထပ် Ramsar Site ဖြစ်လာနိုင်ဖွယ်ရှိသော ဒေသ ၃၄ ခုကို နိုင်ငံအတွင်းတွင် ဖော်ထုတ်ထားပြီး ဖြစ်သည် (BLI, 2005)။

၂၀၁၃ ခုနှစ်တွင် မြန်မာနိုင်ငံ၏ ဂေဟစနစ်ကို လာရောက်လေ့လာသုတေသနပြုသွားသော အဖွဲ့၏ အစီရင်ခံစာ " Dr. Fridtjof Nansen " တွင် ပြည့်စုံကျယ်ပြန့်မှုအရှိဆုံးဖြစ်သော မြန်မာ့ အဏ္ဏဝါသဘာဝပတ်ဝန်းကျင်ဆိုင်ရာ လတ်တလော အချက်အလက်များကို ဖော်ပြထားသည်။ ယင်းအစီရင်ခံစာတွင် ပင်လယ်ကြမ်းပြင်အခြေအနေများ၊ ငါးနှင့် ရေသတ္တဝါမျိုးစိတ်များ ပေါက်ပွားနေမှုများ၊ မျောလှေးများနှင့် အာဟာရဓာတ်သတ္တုများ (IMR-Norway နှင့် DOF-Myanmar, 2013) ဆိုင်ရာ အကျဉ်းချုပ်အစီရင်ခံစာတစ်စောင်ပါဝင်သည်။အချက်အလက်များကို စုဆောင်းရာတွင် ငါးဖမ်းစခန်း ၁၄၅ ခုမှစုဆောင်းထားခြင်းဖြစ်ပြီး ငါးမျိုးစိတ် ၁၂၉ ခုနှင့်သက်ဆိုင်သော မျိုးစိတ်ပေါင်း ၄၄၄ မျိုးကို မှတ်တမ်းတင်နိုင်ခဲ့သည်။အရိုးနုငါးမျိုးစိတ်များနှင့် ပတ်သက်၍ မျိုးရင်း ၁၁ ခုအောက်တွင်ရှိနေသော ငါးမန်းမျိုးစိတ်ပေါင်း ၃၂ မျိုး၊ မျိုးရင်း ၅ ခုမှ ခွဲထွက်လာသော ငါးလိပ်ကျောက်မျိုးစိတ် ၂၀ ခု၊ မတူညီသော မျိုးရင်း ၂ မျိုးမှ ခွဲထွက်လာသော ရေနက်ပိုင်းတွင်ကျက်စားသည့် Chimaera ငါးမျိုးစိတ် ၂ ခု တို့ကို တွေ့ရသည်။ အမျိုးအစားမတူညီသော ငါး၂၅၅ မျိုးကိုလည်း ရခိုင်ကမ်းရိုးတန်းဒေသတွင် ဖော်ထုတ်နိုင်ခဲ့သည့်အပြင် ဧရာဝတီမြစ်ဝှမ်းဒေသတွင် မျိုးကွဲ ၃၅၂ မျိုး နှင့် တနင်္သာရီကမ်းရိုးတန်းတွင် မျိုးကွဲ ၃၂၉ မျိုးတို့ကို ဖော်ထုတ်မှတ်တမ်းတင်နိုင်ခဲ့သည်။

မှတ်တမ်းမှတ်ရာများအရ မြန်မာနိုင်ငံ ကမ်းရိုးတန်းနှင့် ကမ်းလွန်ဒေသများတွင် သန္ဓာကျောက်မျိုးစိတ် ၅၆၅မျိုး (မြိတ်ကျွန်းစု ၂၄ ကျွန်း) ၊ ပင်လယ်မြက် မျိုးစိတ် ၁၀ ခု၊ လိပ်မျိုးစိတ် ၅ ခု၊ လမုပင်မျိုးစိတ် ၉၂ မျိုးနှင့် အဏ္ဏဝါနို့တိုက်သတ္တဝါမျိုးစိတ် ၃၀ တို့ကို မှတ်တမ်းတင်ထားနိုင်ခဲ့သည်ဟု သိရသည်။

နိုင်ငံတကာသဘာဝန်းကျင်ထိန်းသိမ်းစောင့်ရှောက်ရေးသမဂ္ဂ (IUCN) မှ ပြုစုထားသော မျိုးသုန်းမည့်အန္တရာယ်ရှိသည့် မျိုးစိတ်များစာရင်း (Red List of Threatened Species) ကို အပင်နှင့်တိရစ္ဆာန်မျိုးစိတ်များအား ထိန်းသိမ်းစောင့်ရှောက်မည့် အနေအထားကို ဆုံးဖြတ်ရန် အတွက် အကျယ်ပြန့်ဆုံး အပြည့်စုံဆုံး၊ ကမ္ဘာလုံးဆိုင်ရာ ပူးပေါင်းချဉ်းကပ်မှု အဖြစ် နိုင်ငံတကာမှ ကျယ်ပြန့်စွာအသိအမှတ်ပြုထားပြီးဖြစ်သည်။ မျိုးစိတ်တစ်ခုအနေဖြင့် IUCN ၏ မျိုးသုန်းမည့်အန္တရာယ်ရှိသည့် မျိုးစိတ်များစာရင်းတွင် ကြီးမားစွာအန္တရာယ်ဖြစ်နေသည့်အဆင့် (CR) ၊ အန္တရာယ်ပြုခံရသည့်အဆင့် (EN) သို့မဟုတ် ခုခံနိုင်စွမ်းမရှိဘဲ အားနည်းသည့်အဆင့် (VU) ဟု သတ်မှတ်ခံရလျှင် ယင်းမျိုးစိတ်တွင် မျိုးသုန်းမည့်အန္တရာယ် ရှိသည်ဟု သတ်မှတ်ခြင်းခံရသည်။

မြန်မာနိုင်ငံတွင် ငှက်မျိုးစိတ်ပေါင်း ၁,၀၀၀ နေထိုင်ကျက်စားသည်။ ယင်းတို့အထဲတွင် ၅ မျိုးလောက်သာ နေရာအနှံ့တွေ့ရှိရ ပြီး ကျန် ၄၅ မျိုးမှာ မြန်မာနိုင်ငံတွင် မျိုးသုန်းမည့်အန္တရာယ်နှင့်ရင်ဆိုင်နေရသည်။

မြန်မာ့ရေပိုင်နက်အတွင်းရှိ မျိုးသုန်းမည့်အန္တရာယ်နှင့်ရင်ဆိုင်နေရသောသို့မဟုတ် ရင်ဆိုင်ရမည့် အလားအလာရှိနေကြောင်း အတည်ပြုခံထားရသည့် နို့တိုက်ရေသတ္တဝါမျိုးစိတ် ၇ မျိုးမှာ အောက်ဖော်ပြပါအတိုင်းဖြစ်သည်။

- မျိုးသုန်းအန္တရာယ်ရှိနေသောအုပ်စု

- ဝေလငါးပြာကြီးများ (*Balaenoptera musculus*)
- ဆူးတောင်ပါဝေလငါး (*Balaenoptera physalus*)

- အင်အားနည်းပါးနေသောအုပ်စု
  - အင်ဒိုပစိဖိတ် အတောင်မပါသည့်လင်းချူး (*Neophocaena phocaenoides*)
  - Sperm ဝေလငါး (*Physeter macrocephalus*)
  - ဇရာဝတီလင်းပိုင် (*Orcaella brevirostris*)
- Dugong (*Dugong dugon*)မျိုးသုန်းမည့်အန္တရာယ်ရှိလာမည့်အုပ်စု
  - အင်ဒိုပစိဖိတ် Humpack လင်းပိုင် (*Sousa chinensis*)

ကမ္ဘာပေါ်ရှိ လိပ်မျိုးစိတ် (၇) မျိုးထဲမှ (၅) မျိုး ဖြစ်သော Hawksbill (*Eretmochelys imbricata*) ၊ Green (*Chelonia myhdas*) Loggerhead (*Caretta caretta*) ၊ Olive Ridley (*Lepidochelys aolivacea*) နှင့် Leatherback (*Dermochelys coriacea*) တို့ကို မြန်မာ့ရေပြင်ပိုင်နက်များအတွင်းတွေ့ရှိရသည်။ ယင်းမျိုးစိတ် (၅) မျိုးစလုံးမှာ မျိုးသုန်းအန္တရာယ်ရှိနေသောအုပ်စုဝင်များဖြစ်ကြသည်။ယင်းကဲ့သို့ မျိုးသုန်းမည့်အန္တရာယ်ကိုရင်ဆိုင်နေရသော တွားသွားရေသတ္တဝါ မျိုးစိတ်တစ်ခုမှာ CR အဆင့်သတ်မှတ်ခံထားရသော ထိုင်းမိုချောင်း (*Crocodylus siamensis*) (IUCN, 2014) များဖြစ်ကြပါသည်။ မြန်မာ့ရေပြင်ပိုင်နက်အတွင်း တွေ့ရှိရသော ငါးမန်းဖြူ (*Rhincodon typus*) အပါအဝင် ငါးမန်းမျိုးစိတ်အချို့ကိုလည်း မျိုးသုန်းအန္တရာယ်ရှိနေသောအုပ်စုဝင်များ အဖြစ်သတ်မှတ်ထားပါသည်။

စီမံကိန်းဇရိယာနှင့် အနီးဆုံးတွင်တည်ရှိနေသော ဘေးမဲ့အဏ္ဏဝါဒေသ (MPA) များမှာ မိန်းမလှကျွန်းသားရိုင်း တိရစ္ဆာန်ဘေးမဲ့တော၊ သမီးလှကျွန်း သားရိုင်းတိရစ္ဆာန်ဘေးမဲ့တော၊ မိုစကော့ကျွန်း သားရိုင်းတိရစ္ဆာန်ဘေးမဲ့တော၊ လမ်ပီကျွန်း သားရိုင်းတိရစ္ဆာန်ဘေးမဲ့တောတို့ဖြစ်ကြသည်။

၁.၃.၃ လူသားအသုံးပြုမှုတန်ဖိုးများ

ကမ်းလွန်စီမံကိန်းဇရိယာတွင် လူနေထိုင်ခြင်းများမရှိပါ။ တနင်္သာရီကမ်းရိုးတန်းတွင်နေထိုင်သော ဒေသခံများ၏ လူဦးရေနှင့် မြန်မာနိုင်ငံ၏ လူဦးရေ၏ အချို့သော အစိတ်အပိုင်းများနှင့် ဘဝနေထိုင်မှုအရည်အသွေးမှာ သက်ဆိုင်မှုရှိနေသည်။ ကမ်းရိုးတန်းဒေသတွင် နေထိုင်ကြသည့် ဒေသခံအများစုမှာ ရွာငယ်လေးများတွင် နေထိုင်ကြသူများဖြစ်ကြသည်။ စီမံကိန်းဒေသ၏ လူမှုစီးပွားအခြေခံဆိုင်ရာ အချက်အလက်များမှာအမျိုးမျိုးသော နည်းပညာရပ်ဆိုင်ရာ အစီရင်ခံစာများ၊ အစိုးရနှင့် အင်တာနက်စာမျက်နှာများအပြင် တနင်္သာရီတိုင်းဒေသကြီး မြို့တခရိုင် ကလွင်ရွာတွင်နေထိုင်သော လေ့လာဆွေးနွေးမှု ပြုလုပ်ထားပြီး ရရှိလာသော အချက်အလက်များဖြစ်ကြသည်။

မြန်မာနိုင်ငံ၏ အဏ္ဏဝါရေပြင်ပိုင်နက်တွင် ငါးဖမ်းလုပ်ငန်းအတွက် ကောင်းမွန်ထူးခြားသော အလားအလာများရှိသည်။ ကမ်းလွန်ရေပြင်တွင် သတ်မှတ်ထားသော စည်းမျဉ်းစည်းကမ်းများနှင့် ခွင့်ပြုချက်များရယူရန်လိုအပ်သည်။ အထူးစီးပွားရေးဇုန် (EEZ) အပါအဝင် စုစုပေါင်းပင်လယ်ငါးဖမ်းဒေသအကျယ်အဝန်းမှာ ၄၈၆,၀၀၀ စတုရန်းကီလိုမီတာရှိသည်။ မြန်မာ့အထူးစီးပွားရေးဇုန် (EEZ) ၏ ရေပြင်ပိုင်နက်မှာ အင်္ဂလားပင်လယ်အော်အရှေ့ပိုင်း နှင့် အက်ဒမန်ပင်လယ်မြောက်ပိုင်းခြမ်းတို့ဖြစ်သည်။

မြန်မာနိုင်ငံတွင် ပင်လယ်ငါးဖမ်းလုပ်ငန်းမှာ အရေးပါလှသည်။ ထို့ကြောင့် မြန်မာနိုင်ငံသည် ငါးများပေါက်ဖွားရာ ရေပြင်များပြန်းတီးမှုအလွန်အကျွံဖြစ်ခြင်းများကို ရှောင်ရှားစေနိုင်ရန်အတွက် ပင်လယ်ငါးအုပ်များအား စီမံခန့်ခွဲခြင်းနှင့် ထိန်းသိမ်းစောင့်ရှောက်ခြင်း တို့ကို ပြုလုပ်နိုင်ရန်အတွက် အထူးကြိုးစားအားထုတ်နေသည်။ ငါးဖမ်းလုပ်ငန်းအပါအဝင် စုစုပေါင်းငါးထွက်ရှိမှုမှာ ၂၀၁၁ ခုနှစ်တွင် တန်ချိန်ပေါင်း ၄.၁ သန်းရှိကြောင်းကို တရားဝင် (ယာယီ) စာရင်းများအရသိရှိရသည်။ ယင်းပမာဏထဲတွင် ပင်လယ်ငါးဖမ်းလုပ်ငန်းမှထွက်ရှိသော ငါးပမာဏမှာ တန်ချိန် ၂.၁ သန်းရှိပြီး ပြည်တွင်းရေချိုငါးဖမ်းလုပ်ငန်းမှထွက်ရှိသော ငါးတန်ချိန်မှာ ၁ သန်းခန့်ရှိသည်။ ရေချိုငါးဖမ်းလုပ်ငန်းတွင် လုပ်ကွက်အငှားချပေးခြင်းအပြင် ရိုးရိုးတံငါလုပ်ငန်းများလည်း ပါဝင်သည် (BOBLME, 2012) ။ ငါးဖမ်းလုပ်ငန်းနယ်ပယ်တွင် ရေချိုငါးဖမ်းလုပ်ငန်း၊ ရေငန်စနစ်များ၊ အလှမွေးငါးလုပ်ငန်းနှင့် ငါးသားပေါက်လုပ်ငန်းများပါဝင်သည်။ ပုစွန်နှင့် ရေချိုငါးမွေးမြူရေးလုပ်ငန်းကို မြန်မာနိုင်ငံတွင် ၄၄၉,၆၉၄ ဟက်တာဖော်ထုတ်

ပြီးဖြစ်သည်။ ယင်းနေရာများတွင် ငါးထွက်ရှိမှုပမာဏမှာ ၂၀၁၂ - ၂၀၁၃ ခုနှစ်အတွင်းတွင် ခန့်မှန်း တန်ချိန်ပေါင်း ၉၂၉,၃၆၀ တန်ခန့် ထွက်ရှိသည်။ (ကမ်းလွန်ရှိ တူနာငါးနှင့် အခြားပင်လယ်ငါးကြီးဖမ်းလုပ်ငန်းကို အကောင်အထည်ဖော် ဆောင်ရွက်နေပါသည်။ လတ်ရှိတွင် တစ်နှစ်လျှင် တန်ချိန် (၂၀၀) ခန့် နှစ်စဉ် ထွက်ရှိနေပါသည်။မြန်မာ့အထူးစီးပွားရေးဇုန်အတွင်း ငါးဖမ်းပိုက်တန်းရှည်များချ၍ ဖမ်းခြင်းကိုခွင့်ပြုမိန့် ချပေးပြီးဖြစ်သည်။ ၁၉၉၉-၂၀၀၀ ခုနှစ်များတွင် ပြည်ပမှ ငါးဖမ်းသင်္ဘော ၁၂ စီးကို စမ်းသပ်လိုင်စင်များ စတင်ခွင့်ပြုမိန့်ချပေးခဲ့ပြီး ဖြစ်သည်။ ၂၀၁၀-၂၀၁၁ ခုနှစ်များအတွင်းတွင် လိုင်စင်ရငါးဖမ်းသင်္ဘောအစီးရေ မှာ ၁၀၉ စီးအထိ တိုးပွားလာခဲ့သည်။ "နိုင်ငံခြားငါးဖမ်းသင်္ဘောများအတွက် ငါးဖမ်းအခွင့်အရေးဆိုင်ရာဥပဒေ" အရ မြန်မာအထူးစီးပွားရေးဇုန်တွင် တူနာငါးဖမ်း ပိုက်ရှည်များဖြင့် ငါးဖမ်းလုပ်ငန်းများဆောင်ရွက်ခြင်းကို နိုင်ငံပိုင်နယ်နိမိတ် ပြင်ပတွင်သာ ခွင့်ပြုမိန့်ချပေးခဲ့သည်။ နိုင်ငံခြားငါးဖမ်းပိုက်များတွင် ဖမ်းဆီးရမိသော တူနာငါးများအားလုံးကို ပြည်ပသို့တင်ပို့သည်။ မြန်မာနိုင်ငံသို့ လာရောက် ရောင်းချခြင်းမရှိပါ။ လတ်တလောတွင် မြန်မာနိုင်ငံတွင် တူနာငါးစျေးကွက်မရှိသေးပါ။

မြန်မာ့ရေလုပ်ငန်းအဖွဲ့ချုပ် (pers. comm) ၏အလိုအရ မြန်မာ့ငါးဖမ်းသင်္ဘောများသည် လတ်တလောတွင် ယင်းစျေးကွက်အား တင်ပို့နိုင်ခြင်းမရှိသေးပါ။ ထို့ကြောင့် နိုင်ငံခြားငါးဖမ်းသင်္ဘောများအား တူနာငါးဖမ်းခွင့်ပေးထားခြင်းဖြစ်သည်။ တူနာငါးဖမ်းခွင့်ပြုမိန့်များကို DOF မှ ထုတ်ပေးသည်။ မြေထဲပင်လယ်အတွင်း အထူးသဖြင့် ကိုကိုးကျွန်းနှင့် မြိတ်ကျွန်းစုများ အနီးတစ်ဝိုက်တွင်ငါးဖမ်းလိုင်စင်ရရှိရန် စောင့်ဆိုင်းနေသော နိုင်ငံခြားမှလာသော တူနာငါးဖမ်းသင်္ဘောများ အများအပြားရှိ သည်။

မြေထဲပင်လယ်တွင် သွားလာနေသော ရေယာဉ်များတွင် ငါးဖမ်းသင်္ဘောများ နှင့် ကူးသန်းရောင်းဝယ်ရေး သင်္ဘောများ ပါဝင်သည်။ မလက္ကာရေလက်ကြားသို့သွားသော အဓိကရေနံတင်သင်္ဘောလမ်းကြောင်းလည်း ယင်းမြေထဲပင်လယ်သို့ ဖြတ်သန်းသွားလာ ရသည်။ လက်ရှိ သင်္ဘောအသွားအလာဆိုင်ရာ အချက်အလက်များက လုပ်ကွက် MD-5၏ အရှေ့ဘက်နှင့် အနောက်ဘက်တို့တွင် အဓိကလုပ်ငန်းဆောင်ရွက်မှုများ ရှိနေကြောင်း သိရသည်။

၁.၄ သဘာဝပတ်ဝန်းကျင်နှင့်လူမှုရေးဆိုင်ရာ သက်ရောက်မှုများ

၁.၄.၁ နည်းပညာ

စီမံကိန်းနယ်နိမိတ်အတွင်း လောင်စာဆီယိုဖိတ်ခြင်းကဲ့သို့သော မတော်တဆ သို့မဟုတ် စီစဉ်မထားသည့် ဖြစ်ရပ်များ ကဲ့သို့သော လုပ်ငန်းလုပ်ဆောင်ရင်း သဘာဝပတ်ဝန်းကျင်နှင့်လူမှုပတ်ဝန်းကျင်တို့အပေါ် ဖြစ်လာနိုင်ဖွယ်ရှိသည့် သက်ရောက်မှုများ ကို ခန့်မှန်းတွက်ချက် ပြီး ဖြစ်သည်။

အရေးပါမှုအဆင့်အား အကဲဖြတ်လေ့လာရာတွင် ဖြစ်နိုင်ချေများနှင့် သက်ရောက်မှု၏ လက္ခဏာများ (ဥပမာ သဘာဝပတ်ဝန်းကျင်ထိခိုက်မှု ဆိုင်ရာသက်ရောက်မှုပမာဏ အဓိကလက်ခံသူများနှင့် အရေးပါသော အရင်းအမြစ်များ၏ ခံနိုင်စွမ်းအား တို့နှင့်ပတ်သက်ပြီး ဘူမိဗေဒဆိုင်ရာအတိုင်းအတာနှင့် လုပ်ကိုင်မည့်ကာလကြာမြင့်ချိန်သက်ရောက်လာနိုင်မည့် ထူးခြားသော သက်ရောက်မှုများ၏ ပြင်းအားကို လျော့ပါးအောင် သို့မဟုတ် ကာကွယ်နိုင်အောင် ဆောင်ရွက်မှုများကို ဖော်ဆောင်ပြီး သက်ဆိုင်ရာလုပ်ငန်းဆောင်ရွက်ချက်များနှင့် ပြန်လည်ချိတ်ဆက်ပေးပြီး သဘာဝပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲမှုအစီအစဉ် (EMP) တစ်ခု၏ အခြေခံတစ်ခုအား ဖော်ဆောင်ပေးခဲ့သည်။ EMP တွင် အထက်ပါ စီမံကိန်း၏သက်ရောက်မှုများကို လျော့ချတားဆီးရန်အတွက် လိုအပ်သော သဘာဝပတ်ဝန်းကျင်နှင့်လူမှုရေးဆိုင်ရာသက်သာမှု ကို ဖြစ်ပေါ်စေသည်။ ယင်းEMP သည် IEE အစီရင်ခံစာတွင်တွဲလျက်ပါဝင်ပြီးဖြစ်သည်။ သည့်အပြင် ယင်းစီမံကိန်းနှင့်ပတ်သက်သည့် Shell ၏ တာဝန်ဝတ္တရား လည်းဖြစ်သည်။

သက်ရောက်မှုဆိုင်ရာဆန်းစစ်လေ့လာမှု၏ ရည်ရွယ်ချက်တစ်ခုမှာ သက်ရောက်မှုလျော့ပါးစေရန်လုပ်ဆောင်မှုများကို ဆောင်ရွက်ပြီးနောက်နှင့် စောင့်ကြည့်လေ့လာခြင်း သို့မဟုတ် အကဲဖြတ်ခန့်မှန်းခြင်းတို့ကို အကျိုးအကြောင်းခိုင်လုံစေခဲ့ပါက ဒေသအတွင်းကျန်ရှိခဲ့မည့် မည်သည့်သက်ရောက်မှုမဆို၏ အရေးပါအရာရောက်မှုကိုမဆို နားလည်သိရှိရန် ဖြစ်သည်။ဤ IEE တွင် လုပ်ငန်း ပြီးဆုံးပြီးနောက် ကျန်ရစ်ခဲ့မည့် သက်ရောက်မှုများအား ဆန်းစစ်ချင့်တွက်ခြင်းလုပ်ငန်းစဉ်ကို အား Shell မှ အကောင်အထည်ဖော်ဆောင်ရွက်သွားမည့် EMP တွင်ပါဝင်သော သက်ရောက်မှုလျော့ချရေးဆိုင်ရာလုပ်ငန်းစဉ်များအဖြစ် ထည့်သွင်းစဉ်းစားပြီးဖြစ်သည်။

၁.၄.၂ သက်ရောက်မှုအကဲဖြတ်ဆန်းစစ်ခြင်းနှင့် လျော့ချမှုဆိုင်ရာ လုပ်ငန်းစဉ်များ

ဇယား ၁-၁ မှ ဇယား ၁-၃ တွင် ဖြစ်ပေါ်လာနိုင်သောသက်ရောက်မှုများ MD-5 လုပ်ကွက်တွင် တူးဖော်ထုတ်လုပ်ရေးဆိုင်ရာ အစီအစဉ်၏ လုပ်ဆောင်ချက်များအား ဆန်းစစ်သုံးသပ်ရာတွင် ပေါ်ထွက်လာမည့် သက်ရောက်မှုအလားအလာများ ကို အကျဉ်းချုပ်ဖော်ပြထားသည်။ သက်ရောက်မှုအားလုံးကို သတ်မှတ်ထားသောစံလုပ်ထုံးလုပ်နည်းများ နှင့်/သို့မဟုတ် သင့်တော်သော သက်ရောက်မှုလျော့ချရေးလုပ်ဆောင်မှုများဖြင့် အဆင်သင့်စီမံခန့်ခွဲဆောင်ရွက်နိုင်ပါမည်။

ဇယား ၁-၁ သဘာဝပတ်ဝန်းကျင်သက်ရောက်မှုသုံးသပ်ချက်အကျဉ်းချုံးဖော်ပြချက်

ကဏ္ဍ	ဆောင်ရွက်မှု	အလားအလာရှိသော သက်ရောက်မှု	သက်ရောက်မှုလျော့ချရေး လုပ်ငန်းစဉ်များ	သက်ရောက်မှု၏ ထူးခြားချက်	ပမာဏ	ဒေသဆိုင်ရာ အရေးပါမှု
ရေအောက်တွင်ဆူညံမှု	လေသေနတ်များဖြင့် ပစ်ဖောက်ပြီး အသံလှိုင်းထုတ်လွှတ်မှု (ဆိုက်စမစ် ထုတ်လွှင့်မှုအရင်းအမြစ်)	နို့တိုက် ရေသတ္တဝါ (cetaceans) များ၊ လိပ်များ၊ ငါးများနှင့် ကျောရိုးမဲ့သတ္တဝါများ၏ အပြုအမူနှင့် ကိုယ်ခန္ဓာများအား ဆိုးကျိုးသက်ရောက်မှု နို့တိုက် ရေသတ္တဝါ (cetaceans) များ၊ လိပ်များ၊ ငါးများနှင့် ကျောရိုးမဲ့သတ္တဝါများအား အနှောင့်အယှက်ဖြစ်စေသည်။	**လုပ်ထုံးလုပ်နည်း** – နိုင်ငံတကာဘူမိရူပဗေဒဆိုင်ရာ ကန်ထရိုက်တာများအသင်း (IAGC)တွင် လက်ခံကျင့်သုံးသည့်အတိုင်း ဆိုက်စမစ်မြေတိုင်းလုပ်ငန်းမှ နို့တိုက်ရေသတ္တဝါများအား ဒဏ်ရာရစေခြင်းနှင့် ထိခိုက်မှုဖြစ်နိုင်ချေများကို လျော့ချရေးဆိုင်ရာ လမ်းညွှန်ချက်များ JNCC (2010)နှင့်ကိုက်ညီအောင် ဆောင်ရွက်ထားသည်။	ထိန်းချုပ်ထား၊ ကာလတို၊ ပြန်လည်ပြုပြင်နိုင်	အသင့်အတင့်	**အသေးအခွဲ ဖြစ်သည်။**
	သယ်ယူပို့ဆောင်ရေး၊ စက်ပစ္စည်းကိရိယာနှင့် အထောက်အကူပြုပစ္စည်းများ (ရေယာဉ်မှ ထွက်ရှိသော ဆူညံမှု)					
လျှပ်စစ်သံလိုက်တုန်ခါမှုလွှင့်ထုတ် ခြင်း	CSEM လျှပ်စစ်သံလိုက်လှိုင်း တုန်ခါမှုများလွှတ်ထုတ်ခြင်း	ငါးများ ၊ လင်းပိုင်များနှင့် ဝေလငါးများ၊ ပင်လယ်လိပ်များအတွက် အနှောင့်အယှက်ဖြစ်စေသည်	လက်ရှိတွင် လျှပ်စစ်သံလိုက်လှိုင်းအသုံးပြုသော မြေတိုင်းလုပ်ငန်းအတွက် ပြဋ္ဌာန်းသတ်မှတ် ထားသော သက်ရောက်မှုအားလျော့ချသည့် လုပ်ငန်းစဉ်မရှိသေးပါ။	ထိန်းချုပ်ထား၊ ကာလတို၊ ပြန်လည်ပြုပြင်နိုင်	အသေးစား	**လျစ်လျူရှုထား နိုင်သည်။**

ကဏ္ဍ	ဆောင်ရွက်မှု	အလားအလာရှိသော သက်ရောက်မှု	သက်ရောက်မှုလျော့ချရေး လုပ်ငန်းစဉ်များ	သက်ရောက်မှု၏ ထူးခြားချက်	ပမာဏ	ဒေသဆိုင်ရာ အရေးပါမှု
ပင်လယ် ကျောက်ဆူး များ၏ ရုပ်ပိုင်းဆိုင် ရာတည်ရှိမှု	CSEM ကျောက်ဆူးများ (Receiver) များအား နေရာချထားခြင်း၊ ရေအောက်တွင်ရှိနေ ခြင်း နှင့် နောက်ဆုံး ဇီဝအဆင့်သို့လျော့ ချပြီးပျက်စီးစေမှု (Biodegradation)	ပင်လယ် ကြမ်းပြင်ပေါ်တွင် အနှောင့်အယှက်ဖြစ်စေခြင်း ပင်လယ်ကြမ်းပြင်ပေါ်ရှိ ငှင်းတို့ချထားရာနေရာအနီး ကျက်စားနေထိုင်သော ရေသတ္တဝါများနှင့် ဇီဝသက်ရှိများကို အနှောင့်အယှက်ဖြစ်စေခြင်း ကျောက်ဆူးများအောက်တွင် ရောက်သွားမည့် ပင်လယ်ကြမ်းပြင်ပေါ်တွင် ကျက်စားနေထိုင်သော ရေသတ္တဝါများ ပိမိပြီးသေကြေ စေနိုင်ခြင်း ကွန်ကရစ်ကျောက်ဆူးတုံးများ ကို ဖျော်ချပစ်ခြင်းကြောင့် ယင်းအနီးတစ်ဝိုက်ရှိရေ၏ အရည်အသွေးပြောင်းလဲစေခြင်း	• CSEM receivers များကို ပင်လယ်ကြမ်းပြင် ပေါ်ချထားသည့် ၆ လမှ ၈ လအတွင်း အလိုအလျောက် အရည်ပျော်ကြေပျက်သွားနိုင်သည့် ဘိလပ်မြေကျောက်ဆူးတုံးများပေါ်တွင် တပ်ဆင်ထားသည်။ • သေးငယ်သည့် (၁.၀မီတာ x ၁.၀မီတာ x ၀.၂၅ မီတာ) ရှိသော ကွန်ကရစ်တုံးငယ်များအား အသုံးပြုသည်။	ထိန်းချုပ်ထား၊ ကာလတို၊ ပြန်လည်ပြုပြင်နိုင်	အသေးစား	**လျစ်လျူရှုထားနိုင်သည်။**
မီးလုံးများမှ မီးအလင်း ရောင်များ	မှောင်နေချိန်တွင် သဘော်များမှ အလင်းရောင်ထုတ် လွှတ်ခြင်း	ငှက်၊ လိပ် နှင့် ငါးများ ဖြစ်သော ဒေသရင်းတိရစ္ဆာန်များ၏ အပြုအမူများအပေါ် သက်ရောက်မှု	• သဘော်များပေါ်ရှိမီးရောင်များ၏ ဦးတည်ရာအား ဖြစ်နိုင်လျှင် အတွင်းဘက်သို့လှည့်ထားမည်။	အထူးထိန်းချုပ်ထား၊ ကာလတို၊ ပြန်လည်ပြုပြင်နိုင်	အသေးစား	**လစ်လျူရှု ထားနိုင်သည်။**
လေထုအတွင်း သို့ ဓာတ်ငွေ့ များလွှတ်ထုတ် ခြင်း	သဘော်များပေါ် တွင် အင်ဂျင်စက် များအား အသုံးပြုခြင်း	ယင်းလေများထုတ်လွှတ်မှု ကြောင့် ဒေသလေထုကို ညစ်နွမ်းစေသည်	• (ရေယာဉ်များမှလွှတ်ထုတ်သောဓာတ်ငွေများကြောင့် ဖြစ်ပေါ်သော လေထုညစ်ညမ်းမှုကာကွယ်ရေးဆိုင်ရာ စည်းမျဉ်းစည်းကမ်းများ)MARPOL 73/78 Annex VI အရ သဘော်အမျိုးအစားကို အောက်ပါအတိုင်း သင့်တော်မှုရှိအောင်ဆောင်ရွက်သည်။ • လောင်စာဆီအသုံးပြုမှုအား အလှည့်ကျ စစ်ဆေးခြင်းနှင့် ထိန်းသိမ်းပြုပြင်မှု လုပ်ငန်းစဉ်ဇယားတစ်ခုကိုသုံးပြီး သို့မဟုတ် ထုတ်လုပ်သူမှ ထောက်ခံထားသည့်အတိုင်း ဆောင်ရွက်ပြီး စက်များအားလုံး၏ စွမ်းဆောင်ရည်ကောင်းမွန်စေရန် ကြိုတင်ကာကွယ် ထိန်းသိမ်းရေးပြုလုပ်ခြင်း • စက်ပစ္စည်းနှင့် ကိရိယာများအားလုံး၏ အသုံးပြုပုံစာအုပ်ပါ ညွှန်ကြားချက်များအတိုင်း လိုက်နာဆောင်ရွက်ပြီး ကောင်းစွာ ပြုပြင်ထိန်းသိမ်းမှု ပြုလုပ်မည်။ • မြေတိုင်းလုပ်ငန်းတွင် ကြန့်ကြာမှုများ အနည်းဆုံး ဖြစ်စေရန်နှင့် သဘော်များအသုံးပြုမှုကိုလည်း လက်တွေ့လုပ်ငန်းချိန်အတွင်းသာ အသုံးပြုစေမည်။	ထိန်းချုပ်ထား၊ ကာလတို၊ ပြန်လည်ပြုပြင်နိုင်	အသေးစား	**လစ်လျူရှု ထားနိုင်သည်။**

ကဏ္ဍ	ဆောင်ရွက်မှု	အလားအလာရှိသော သက်ရောက်မှု	သက်ရောက်မှုလျော့ချရေး လုပ်ငန်းစဉ်များ	သက်ရောက်မှု၏ ထူးခြားချက်	ပမာဏ	ဒေသဆိုင်ရာ အရေးပါမှု
အရည်များစွန့်ပစ်မှုအား စွန့်ပစ်ခြင်း သတ်မှတ်ခြင်း	မိလ္လာအညစ်အကြေးများ စွန့်ပစ်ခြင်း	ပါဝင်ပစ္စည်းများကြောင့် အနီးတစ်ဝိုက်ရှိ ရေအရည်အသွေးကို လျော့ကျစေသည်။	• MARPOL သတ်မှတ်ချက်များ (Annex IV) နှင့် အညီ ကမ်းလွန်ဒေသတွင် မစွန့်ပစ်ခင် ပြုပြင်စီရင်ထားမည်။ • မြေတိုင်းနှင့် ထောက်ပံ့ရေး ရေယာဉ်များတွင် အညစ်အကြေးများအား စီမံရန်အတွက် အသိအမှတ်ပြု ထောက်ခံချက်ရထားသော စီရင်မှု စနစ်ကို အသုံးပြုမည်။	ထိန်းချုပ်ထား၊ ကာလတို၊ ပြန်လည်ပြုပြင်နိုင်	နည်းသည်။	**လစ်လျူရှု ထားနိုင်သည်။**
	သဘော်ကုန်းပတ်စနစ်များ၊ ဝမ်းဗိုက်အတွင်းရှိ ရေဆိုးများ ၊ စက်ပစ္စည်းများမှ စိမ့်ထွက်လာသော ရေဆိုးများကြောင့် ဖြစ်ပေါ်လာသော လောင်စာဆီ ရောနှောနေသည့် ရေဆိုးများကို စွန့်ပစ်ခြင်း	ပါဝင်ပစ္စည်းများကြောင့် အနီးတစ်ဝိုက်ရှိ ရေအရည်အသွေးကို လျော့ကျစေသည်။ ပင်လယ်သတ္တဝါများနှင့် ရေအောက် အပင်မျိုးစိတ်များ အတွက်အဆိပ်အတောက်များ ဖြစ်ပေါ်စေသည်။	• MARPOL 73/78 Annex I နှင့်အညီ သဘော်ဝမ်းဗိုက် အတွင်းရှိ ရေဆိုးများနှင့် ယိုစိမ့်ထွက်လာသောရေဆိုးများကို ပြုပြင်စီမံမည်။ • ရေတွင် ဆီပါဝင်နှုန်း ၁၅ ppm ရှိသော သဘော်ဝမ်းဗိုက် အတွင်းရှိ ရေဆိုးများနှင့် ယိုစိမ့်ထွက်လာသောရေဆိုးများကို စုဝေးထားရှိပြီး ကုန်းပေါ်တွင် စွန့်ပစ်မည်။ • သဘော်ဝမ်းဗိုက် အတွင်းရှိ ရေဆိုးများနှင့် ယိုစိမ့်ထွက်လာသောရေဆိုးများအား စွန့်ပစ်မှုအား Oil Record Book တွင် မှတ်တမ်းသိမ်းဆည်းထားရှိမည်။			
အညစ်အကြေးအဖတ်များအား စီမံခန့်ခွဲခြင်း	သဘော်များပေါ်တွင် အဆိပ်အတောက်မဖြစ်စေသော အညစ်အကြေးဖတ်များအား ထွက်ရှိခြင်း	ရေ၏ အရည်အသွေးကို ကျဆင်းစေပြီး ရေနေသတ္တဝါများနှင့် ရေအောက်အပင်များ၏ စားကျက်များအရည်အသွေးကို ကျဆင်းစေသည်။	• မြေတိုင်းကန်ထရိုက်တာများ အနေဖြင့် မြေတိုင်းလုပ်ငန်းများဆောင်ရွက်ရန်အတွက် အညစ်အကြေးစီမံခန့်ခွဲမှုအစီအစဉ်ကို ဆောင်ရွက်ရမည်။ • အညစ်အကြေးများအား ပြန်သုံးရရှိသော အမျိုးအစားနှင့် ပြန်သုံးမရသော အမျိုးအစားကို ခွဲခြားစေပြီးနောက် ရှင်းလင်းစွာ အမှတ်အသားပြုထားသည့် ကွန်တိန်နာများနှင့်ထည့်ပြီး သယ်ပို့ကာ စွန့်ပစ်စေမည်။ • အမှိုက်များစွန့်ပစ်ရာတွင် MARPOL 73/78 Annex V သတ်မှတ်ချက်နှင့် ကိုက်ညီစွာစွန့်ပစ်မည်။ • မြေတိုင်းနှင့် ထောက်ပံ့ရေးသဘော်များအပေါ်တွင် အသုံးပြုမည့် မီးဖိုများအားလည်း MARPOL/IMO သတ်မှတ်ချက်များအတိုင်းသာ အသုံးပြုမည်။ • စားကြွင်းစားကျန်များစွန့်ပစ်မှုကို ၂၅ မီလီမီတာ အကြီးဆုံးရှိသော အရွယ်အစားများဖြစ်အောင် ပြုလုပ်ပြီးမှ ပင်လယ်ထဲသို့ စွန့်ပစ်မည်။ • အန္တရာယ်ရှိသော အညစ်အကြေးများစာရင်းကို အညစ်အကြေးစီမံခန့်ခွဲမှုအစီအစဉ်တွင် ထည့်သွင်းထားမည်။ • အန္တရာယ်ရှိသော မည်သည့်အညစ်အကြေးများကို မဆို သက်ဆိုင်ရာ ဓာတ်သတ္တုပစ္စည်းများဘေးကင်းမှုဒေတာမှတ်တမ်း (MSDS) နှင့်အညီ ကိုင်တွယ် သိမ်းဆည်းခြင်းများ ဆောင်ရွက်မည်။ • လုပ်ငန်းဆောင်ရွက်နေသော သဘော်များအားလုံးပေါ်တွင် အမှိုက်စီမံခန့်ခွဲမှု အစီအစဉ်အား IMO လမ်းညွှန်ချက်များနှင့် အညီ စီစဉ်ထားရှိမည်။ • အကယ်၍ သဘော်အရွယ်အစားအလိုက်	ထိန်းချုပ်ထား၊ ကာလတို၊ ပြန်လည်ပြုပြင်နိုင်	နည်းသည်။	**လစ်လျူရှု ထားနိုင်သည်။**

ကဏ္ဍ	ဆောင်ရွက်မှု	အလားအလာရှိသော သက်ရောက်မှု	သက်ရောက်မှုလျော့ချရေး လုပ်ငန်းစဉ်များ	သက်ရောက်မှု၏ ထူးခြားချက်	ပမာဏ	ဒေသဆိုင်ရာ အရေးပါမှု
			လိုအပ်လာပါက လုပ်ငန်းဆောင်ရွက်နေသော သင်္ဘောများတွင် အမှိုက်စွန့်ပစ်မှုမှတ်တမ်းစာအုပ်ကို MARPOL 73/78 Annex V နှင့်အညီ ယူဆောင်လာမည်။			

ဇယား ၁-၂ မထင်မှတ်သောသက်ရောက်မှုဆိုင်ရာသုံးသပ်ချက်များအားအကျဉ်းချုံးဇယားပြုစုခြင်း

ကဏ္ဍ	ဆောင်ရွက်မှု	အလားအလာရှိသော သက်ရောက်မှု	သက်ရောက်မှုလျော့ချရေး လုပ်ငန်းစဉ်များ	ပြင်းထန်မှု	ဖြစ်တန်စွမ်း	ဒေသဆိုင်ရာ အရေးပါမှု
သင်္ဘောများနှင့် ပင်လယ်သတ္တဝါများအကြား ဖြစ်လာနိုင်သည်များ	သင်္ဘောများနှင့် ဝင်တိုက်မိ၊ ဆောင်မိခြင်း ရေပြင်ပေါ်တွင် ချိတ်ဆွဲထားသော စက်ပစ္စည်းများနှင့် ရေသတ္တဝါများချိတ်မိတတ်ခြင်း	နို့တိုက်ရေနေသတ္တဝါများ (လင်းပိုင်နှင့် ဝေလငါးများ) နှင့် ပင်လယ်လိပ်များ အပါအဝင် ရေနေသတ္တဝါများကိုထိခိုက်မိခြင်း	• အပိုဒ် ၆.၄.၁.၃ တွင်ဖော်ပြထားသည့် လုပ်ထုံးလုပ်နည်းအရ မည်သည့်ရေယာဉ် သို့မဟုတ် ရေထဲတွင် ဆွဲထားသော စက်ပစ္စည်းများ နှင့် ရေသတ္တဝါများ ထိတွေ့မှုများအပါအဝင် MMO အား သင်္ဘောပေါ်တွင် အသုံးပြုခြင်းနှင့် ပတ်သက်သော စီမံခန့်ခွဲမှုလုပ်ငန်းစဉ်များကို မှတ်တမ်းသိမ်း ထားပြီး MMO အစီရင်ခံစာတွင် အစီရင်ခံမည်။ • မြေတိုင်းသင်္ဘောများသည် အရှိန်နှုန်းနှိမ့်နှိမ့်ဖြင့် ခုတ်မောင်းနေမည်ဖြစ်ပြီး တစ်နာရီလျှင် ၇ မှ ၉ ကီလိုမီတာနှုန်းနီးပါးခန့် (၄ မှ ၅ ရေနှိုင်) နှုန်းအတွင်းသာမောင်းနှင်မည်။ • ဒီဇိုင်းအရ လိုအပ်ချက်ရှိလာပါက ရေနုံရှာဖွေခြင်း ကောဘယ်လ်ကြိုးများတွင် တပ်ဆင်ထားသော ရေကြောင်းပြ ဇော်ယာများတွင် လိပ်များမလာရန်ကာကွယ်သည့် ကိရိယာများတပ်ဆင်ထားမည်။	ထိန်းချုပ်ထား၊ ကာလတို၊ ပြန်လည်ပြုပြင်နိုင်	နည်းပါးသည်	**သေးငယ်**
(ဟိုက်ဒရိုကာဗွန်များ) မတော်တဆ ဖိတ်စင်ခြင်းများ	လောင်စာဆီများ ဖိတ်ကျခြင်း (သင်္ဘောတစ်ခုခုနှင့် တိုက်မိဆောင့်မိခြင်း ၊ လောင်စာဆီ ဖြည့်ခြင်း နှင့် အခြားအစိတ်အပိုင်းများ သို့မဟုတ် စက်ချွတ်ယွင်းမှုများကြောင့်ဖြစ်သည်	ပင်လယ်သတ္တဝါများနှင့် ရေအောက်အပင် အများအား အဆိပ်အတောက်ဖြစ်စေသည် နီးစပ်ရာရှိရေအရည်အသွေးကို နိမ့်ကျစေနိုင်သည် ကမ်းလွန်ငါးဖမ်းလုပ်ငန်းများအတွက် သွယ်ဝိုက်ပြီး ထိခိုက်မှုများ ရှိနိုင်သည်။	• နိုင်ငံတကာပင်လယ်ရေကြောင်းသွားလာမှုဆိုင်ရာမတော်တဆ တိုက်မိခြင်းများကာကွယ်ရေးဆိုင်ရာသတ်မှတ်ချက်များ COLREGS မှ အပိုင်း(၉) ရေယာဉ်ပွဲကိုင်ခြင်းနှင့် ပင်လယ်တွင်းမောင်းနှင်ခြင်း၊ အပိုင်း (၇) မီးထိုးခြင်းနှင့် အရိပ်များ (စည်းမျဉ်း အမှတ် ၂၇) အရ ရေယာဉ်၏ အရွယ်အစားအပေါ်အခြေ အောက်ပါတို့နှင့် ကိုက်ညီမှုရှိစေရမည် • COLREGSတွင်ပါဝင်သော ပဲ့ထိန်းမောင်းနှင်ခြင်းဆိုင်ရာစည်းမျဉ်းသတ်မှတ်ချက်များအရ ပင်လယ်တွင်းသွားလာနေသော သင်္ဘော အချင်းချင်းထိခိုက်မိခြင်း တိုက်မိခြင်းမဖြစ်ပေါ်စေရန် သင်္ဘောသား အဖွဲ့ဝင်များအား လေ့ကျင့်ပေးရ မည် ဖြစ်ကာ ယင်းသို့ မတော်တဆတိုက်မိခြင်းများမဖြစ် အောင် ကြိုတင်ကာကွယ်နိုင်ရန်စောင့်ကြည့်ထားခြင်း နှင့် အရှိန်လွန်ပြီးတိုက်မိခြင်းများမဖြစ်ပေါ်အောင် သင်္ဘော အရှိန်ကို ထိန်းညှိထားရမည်ဖြစ်သည်။ • မီးရောင်များလုံလောက်စွာထားရှိရမည်ဖြစ်ကာသတိပေးအချက်ပြမီးများကို လည်း ရေယာဉ်ပေါ်တွင် တပ်ဆင်ထား ရှိရမည်ဖြစ်သည်။ • သင်္ဘောစတင်မထွက်ခွာမီ အနည်းဆုံး ရက်ပေါင်း (၃၀) ကြိုတင်၍စီမံကိန်းလုပ်ငန်းဆောင်ရွက်ချက်များ နှင့်ပတ်သက်၍ "သင်္ဘောသားများသိရန်နှိုတစ်စာ"ကိုသက်ဆိုင်ရာ အဖွဲ့အစည်းများ ဖြစ်သည့် ရေလုပ်ငန်းဦးစီးဌာန၊ မွေးမြူရေးနှင့် ရေလုပ်ငန်းဝန်ကြီးဌာန နှင့် ရေကြောင်းရေတပ်ဖွဲ့တို့အား ထုတ်ဝေမည့် MOGE နှင့် ပူးပေါင်းဆောင်ရွက်မည်။ • ရေနုံရှာဖွေခြင်းနှင့် CSEM သင်္ဘောများအနီးတစ်ဝိုက်အား လုပ်ငန်းဇုံအန္တရာယ်ရှိရုန်များအဖြစ်သတ်မှတ်မည်။ • မြေတိုင်းသင်္ဘောများနှင့် ရေထဲတွင် ဆွဲထားသော စက်ပစ္စည်းများကြောင့် အခြားသင်္ဘောများ အန္တရာယ်မဖြစ်ပေါ်စေရန် သတိပေးသင်္ဘောများဖြင့် လိုက်လံသတိပေးမည်။ • မတော်တဆတိုက်မိခြင်းများဖြစ်ပေါ်လာပါက သက်ဆိုင်ရာ မြန်မာရေပြင်အာဏာပိုင်အဖွဲ့အစည်းများ (ဥပမာ - MONREC	အတူးထိန်းချုပ်ထား၊ ကာလတို၊ ပြန်လည်ပြုပြင်နိုင်	အသေးစား	**အသင့်အတင့်**

ကဏ္ဍ	ဆောင်ရွက်မှု	အလားအလာရှိသော သက်ရောက်မှု	သက်ရောက်မှုလျော့ချရေး လုပ်ငန်းစဉ်များ	ပြင်းထန်မှု	ဖြစ်တန်စွမ်း	ဒေသဆိုင်ရာ အရေးပါမှု
			၊DMA နှင့် မြန်မာ့ရေတပ်) သို့ သတင်းပို့မည် • သင်္ဘောများတိုက်မိခြင်းဖြစ်ပွားမှုဆိုင်ရာ အသေးစိတ် မှတ်တမ်းများအား လုံးကို မှတ်တမ်းတင်ထားမည်။ • MARPOL နှင့်အညီ သင်္ဘောပေါ်တွင်ကျင့်သုံးသော လောင်စာဆီညစ်ညမ်းမှုအရေးပေါ်အစီအစဉ် (SOPEP) အား ရေးသား ဆောင်ရွက်မည်။ • မြေတိုင်းသင်္ဘောများတွင် ရာသီဥတုသတင်းများကို နေ့စဉ်ရယူမည်။ • ရာသီဥတုဆိုးရွားမှုအတွက် အစီအစဉ် • ပင်လယ်ပြင်တွင် လောင်စာဆီဖြည့်တင်းခြင်းများကို နေ့ဖက်တွင်သာဖြည့်ခြင်းနှင့် စံသတ်မှတ်ထားသော လုပ်ငန်းစဉ်များ အတိုင်းသာဆောင်ရွက်ခြင်း • သင်္ဘောပေါ်တွင် တင်ဆောင်လာသော ဟိုက်ဒရိုကာဗွန်များအား လုံခြုံစိတ်ချရသည့် သိုလှောင်ကန်များအတွင်းတွင်သာ သိမ်းဆည်းမည်။ • သင်္ဘောပေါ်ရှိဝန်ထမ်းများအား လုံးသည် အရေးပေါ်အခြေအနေများအတွက် လိုအပ်သော လေ့ကျင့်ရေးများပြုလုပ်ပြီး သက်ဆိုင်ရာတာဝန်အလိုက် ကျွမ်းကျင်မှုရှိနေပြီးဖြစ်သည်။ • မည်သည့်ဖိတ်စင်မှုများမဆိုအတွက် ခန့်အပ်ထားသော အလျင်အမြန်သိမ်းဆည်းမည့် အဖွဲ့အတွက် လိုအပ်သော သင်တန်းနှင့် ဖိတ်စင်မှုအားသိမ်းဆည်းရာတွင် အသုံးပြုရမည့် ပစ္စည်းကိရိယာများဖြည့်တင်းတပ်ဆင်ပေးသည်။ • လုံလောက်သောဆေးဝါးကုသမှုဆောင်ရွက်ပေးမည်။ သန့်ရှင်းရေးဆောင်ရွက်ပေးမည်။ ဖြစ်ပေါ်ခဲ့သည့် မတော်တဆမှုများကို အစီရင်ခံတင်ပြမည်။ • လောင်စာဆီယိုဖိတ်မှုပမာဏ (၈၀ လီတာအထက်) ကို စာဖြင့် ရေးသားပြီး MONRE ကိုအစီရင်ခံတင်ပြမည်။ • ဟိုက်ဒြိုကာဗွန်ဖိတ်စင်မှုကို ထိန်းသိမ်းရေးနှင့် ပြန်လည်ပြုပြင်ရေးဆိုင်ရာ စက်ပစ္စည်းကိရိယာများကို ယင်းဟိုက်ဒြိုကာဗွန်ကန်များအနီးတွင်ထားရှိပေးမည်။ • ဟိုက်ဒြိုကာဗွန်ဖိတ်စင်မှုများတွင် ဆောင်ရွက်ရမည့်လုပ်ငန်းစဉ်များကို Shell ၏ ERP တွင် အသေးစိတ်ဖော်ပြထားမည်။			
(ဓာတုပစ္စည်း သို့မဟုတ် အဆိပ်သင့်စေသော အညစ်အကြေးများ) မတော်တဆ ယိုဖိတ်မိခြင်း	ဓာတုပစ္စည်း သို့မဟုတ် အဆိပ်သင့်စေသော အညစ်အကြေးများအား နည်းလမ်းမမှန်မကန်ဖြင့် ကိုင်တွယ်အသုံးပြုခြင်း	ရေနေသတ္တဝါများနှင့်အပင်များအား အဆိပ်သင့်မှုရှိစေသည်။အနီးတစ်ဝိုက်ရေပြင် ၏ အရည်အသွေးကို လျော့ကျစေသည်။ ကမ်းလွန်ငါးဖမ်းလုပ်ငန်းများကို သွယ်ဝိုက်ပြီးထိခိုက်စေသည်။	• ဓာတု/အဆိပ်သင့်စေသော ဓာတ်ပစ္စည်းများအားလုံးကို MARPOL 73/78 Annex III နှင့်အညီ ပွန့်ပစ်ရမည်။ • မြေတိုင်းသင်္ဘောများပေါ်ရှိဝန်ထမ်းများအားလုံးအတွက် သဘာဝပတ်ဝန်းကျင်ဆိုင်ရာအသိပညာပေးခြင်း • ကန်ထရိုက်တာများအားလုံးက သက်ဆိုင်ရာ ဓာတုပစ္စည်းများအားလုံးကို အသုံးပြုခြင်းနှင့်ကိုင်တွယ်ခြင်းများအတွက်သင့်တော်သော သင်တန်းများပေးခြင်းနှင့် ဘေးကင်းလုံခြုံရေးဆိုင်ရာ စံလုပ်ငန်းစဉ်များကိုသတ်မှတ် အကောင်အထည်ဖော်ပေးရမည်။ • သင့်တော်သော ဆေးဝါးကုသမှုများကို ဆောင်ရွက်မည်။ သန့်ရှင်းရေး ဆောင်ရွက်မည်။ မတော်တဆဖြစ်ပါက မှတ်တမ်းသွင်းထားမည်။ • မည်သည့်ဖိတ်စင်မှုများကိုမဆို အလျင်အမြန် သိမ်းဆည်းရန် ခန့်အပ်ထားသောအဖွဲ့အတွက် လိုအပ်သော သင်တန်းနှင့် ဖိတ်စင်မှုအားသိမ်းဆည်းရာတွင် အသုံးပြုရမည့် ပစ္စည်းကိရိယာများကိုဖြည့်တင်းတပ်ဆင်ပေးသည်။ • သင်္ဘောပေါ်တွင် တင်ဆောင်လာသော ဟိုက်ဒရိုကာဗွန်များအားလုံးကို မစိမ့်ဝင်နိုင်သော ကွန်ကရစ်သို့မဟုတ် ပလပ်စတစ်) နံရံနှင့်ကြမ်းပြင်ရှိသော လုံခြုံစိတ်ချရသည့် သိုလှောင်ကန်များအတွင်းတွင်သာ သိမ်းဆည်းမည်။ • ဓာတုပစ္စည်းများနှင့် အဆိပ်သင့်စေတတ်သောပစ္စည်းများအားလုံးကို ရှင်းလင်းစွာအမှတ်အသားပြုထားသော ကန်များထဲတွင်သိမ်းဆည်းသယ်ဆောင်ပြီး ကမ်းပေါ်တွင် စွန့်ပစ်မည်။ • သိမ်းဆည်သိုလှောင်ကန်များနှင့် ကိုင်တွယ်သည့်ပစ္စည်းများအားလုံးကောင်းမွန်စွာအသုံးပြုနိုင်သော အနေအထားရှိပြီး ဖိတ်စင်မှုများအား လက်တွေ့ ကာကွယ် ထိန်းသိမ်း နိုင်စွမ်းရှိရမည်။ • မြေတိုင်းနှင့် ထောက်ပံ့ရေးရေယာဉ်များအားလုံးတွင် SOPEP ကိုစမ်းသပ်အကောင်အထည်ဖော်ထားရမည်။ မိတ္တူများကို သင်္ဘောပေါ်တွင် ယူဆောင်လာရမည်။	အတူးထိန်းချုပ်ထား၊ ကာလတို၊ ပြန်လည်ပြုပြင်နိုင်	နည်းပါးသည်	**အသေးစား**

ကဏ္ဍ	ဆောင်ရွက်မှု	အလားအလာရှိသော သက်ရောက်မှု	သက်ရောက်မှုလျော့ချရေး လုပ်ငန်းစဉ်များ	ပြင်းထန်မှု	ဖြစ်တန်စွမ်း	ဒေသဆိုင်ရာ အရေးပါမှု
			• သင်္ဘောပေါ်တွင် အလွယ်တကူရနိုင်သော နေရာတွင် ဓာတုပစ္စည်းများနှင့် အဆိပ်သင့်စေသော ပစ္စည်းများအတွက် MSDS ကိုထားရှိပေးမည်။ • ဖိတ်စင်မှုဖြစ်ပေါ်ရာတွင် အသုံးပြုသော ပုံးများ/ကိရိယာတန်ဆာပလာများအားလုံးကို ဓာတုနှင့်အဆိပ်သင့်စေတတ်သော ပစ္စည်းများနှင့် အနီးစပ်ဆုံးနေရာတွင် သိမ်းဆည်းပြီး ဖိတ်စင်မှုဖြစ်ပေါ်လာပါက ချက်ခြင်းဆောင်ရွက်နိုင်အောင် ထားရှိရမည်။ ယင်းကိရိယာများအား အဆင်သင့်အသုံးပြုနိုင်ခြင်း ရှိမရှိကို သင်္ဘောမထွက်ခါမီနှင့် ထွက်ခွာပြီးနောက်ပိုင်း ပုံမှန်စစ်ဆေးခြင်းများ ပြုလုပ်ရမည်။ ယင်းပစ္စည်းများကို အသုံးပြုရန် သတ်မှတ်ထားသော ဝန်ထမ်းအား လေ့ကျင့်သင်တန်းပေး ထားမည်။ • ဓာတုနှင့်အဆိပ်သင့်စေတတ်သောဓာတ်ပစ္စည်းများဆိုင်ရာ မတော်တဆဖြစ်ပွားသော ယိုစိမ့်မှု/စွန့်ပစ်မှုများ အတွက် အသေးစိတ်မှတ်တမ်းများကို ထားရှိသွားမည်ဖြစ်သည်။			

မတော်တဆဝင်ရောက်လာသော ရေသတ္တဝါမျိုးစိတ်များနှင့် ထိတွေ့မှုဖြစ်ခြင်း (IMS)	သင်္ဘောဝမ်းစာရေနှင့်ရောနှောပြီး သင်္ဘောဝမ်းပိုက်သို့မဟုတ် ရေနှင့်ပတ်သက်သော စက်ပစ္စည်းတစ်ခုခုတွင် IMS ဝင်ရောက်ခြင်း	ဒေသတွင်းရေသတ္တဝါမျိုးစိတ်များကို ထိခိုက်စေမည့် အခြားဒေသမှ IMS များ ဝင်ရောက်လာခြင်း	• (IMO 2004) နိုင်ငံတကာ သင်္ဘောဝမ်းစာရေနှင့် အနည်အနှစ်များ ထိန်းချုပ်ရေး ညီလာခံတွင်ချမှတ်ထားသည့် အတိုင်း နိုင်ငံတကာရေပိုင်နက်အတွင်းသွားလာနေသော သင်္ဘောများအားလိုက်နာရသည့် အချက်များနှင့်အညီ (သင်္ဘော၏ အရွယ်အစား အဆင့်နှင့်သင့်လျော်သလို)
			  • ဝမ်းစာရေများလဲလှယ်ခြင်းကို ကုန်းနှင့် ၅၀ nm ထက်ပိုဝိုဝေးကွာ သော ရေအနက်ပေ ၂၀၀ ခီတာ ရှိသည့် ရေပြင်တွင်သာ ဆောင်ရွက်မည်။
			  • ဝမ်းစာရေလဲလှယ်ခြင်းများအား မှတ်တမ်းပြုစုသိမ်းဆည်းထားမည်။
			  • IMS အန္တရာယ် လေ့လာသုံးသပ်မှုကို ဆောင်ရွက်မည်ဖြစ်ပြီး ယင်းသုံးသပ်ချက်အပေါ်တွင်အခြေခံ၍ အန္တရယ်အဆင့်ပေါ်တွင် မူတည်၍ စီမံခန့်ခွဲမှုများကိုဆောင်ရွက်အကောင်အထည်ဖော်သွားမည်ဖြစ်သည်။
			• ဖြစ်လာနိုင်သည့် ဇီဝဥစ္စည်းမှုကိုစီမံခန့်ခွဲနိုင်ရန်အတွက် အောက်ပါ စီမံမှုများကို ဆောင်ရွက်သွားမည်ဖြစ်သည်။
			  • (400t ထက်ကြီးမားသော) ရေယာဉ်များတွင် လက်ရှိနိုင်ငံတကာသုံး ညစ်ညမ်းမှုကာကွယ်ရေးစနစ်လက်မှတ် (IAFS) ရယူထားမည်ဖြစ်ကာ သင်္ဘောများပေါ်တွင် အန္တရယ်ရှိသော ဇီဝဥစ္စည်းမှု များအား ထိန်းချုပ်ရေးဆိုင်ရာ နိုင်ငံတကာညီလာခံ (IMO 2001) နှင့်အညီဆောင်ရွက်ရမည်။
				ထိန်းချုပ်ထား၊ အလယ်အလတ်ကာလ	အသေးစား	**အသေးစား**

ဇယား ၁-၃ လူမှုရေးသက်ရောက်မှုသုံးသပ်ချက်အကျဉ်းချုပ်ဖော်ပြချက်

ကဏ္ဍ	ဆောင်ရွက်မှု	အလားအလာရှိသော သက်ရောက်မှု	သက်ရောက်မှုလျော့ချရေး လုပ်ငန်းစဉ်များ	ပြင်းထန်မှု	ပမာဏ	ဒေသဆိုင်ရာ အရေးပါမှု
စက်ပစ္စည်းများ နေရာချထားမှု— ငါးဖမ်းလုပ်ငန်းများနှင့် အပြန်အလှန်ပူးပေါင်းဆောင်ရွက်ခြင်း	ရေနံရှာဖွေရေးလှုပ်ရှားမှုများနှင့် ရေပြင်ဆွဲစက်ပစ္စည်းများ နေရာချထားခြင်းနှင့် မောင်းနှင်အသုံးပြုခြင်း	ရေပြင်ဆွဲစက်ပစ္စည်းများနှင့် ငါးဖမ်းပိုက်များ ပြီမိခြင်း	• သင်္ဘောများမထွက်ခွာမီ ရက် (၃၀) အနည်းဆုံးကြိုတင်၍ "သင်္ဘောသားများသိစေရန်" အကြောင်းကြားစာကို သက်ဆိုင်ရာ အဖွဲ့အစည်းများဖြစ်သည့် မြန်မာနိုင်ငံ ငါးဖမ်းလုပ်ငန်းအဖွဲ့ချုပ် နှင့် ရေလုပ်ငန်းဦးစီးဌာနများအား ပေးပို့မည်။ • သတိပေးသင်္ဘောများကို ဆိုက်စမစ်မြေတိုင်းလုပ်ငန်းဆောင်ရွက်နေစဉ်အတွင်း ယင်းဇရိယာအတွင်း ငါးဖမ်းသင်္ဘောများ ဝင်ရောက်လာခြင်းရှိမရှိ စောင့်ကြည့်ရန်နှင့် ဝင်လာပါက ဆက်သွယ်အသိပေးရန်အသုံးပြုသွားမည်။ • COLREGS မှ အပိုင်း(၉) ရေယာဉ်ပဲ့ကိုင်ခြင်းနှင့် ပင်လယ်တွင်းမောင်းနှင်ခြင်း၊ အပိုင်း (၇) မီးထိုးခြင်း နှင့် အဓိပ်္ပါများ (စည်းမျဉ်းအမှတ် ၂၇) အရ ရေယာဉ်၏ အရွယ်အစား အပါအဝင် အောက်ပါတို့နှင့် ကိုက်ညီမှုရှိစေရမည် ○ COLREGS တွင်ပါဝင်သော ပဲ့ထိန်းမောင်းနှင်ခြင်းဆိုင်ရာစည်းမျဉ်းသတ်မှတ် ချက်များ အရ ပင်လယ်တွင်းသွားလာနေသော သင်္ဘောအချင်းချင်း ထိမိုက်မိခြင်း တိုက်မိခြင်းမဖြစ် ပေါ်စေရန် သင်္ဘောသားအဖွဲ့ဝင်များအား လေ့ကျင့်ပေးရမည်ဖြစ်ကာ ယင်းသို့ မတော်တဆတိုက်မိခြင်း များမဖြစ်အောင် ကြိုတင်ကာကွယ်နိုင်ရန် စောင့်ကြည့်ထားခြင်း နှင့် အရှိန်လွန်ပြီး တိုက်မိခြင်းများ မဖြစ်ပေါ်အောင် သင်္ဘောအရှိန်ကို ထိန်းညှိထားရမည်ဖြစ်သည်။ ○ မီးရောင်များလုံလောက်စွာထားရှိရမည်ဖြစ်ကာ သတိပေးအချက်ပြမီးများကိုလည်း ရေယာဉ်ပေါ်တွင် တပ်ဆင်ထားရှိရမည်ဖြစ်သည်။	ထိန်းချုပ်ထား၊ ကာလတို၊ ပြန်လည်ကုစားနိုင်	နည်းပါးသည်	**အသေးစား**
စက်ပစ္စည်းများ နေရာချထားမှု — ငါးဖမ်းလုပ်ငန်းများအပေါ် သက်ရောက်မှု	ရေနံရှာဖွေရေးလှုပ်ရှားမှုများနှင့် ရေပြင်ဆွဲကြိုးလိုင်းများ နေရာချထားခြင်းနှင့် မောင်းနှင်အသုံးပြုခြင်း	စီမံထားသည့် မြေတိုင်းဇရိယာအတွင်း လေ့သင်္ဘောသွားလာမှုတိုးလာမည်။ သင်္ဘောများသွားလာမှုရှုပ်ထွေးလာသောကြောင့် လမ်းကြောင်းပြောင်းလွဲခြင်းနှင့် အခြားဖြစ်နိုင်ချေရှိသော ကြန့်ကြာမှုများကို တတိယအဖွဲ့အစည်းများ၏ခရီးစဉ်တွင် ဖြစ်ပေါ်စေနိုင်သည်	• COLREGS မှ အပိုင်း(၉) ရေယာဉ်ပဲ့ကိုင်ခြင်းနှင့် ပင်လယ်တွင်းမောင်းနှင်ခြင်း၊ အပိုင်း (၇) မီးထိုးခြင်း နှင့် အဓိပ်္ပါများ (စည်းမျဉ်းအမှတ် ၂၇) အရ ရေယာဉ်၏ အရွယ်အစား အပါအဝင် အောက်ပါတို့နှင့် ကိုက်ညီမှုရှိစေရမည်။ ○ COLREGS တွင်ပါဝင်သော ပဲ့ထိန်းမောင်းနှင်ခြင်းဆိုင်ရာစည်းမျဉ်းသတ်မှတ် ချက်များ အရ ပင်လယ်တွင်းသွားလာနေသော သင်္ဘောအချင်းချင်း ထိမိုက်မိခြင်း တိုက်မိခြင်း မဖြစ်ပေါ်စေရန် သင်္ဘောသားအဖွဲ့ဝင်များအား လေ့ကျင့်ပေးရမည် ဖြစ်ကာ ယင်းသို့ မတော်တဆ တိုက်မိခြင်းများမဖြစ်အောင် ကြိုတင်ကာကွယ်နိုင်ရန် စောင့်ကြည့်ထားခြင်း နှင့် အရှိန်လွန်ပြီး တိုက်မိခြင်း များမဖြစ်ပေါ်အောင် သင်္ဘောအရှိန်ကို ထိန်းညှိထားရမည်ဖြစ်သည်။ ○ မီးရောင်များလုံလောက်စွာထားရှိရမည်ဖြစ်ကာ သတိပေးအချက်ပြမီးများကိုလည်း ရေယာဉ်ပေါ်တွင် တပ်ဆင်ထားရှိရမည်ဖြစ်သည်။	ထိန်းချုပ်ထား၊ ကာလတို၊ ပြန်လည်ကုစားနိုင်	နည်းပါးသည်	**အသေးစား**

ကဏ္ဍ	ဆောင်ရွက်မှု	အလားအလာရှိသော သက်ရောက်မှု	သက်ရောက်မှုလျော့ချရေး လုပ်ငန်းစဉ်များ	ပြင်းထန်မှု	ပမာဏ	ဒေသဆိုင်ရာ အရေးပါမှု
			• သင်္ဘောများမထွက်ခွာမီ ရက် (၃၀) အနည်းဆုံးကြို တင်၍ "သင်္ဘောသားများသိစေရန်" အကြောင်းကြားစာကို သက်ဆိုင်ရာ အဖွဲ့အစည်းများ ဖြစ်သည့် ရေလုပ်ငန်းဦးစီးဌာန၊ မွေးမြူရေးနှင့်ရေလုပ်ငန်းဝန်ကြီးဌာန နှင့် မြန်မာ့ရေတပ်) တို့အား ပေးပို့မည်။ • သင်္ဘောကပ္ပတိန်က ဦးဆောင်၍ မြေတိုင်း သင်္ဘောများအနီးတစ်ဝိုက်တွင် ရွေ့လျားနှင့် ယာယီ ဘေးကင်းဇုန်များကို သတ်မှတ်ရမည်။ • အန်းသို့ချည်းကပ်လာသော သင်္ဘောများနှင့် မတော်တဆထိခိုက်တိုက်မိခြင်းများမဖြစ်အောင် သတိပေးသင်္ဘောများကိုအသုံးပြုပြီးလိုက်လံ သတိပေးဆော်သြမည်။			
မြေတိုင်းအစီအစဉ်	နိုင်ငံတော်နှင့်ဒေသတွင်း အလုပ်အကိုင်ချထားမှုနှင့် ဝင်ငွေ	အလုပ်အကိုင်နှင့် ဝင်ငွေများကြောင့် မြန်မာ့စီးပွားရေးအား တိုက်ရိုက်နှင့် သွယ်ဝိုက်တိုးတက်စေနိုင်မည်။	• ရန်ကုန်ရုံးတွင်ခန့်အပ်သော ဝန်ထမ်းများထက်ကျော်လွန်၍ နောက်ထပ် လျော့ပေါ့ခြင်းများမရှိပါ။	ရှိသည်။ ကာလတိုသာဖြစ်သည်။	နည်းသည်	**လစ်လျူရှုထားနိုင်သည်** **ရှိသည်ဆောင်သည်**

၁.၄.၃ နိဂုံး

ဤ IEE ပါ သက်ရောက်မှု အကဲဖြတ်ဆန်းစစ်ချက်တွင် လုပ်ကွက် MD-5 တွင် အဆိုပြုထားသော ရေနံရှာဖွေခြင်းအစီအစဉ်၏ ရေနက်ကမ်းလွန်နှင့်သက်ဆိုင်သည့် ဖြစ်နိုင်ချေရှိသော သဘာဝပတ်ဝန်းကျင်နှင့် လူမှုရေးကိစ္စများကို ဖော်ပြထားသည်။ စီစဉ်ထားသော ဆိုက်စမစ်နှင့် CSEM မြေတိုင်းလုပ်ငန်းများကို ကာလတိုနှင့် ယာယီ (တစ်မျိုးလျှင် ရက်ပေါင်း ၆၀ ထက်မပို) သာဆောင်ရွက်မည်ဖြစ်သည်။ ယင်းလုပ်ငန်းများတွင် သဘာဝပတ်ဝန်းကျင်နှင့် လူမှုရေးသက်ရောက်မှုအကန့်အသတ်တစ်ခု ရှိသည့်အပြင် ကမ်းခြေအခြေပြုဆောင်ရွက်မှု အနည်းငယ်သာရှိသည်။

ခြုံငုံပြီးဆိုရလျှင် MD-5 လုပ်ကွက်၏ ရေနံရှာဖွေခြင်းအစီအစဉ်မှာ လက်ခံနိုင်ဖွယ်ရှိပြီး အောက်ပါတို့ကို ထည့်သွင်းစဉ်းစားပါက အဆင်သင့်စီမံခန့်ခွဲနိုင်မည်ဖြစ်သည် __

- စီမံကိန်းအား သက်ဆိုင်ရာတည်ဆဲဥပဒေများ၊ သတ်မှတ်ချက်များ၊ လုပ်ငန်းနယ်ပယ်ဆိုင်ရာ လမ်းညွှန်ချက်များ နှင့် သဘာဝပတ်ဝန်းကျင်စီမံခန့်ခွဲမှုဆိုင်ရာ Shell ၏ ကော်ပိုရိတ် မျှော်လင့်ချက်များ (အခန်း ၂ နှင့် ၃ ကိုကြည့်ပါ) နှင့်အညီ ဆောင်ရွက်မည်ဖြစ်သည်။
- လုပ်ငန်းဆောင်ရွက်မှုများနှင့်ကိုက်ညီမှုရှိသော သဘာဝနှင့်ကိုက်ညီမှုနှင့် လုပ်ငန်းဆောင်ရွက်မှုပမာဏ(အခန်း ၄)
- စီမံကိန်းတည်နေရာ (ဥပမာ-ကမ်းလွန်ပင်လယ်ရေပြင်) နှင့် အဓိက ဒဏ်မခံနိုင်သည့်နေရာများနှင့် အကွာအဝေး (**အခန်း ၅**)
- သဘာဝပတ်ဝန်းကျင်ဆိုင်ရာသက်ရောက်မှုများနှင့် အန္တရာယ်များအားလုံးအား သင့်တော်သောလျော့ချမှုလုပ်ငန်းစဉ်များအား အသုံးချပြီး စီမံခန့်ခွဲနိုင်ကြောင်း တင်ပြထားသည်။ (အခန်း ၆ တွင် တင်ပြထားသည့်အတိုင်းဖြစ်သည်။)
- ရေနံရှာဖွေခြင်းစီမံကိန်းနှင့်ဆက်နွယ်နေသော သဘာဝပတ်ဝန်းကျင်နှင့် လူမှုရေးသက်ရောက်မှုများ ကို စီမံခန့်ခွဲရန်အတွက် သက်ရောက်မှုလျော့ချရေး လုပ်ငန်းစဉ်များအား ရှင်းလင်းစွာ ဖော်ပြထားပြီး ထိရောက်စွာ

အကောင်အထည်ဖော်နိုင်ရေးအတွက်လည်း ရှင်းလင်းသည့် တာဝန်နှင့်ဝတ္တရားများကို သတ်မှတ်ထားသည်။ (အခန်း ၈ တွင်ကြည့်ပါ)

- အဆိုပြုထားသောလုပ်ငန်းဆောင်ရွက်မှုများအတွက် ပူးပေါင်းလုပ်ကိုင်သူများ ဆွေးနွေးတိုင်ပင်အကြံပြုချက်များက ကျယ်ပြန့်သော ထောက်ပံ့မှုကို ပြသပြီးဖြစ်သည်။ (အခန်း ၉)

Shell ၏ သဘာဝပတ်ဝန်းကျင်နှင့် လူမှုရေးစွမ်းဆောင်မှုများဆိုင်ရာ ရည်ရွယ်ချက်များနှင့် ကိုက်ညီမှုရှိစေရန်နှင့် ဝတ္တရားများအား အကောင်အထည်ဖော်ဆောင်ရွက်နိုင်ခြင်းရှိမရှိကို စစ်ဆေးရန်အတွက် အခန်း-၈ တွင်ဖော်ပြထားသော EMP တွင် ကန်ထရိုက်တာ၏ လုပ်ငန်းစွမ်းဆောင်ရည်အား သုံးသပ်စစ်ဆေးခြင်းပြုလုပ်ပြီး ထိရောက်မှုကို တိုင်းတာခြင်းဆိုင်ရာ သတ်မှတ်ချက်များပါဝင်သည်။

၁.၅ တိုးပွားလာမည့်သက်ရောက်မှုများ

တိုးပွားလာမည့်သက်ရောက်မှုများအား ဆန်းစစ်လေ့လာမှု၏ ရည်ရွယ်ချက်မှာ ယင်းသို့သော သဘာဝပတ်ဝန်းကျင်နှင့် လူမှုရေးဆိုင်ရာ ကိစ္စရပ်များသည် ၄င်းတို့ချည်းဘဲဆိုလျှင် ထူးခြားသော သက်ရောက်မှု ဖြစ်မလာနိုင်သော်လည်း ယခင်က ကျန်ရှိခဲ့သော သက်ရောက်မှုအပေါင်းများ သို့မဟုတ် လက်ရှိ သို့မဟုတ် ဤစီမံကိန်းနှင့်/သို့မဟုတ် အခြားစီမံကိန်းများကို အနာဂတ်တွင်ဆက်လက်ဆောင်ရွက်ရာမှ ဖြစ်လာနိုင်မည့်သက်ရောက်မှုများနှင့် ပူးပေါင်းမိသွားသောအခါ ပိုမိုကြီးမားပြီးပိုမို အရေးပါသော သက်ရောက်မှု (များ) ဖြစ်လာစေနိုင်သည့် သက်ရောက်မှုမျိုးဟုတ်မဟုတ် ခွဲခြားသိရှိစေရန်ဖြစ်သည်။

ယခုလေ့လာမှုနှင့်ဆက်နွယ်သော အန္တရာယ်များနှင့် သက်ရောက်မှုများအား ဆန်းစစ်အကဲဖြတ်သုံးသပ်ရာတွင် ကပ်လျက်ရှိသော လုပ်ကွက်များတွင် တစ်ပြိုင်နက်ဆောင်ရွက်နေသော လုပ်ငန်းများကိုပါ ထည့်သွင်းစဉ်းစားလျက် အဓိကအလားအလာရှိသော တစ်စတစ်စတိုးပွားလာနိုင်သည့် သက်ရောက်မှုဖြစ်စဉ်များကို ဖော်ထုတ်ထားသည်။

- တတ်နိုင်သမျှ ငါးဖမ်းဇရိယာကို ယာယီလျော့ချရာတွင် သက်ရောက်မှုတိုးပွားခြင်း
- ရေအောက်သို့ပစ်လွှတ်မည့်အသံဒဏ်ကိုမခံနိုင်သောရေသတ္တဝါများအတွက်ယင်းအသံ၏တိုးပွားလာနေသောသက်ရောက်မှု

တတ်နိုင်သမျှ ငါးဖမ်းဇရိယာကို ယာယီလျော့ချရာတွင် သက်ရောက်မှုတိုးပွားခြင်း

IEE လေ့လာမှုများပြုလုပ်ရာတွင်ရရှိခဲ့သော အချက်အလက်များကို အခြေခံကြည့်သောအခါ ယင်းဒေသတွင်ဆောင်ရွက်နေသော ငါးဖမ်းလုပ်ငန်းများမှာ အကန့်အသတ်ရှိသော်လည်း တူနာငါးဖမ်းလုပ်ငန်းကို ဆောင်ရွက်နိုင်မည့် အလားအလာရှိနေမည်ဟု မျှော်လင့်ရသည်။ MD-5, MD-15 နှင့် MD-4 လုပ်ကွက်များအတွင်း တစ်ပြိုင်နက် ဆောင်ရွက်သော ဆိုက်စမစ်မြေတိုင်း လုပ်ငန်းများ ကြောင့် ယင်းငါးဖမ်းလုပ်ငန်းတွင် ဖြစ်ပေါ်လာနိုင်သည့် သက်ရောက်မှုကို ထည့်သွင်းတွက်ချက်ပြီး ဖြစ်သည်။

ယင်းကမ်းလွန်လုပ်ကွက်များမှာ အလွန်ကြီးမားပြီး လက်ရှိလုပ်နိုင်မည့် ဇရိယာအတွင်းတွင် ယာယီလုပ်၍မဖြစ်မည့် ဇရိယာမှာ ရာခိုင်နှုန်းနည်းပါးလှသည်။ ထို့ကြောင့် MD-5 လုပ်ကွက်အပြင် ၄င်းနှင့် တစ်ပြိုင်နက်တည်းလုပ်ကိုင်နေသည့် အခြားသော လုပ်ကွက်တစ်ခုတွင် ဆောင်ရွက်နေသော အလားတူ မြေတိုင်းလုပ်ငန်းများ၏ သက်ရောက်မှုများမှာ ကြီးမားပြင်းထန်မှု မရှိပါ။ CSEM မြေတိုင်းလုပ်ငန်းကို လက်ရှိတွင် ၂၀၁၆ ခုနှစ် တတိယသုံးလပတ်ကာလတွင်စတင်ဆောင်ရွက်ရန် သတ်မှတ်ထားပါသည်။ ယင်းလုပ်ငန်းက ယာယီဖြစ်ပြီး လုပ်ကွက်အတွင်း စုစုပေါင်းငါးဖမ်းဇရိယာများကိုယာယီလျော့ချခြင်းကို ၂ လခန့်အထိ ဆောင်ရွက်ပါမည်။ အခြားကပ်လျက်ရှိနေသော လုပ်ကွက်များတွင်မည်သည့် မြေတိုင်းလုပ်ငန်းကိုမှ ယခု CSEM ဆောင်ရွက်နေချိန်တွင် ဆောင်ရွက်နေခြင်းမရှိဟု မျှော်လင့်ရပါသည် သို့မဟုတ် သိထားပါသည်။ သက်ရောက်မှုများစုပေါင်းခြင်းကို လျစ်လျူရှုထားနိုင်ပါသည်။

ရေအောက်သို့ပစ်လွှတ်မည့်အသံဒဏ်ကိုမခံနိုင်သောရေသတ္တဝါများအတွက် ယင်းအသံ၏ တိုးပွားလာနေသောသက်ရောက်မှု

ကမ်းလွန်လုပ်ကွက်များက အလွန်ကြီးမားလှသော်လည်း ရေနေသတ္တဝါများအတွက် သက်ရောက်မှုစုဝေးများပြားလာရန် အလားအလာရှိနေပါသည်။ အထူးသဖြင့် ကပ်လျက်ရှိသည့် တစ်ခုထက်ပိုသော လုပ်ကွက်များတွင် ဆောင်ရွက်သည့် ဆိုက်စမစ်

မြေတိုင်းလုပ်ငန်းများလုပ်ဆောင်နေချိန်တွင် ရေနေနို့တိုက်သတ္တဝါများကို သက်ရောက်မှုများရှိနေပါသည်။ ယင်း မြေတိုင်းလုပ်ငန်းများဆောင်ရွက်နေစဉ်တွင် ဆိုက်စမစ်မြေတိုင်းလုပ်ငန်းနှစ်ခုသည် အနည်းဆုံး ၅၀ မှ ၁၀၀ ကီလိုမီတာ အကွာအဝေးတွင် ရှိနေမည်ဟု ခန့်မှန်း ထားပါသည်။

ကျန်ရေနေသတ္တဝါများအပေါ် သက်ရောက်မှု

MD-5 လုပ်ကွက်နှင့် ကပ်လျက်တည်ရှိနေသော လုပ်ငန်းဆောင်ရွက်မှုများရှိ ဖြစ်နိုင်ချေရှိသော အပြန်အလှန်ဆက်သွယ်မှုများကို သုံးသပ်မှုအား ထည့်သွင်းစဉ်းစားကြည့်ရာတွင် ရေအောက်သို့ပစ်လွှတ်မည့်အသံဒဏ်ကိုမခံနိုင်သော ရေသတ္တဝါများနှင့် ငါးဖမ်းလုပ်ငန်းများအတွက် အတွက် ယင်းအသံ၏ တိုးပွားလာနေသောသက်ရောက်မှုကို ဒေသခံများအတွက် အားနည်းသော သက်ရောက်မှုအဖြစ် သတ်မှတ်သည်။

၁.၆ သဘာဝပတ်ဝန်းကျင်စီမံခန့်ခွဲမှုအစီအစဉ် (EMP)

EMP သည် Shell ၏ ကတိကဝတ်ပင်ဖြစ်သည်။ Shell သည် သက်ရောက်မှုလျော့ချရေးလုပ်ငန်းရပ်များကို မြေတိုင်းလုပ်ငန်းကန်ထရိုက်တာများအား လုပ်ငန်းအစီအစဉ်များ နှင့် လုပ်ငန်းစဉ်များအဖြစ်သို့ သင့်တော်သလို ပြောင်းလဲ လုပ်ကိုင်ရန် ဖြစ်သည်။ ယင်းအသေးစိတ်အစီအစဉ်များနှင့်လုပ်ငန်းစဉ်များကို ဆိုက်စမစ်ကန်ထရိုက်တာက Shell နှင့် ညှိနှိုင်း တိုင်ပင်ပြီး Shell မပါဝင်ဘဲ ရေးဆွဲချမှတ်မည်ဖြစ်သည်။ Shellသည် မြေတိုင်းလုပ်ငန်းဆောင်ရွက်နေစဉ်ကာလအတွင်း EMP အား ထိရောက်စွာအကောင်အထည်ဖော်နိုင်စေဖို့ စီမံပေးရန်အတွက်သာ တာဝန်ခံသည်။ယင်းကို အကောင်အထည်ဖော်ရန်အတွက် Shell ၏ လုပ်ငန်းဦးဆောင်မှုဖြင့် အပြည့်အဝ တာဝန်ခံသည်။

ယင်း EMP တွင် Shell ၏ သဘာဝပတ်ဝန်းကျင်နှင့် လူမှုစွမ်းဆောင်ရေးဆိုင်ရာရည်ရွယ်ချက်များ ပြည့်ဝပြီး အဓိဋ္ဌာန်များကို အကောင်အထည်ဖော်နိုင်စေရန်အတွက် ကန်ထရိုက်တာ၏ လုပ်ငန်းစွမ်းဆောင်ရည်အား သုံးသပ် စစ်ဆေးပြီး ထိရောက်မှုကို တိုင်းတာရန် အထောက်အပံ့ပေးခြင်း ပါဝင်သည်။

Shell သည် စာချုပ်ပါအတိုင်း မြေတိုင်းကန်ထရိုက်တာ(များ) ကို အသေးစိတ်အစီအစဉ်များနှင့် လုပ်ငန်းအစီအစဉ်များကိုရေးဆွဲရန်နှင့် EMP နှင့်အညီ လက်တွေ့ပြသရန်တောင်းဆိုမည်ဖြစ်သည်။ ယင်းအစီအစဉ်များနှင့် လုပ်ငန်းစဉ်များတွင် အောက်ပါတို့ကို ကန့်သတ်မထားပါ __

- နို့တိုက်ရေသတ္တဝါများအတွက် အနောင့်အယှက်ဖြစ်စေမှုကို လျော့ချခြင်းဆိုင်ရာ ကျင့်ထုံး
- ဖိတ်စင်မှုကိုကိုင်တွယ်ခြင်းအစီအစဉ်
- စွန့်ပစ်ပစ္စည်းစီမံကိုင်တွယ်မှုအစီအစဉ် နှင့်
- ငါးဖမ်းလုပ်ငန်းများနှင့် ပူးပေါင်းဆောင်ရွက်မှု တို့ဖြစ်သည်။

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1. Executive Summary

1.1 Introduction

This impact assessment study report has been prepared in respect of activities to be conducted within the Offshore Licence block MD-5 in the Andaman Sea. The block is located in deep water offshore Myanmar as shown in **Figure 1-1**.

On 5th February 2015, Shell Myanmar Energy Pte Ltd (hereafter called "Shell") and its partner Mitsui Oil Exploration Co. Ltd. group (MOECO) signed three exploration and production sharing contracts (PSCs) with Myanma Oil and Gas Enterprise (MOGE) of the Republic of the Union of Myanmar for offshore deep-water blocks AD-9, AD-11 and MD-5. This marked the Shell Group's return to upstream oil and gas operations in Myanmar.

Shell as operator for the activities under the PSC is responsible to MOGE for the execution of oil and gas operations within the block in accordance with the terms of the PSC. Therefore, on behalf of MOGE, Shell and MOECO, proposes to undertake an exploration survey programme in Block MD-5. Block MD-5 covers an area of 2,452 Sq. Miles or 6,350.65 km^2 and its eastern boundary lies approximately 230 km west of the shoreline of Kyunsu Township, Myeik district, State division of Tanintharyi and approximately 120 km west of Great Western Torres Island, Kyunsu Township, Myeik district, State division of Tanintharyi on the Myanmar Coast.

The proposed survey programme consists of exploration survey operations carried out from a survey vessel with assistance of smaller support vessels, and it is currently scheduled to take place between 4th Quarter 2015 and 4th Quarter 2016. Due to the sensitivity of the survey programme to severe weather, it may be conducted over two seasons. The exploration survey programme proposed for Block MD-5 consists of obtaining in excess of approximately 2,680 km^2 (and up to 3,500 km^2) three-dimensional (3D) offshore seismic data followed by a smaller targeted Controlled Source Electro-Magnetic (CSEM) survey (approximately 385 km^2). The extent of the CSEM activities cannot be determined in detail prior to 3D acquisition, but will be significantly smaller in coverage than the 3D survey.

Jacobs Group Pty Limited, International Environmental Management Co. Ltd. (IEM) and Environmental Quality Management Co. Ltd (EQM) have been contracted by Shell to conduct an Initial Environmental Examination (IEE) for the proposed Block MD-5 Project ("the Project"), and to develop an associated Environmental Management Plan (EMP) to eliminate or minimise impact where possible.

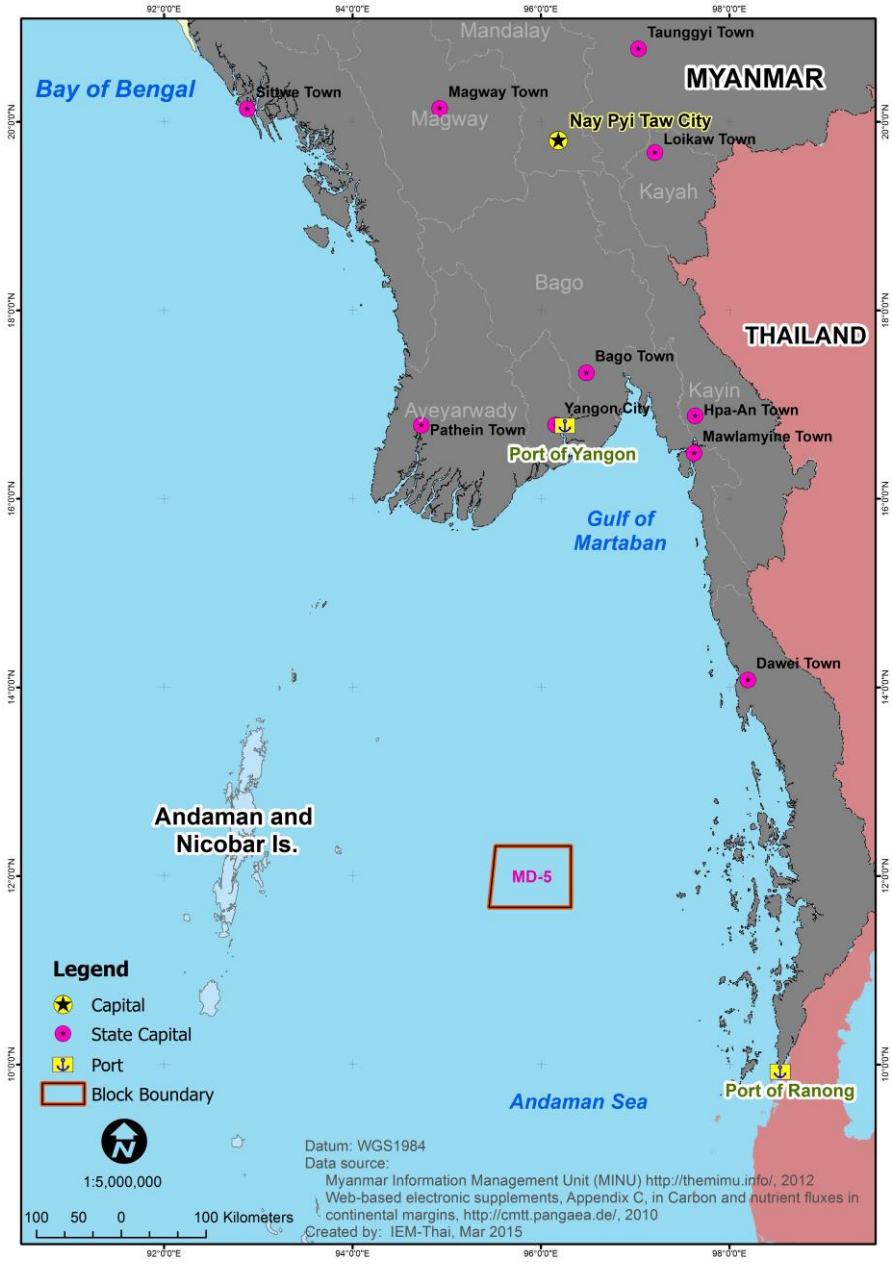

Figure 1-1: Block MD-5 Project Location

1.2 PROJECT DESCRIPTION

1.2.1 Overview

The purpose of the surveys is to map geological structures under the seabed, to help determine the potential presence of hydrocarbon bearing prospects. The 3D seismic survey will cover an area in excess of 2,680 km^2 (and up to 3,500 km^2), and in combination with the CSEM survey, it will fulfill the survey commitments of the PSC for Block MD-5. The survey activities will be carried out in water depths ranging from 2,100 to 2,600 m.

The 3D seismic survey is scheduled to commence in November 2015 or soon thereafter. The CSEM survey will follow during 3rd or 4th Quarter of 2016 concentrating on areas identified from the initial processing of the data acquired in the 3D survey.

1.2.2 3D Seismic Survey

Seismic surveying is an essential part of exploring for oil and natural gas. Marine seismic surveying applies the science of sound energy and seismology to map geological structures under the seabed. Towed devices produce bursts of acoustic (sound) waves that travel through the water column and into the seabed, and then reflected back to receivers that measure the strength and return time of each wave.

The reflected signals are combined and interpreted electronically. The data provides information in relation to the depth, position and shape of underground geological formations that may contain crude oil or natural gas.

Marine seismic surveys require a specialised ship typically 75 to 90 metres long with a crew of mariners, survey engineers and technicians. During a survey, the seismic vessel travels over a predetermined survey pattern and tows underwater equipment (air gun arrays) immediately behind the ship to generate sound waves; as well as several long cables or "streamers," each containing evenly spaced individual listening devices called hydrophones. The seismic streamers are typically between 6 and 10 km in length but can in some circumstances be as short as 4 km or as long as 16 km.

Once the data are compiled, a computer-generated map of the subsurface geology is produced. Interpretation of the 3D data provides a detailed image of subsurface features (**Figure 1-2**).

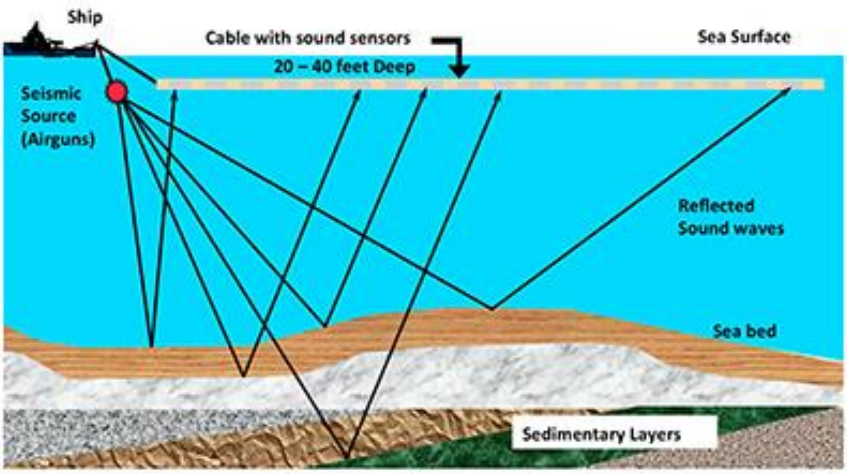

Figure 1-2: Seismic survey schematic

Source: http://www.energytomorrow.org/, 2015

1.2.3 CSEM Survey

Following the 3D survey and subject to initial processing of the acquired data, Shell proposes to carry out a limited CSEM survey in specific locations identified during the acoustic survey. CSEM surveying uses the difference in electrical resistivity to identify subsurface water and hydrocarbon reservoirs, and used in combination with data obtained from traditional 3D seismic survey, it will improve the ability to distinguish potential hydrocarbon reservoirs from other geological features in MD-5.

During the survey, a horizontal electric dipole is towed about 30 m above the seabed. The dipole transmits a carefully designed, low-frequency electromagnetic signal into the subsurface. Different rock types, water and hydrocarbons alter the properties of the electromagnetic field as it passes through them. The electromagnetic energy is attenuated rapidly in conductive sediments, but is attenuated less and propagated faster in more resistive layers such as hydrocarbon-filled reservoirs.

Receivers placed in a grid on the seabed measure the energy that has propagated through the sea and the subsurface (**Figure 1-3**) and record these variations in electromagnetic field properties.

A submerged electrical source powers the dipole, i.e. two antennae located between 50 - 300 m apart along a cable attached to the electrical source. The survey vessel generates the electrical power which is supplied to

the submerged electrical source through the combined power and tow line. The electromagnetic fields generated are very weak, and at a distance of approx. 4 metres from the antennae, are comparable to the Earth's magnetic field.

The seabed receivers have detachable, concrete anchor bases, each of which has a footprint of approx. 1 m^2. Once the survey is completed the receivers are detached from the anchor bases and rise to the surface for recovery. The anchors left on the seabed will disintegrate over about 6 – 8 months.

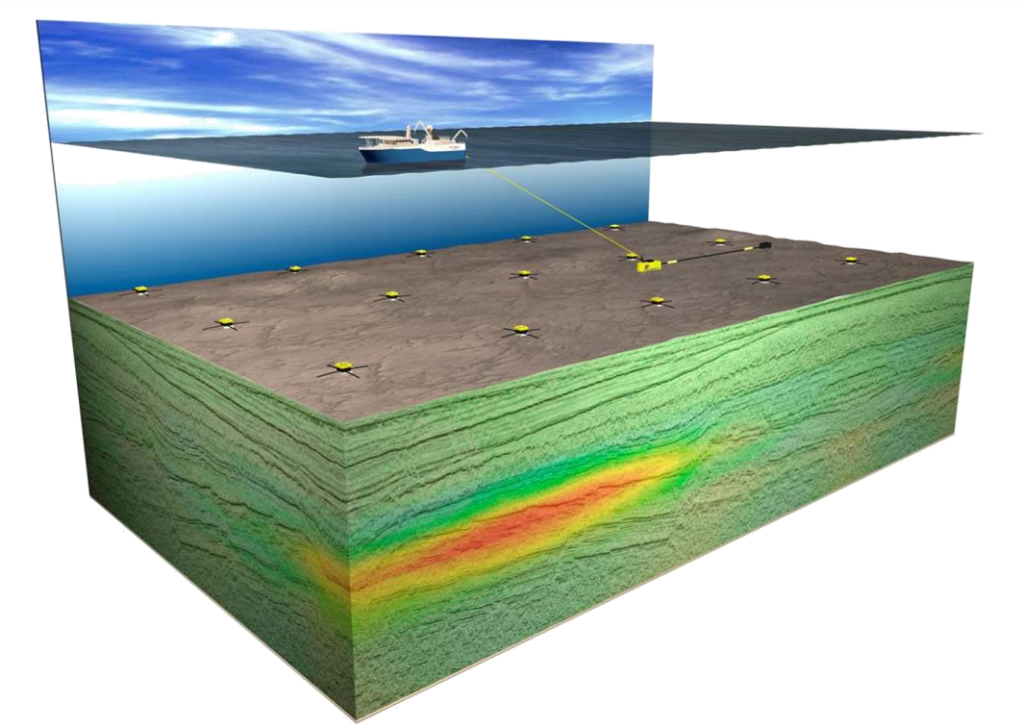

Figure 1-3 Schematic of CSEM survey technique

Source: http://www.emgs.com/, 2015

1.2.4 Workforce

The seismic survey is estimated to employ up to 110 people. This includes 60 personnel on the seismic acquisition vessel, 48 between the support vessel and the chase vessels, and 2 people on shore base for approx. 60 days.

The CSEM survey is estimated to employ about 52 people: 42 personnel on the CSEM acquisition vessel, a provisional 8 allowing for a support vessel (if required) and 2 people on shore base for approx. 60 days.

1.2.5 Transportation

The survey vessels are expected to mobilise out of an international port (e.g. Singapore or Yangon). The survey vessels are self sufficient, and, if any further supplies become necessary, support will be obtained by the supply vessel via Ranong (Thailand) or Yangon as and when required. Refuelling of the survey vessels is likely to be completed at sea as required, from the supply vessel.

Crew change for survey vessel personnel is usually conducted at five week intervals. Crew change will conducted by ship to ship transfer via the supply port in Ranong or Yangon.

In the event of a medical emergency the survey vessel is equipped with a fully equipped clinic and carries a trained medical personnel. An emergency response plan including medical evacuation will be established by the Contractor and Shell prior to the survey being mobilised.

1.2.6 Shore Base / Port

It is likely that the Contractor will have 1 or 2 personnel based at the shore base for the duration of the seismic survey. The shore base has not yet been selected, but is likely to be Ranong or Yangon.

1.2.7 Emissions, Discharges and Waste Generation

1.2.7.1 Air Emissions

Air emissions will arise from the operation of the survey vessels, mainly resulting from engine combustion of hydrocarbon fuels. Air pollutants emitted include carbon monoxide (CO), carbon dioxide (CO_2), nitrogen dioxide (NO_2) and sulfur dioxide (SO_2). CO_2 associated with the combustion process is a greenhouse gas (GHG), considered to contribute to climate change. The total release of greenhouse gas emissions (expressed as CO_2 equivalent) during the seismic and CSEM operations is estimated to be 19,619 tonnes, which represents approx. 0.01% of Myanmar's national CO_2 equivalent GHG emissions.

1.2.7.2 Sanitary Wastewater

Wastewater in the form of grey and black water will arise from the operation of the vessels. The total quantity estimated for the seismic survey is approx. 490 m^3 of black water and 720 m^3 of grey water for 60 days of operation with a maximum crew number of 108. The total wastewater quantity for the CSEM Survey is estimated to be approximately 230 m^3 of black water and 330 m^3 of grey water for 60 days of operation with a maximum crew number of 50. Any discharge to sea of sanitary wastewater from the survey and support vessels will be at a distance of over 12 nautical miles from the nearest shore in compliance with MARPOL 73/78 (Annex IV) requirements.

1.2.7.3 Drainage / Bilge Water

Drainage water consists of ballast water and deck drainage from survey and support vessels, and may be contaminated with oil and grease. Drainage will be collected and treated in a dedicated oil/water separator, installed on each vessel. The oil/water separator will separate water from oil prior to discharging the treated water portion to the sea. Treated drainage water discharged from the vessels will comply with MARPOL 73/78 Annex I requirements. These regulate maritime pollution prevention and set limits for vessel and ship drainage (oil content < 15 ppm prior to discharge).

1.2.7.4 Solid Waste

Offshore seismic surveys generally do not produce significant quantities of waste other than conventional ship waste. All waste arising in the course of the two surveys will be classified by type prior to treatment, transport, disposal or recycling. A Waste Management Plan will form part of the Seismic Operator's (Contractor) environmental management and compliance plan. Project vessels will have a garbage management plan, in accordance with International Maritime Organization (IMO) Guidelines.

1.3 Existing Environmental and Social Setting

1.3.1 Physical Environment

The study area for this project is focused on the coastal and offshore areas of the Tanintharyi Coastal Zone where Block MD-5 is located. The Tanintharyi Coast is the longest coastal zone in Myanmar, approx. 1,200 km long. It includes the Myeik Archipelago (also called the Mergui Archipelago), comprising more than 800 islands.

In the Andaman Sea, water circulates from the north Indian Ocean, Bay of Bengal, southwards along the coast of Myanmar and Thailand, extending southwest of Phuket Island and turning to the Indian Ocean. The southern water mass circulates from Malacca Strait northwards to the southwest coast of Phuket Island, meeting with the northern water mass and moving offshore to the Indian Ocean. The oceanic flow changes direction twice during the year; it is cyclonic during the spring and early summer and anticyclonic the rest of the year.

The tides along the Tanintharyi coast and along the west coast of Thailand are semidiurnal, with a small diurnal inequality in both time and height. The average depth of the Andaman Sea is about 1,000 metres (3,300 ft). The

northern and eastern parts are shallower than 180 metres (600 ft) due to the silt deposited by the Irrawaddy River. This major river flows into the sea from the north through Myanmar. The western and central areas are 900–3,000 metres deep (3,000–10,000 ft). Less than 5% of the sea is deeper than 3,000 metres (10,000 ft), and in a system of submarine valleys east of the Andaman-Nicobar Ridge, the depth exceeds 4,000 metres (13,200 ft).

Representative water quality data shows the Andaman Sea surface temperatures are between 29 and 30°C. Low salinity and high temperature is observed at the surface level. The pH at the surface varies between 8.36 – 8.33. Surface dissolved oxygen in the Andaman Sea is typically within the range of 3.95 – 4.93 ml / l. A thermocline layer in the area is detectable between 30 to 211 metres depth, where rapid changes of salinity, dissolved oxygen and pH with increased depth can be observed. At a greater depth, salinity and pH are nearly stable, while dissolved oxygen has a slight increase with increased depths.

1.3.2 Biological Environment

Myanmar straddles four biogeographic regions: sub-continental Asia, Palearctic central Asia, Indochina and Malaysia (Sundaic), the latter two also referred to as the Southeast Asian or Oriental region. Its diverse flora and fauna is attributable to the mixing of these broadly varying regions.

According to BANCA (2011), about 250 mammal species, more than 1,000 birds, 370 reptiles and 7,000 plants have been recorded in Myanmar. Of these, 39 species of mammals, 45 of birds, 21 of reptiles and 38 of plants are globally threatened (NCEA, 2009). Seventy six Key Biodiversity Areas (KBAs) have been identified, out of which 54 are recognized as Important Birds Areas (IBAs) (BLI, 2005). Only one Ramsar Site has been designated so far (overlaps with an IBA), and an additional 34 potential Ramsar Sites have been identified in the country (BLI, 2005).

The Cruise Report “Dr. Fridtjof Nansen”, Ecosystem Survey Myanmar, 2013, provides the most comprehensive and recent information on Myanmar’s marine environment, and includes a summary of sea bed conditions, fish and marine fauna occurrence, plankton and nutrients (IMR-Norway and DOF-Myanmar, 2013). Data was collected from 145 fishing stations and 444 species belonging to 129 fish families were recorded. Of cartilaginous species the catches showed: 32 shark species belonging to 11 different families, 20 ray species from 5 families and 2 species of chimaeras from two different families. 235 different taxonomic entities were identified on the Rakhine Coast, while 352 entities were identified in the delta area and 329 entities on the Tanintharyi coast.

From literature analysis, 565 species of corals (24 islands of Myeik Archipelago), 10 species of seagrass, 5 species of turtle, 92 species of mangrove and 30 species of marine mammals have been recorded in coastal and offshore areas of Myanmar.

The International Union for Conservation of Nature (IUCN) Red List of Threatened Species is widely recognized as the most comprehensive, objective global approach for evaluating the conservation status of plant and animal species. A species is determined to be threatened if it is rated as Critically Endangered (CR), Endangered (EN) or Vulnerable (VU) in the IUCN Red List of Threatened Animals.

Myanmar has about 1,000 bird species. Of these, five are endemic to Myanmar, 45 species are classed as threatened in Myanmar. None of these are marine seabirds.

There are 7 threatened marine mammal species confirmed or potentially occurring in Myanmar’s maritime territorial waters as follows:

- Endangered
  - Blue Whale (*Balaenoptera musculus*)
  - Fin Whale (*Balaenoptera physalus*)
- Vulnerable
  - Indo-Pacific finless porpoise (*Neophocaena phocaenoides*)
  - Sperm Whale (*Physeter macrocephalus*)
  - Irrawaddy Dolphin (*Orcaella brevirostris*)
  - Dugong (*Dugong dugon*)
- Near Threatened
  - Indo-Pacific humpback dolphin (*Sousa chinensis*).

Five of the world's seven marine turtle species, the Hawksbill (*Eretmochelys imbricata*), Green (*Chelonia mydas*), Loggerhead (*Caretta caretta*), Olive Ridley (*Lepidochelys aolivacea*), and Leatherback (*Dermochelys coriacea*) are found in territorial waters of Myanmar. All five species are classified as threatened. The only "threatened" reptile species is the Critically Endangered (CR) Siamese crocodile (*Crocodylus siamensis*) (IUCN, 2014). Several species of shark are classed as threatened, including the whale shark (*Rhincodon typus*), which occur in Myanmar's marine waters.

The Marine Protected Areas (MPAs) nearest the project activity are Mainmahla Kyun Wildlife Sanctuary, and Thamihla Kyun Wildlife Sanctuary, Moscos Island Wildlife Sanctuary, Lampi Island National Park and the Shark Protected Area. Of these, the closest protected area is Lampi Island MPA located approximately 200 km to the southeast, and Moscos Island Wildlife Sanctuary located approximately 240 km to the northeast of Block MD-5. It should be noted that there are no protected areas in or near the area of the proposed exploration surveys.

1.3.3 Human Use Values

There is no resident population in the offshore project area. The quality of life issues addressed pertain to certain parts of the population in Tanintharyi coastal communities and the general population of Myanmar. People along the coast generally live in small villages. Data for the socio-economic baseline of the Project area has been derived from a review of various technical reports, government, and on-line sources as well as from local consultation undertaken in coastal communities in Ka Lwin, Myeik, Tanintharyi Region.

Myanmar has significant fisheries potential in its marine waters, and the offshore area is subject to regulation and licensing. The total marine fisheries area in Myanmar, including the exclusive economic zone (EEZ), is about 486,000 square kilometres. The Exclusive Economic Zone (EEZ) of Myanmar occupies the eastern part of Bay of Bengal and northern part of Andaman Sea.

Pelagic fisheries are economically important to Myanmar. Therefore, Myanmar is exerting efforts to manage and conserve its pelagic fish stocks in order to avert possible overexploitation of the fishery resources. Total fish production including aquaculture is estimated at 4.1 million tonnes in 2011 according to official (provisional) statistics. This includes 2.1 million tonnes from marine fisheries and about 1 million tonnes from inland fisheries, consisting of so-called lease fisheries and other types of capture fisheries (BOBLME, 2012). The aquaculture industry comprises freshwater culture, brackish-water systems, ornamental fish production and fingerling production. 449,694 hectares have been established for shrimp and freshwater fish farming in Myanmar, with an estimated aquaculture production of 929,360 tonnes during 2012-2013.[1]

Offshore fishery for tuna and other large pelagic species is gradually being developed, and is currently producing nearly 200 tonnes per annum. Long lining in the Myanmar EEZ is licensed, and started with the issuing of experimental licenses to 12 foreign fishing vessels in 1999-2000. In 2010-2011 the number of licensed vessels had increased to 109. According to the "Law Relating to Fishing Rights for Foreign Fishing Vessels" tuna long-ling fishing operations in Myanmar EEZ are only permitted outside of the territorial limit. All of the tuna caught by foreign long line fishing vessels is exported, and none of the catch is landed in Myanmar. There is currently no developed market in Myanmar for tuna.[2]

According to Myanmar Fisheries Federation (pers. comm), the Myanmar fishing fleet is currently unable to cover this market, hence foreign vessels are being allowed to fish for tuna. Tuna fishing licenses are issued by DOF[3], and there are large long lining foreign tuna vessels fishing in the Andaman Sea particularly around Coco Island and the Myeik Archipelago.

Marine traffic in the Andaman Sea consists of fishing vessels and commercial ships, and a major oil tanker lane to the Malacca Strait goes through the area. Existing shipping data shows primary activity occurring to the west and to the east of Block MD-5.

[1] DOF, Fisheries Statistics 2001-2013, Department of Fisheries.

[2] Presentation on Present Status of Off-shore Fishery Resources and Information on Tuna Fishery in MYANMAR. Julius Kyaw Department of Fisheries MYANMAR, Special Meeting on Improvement of Tuna Information and Data Collection in the Southeast Asia 7-9 September, 2011. Songkhla Province, Thailand.

[3] IEM correspondence with MFF on July 2, 2015

1.4 Environmental and Social Impacts

1.4.1 Methodology

Potential environmental and social impacts arising from routine (planned) activities have been assessed, as have those that could result from credible accidental or unplanned events within the project scope (e.g. a fuel spill).

Assessment of the level of significance has included consideration of the likelihood and impact characteristics (i.e. magnitude of the environmental effect, its geographical scale and duration in relation to the sensitivity of the key receptors and resources considered).

Measures to prevent or mitigate (reduce) the severity of potentially significant impacts have been developed and linked back to the related activities, and form the basis of an Environmental Management Plan (EMP). The EMP brings together the environmental and social mitigation needed to prevent or reduce the potential impacts of the project, and forms part of the IEE Report and Shell's commitment to the project.

An objective of the impact assessment process is to understand the significance of any residual impacts that will remain after mitigation measures have been applied and if some form of monitoring or measurement might be justified. The evaluation of residual impacts in this IEE has taken into consideration the mitigation measures that Shell has committed to implement, and which are contained in the EMP.

1.4.2 Summary of Impact Assessment and Mitigation Measures

Table 1-1 to **Table 1-3** summarise the potential impacts identified during the assessment of the MD-5 exploration survey programme activities. All impacts are considered to be readily manageable through standard operating procedures and/or through appropriate mitigation measures.

Table 1-1: Summary of Environmental Impact Conclusions

Aspect	Activity	Potential Impact	Mitigation Measures	Impact Characteristics	Magnitude	Residual Significance
Underwater Noise	Operation of airgun array source (seismic source noise) Transportation, Equipment & Supplies (vessel-related noise)	Behavioural and physiological effects on marine mammals (cetaceans), turtles, fish and invertebrates Disturbance to marine mammals (cetaceans), turtles, fish and invertebrates.	• Code of Conduct – aligned with the JNCC (2010) 'Guidelines for minimising the risk of injury and disturbance to marine mammals from seismic surveys' as adopted by the International Association of Geophysical Contractors (IAGC).	Localised, short-term, reversible	Moderate	**Minor**
Electromag-netic Pulse Emissions	CSEM unit electromagnetic pulsing	Disturbance to fish, cetaceans and sea turtles.	• At present, there are no prescribed mitigations specific to EM surveys.	Localised, short-term, reversible	Minor	**Negligible**
Physical Presence of Marine Anchors	Deployment, presence and eventual biodegradation of CSEM anchors (Receivers)	Seabed disturbance Disturbance of benthic habitats and organisms in immediate vicinity. Smothering of benthic habitat immediately underneath the anchors. Changes in local water quality due to biodegradation of concrete blocks.	• CSEM receivers to be placed on the seabed with biodegradable cement anchors that break down in 6 to 8 months. • Use of small (1.0 m x 1.0 m x 0.25 m), dissolvable concrete weights.	Localised, short-term, reversible	Minor	**Negligible**
Artificial Light	Light emissions from vessels during hours of darkness	Behavioural effects on marine fauna (birds, turtles and fish).	• Deck lighting will be directed inwards where possible.	Highly localised, short-term, reversible	Minor	**Negligible**

Aspect	Activity	Potential Impact	Mitigation Measures	Impact Characteristics	Magnitude	Residual Significance
Atmospheric Emissions	Operation of combustion engines on vessels	Deterioration of local or regional air quality as a result of emissions.	• Adherence to MARPOL 73/78 Annex VI (Regulations for the Prevention of Air Pollution from Ships) requirements as appropriate to vessel class, including: o optimisation of fuel use to increase efficiency and minimise emissions; o emissions managed by the implementation of a planned maintenance system (PMS). • Routine inspection and preventive maintenance as per maintenance schedule or recommendation by manufactures to ensure efficiency of all machineries. • Strictly follow the instruction manual of equipment and machines, and keep them properly maintained. • Minimise survey delays and vessel operating time to the extent practicable.	Localised, short-term, reversible	Minor	**Negligible**
Routine Aqueous Discharges	Discharge of sewage waste	Localised reduction in water quality due to nutrient enrichment	• Sewage will be treated prior to disposal offshore in accordance with MARPOL regulations (Annex IV). • Survey and support vessels will have certified/approved sewage treatment plants.	Localised, short-term, reversible	Low	**Negligible**
	Discharge of treated oily water originating from deck drainage systems, bilges and machinery drainage	Localised reduction in water quality due to nutrient enrichment Toxic effects on marine fauna and flora	• Bilge and drainage water will be treated and disposed of in accordance with MARPOL 73/78 Annex I. • Bilge and drainage water with oil-in-water content exceeding 15 ppm will be contained and disposed of onshore. • Bilge and drainage water discharges recorded in the Oil Record Book.			
Solid Waste Management	Non-Hazardous solid waste generation onboard vessels	Deterioration of water quality and marine habitat.	• A Waste Management Plan for the operations will be developed and implemented by the survey contractor(s). • Waste will be segregated into recyclable and non-recyclable wastes where practicable, and stored in clearly marked containers for transport and disposal. • All garbage will be disposed of in accordance with MARPOL 73/78 Annex V. • Incinerators used aboard the survey and support vessels will be compliant with MARPOL / IMO requirements. • Food wastes will be macerated to a maximum particle size 25mm prior to being discharged to sea. • Hazardous waste inventory will form part of the waste management plan. • Any hazardous waste materials will be handled and stored in accordance with the corresponding Material Safety Data Sheet (MSDS). • All project vessels will have a garbage management plan, in accordance with IMO Guidelines. • If required by vessel class, project vessels will also carry a garbage record book in accordance with MARPOL 73/78 Annex V.	Localised, short-term, reversible	Low	**Negligible**

Table 1-2: Summary of Unplanned Impact Conclusions

Aspect	Activity	Potential Impact	Mitigation Measures	Impact Characteristics	Magnitude	Residual Significance
Vessel Interactions with Marine Fauna	Vessel Collisions Fauna entanglement in towed equipment	Physical effects on marine fauna particularly marine mammals (cetaceans) and sea turtles	• The Code of Conduct outlined in Section 6.4.1.3, in particular the management measures relating to the use of MMO onboard source vessels, including any vessel or towed equipment interactions with marine fauna will be recorded and reported in the MMO report. • Survey vessels will generally be travelling at low speed, between approximately 7 – 9 km/hr (4 – 5 knots). • Tail buoys on seismic streamers will be fitted with turtle exclusion devices if their design requires it.	Localised, short-term, reversible	Low	**Minor**

Accidental discharges (hydrocarbon spill)	Fuel spill (due to vessel collision, refuelling or other equipment or system failure)	Toxic effects on marine fauna and flora
		Localised reduction in water quality
		Indirect effects on offshore fisheries
			• Adherence to the requirements of the International Regulations for Preventing Collisions at Sea 1972 (COLREGS) Part B - Steering and Sailing (Rules 4-19) and Part C - Lights and Shapes (Rules 27) as appropriate to vessel class, including:
			  ○ Crew trained in accordance with COLREGS steering and sailing rules to prevent vessel collisions, including maintaining a proper look-out to prevent the risk of collision and maintaining a safe speed at all times to allow for avoidance of collisions;
			  ○ Display appropriate lights and warning signals on all vessels to prevent accidental collision.
			• At least 30 days prior to vessel mobilization, coordinate with MOGE, who will issue "Notice to Mariner" regarding project activities to appropriate parties (i.e. Department of Fisheries, Ministry of Livestock and Fisheries, and Marine Police Force).
			• Establish a safety zone around the seismic and CSEM vessels.
			• Use of chase vessels to warn other vessels/shipping of the navigation hazard posed by the survey vessels and towed equipment.
			• Any vessel collision incidents will be reported to the appropriate authorities in Myanmar (e.g. MONREC, the DMA and the Myanmar Navy).
			• Detailed records will be maintained of all vessel collision incidents.
			• Develop and implement Shipboard Oil Pollution Emergency Plan (SOPEP), kept onboard vessels, and conforming to MARPOL.
			• Weather reports received daily on the survey vessels.
			• Adverse weather contingency plan.
			• Refuelling at sea undertaken in daytime only and will follow standard operating procedures.
			• All hydrocarbons stored on deck will be stored in secured storage area.
			• Crew will have received training in, and be competent in, their emergency response roles, as appropriate.
			• Provide spill clean-up kits and training for designated rapid response team to clean up any spills.
				Localised, short-term, reversible	Minor	**Moderate**

Aspect	Activity	Potential Impact	Mitigation Measures	Impact Characteristics	Magnitude	Residual Significance
Accidental discharges (hydrocarbon spill) (Cont.)	Fuel spill (due to vessel collision, refuelling or other equipment or system failure) (Cont.)	Toxic effects on marine fauna and flora Localised reduction in water quality Indirect effects on offshore fisheries (Cont.)	• Appropriate medical care will be provided, clean-up will be carried out, and incident or accident reports will be filed. • All oil spills (>80L) will be documented and reported to MONREC. • Hydrocarbon spill containment and recovery equipment will be available near hydrocarbon storage. • Procedures for response to hydrocarbon spills will be detailed in Shell's ERP.	Localised, short-term, reversible	Minor	**Moderate**
Accidental Release (Chemical or Hazardous Waste)	Incorrect handling of chemical or hazardous waste	Toxic effects on marine fauna and flora Localised reduction in water quality Indirect effects on offshore fisheries	• All chemicals/hazardous materials handled and disposed of in accordance with MARPOL 73/78 Annex III. • Environmental induction for all personnel on survey vessels. • Proper training in the use and handling of the relevant chemicals and standard safety procedures implemented by all contractors. • Appropriate medical care will be provided, clean-up will be carried out, and incident or accident reports will be filed. • Provide spill cleanup kits and training for designated rapid response team to clean up any spills. • Store all chemicals in secured storage. • All chemical and hazardous wastes will be segregated into clearly marked containers prior to onshore disposal. • All storage facilities and handling equipment will be in good working order and designed in such a way as to prevent and contain any spillage as far as practicable. • The survey and support vessels have implemented and tested SOPEP, and copies are kept aboard vessels. • All hazardous substances will have MSDS in place that is readily available on board. • Spill response bins/kits will be located in close proximity to chemical/Hazardous materials storage areas for prompt response in the event of a spill or leak. The kits will be checked for their adequacy and replenished as necessary prior to the commencement of activities and on a regular basis thereafter. Identified personnel will be trained in use of this equipment. • Detailed records will be maintained of all accidental releases/discharges of chemicals/hazardous materials.	Highly localised, short-term, reversible	Low	**Minor**

Accidental Introduction of Invasive Marine Species (IMS)	Introduction of IMS associated with ballast water discharges or transferred via vessel hull or in-water equipment	Establishment of non-native IMS with potential to affect native marine species	• Compliance with the International Convention for the Control and Management of Ships' Ballast Water and Sediments (as appropriate to vessel class) (IMO 2004); as applied to all vessels being mobilised from international waters, which includes:
			  ○ All ballast water exchanges conducted more than 50 nm from land and in greater than 200 m water depth;
			  ○ Ballast water exchange records maintained.
				Localised, medium term	Minor	**Minor**

Aspect	Activity	Potential Impact	Mitigation Measures	Impact Characteristics	Magnitude	Residual Significance
Accidental Introduction of Invasive Marine Species (IMS) (Cont.)	Introduction of IMS associated with ballast water discharges or transferred via vessel hull or in-water equipment (Cont.)	Establishment of non-native IMS with potential to affect native marine species (Cont.)	○ An IMS risk assessment will be taking place, and on the basis of its outcome, management measures will be implemented commensurate with the level of risk. • To manage the potential risk of biofouling, the following measure will be implemented: ○ Vessels (of appropriate class (>400t)) to have a current International Anti Fouling System (IAFS) Certificate, as per the International Convention on the Control of Harmful Anti fouling Systems on Ships (IMO 2001).	Localised, medium term	Minor	**Minor**

Table 1-3: Summary of Social Impact Conclusions

Aspect	Activity	Potential Impact	Mitigation Measures	Impact Characteristics	Magnitude	Residual Significance
Physical presence – Interaction with Fisheries	Presence and manoeuvring of survey boat and towed equipment	Fouling of fishing gear as equipment is towed in the water.	• At least 30 days prior to vessel mobilization, a "Notice to Mariner" will be issued to appropriate parties (i.e. Department of Fisheries, Ministry of Livestock and Fisheries, and Myanmar Navy). • Consultation with relevant fishing groups through Myanmar Fisheries Federation and the Department of Fisheries. • Chase vessels will be used during the seismic survey to monitor and communicate with fishing vessels in the area. • Adherence to COLREGS Part B - Steering and Sailing (Rules 4-19) and Part C - Lights and Shapes (Rules 27) as appropriate to vessel class, including: ○ Crew trained in accordance with COLREGS steering and sailing rules to prevent vessel collisions, including maintaining a proper look-out to prevent the risk of collision and maintaining a safe speed at all times to allow for avoidance of collisions; ○ Display appropriate lights and warning signals on all vessels to prevent accidental collision.	Localised, short-term, reversible	Low	**Minor**
	Presence and manoeuvring of seismic survey boat and towed equipment)	Disruption of fishing and fishing vessels and/or damage to fishing equipment				
Physical Presence – Impact on Shipping	Presence and manoeuvring of survey vessels and tow lines	Increased traffic volume in the local area of the planned survey Interaction with shipping leading to disruption of shipping activities, e.g. diversion and some potential delays to third party journeys	• Adherence to COLREGS Part B - Steering and Sailing (Rules 4-19) and Part C - Lights and Shapes (Rules 27) as appropriate to vessel class, including: ○ Crew trained in accordance with COLREGS steering and sailing rules to prevent vessel collisions, including maintaining a proper look-out to prevent the risk of collision and maintaining a safe speed at all times to allow for avoidance of collisions; ○ Display appropriate lights and warning signals on all vessels to prevent accidental collision. • At least 30 days prior to vessel mobilization, a "Notice to Mariner" regarding project activities to appropriate parties (i.e. Department of Fisheries, Ministry of Livestock and Fisheries, and Myanmar Navy).	Localised, short-term, reversible	Low	**Minor**

Aspect	Activity	Potential Impact	Mitigation Measures	Impact Characteristics	Magnitude	Residual Significance
Physical Presence – Impact on Shipping (Cont.)	Presence and manoeuvring of survey vessels and tow lines (Cont.)	Increased traffic volume in the local area of the planned survey Interaction with shipping leading to disruption of shipping activities, e.g. diversion and some potential delays to third party journeys (Cont.)	• Establish a mobile and temporary safety zone around the seismic vessels – coordinated by the captain of the survey vessel. • Use chase vessels to liaise with approaching shipping in the project area to prevent accidental collision.	Localised, short-term, reversible	Low	**Minor**
Survey Programme	National and local employment and income	Direct and indirect contribution to the Myanmar economy through jobs and income	• Beyond the staff employed at the Yangon office, no further mitigation is planned.	Positive, short-term	Low	**Negligible Positive**

1.4.3 Conclusion

The impact assessment presented in this IEE has addressed the potential environmental and social aspects relevant to the deepwater offshore context of the proposed exploration survey programme in Block MD-5. The planned seismic and CSEM activities will be short-term and temporary (less than 60 days each), with a limited environmental and social footprint and minimal shore-based interaction.

Overall, it is concluded that the MD-5 exploration survey programme is considered to be acceptable and readily manageable taking into account the following:

- The project will be undertaken in accordance with relevant legislative requirements, standards, industry guidelines and Shell corporate expectations for responsible environmental management (**Chapter 2** and **Chapter 3**);
- The very localised nature and scale of operations associated with the programme (**Chapter 4**);
- The project location (i.e. deep, open offshore waters) and distance to key values and sensitivities (**Chapter 5**);
- All environmental impacts and risks are demonstrated to be manageable, with application of appropriate mitigation measures (as presented in **Chapter 6**);
- Clear definition of appropriate mitigation measures (**Chapter 8**) to manage the environmental and social aspects associated with the survey programme, with clear roles and responsibilities for effective implementation; and
- Stakeholder consultation (**Chapter 9)** has demonstrated broad support for the proposed activities.

The EMP presented in **Chapter 8** includes provisions for measuring its effectiveness through review and audit of the contractor's performance, to ensure that Shell's objectives for environmental and social performance are met and commitments are implemented.

1.5 Cumulative Impacts

The objective of the cumulative impact assessment is to identify those environmental, social or health aspects that may not on their own constitute a significant impact but when combined with impacts from past, present or reasonably foreseeable future activities associated with this and/or other projects, result in a larger and more significant impact(s).

On review of the assessment of risks and impacts relevant to this exploration, the key potential cumulative impact scenarios are identified, taking into account potential for concurrent operations in adjacent blocks:

- Cumulative impact of temporary reduction in available fishing area, and
- Cumulative impact of underwater sound on sensitive marine fauna.

Cumulative impact of temporary reduction in area available for fishing

On the basis of information acquired during the IEE studies, it is expected that fishing activity in this area is limited, however, there is a potential for tuna fishery to occur. The potential for impact on this fishery as a result of the seismic survey in Block MD-5 occurring at the same time as a similar survey taking place in Block MD-4 or Block M-15 has been considered.

As these offshore blocks are very large, and any temporarily unavailable area will only represent a small percentage of the total area available, the potential cumulative impact of the MD-5 seismic survey and a similar survey being conducted in a neighbouring block at the same time is therefore expected to be insignificant. The CSEM survey, currently is scheduled to commence in Q3 2016, will also result in a temporary but transient reduction in total available fishing area within the block for a period up to 2 months. As no other surveys in neighbouring blocks are expected or known to occur at the time of the CSEM survey, the potential for cumulative impact is concluded to be negligible.

Cumulative impact of underwater noise on sensitive marine fauna

Although the offshore blocks are very large, there is potential for cumulative impact or impact interaction on marine fauna, particularly mammals in the event that more than one seismic survey is conducted at any one time in neighbouring blocks. It is currently expected that in the event that surveys occur at the same time, two seismic surveys will never be less than 50 – 100 km apart.

The potential cumulative impact on sensitive fauna of two concurrent surveys is therefore predicted to be of a behavioural nature, and is concluded to be temporary and transient.

Residual Impact

Taking into account the above assessment of potential interactions from activities in adjacent blocks to MD-5, the cumulative impact of underwater sound on fishing interests and sensitive marine fauna is ranked as having a low residual impact.

1.6 Environmental Management Plan (EMP)

The EMP represents a commitment by Shell to ensure that the mitigation measures are translated into operational plans and procedures by the survey contractors as appropriate. These detailed plans and procedures will be developed by the seismic contractor in consultation with Shell, and will require Shell sign-off. Shell's on-board representative is accountable to Shell management for the effective implementation of the EMP during the survey programme, and the ultimate responsibility and accountability for its implementation lies with Shell's Venture Lead.

The EMP includes provisions for measuring its effectiveness through review and audit of the contractor's performance, to ensure that Shell's objectives for environmental and social performance are being met and commitments are implemented.

Shell through its contractual relationships will require the survey contractor(s) to develop detailed plans and procedures and demonstrate compliance with the EMP. These plans and procedures include are not limited to the following:

- Code of Conduct for minimising disturbance to marine mammals;
- Spill Response Plan;
- Waste Management Plan; and
- Fisheries Liaison.

2. Introduction

2.1 Background

This impact assessment study report has been prepared in respect of activities to be conducted within the Offshore Licence block MD-5 in the Andaman Sea. The block is located in deep water offshore Myanmar as shown in **Figure 2-1**.

On 5th February 2015, Shell Myanmar Energy Pte Ltd (hereafter called "Shell") and its partner Mitsui Oil Exploration Co. Ltd. group (MOECO) signed three exploration and production sharing contracts (PSCs) with Myanma Oil and Gas Enterprise (MOGE) of the Republic of the Union of Myanmar for offshore deep-water blocks AD-9, AD-11 and MD-5. This marked the Shell Group's return to upstream oil and gas operations in Myanmar.

Shell as operator for the activities under the PSC is responsible to MOGE for the execution of oil and gas operations within the block in accordance with the terms of the PSC. Therefore, on behalf of MOGE, Shell and MOECO, proposes to undertake an exploration survey programme in Block MD-5. The purpose of the surveys is to map geological structures under the seabed, to help determine the potential presence of hydrocarbon bearing prospects. Block MD-5 covers an area of 2,452 Sq. Miles or 6,350.65 km^2 and its eastern boundary lies approximately 230 km west of the shoreline of Kyunsu Township, Myeik district, State division of Tanintharyi and approximately 120 km west of Great Western Torres Island, Kyunsu Township, Myeik district, State division of Tanintharyi on the Myanmar Coast.

The proposed survey programme consists of exploration survey operations carried out from a survey vessel with assistance of smaller support vessels, and it is currently scheduled to take place between 4th Quarter 2015 and 4th Quarter 2016. Due to the sensitivity of the survey programme to severe weather, it may be conducted over two seasons. The exploration survey programme proposed for Block MD-5 consists of obtaining in excess of approximately 2,680 km^2 (and up to 3,500 km^2) three-dimensional (3D) offshore seismic data followed by a smaller targeted Controlled Source Electro-Magnetic (CSEM) survey (approximately 385 km^2). The extent of the CSEM activities cannot be determined in detail prior to 3D acquisition, but will be significantly smaller in coverage than the 3D survey.

Jacobs Group Pty Limited, International Environmental Management Co. Ltd. (IEM) and Environmental Quality Management Co. Ltd (EQM) have been contracted by Shell to conduct an Initial Environmental Examination (IEE) for the proposed Block MD-5 Project ("the Project"), and to develop an associated Environmental Management Plan (EMP) to eliminate or minimise impact where possible.

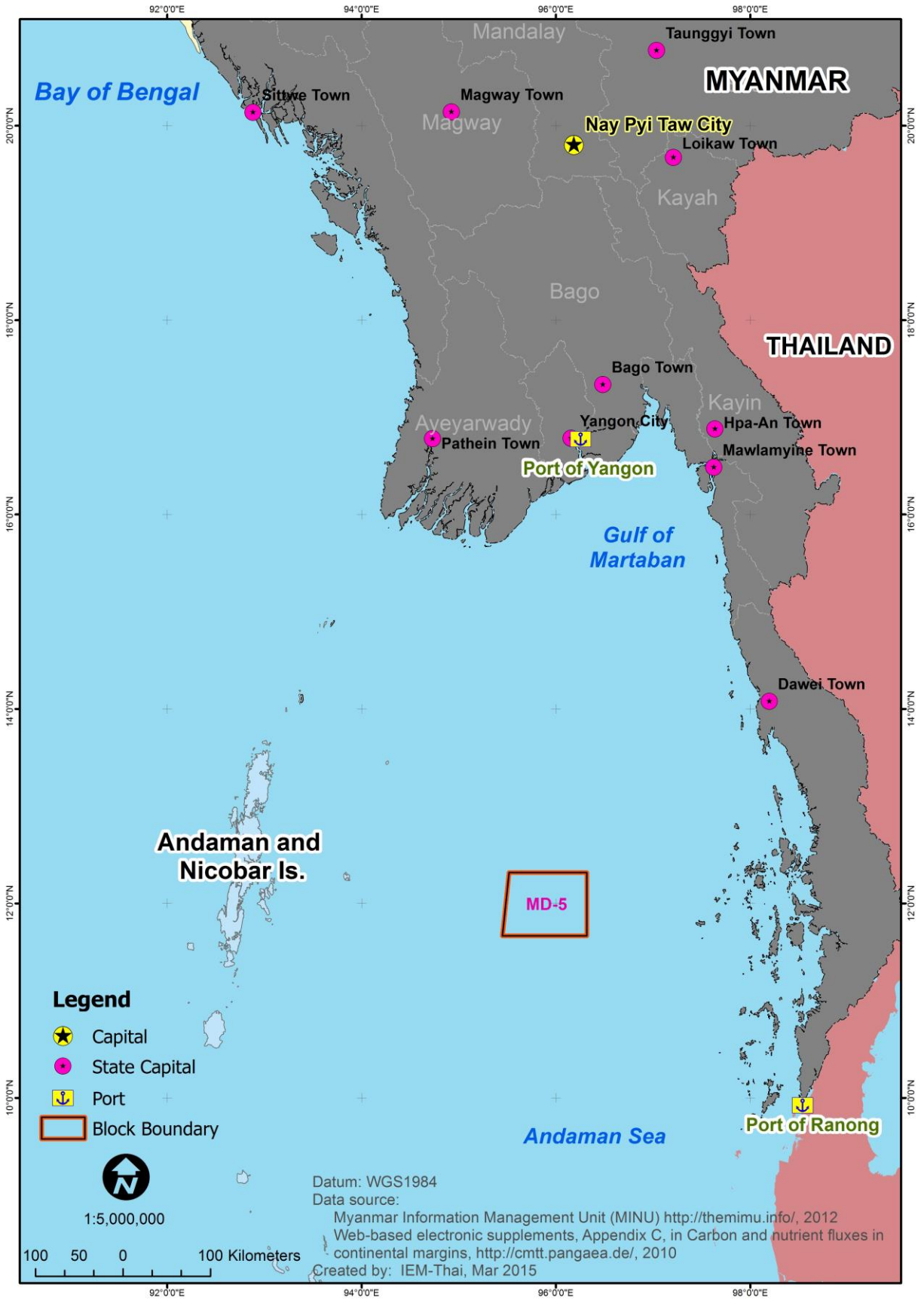

Figure 2-1 : Block MD-5 Project Location

2.2 IEE Report

2.2.1 Need for Impact Assessment

In accordance with the requirements of the PSC and the guidance of the Environmental Conservation Department (ECD) of the Ministry of Natural Resources and Environmental Conservation (MONREC), Shell has committed to undertake an Initial Environmental Examination (IEE) of its proposed offshore exploration survey program in Block MD-5. This impact assessment study also meets the requirements for economic activities requiring an environmental impact assessment as set out by Myanmar Investment Commission (MIC) in Notification 50/2014 dated 14 August 2014. The content and structure of the report complies with the Government of Myanmar's Environmental Impact Assessment Procedure, prepared in accordance with powers conferred under sub section 42 of the Environmental Conservation Law (2012).

The impact assessment is also undertaken in accordance with Shell's corporate commitment to environmental and social governance. The Shell Group Health, Safety, Security and the Environment (HSSE) & Social Performance (SP) Standards that apply Shell globally require that:

- The Impacts of Shell operations on communities and other Stakeholders are assessed and considered in Business decisions and,
- Negative Impacts of Business activities are minimised, and positive impacts maximised, in a sustainable manner.

2.2.2 IEE Objectives

The objective of the IEE Report is to consider all biological, physical, social, economic, health, cultural and visual components of the environment, together with all pertinent legal matters relating to the environment that may be affected by the project; and the IEE report shall identify and assess all adverse environment, social and, if relevant, health impacts that potentially could arise from the project. Once the impacts have been identified, prevention, mitigation, and monitoring measures are proposed to avoid or minimize them.

The key objectives of this report are to:

- Describe all planned activities and potential unplanned events;
- Establish an environmental and social baseline of the marine and coastal environment relevant to the proposal's area of influence;
- Identify all potential sources of impacts to the physical, biological, and socio-economic elements of the environment for the project, and determine the significance of these impacts;
- Propose appropriate mitigation measures to minimise potential impacts, and compile these and the associated monitoring in the Environmental Management Plan (EMP); and
- Determine any residual impacts.

2.2.3 IEE Methodology and Scope

The IEE studies have been conducted on the basis of information from a number of sources including past studies and research relevant to the area of operation. Technical and operational type information in relation to the proposed exploration surveys have been acquired from Shell's technical and management staff as well as industry sources such as the International Association of Geophysical Contractors (IAGC) and other international institutions. Information on the receiving physical, biological, socio-economic and cultural environment has been acquired through literature studies as well as direct consultation with groups or individuals.

The scope of this IEE report includes:

- A review of applicable legislation;
- A detailed project description;
- An evaluation of the 'receiving' (existing) environmental, cultural heritage and socio-economic conditions;

- An impact assessment, covering the mobilisation, execution and de-mobilisation phases of the marine exploration survey activities;
- Proposed mitigation measures to eliminate and/or reduce potential adverse impacts to the surrounding environment, as appropriate to the nature and risk of impacts; and
- Proposed monitoring.

The mitigation measures and associated monitoring plan are compiled and presented in an Environmental Management Plan (EMP) also included in this document.

Figure 2-2 presents the overall IEE process as a context for the impact assessment methodology.

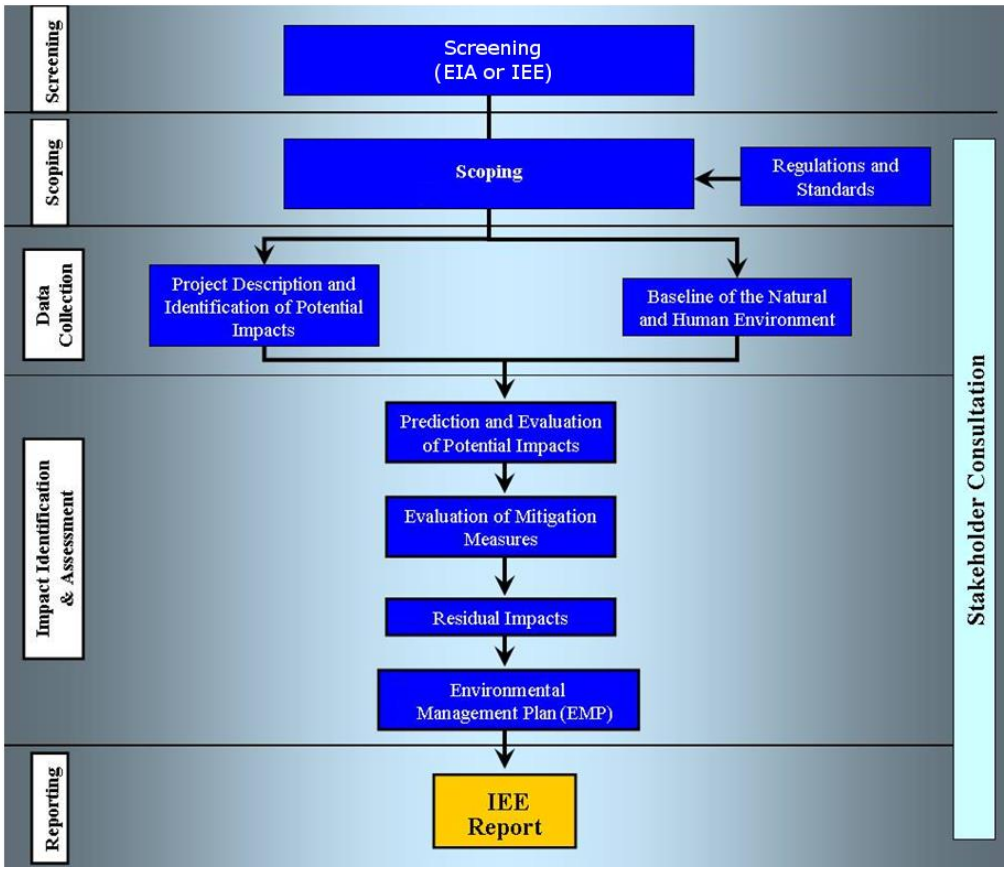

Figure 2-2: Overview of Impact Assessment Approach

2.2.3.1 IEE Experts

The impact assessment was conducted by environmental consultants Jacobs Group Pty Limited in cooperation with IEM and EQM. Jacobs provides full spectrum consulting and project delivery capabilities, including environmental and social impact assessment, natural resource management, ecology, cultural heritage, air/water quality, spatial analysis, strategic planning and approvals. IEM are experts in the oil and gas sector and have experience in undertaking environmental, social and health assessments and approvals internationally and throughout South East Asia. EQM is a local, Myanmar environmental company that has worked closely with IEM to complete environmental and social assessments of onshore and offshore oil and gas developments in Myanmar since 2009. The Ministry of Natural Resources and Environmental Conservation (MONREC) has approved the environmental consultants and when the formal registration process has been approved in Myanmar, IEM and EQM will register accordingly. The IEE assessment team members, their specialist areas and contributions to the report are set out described in **Table 2-1.**

Table 2-1: IEE Assessment Team

No.	Name	Position	Responsibility
Jacobs/International Environmental Management			
1	Nigel Peters	Jacobs – Principal Environmental Scientist	Chapter 1 to 6
2	Tim Mitchell	Jacobs – Principal Environmental Scientist / Project Manager	Chapter 1 to 9
3	Ron Livingston	IEM – Senior Environmental and Social Management Expert	Chapter 1 to 9
4	Randal Glaholt	IEM – Senior Environmental / Biological Expert	Chapter 5
5	Dylan Jenkins	IEM – Environmental Analyst	Chapter 1 - 9
EQM / Socio-Economic Survey Team			
1	Dr. Ohnmar May Tin Hlaing	Public Health Expert / Local Coordinator	Chapter 5 & 9
2	Miss. Moh Moh Thant Zin	Socio-Economic Team Leader	Chapter 5 & 9
3	Mrs. Aye Moet Moet Zaw Win	Socio-Economic Team Leader	Chapter 5 & 9
4	Miss Twae Mu Mu Myint	Socio-Economic Team Leader	Chapter 5 & 9
5	Mr. Pyae Phyo Maung	Socio-Economic Interviewer	Chapter 5 & 9
6	Mr. Thiha Htut	Socio-Economic Interviewer	Chapter 5 & 9
7	Mr. Soe Pyae Htun	Socio-Economic Interviewer	Chapter 5 & 9

2.2.3.2 Project Proponent

Shell is a global group of energy and petrochemical companies with headquarters in The Hague, the Netherlands. The parent company of the Shell Group is Royal Dutch Shell plc., which is incorporated in England and Wales (Shell, 2014).

Shell Myanmar Energy Pte Ltd (SMEPL) is incorporated in Singapore and is a fully owned subsidiary of Shell.

The contact person in respect of this IEE is:

Tony Cortis, Venture Lead

SHELL MYANMAR ENERGY PTE. LTD. (Yangon Branch)
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Bahan Township
Yangon, Myanmar
Tel/Fax no: +951 538757
www.shell.com/myanmar

Under the PSCs, Shell, as Operator, holds a 90% interest with MOECO holding the remaining 10%.

2.2.3.3 IEE Study Area

The geographical study area for the project covers the area to be surveyed within Block MD-5, as well as areas which may have potential to be affected by the project. This includes any support activities from shore, movements of vessels between port(s) and the offshore survey area, as well as other areas of potential impacts, and considers other sea users, including fishermen who fish in or near the Block and the coastal communities they belong to.

2.2.4 Data Collection

To inform this study, the impact assessment team undertook a comprehensive review of all available information to characterise the existing environmental and socio-economic setting of the offshore area. Secondary data sources came from literature, relevant authorities and previous EIAs in or near the project area, and also supported by targeted engagement with organisations. The secondary data sources are cited throughout this report, and listed in the references section. No primary environmental data has been collected for this impact assessment for deep-water offshore seismic activities due to its temporary duration and limited environmental footprint. Socio-economic data was collected during the public involvement process in representative coastal communities.

2.2.4.1 Public Involvement

A Consultation Plan identifying the range of stakeholders and priorities for targeted engagement was established at an early stage of the project. The local consultation element included focus group meetings with regional, district and township officials, coastal townships and villages, key informant interviews, household leader attitude survey and key ecological knowledge surveys.

The list of consultees and nature of engagement included:

- Meeting with Chief Minister, Tanitharyi Region, Finance Minister, Director of Chief Minister's Office;
- Meeting with Director of Forest Department, Thanintharyi Region; U Aye Myint, Director (Division), Myanmar Port Authority, Thanintharyi Region; U Win Phay, Head of Port Authority, The Department of Fisheries, Thanintharyi Region; U Tun Win Myint, Division Head, Environmental Conservation Committee, Thanintharyi Region; U Tin San Win, Head of Environmental Conservation Committee
- Myeik Fishery Federation ; U Thaung Myint, Executive Committee member
- Focus Group Meetings in two Myeik villages, including Key Informant Interviews, Socio-economic surveys and traditional ecological knowledge surveys;
- Meeting in Yangon with the Myanmar Fishery Federation (MFF); and
- Meetings in Naypyidaw with the Environmental Conservation Department of the Ministry Natural Resources and Environmental Conservation (MONREC).

Information pamphlets (in Myanmar language) were prepared, and distributed during the meetings. Further information is provided in **Chapter 9** of this report.

During local consultation in the Dawei/Myeik region, MOGE assisted Shell and the impact assessment team by contacting local officials in each fishing village and making arrangements for the assessment team to meet with them. MOGE participated in each focus group meeting and addressed questions relevant to them.

2.2.5 Project Description

The IEE provides a complete project description that includes the following:

- Maps showing the block coordinates and provisional/indicative seismic survey area;
- Maximum planned extent of the seismic survey activities;
- Typical survey information including indicative spacing of seismic path lines, number of hydrophone streamers in array and length of streamers, energy source (airguns/electromagnetic sources) and capacity;
- Vessel information (typical);
- Anticipated start date and duration of surveys;
- Crew sizes and logistics;
- Shore base requirements;
- Waste generation and management; and
- Fuel / refuelling requirements.

2.2.6 Description of the Environment

The IEE provides a description of the physical and biological environment, and of the socio-economic conditions within the study area, as follows:

- **Physical Environment:** bathymetry, meteorology, geology, oceanography, sea water quality, sediment quality;
- **Biological Environment**: marine flora, marine invertebrates, fish, turtles, marine mammals, sensitive ecosystems and protected areas;
- **Human Use Values:** fisheries, aquaculture, marine transportation, submarine cable and pipelines;
- **Quality-of-Life Values:** employment, local economy, traditional cultural activities; archaeological resources, historical, and aesthetics and tourism.

2.2.7 Impact Assessment

The impact assessment systematically evaluates impacts from both a qualitative and semi-quantitative (where the data will allow) perspective. The assessment considers the potential for residual impacts based on the assumption that all proposed mitigation measures are adopted, and that the EMP is fully implemented by Shell and its contractors.

The impacts that result from routine (planned) activities are assessed, as are those that could result from credible accidental or unplanned events within the project scope (e.g. a fuel spill) or in the external environment affecting the project.

2.2.8 Mitigation and Monitoring (EMP)

The impact assessment process identifies potentially significant impacts that may warrant a specific management response. Mitigation measures have been defined to prevent and/or reduce the likelihood and/or magnitude of impacts. The proposed mitigation measures take into account applicable guidelines, industry practices, expert judgement, design techniques and operational controls and are set out in the EMP. The EMP also includes monitoring measures, to enable the implementation and performance of the mitigation measures to be determined.

3. Legislation and Policy Framework

3.1 Overview of Myanmar Legislation and International Conventions Applicable to Offshore Block MD-5 activities

This section lists legislation and international conventions relevant to the undertaking of industrial projects in Myanmar. The legislation can be divided into two categories as follows:

- Myanmar Legislation (summarised in **Section 3.2**)
- International Agreements and Conventions (**Section 3.3**)
- International Standards and Guidelines (**Section 3.4**)

In addition, relevant Shell Group Corporate Policies are outlined in **Section 3.5**.

3.2 Key Legislation

3.2.1 Environmental Legislation and Policy Framework

Environmental legislation and arrangements for environmental conservation in Myanmar are developing rapidly. The first official environmental body, the National Commission on Environmental Affairs (NCEA), was established in 1990. The NCEA represented a national focal point on cooperation with international and regional agencies on global environmental issues. Due to the international nature of this work, the NCEA was initially operating within the Ministry of Foreign Affairs (MOFA) until 2004, when it was transferred to the then Ministry of Forestry (MOF).

In April 2011, the NCEA was re-organised into the National Environmental Conservation Committee (NECC) in April 2011 based on Notification No.21/2011, (20/04/2011) of the Office of the President.

In September 2011, the Ministry of Forestry became the Ministry of Natural Resources and Environmental Conservation (MONREC), which now is the focal point and coordinating agency for environmental conservation and management.

Subsequently, in February 2012, the Environmental Conservation Department (ECD) was set up within MONREC to implement and manage the environmental conservation agenda. This led to the NCEA being dissolved, and its functions moved to the ECD in May 2012.

At present, all laws relating to the environment are being formulated and administered by the sectoral ministries and departments concerned. **Section 3.2.4** provides a list of environmental legislation relevant to the Project activities.

3.2.1.1 National Environment Policy (NEP) (1994)

The National Environment Policy (NEP) was the first principal policy on environmental protection developed by the NCEA and adopted by the Myanmar Government in 1994. The objective of the NEP is stated as:

"… the integration of environmental considerations into the development process to enhance the quality of life of all its citizens. ...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."

With a view to implement the NEP, the NCEA formulated Myanmar Agenda 21 in 1997, under the guiding principles established at the United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro in 1992. Agenda 21 provided the first framework for integrating environmental considerations into national development plans in Myanmar.

3.2.1.2 Myanmar Agenda 21 (1997)

Agenda 21 represented an environmental action plan for Myanmar and was approved in February 1997. It was written with the assistance of the Asia-Pacific Centre for Environmental Law and the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP). The document was presented at the June 1997 United Nations General Assembly Session on Agenda 21. It is divided into 4 Parts and 19 Chapters, and reviewed the current state of Myanmar development and environment. It suggested policies to be undertaken for improving environmental protection in Myanmar, including the creation of national framework legislation on the environment to improve coordination and cooperation between ministries on issues related to the environment; and creating legislation that requires environmental impact assessments to be done before developments are undertaken.

In 2007, the NCEA developed the National Sustainable Development Strategy (NSDS) for Myanmar. It incorporated the aspirations of Agenda 21 as well as Myanmar's Millennium Development Goals. The NSDS was approved in 2009 thereby setting the main guiding principles on environmental protection for the country.

3.2.1.3 National Sustainable Development Strategy (NSDS)

The aim of the NSDS is to achieve sustainable development focused on natural resource management, economic development, and social development. Government ministries are expected to apply the NSDS principles within their sectoral development through short-term, medium-term and long-term actions.

Although much of the NSDS guidelines are intended for adoption and integration into legislation, some aspects are targeted at developers, such as the 'polluter pays' principle, as well as the need for reducing energy consumption and greenhouse gas emissions from industry. As the principles set out in the NSDS begin to be incorporated in the country's legislative development, it provides opportunities for companies within the private sector to work with Government in bringing their operations into line with the objectives of the NSDS.

3.2.2 National Legislation

National legislation applicable to the Project includes the following:

- The Constitution (2008);
- The Environmental Conservation Law (2012);
- Environmental Conservation Rules (2014);
- The Foreign Investment Law (2012) & MIC Notification 50/2014 dated 14 August 2014.

A summary of these is provided in the sub-sections below.

In addition, other statutes at a number of administrative levels have been included, as follows:

- Laws issued by the State Peace and Development Council (SPDC), Myanmar governing body (exercising legislative functions);
- Decrees or subsidiary legislation issued by Ministers.

3.2.2.1 The Constitution

The latest enacted Constitution (May 2008) provides information on governing laws and regulations in Myanmar. The Constitution prevails over any other national legislation or international agreements.

It guarantees every citizen equal rights before the law, and requires enactment of necessary laws that recognize citizens' freedom, equality, rights to liberty and justice, benefits, responsibilities, and restrictions (Article 347, and 21 (a) and (d)).

Article 45 states that 'The Union shall protect and conserve natural environment'. Article 390, calls on the duty of its citizens to assist the Union on the following issues:

- preservation and safeguarding of cultural heritage;
- environmental conservation;
- striving for development of human resources;
- protection and preservation of public property.

3.2.2.2 The Environmental Conservation Law (2012)

The Environmental Conservation Law (Pyidaungsu Hluttaw Law No. 9 / 2012) has the following objectives:

a) to implement the Myanmar National Environment Policy;
b) to provide basic principles and give guidance for systematic integration of environmental conservation matters in the sustainable development process;
c) to promote a good and clean environment and to conserve natural and cultural heritage for the benefit of both present and future generations;
d) to reclaim ecosystems that are in the early stages of degradation;
e) to manage prevention of degradation of natural resources and to enable the sustainable use;
f) to implement for the promotion of public understanding and to provide educational programmes for dissemination of environmental awareness;
g) to promote international, regional and bilateral cooperation in environmental affairs;
h) to enable cooperation among government departments, government organizations, international organizations, non-governmental organizations and individuals in matters of environmental conservation.

The Government has established the Environmental Conservation Committee with the Union Minister for the Union Ministry (MONREC), assigned by the Union Government as the Chairman and with suitable members, to conserve the environment of the Republic of the Union of Myanmar. The duties and powers of the Committee include:

i) carrying out awareness and activities relating to environmental conservation;
j) suggesting amendments and inclusions, as may be necessary, in the lessons on environmental conservation contained in school lessons in coordination;
k) accepting donations, grants, materials and aids in technology from local and foreign sources and managing and using such money, materials and technologies in environmental conservation activities;
l) forwarding suitable suggestions relating to environmental conservation to the relevant Government departments and organizations;
m) soliciting necessary proposals and suggestions for the conservation and enhancing of environment from the relevant government departments and organizations;
n) prohibiting respective government departments and organizations in the event of the occurrence of environmental damage or situations in which damage may occur and, if necessary, seeking policy from the Union Government;
o) formulating and implementing Myanmar National policies for conservation and enhancement of the environment and other environmental policies.

3.2.2.3 Environmental Conservation Rules (June 2014)

The Environmental Conservation Rules relating to the Environmental Conservation Law, were enacted in 2014 which contain specific items relating to EIA and pollution prevention which fall under the powers of the Ministry Natural Resources and Environmental Conservation.

3.2.2.4 Foreign Investment Law

Relevant rules defined under the Foreign Investment Law include:

- If a project needs to conduct Environmental Impact Assessment (EIA) and Social Impact Assessment (SIA) in accordance with existing relevant laws, the necessary plans have to be included with the project proposal and be submitted to the Myanmar Investment Commission (MIC).
- For a project which is notified as a large scale investment by MIC the projects will need to conduct EIA/SIA notified by the Ministry of Natural Resources and Environmental Conservation (MONREC). An EIA/SIA report has to be enclosed when the project proposal is submitted to the MIC.
- The MIC shall ask the comments from the Ministry of Natural Resources and Environmental Conservation on the plans or activities to be included in the Initial Environmental Examination (IEE) or EIA.

3.2.2.5 EIA Procedures

In their Production Sharing Contracts Myanma Oil and Gas Enterprise (MOGE) require that oil and gas companies prepare an EIA, SIA and an EMP for all new activities/developments.

New union regulations on the EIA process are expected to be implemented in the near future, as indicated by the approved 2009 National Sustainable Development Strategy (see below for more details).

The EIA procedures define requirements for a variety of development projects, and have been subject to wide consultation. Presently, the EIA procedures specify the following:

- IEE Type Project means a Project judged by the Ministry to have some Adverse Impacts, but of lesser degree and/or significance than those for EIA Type Projects;
- Offshore Oil and Gas Activities such as seismic exploration; exploration drilling; transportation; pump stations, metering stations, are required to undertake IEE, subject to prior permission.
- IEE Report means a report comprising a systematic assessment of a proposed activity or project that is prepared to aid in determining whether such activity or project has the potential significantly to affect the environment, humans and other living things, including socio-economic impacts, and in deciding whether such activity or project should be allowed or not. The form, content and structure of the report shall be in accordance with the Ministry's requirements and guidelines and international best practice, and include the EMP.
- The EIA/IEE has to be conducted by an independent party, registered/approved by the Ministry of Natural Resources and Environmental Conservation (MONREC).
- Should the IEE report be acceptable to MONREC, they will issue an Environmental Compliance Certificate.

The following sub-sections provide a summary of the currently published Procedures, at an IEE level of assessment.

- **Screening** - The Project Proponent shall submit to the Department a full Project Proposal for Screening. The Department shall determine the necessary level of environmental assessment (an EIA Type or IEE Type project) and submit that determination to the Ministry.
- **IEE Report Preparation** - The Project Proponent shall inform to the Ministry in writing as to the identity of the organization(s) and/or person(s) it has selected to undertake the IEE investigation and reporting. Upon receipt of the information about the identity of the proposed organization(s) and/or person(s) selected by the Project Proponent to undertake the IEE, the Department will check the information provided and will make a decision on whether the individual or organization is registered with the Department or qualified to conduct an IEE and provide a response.
- **Public Consultation** - The Project Proponent shall undertake the following public consultation process for the IEE:
  a) disclose information about the proposed Project to the public and civil society organisations, including by means of websites, the prominent posting of legible sign boards at the Project site which are visible to the public, national media, to allow sufficient time for the public to be aware, and a minimum of two weeks; and
  b) Arrange necessary consultation meetings, with local communities, potentially PAPs, local authorities, community based organizations, and civil society organisations, as advised by the Ministry.
- **IEE Report Requirements** - The form, content and structure of the report shall be in accordance with the Ministry's requirements and guidelines and international best practice, and include the EMP.
- **Submission of IEE Report** - After completing all investigations and public consultation and participation processes required for IEE type Projects, the Project Proponent shall submit the IEE Report for the Project to the Department via the Ministry in both digital form and complete paper copies, and pay the required service fee to the Department.

No later than ten (10) days after submission of the IEE Report to the Ministry, the Project Proponent shall disclose the IEE Report to civil society organizations, PAPs, local communities and other concerned stakeholders by means of local media (i.e., newspapers, etc.), at public meeting places (e.g. libraries, community halls) and at the offices of the Project Proponent, so as to allow sufficient time for the public to be aware of it.

- **Review and Approval Process for IEEs** - Upon receipt of the IEE Report from the Project Proponent, the Department shall:

  a) disclose the IEE Report to the public through the Ministry or Department website or other appropriate means;
  b) invite comments and suggestions on the IEE Report from all relevant parties including relevant government organizations, institutions, civil society organizations, and PAPs, through the appropriate channels;
  c) arrange public consultation meetings at the local level, at which the Project Proponent shall present the IEE Report; and
  d) collect and review all comments and recommendations received, analyse them and submit it to the Ministry for a final decision concerning the approval of the IEE Report.

If it is determined by the Ministry that the IEE Report does not satisfy requirements, the Department will inform the Project Proponent about what necessary amendments should be made or supplementary information provided, as directed by the Ministry.

Upon completion of its review of the IEE Report, the Ministry shall:

  e) approve the IEE Report, subject to any conditions as may be prescribed, and issue an ECC; or
  f) require that the Project undergo EIA and cite the reasons for this decision and inform the Project Proponent of its decision; and in either case
  g) publicly disclose its decision.

The Ministry's final decision shall be provided within sixty (60) days of the Department receiving the IEE Report. If the Ministry requires an IEE Report to be amended, then the due date for delivery of the Ministry's decision shall be extended accordingly.

3.2.2.6 National Legal and Administrative Framework

Myanmar is divided into 21 administrative subdivisions, which include:

- 7 states;
- 7 regions (formerly divisions);
- 5 self-administered zones;
- 1 self-administered division;
- 1 union territory.

States and regions are divided into districts. These districts consist of townships that include towns, wards and village-tracts. Village-tracts are groups of adjacent villages. The administrative structure of the states, regions and self-administering bodies is outlined in the new constitution adopted in 2008.

Each state and region has a Regional Government or a State Government consisting of a Chief Minister, other Ministers and an Advocate General. Legislative authority resides with the State Hluttaw or Regional Hluttaw made up of elected civilian members and representatives of the Armed Forces.

The proposed survey programme will be conducted offshore in the Andaman Sea, to the west of the Tanintharyi Region, which covers the long narrow southern part of the country. The Region is bordered by the Andaman Sea to the west and by Thailand to the east. It covers an area of approximately 43,345 km², and has a population of 1,406,434 (2014 Census). The Region comprises ten townships spread over three districts: - Dawei, Myeik and Kawthoung, and its regional capital is Dawei.

3.2.3 Protected Areas

Conservation and protection of natural environment is stipulated under Article 45 of the Constitution (2008):

> *"The Union shall protect and conserve natural environment."*

The two major laws concerning protected areas are:

1. Forest Law 1992
2. Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law 1994

The Forest Law of 1992 replaced the Forest Act of 1902. The new law has a stronger emphasis on environmental protection and biodiversity conservation, including creation of protected areas.

The 1994 Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law replaces the Burma Wildlife Protection Act of 1936. This new law highlights habitat maintenance and restoration; protection of endangered and rare species of fauna and flora; establishment of new parks and naturally protected areas; and buffer zone management.

The natural areas for protection are categorized as follows:

- Scientific Nature Reserve;
- National Park;
- Marine National Park;
- Nature Reserve;
- Wildlife Sanctuary;
- Geo-physically Significant Reserve; and
- Other Nature Reserve as determined by the Minister.

A total of 45 protected areas have been established in Myanmar. Of these, no protected zones are located within or in the proximity of the project area for the proposed offshore exploration activities. The closest protected area is Lampi Island MPA located approximately 200 km to the south-east of Block MD-5's eastern boundary, and Moscos Island Wildlife Sanctuary located approximately 240 km to the north-east.

3.2.4 Project-Relevant Laws

Some legislation exist which, either directly or indirectly, relate to environmental and social management of development in the Union of Myanmar. These laws are general in nature and refer primarily to good practice recommendations, and limited, if any, specific criteria are presented.

There are currently no specific regulations on environmental and social management issues such as waste management and land use.

Legislation potentially relevant to offshore exploration survey activities are discussed below, and a complete list of national environmental legislation is presented in **Appendix A.**

3.2.4.1 National Environmental Quality Standard & Guideline

MONREC has established environmental quality standards, the National Environmental Quality Standard. The standards were written by ECD in cooperation with the Ministry of Science and Technology and with technical assistance of the Asian Development Bank (ADB) and EU (Environmental Management Group).

ECD / MONREC have indicated that the discharge standards shown in **Table 3-1** below would be applicable for Offshore Oil and Gas activities conducted from ships. These are in accordance with international standards.

Table 3-1: Myanmar Discharge Standards Applicable to Offshore Oil and Gas activities

Guideline	Standard
Sewage	Compliance with MARPOL 73/78 [a]
Food waste	Compliance with MARPOL 73/78 [a]
Storage displacement water	Compliance with MARPOL 73/78 [a]
Bilgewater	Compliance with MARPOL 73/78 [a]
Deck drainage (non-hazardous and hazardous drains)	Compliance with MARPOL 73/78 [a]

[a] In nearshore waters, discharge locations should be carefully selected taking into account environmental sensitivities and the assimilative capacity of receiving waters.

3.2.4.2 Public Health Law, 1972

Section 3 of the Public Health Law empowers the Government of the Union of Myanmar 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.

3.2.4.3 The Oilfields Act, 1918

The Oilfields Act, 1918, 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 may make rules for regulating all matters connected with many operations related to the extraction of oil and/or gas. The Act also provides guidance on issues such as preventing oil and gas waste, notifiable incidents including of fire, accidents and other occurrences as well as the regulation of the collection and disposal of oil and gas.

3.2.4.4 The Oilfields (Labour and Welfare) Act, 1951

The 1951 Oilfields (Labour & Welfare) Act prescribes a wide range of protection measures for workers in the oil and gas industry, including health, safety and worker welfare. It also covers working hours, holidays and extensive restrictions on employing children. It also dictates that the warden of the oilfield is responsible for supervising the waste output of oil or natural gas exploration etc.

3.2.4.5 The Petroleum Act, 1934

The Petroleum Act, 1934 is concerned with regulation of the production, storage and transportation of oil including aspects so as not to cause pollution and/or fire.

3.2.4.6 The Underground Water Act, 1930

The Underground Water Act, 1930 provides measures for the protection of groundwater including its systematic and sustainable use.

3.2.4.7 Union of Myanmar Marine Fisheries Law, 1990

There are several restrictions relating to the catching, chasing or contaminating of marine fisheries contained within the Fisheries Law. Person(s) found guilty of violating any of the prohibitions shall be liable to heavy fines and/or imprisonment. The relevance of this law to the offshore component of the project is that it places restriction on pollution: “No person shall dispose of living aquatic creatures or any polluting material into the Union of Myanmar Marine Fisheries”.

3.2.4.8 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.

3.2.4.9 Penal Code, 1961 (and extended in Public Health Law, 1972)

The Penal Code is mainly concerned with public health. The Penal code guidelines 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.

3.2.4.10 Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law, 1994

Under the Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law, 1994, hunting without licence, breeding protected animals without permission, causing water and air pollution, poisoning water, possessing, selling, transporting or transferring wildlife or any part thereof without permission are treated as actionable crimes. The punishments are more severe for those offences committed against protected wildlife. The Law exempts the possessing of any part of a normally protected or seasonally protected wildlife as a souvenir or wearing as a traditional custom, the possessing or wearing of any part of a completely protected animal with a certificate or registration, possessing, use, sale, transport or transfer of a drug prepared from a part of a protected wildlife species.

3.3 International Environmental Conventions, Protocols and Agreements

Myanmar has ratified several international and regional conventions. Those relevant to the project are provided in **Table 3-2**.

Table 3-2: Relevant International and Regional Agreements and Conventions

No.	Conventions	Year (Ratified/Acceded/ Accepted)
Environment		
1	MARPOL: International Convention for the Prevention of Pollution from Ships 1973 and MARPOL Protocol of 1978	1988 (Accession)
2	ICAO: ANNEX 16 to the Convention on International Civil Aviation Environmental Protection Vol. I and II, Aircraft Noise and Aircraft Engine Emission	Accession
3	Vienna Convention for the Protection of the Ozone Layer, Vienna 1985	1993 (Ratification)
4	Montreal Protocol on Substances that Deplete the Ozone Layer, Montreal 1987	1993 (Ratification)
5	London Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer, London 1990	1993 (Ratification)
6	United Nations Framework Convention on Climate Change (UNFCCC), New York 1992	1994 (Ratification)
7	Convention on Biological Diversity, Rio de Janeiro 1992	1994 (Ratification)
8	The Convention Concerning the Protection of the World Cultural and Natural Heritage, Paris 1972	1994 (Acceptance)
9	United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought, Paris 1994	1997 (Accession)
10	Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Washington DC 1973; and as amended in Bonn, Germany 1979	1997 (Accession)
11	ASEAN Agreement on Conservation of Nature and Nature Resources, Kuala Lumpur, 1985	1997 (Signatory)
12	Kyoto Protocol to the Convention on Climate Change, Kyoto 1997	2003 (Accession)
13	ASEAN Agreement on Trans-boundary Haze Pollution	2003 (Ratification)
14	Stockholm Convention on Persistent Organic Pollutants (POPs), 2001	2004 (Accession)
15	Ramsar Convention on Wetlands of International Importance	2005 (Accession)
16	Establishment of ASEAN Regional Centre for Biodiversity	2005 (Signatory)
17	Declaration on ASEAN Heritage Parks	2003 (Signatory)
18	Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas, Rome, 1973	1994 (Acceptance)
19	United Nations Convention on the Law of the Sea (UNCLOS), Montego Bay, 1982	1996 (Ratified)
20	Agreement Relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982, New York, 1994	1996 (Accession)
21	Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (1992)	2015 (Acceptance)

No.	Conventions	Year (Ratified/Acceded/ Accepted)
Social, Labour and Health		
22	Universal Declaration of Human Rights (UNDHR)	signed
23	Convention on the Rights of the Child	1991 (acceded)
24	Convention on Elimination of All Forms of Discrimination against Women (CEDAW)	1997 (acceded)
25	Relevant ILO Conventions in force in Myanmar: • C1 Hours of Work (Industry) • C14 Weekly Rest (Industry) • C17 Workmen's Compensation (Accidents) • C19 Equality of Treatment (Accident Compensation) • C26 Minimum Wage Fixing Machinery • C29 Forced Labour Convention • C42 Workmen's Compensation (Occupational Diseases) Revised 1934 • C52 Holidays with Pay • C87 Freedom of Association and Protection of the Right to Organize	

3.4 International Standards & Guidelines

The Project will also follow International Environmental guidelines and standards including World Bank /IFC (International Finance Corporation) Guidelines & Industry Standards as detailed in **Table 3-3**.

Table 3-3 : International Guidelines

Applicable International Standards & Guidelines	
1	Equator Principles (2013)
2	International Financial Cooperation/ World Bank (IFC/WB) General Environmental Health and Safety (EHS) Guidelines (April 30, 2007)
3	International Financial Cooperation/ World Bank (IFC/WB) Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development, 2007
4	Joint Nature Conservation Committee (JNCC), Guidelines for minimising the risk of injury and disturbance to marine mammals from seismic surveys, August 2010
5	International Association of Geophysical Contractors (IAGC), Recommended Mitigation Measures For Cetaceans during Geophysical Operations, June 2011
6	Seismic surveys & marine mammals - joint OGP/IAGC position paper
7	IAGC 'Marine Geophysical Operations Safety Manual' published by the International Association of Geophysical Contractors (10th edition).
8	IAGC 'Environmental Guidelines for Worldwide Geophysical Operations'.
9	International Convention for the Safety of Life at Sea (SOLAS), 1974.

3.5 Shell Corporate Policy and Standards

Shell's group standards require that the Company's activities and those of its contractors are consistent with corporate policy and procedures with respect to the environment, safety and community relations, and that:

- *"The Impacts of Shell operations on communities and other Stakeholders are assessed and considered in Business decisions" and,*
- *"Negative Impacts of Business activities are minimised, and positive impacts maximised, in a sustainable manner".*

The Shell Commitment and Policy on HSSE and SP applies across Shell globally and is designed to protect people and the environment. The key features of the policy are:

- Systematic approach to HSSE and SP management designed to ensure compliance with the law and to achieve continuous performance improvement;
- Targets for improvement and measurement, appraisal and performance reporting;
- Requirement for contractors to manage HSSE and SP in line with this policy; and
- Effective engagement with neighbours and impacted communities.

All Shell's operations are conducted in accordance with Shell's HSSE and SP Control Framework, a comprehensive corporate management framework. This Framework contains the HSSE and SP requirements that apply to every Shell company, contractor and joint venture under Shell's operational control. It contains a simplified set of mandatory requirements that define high level HSSE and SP principles and expectations, which are documented in a set of supporting manuals. The framework covers areas including contractor HSSE and SP management, safety, environment, health, security and social performance management systems, maritime (vessel) safety and emergency response planning including oil spill response preparedness.

Only prequalified companies with whom Shell has confirmed the suitability of their HSSE&SP management are qualify to bid for the survey work. In addition, the specific vessel tendered will also undergo a vetting and qualification process, including assessment of the specific vessel's existing HSE management. A HSE questionnaire will be included in the tender package, which will be evaluated in parallel to the technical and commercial evaluations, and also allow Shell to determine the need to address any HSE compliance short-comings against Shell requirements.

Finally, Shell's Design and Engineering Practice for Planning and Design of Geophysical Surveys requires:

The impact of the acoustic sound generated by airguns used in offshore 2D and 3D seismic surveys on marine life shall be mitigated by:

- Adhering to applicable local regulatory requirements;
- Application of the JNCC guidelines for minimising the risk of injury and disturbance to marine mammals from seismic surveys in absence of any stricter local regulatory requirements and if not mandated otherwise;
- As part of the applicable EIA, determine the sensitivity of species present in the area of operations to the type of sound produced, assess seasonal variations and the need for additional controls.

A copy of Shell's HSE Commitment and Policy is provided in **Chapter 4.13**.

4. Project Description

4.1 Background

The proposed project is an offshore exploration survey programme consisting of a three dimensional (3D) seismic survey and a Controlled Source Electromagnetic (CSEM) survey in Block MD-5. The purpose of the surveys is to map geological structures under the seabed, to help determine the potential presence of hydrocarbon bearing prospects. The 3D seismic survey will cover an area in excess of 2,680 km^2 (and up to 3,500 km^2), and will fulfil the seismic survey commitments of the Production Sharing Contract (PSC) for Block MD-5. The survey activities will be carried out in water depths ranging from 2,100 to 2,600 m. Block MD-5 has an area of 6,350.65 km^2 (2,452 sq. miles) and its coordinates are shown in **Table 4-1** below.

Shell expects to commence the 3D seismic survey in November 2015 or soon thereafter. The CSEM survey will follow during 3rd or 4th Quarter of 2016 concentrating on areas identified from the initial processing of the data acquired in the 3D survey.

If the subsequent processing and analysis of survey data from the combined surveys reveal potentially viable petroleum prospects, Shell may proceed to drilling of exploration wells in the block.

The block location is shown in **Figure 4-1**.

Table 4-1: Block MD-5 Coordinates

POINTS NO.	LATITUDE (N)	LONGITUDE (E)
A	12° 19' 00"	95° 31' 00"
B	12° 19' 00"	96° 19' 00"
C	11° 40' 00"	96° 19' 00"
D	11° 40' 00"	95° 27' 00"

Note: Reference system of the coordinates is Indian 1954 [EPSG:4239]

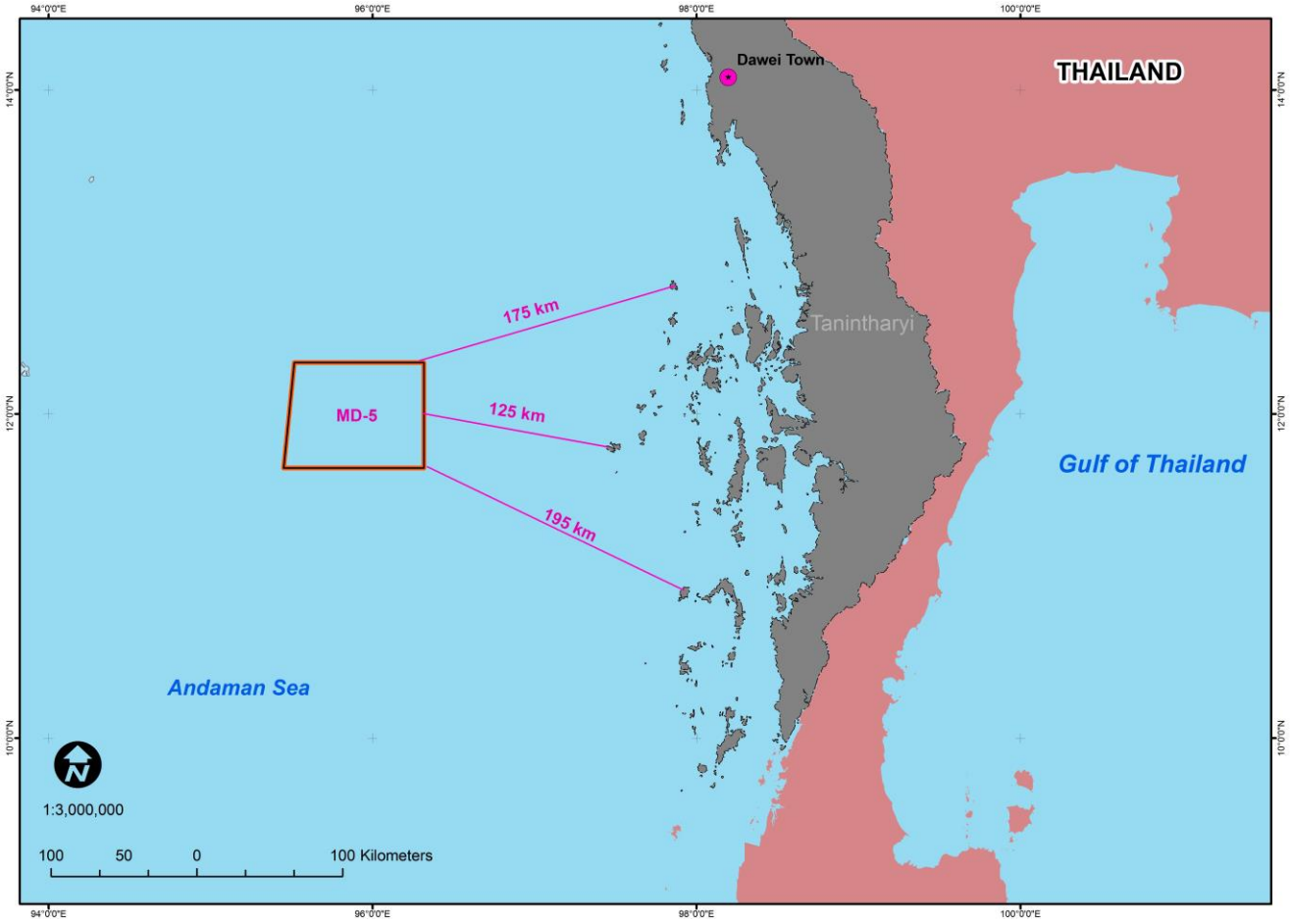


Figure 4-1: Block MD-5 Location

4.2 Production Sharing Contract (PSC) Information

The general terms of the PSC includes the definition of distinct phases of exploration and production as follows:

1. Preparation period
2. Study period
3. Initial exploration period
4. Extended exploration period
5. Production period

This IEE considers aspects and impacts of the committed work programme for the Study Period only. The periods are described below:

1. Preparation period
   - Within 6 months after signing of the PSC, Contractor (Shell) shall conduct an Environmental Impact Assessment (EIA) and Social Impact Assessment (SIA) and then shall submit the final report including an executive summary and mitigation plan (also termed an Environmental Management Plan – EMP), to MOGE for MIC approval.
2. Study period
   - The Study period is a two year period from the date of commencement (approval of EIA/SIA and EMP by MIC). The works programme commitments must be completed within the study period.

3. Initial exploration period
   - Should the exploration surveys identify feasible prospect, the PSC enters an Initial Exploration Period during which the prospects are tested by drilling.
4. Extended exploration period
   - If the outcome of exploration drilling is positive, the exploration period can be extended. During this period a decision is made on whether or not to continue to develop the reserves.
5. Production period
   - The production phase can last for 20 years or more in accordance with an agreed Development Plan starting on completion of the development, or according to a Petroleum (Crude oil / Natural Gas) Sale Agreement, whichever is longer.

4.3 Purpose and Objectives of Project

The primary objective of the 3D seismic and CSEM surveys in Block MD-5 is to acquire information on the geological properties in the area and to identify the presence of structures that may contain potential oil and gas areas.

4.4 History of Petroleum Activity in Block MD-5

A 2D seismic survey was conducted in Block MD-5 in 2010. There has been no previous exploration drilling conducted in Block MD-5.

There has been no previous environmental or social impact assessments conducted in respect of petroleum activities in Block MD-5.

4.5 Project Need and Justification

Myanmar has proven natural gas reserves of 7.8 trillion cubic feet.[1] Gas production in 2014 was over 2 billion cubic feet per day and oil production onshore reached 8,300 barrels per day in 2014, in addition to offshore gas fields that produced 8,000 barrels per day of condensate. As of 2014, the country operated three refineries with a combined capacity of 55,000 barrels per day of petroleum products, the vast majority of natural gas production, about 95 percent, came from the two offshore fields at Yadana and Yetagun in the Andaman Sea. There is some domestic offtake, but the majority of this gas is exported via pipeline to Thailand.[2] Since then, the Shwe field in the Bay of Bengal and the Zawtika field in the Andaman Sea have been commissioned and put into production (2013 and 2014 respectively). The majority of the gas from the Shwe field is exported to China via a newly built pipeline and the Zawtika gas is mainly exported to Thailand also via pipeline.

As of 1 December 2014[3] oil and gas production in Myanmar was as follows:

Production	Onshore	Offshore
Gas mmcfd	70	2,000
Oil and condensate bpd	8,300	8,000

Gas sales were as follows:

Sales	Thailand	China	Domestic
Gas mmcfd	1,400	400	300

1 BP, “BP Statistical Review of World Energy” (June 2011).

2 Asian Development Bank, Interim Country Partnership Strategy: Myanmar, 2012–2014 (Manila: October, 2012).

3 MOGE 1 December 2014

Myanmar faces energy access and security challenges. The International Energy Agency has calculated that Myanmar has the poorest level of energy access in all of the Asia-Pacific and Myanmar is the least developed economy in Southeast Asia. Only 13 percent of the country's population have access to the national electricity grid, approx. 26 per cent have access to electricity, and almost 95 percent of its people depend on solid fuels such as wood and rice husks for cooking and heating.[4]

Secure energy supplies will be important to Myanmar's future development. The Ministry of Energy (MoE) has set the basis of Myanmar's energy policy framework — (i) fulfilling domestic energy requirement; (ii) implementing sustainable energy development; (iii) promoting the wider use of new and renewable sources of energy; (iv) promoting energy efficiency and conservation; (v) promoting use of alternative fuels; (vi) implementing effective utilisation of discovered crude oil and natural gas resources in the interest of the entire nation; and (vii) promoting more private participation.[5]

The purpose of the proposed 3D seismic and CSEM survey programme is to obtain a data set that will:

- Enable imaging within the survey area of below seabed geological structures and strata;
- Allow identification and assessment of whether subsurface formations could be hydrocarbon bearing;
- Identify areas where drilling of exploration wells would have a higher probability of finding commercial quantities of hydrocarbons (than if such seismic data were unavailable).

4.6 Project Alternatives

In the case of Block MD-5, the work programme commitment associated with the PSC is for a 3D survey to be conducted without a prior 2D survey. This has a distinct advantage of acquiring much more accurate data over a larger area and within a relatively short period of time. Due to the limited environmental and social footprint of such offshore deep-water surveys, the disadvantages are mainly effort and cost should the area prove to be non-prospective.

An alternative to the proposed 3D seismic programme would be to initially acquire 2-dimensional (2D) data over a wide area within the block. However, the environmental and social considerations are similar, and does not represent a significant development alternative to the current proposal from an environmental context.

A more significant alternative to the proposed seismic and CSEM programme would be to conduct exploration drilling to establish stratigraphy and delineate hydrocarbon reservoirs. Detailed information at specific locations can be obtained from exploration well logs; information from multiple wells can be projected between well ties to interpret subsurface geology. Compared to seismic surveys, however, exploration drilling requires heavy machinery, is intrusive and very costly, has greater environmental impact, and provides less information (over a large area).

CSEM is an effective technique which can improve the understanding beyond 3D seismic and gives the ability to rule out certain prospects, thereby avoiding drilling on structures that may look prospective from 3D seismic, but can be determined unviable through CSEM.

No Project Option

The oil and gas industry business process is divided in five sequential lifecycle stages as follows:

- Exploration
- Appraisal
- Development
- Production, and
- Abandonment.

[4] UNDP, "Accelerating Energy Access for All in Myanmar" (2013), Executive Summary.

[5] Myanmar Ministry of Energy, "Regional Energy Cooperation" (accessed 15 July 2014).

These stages are different in nature and characteristics and require operations-specific activities planning and management. The proposed exploration survey programme for Block MD-5 is conducted on the basis that, if successful, it could lead to the identification of prospects, on which possible exploration well(s) could be drilled, which if proven to be commercially viable could lead to a development and production. If no such prospects are identified, it is likely that no further exploration activity would take place in the block and the block would be relinquished.

Development of additional petroleum resources would be important factor in maintaining the growth of Myanmar's economy, and positively contribute to the global energy supply. Without conducting these exploration surveys, the potential for hydrocarbon reserves cannot be identified. It is extremely unlikely that any other petroleum activities would take place within the Block without firstly conducting a seismic survey, hence any potential reserves would remain undiscovered and undeveloped.

4.7 Exploration Survey Overview

The exploration survey programme proposed for Block MD-5 will consist of ship based exploration survey operations carried out by a survey vessel with assistance of smaller support vessels. The survey programme is scheduled to commence with a 3D seismic survey in November 2015 or soon thereafter, subject to contract and availability of vessels. The seismic survey in MD-5 is likely to be completed in less than two months. A smaller, targeted, Controlled Source Electro-Magnetic (CSEM) survey is planned for Q3 or Q4 2016, and will also take less than two months to complete.

4.8 3D Seismic Survey

Seismic surveying is an essential part of exploring for oil and natural gas. Marine seismic surveying applies the science of sound energy and seismology to map geological structures under the seabed. Towed devices produce bursts of acoustic (sound) waves that travel through the water column and into the seabed, and then reflected back to receivers that measure the strength and return time of each wave.

The reflected signals are combined and interpreted electronically. The data provides information in relation to the depth, position and shape of underground geological formations that may contain crude oil or natural gas. If the information obtained from the survey indicates rock formations or geological structures that could contain hydrocarbons, a company may decide to seek approval to drill an exploratory well.

Marine seismic surveys require a specialised ship typically 75 to 90 metres long with a crew of mariners, survey engineers and technicians (**Figure 4-2**). During a survey, the seismic vessel travels over a predetermined survey pattern and tows underwater equipment (air gun arrays) immediately behind the ship to generate sound waves; as well as several long cables or "streamers," each containing evenly spaced individual listening devices called hydrophones.

Three-dimensional (3D) surveys use two sound sources and multiple sets of receivers. As the vessel moves along the pre-determines survey path, computers control the simultaneous discharge of a brief pulse of compressed air from the air guns, usually once every 10 seconds (or approx. every 25 metres). The sound waves, which can penetrate more than 6,000 metres into the sea floor, travel down through rock formations. When they encounter a boundary between different formations, some sound waves are reflected toward the surface where individual hydrophones in each streamer intercept them. Signals from each hydrophone are sent back to high-capacity computers on board the vessel that record, check and store the large volumes of seismic data collected.

Once the data are compiled, a computer-generated map of the subsurface geology is produced. Interpretation of the 3D data provides a detailed image of subsurface features (**Figure 4-3**).

Figure 4-2: Typical 3D Survey Spread

Source: http://tle.geoscienceworld.org/, 2015

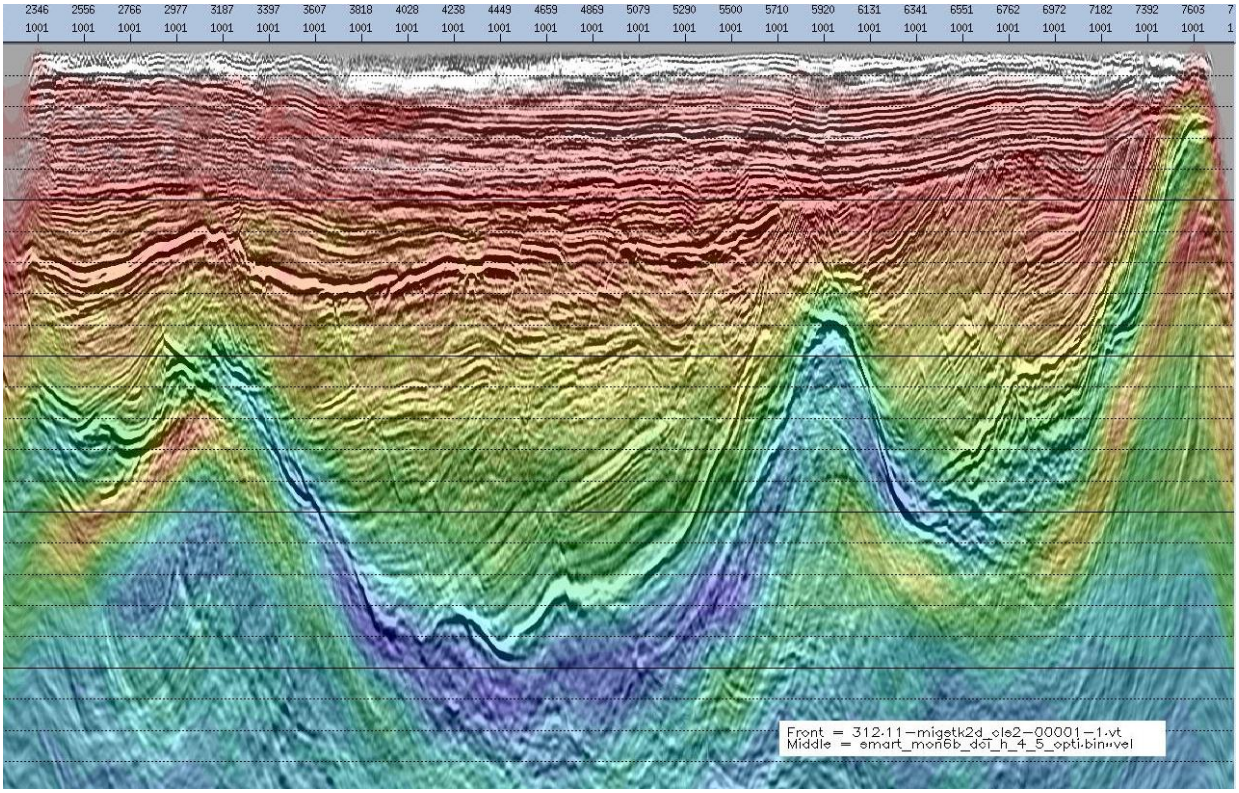


Figure 4-3: Seismic Imaging

Source: Shell, 2015

4.8.1 Seismic Survey Activities

Seismic exploration consists of four main stages: site preparation, data acquisition, data processing and interpretation. Site preparation and data acquisition are carried out on site while data processing and interpretation are performed onshore in an office environment.

The main objective of the proposed survey is to acquire a minimum of 2,680 km^2 of 3D seismic data over the block.

Activities include:

- Mobilisation of vessels including survey vessel and support vessels to the survey area. Support boats ('chase boats' conduct search and confirm that the area along the initial survey sail lines are clear of fishing gear/vessels and/or other vessels;
- Deployment of towed equipment (air gun array and streamers);
- Data acquisition (except when vessels may be kept on standby due to adverse weather conditions, equipment repair etc.); and
- Retrieval of equipment and demobilisation from the area.

4.8.2 Notification and Site Preparation

A Request for Notice to Mariners will lodged with MOGE and a Notice issued to fisheries associations and other relevant parties prior to the survey to inform them of the location and timing of the planned survey.

Under the Part A, Rule 10 of the International Maritime Organization (IMO) Convention on the International Regulations for Preventing Collisions at Sea (COLREGS), 1972, a seismic survey vessel that is engaged in surveying is defined as a 'vessel restricted in its ability to manoeuvre' which requires that other power-driven and sailing vessels give way. A mobile "Exclusion Zone" will be applied by the seismic survey contractor to prevent interaction with other vessels (e.g. cargo vessels, fishing vessels).

The seismic vessel will monitor the exclusion zone via radio and remote tracking systems, while chase boats will be deployed behind and ahead of the survey vessel to liaise with other vessels and fishermen working in the area.

The Block, although located in an area which straddles Fisheries licence areas (E13, E14, E20, E21), it is not normally known to attract intensive fishing effort, but there may be boats fishing for tuna or other deep pelagic species in the area.

The site preparation is carried out by chase vessels with stand-alone navigational equipment to scout the survey lines and identify and log the location of any obstacles (including debris) and will clear the area of debris in the water that could come into contact with and damage the streamer cables. It will be important to remove fishing equipment and other obstacles from the survey area to prevent damage to fishing vessels and gear and prevent entanglement between gear and seismic streamers.

Details of mitigation measures to minimise impact on fisheries is provided further in **Chapter 8**.

4.8.3 Seismic Deployment

The seismic survey is scheduled to commence in Q4 2015 after the end of the monsoon season. The actual time will depend on contract, vessel scheduling and the weather outlook. It is anticipated that only one survey vessel will be used for MD-5 in order to undertake the work programme.

The survey will be acquired using typical 3D seismic techniques whereby a survey vessel tows airgun arrays providing the seismic energy source and a number of streamers containing hydrophones to receive the seismic reflection data. 3D seismic survey pattern comprises a series of parallel transects along which seismic data is acquired.

Once all equipment is ready, mitigation measures to minimise the disturbance of marine mammals from underwater noise will be implemented. A dedicated Marine Mammal Observer will visually scan the surrounding area for presence of marine mammals using the highest available location with the best all-round vision, and using a pair of binoculars. As per JNCC guidelines, any break in the firing sequence longer than 20 minutes will

be followed by a pre-shoot search and a soft-start. The pre-shoot search consists of a visual assessment of the mitigation zone. The soft-start consists of turning on the airguns at low power and gradually and systematically increasing the output until full power is achieved. This build up of power will occur in uniform stages to provide a constant increase in output. The duration of the pre-shooting search is at least 60 minutes and the soft-start procedure is at least 20 minutes.

Details of mitigation measures for minimising disturbance to marine mammals are described in **Chapter 8**.

The seismic vessel will operate 24 hours a day, seven days a week, with the exception of periods of downtime for bad weather or equipment maintenance.

4.8.4 Seismic Data Acquisition

During the data acquisition phase of the activity, the seismic vessel will follow pre-determined sail lines. These may be subject to change depending on prevailing current and wind conditions. The actual distance currently scheduled to be covered by the data acquisition operations will be approx. 5,700 km (excluding turns).

The survey vessel will tow its array of streamers, air guns and hydrophones up and down the parallel lines. This involves sailing down the initial line before turning to sail back up a more distant line, then turning back to sail down the second line in the sequence, giving rise to the 'racetrack' shape as shown in **Figure 4-4**. The expected turning radius for each turn will be approx. 5,000 m. As the line change time is expected to be greater than 20 minutes, as per JNCC 2010 guidelines; airgun firing will be terminated at the end of the line and a full 20 minute soft-start undertaken before the next line. A pre-shooting search will also be undertaken during the scheduled line change, and the soft-start delayed if marine mammals are seen within 500 metres of the centre of the airgun array. Line turns may be undertaken outside the block area boundaries.

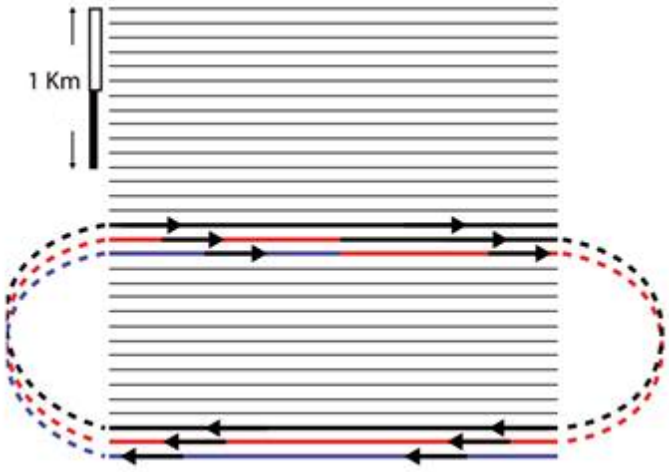


Figure 4-4: Marine 3D seismic survey vessel data acquisition racetrack pattern

Source: OGP, 2011

The vessel will travel at an approximate speed of 7 to 9 km/hr (4 to 5 knots). The parallel sail lines are typically spaced between 800 m and 1,400 m apart, with a turning radius of 3 – 5 km. Throughout the duration of the survey, the chase boats continue to ensure that the sail lines are clear of static fishing gear and that other vessels do not impinge on the survey area.

4.8.5 The Acoustic Seismic Source and Streamers

The seismic source (or airgun array) is typically made up of three sub-arrays or 'strings' of airguns which are suspended from a floatation device to maintain a specific depth. The seismic streamers are typically between 6 and 10 km in length but can in some circumstances be as short as 4 km or as long as 16 km. They are expected to be towed either at a constant depth of 7 – 10 m or at an angle with depth increasing from 10 m near the vessel to 50 m at the tail of the streamer. The source array is typically activated every 10 seconds during

data acquisition for periods of up to 12 hours, depending on the length of the sail line. The principle of seismic acquisition of geophysical data is shown in **Figure 4-5**.

An air gun source array is operated at a pressure of around 2,000 psi (13,800 kPa) and has a typical maximum volume of 3,500 – 4500 cubic inches (0.057 to 0.074 m^3). The sound pressure level emitted by a source array is dependent on the number and configuration of the guns in the array. A typical source array of the above size will typically emit a pulse with a sound pressure level of approx. 254 - 260 dB re1µPa-m (0-Peak).

4.8.5.1 Seismic Survey Execution

Source (air gun) configuration:	Dual arrays / 50 m apart
Volume of air gun array:	3,500 – 4,500 cubic inches
Source depth:	6 – 9 m
Source interval:	25 m 'flip-flop'
Streamer type:	Solid
Streamer configuration:	10-12 x 100 m x 8,000 m
Streamer depth:	Either at a constant depth of 7 – 10 m or angled from 10 m through to 50 m.

Broadband seismic techniques are a non-conventional way to acquire a 3D seismic survey. These techniques are becoming increasingly more common in the industry. Broadband techniques improve the received seismic bandwidth, that is, broaden the frequency spectrum both on the low frequency and high frequency sides.

There are several different methods of acquiring broadband streamer data but all are similar in that the streamer and/or source is deployed at a deeper than normal depth compared to conventional towed streamer seismic survey. The streamer may be towed in a slant configuration commencing at 6 – 8 m at the head to up to 50 m at the tail end of the streamer. This is the deepest the streamer may be deployed for any technique.

Broadband source arrays are typically deployed slightly deeper than for conventional streamer seismic, to a depth of 9 m or so. The arrays may be compiled of airguns split over two levels such as 6 m to 9 m. The variable source depth will increase the low frequency response of the received frequency spectrum but will not significantly alter sound level output of a source array compared to a shallower towed conventional source.

To indicate the tail end of the streamers to shipping traffic and other vessels in the area, there will be a radar reflector and a GPS receiver present at the end of each streamer. This reflector is in the form of a tail-buoy, which is an orange coloured aluminium 'mini-pontoon' structure, clearly visible in daylight hours and equipped with a flashing light for night-time.

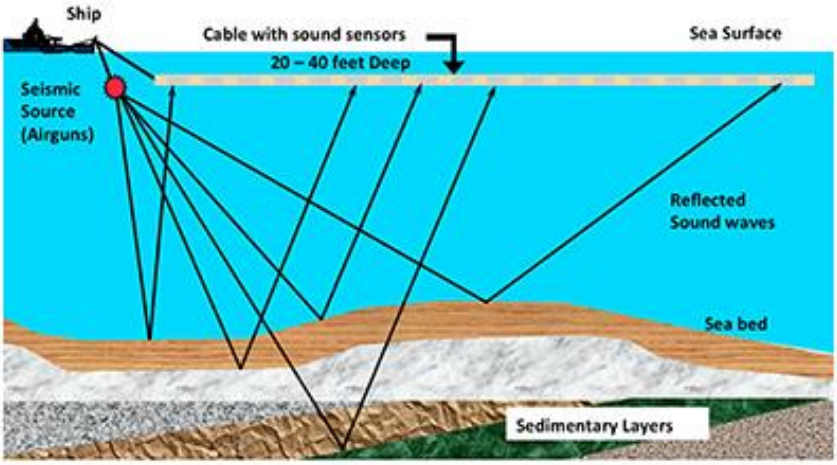


Figure 4-5 Seismic survey schematic

Source: http://www.energytomorrow.org/, 2015

4.8.6 Seismic Vessels

The proposed dedicated seismic acquisition survey vessel will be contracted from a qualified international seismic survey contractor (**Figure 4-6**). The 3D Seismic Survey Vessel is typically 80 – 110 m in length. It will be a dual-source, multi-streamer seismic vessel equipped with advanced integrated geophysical and navigation data acquisition systems, full quality assurance capabilities and onboard positioning and seismic data processing facilities. The survey vessel will be MARPOL compliant. The seismic vessel is expected to be mobilized out of an international port, e.g. Singapore or Yangon.

The vessel will operate with a total crew of 50 - 60 persons (30 vessel/ancillary crews, and 20 - 30 seismic crews). The seismic vessel will operate on fuel oil (LFO or HFO), subject to contract, with an estimated fuel consumption rate of 40 tonnes/day. The survey vessels are similar in layout to typical marine supply vessels. Survey vessels can have a fuel storage capacity in in the order of 1,000 m^3 that is distributed through a number of isolated tanks. Fuel storage is typically distributed through multiple isolated tanks located mid-ship and individual tanks can range in size up to approx. 250 m^3.

Figure 4-6: A typical seismic vessel

Source: Shell, 2015

4.8.6.1 Support Vessels

The support vessel will be an ocean-going work/supply boat typically 40 – 50 m in length and manned by a crew of 10 – 12 personnel. It will have the capability to refuel the survey vessel as and when required, carry supplies and transfer personnel for crew change. The support vessel will be assisted by 2-3 chase vessels.

Chase vessels are typically 20 – 30 m in length and manned by a crew of 8 – 10 personnel. The vessels carry out coordinated patrols of the survey spread are used to carry out liaison with any fishing activity and any other vessel traffic as well as general purpose duties.

The survey vessel master will act in an overall marine coordination role in relation to the movements and functions of the supply and chase vessels in the field. The support / chase vessels are diesel-engine powered with a fuel consumption rate of approx. 10 tonnes/day. There will be between 1-2 trips per month for refuel / resupply runs between Block MD-5 and the shore base either in Ranong or Yangon.

4.8.6.2 Data Processing

Once the seismic data is acquired, it will undergo initial processing onboard the seismic vessel, then transferred to shore for further detailed processing in an office environment. Specialized proprietary software is used by the contracting firm to process the seismic data, and the processing may take several months to complete.

4.8.6.3 Abandonment

Upon completion of the 3D-seismic survey, all of the contracted vessels will leave the area and go off hire. No equipment associated with the seismic survey will remain in the Block.

4.9 CSEM Survey

Following the 3D survey and subject to initial processing of the acquired data, Shell proposes to carry out a limited Controlled-Source Electromagnetic (CSEM) survey in specific locations identified during the acoustic survey. CSEM surveying is an advanced new methodology for identification of hydrocarbon layers in offshore areas. It uses the difference in electrical resistivity to identify subsurface water and hydrocarbon reservoirs, and used in combination with data obtained from traditional 3D seismic surveys, CSEM improves the ability to distinguish potential hydrocarbon reservoirs from other geological features.

In CSEM surveying, a horizontal electric dipole is towed about 30 m above the seabed. The dipole transmits a carefully designed, low-frequency electromagnetic signal into the subsurface. Different rock types, water and hydrocarbons alter the properties of the electromagnetic field as it passes through them. The electromagnetic energy is attenuated rapidly in conductive sediments, but is attenuated less and propagated faster in more resistive layers such as hydrocarbon-filled reservoirs.

Grids of receivers placed on the seabed measure the energy that has propagated through the sea and the subsurface (**Figure 4-7**). The receiver units placed on the seafloor along the survey route record these variations in electromagnetic field properties.

The data from the receivers is then processed, and modelling carried out to produce 3 dimensional resistivity volumes. These datasets are integrated with other subsurface information such as the 3D seismic data and provide better definition of the structure, potentially enabling decisions on whether and where to drill one or more exploration wells.

During the survey a submerged electrical source powers the dipole, i.e. two antennae located between 50 - 300 m apart along a cable attached to the electrical source. The survey vessel generates the electrical power which is supplied to the submerged electrical source through the combined power and tow line. The electromagnetic fields generated are very weak, and at a distance of approx. four metres from the antennae, are comparable to the Earth's magnetic field.

Activities include:

- Mobilisation of survey vessel and support vessel (if required) to the survey area;
- A smaller survey vessel will conduct a bathymetric survey of the area to be covered by the survey;
- Receivers are lowered from the survey vessel to the seabed in locations in a pre-determined grid. The seabed receivers are connected to concrete anchors, which each has a footprint of approx. 1 m^2;
- The vessel tows the energy source along the sail lines at either approx. 30-50 m above the seabed; or at a depth of 10 m below the sea surface.

When the survey has been completed, the receivers are detached from the concrete anchor bases and rise to the surface for recovery to the survey vessel. The concrete anchors, which are left on the seabed are biodegradable, and will disintegrate in approx. 6 – 8 months. The CSEM vessel is expected to be mobilized out of an international port, e.g. Singapore or Yangon.

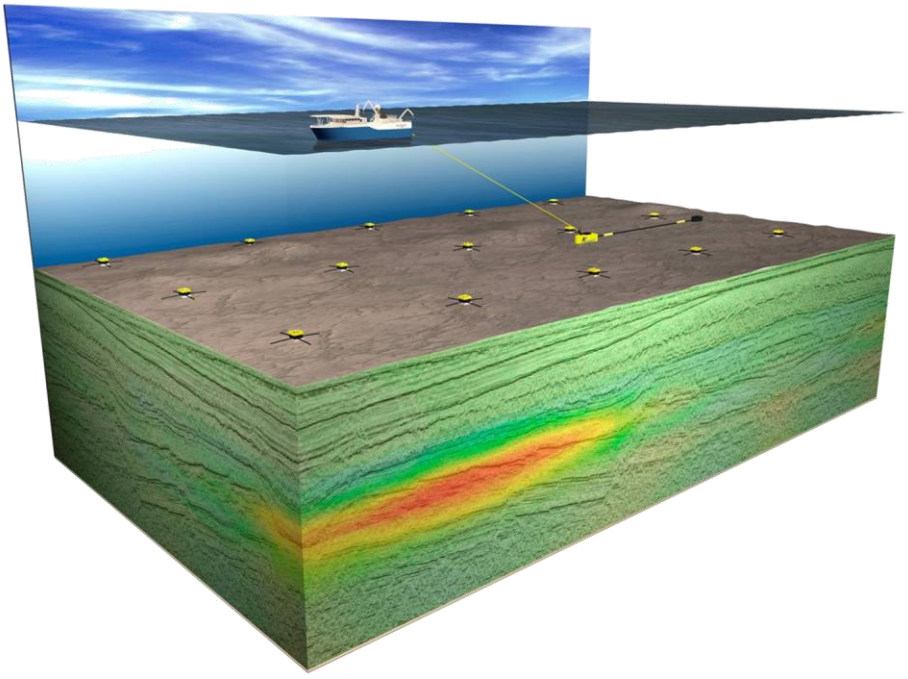


Figure 4-7 Schematic of CSEM survey technique

Source: http://www.emgs.com/, 2014

4.9.1 Source and Receivers

The energy source will be composed of an electrical di-pole varying between 50-300 m in length. This source will emit an electro-magnetic field of 1500 Ampere. It is towed above the seafloor (between approx. 30 to 50 metres) along pre-determined survey lines. The survey lines are designed to cover a grid of receivers placed on the seabed. The grid spacing of the receivers will vary between 1 x 1.5 km up to 5 x 5 km (to be determined at a later stage). The survey lines will extend 8-12 km beyond the grid outline to allow for tow-in/out of the source. In addition, two to three 'broadside' survey lines will be towed parallel to the survey lines, but outside of the grid, to allow wider data acquisition.

The sail direction of the vessel will be parallel to the seabed bathymetric contours, if possible. The survey will most likely be acquired in "roll-over mode" due to the limited amount of receivers that can be deployed at any given time (160-190). This means that the area to be surveyed may be covered by initially deploying receivers in one part of the grid, and after surveying that part, the receivers are retrieved and deployed in an adjacent part of the grid and so on, until the area has been fully covered.

It is possible that some test receivers will be deployed before the survey starts to determine the optimal frequencies for avoiding 'noise' in the data.

4.9.2 CSEM Survey Execution

The following parameters are expected for the CSEM survey:

Source Depth:	10-50 m above seabed (ideally 30 m)
Source Strength:	1500 Ampere
Source Tow in/out:	8-12 km
Receiver Spacing Grid:	1 x 1.5 km up to 5 x 5 km
Receiver Depth:	On seabed; Biodegradable concrete base will remain for 6-8 months after retrieval receivers
Receiver GPS:	Hybrid

4.9.3 CSEM Vessel

The CSEM vessel will be an ocean-going boat typically 50 – 70 m in length and manned by a crew of 35 – 42 personnel. Should the survey require support vessels the CSEM vessel master will act in an overall marine coordination role in relation to the movements and functions of the vessel activities. It is currently estimated that the CSEM vessel will operate without the assistance of support vessels.

The CSEM vessel will operate on fuel oil (HFO or LFO), subject to contract, with estimated fuel consumption rates of approx. 20 tonnes/day.

4.10 Workforce, Accommodation, Transportation and Support

This section contains some estimates which form the basis of subsequent calculations of greenhouse gas emissions and waste water discharges. The numbers, duration and arrangements should be as indicative only, and include estimates for mobilisation and demobilisation, i.e. the transit of vessels from and to their home port(s) before and after the survey.

4.10.1 Workforce

The entire seismic survey is estimated to employ up to 110 people. This includes 60 personnel on the seismic acquisition vessel, and 48 between the support vessel and the chase vessels, and 2 people on shore base for approx. 60 days.

The CSEM survey is estimated to employ about 52 people: 42 personnel on the CSEM acquisition vessel, and a provisional 8 allowing for a support vessel (if required) and 2 people on shore base for approx. 60 days.

4.10.2 Accommodation

During seismic activities, the crew and specialists working on the seismic vessel will be accommodated on board the vessel. The crew of the supply and chase vessels will likewise be accommodated on their respective vessels.

4.10.3 Transportation

Crew change for the survey vessel personnel is normally conducted at five week intervals. Crew change will be conducted by ship to ship transfer via supply port in Ranong (Thailand), or via Yangon.

The survey vessel is equipped with a clinic and carries a trained paramedic. In the event of a medical emergency the injured person is stabilised on-board while awaiting medevac transport, which is likely to be by ship (see **Section 4.14**). A medical emergency response plan will be established by the Contractor and Shell prior to the survey being mobilised.

The seismic survey vessel is expected to mobilise out of an international port (e.g. Singapore) or Yangon. It will be self sufficient, and, if any further supplies become necessary, support will be obtained via the supply vessels

which can transit to Ranong or Yangon as and when required. Refuelling of the survey vessels will be completed at sea as required, from the supply vessel.

4.10.4 Shore Base / Port

The MD-5 seismic survey will be supported from Ranong Port in Thailand or Yangon. The Ranong shore base is currently supporting other oil and gas offshore operations offshore Myanmar, and it is likely that the Contractor will have 1 or 2 personnel based at the shore base for the duration of the seismic survey.

4.11 Survey Work Plan and Work Schedule

4.11.1 Seismic Survey

The seismic survey is currently scheduled to take place over a 1 - 2 month period between November 2015 and February 2016. For the purpose of estimating environmental emissions, it is estimated that seismic and support vessel mobilization can take up to 2 days, the seismic acquisition up to 56 days and demobilization 2 days, therefore a maximum of approx. 60 days to complete the 3D seismic survey. The schedule breakdown of the seismic program is presented in **Table 4-2**.

Table 4-2: 3D Seismic Acquisition Schedule for Block MD-5

Activities	Days
1. Mobilization	2
2. Seismic Acquisition	Up to 56
3. Demobilization	2
Total	60 max

4.11.2 CSEM Survey

It is possible that CSEM vessel and support vessel mobilization can take up to 2 days, the CSEM acquisition up to 56 days and demobilization 2 days, therefore a maximum of approx. 60 days is estimated to complete the CSEM survey.

The schedule breakdown of the CSEM survey is presented in **Table 4-3**.

Table 4-3: CSEM Acquisition Schedule for Block MD-5

Activities	Days
1. Mobilization	2
2. CSEM Acquisition	up to 56
3. Demobilization	2
Total	60 max

4.12 Emissions, Discharges and Waste Generation

4.12.1 Greenhouse Gas (GHG) Emissions

The total release of greenhouse gas emissions (expressed as CO2 equivalent) during the seismic and CSEM operations is estimated to be 19,619 tonnes. Detailed greenhouse gas emission assumptions and calculations are described in **Chapter 6**.

4.12.2 Sanitary Wastewater

Sanitary wastewater includes wastewater from the sanitation facilities and the canteen facilities on the seismic and support vessels.

The wastewater from the project will consist of grey water and black water. The flow rate as determined by the US Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) for EIA in the Gulf of Mexico is 75 litres/person/day for black water and 110 litre/person/day for grey water. Therefore the total quantity for the seismic survey is estimated to be approx. 490 m^3 of black water and 720 m^3 of grey water for 60 operation days with a maximum crew number of 108 (**Section 4.10**). The total wastewater quantity for the CSEM Survey is estimated to be approx. 230 m^3 of black water and 330 m^3 of grey water for 60 operation days with a maximum crew number of 50 (**Section 4.10**). The total quantity of sanitary wastewater for the project is estimated to be approx. 720 m^3 of black water and 1,050 m^3 of grey water. Blackwater from vessels will be discharged directly to sea at a distance of over 12 nautical miles from the nearest shore to comply with MARPOL 73/78 (Annex IV) requirements.

4.12.3 Drainage / Bilge Water

Drainage water consists of deck drainage and slops water from both support vessels and the seismic vessel, and may be contaminated with oil and grease. Drainage water on each vessel will be collected and treated at the dedicated oil/water separator, installed on each vessel. The oil/water separator will separate water from oil prior to discharging the water portion to the sea. Treated drainage water discharged from the vessels will comply with MARPOL 73/78 Annex I requirements. These regulate maritime pollution prevention and set limits for vessel and ship drainage (oil content < 15 ppm prior to discharge). Separated oil and grease will be collected and stored on-board for further onshore disposal.

4.12.4 Solid Waste

Offshore seismic surveys generally do not produce significant quantities of waste other than conventional ship waste. All waste arising in the course of the two surveys will be classified by type prior to treatment, transport, disposal or recycling. A Waste Management Plan will form part of the Seismic Operator's (Contractor) environmental management and compliance plan.

The survey operations will generate two main categories of waste:

- Domestic and non-hazardous waste (i.e. normal household type garbage, such as food waste, cardboard and paper, tin cans and plastic bags);
- Hazardous waste (i.e., substance that may be harmful to the environment by way of pollution, such as old sump oil, diesel oil, and kerosene).

Waste management practices expected to be in place on the seismic vessel are outlined below.

Domestic and Non-Hazardous Waste

Based on previous projects experience, the amount of domestic non-hazardous waste generated is about 1kg / person / day on a vessel. Therefore there will be 108 kg per day generated during the seismic survey and 50 kg per day during the CSEM survey. Therefore the total non-hazardous waste during the seismic survey and CSEM survey is approx. 6.5 tonnes and 3.0 tonnes, respectively.

MARPOL Annex V, which was recently amended, apply to all ships. The new amendments prohibit the disposal of almost all kinds of garbage at sea with the exemption under specific requirements of food waste, animal carcasses, cargo residues contained in wash water and environmental friendly cleaning agents. Every ship of

100 gross tonnage and above, and every ship which is certified to carry 15 or more persons, is required to carry a garbage management plan (based on IMO Guidelines MEPC.220(63) and in working language of the crew).

Waste will be segregated and disposed as follows:

- All garbage will be disposed of in accordance with MARPOL 73/78 Annex V;
- Food waste will be segregated and stored in containers in compliance with SOLAS;
- Food waste which can be macerated to <25 mm sized particles, can be discharged in offshore water (greater than 12 nautical miles from the nearest shore) in compliance with MARPOL 73/78 Annex V requirements;
- Waste will be segregated into recyclable and non-recyclable wastes where practicable, and stored in clearly marked containers for transport and disposal;
- It is possible that the selected Seismic survey vessel may operate an on-board waste incinerator. This will operate in compliance with MARPOL Annex VI.

Hazardous Waste

Hazardous Waste includes:

- Chemical containers, thinner, chemical, contaminated clothes, fluorescent, batteries, etc;
- Medical Waste;
- Oily Waste (spent lube oils, etc.);
- Chemical Waste (batteries, obsolete chemicals).

All hazardous waste will be stored in appropriate labelled containers in a designated area on the vessels. After the end of the project, any hazardous waste will be transported to shore and disposed of by a licensed hazardous waste contractor. Documentation confirming appropriate safe disposal of hazardous waste (e.g. receipts from licensed waste management subcontractors) will be retained by the Seismic Contractor.

4.13 Health, Safety and Environmental, Management

4.13.1 Shell's Health Safety and Environmental Management System

In accordance with its corporate governance and assurance processes, Shell will ensure that the seismic contractor has a comprehensive Health, Safety and Environmental Management System (HSEMS) in place and that it is properly implemented throughout the course of the project. Shell will require the contractor to carry out activities in accordance with the principles of Shell's HSE Control Framework, and in doing so the Contractor needs to operate a similar system of managing health safety and environmental matters. A Shell HSE representative will be onboard the entire program to ensure all activities are completed in accordance with the principles of Shell's HSEMS.

An Environmental Management Plan (see **Chapter 8**) has been prepared for the Project, and this will be implemented by the Contractor during the survey.

4.13.1.1 Shell HSE Commitment & Policy

SHELL COMMITMENT AND POLICY ON HEALTH, SECURITY, SAFETY, THE ENVIRONMENT AND SOCIAL PERFORMANCE

COMMITMENT

In Shell we are all committed to:

- Pursue the goal of no harm to people;
- Protect the environment;
- Use material and energy efficiently to provide our products and services;
- Respect our neighbours and contribute to the societies in which we operate;
- Develop energy resources, products and services consistent with these aims;
- Publicly report on our performance;
- Play a leading role in promoting best practice in our industries;
- Manage HSSE & SP matters as any other critical business activity; and
- Promote a culture in which all Shell employees share this commitment.

In this way we aim to have an HSSE & SP performance we can be proud of, to earn the confidence of customers, shareholders and society at large, to be a good neighbour and to contribute to sustainable development.

POLICY

Every Shell Company:

- Has a systematic approach to HSSE & SP management designed to ensure compliance with the law and to achieve continuous performance improvement;
- Sets targets for improvement and measures, appraises and reports performance;
- Requires contractors to manage HSSE & SP in line with this policy;
- Requires joint ventures under its operational control to apply this policy, and uses its influence to promote it in its other ventures;
- Engages effectively with neighbours and impacted communities; and
- Includes HSSE & SP performance in the appraisal of staff and rewards accordingly.

Ben van Beurden
Chief Executive Officer

Originally published in March 1997 and updated by the Executive Committee December 2009.

General Disclaimer: The companies in which Royal Dutch Shell plc directly and indirectly owns investments are separate entities. In this Policy the expression "Shell" is sometimes used for convenience where references are made to companies within the Shell group or to the group in general. Likewise, the words "we", "us" and "our" are also used to refer to Shell companies in general or those who work for them. These expressions are also used where no useful purpose is served by identifying specific companies.

4.14 Emergency Response Plan

An Emergency Response Plan will be established for emergency situations that may arise during the activities. The plan will give guidance on actions and lines of communication in the event of an emergency and outline the respective responsibilities of Shell and the Contractor. The operational control of the emergency will be the seismic contractor's responsibility. A remote health care plan will be implemented to cover any health issues should these occur on-board any of the vessels during the survey. Medical evacuation (Medevac) in the event of life-threatening medical emergency will be conducted via Ranong or via Yangon. The Medevac procedure may entail the seismic vessel interrupting survey to commence steaming towards port due to constraints on the availability in the region of long range helicopters to take a casualty to port. Further transport will be arranged to transfer the patient to a suitable hospital.

The survey contractors Emergency Response Plan for the proposed programme will include, but not be limited to, the following scenarios:

- Fire
- Abandon ship scenario / Evacuation
- Security incident
- Extreme weather
- Collision / vessel grounding
- Rescue or workboat Emergency recovery
- Man Overboard (MOB) / search
- Medevac
- Fatality
- In-water Emergency (e.g. loss of propulsion or steering)
- Fuel/chemical spill and rescue operation (SAR)

4.14.1 Competence and Training for Emergency Response

Vessel crew members will be subject to medical Fitness to Work certification prior to sailing. Crew will also be clearly briefed on their roles and responsibilities in emergency situations, and will receive appropriate training to fulfill their job in developing emergency plans and during emergency situations. Core elements include:

- Master and First Mate will have IMO Command and Control of Emergencies Training;
- Party Chief and Vessel Master roles for coordination of vessel operations response;
- Fire fighting training for designated response personnel;
- Fire crews relevant to helicopter operations - HLO and assistants will have helideck fire-fighting training from an IMO recognized institute.

4.14.1.1 Safety and Survival Training

All persons including Shell representatives on the ship will receive appropriate sea survival training before mobilising.

Basic Offshore Safety Induction and Emergency Training (BOSIET) will be required for personnel required to transfer via helicopter. The BOSIET course is a minimum requirement to work offshore. The course consists of four modules; Safety Induction, Helicopter Safety and Escape (HUET), Sea Survival and First Aid, Fire Fighting and Self Rescue.

4.14.1.2 Emergency Response Plan, Checks and Tests

The emergency procedures relevant to the operation will be practised on a regular basis, through planned drills and exercises.

In case of leakage or spill of hazardous materials, workers will be evacuated from the affected area, which will be isolated and cleaned in accordance with set procedures. Hazardous waste arising from a spill will be stored in a secure and segregated storage area and disposed in port of through an appropriate licences hazardous waste contractor.

The seismic vessel will carry the appropriate spill response equipment as per Regulation 37 of Annex I of MARPOL which requires that all ships of 400 tonnes gross tonnage or more carry an approved Shipboard Oil Pollution Plan (SOPEP) which includes an appropriate oil spill response kit. This will typically consist of:

- 1 x 4 WB510SN, oil boom 3 m x dia. 13 m
- 1 x WSWL100F, oil sweep 48 cm x 30 cm
- 6 x WSO410, oil socks 120 cm x dia. 7.5 cm
- 2 x Oil truck pack KTO 100
- 200 x WP200S, oil pads 50 x 40 cm
- 50 x YPB200S, oil pads 50 x 40 cm
- 1 x PPE105, PVC protective gloves
- 2 x MTL103, disposal bags.

5. Existing Environmental and Social Setting

5.1 Introduction

This chapter describes the physical, biological and socio-economic characteristics of the project's study area.

5.1.1 Study Area

The study area for this project is focused on the physical, biological, and human components of the environment in the coastal and offshore areas of the Tanintharyi Coastal Zone including the broader Andaman Sea and adjacent Indian Ocean area where Block MD-5 is located. The Tanintharyi Coast (**Figure 5-1**) is the longest coastal zone in Myanmar, approx. 1,200 km long. It includes the Myeik Archipelago (also called the Mergui Archipelago), comprising more than 800 islands.

Figure 5-1: Coastal Zones of Myanmar

5.1.2 Data Sources

5.1.2.1 Primary Data Sources

Due to the nature of the project, which is characterised by being temporary, transient and with a limited environmental and social footprint, primary baseline data was not collected.

5.1.2.2 Secondary Data Sources

A detailed review and summary of available baseline data has been undertaken as part of this study. Secondary data sources are available from literature, relevant authorities, and previous ESHIA and EIA reports conducted near the project area. The following data has been considered:

- Conceptual Field Development Plan for Development and Production Area Application Block M-9 Report by PTTEPI's Myanmar Asset Team during September 2008;
- Environmental, Social and Health Impact Assessment (ESHIA), Zawtika Production Development and Offshore Gas Transportation System, Pro-En Technologies, 2010;
- Additional secondary data sources as cited and listed in the references section.

Information studied includes an environmental baseline survey of Block M-9 undertaken in December 2009, by STS Green, on behalf of PTTEPI for the Zawtika Block M-9 Production Development and Offshore Gas Transportation System ESHIA (hereafter referred to as "the Block M-9 secondary baseline survey"). The survey was completed 190 km north of Block MD-05. The study collected samples and analyzed seawater quality, sediment quality, plankton and benthic communities. The data obtained from the Block M-9 secondary baseline survey for seawater quality, plankton and benthic communities is deemed by IEM to be broadly representative of the regional environmental setting for the Tanintharyi Offshore area as both areas are considered to be undisturbed marine environments in the Andaman Sea. Additional secondary data from the study conducted by the MV. SEAFDEC in the Andaman Sea in November 2004 included 5 sampling stations in Myanmar waters near the Block MD-05 project area.

5.2 Physical Environment

5.2.1 Climate

Myanmar has a tropical climate, and can be divided into two climatic regions, the tropical south and the temperate north. The weather in the Andaman Sea area is primarily influenced by the Northeast (NE) Monsoon and the Southwest (SW) Monsoon, and the short transitional periods between them (Britannica Encyclopedia, 2009).

The Andaman monsoon regime generates four seasons:

- Winter - The northeast monsoon brings infrequent rainfall, mild temperatures, and lower humidity during winter (December to April).
- Spring - The spring transition period between the monsoons (April and May) is hot with very variable weather and thundery squalls.
- Summer - The southwest monsoon (June to September) is characterized by cloudiness, overcast skies, frequent light rain, interspersed with rain squalls or thunderstorms.
- Autumn - Post-monsoon transition from October and November.

5.2.2 Temperature

In the coastal and offshore areas the air temperature varies little during the year but, as recorded in the coastal regions, the hottest months in the area are usually March and April. As an example monthly temperature data for Dawei and Myeik meteorological stations, during the period 1998-2007 are shown in **Table 5-1**. In 2007, the mean maximum temperature was in the range of 31.7-32.1°C and mean minimum temperature was between 21.6 – 23.5°C. The warmest months were March and April, while the coolest months were July and August.

Table 5-1: Monthly Mean Temperature at Dawei and Myeik (1998 - 2007 Average)

Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dawei (°C)	26.2	27	28	29.3	27.1	25.9	25.5	25.2	25.9	27.3	26.8	25.6
Myeik (°C)	27.1	28	28.7	29.5	27.9	27.1	26.6	26.3	26.6	27.4	27.7	26.9

Source:Myanmar Department of Meteorology and Hydrology, 2008

5.2.3 Rainfall

Rainfall is highly seasonal in Myanmar. At least 75% of the precipitation occurs during the southwest monsoon (June to September). Average annual rainfall in Dawei and Myeik from 1998 – 2007 was in the range of 4,184 – 5,283 mm. In 2007, annual rainfall was in the range of 3,762 – 4,312 mm, as shown in **Table 5-2**.

Table 5-2: Rainfall Data at Dawei and Myeik

Station	1998-2007 Average	2007 Actual
	Annual Rainfall (mm)	Annual Rainfall (mm)
Dawei	5,283	4,312
Myeik	4,184	3,762

Source: Myanmar Department of Meteorology and Hydrology, 2008

5.2.4 Humidity

Mean relative humidity at Dawei and Myeik meteorological stations have been recorded to range from 79 - 81% over the period1998 - 2007, and between 78 - 80% in 2007 (**Table 5-3**).

Table 5-3: Humidity Data at Dawei and Myeik

Station	1998-2007 Average	2007 Actual
	Mean Relative Humidity (%)	Mean Relative Humidity (%)
Dawei	79	78
Myeik	81	80

Source: Myanmar Department of Meteorology and Hydrology, 2008

5.2.5 Wind Speed and Direction

The climatic seasons of the Andaman Sea are based on two major wind systems, the Northeast Monsoon and the Southwest Monsoon, each with its own characteristics.

During the Northeast Monsoon, from early December through March, a flow of warm moist air from across the South China Sea covers the coasts. During this time winds blow most frequently from between NNW and ENE although there is some variability. Winds at this time are generally light, averaging Beaufort force 2 - 3. Winds in excess of force 5 are rare, except during tropical cyclones, and sea conditions are generally benign.

During the spring inter-monsoon season from mid-March to mid-May, dry northeast winds give way to moist southwest winds. Weak and variable winds occur in April and May.

The Southwest Monsoon, which extends from mid-May through late September, brings the rainy season, along with maximum cloudiness. Winds are stronger, most frequently in the range of force 3 to force 5. During the height of the SW monsoon, between June and August the wind reaches force 8 (gale force) for about 1% of the time averaged over a number of years.

The autumn inter-monsoon season, in October and November, sees moist Southwest Monsoon air replaced by moist east winds over the coasts. These bring weak and variable winds, with land and sea breezes prevailing until the Northeast Monsoon is established (National Geospatial-Intelligence Agency, 2005).

Table 5-4 shows maximum observed 10-minute and 1-minute wind velocities at return periods of 1, 10, and 50 years in the Block M-9 area.

Table 5-4: Extreme Wind Parameters for Block M-9, 10 m above Water

Return Period	10 Minute Mean Velocity (m/s)	1 Minute Mean Velocity (m/s)
1 year	15.3	16.6
10 years	17.7	19.3
50 years	19.4	21.2

Source: PTTEPI, 2008

5.2.6 Tropical Cyclones

Myanmar is vulnerable to cyclones, which originate in the Bay of Bengal during pre- and post-monsoon seasons from April to May and from October to November.

Cyclone-related disasters occur in this region every 3 to 4 years (Asian Disaster Reduction Centre, 2003). The Arakan Coast is more likely to be struck by a cyclone during the autumn transitional season (National Geospatial-Intelligence Agency, 2005). In addition to the destruction caused by high winds, storm surges generated by the cyclones in the region usually flood the low-lying and densely populated Ayeyarwady river delta region, and other coastal regions along the Andaman Sea.

In early May 2008, Cyclone Nargis, generated in the Bay of Bengal, was the deadliest cyclone to ever hit the country. It made landfall across the delta of the Ayeyarwady River, then continued northeast along the coastline and devastated parts of Myanmar, with a storm surge of up to 3 m that travelled up the rivers within the delta (Theilen and Pararas-Carayannis, 2009).

Table 5-5 shows all tropical cyclones recorded in the Andaman Sea in the past ten years. **Figure 5-2** shows historical cyclone tracks in the Andaman Sea.

Table 5-5: Significant Tropical Cyclones affecting the Andaman Sea since 2005

Year	Name	Type	Max. Wind Speed (Knots)	Distance/Km (Nearest Storm-Block)	Latitude (Decimal Degree)	Longitude (Decimal Degree)
2005	BAAZ	DP	45	141	10.7	94.6
2006	MALA	CY	120	530	11.8	90.6
2007	SIDR	CY	140	338	9.5	93.2
2008	NARGIS	CY	115	580	10.5	90.3
2012	NILAM	DP	55	198	11.3	93.7
2013	PHAILIN	DP	140	2	12.3	95.6
2013	LEHAR	DP	75	150	10.6	94.6

Source: Unisys, 2015

Remark: DP- Depression
CY- Cyclone

Note: 2009-2011 storms were not included as not near Block MD-5
The maximum sustained wind speeds in knots are for the centre of the storm at the time of closet approch

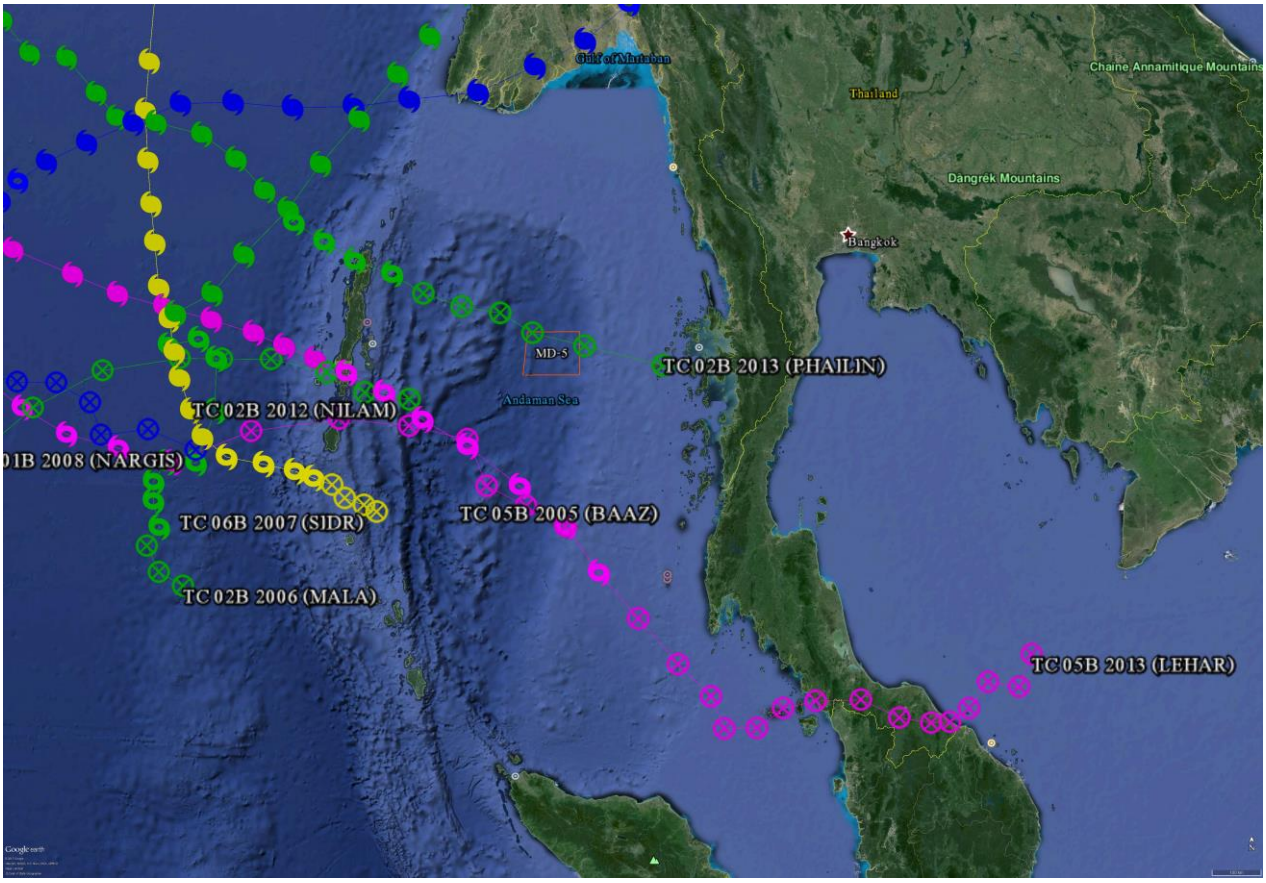


Figure 5-2: Historical Cyclone Tracks in Andaman Sea

Source: Unisys, 2015

5.2.7 Geologic Setting Bay of Bengal and Andaman Sea

The prominent sedimentary basins in Myanmar and neighbouring Bangladesh are the Kaveri Basin, Krishna-Godavari Basin, Palar Basin, Mahanadi Basin, Bengal basin, Andaman Basin and Nicobar Basin. The Andaman-Nicobar Ridge separates the Bay of Bengal from the Andaman Basin. The sediments of the Bengal Fan range in age from Cretaceous to Holocene and can reach thicknesses up to 15 km. It is the largest deltaic system in the world.

The Andaman Sea lies along a convergent margin between the northeastern moving Australian and Indian plate and the nearly stationary Eurasian or Southeast Asian plate (Curray, 2005). It is an active back-arc basin lying behind the Sunda subduction zone where convergence between the overriding Southeast Asian plate and the subducting Australian plate is strongly oblique. Additionally there is an active spreading centre to the north east of the basin. The regional tectonic setting of Myanmar is shown in **Figure 5-3.**

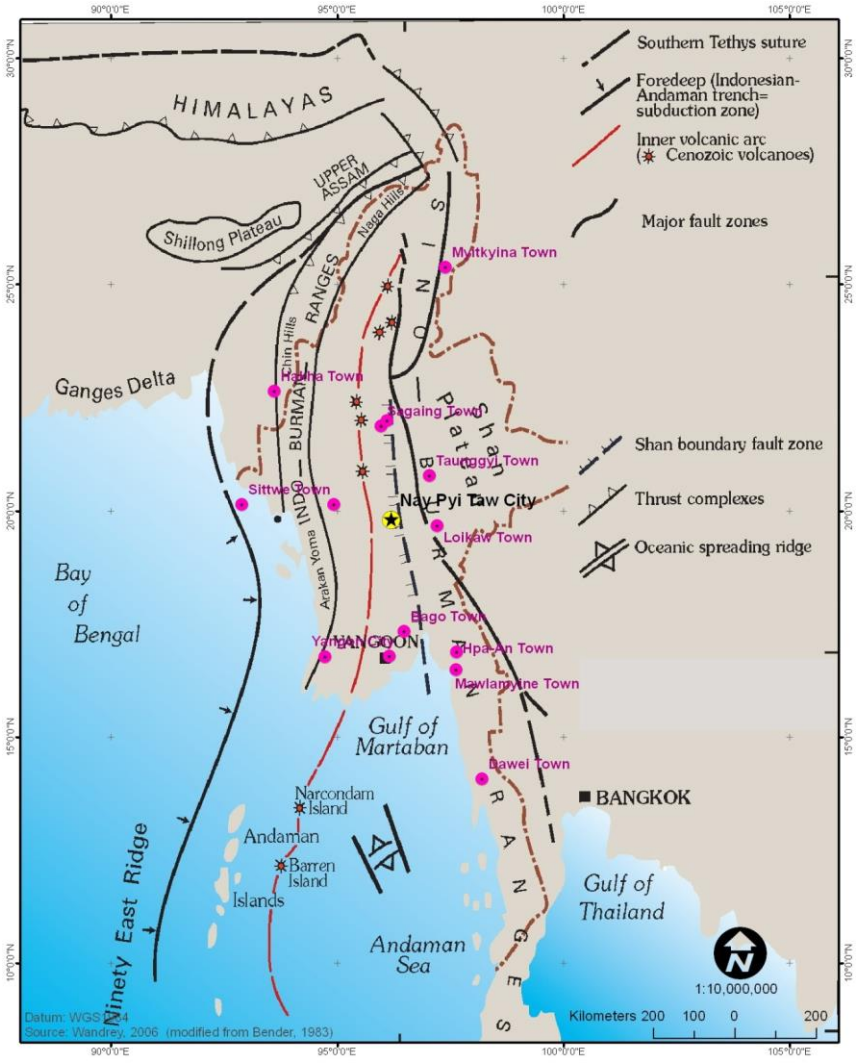


Figure 5-3: Regional Tectonic Setting

5.2.8 Earthquakes

According to Theilen and Pararas-Carayannis (2009), Myanmar is seismologically unstable and vulnerable to earthquakes due to its proximity to boundaries of major interacting tectonic plates. Specifically, the eastern Himalayan belt marks the collision boundary of the Indian tectonic plate underthrusting the Eurasian plate.

The seismicity of Myanmar's coastal area is expected to be relatively low, due to the presence of a fossil plate boundary. Historic records show that at least 15 major earthquakes with magnitudes 7.0 have occurred in Myanmar in the last hundred years. Destructive earthquakes occurred in 1930 at Bago, in 1970 at Yangon, and in 1975 at Pagan.

A map of earthquakes in the South East Asian region is shown in **Figure 5-4**

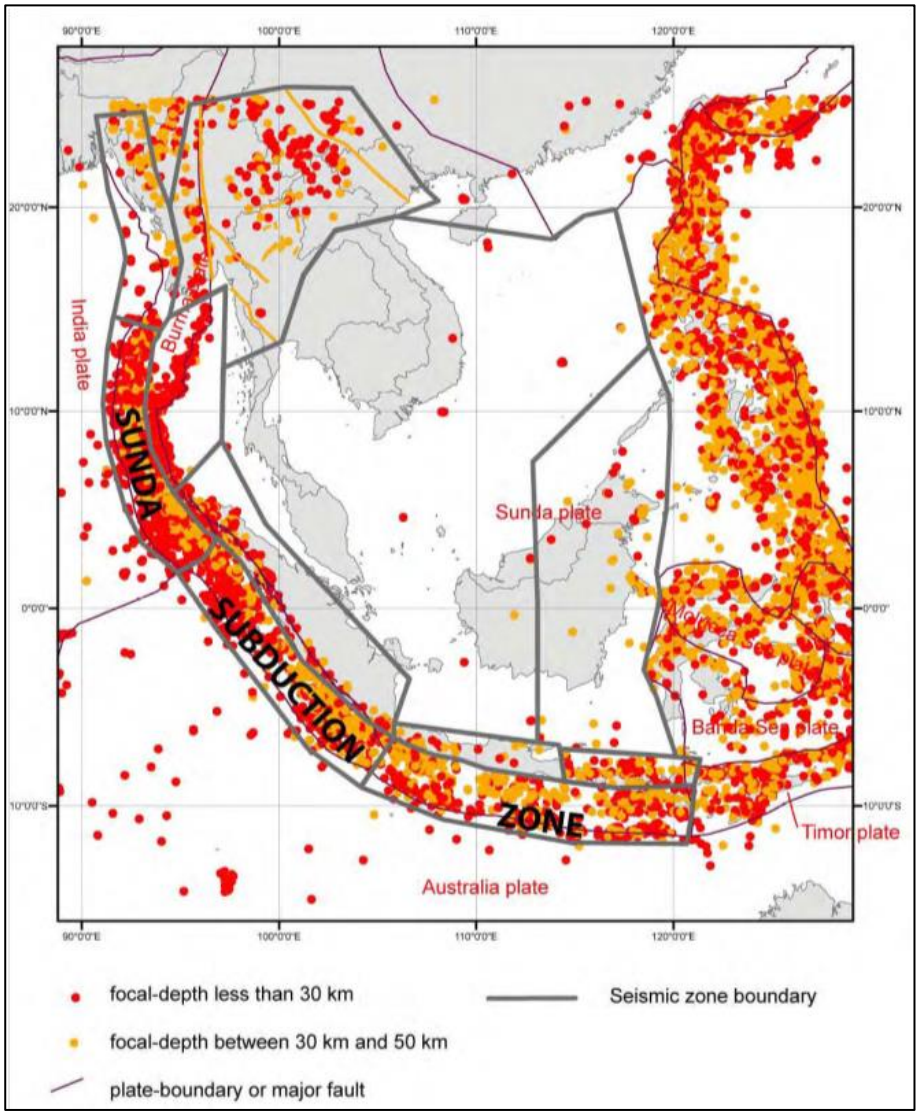


Figure 5-4: Regional Map of Earthquake Occurrence over the Period 1965-2005

Source: USGS, 2007

5.2.9 Oceanography

5.2.9.1 Currents

The oceanic flow changes direction twice during the year; it is cyclonic during the spring and early summer, and anticyclonic the rest of the year (**Figure 5-5**).

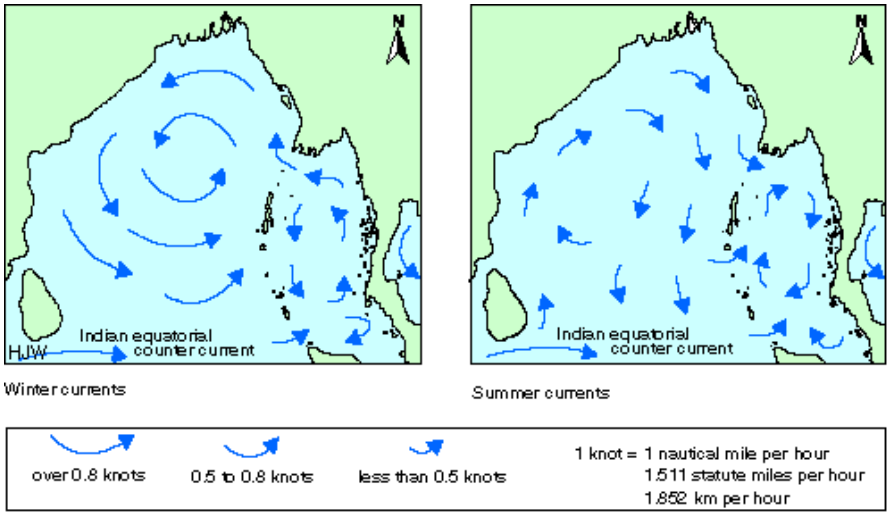


Figure 5-5: Bay of Bengal and Andaman Sea Current Directions

Source: India Engineering (2015)

In the Andaman Sea, water circulates from the north Indian Ocean, Bay of Bengal, southwards along the coast of Myanmar and Thailand, extending southwest of Phuket Island and turning to the Indian Ocean. The southern water mass circulates from Malacca Strait northwards to the southwest coast of Phuket Island, meeting with the northern water mass and moving offshore to the Indian Ocean. Subsequently, such interaction between the two circulation leads to mixing of water mass around southwest of Phuket Island as shown in **Figure 5-6** and **Figure 5-7** during the two monsoon seasons.

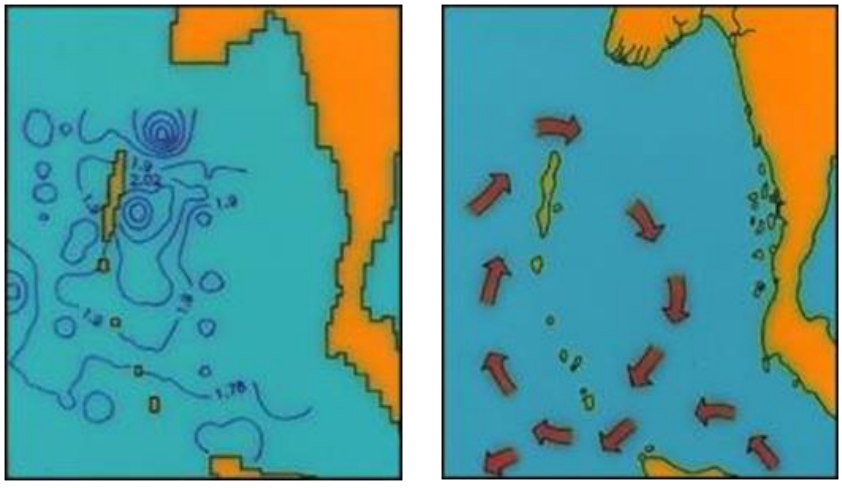


Figure 5-6: Water Circulation during the Northeast Monsoon

Note: Left image shows the contour line of seabed, and right image shows the water circulation which is derived from left image
Source: Khokiattiwong and Limpsaichol, 1994, as cited in Limpsaichol, Undated

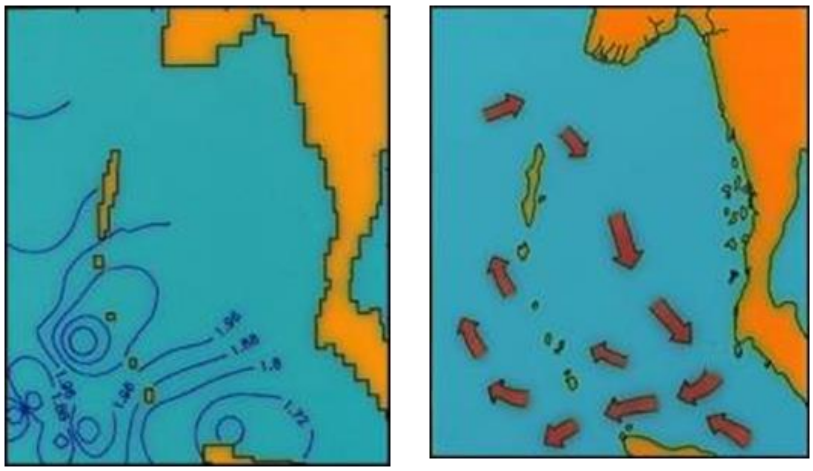


Figure 5-7: Water Circulation during the Southwest Monsoon

Note: Left image shows the contour line of seabed, and right image shows the water circulation which is derived from left image
Source: Khokiattiwong and Limpsaichol, 1994, as cited in Limpsaichol, Undated

5.2.9.2 Tides

The tides along the Tanintharyi coast and along the west coast of Thailand are semidiurnal, with a small diurnal inequality in both time and height. The tides approach these coasts from the south-southwest and progress north. The mean spring ranges increase from about 3 m at the Myanmar-Thailand border to over 5.2 m at Myeik (National Geospatial-Intelligence Agency, 2005). The currents flow at an average rate of 0.4 knots, with a maximum of about 0.7 knots. Near the coast, the tidal currents will also exert great influence and will either augment or deter the non-tidal currents (National Geospatial-Intelligence Agency, 2005).

5.2.9.3 Wind and Waves

The monsoon winds affect and influence surface currents in the Andaman Sea. The currents are variable, and at the height of each monsoon, currents may sometimes be met setting in the opposite to the monsoon current, or in general in any direction.

Solitons are phenomena commonly used to describe large internal waves, associated with strong and rapidly changing currents. During a measurement program in the Andaman Sea near northern Sumatra, large-amplitude, long internal waves were observed with associated surface waves called tide rips (Osborne and Burch, 1980).These wave phenomena are of relevance for offshore operations in the Andaman Sea.

Wind and wave data in the Andaman Sea measured by PTTEPI in 2008 is shown in **Table 5-6**.

Table 5-6: Wind and Wave Data

Return period	Maximum Wave Height (m)	Period (s)
1 year	9.3	11.3
10 years	11.3	11.3
50 years	12.8	11.3

Source: PTTEPI, 2008

5.2.9.4 Bathymetry

The average depth of the Andaman Sea is about 1,000 metres (3,300 ft). The northern and eastern parts are shallower than 180 metres (600 ft) due to the silt deposited by the Irrawaddy River. This major river flows into the sea from the north through Myanmar. The western and central areas are 900–3,000 metres deep (3,000–10,000 ft). Less than 5% of the sea is deeper than 3,000 metres (10,000 ft), and in a system of submarine valleys east of the Andaman-Nicobar Ridge, the depth exceeds 4,000 metres (13,200 ft).

A bathymetric profile along the eastern continental margin of India and the Andaman Sea is shown in **Figure 5-8**. The bathymetry for the coast of Myanmar is shown in **Figure 5-9**.

Bathymetry in Block MD-5 is in deep waters between 2,100 m and 2,600 m.

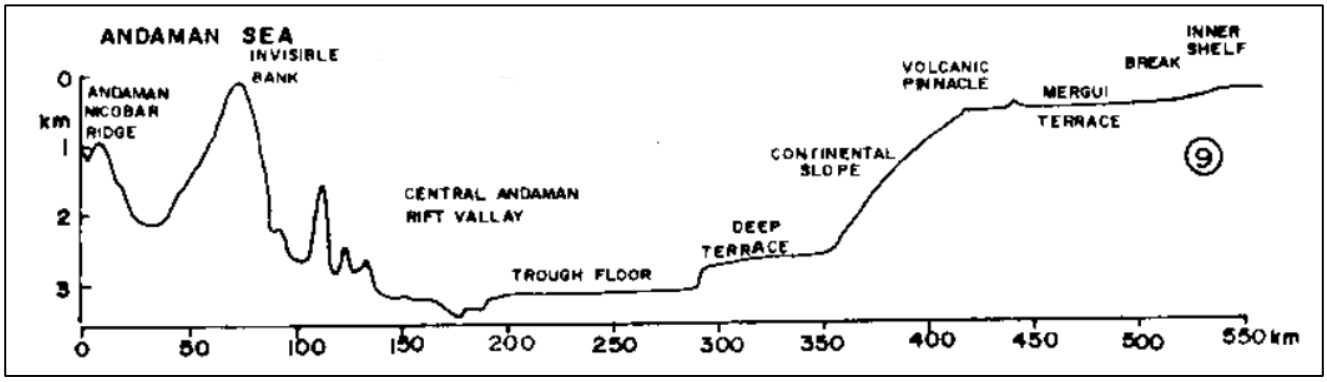


Figure 5-8: Bathymetric profile along the eastern continental margin of India and the Andaman Sea

Source: Rodolfo, 1969, Closs et al, 1974, Murty, 1989, Rao,1991, Narain et al., 1968, Murty et al.1992

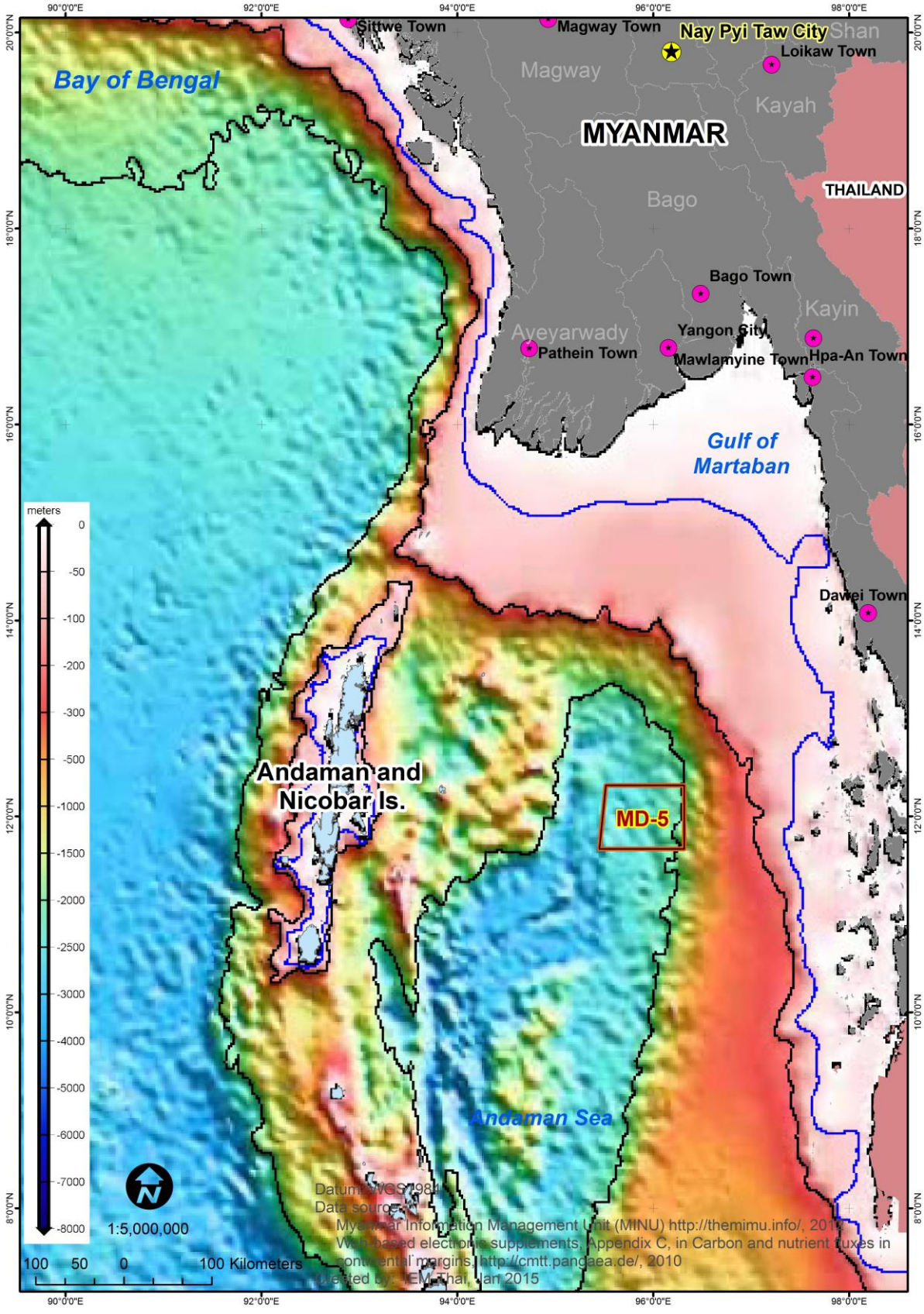


Figure 5-9: Bathymetry off Myanmar's Coast

5.2.10 Seawater Quality

Information on existing seawater quality has been derived from a number of studies in the public domain. This includes data from the Block M-9 secondary baseline survey, performed during December 2009, by STS Green, and is presented as broadly representative baseline data for the Andaman Sea area. Seawater quality sampling results from the research vessel "Dr. Fridtjof Nansen" which were sampled in 2013 with a horizontal near-surface (5 m depth) distribution of temperature, salinity, oxygen and fluorescence for the whole Myanmar coastal area, have also been reviewed. Station positions from this survey are indicated as black dots as shown in **Figure 5-10**.

There are no seawater quality standards in the Union of Myanmar; therefore seawater quality results obtained from the Block M-9 secondary baseline survey were compared to three other applicable standards.

- Seawater Quality Standard Class 1: Natural Resources Preservation Areas, issued as specified in the Notification of the National Environmental Board No 27, BE 2549 (2006), Determination of Seawater Quality Standards;
- Marine Water Quality Criteria for the ASEAN Region for aquatic life protection;
- USEPA National Recommended Water Quality Criteria.

All parameters at all stations met the compared standards, with the exception of dissolved oxygen at depths below 100 m at all stations. The low dissolved oxygen at these depths is most likely due to the seasonal thermocline present at these depths.[1]

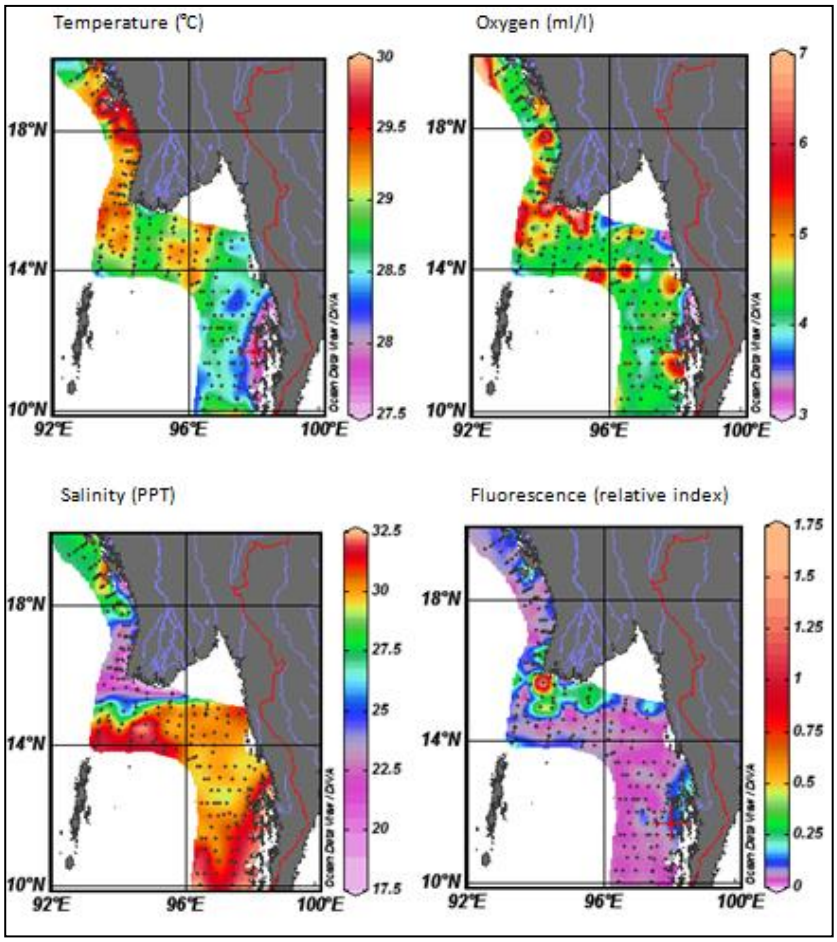


Figure 5-10: Seawater Quality Results from the research vessel "Dr. Fridtjof Nansen" (2013)

[1]Preliminary Results On the Large Pelagic Fisheries Resources, Survey in the Andaman Sea, SEAFDEC, 2006

5.2.10.1 Oceanic Conditions

MV. SEAFDEC conducted a survey in the Andaman Sea during 16th to 25th November 2004. Five stations were sampled in Myanmar waters. The sample locations are shown in **Figure 5-11**.

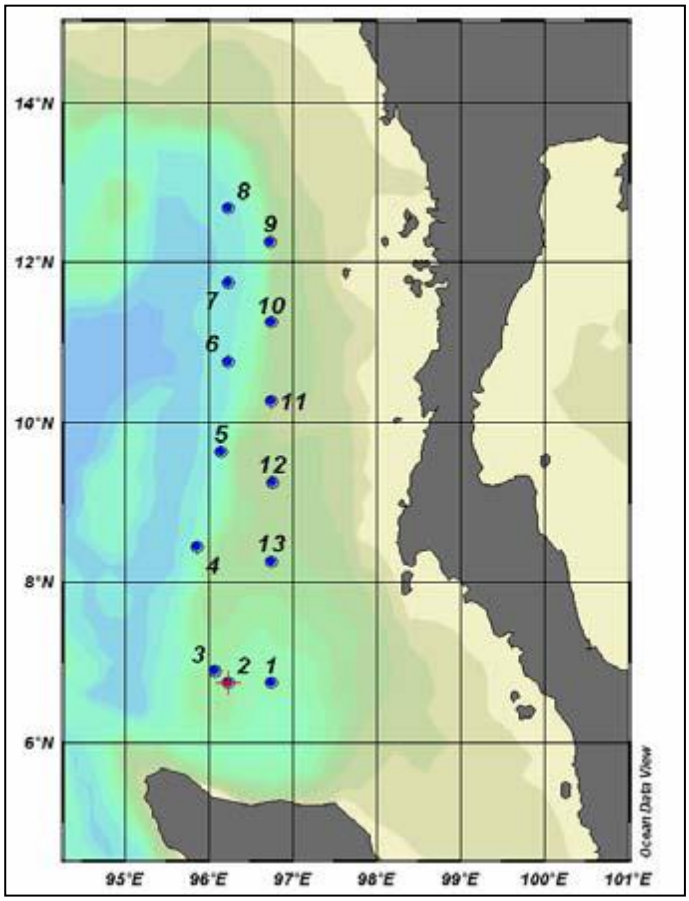


Figure 5-11: MV. SEAFDEC Oceanic Conditions Sample Locations

The temperature, salinity, dissolved oxygen and pH profiles from the SEAFDEC study are shown in **Figure 5-12**.

Representative water quality data shows the Andaman Sea surface temperatures are between 29 and 30°C. Low sanity and high temperature is observed at the surface level. The pH at the surface varies between 8.36 – 8.33. Surface dissolved oxygen in the Andaman Sea is typically within the range of 3.95 – 4.93 ml / l. A thermocline layer in the area is detected between 30 to 211 metres depth, where rapid changes of salinity, dissolved oxygen and pH with increased depth can be observed. At a greater depth, salinity and pH are nearly stable, while dissolved oxygen has a slight increase with increased depths.

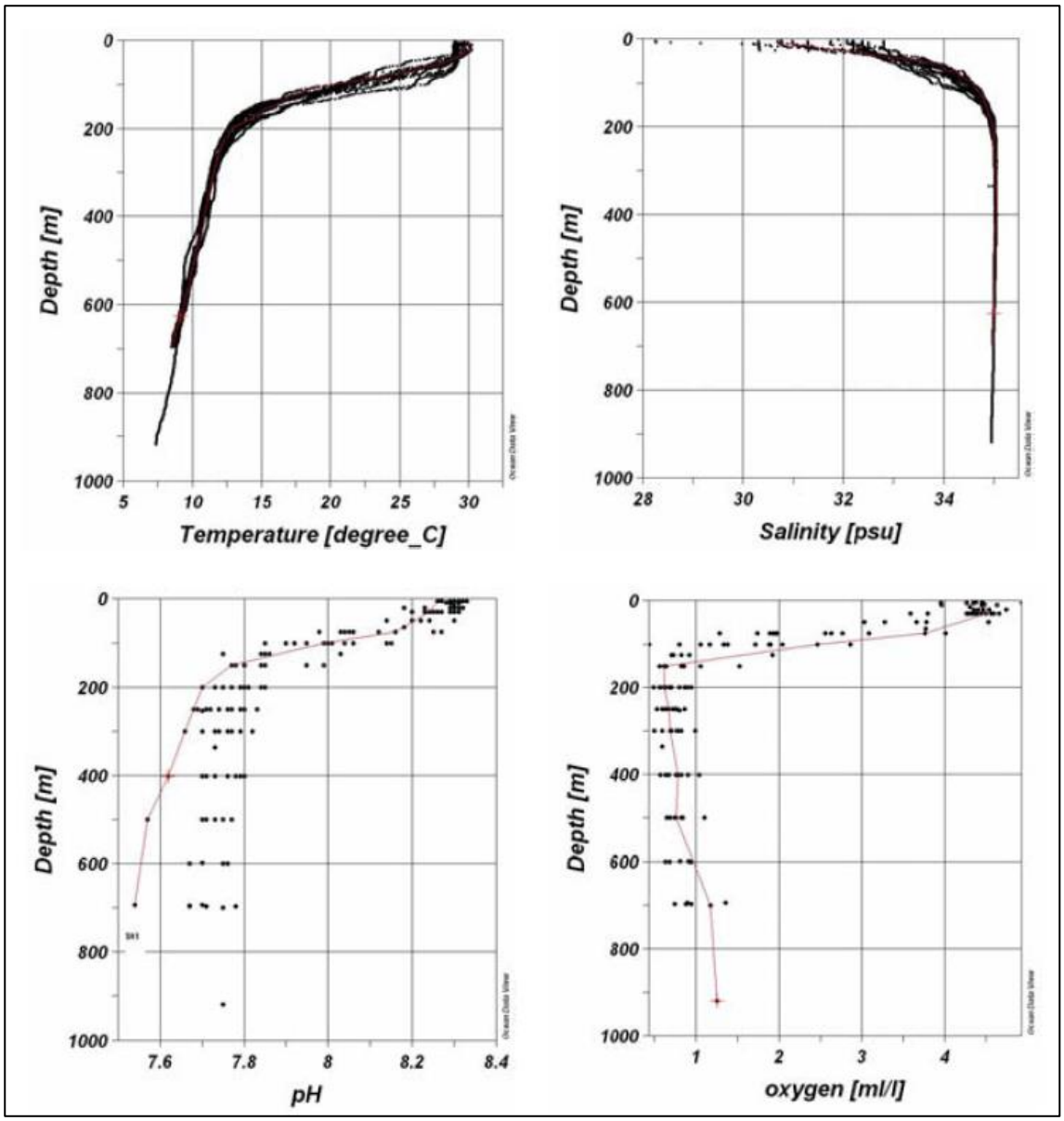


Figure 5-12: Profile of Temperature, salinity, dissolved oxygen and pH from SEAFDEC study

5.2.10.2 Hydrocarbons in Seawater

Total Recoverable Hydrocarbons (TRH) gives an indication of the total hydrocarbons in the sediment, from both natural, biogenic and petrogenic sources.

TRH measured at the relevant stations from the Block M-9 secondary baseline survey ranged from < 0.2 – 0.247 µg/L. The levels found are typical of uncontaminated offshore waters.

5.2.10.3 Heavy Metals in Seawater

Metals occur naturally in water, sediments and the atmosphere as result of the natural occurrence of metals in the earth's crust. At their natural concentrations, most metals play an essential role in many biochemical processes. However, in elevated concentrations, some heavy metals may pose a risk to health or to the environment (e.g. mercury, cadmium, lead, chromium).

All metals measured at the relevant stations from the Block M-9 secondary baseline survey were below the standards.

5.2.10.4 Overview of Existing Seawater Quality

Seawater quality results for the Block M-9 secondary baseline survey are summarized in **Table 5-7**.

Table 5-7: Summary of Seawater Quality Results for the Block M-9 secondary baseline survey

Parameters	Unit	Range of Results	Std 1	Std 2	Std 3
Conductivity	mS/cm	44.5 - 54.6	N/A	N/A	N/A
pH	-	7.91 - 8.10	7.0-8.5	N/A	6.5 – 8.5
Temperature	˚C	19.1 - 29.2	/1	N/A	N/A
Dissolved Oxygen	mg/L	2.12 - 6.91	4	4	N/A
Turbidity	NTU	0.05 - 2.20	N/A	N/A	N/A
Salinity	ppt	28.7 - 36.3	/2	N/A	N/A
Total Suspended Solids	mg/L	< 2.5 – 4.0	/3	N/A	N/A
Petroleum Hydrocarbon	µg/L	< 0.2 – 0.247	0.5	N/A	N/A
Arsenic (As)	mg/L	< 0.0020 - 0.0031	0.01	0.069	N/A
Barium (Ba)	mg/L	0.0063 - 0.010	N/A	1	N/A
Cadmium (Cd)	mg/L	< 0.0020	0.005	0.0088	0.010
Chromium (Cr)	mg/L	< 0.0020 - 0.0024	0.1	0.05	0.05
Copper (Cu)	mg/L	< 0.0050	0.008	0.0031	0.008
Iron (Fe)	mg/L	< 0.20	0.3	N/A	N/A
Nickel (Ni)	mg/L	< 0.0020	N/A	0.0082	N/A
Lead (Pb)	mg/L	< 0.0020	0.0085	0.0081	0.0085
Manganese (Mn)	mg/L	< 0.0020 - 0.0024	0.1	N/A	N/A
Zinc (Zn)	mg/L	< 0.0070 - 0.035	0.05	0.081	N/A
Total Mercury	ng/L	1.34 - 6.40	100	1,800	160

Standards:

Std 1 - Seawater Quality Standard Class 1: Natural Resources Preservation Areas, issued as specified in the Notification of the National Environmental Board No 27, BE 2549 (2006), Determination of Seawater Quality Standards, published in the Royal Government Gazette No. 124 Special Part 11 Ngor, dated February 1, B.E.2550 (2007)

Std 2 - Marine Water Quality Criteria for the ASEAN Region for aquatic life protection.

Std 3 -USEPA National Recommended Water Quality Criteria, Saltwater, acute/chronic, whichever is stricter

Source: STS Green Co. Ltd., 2010

Remark:

/1 Increased not exceed 1oC from the natural condition.

/2 Changed not exceed 10% of minimum salinity measured.

/3 Increased not exceed combining of average value for 1 day or 1 month or 1 year and standard variation value of such average value.

5.2.11 Sediments

There are seven provinces of sediment in the Andaman Basin. The delta provinces are comprised of silty clays. The outer delta shelf sediments (> 60 m) are relict and enriched with feldspar, quartz and mollusc fragments and foraminifera. The Mergui Terrace is surface with muddy sands with abundant quartz (80-90%) and traces of feldspar. Homogenous silty clay dominates the central portion of the Andaman Basin. Foraminifera and radiolarian, with minor admixture of terrigenous mica, constitute the small coarse fraction of the sediments. The early Tertiary sediments are the most dominant type and cover nearly 75% of the surface area of the island. Sea highs are rich in foraminifera (Globigenrina ooze). Coarser sediment intercalations between clayey sediments indicate slumping from sea highs. Volcanic sediments are rare in the Andaman basin but volcanic ash and volcanic clay occur at sub-surface depths in the cores from the Sumatra shelf. Sediments of the Andaman-Nicobar Ridge are coarse, poorly sorted coraline detritus and reef foraminifera on the shelves and silty clay on the ridge slopes (**Figure 5-13**).

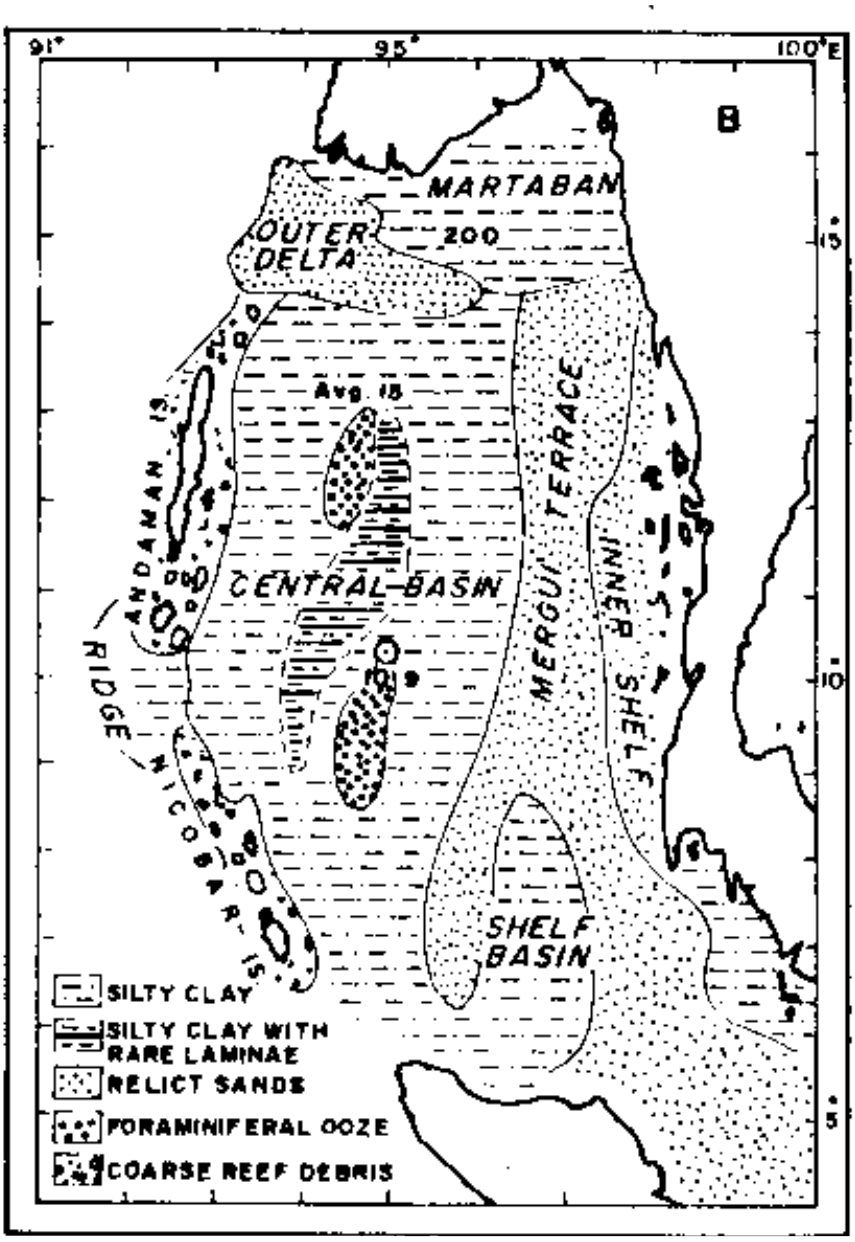


Figure 5-13: Andaman Basin Sediments

Source: Rodolfo, 1969

5.3 Biological Environment

Myanmar straddles four biogeographic regions: sub-continental Asia, Palearctic central Asia, Indochina and Malaysia (Sundaic), the latter two also referred to as the Southeast Asian or Oriental region. Its diverse flora and fauna is attributable to the mixing of these broadly varying regions (Davies, Sebastian and Chan, 2004).

According to BANCA (2011), about 250 mammal species, more than 1,000 birds, 370 reptiles and 7,000 plants have been recorded in Myanmar. Of these, 39 species of mammals, 45 of birds, 21 of reptiles and 38 of plants are globally threatened (NCEA, 2009). Seventy six Key Biodiversity Areas (KBAs) have been identified, out of which 54 are recognized as Important Birds Areas (IBAs) (BLI, 2005). Only one Ramsar Site has been designated so far overlaps with an IBA, and an additional 34 potential Ramsar Sites have been identified in the country (BLI, 2005). Refer also **Section 5.3.8** for further detail on Protected Areas.

The Cruise Report "Dr. Fridtjof Nansen", Ecosystem Survey Myanmar, 2013, provides the most comprehensive and recent information on Myanmar's marine environment, and includes a summary of sea bed conditions, fish and marine fauna occurrence, plankton and nutrients (IMR-Norway and DOF-Myanmar, 2013). Data was collected from 145 fishing stations and 444 species belonging to 129 fish families were recorded. Of cartilaginous species the catches showed: 32 shark species belonging to 11 different families, 20 ray species from 5 families and 2 species of chimaeras from two different families. 235 different taxonomic entities were identified on the Rakhine Coast, while 352 entities were identified in the delta area and 329 entities on the Tanintharyi coast.

From literature analysis, 565 species of corals (24 islands of Myeik Archipelago), 10 species of seagrass, 5 species of turtle, 92 species of mangrove and 30 species of marine mammals have been recorded in coastal and offshore areas of Myanmar.

5.3.1 Threatened Species Overview

The International Union for Conservation of Nature (IUCN) Red List of Threatened Species is widely recognized as the most comprehensive, objective global approach for evaluating the conservation status of plant and animal species. A species is determined to be threatened if it is rated as Critically Endangered (CR), Endangered (EN) or Vulnerable (VU) in the IUCN Red List of Threatened Animals.

Myanmar has approx. 1,000 bird species. Of these, five are endemic to Myanmar, 45 species are classed as threatened in Myanmar. None of these are marine seabirds.

There are 7 threatened marine mammal species confirmed or potentially occurring in Myanmar's maritime territorial waters as follows:

- Endangered
  - Blue Whale (*Balaenoptera musculus*)
  - Fin Whale (*Balaenoptera physalus*)

- Vulnerable
  - Indo-Pacific finless porpoise (*Neophocaena phocaenoides*)
  - Sperm Whale (*Physeter macrocephalus*)
  - Irrawaddy Dolphin (*Orcaella brevirostris*)
  - Dugong (*Dugong dugon*).

- Near Threatened
  - Indo-Pacific humpback dolphin (*Sousa chinensis*).

Five of the world's seven marine turtle species, the Hawksbill (*Eretmochelys imbricata*), Green (*Chelonia mydas*), Loggerhead (*Caretta caretta*), Olive Ridley (*Lepidochelysa olivacea*), and Leatherback (*Dermochelys coriacea*) are found in territorial waters of Myanmar. All five species are classified as threatened. The only other "threatened" marine-inhabiting reptile species is the Critically Endangered (CR) Siamese crocodile (*Crocodylus siamensis*) (IUCN, 2014). Several species of shark are classed as threatened, including the whale shark (*Rhincodon typus*), which occur in Myanmar's marine waters.

These marine species are discussed in more detail in the following sections.

5.3.2 Plankton

Plankton forms the base of the food chain supporting the marine ecosystem. It comprises a diverse range of small invertebrate plants and animals found suspended in the water column. Most species of marine fish and molluscs have a planktonic larval stage. No primary plankton survey was done for this IEE. However, plankton data is available from the M.V. SEAFDEC study. The results from these surveys are considered representative of the Andaman Sea area.

5.3.2.1 Phytoplankton

The M.V. SEAFDEC study revealed that the highest density was 8,658 cells / L found at the nothernmost station of the study in Myanmar. Sixty-nine genera and 164 species were identified. *Oscillatoria erythrea* distributed predominantly in the surface layer and the other dominant species which occurred below the surface layer were *Chaetoceros affinis, C. pseudiduchaeta, Fragilariopsis dollollus, Leptocyclindrus mediterraneous* and *Thalassionema frauenfeldii*.

5.3.2.2 Zooplankton

The M.V. SEAFDEC study identified 65 taxonic groups of zooplankton. The most common groups in the study area are copepods, chaetognaths, ostracods, pteropods, amphipods and euphausiids.

5.3.3 Marine Fish

The coastal small pelagic fish inhabit the nutrient-rich inshore, continental shelf (neritic) waters to 200 m depth, while the large pelagic fish such as billfish (marlin, sailfish, swordfish) and tuna tend to inhabit the deeper offshore oceanic waters.

Myanmar is the largest fishing nation in the Bay of Bengal region. Total marine catches are uncertain but estimates ranges as high as 1.3 – 1.8 million tons. The wild fish sector contributes around 10 % to the GDP and a large part of the human population finds their livelihood in this sector. Myanmar has unreliable fisheries statistics and the only estimates of Maximum Sustainable Yield (MSY) were calculated based on data from the past Nansen surveys.

The ‘Nansen project’ is a partnership between the Norwegian Agency for Development Cooperation (Norad), the Norwegian Institute of Marine Research (Havforskningsinstituttet) and the Food and Agriculture Organization of the United Nations (FAO).

Four surveys were carried out in Myanmar waters from 1979-1981 in a collaboration between the Myanmar Government, Norwegian Institute of Marine Research and FAO. On the invitation of the Government of Myanmar, RV Dr. Fridtjof Nansen returned in 2013 and again April 2015. The survey from 2013 showed a decrease in fish body size rates, declining catches and increasing fishing efforts. The 2015 survey aims to verify data collected in 2013, observe changes in oxygen and pollution levels and identify seasonal changes. In addition to technical support, the Nansen ship provides training of local researchers who will join the Norwegian research team aboard. A report from the 2015 cruise has not yet been published.

The data from the research vessel "Dr. Fridtjof Nansen” survey conducted in 1979-80 shows that there were over 800 marine fish species recorded. In the more recent survey by the same vessel (2013), 444 species were encountered. Acomparison between the pelagic fish biomass estimate from 1979/80 and 2013 shows that the biomass is now estimated at 110,000 t (10 cm mean length) compared to 1,000,000 t in 1979/80. Therefore, standing stock in 2013 was possibly about 10% of the 1980 biomass with a species distribution as shown in **Figure 5-14**.

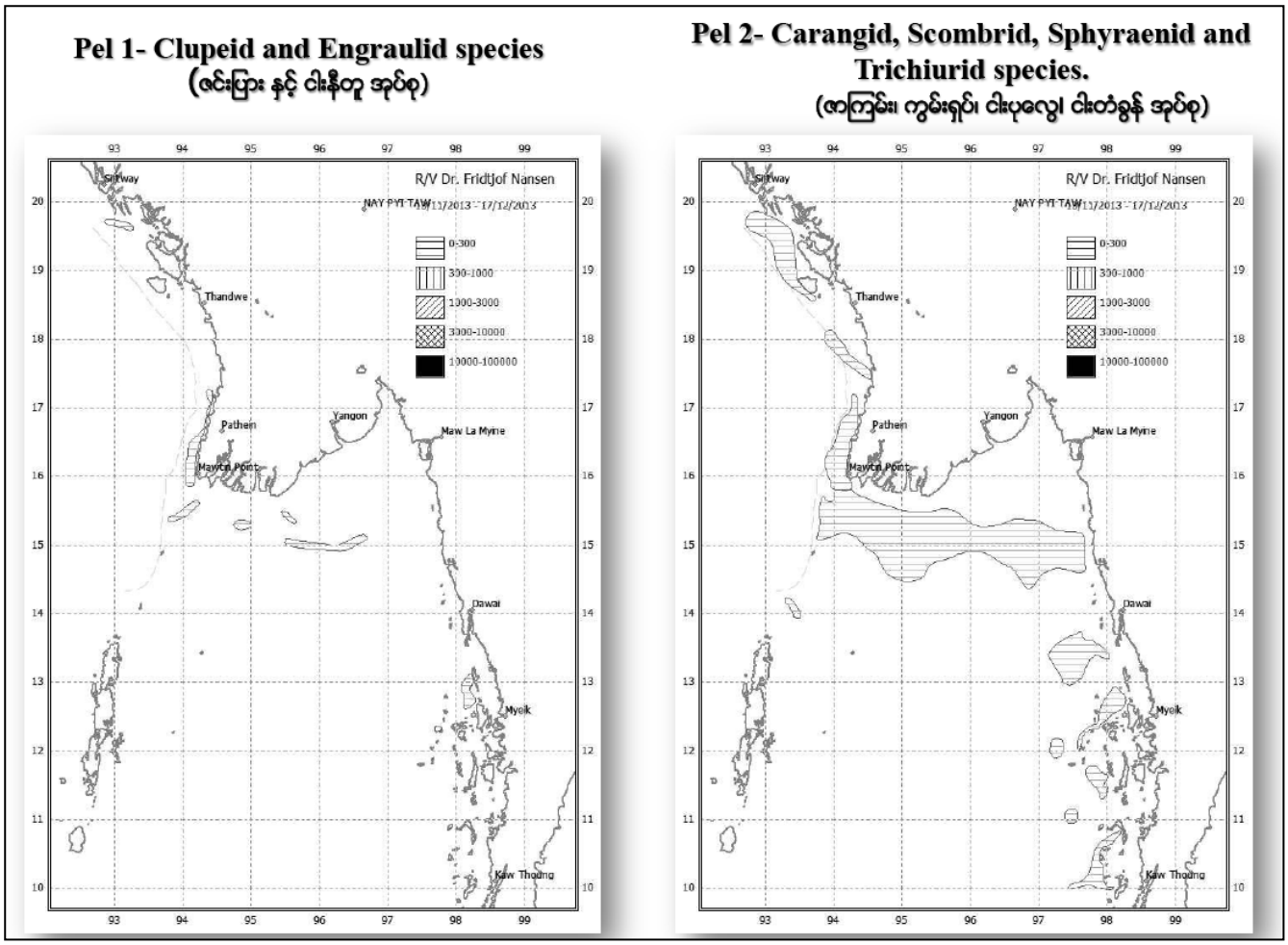


Figure 5-14: Fish Distribution results from "Dr. Fridtjof Nansen" survey conducted in 2013

A list of commercially important species of demersal and pelagic fish of Myanmar is shown in **Table 5-8** (Pe, 2004).

Table 5-8: Common Demersal and Pelagic Fish of Myanmar

No.	Scientific Name	Common Name	No.	Scientific Name	Common Name
1.	***ARRIDAE***	**Sea Cat Fish**	6.	***MURANESOCIDAE***	**Sea eel / Pike conger**
	Arius caelatus	Engraved catfish		*C. Congresoxtalabon*	Yellow pike conger
	A. maculates	Spotted catfish		*Congresox talabonoides*	Indian pike conger
	A. thalassinus	Giant catfish	7.	***NEMIPTERIDAE***	**Threadfin bream**
	A. venosus	Veined catfish		*Nemipterus dalagoae*	Dalagoa threadfin bream
	Osteogeneosus militaris	Soldier catfish		*N. japonicus*	Japanese threadfin bream
2.	***CARANGIDAE***	**Trevally / Scad**		*N. nematophorus*	Double whip threadfin bream
	A. Alecticindicus	Threadfin trevally		*N. tolu*	Notched threadfin bream
	Alepes djeddaba	Djeddabacrevally	8.	***POLYNEMIDAE***	**Threadfin**
	Alepes melanoptera	Black fin crevally		*D. Eleutheronematetradactylum*	Four finger threadfin
	Atropus atropus	Kuweh trevally		*Polynemus indicus*	Indian threadfin
	Carangoides chrysophrys	Long nose cavalla		*P. sextarius*	Black spot threadfin
	C. ciliarius	Long nose cavalla	9.	***POMADASYIDAE***	**Grunt / Javelin fish**
	C. ferdau	Ferdau's cavalla		*E. Pomadasys hasta*	Lined silver grunt
	C. malabaricus	Malabar's cavalla		*Pomadasys maculatus*	Blotched grunt
	Caranx ignobilis	Yellow fin jack	10.	***SCIAENIDAE***	**Croaker / Drum**
	C. sexfasciatus	Dusky jack		*Chrysochir aureus*	Reeve's croaker
	Decapterus macrosoma	Layang scad		*Otolithes rubber*	Tiger toothed croaker
	D. maruadsi	Round scad		*Otolithoides biauritus*	Bronze croaker
	Gnathanodon speciosus	Golden toothless trevally		*Panna microdon*	Penna croaker
	Megalaspis cordyla	Hard tail scad		*Pennahia macrophthalmus*	Big eye croaker
	Scomberoides commersonianus	Talang queen fish		*P. macrocephalus*	Big head pennah croaker
	Selaroides leptolepsis	Yellow stripe trevally		*Prontonebiadiacanthus*	Spotted croaker
	Seriolina nigrofasciata	Black banded trevally		*Pterotolithus maculates*	Blotched tiger toothed croaker
3.	***CLUPEIDAE***	**Herring/Shad/Sardine**	11.	***SCOMBRIDAE***	**Mackerels**
	Anodontostoma chacunda	Chacunda gizzard shad		*Rastrelliger branchysoma*	Short bodied mackerel
	Dussmieria acuta	Rainbow sardine		*R. kanagurta*	Indian mackerel
	Tenualosa ilisha	Hilsa shad		*Scomberomorus commerson*	Narrow barred Spanish mackerel
	Hilsa ilisha	Elongate ilisha		*S. guttatus*	Indo-pacific Spanish mackerel
	Opisthopterus tardoore	Tardoore		*S. lineolatus*	Streaked Spanish mackerel
	Sardinella gibbosa	Gold stripe sardinella	12.	***SERRANIDAE***	**Grouper / Seabass**
4.	***LUTJANIDAE***	**Snappers**		*Epinephelus bleekeri*	Bleeker's grouper
	B. Aprionvirescens	Green job fish		*Epinephelus tauvina*	Greasy grouper
	Lutjanus argentimaculatus	Mangrove red snapper	13.	***STROMATEIDAE***	**Pomfret**
	L. johni	John's snapper		*F. Pampusargenteus*	Silver pomfret
	L. malabaricus	Malabar red snapper	14.	***SYNODONTIDAE***	**Lizard fish**
	L. russelli	Russell's snapper		*G. Sauridamicropectoralis*	Short fin lizard fish
	L. sanguineus	Blood red snapper		*Saurida tumbil*	Greater lizard fish
	L. sebae	Emperor red snapper		*Saurida undosquamis*	Brush toothed lizard fish
	L. vitta	Brownstripe red snapper	15.	***TRICHIURIDAE***	**Hair tail / Ribbon fish**
	Pristipomoides typus	Sharp toothed snapper		*Trichieurus lepturus*	Small head hair tail
5.	***MULLIDAE***	**Goat fish**			
	Parapeneus heptacanthus	Spotted Golden goat fish			
	Upeneus moluccensis	Golden band goat fish			
	U. sulphuresu	Yellow goat fish			
	U. vittatus	Yellow stripe goat fish			

SEAFDEC (2011) conducted a joint research survey on pelagic fisheries resources in 2004 & 2007 to investigate large pelagic fish in Myanmar waters, and to determine the relative abundance and size composition of the commercially important species. The results from this survey indicated that many commercially important species, such as Swordfish (*Xiphias gladius*), Yellowfin Tuna (*Thunnus albacares*), Striped marlin (*Tetrapturus audax*) and Sailfish (*Istiophorus platypus*) inhabit Myanmar offshore waters. Bigeye Thresher shark (*Alopias pelagicus*), White-tipped shark (*Carcharhinus longimanus*), Escolar, Pelagic stingray (*Dasyatis sp.*), dolphinfish (*Coryphaena bipinnulata*) and Snake mackerel (*Gympylus surpens*) were also found as by-catch in this survey.

The 2007 study had a total catch weighing 1,755 kg with 77 catches. There was seventeen species belonged to 16 genera and 12 families caught during the survey. The main catch, by weight and number, were swordfish 650 kg (37.0%), 21 individuals followed by bigeye thresher shark 641 kg (36.5%), 11 individuals and yellowfin tuna 75.0 kg (4.3%), 3 individuals.[2]

Figure 5-15 shows the offshore fishing grounds for tuna and other large pelagic species identified by the SEAFDEC (2011) studies. Block MD-05 project area is located in the Andaman Sea tuna and pelagic fishing area.

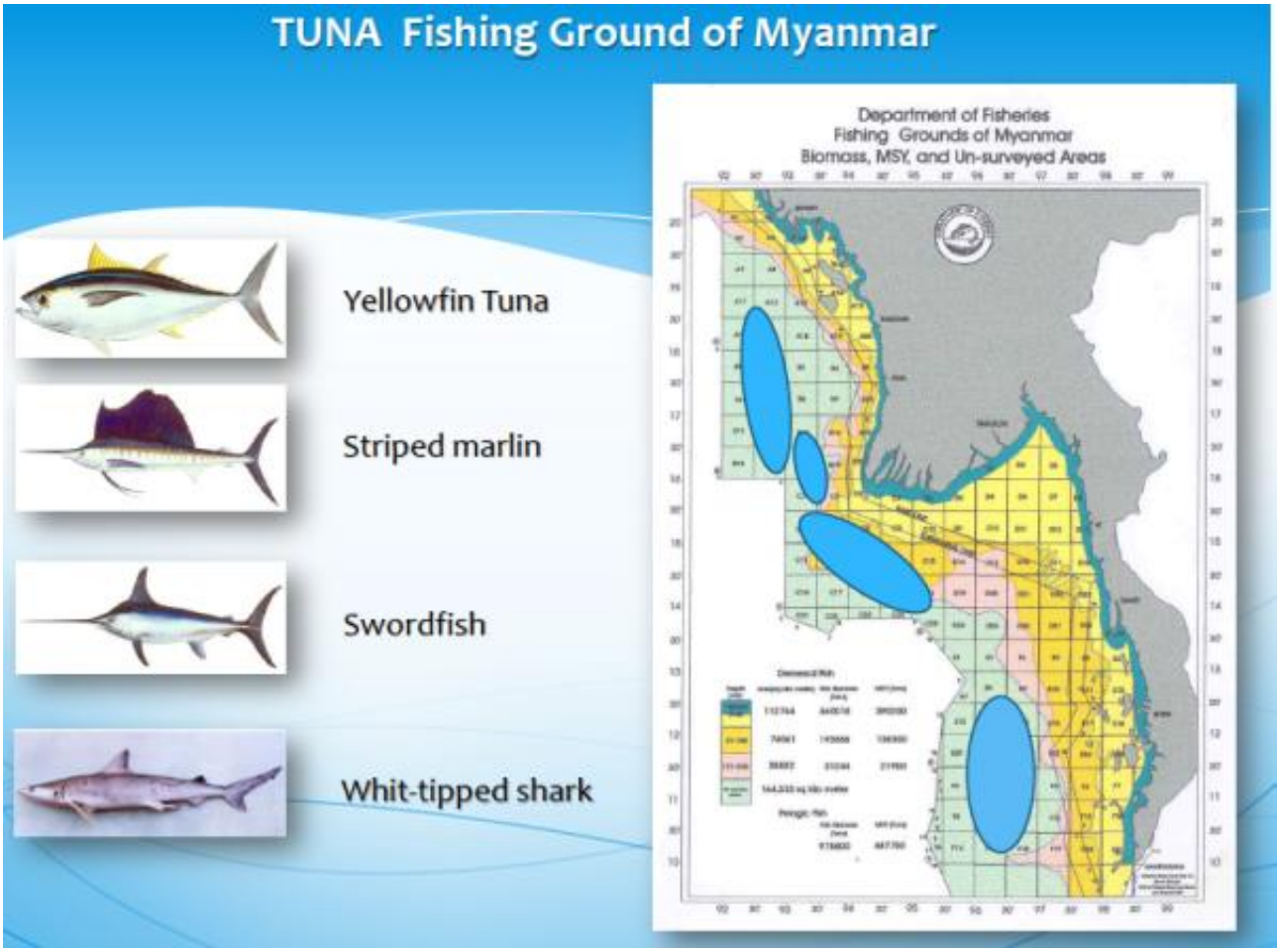


Figure 5-15: Tuna Fishing Grounds of Myanmar

Source: SEAFDEC, 2011

[2] Large Pelagic Fishery Resource Survey using Pelagic Longline in the Bay of Bengal, M.V. SEAFDEC, of the Southeast Asian Fisheries Development Center (SEAFDEC) collaborated with the BIMSTEC, during 5 November to 4 December 2007

5.3.3.1 Sharks

Shark is caught worldwide for their meat, skins, fins, cartilage, jaws and livers. There is increasing concern that heavy, largely unregulated trade in shark species is contributing to a decline in global shark stocks.

The Myeik Archipelago's southernmost dive site, Western Rocky is known to have occasional whale shark sightings. February to May tend to witness the most frequent whale shark sightings in the Myeik Archipelago due to the increased feeding opportunities represented by the plankton blooms that occur at this time of year.[3]

Shark species found in Myanmar waters are shown in **Table 5-9**.

Table 5-9: Shark Species found in Myanmar Waters

Family	Scientific Name	English Name
1. HEMISCYLLIIDAE	*Chioscyillium griseum*	Graybambooshark
	Chioscyillium punctatum	Brownbanded bamboo shark
2. STEGOSTOMATIDAE	*Stegostoma fasciatum*	Zebra shark
3. HEMIGALEIDAE	*Chaenogaleus macrostoma*	Hooktooth shark
4. CARCHARHINIDAE	*Carcharhinus albimarginatus*	Silvertip shark
	C. amblyrhynchoides	Graceful shark
	C. borneensis	Borneo shark
	C. brivipinna	Spinner shark
	C. dussumieri	Whitecheek shark
	C. falciformis	Silky shark
	C. leucas	Bull shark
	C. limbatus	Blacktip shark
	C. melanopterus	Blacktip reef shark
	C. plumbeus	Sandbar shark
	C. sorrah	Spottail shark
	Galeocerdo cuvier	Tiger shark
	Glyphis gangetis	Ganges shark
	Loxodon macrorhinus	Sliteye shark
	Rhizoprionodon acutus	Milk shark
	R. oligolinx	Graysharpnose shark
	Scoliodon laticaudus	Spadenose shark
	Eusphyra blochii	Winghead shark
5. SPHYRNIDAE	*Sphyrna lewini*	Scalloped hammerhead
	S. mokarran	Great hammerhead

Source: DOF, as cited in Nay Pyi Taw, 2009

[3] Accessed from http://www.dive-the-world.com/diving-sites-burma.php on July 3, 2015

5.3.4 Marine Mammals

There are a total of 29 mammal species reported in Myanmar coastal waters. The habitat and conservation status of the marine mammals found in Myanmar waters are described in **Table 5-10**.

Table 5-10: Marine Mammal Species Recorded in Myanmar (LGL 2007)

Common Name		(Scientific name)	Habitat	Status		
				U.S. ESA[1]	IUCN[2]	CITES[3]
Sub-order : Mysticetes (Baleen whales)						
1.	Humpback whale	(*Megaptera novaeangliae*)	Mainly nearshore waters and banks	EN	LC	I
2	Minke whale	(*Balaenoptera acutorostrata*)	Pelagic and coastal	NL	LC	I
3	Bryde's whale	(*Balaenoptera edeni*)	Pelagic and coastal	NL	DD	I
4	Fin whale	*(Balaenoptera physalus)*	Primarily offshore, pelagic	EN	EN	I
5	Blue whale	(*Balaenoptera musculus*)	Pelagic and coastal	EN	EN	I
Sub-order : Odontocetes (Toothed Whales)						
6	Sperm whale	*(Physeter macrocephalus)*	Usually pelagic and deep seas	EN	VU	I
7	Pygmy sperm whale	(*Kogia breviceps*)	Deep waters off the shelf	NL	DD	II
8	Dwarf sperm whale	(*Kogia sima*)	Deep waters off the shelf	NL	DD	. II
9	Cuvier's beaked whale	(*Ziphius cavirostris*)	Pelagic	NL	LC	II
10	Indo-pacific Beaked Whale	(*Indopacetus pacificus*)	Pelagic	NL	DD	II
11	Blainville's Beaked Whale	(*Mesoplodon densirostris)*	Pelagic	NL	DD	II
12	Ginkgo-toothed beaked whale	(*Mesoplodon ginkgodens*)	Pelagic	NL	DD	II
13	Rough-toothed dolphin	(*Steno bredanensis*)	Deep water	NL	LC	II
14	Common Bottlenose dolphin	(*Tursiops truncatus*)	Coastal and oceanic, shelf break	NL	LC	II
15	Pantropical spotted dolphin	(*Stenella attenuata*)	Coastal and pelagic	Da	LC	II
16	Spinner dolphin	(*Stenella longirostris*)	Coastal and pelagic	Db	DD	II
17	Striped dolphin	(*Stenella coeruleoalba*)	Off continental shelf	NL	LC	II
18	Fraser's dolphin	(*Lagenodelphis hosei*)	Waters >1000 m	N.A.	LC	II
19	Risso's dolphin	(*Grampus griseus*)	Waters >1000 m, seamounts	NL	LC	II
20	Indo-Pacific Finless porpoise	(*Neophocoena phocaenoides*)	Coastal far from shore (up to 240 km) in waters < 200 m deep mangrove estuaries.	NL	VU	I
21	Indo Pacific hump-backed dolphin	(*Sousa chinensis*)	coastal, mangrove, estuarine	Candidate Species	NT	I
22	Indo-pacific Bottlenose Dolphin	(*Tursiops aduncus*)	coastal waters, oceanic shelf or around oceanic islands	N.A.	DD	II
23	Melon-headed whale	(*Peponocephala electra*)	Oceanic	NL	LC	II
24	Pygmy killer whale	(*Feresa attenuata*)	Deep, pantropical waters	NL	DD	II
25	False killer whale	(*Pseudorca crassidens*)	Pelagic	NL	DD	II
26	Killer whale	(*Orcinus orca*)	Widely distributed	NL	DD	II
27	Short-finned pilot whale	(*Globicephala macrorhynchus*)	Mostly pelagic, high relief topography	NL	DD	II
28	Irrawaddy Dolphin	(*Orcaella brevirostris*)	Oceanic, brackish water, coastal areas, estuaries	N.A.	VU	I
Order : Sirenia (Manatee and Dugongs)						
29	Dugong	(*Dugong dugon*)	Coastal, estuarine	EN	VU	I

Notes:

N.A. - Data not available or species status was not assessed.
1 Endangered Species Act, EN = Endangered, NL = Not listed, D = Depleted
2 Codes for IUCN classifications: CE – Critically Endangered EN = Endangered; VU = Vulnerable; LC = Least Concern, NT = Near Threatened); DD = Data Deficient. Classifications are from the 2014 IUCN Red List of Threatened Species.
3 CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) (UNEP-WCMC 2006).
a Depleted status applies to the northeastern offshore and coastal stocks of spotted dolphins, which occur in the ETP.
b Depleted status applies to the eastern stock of spinner dolphins, which occurs in the ETP.

5.3.4.1 Conservation Status of Marine Mammals in Myanmar

5.3.4.1.1 Whales

Commercial whaling severely depleted all the large whale populations in the Indian Ocean area, and subsequently, in 1979, the International Whaling Commission declared the Indian Ocean north of 55ºS latitude a whale sanctuary. Under the IUCN Red List of Threatened Species, the blue whale and the fin whale are classified as Endangered.

Although there is limited information available on the distribution and abundance of marine mammals in Myanmar offshore waters, it is assumed for the purpose of this IEE, that conservation significant marine mammal species have potential to transit the waters in the vicinity of Block MD-5 during the period of the surveys.

5.3.4.1.2 Irrawaddy Dolphin

The Irrawaddy Dolphin is found in the Mekong, Ganga, Brahmaputra and Ayeyarwady rivers. The International Union for the Conservation of Nature (IUCN) states the best estimate of abundance for the Ayeyarwady population of Irrawaddy dolphins is 59 individuals, based on the December 2003 upstream survey from Mandalay to just above the Taping tributary confluence in Bhamo (IUCN, 2014), making the *Orcaella brevirostris* (Ayeyarwady River subpopulation) Critically Endangered (CR).

In 2005, the Department of Fisheries established a protected area for Irrawaddy dolphins in a 74 km (46 mile) segment of the Ayeyarwady River between Mingun and Kyaukmayaung. Protective measures in the area include mandatory release of entangled dolphins, prohibition of the catching or killing of dolphins, trade in whole or parts of them, and the prohibition of electro fishing and gillnets more than 300 feet (91 m) long, or spaced less than 600 feet (180 m) apart. Mercury discharges (leading to poisoning) and habitat loss from gold mining dredging operations in the river are also subject to tighter controls.

A vessel-based line-transect survey of nearshore waters (to a depth of 40-60m) was conducted in 2005 off the Myeik Archipelago of southern Myanmar, searching along 955 km of trackline. This survey resulted in 30 cetacean sightings, only one of which was an Irrawaddy dolphin.[4]

The nearest area of habitat where Irrawaddy dolphins are known to occur is the shallow (< 60 m depth) coastal area of the Myeik Archipelago, which is located approx.130 km from Block MD-5.

5.3.4.1.3 Dugong

Dugongs are completely protected in Myanmar (Chapter V, Article 15(a) of the Protection of Wildlife and Protected Area Law, Ministry of Forestry, Union of Myanmar (Notification No. 583/94, dated 26 October 1994). Despite this protection the species is opportunistically taken by fishermen and suffers additional mortality as a result of entanglement in nets. The Dugong is listed as vulnerable in the IUCN Red Data Book of Threatened Species (IUCN, 2014).

Occurrence of dugong at some islands of the Myeik Archipelago such as Sular Island, La NganIsland, Bo Lut Island and War Kyunn Island, as well as waters in the Rakhine Coast has been reported by local communities (Ilangakoon and Tun, 2007).

The nearest area of habitat where dugongs are known to occur is in the Myeik Archipelago near Lampi, and Nyaung Wee Islands of the Myeik Archipelago which is approx. 200 km from Block MD-5.

5.3.5 Sea Turtles

Five of the world's seven marine turtle species, the Hawksbill (*Eretmochelys imbricata*), Green (*Chelonia mydas*), Loggerhead (*Caretta caretta*), Olive Ridley (*Lepidochelysa olivacea*), and Leatherback (*Dermochelys coriacea*) are found in waters of Myanmar, as shown in **Table 5-11**, along the coast of Rakhine, Ayeyarwady and Tanintharyi. All five species are classified as endangered or critically endangered according to IUCN's Red List of Endangered Species. Threats from humans include capture for consumption, harvesting for the crafting

[4]Smith, B. D. and M. T. Tun (2008)."A note on the species occurrence, distributional ecology and fisheries interactions of cetaceans in the mergui (myeik) archiopelago, myanmar." Journal of Cetacean Research and Management 10(1): 37-44.

of ornamental items, egg collection, accidental capture by fishing operations (by-catch), destruction of nesting sites, and pollution. The exact population of marine turtles nesting along Myanmar's coast is unknown.

The Department of Fisheries (DOF) has sighted at least 35 nesting sites in areas along the coastal regions of Myanmar (Pyi Taw, 2009). Among them, six are actively conserved through monitoring and surveillance of turtles landing sites; clutches and magnitude of hatchling enable to return to the sea. Regulations issued in 2005 by the Ministry of Fisheries prohibit the eating of turtle meat and eggs. The regulations also require that turtles caught in fishing nets be released, and trawlers must be equipped with devices to minimize the risk of turtle capture (Hamann et al, 2006).

The nearest known turtle nesting areas is at the Lampi Island Marine National Park which is approx. 200 km distance from Block MD-5. The hawksbill and olive ridley sea turtles are primarily found in tropical coral reefs and coastal areas and unlikely to be encountered in the deep offshore areas, while green, loggerhead and leatherback turtle populations are pelagic and so are encountered in small numbers at a time in open waters.

Table 5-11: Distribution of Marine Turtles in Myanmar

Species Summary	Leatherback (*Dermochelys coriacea*)	Hawksbill (*Eretmochelys imbricata*)	Loggerhead (*Caretta caretta*)	Green (*Chelonia mydas*)	Olive Ridley (*Lepidochelys olivacea*)
Locations	Ayeyarwady Region, Taninthayi Region, Yangon Region	Ayeyarwady Region, Rakhine State, Taninthayi Region, Yangon Region (Coco Island)	Rakhine State	Ayeyarwady Region, Rakhine State, Mon State, Taninthayi Region, Yangon Region (Coco Island)	Ayeyarwady Region, Rakhine State, Mon State, Taninthayi Region, Yangon Region (Coco Island)
Status	Critically Endangered	Critically Endangered	Endangered	Endangered	Endangered

Source: (1) MaungMaung Lwin, Fisheries Officer, Sea Turtle Conservation Unit, Research and Development Division, Department of Fisheries Ministry of Livestock and Fisheries, Yangon, Myanmar.

(2) Sea Turtle Threats, Conservation and Management in Myanmar, ASEAN/SEAFDEC Regional Technical Consultation on Management and Conservation of Sea Turtle in Southeast Asia, Kuala Lumpur, Malaysia , 2003

Maps produced by WWF identify the Coral Triangle, comprised of waters off the coasts of Indonesia, Malaysia, Papua New Guinea, the Philippines, Solomon Islands and Timor-Leste. With the help of satellite tracking, this mapping identifies green turtles migrating in the Andaman sea, including the offshore waters in the vicinity of Block MD-5, as shown in **Figure 5-16**.

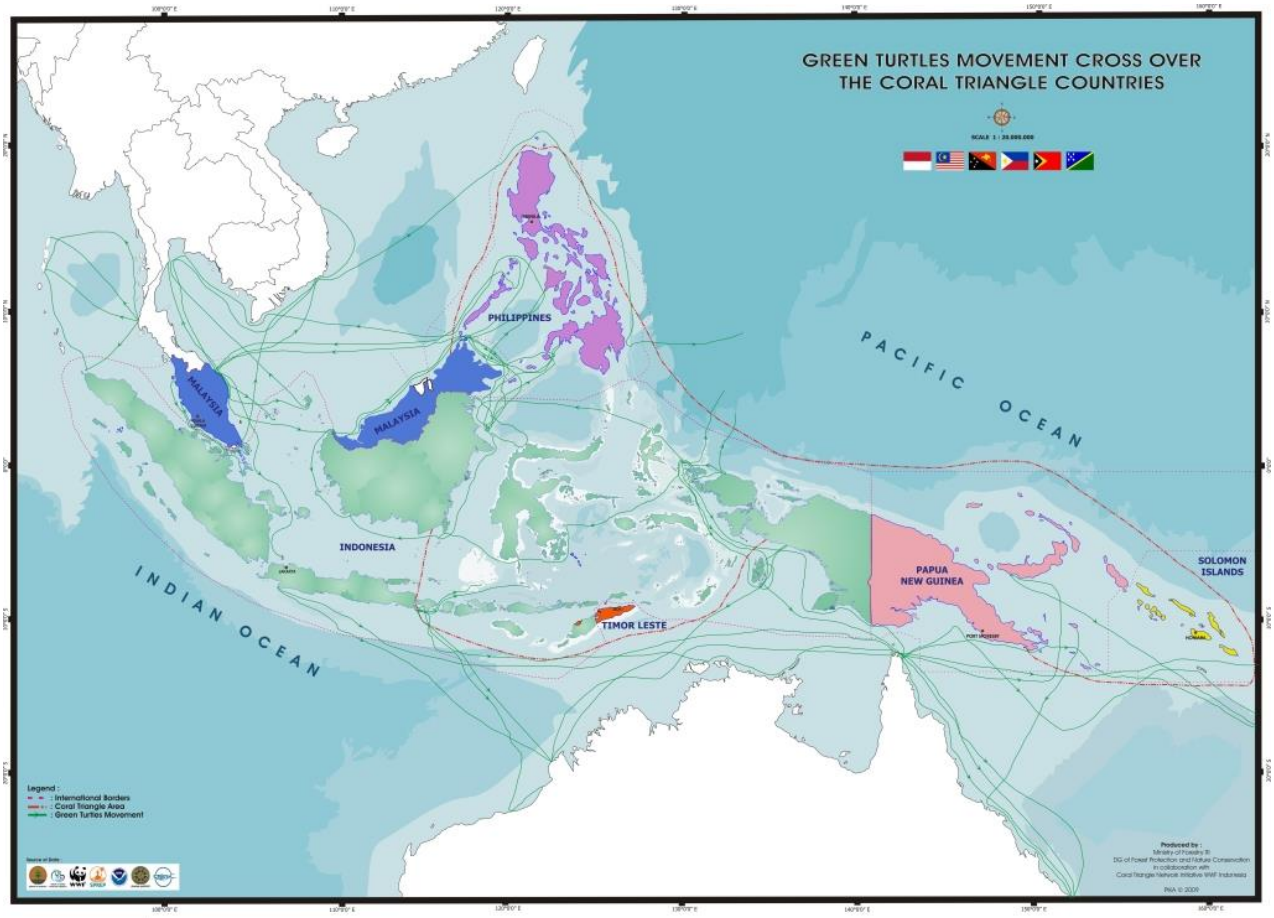


Figure 5-16: Green Turtle Movements across the Coral Triangle Countries

Source: WWF, 2009[5]

5.3.6 Seabirds

Areas of importance in Myanmar for seabirds/shorebirds include the Ayeyarwady Delta, Central Tanintharyi Coast and northern Myeik Archipelago, and Moscos Islands Wildlife Sanctuary (Scott, 1989).

Terns are the most abundant group of seabirds offshore Myanmar. Other seabirds which may use these waters include gulls, storm petrels, Jaegers (also known as Skuas), tropicbirds, boobies, noddies and frigate birds. Seabird species tend be highly migratory, far ranging and widely distributed away from breeding areas. Offshore Myanmar waters are used by seabirds for foraging and loafing (resting). The seabird species of Myanmar, according to Avibase and Birdlife International, are listed in **Table 5-12**.

During the Asian Waterbird Census in 2008, a wintering Spoon-billed Sandpiper survey was conducted at 13 coastal wetland sites of the Gulf of Martaban and Rakhine Coast. A total of 63,298 shorebirds, consisting of 33 species and 7,027 waterbirds, consisting of 45 species, were recorded during the survey. Eighty-four individuals of Spoon-billed Sandpiper at five sites and one Nordmann's Greenshank, which are globally endangered species, were recorded (Wetlands International, 2008).

[5] Accessed from http://d2ouvy59p0dg6k.cloudfront.net/downloads/greenturtlemigrationcoraltriangle.jpg

Table 5-12: Seabird Species in Myanmar

Family		Species	
Scientific Name	**Common Name**	**Scientific Name**	**Common Name**
Hydrobatidae	Storm-petrels	*Oceanodroma monorhis*	Swinhoe's Storm Petrel
		Oceanites oceanicus	Wilson's Storm-Petrel
		Fregetta tropica	Black-bellied Storm-Petrel
Phaethontidae	Tropicbirds	*Phaethon lepturus*	White-tailed Tropicbird
		Phaethon aethereus	Red-billed Tropicbird
Sulidae	Gannets and boobies	*Sula leucogaster*	Brown Booby
		Fregata andrewsi	Christmas Island Frigatebird
		Stercorarius pomarinus	Pomarine Jaeger
		Stercorarius parasiticus	Parasitic Jaeger
Laridae	Gulls and terns	*Anous stolidus*	Brown Noddy
		Larus vegae	East Siberian Gull
		Larus ichthyaetus	Great Black-headed Gull
		Larus ridibundus	Black-headed Gull
		Chlidonias hybrida	Whiskered Tern
		Chlidonias leucopterus	White-winged Tern
		Gelochelidon nilotica	Gull-billed Tern
		Hydroprogne caspia	Caspian Tern
		Sterna hirundo	Common Tern
		Onychoprion anaethetus	Bridled Tern
		Sterna sumatrana	Black-naped Tern
		Sterna dougallii	Roseate Tern
		Onychoprion fuscatus	Sooty Tern
		Thalasseus bergii	Great Crested Tern
		Thalasseus bengalensis	Lesser Crested Tern
		Sternula albifrons	Little Tern
		Larus argentatus	Herring Gull
		Larus cachinnans	Yellow-legged Gull
		Larus brunnicephalus	Brown-headed Gull
		Sterna aurantia	River Tern
		Sterna acuticauda	Black-bellied Tern
Spheniscidae	Penguins	*Chlidonias leucopterus*	White-winged Tern
Gaviidae	Loons	*Anous stolidus*	Brown Noddy
Diomedeidae	Albatrosses	*Rynchops albicollis*	Indian Skimmer
Pelecanidae	Pelicans	*Pelecanus onocrotalus*	Great White Pelican
		Pelecanus philippensis	Spot-billed Pelican
Phalacrocoracidae	Cormorants	*Phalacrocorax niger*	Little Cormorant
		Phalacrocorax fuscicollis	Indian Cormorant
		Phalacrocorax carbo	Great Cormorant
Stercorariidae	Skuas and jaegers	*Stercorarius pomarinus*	Pomarine Jaeger
Procellariidae	Petrels and shearwaters		
Pelecanoididae	Diving-petrels		
Fregatidae	Frigatebirds		
Alcidae	Auks		

Source:Avibase, BirdLife International

Bird life in the mangroves is rich in migrant and resident waterbirds. Resident waterbirds include the oriental darter (*Anhinga melanogaster*), little cormorant (*Phalacrocorax nigers*), reef heron (*Egretta sacra*), dusky gray heron (*Ardea sumatrana*), ruddy shelduck (*Tadorna ferruginea*), bronze-winged jacana (*Metopidius indicus*), lesser sand plover (*Charadrius mongolus*), great stone plover (*Esacus magnirostris*), black-winged stilt (*Himantopus himantopus*), spotted greenshank (*Tringa guttifer*), lesser black-back gull (*Larus fuscus*), and common moorhen (*Gallinula chloropus*) (WWF, 2008).

5.3.7 Sensitive Coastal Ecosystems

Coastal and marine ecosystems play important roles in the productivity of coastal and marine waters, such as biogeochemical cycling, and geomorphological stability of the coastal zone (Pe, 2004). Myanmar's coastal regions contain large numbers of estuaries and islands, some of which contain sensitive ecosystems. An overview of the sensitive marine ecosystems is shown in **Figure 5-17**. These areas are discussed further in this section.

It should be noted that none of these sensitive marine ecosystems occur in or near the planned offshore exploration operations in Block MD-5.

5.3.7.1 Coral Reefs

There are a total of 565 coral species recorded in Myanmar, among them 32% are regarded as least concern, 24% are Near Threatened and 18% are Vulnerable (Cherry Aung, 2009). According to UNEP (2004), coral reefs in Myanmar represent 0.66% of the world's reefs, covering an area of 1,870 km^2. 56% of Myanmar's reefs are threatened (WRI, 2002). Storms, coral bleaching, diving, fishing gear, blast fishing, dredging, and land-based pollutants pose threats to coral reefs.

The majority of Myanmar's coral reefs are found in the Myeik Archipelago, a complex of forested offshore islands in the Tanintharyi coastal area (**Figure 5-17**).

5.3.7.2 Mangroves

Coastal mangrove forests play a significant role as habitats for many wildlife and fisheries. They provide nursery and rearing areas for numerous fish and crustacean species, nesting and feeding areas for birds, and actively sequester carbon from the atmosphere. They also act as an important buffer zone for inland areas against storms. Mangroves along Myanmar coasts are of immediate value to local populace, particularly as fire wood and charcoal for cooking, timber for construction and fisheries. There is a positive correlation between fish and shrimp catches in near shore waters and the extent of mangrove area (Matosobroto and Naamin 1977).

Total mangrove coverage is estimated at 4,219 km^2, of which approx. 0.6% is protected (UP MSI et al. 2002). According to JICA (2000), there are 29 species of mangrove in Myanmar, hosting 69 species of fish, 13 species of shrimp, 4 species of crab and 9 species of other shellfish. *Rhizophora, Sonneratia, Avicennia, Bruguiera and Xylocarpus spp.* are dominant species in Myanmar. Predominant species in the Rakhine and Tanintharyi coastal mangroves are *Rhizophora mucronata and Rhizophora apiculata*. Predominant species in the Ayeyarwady delta mangroves are *Heritiera fomes* (Mangrove Service Network, 2006). There are two species of mangrove regarded as Critically Endangered. Six species are Endangered, one species is Vulnerable and seven species are regarded as Near Threatened (IUCN, 2014).

The mangrove forests in Myanmar are degraded due to a number of reasons, including sedimentation from the Ayeyarwady River, which again is a result of land use including forestry, agriculture, aquaculture, and development (earthworks / construction) activities.

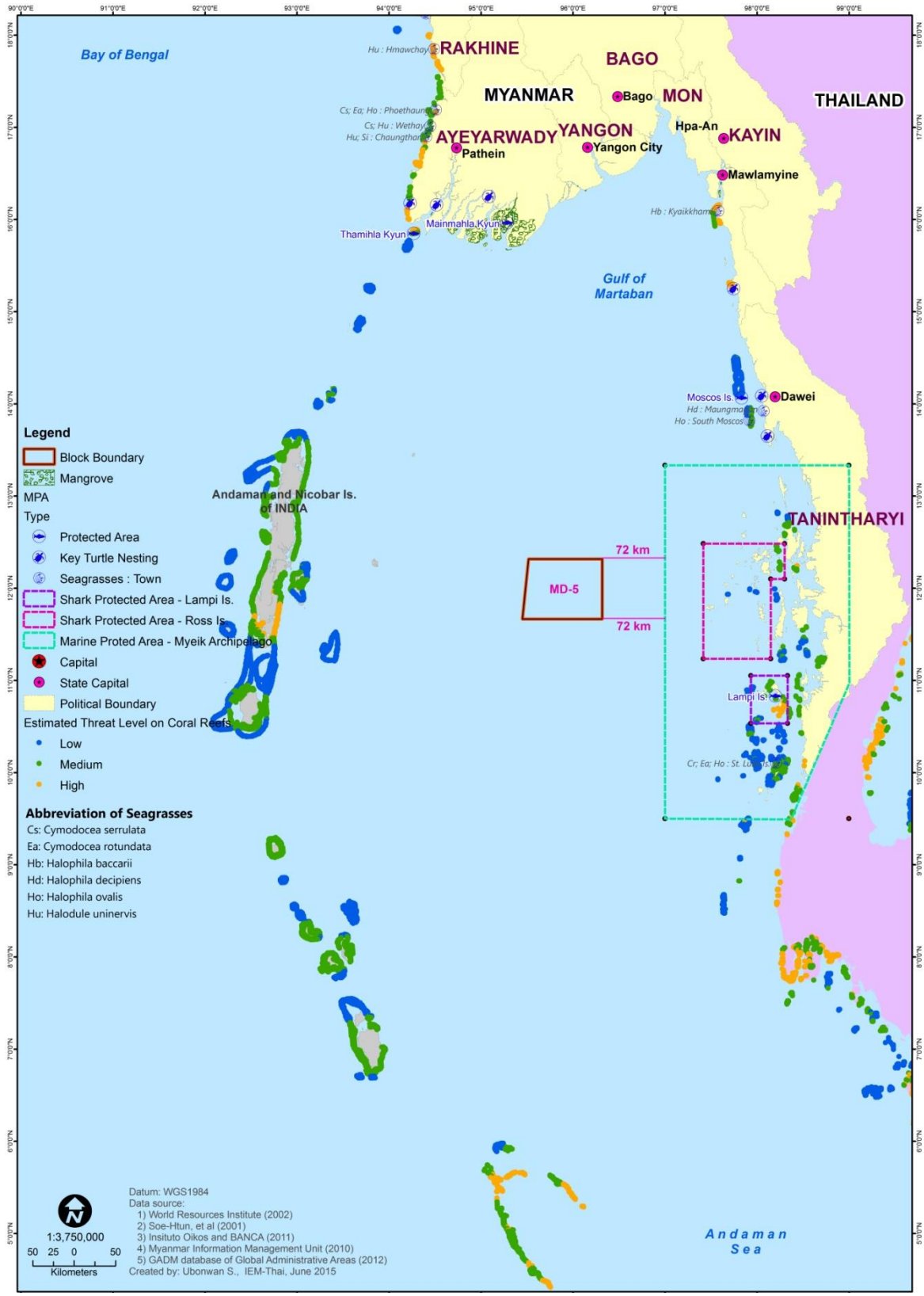


Figure 5-17: Map of Sensitive Marine Ecosystems in Southern Myanmar

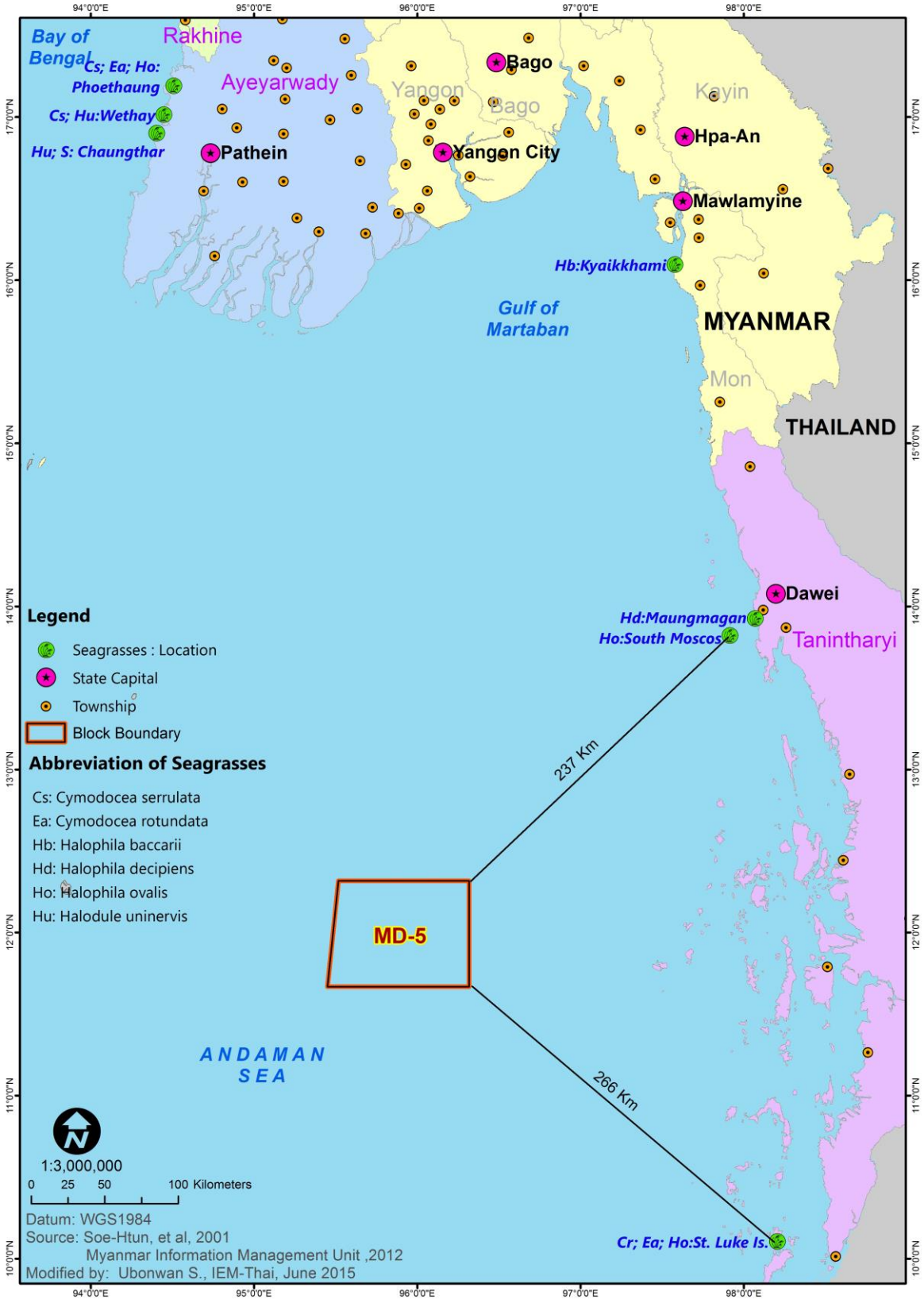


Figure 5-18: Seagrass occurrence in the region

5.3.7.3 Seagrass

Seagrass usually grows in relatively shallow waters, and form a key feeding, breeding, and nursery ground for many species of fish, turtle, lobster, and dugong. Seagrass also improves water quality, and their root-like stems stabilize the sea bottom (World Bank, 2006).

Based on data from Soe Htun (2009), Myanmar has 10 species of seagrass belonging to 5 genera from two families. Of these, *Cymodocea rotundata, C. serrulata and Enhalus acoroides* are dominant in the seagrass beds. *Cymodocea rotundata, Enhalusacoroides, Thalassia hemprichii, Halophila beccarii, Halophila decipiens, Halophila ovalis* are the species found in the Tanintharyi Coastal Zone (Soe Htun (2009).

Threats to seagrass meadows include the use of push nets and trawls for fishing, wastewater discharges from shrimp farms, urban and industrial pollution, and salinity variations caused by irrigation and land clearing.

The seagrass areas closest to the Block MD-5 are shown in **Figure 5-18**.

5.3.8 Protected Areas

A total of 45 protected areas have been established in Myanmar. Despite rich marine and coastal habitat, there are only 6 marine protected areas (MPA), including 1 marine national park, 3 wildlife sanctuaries, 1 protection area and 1 Reserved forest (BOBLME, 2011). Tordoff et al (2012), in defining Key Biodiversity Areas (KBAs) across the Indo-Burma Hotspot, identified that as of 2004 only 24 of the 76 KBAs (less than 32%) are formally protected in Myanmar. As for the protection afforded to the non-gazetted ones it is expected that there is little, possibly some local community-based conservation taking place. International organisations have identified limited coverage of 'formalised' protected areas, which highlights the potential gap in legal protection afforded to key bioregionally significant areas in the region.

The MPAs nearest the project activity are Mainmahla Kyun Wildlife Sanctuary, and Thamihla Kyun Wildlife Sanctuary, Moscos Island Wildlife Sanctuary, Lampi Island National Park and the Shark Protected Area. Of these, the closest protected area is Lampi Island MPA located approx. 200 km to the southeast, and Moscos Island Wildlife Sanctuary located approx. 240 km to the northeast of Block MD-5, as shown in **Figure 5-19**. It should be noted that there are no protected areas in or near the area of the proposed exploration surveys.

Moscos Island Wildlife Sanctuary, shown in **Figure 5-20**, is situated in the Dawei District, Tanintharyi Region. The sanctuary comprises the south, middle and north Moscos group of islands. The islands are covered with evergreen forest, except for some rocky islands. Although it is one of the five marine protected areas, mostly the terrestrial part of the islands is protected. The most common forest type (75%) is evergreen forest. Swiftlets nest on the rocky islands of the sanctuary (BANCA, 2011). Some species of swiftlets are also known for the commercial value of their nests, which are used to make "bird's-nest soup." The increasing demand is threatening the survival of these economically important species.[6]

Lampi Island Marine National Park, shown in **Figure 5-21**, encompasses a section of the Myeik Archipelago including Lampi Island itself, several smaller islands and the seas around them. The sea between Lampi and the mainland is on average 12 m deep and nowhere deeper than 24 m. Lampi Island is generally hilly and rises steeply from sea level up to 455 m. The majority of the coastline is rocky, presenting also sandy beaches, bays and inlets. Lampi Island has two major perennial rivers and many small seasonal streams. Lampi is an ASEAN heritage site, an Important Bird Area (IBA) and a designated Myanmar ecotourism site. Evergreen forest is the major forest type of the site. Mangrove and beach & dune forests are also present at the site. Coral reefs fringe the islands. Seagrass beds are present especially on the eastern side of the island (BANCA, 2011). The Lampi Island Marine National park also forms part of the Shark Protected Area.

[6] Lau, A. S. M. & Melville, D. S. (1994) International Trade in Swiftlet Nests with Special Reference to Hong Kong (Traffic International, Cambridge, U.K.).

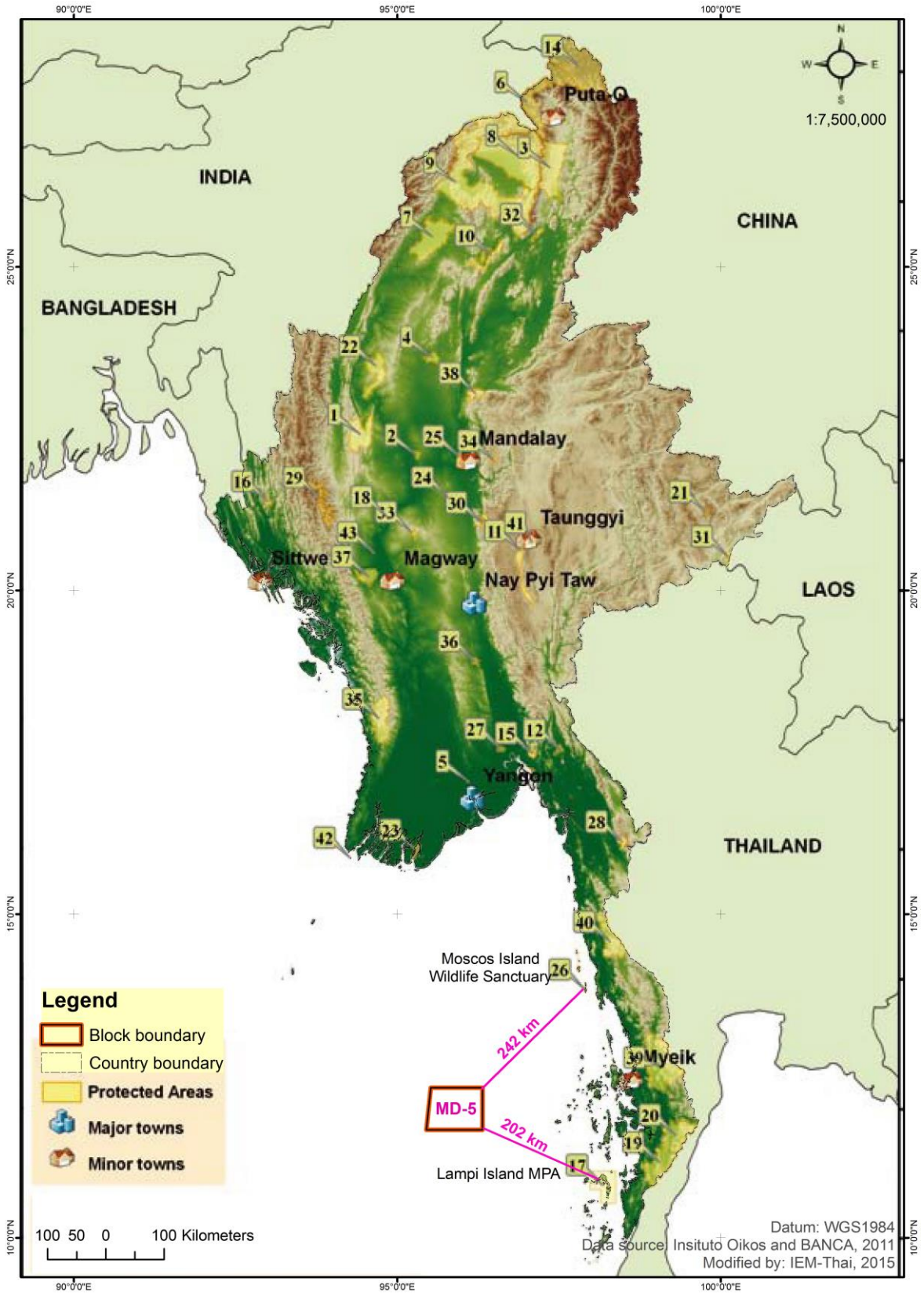


Figure 5-19: Protected Areas in Myanmar

Source: BANCA, 2011

MOSCOS ISLAND

Site ID	26
Locality	Tanintharyi Region, Yebyu and Launglon Townships
Coordinates	N 14° 04′, E 97° 50′
Size (km²)	49
Altitude (m. asl)	0 - 355
Myanmar category	Wildlife Sanctuary
IUCN category	IV
Site Governance	Forest Department
Boundaries	Demarcated
Year gazetted	1927
Protection level	Total
Main purposes	Conservation, Natural resources maintenance
Habitat	Evergreen Forest (Typical)
Key resources	Sambar Deer, Swiftlets, Barking Deer

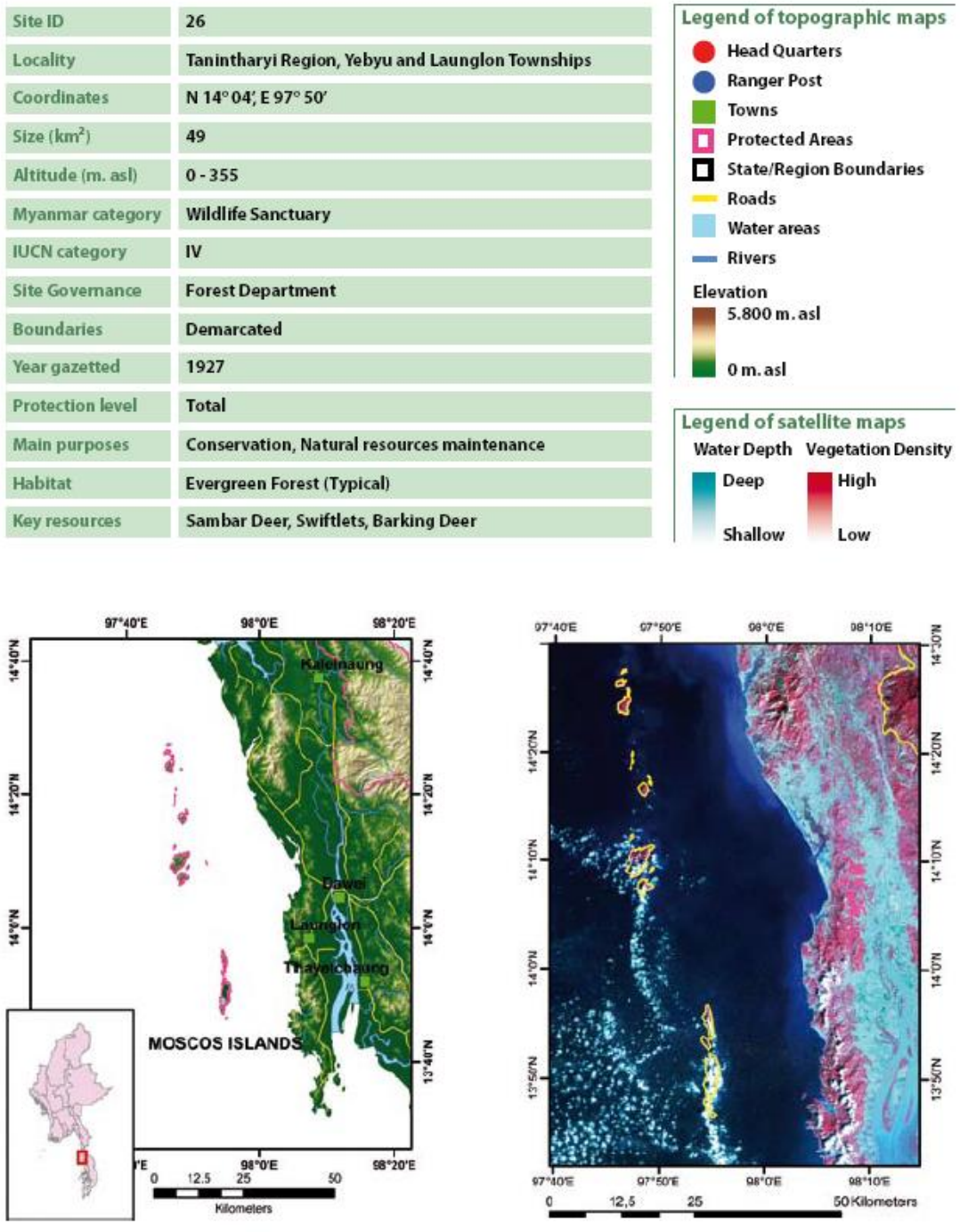


Figure 5-20: Summary of Features of Moscos Island Wildlife Sanctuary

Source: BANCA, 2011

LAMPI ISLAND

Site ID	17
Locality	Tanintharyi Region (Boke Pyin Township)
Coordinates	N 10° 50', E 98° 12'
Size (km²)	205
Altitude (m. asl)	0 – 455
Myanmar category	National Park
IUCN category	II
Site Governance	Nature and Wildlife Conservation Division
Boundaries	Demarcated
Year gazetted	1996
Protection level	Total
Main purposes	Conservation
Habitat	Evergreen Forest (Typical), Mangrove Forest, Beach and Dune Forest, Sea Grass Beds, Coral Reefs
Key resources	Coral Reefs, Mouse Deer and Salone Ethnic Groups

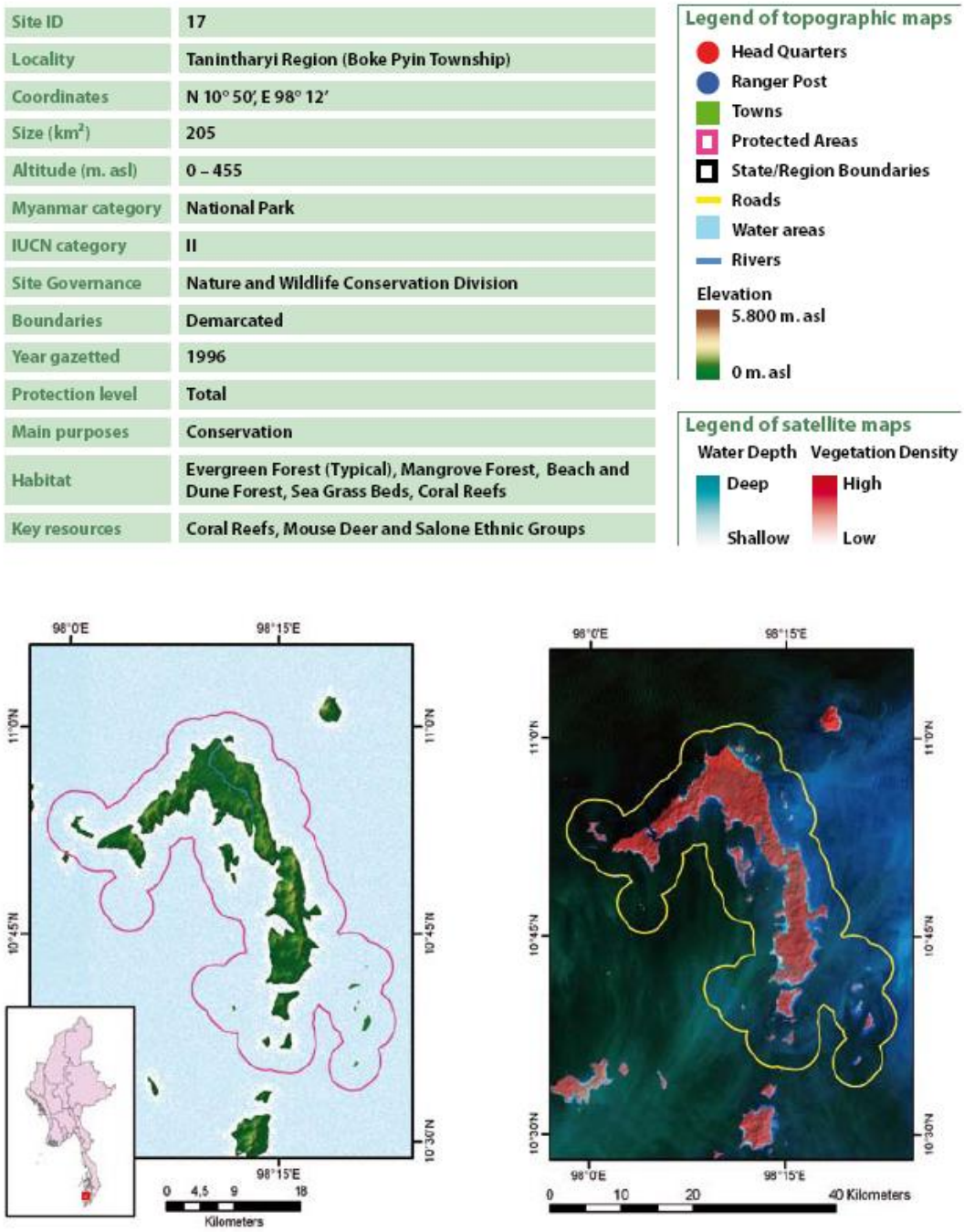


Figure 5-21: Summary of Features of Lampi Island National Park

Source: BANCA, 2011

5.4 Project Environmental Setting- Local Knowledge

5.4.1 Methodology

The offshore surveys are not expected to have any significant impact on local communities in the coastal areas of Tanintharyi. However, local consultation associated with this IEE study was undertaken in Myeik in order improve the understanding of potential fishing patterns in MD-5. As part of this, in March 2015, IEM conducted traditional ecological interviews with 40 householders in two villages in Ka Lwin, Myeik, Tanintharyi Region. The interviews were conducted in focus group meetings of one to six participants. The two villages were selected on the basis that they represented communities on or near the coast and with direct and/or indirect ties with the local fishing industry.

IEM's Traditional Ecology team consisted of the Project Director/IEE Expert and Biodiversity Assistants who were trained by IEM.

The questions focused on whether participants make use of any of the wild plants and animals and whether they had observed changes to the environment over the past ten years. The data collected from these surveys have contributed to the ecological baseline understanding.

The following villages were included in the survey:

1. Ye Pone Village, Ka Lwin, Myeik, Tanintharyi Region
2. Shar Taw Wa Village, Ka Lwin, Myeik, Tanintharyi Region

5.4.2 Traditional Ecology Survey Results

The traditional ecology knowledge survey consisted of 104 questions. The results of the surveys have been analyzed and a summary of the results is provided below. It is acknowledged that the survey sample is limited, however, given that there are no potentially affected populations identified due to the offshore nature and extent of the survey, the survey is considered largely representative of other communities along the coastline.

Generally it is known that only male villagers go fishing. Marine species caught include perch-like fish (grunts, croaker, etc), herring-like fish (sardines, etc), anchovies, tuna and billfishes, sharks and rays, flatfishes, and eels. The most valuable fish caught include anchovies and flatfish. Villagers advised that fishing yield and the diversity/type of wild fish has decreased over the last 10 years and attribute overfishing as the cause of reduced fish yields. The main types of non-fish caught are shellfish, crabs, lobster and sea cucumber. Villagers indicated that wild fish is an important source of food/medicine.

Whales

73% of the villagers have not seen any whales in the last two years. All villagers noted that there are no areas of importance for whales near the village. 62% of the villagers believe whales are not an important source of food/medicine.

Dolphins

62% of fishermen have not seen any dolphins in the last two years. Villagers noted that there are not any areas of importance for dolphins near the village and do not fish in areas that are important for dolphins. Half of the villagers claim that the number of porpoises and dolphins has decreased over the last 10 years. Villagers believe the change in the population and diversity of porpoises/dolphins is either due to exploitation or global climate change. Villagers noted that porpoises and dolphins are not an important source of food/medicine.

Dugongs

Villagers have not seen any dugongs in the last two years. All villagers noted that there are no areas of importance for dugong near their village. Villagers claim they do not fish in any areas of importance for dugongs. Villagers noted that dugongs are not an important source of food/medicine.

Sharks

50% of villagers have seen sharks in the last two years. All villagers noted that there are no areas of importance for sharks near their village. All villagers noted that they do not fish in areas which are important to sharks. Half of the villagers feel that the number and diversity/type of sharks have decreased over the past 10 years. Villagers attribute global climate change, and exploitation as the cause for the change in shark type/diversity. Half of the villagers do not think sharks are an important source of food/medicine.

Otters

50% of the villagers have seen otters in the last two years. Most villagers noted that there are no areas of importance to otters near their village. All villagers noted that they do not fish in areas of importance to otters. Half of the villagers feel that the number and diversity/type of otters has decreased over the past 10 years. 24% suggest a possible increase. Most villagers feel that global climate change is the cause for change in otter type/diversity. Most villagers suggest that otters are an important source of food/medicine.

Seabirds

All villagers noted that there are no areas of importance for sea birds near their village. All villagers noted that they do not fish in areas which are important to sea birds. Half of the villagers suggest that that the number of sea birds has decreased over the past 10 years. 67% of the villagers claim that the diversity/type of sea birds has remained the same over the past 10 years while 33% claim they have decreased. All villagers feel that global climate change is the reason for the change in sea bird type/diversity. Most villagers do not think sea birds are an important source of food/medicine.

Sea turtles

27% of the villagers claimed tohave seen sea turtles in the last two years, the remainder had not. 95% of the villagers claim that there are no areas of importance for sea turtles near their village. Most of the villagers claim that they do not fish in areas which are important to sea turtles. Half of the villagers noted that the number of sea turtles has decreased over the past 10 years. 71% of the villagers claim that the diversity/type of sea turtles has remained the same over the past 10 years while 29% claim the diversity/type has decreased. All villagers attribute global climate change as the reason for the reduction in sea turtle type/diversity. 95% of the villagers do not think sea turtles are important source of food/medicine. 72% of the villagers do not think sea turtle eggs are an important source of food/medicine:

Seagrass

The survey indicates that there are no areas containing sea grass near the village. The survey indicates that there is no sea grass in or near where villagers fish. Most villagers do not think sea grass is an important source of food/medicine.

Corals

73% of the villagers have not seen any areas containing coral near the village, while 27% have. 73% of the villagers state that there are no areas containing coral where they fish. All villagers suggest that coral areas have remained stable over the past 10 years. All villagers feel that the diversity/type of coral has remained stable over the past 10 years. 68% of the villagers do not think coral areas are an important source of food/medicine.

Mangroves

Villagers (73%) have not seen any mangrove areas near the village or where they fish. Villagers (68%) noted that the number of areas and diversity/type of mangroves have remained stable over the past 10 years. Villagers (86%) suggest that exploitation is the cause for any change in mangrove type/diversity. Villagers (68%) do not think mangrove areas are an important source of food/medicine.

General Environment

Half of the villagers suggest that natural habitats and wildlife have decreased by 25% to 50% over the past 10 years. All villagers noted that the number of people in this area has increased significantly over the past 10 years. All villagers feel that the weather has changed significantly over the past 10 years. All villagers noted that the marine plants and animals in this local environment is a significant and important source of food or medicine. Half of the villagers also noted that marine plants and animals in the local environment provide a significant and important source of income.

5.5 Human Use Values

5.5.1 Fisheries

Myanmar has significant fisheries potential in its marine waters, and the offshore area is subject to regulation and licensing. The total marine fisheries area in Myanmar, including the exclusive economic zone (EEZ), is about 486,000 square kilometres. The Exclusive Economic Zone (EEZ) of Myanmar occupies the eastern part of Bay of Bengal and northern part of Andaman Sea.

Pelagic fisheries are economically important to Myanmar. Therefore, Myanmar is exerting efforts to manage and conserve its pelagic fish stocks in order to avert possible overexploitation of the fishery resources. Total fish production including aquaculture is estimated at 4.1 million tonnes in 2011 according to official (provisional) statistics. This includes 2.1 million tonnes from marine fisheries and about 1 million tonnes from inland fisheries, consisting of so-called lease fisheries and other types of capture fisheries (BOBLME, 2012).The aquaculture industry comprises freshwater culture, brackish-water systems, ornamental fish production and fingerling production. 449,694 hectares have been established for shrimp and freshwater fish farming in Myanmar, with an estimated aquaculture production of 929,360 tonnes during the year 2012-2013.[7]

Export data indicates that hilsa is an important export item (about 11,000 tonnes) exported in 2011). Hilsa (*Tenualosa ilisha*), Indian mackerel (*Rastrelliger kanagurta)* and the short bodied mackerel are considered to be economically-important fish species in Myanmar, but specific data is not available (BOBLME, 2012). The Indian mackerel and short bodied mackerel habitat is the shallow waters. The hilsa is known to occur in a range of marine, pelagic and schooling habitats in coastal waters and mainly breed in rivers.[8]

The Tanintharyi coastal area is productive in shoaling pelagic fish (e.g. mackerels, sardines, tuna and demersal fishes e.g. snappers, nemipterus, hair tails, sharks, rays and shrimps). BOBLME research, indicated that reported landings from the EEZ waters of Myanmar for the period 1950-2006 were dominated by 'miscellaneous marine fishes' (91%), while 'Natantian decapods' (prawns and shrimp) was the most important taxonomic group, accounting for 1.1% of landings and 1.2 billion USD landed value. Myanmar fleets accounted for the majority of reported landings (86% by weight, 17 billion USD landed value), followed by Thai vessels with 14% of landings (4 billion USD). Landings were taken almost entirely by gillnet (landed value 16.5 billion USD), with a small fraction taken by mid-water trawls, bottom trawls and shrimp trawls. The total marine fisheries catches for Myanmar based on various sources were estimated to approximate 32 million tonnes from 1950 to 2008. This estimate is 9% larger than landings reported by Myanmar to the Food and Agriculture Organization of the United Nations (FAO). Inshore catches were found to be declining, while total reconstructed catches have levelled off or are even beginning to decline; this is in contrast to the reported landings data, which suggest continued growth in landings (BOBLME, 2011). Tuna and large pelagic fishing occurs in the deep offshore waters in the broad vicinity of the Block MD-5 area, currently conducted by foreign vessels. None of the catch is landed in Myanmar (refer also **Section 5.5.1.2**).

5.5.1.1 Fisheries Management

Myanmar's territorial fishing zone is within 12 nautical miles offshore from the baseline, whereas the exclusive economic zone (EEZ) extends 200 nautical miles offshore. The total marine fisheries area in Myanmar including the EEZ is about 486,000 square kilometres as shown in **Figure 5-22**.

[7]DOF, 2013, Fisheries Statistics 2001-2013, Department of Fisheries.

[8] IUCN Red List of Threatened Species, Accessed from http://www.iucnredlist.org/details/166442/0

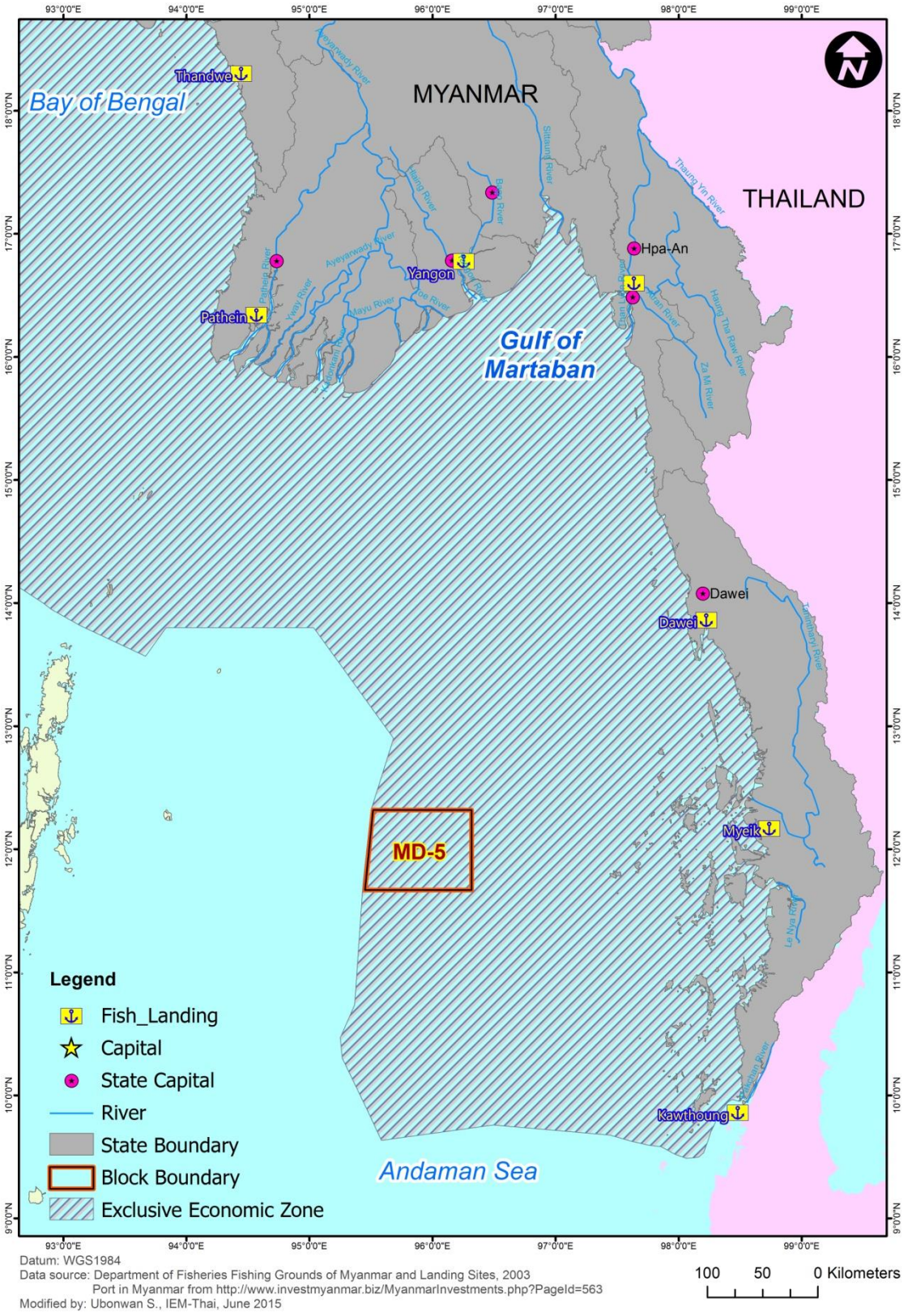


Figure 5-22: Block MD-05 in Exclusive Economic (EEZ) of Myanmar

The Department of Fisheries (DoF) controls fishing activities and issues licenses within two fishing zones (inshore and offshore), and restrict fishing activities providing a degree of protection to fisheries resources as follows:

- Inshore fisheries includes fishing grounds from lowest tide level, up to about 16 m (48 feet) depth, which generally is from five to ten nautical miles from the Tanintharyi coast. Small boats of less than 10 m (30 feet) and 12 horsepower (HP) engines, and some traditional style boats, are used in this fishing zone. Inshore fisheries are small scale, but supply several high value species (lobsters, shrimp, grouper, mud crab, clams, etc.).
- Offshore fisheries include the fishing grounds from the demarcation line of inshore fisheries out to the edge of the EEZ, which is 200 nautical miles from the coastline. Vessels more than thirty-feet in overall length and engine power more than 12 HP are used in offshore fisheries. Large-scale fishing such as bottom trawling, purse seining, surrounding, drift netting and long lining are common in offshore fishing. In order to properly administer and monitor fisheries activities, the DoF has divided Myanmar's offshore fisheries into 140 grid blocks of 30x30 nautical miles each. Using these grid blocks, four fishing areas are identified as follows (see also **Figure 5-23**):
    - Rakhine Fishing Area - Includes grounds A1 to A20, B1 to B10. Total 30 grounds.
    - Ayeyarwady Fishing Area - Includes grounds B11 to B20, C1 to C25 and D1, D4, D5, D9, D10, D14, D15, D19, D20. Total 44 grounds.
    - Mon Fishing Area - Includes grounds D2, D3, D6, D7, D8, D11, D12, D13, D16, D17, D18, D21, D22, D23. Total 14 grounds.
    - Tanintharyi Fishing Area - Includes grounds D24 to D29, E1 to E25, F1 to F21. Total 52 grounds.

Block MD-5 straddles four offshore fishing licence blocks of the Tanintharyi Fishing Area (E13, E14, E20, E21). The MD-5 survey area is also within an area of tuna and large pelagic fishing (**Figure 5-23**).

The Department of Fisheries (DoF) has established a legal framework and developed and implemented various strategies for the sustainable development and management of marine fisheries. Fisheries management is pursued by proper licensing, prescribing exploitable species, designating environmental friendly fishing gears and methods, and by imposing closed area and seasons. Enforcement of fishing activities involves Myanmar Navy, Myanmar Coast Guard, Department of Fisheries, Myanmar Customs Department and Myanmar Police Force.

The Myanmar Fisheries Federation (MFF) was founded in 1989 to encourage and promote the fishery industries of Myanmar. The Central Executive Committee Members of MFF, Executive Committee Members of The Functional Associations, and Executive Committee Members of Regional Fisheries Associations at different levels are elected for three-year-term.

As of August 2012, the total number of MFF members (both individuals and companies) were 28,539 (comprising 27,775 individuals and 764 companies (MFF, 2014).

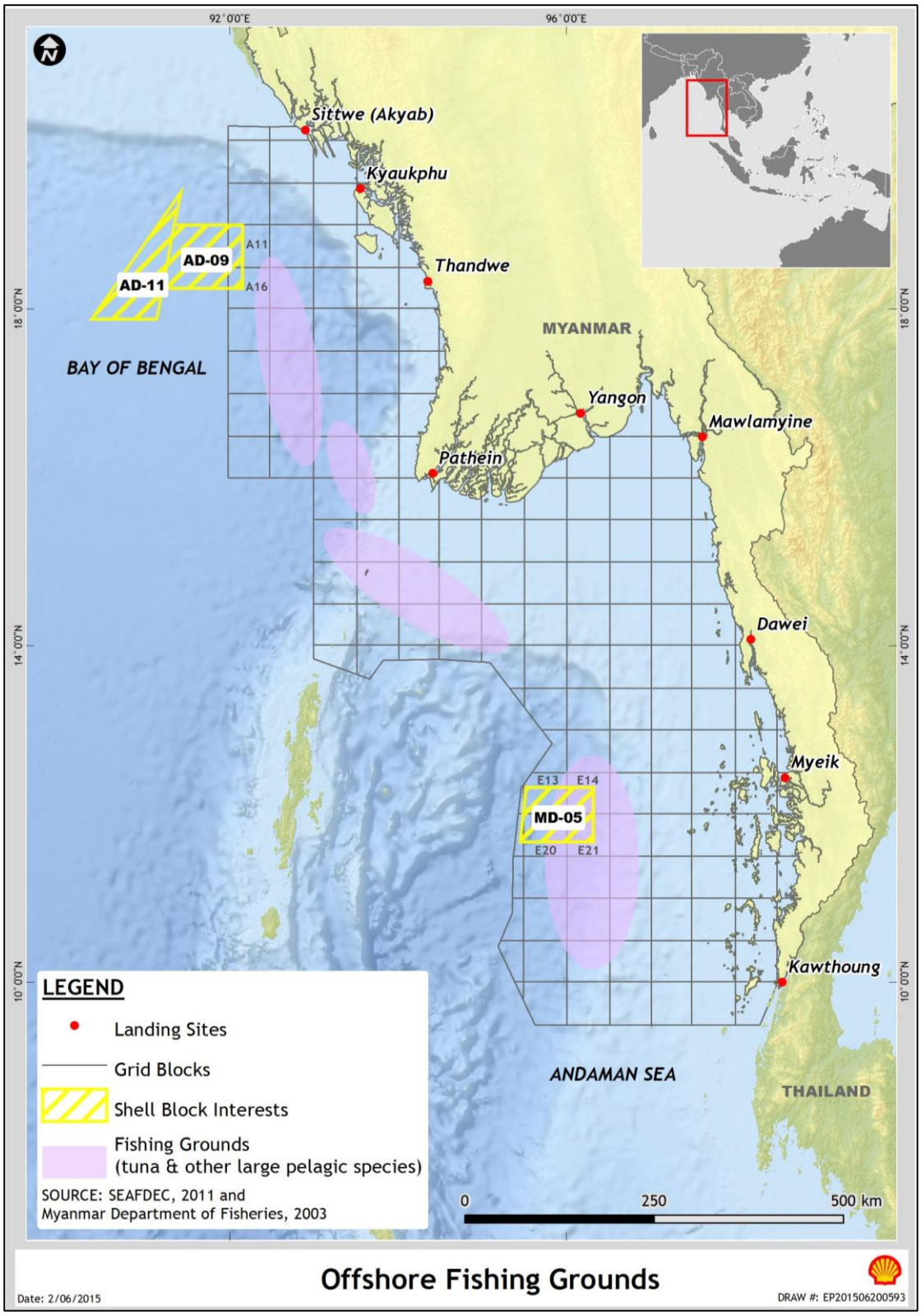


Figure 5-23: Fishing Grounds and Landing Sites in Myanmar

5.5.1.2 Marine Capture Fisheries

The marine capture fishery comprises coastal or inshore fisheries, and offshore or deep-sea fisheries. Various types of fishing gear are used to exploit the large diversity of marine species found in Myanmar waters. The fishing gear is classified into commercial, such as trawl net, purse seines, driftnet and gillnet, and traditional, including hook-and-line, cast net, bag net, trammel gill net, lift net and traps. The bulk of landings derive from trawls, purse seines, drift nets and gill nets. Vessels statistics for inshore and offshore fisheries in Myanmar are shown in **Table 5-13** and **Table 5-14.** Examples of fishing boats are shown in **Figure 5-24**. Currently, most Myanmar vessels are working in water depths less than 100 m due to limitations of vessels and gear.

The offshore fishery for tuna and other large pelagic species in Myanmar has been initiated and developed gradually during the last decade, and is currently producing nearly 200 tonnes of fish per annum. Long lining in the Myanmar EEZ started with the issuing of experimental licenses to 12 foreign fishing vessels in 1999-2000. In 2010-2011 the number of licensed vessels had increased to 109. According to the "Law Relating to Fishing Rights for Foreign Fishing Vessels" tuna long-ling fishing operations are permitted only outside of the territorial sea in Myanmar EEZ. All of the tuna catch by foreign long line fishing vessels are not landing in Myanmar ports. There is no market in Myanmar currently for tuna.[9] According to MFF information, currently foreign vessels are being allowed to fish for tuna as local Myanmar vessels cannot conduct tuna fishing. Therefore, there are large long lining foreign tuna vessels fishing around Coco Island and Myeik Archipelago in the Andaman Sea. The tuna fishing licenses are issued by DOF.[10] No specific data is available for the marine capture fishery in Block MD-05.

Table 5-13: Number of fishing vessels engaged in inshore fishery

Year	Mechanized Boat	Non-mechanized Boat	Total
2005-06	14,099	16,361	30,460
2006-07	14,284	16,284	30,568
2007-08	14,289	15,219	29,508
2008-09	14,052	14,645	28,697
2009-10	13,788	17,054	30,842
2010-11	13,823	15,548	29,373
2011-12	12,288	15,463	27,751
2012-13	12,157	12,757	24,914

Source: Fisheries Statistics 2001-2013, Department of Fisheries.

Table 5-14: Number of fishing vessels engaged in Offshore fishery in Myanmar

Year	National	Foreign	Total
2005-06	2,022	254	2,276
2006-07	1,871	206	2,077
2007-08	1,863	248	2,111
2008-09	1,758	356	2,114
2009-10	1,814	391	2,205
2010-11	2,196	396	2,592
2011-12	2,230	264	2,494
2012-13	2,452	132	2,584

Source: Fisheries Statistics 2001-2013, Department of Fisheries.

Illegal fishing involving foreign vessels also occurs in Myanmar territorial waters. A total of 10 foreign fishing boats were seized in Myanmar in 2010/11. Myeik Archipelago fish stocks and coral areas are also at risk due to the continued practice of blast fishing, an illegal fishing technique that uses explosives. Steps have already been taken to preserve the Myeik islands, and the government seems to be very interested in developing the

[9] Presentation on Present Status of Off-shore Fishery Resources and Information on Tuna Fishery in MYANMAR. Julius Kyaw Department of Fisheries MYANMAR, Special Meeting on Improvement of Tuna Information and Data Collection in the Southeast Asia 7-9 September, 2011. Songkhla Province, Thailand.

[10] IEM correspondence with MFF on July 2, 2015

area in a positive way. Unfortunately, blast fishing continues and many sites show signs of wear and tear that the dynamite causes.[11]

The type of fishing gear for the region is shown in **Table 5-15**.

Table 5-15: Types of Fishing Gear used in the Tanintharyi Region (2011-2013)

Year	State& Regions	Trawl	Purse Seine	Drift net	Long Line	Stick-held falling net	Trap	Total
2011-2012	Tanintharyi	542	187	-	15	302	60	1,106
2012-2013	Tanintharyi	558	201	-	30	349	57	1,195

Source: Fisheries Statistics 2001-2013, Department of Fisheries.

Figure 5-24: Examples of Offshore Fishing Vessels in Thanintharyi

5.5.2 Marine Transportation

The Myanmar ports and landing sites are shown in **Figure 5-23**. The Port of Yangon is the primary port of Myanmar and handles about 90 % of the country's exports and imports (Myanmar Port Authority, 2012). The Tanintharyi region has three ports (Dawei, Myeik, Kawthoung).

Marine traffic in the Andaman Sea consists of fishing vessels and commercial ships. The Commercial ships may be travelling in any direction, depending on the shipping route set by the ship's captain, which is generally based on travelling the shortest distance between origin and destination. Block MD-05 is located between two identified shipping routes as shown in **Figure 5-25**.

[11]http://siamdivers.com/thailand/dive_sites/mergui_archipelago/detail.php

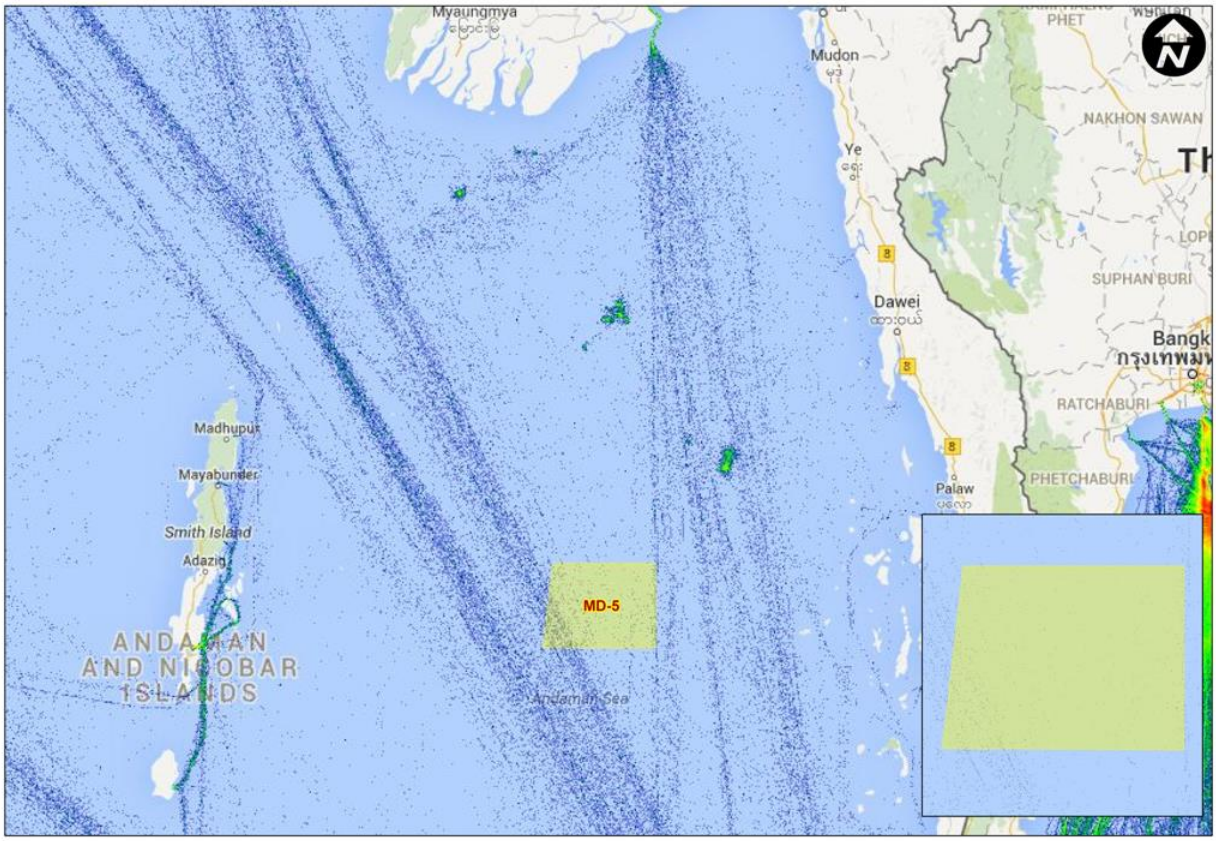


Figure 5-25: Shipping Routes near the project Area

Source: Adapted from marinetraffic.com

5.5.3 Offshore Oil and Gas Infrastructure

The existing offshore oil and gas facilities in the Andaman Sea consist of the Yadana, Zawtika and Yetagun gas field developments. These are shown in **Figure 5-26**, and described briefly below.

The Yadana gas field at the boundary of offshore Blocks M-5 and M-6 situated in the Gulf of Martaban and operated by Total S.A. is located around 60 km offshore and consists of offshore platforms, subsea gas pipelines and onshore support, land pipeline and a control and maintenance centre along with a gas metering station. The offshore gasfield has three well-head platforms, one accommodation platform and one production platform. The facilities include a 36 inch 346 km subsea pipeline to shore in the Dawei area, and a 63km onshore pipeline connecting through the Tanintharyi Region to the Thai border. A 24 inch Myanmar Domestic Gas Pipeline is routed from the Yadana Field, and passes through Block M-3 and then to the Dawnyein Pipeline Center and then in to Yangon (both receiving and transmission station). The Yadana Field has been producing since 1998.

The Zawtika gas and condensate field development, operated by Petroleum Authority of Thailand Exploration and Production International (PTTEP International) includes the Zawtika, Kakonna and Gawthaka fields, located in blocks M9 and M11 of the Gulf of Martaban. The facilities are spread across an area of 11,746 square kilometres. The facilities include three wellhead platforms, an integrated processing and living quarters platform, and 18 km infield pipelines and an approx. 230 km 28 inch export pipeline to shore, and 72 km onshore pipeline to Thailand.

The Zawtika development has been exporting gas since 2014.

Gas from the Zawtika development is transported via pipeline to Yangon for domestic use and to Thailand via an overland pipeline from the Dawei area.

The Yetagun gas and condensate field straddles blocks M12, M13 and M14 in the Gulf of Martaban, covering an area of approx. 24,130 km². Petronas Carigali Myanmar holds a 40.91% interest and operates the field. The development includes the Yet A drilling/wellhead platform, Yet B processing platform, the leased Yetagun floating storage and offloading (FSO) vessel, and installation of an approx. 202 km-long 24 inch offshore pipeline and a 270 km-long 24 inch onshore pipeline from the Dawei area to Thailand, and an operating centre and metering station. The Yetagun booster compression platform (Yet C) was commissioned in July 2012. The Yetagun North Field is located 12 km north-east of the main field. The satellite field's development includes the Yet D platform and two production wells with an 11.2 km pipeline from Yet D to the existing Yet C platform.

The Yetagun Field has been in production since year 2000.

Two fibre optic cable lines, which are branches of international cable lines, also pass through the Andaman Sea to Myanmar as shown in **Figure 5-27**.

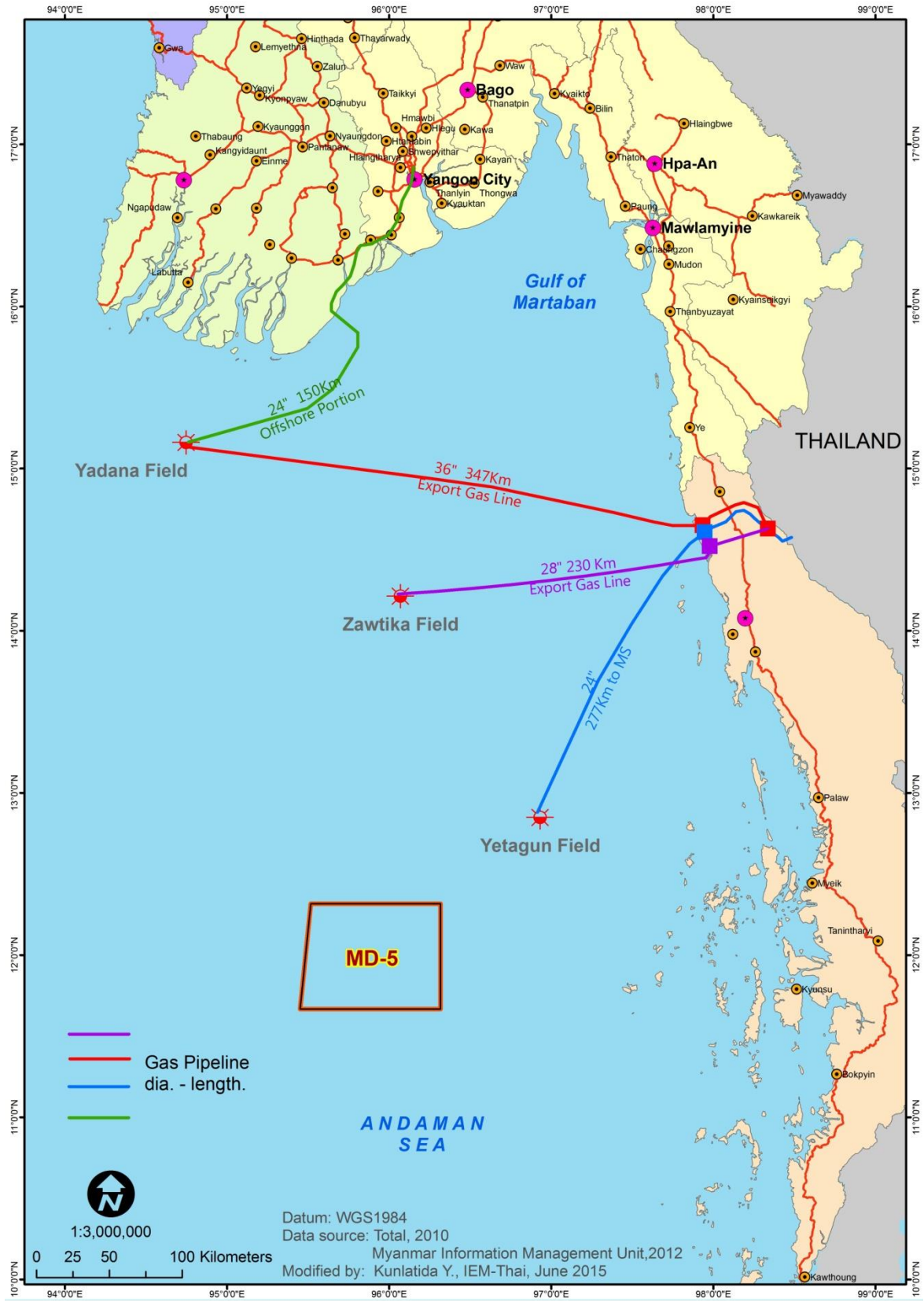


Figure 5-26: Existing Gas Pipelines in the Andaman Sea Area

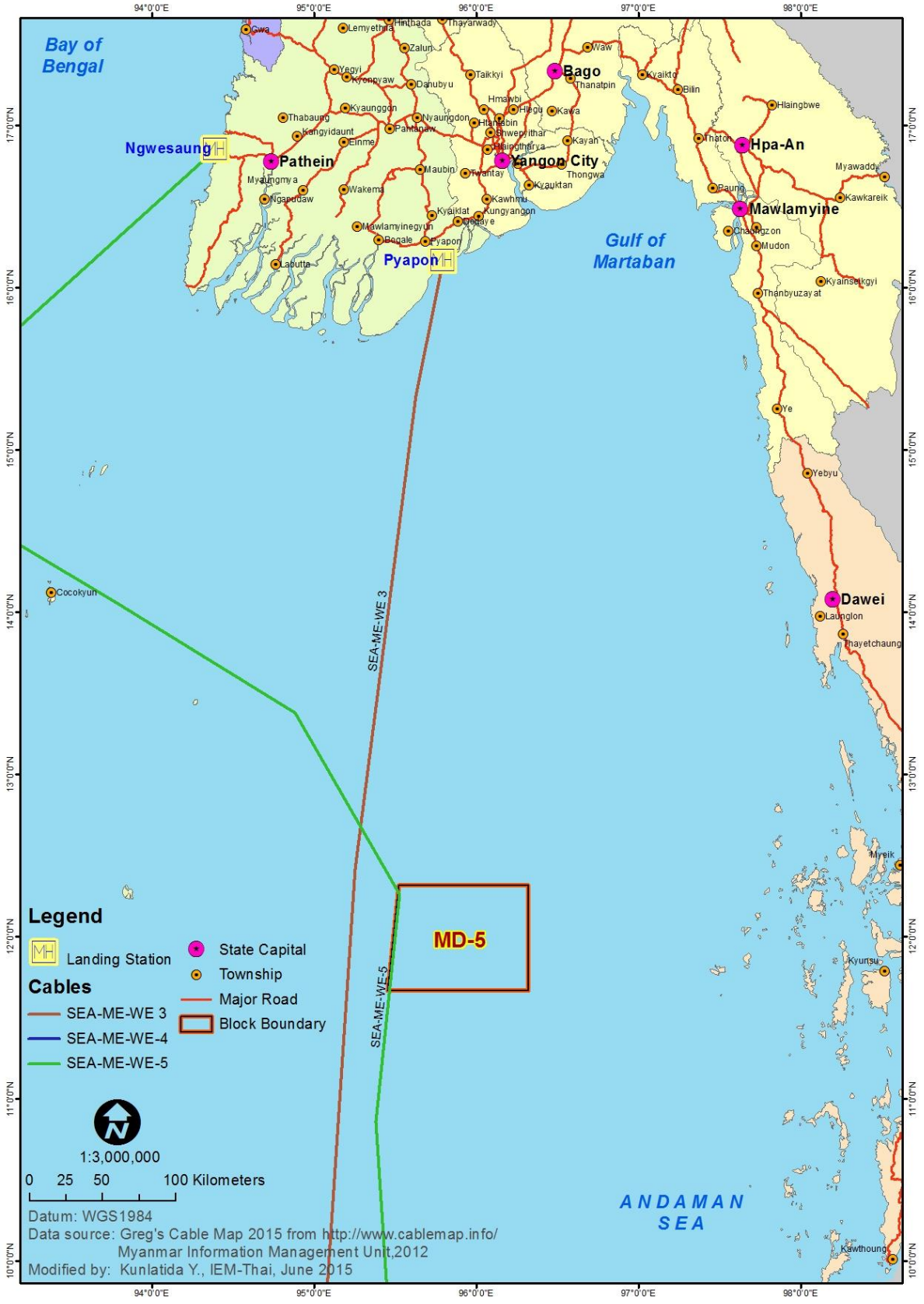


Figure 5-27: Subsea Cable Lines in the Andaman Sea

5.6 Quality of Life Values

5.6.1 Administration

In Myanmar, states and regions are divided into districts. These districts consist of townships that include towns, wards and village-tracts. Village-tracts are groups of adjacent villages. The administrative structure of the states, regions and self-administering bodies is outlined in the new constitution adopted in 2008.

The project is located offshore from the Tanintharyi Administrative Region, which covers the long narrow southern part of Myanmar. It is bordered by the Andaman Sea to the west and the Tenasserim Hills, beyond which lies Thailand to the east. To the north is the Mon State. There are many islands off the coast, the large Merqui Archipelago in the southern and central coastal areas and the smaller Moscos Islands off the northern shores.

Tanintharyi consists of three districts – Dawei, Myeik and Kawthoung. The capital of the region is Dawei (Tavoy). Other important cities are Myeik (Mergui) and Kawthoung. The region covers an area of 43,344.91 km^2 and is shown in **Figure 5-28**.

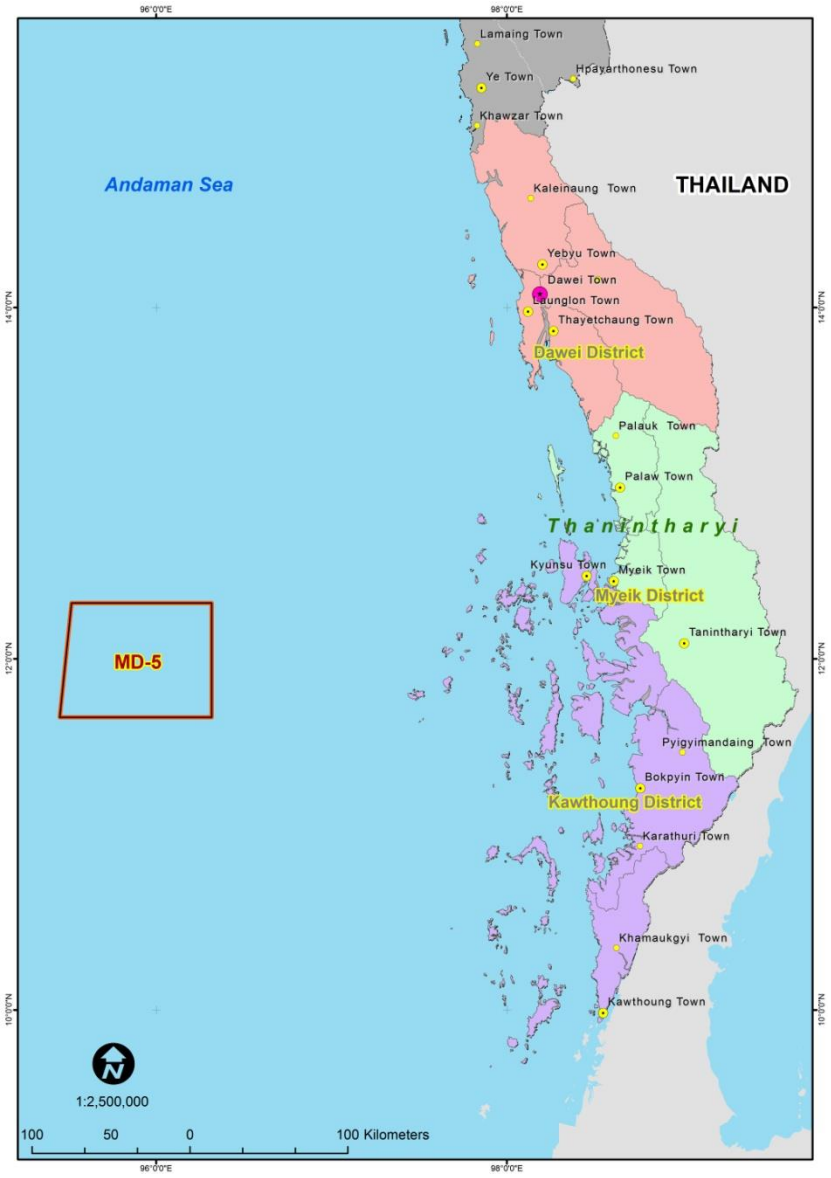


Figure 5-28: Tanintharyi Region Administration

5.6.2 Governance

Each state or region has a Regional Government or a State Government consisting of a Chief Minister, other Ministers and an Advocate General. Legislative authority would reside with the State Hluttaw or Regional Hluttaw made up of elected civilian members and representatives of the Armed Forces.

The General Administration Department (GAD) under the Ministry of Home Affairs acts as the backbone of the local administration. Thus, at the township level the overall administration (and coordination functions) falls under the authority of township administrators, who are appointed by the GAD and replaced on a three-year basis. In addition sectorial line ministries deliver services and have departments at the township level and refer to the Union level government. While elections take place for the region/state level parliament (which has limited powers) and for the village tract/ward level (which forms the main point of interaction between the state and its citizens), no elected bodies exist at the township or district levels - although this may change in the future.

5.6.3 Demographics

The 2014 Myanmar Population and Housing Census (2014 MPHC) was conducted from 29th March to 10th April 2014. The 2014 MPHC shows that Myanmar's total population was 51,486,253 persons as of 29th March, 2014. Of these, 24,824,586 were males and 26,661,667 were females. This overall number includes an estimated population of 1,206,353 persons who were not enumerated in certain specific areas of the country. The census enumerated a total population of 50,279,900.

Myanmar is divided into 15 States and Regions. Accordingly, the 2014 Census results show that Yangon Region has the largest population (7.36 million), followed by Ayeyawady (6.18 million), Mandalay (6.16 million), Shan (5.82 million), and Sagaing (5.32 million). These five States and Regions account for almost 60 % of the total population of the country.

With a population of 1,408,401 and population density of 32 persons per km^2, Tanintharyi is among the most sparsely populated of Myanmar's States/Regions. The Region is primarily rural, with an urban population of 338,419 (24%) versus a rural population of 1,069,982 people (76%). There are 700,619 (49.8%) men and 707,782 (50.2%) women in the region. The average household has 4.8 persons per household (the national average is 4.4). Township population size in Tanintharyi varies significantly: the region's least populous township of Pyigyimandaing comprises 16,604peoplewhilst the most populous is Myeik, with a population of 284,489.[12]

Tanintharyi's economy is driven mainly by agriculture, forestry, mining, fisheries and to some extent tourism. The region has been affected by ethnic armed conflict which has remained at relatively low levels since 1948. Non-state armed groups have operated and continue to have a presence in northern and eastern parts, particularly those more remote areas in the Region. Some parts of the Region which continue to feel the repercussions of the conflict have Internally Displaced Persons (IDPs) and people living in neighbouring Thailand as refugees. Access to electricity and bad road infrastructure continue to be major challenges.

The rubber and palm oil plantations have been a prominent employer in the Region, but have also been the cause of environmental and social impacts such as deforestation, displacement and land grabbing. The development of Dawei Special Economic Zone (SEZ) and deep-sea port is one of the largest and most high profile infrastructure projects in Myanmar. It is expected to transform the Region's economy, but it has also attracted criticism from civil society and local communities whose land has been affected. Some groups argue that a focus on promoting tourism and protecting local biodiversity is more sustainable than establishing a large industrial zone.[13]

[12] 2014 Myanmar Population and Housing Census (2014 MPHC)

[13] The State of Local Governance: Trends in Tanintharyi - UNDP Myanmar 2014

5.6.4 Regional Development

The Union Government of Myanmar has prepared a long term national development plan, the National Comprehensive Development Plan (NCDP) (2011-2031).[14]

Myanmar has a history of national and sector development plans, and large number of new long-term government reform plans were developed during 2013 and 2014. The Framework for Economic and Social Reforms (FESR) identifies policy priorities for the period 2012 to 2015. It acts as a bridge between the Fifth Five-Year Plan (2011-12 to 2015-16) on one hand and, on the other, the reform-oriented National Comprehensive Development Plan (2011-31) and the future five-year plans that will support it. The Ministry of National Planning and Economic Development co-ordinates and drafts the FESR after consulting with other ministries and departments. The FESR reflects the progress that the new government has made since it was elected in March 2011 and its continuing commitment to the socio-economic reform goals in the near future in: tax and public finance, monetary policy and finance, trade and investment, private sector development, health and education, food security and agriculture, governance and transparency, mobile phones and the Internet, infrastructure, and government effectiveness and efficiency.[15] The new long-term plans also included: The 'first' Five-Year Plan (2011–16); the Myanmar National Spatial Development Plan containing goals for urban development; the Myanmar Tourism Master Plan (2013–20); the National Strategic Plan for Women Advancement (2013–22); and the Comprehensive Education Sector Review (2014–20).

Similar to other States and Regions, planning activities at township level in Tanintharyi is limited in scope and focuses on collecting data and information for decision-making at the Union level, and increasingly at the Regional level. Unlike other key township committees, for which there are more specific rules, the composition of the Township Planning and Implementation Committees (TPIC) under the Ministry for National Planning and Economic Development (MoNPED) is flexible across the three townships in Tanintharyi, and contingent on the needs of each particular one.

In 2014-15, Tanintharyi was allocated 1 billion Kyats (1 million USD), which was then distributed by equal shares among townships. These funds allocated to townships through the Poverty Reduction Fund (PRF) are substantial on a per township basis. The investment impact of the PRF is more diluted for large townships such as Myeik. In 2013-14 and a Constituency Development Fund (CDF) was established by the Union parliament whereby each township was allocated an additional 100 million Kyats (100,000 USD) for development projects, selected in consultation with Members of the Hluttaws. For 2014-15 the amount remained the same, 100 million Kyats per township (100,000 USD).

The Dawei Special Economic Zone Development aims to connect Myanmar to Thailand through a US$50-billion industrial area and deep-sea port. The development plan for the SEZ is broken down into five phases with different duration, all within 75 years. The entire zone may ultimately extend to 205 square kilometres (80 square miles).

The National Myanmar Ecotourism Policy and Management Strategy (2015-2020) is focused on tourism and protected areas. Protected areas are to develop an ecotourism strategy/management plan which supports conservation objectives. Lampi Marine National Park is the first national PA to have developed a General Management Plan (approved by MONREC in Nov 2014) and a Draft Ecotourism plan in line with National Policy. The plan includes a 4-year Action Plan to guide the activities to be implemented in this National Park.[16]

The Myanmar Investment Commission (MIC) has approved hotel projects in Ngalonelapel, 155 island, Kayinkwa, Ngakhinnyo, Kyunphila, Ngaman and Boywe islands in Myeik Archipelago of Tanintharyi Region according to the Myeik Division of the Hotels and Tourism Ministry. Altogether 13 hotels are due to be built on these islands.[17]

[14] Dr.Than Htut ,Deputy Director-General , Foreign Economic Relations Department, Ministry of National Planning and Economic Development The Government of the Republic of the Union of Myanmar 2013.

[15] Economic Outlook for Southeast Asia, China and India 2015: Strengthening Institutional Capacity, http://dx.doi.org/10.1787/saeo-2015-en

[16] Stakeholder Consultation: Lampi Marine National Park Ecotourism PlanYangon, 28th May 2015, OIKOS

[17] Ngalonelapel, 155 island, Kayinkwa, Ngakhinnyo, Kyunphila, Ngaman and Boywe islands.

5.6.5 Ethnicity

The majority of the region's population of 1.41 million (2014 MPHC) is of Bamar ethnicity. There are some who self-identify as members of sub-groups such as the Dawei/Tavoyan people. Language with various local dialects is spoken by almost all of the population. Several defined ethnic minorities are also present in Tanintharyi, including the Karen/Kayin, Mon, Shan and Rakhine. Pa-O are also present and Moken / Salon people inhabit some of the islands.[18]

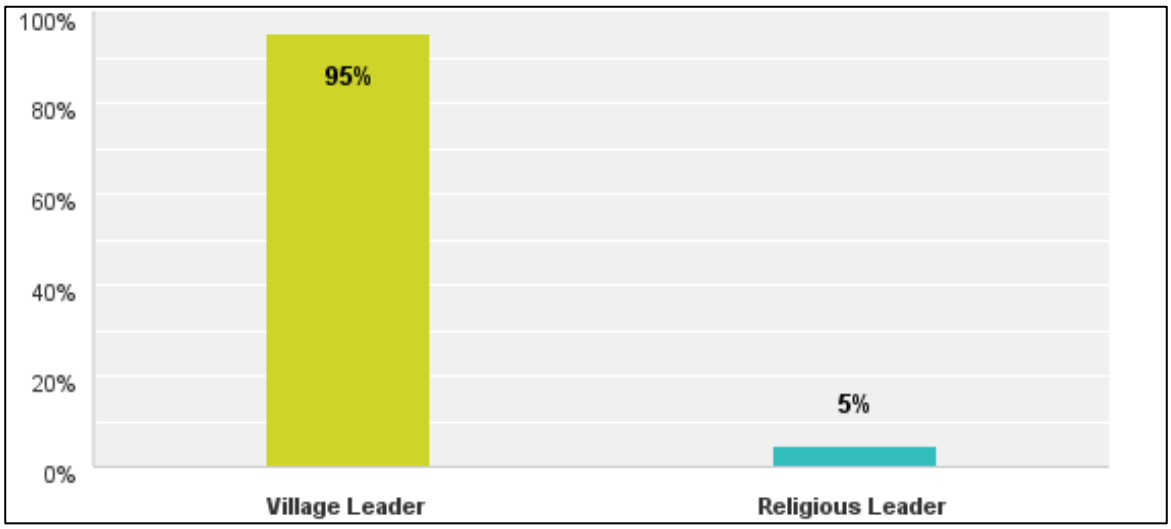
5.6.6 Coastal Socio-Economic Context

There is no resident population in the offshore project area. The quality of life issues addressed pertain to certain parts of the population in Tanintharyi coastal communities and the general population of Myanmar. People along the coast generally live in small villages. Data for the socio-economic baseline of the Project area has been derived from a review of various technical reports, government, and on-line sources as well as from local consultation undertaken in coastal communities in Ka Lwin, Myeik, Tanintharyi Region. A summary of the information acquired in the interviews is provided below.

5.6.6.1 Community Decisions

At community level, local villagers identified the elected Village Leader as responsible for community decision making (**Chart 5-1**).

Chart 5-1: Responsibility for community decision making in coastal areas near MD-5



5.6.6.2 Household Characteristics

The survey identified the age structure of the respondents' families, and showed that 27.3% of household members are between 50-60 years of age followed by those in the range of 30-40 and 40-50 years of age. The average households had 6 family members, which is above the regional average of 4.8 per household. Of the respondents, 97% were Bamar, with 1.5% Rakhine and 1.5% reporting as other Myanmar race. All of the respondents were Buddhist (100%).

5.6.6.3 Housing

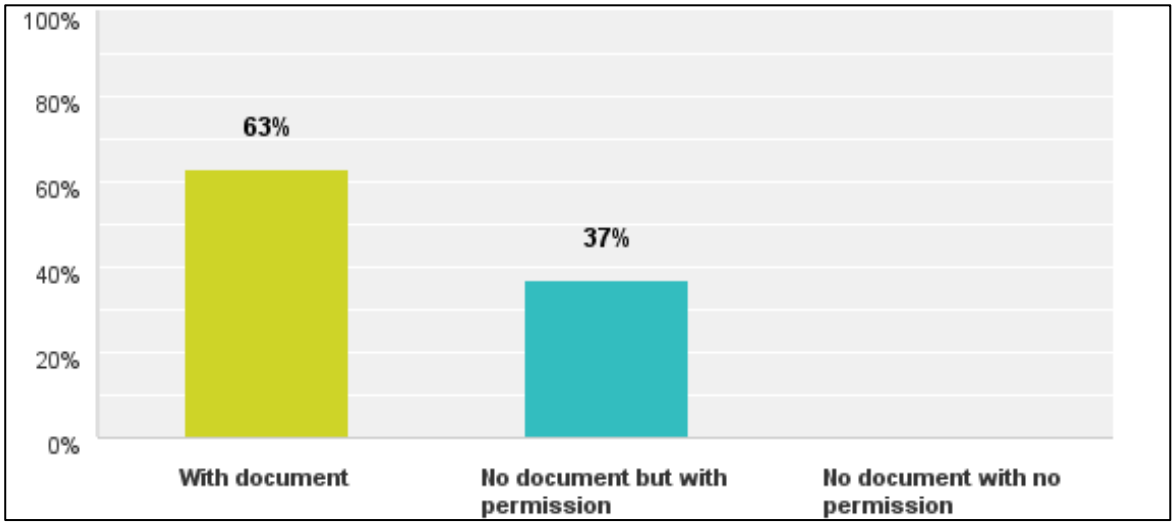
Approx. 86% of those surveyed live in single-story homes, and the remainder in two-story homes. The roof type is an indicator of wealth. In the two villages included in the survey, the villagers (98%) use traditional thatched roofs.This differs slightly from the 2014 census which indicated that approx. 75 per cent (74.8) of the households in the Region live in housing units with thatched roofs made of dhani (74.8%), and 20 per cent use corrugated sheets. The vast majority (98%) of the villagers surveyed had lived in this location for over 10 years with only 2% living in the area between three to ten years.

[18] The State of Local Governance: Trends in Tanintharyi - UNDP Myanmar 2014

5.6.6.4 Home Ownership

The conditions of housing units are important characteristics which indicate the quality of life of the population. The 2014 Census showed that about four out of five households in Myanmar are owners of their housing unit. In urban areas, 66% of households own the housing units where they reside, 20% are tenants while 7% live in housing provided by the Government. In rural areas, 93% of households own the housing units where they reside and 2.4% are tenants. In the Myeik villages surveys for this IEE, the majority (58%) of the households surveyed, own the land where they live. The nature of ownerships vary: 63% of the households have documents to show ownership, and 37% have no formal land ownership documents but have permission (**Chart 5-2**).

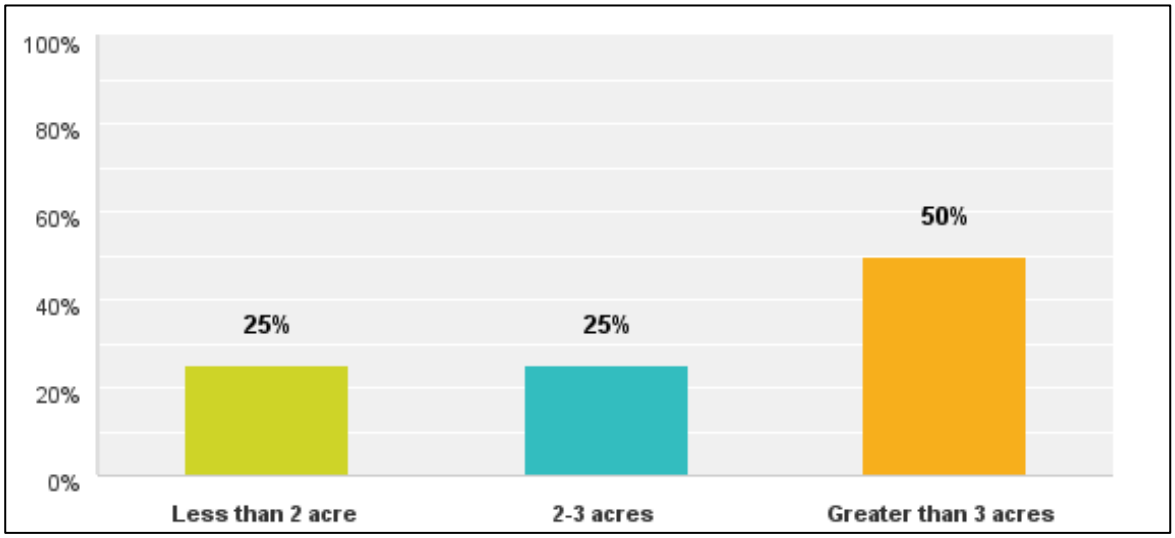
Chart 5-2: Ability to demonstrate land ownership in two coastal villages, Myeik



5.6.6.5 Farmland Ownership

Landownership patterns vary in Myanmar. In the coastal areas surveyed approx. 83% of household owners stated that they own farmland. Approx. 50% of the farmers surveyed own more than 3 acres (**Chart 5-3)**.

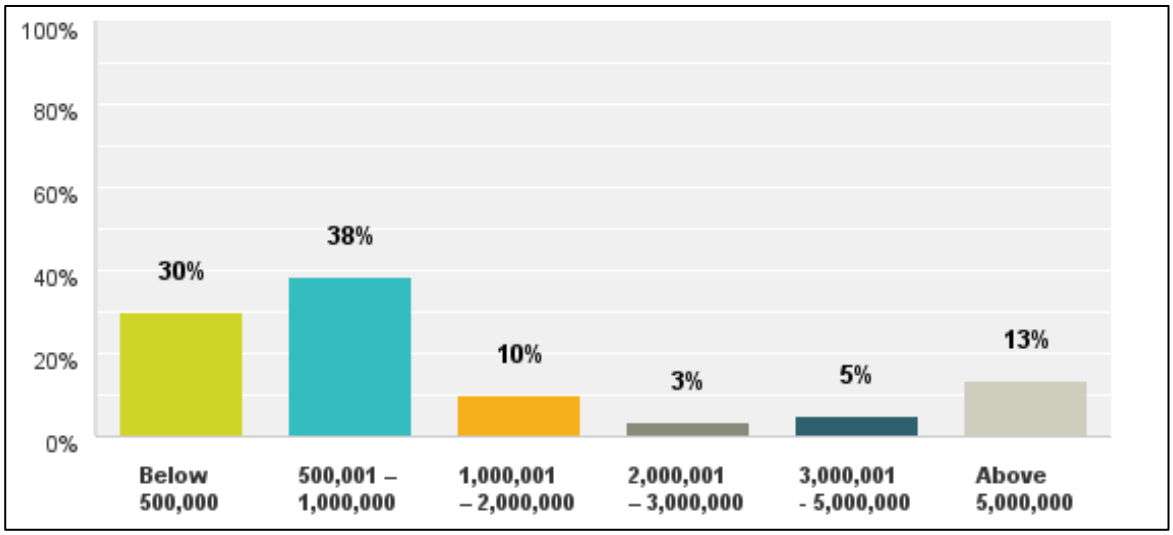
Chart 5-3: Area of farmland owned by households reported in two coastal villages, Myeik



5.6.6.6 Income and Employment in coastal areas near MD-5

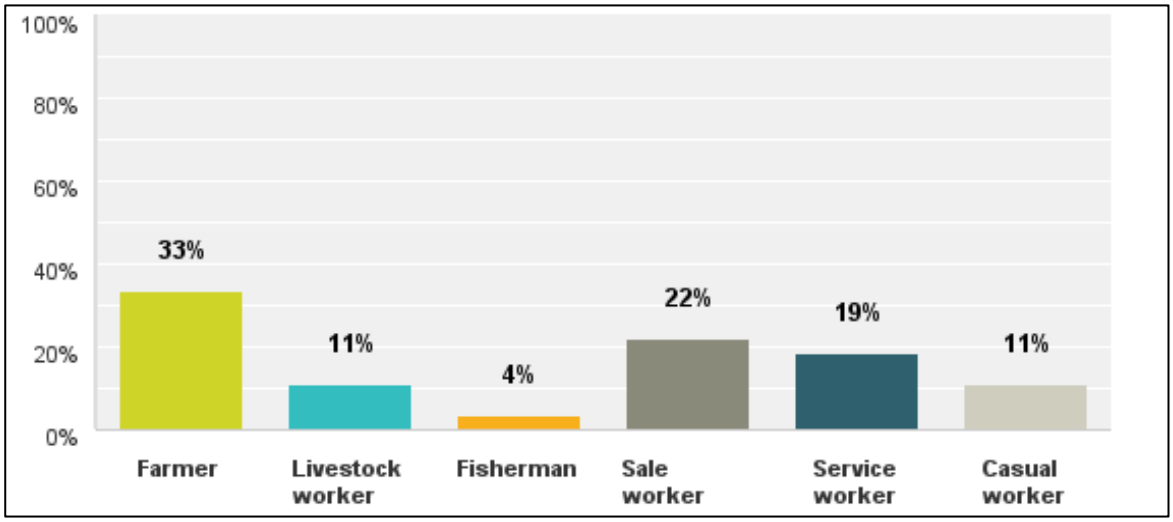
Approx. 48% of the respondents had an average daily wage of over 2,000 kyat, with 22% having an average daily wage between 500-1,000 kyat; and 16% with an average daily wage of below 500 kyat. The survey group indicated that 38% had an annual income of 500,001-1,000,000 kyat; 30% had an annual income of below 500,000 kyat; and 13% with an annual income of above 5,000,000 kyat (**Chart 5-4**). When asked whether they felt they had sufficient money respondents indicated that 61% have enough money but do not have savings, while 36% do not have enough money or savings.

Chart 5-4: Annual household income reported in two coastal villages, Myeik



The primary occupation of those surveyed were farmers (33%) (**Chart 5-5**).

Chart 5-5: Primary occupation reported in two coastal villages, Myeik

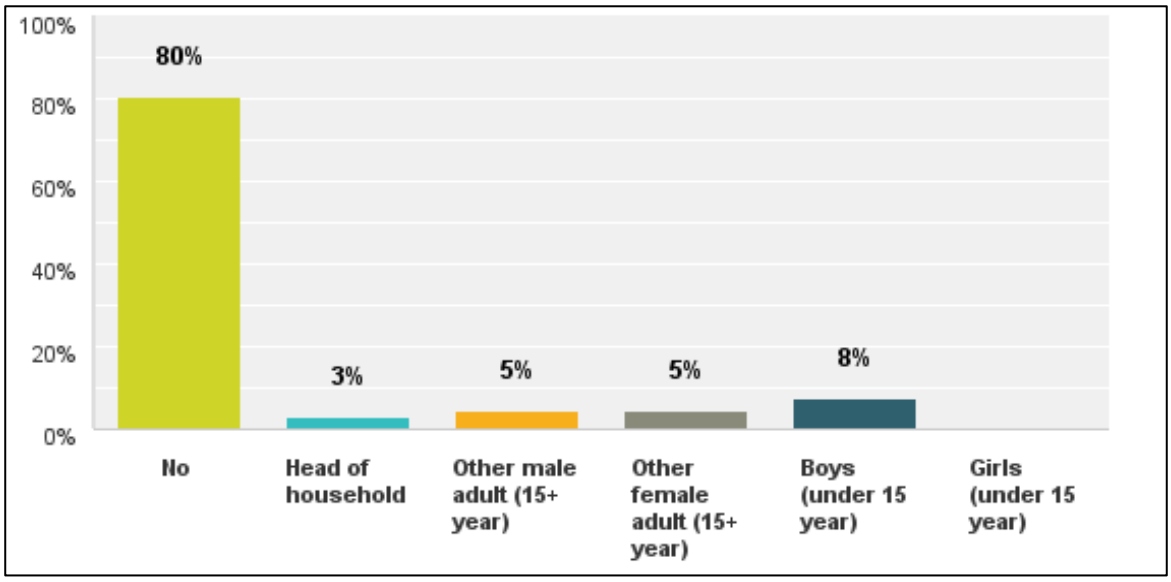


Regarding available labour, 58% of those surveyed indicated that labourers were not available. The majority (97%) of those surveyed felt that oil and gas projects did not affect the availability of labour.

5.6.6.7 Migration

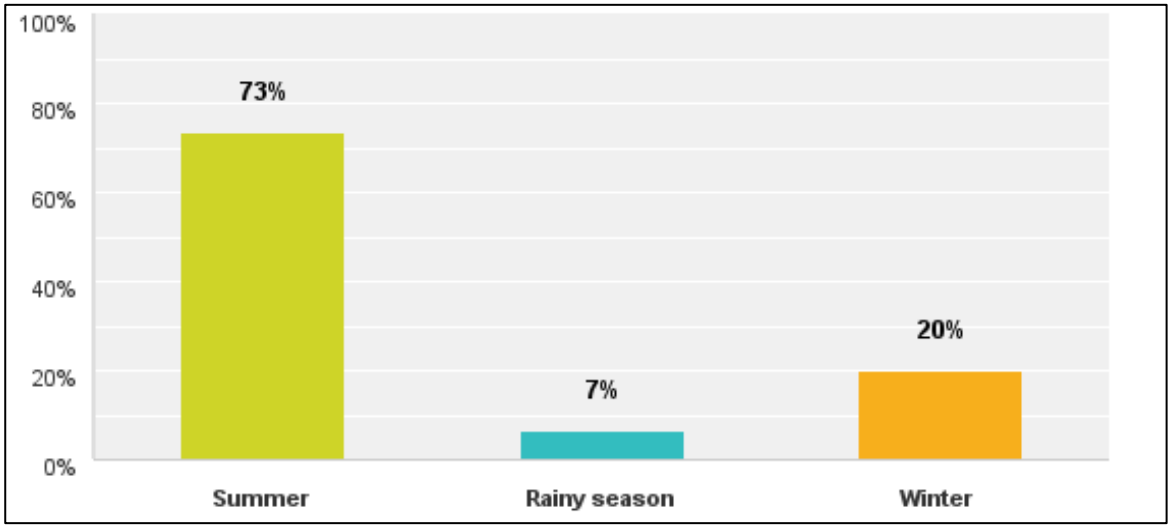
Of the total survey group 80% do not migrate for work (**Chart 5-6**). The 2014 Census shows that 53% of all persons who moved from their previous place of usual residence within Myanmar were female. The main reason for movement for both sexes was “following family” and “seeking employment.” Females were more likely to follow family (49%) than males (32%); and males migrated more for reasons of employment (47%) than females (23%).

Chart 5-6: Pattern of migration reported in two coastal villages, Myeik



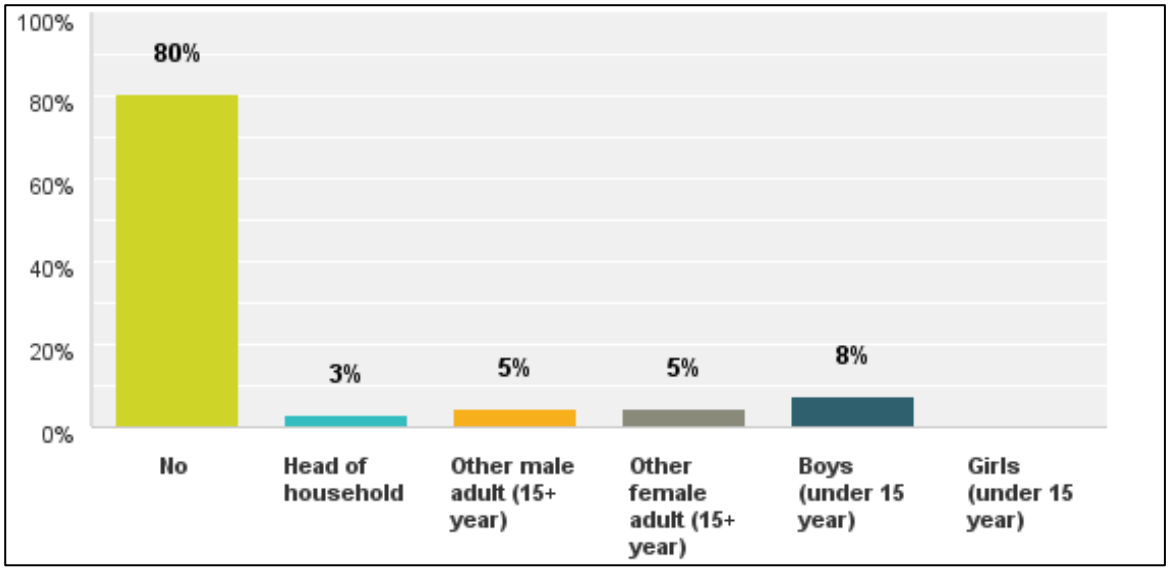
When individuals migrate for work, (47%) migratefor 6-12 months on average, with the remained for less than 6 months. The summer season was greatest period during which people migrated for work (73%) (**Chart 5-7**).

Chart 5-7: Season of job migration reported in coastal areas near MD-5



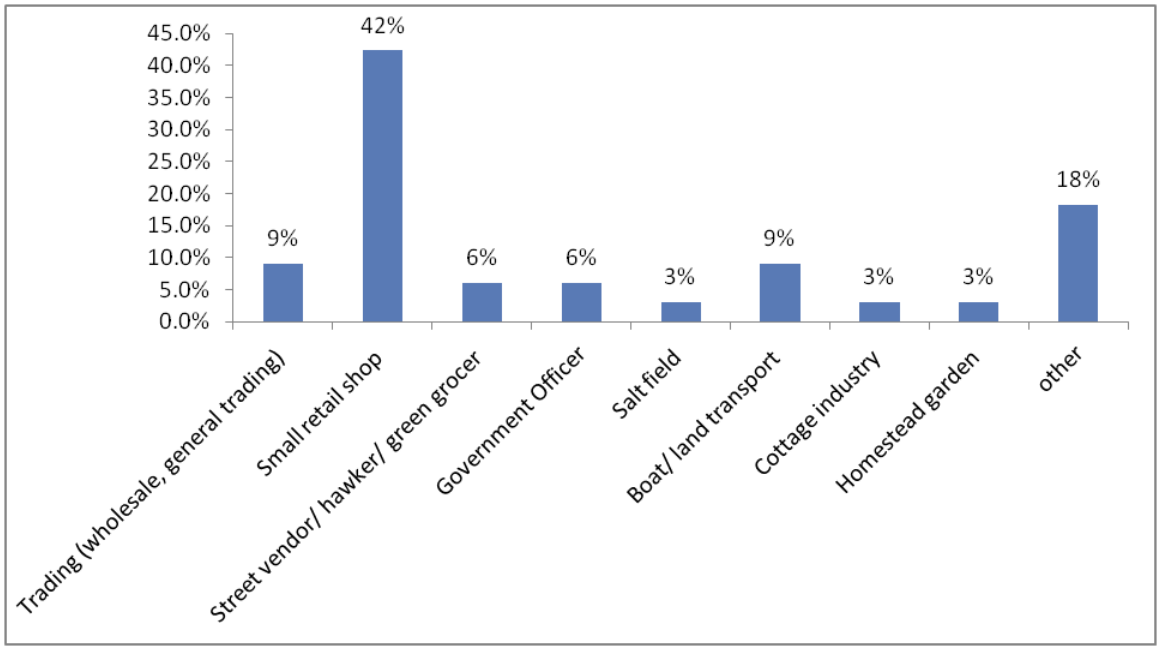
The main type of work for which the survey group migrated was factory/production (36%) (**Chart 5-8**). The majority (72%) of workers who migrated went abroad

Chart 5-8: Type of work pursued by migrating workers reported in coastal areas near MD-5



The majority of households 58% do not participate in off-farm activities. Of those involved in off-farm activities, 42% were involved in a small retail shops (**Chart 5-9**).

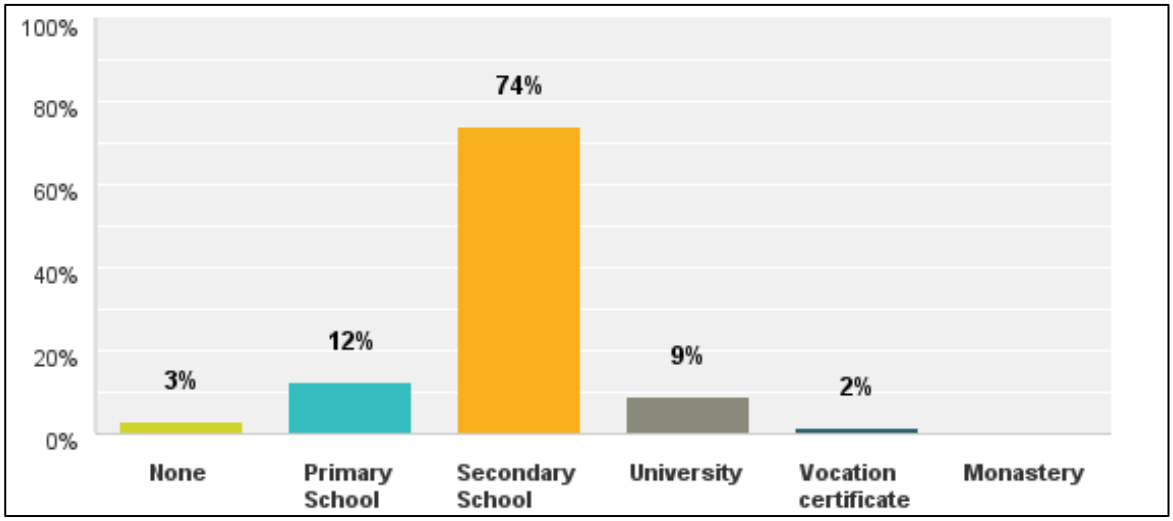
Chart 5-9: Type of household activity reported in two coastal villages, Myeik



5.6.6.8 Education

The majority (79%) of household members indicated that education was accessible to their family. Approx. 74% of those surveyed had secondary school education as the highest form of education in their household (**Chart 5-10**).

Chart 5-10: Education levels reported in coastal areas near MD-5



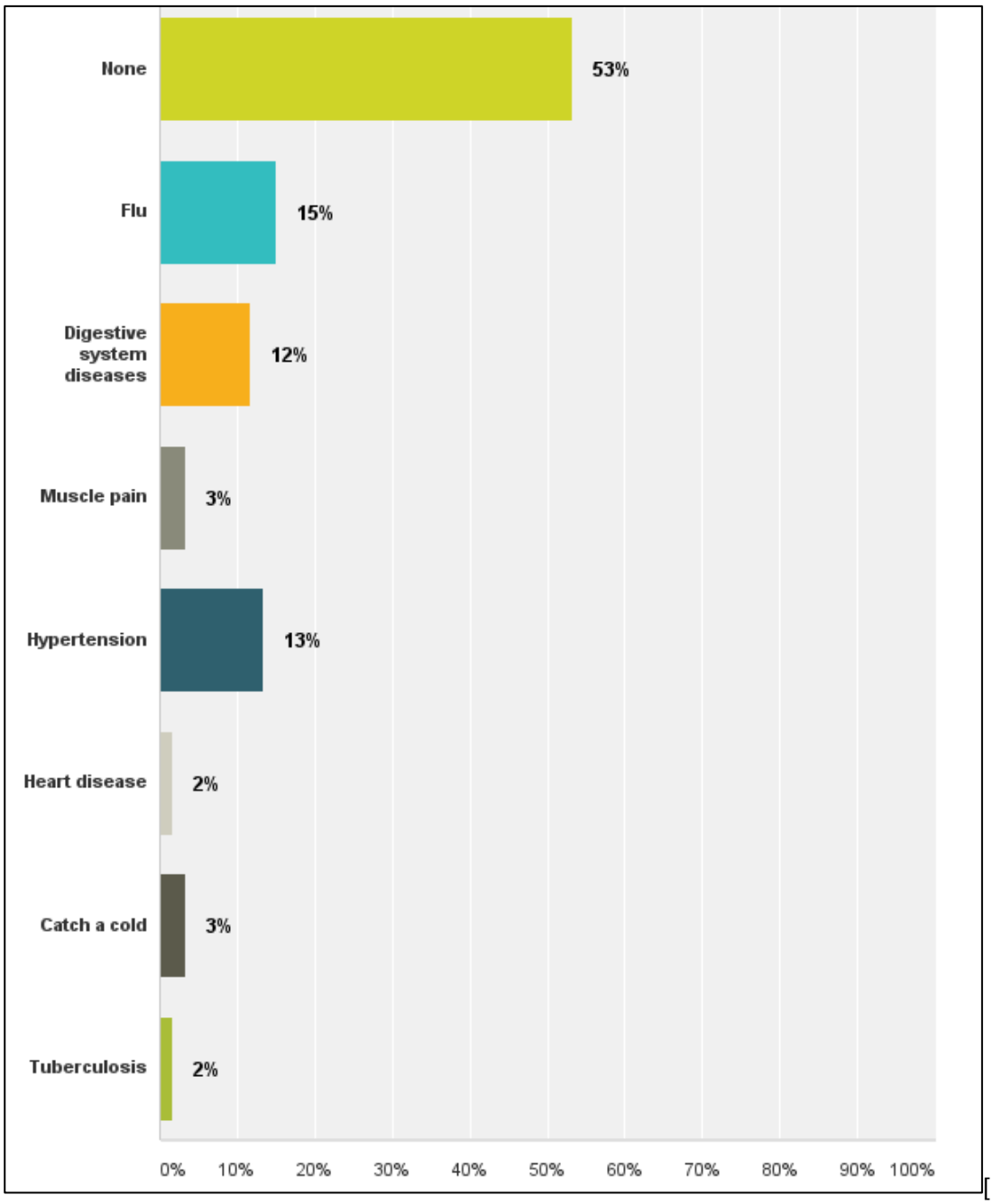
5.6.6.9 Public Health

The information on disability in the 2014 National Census included four categories (seeing, hearing, walking and remembering/mental) and the degree of difficulty a respondent experienced for each type. A total of 2,311,250 people (4.6%) have at least one type of disability. The most common type of disability is seeing (2.5%), followed by walking (1.9%), remembering/mental (1.7%) and lastly hearing (1.3%). The disability prevalence is higher among females (4.8%) than males (4.4%). By State and Region, the highest prevalence is reported in Ayeyawady (7.6%), Chin (7.4%) and Tanintharyi (7%), while the lowest is observed in Nay Pyi Taw, the administrative capital city[19].In general villagers in the two Myeik coastal villages surveyed do not suffer from high incidence of serious health issues or disability. The majority (88%) of those surveyed did not have any physical disability in the household, 9% had mobility / walking, 2% blindness and 2% hearing loss disabilities.

When villagers were asked what common illnesses they had, 53% said they did not have one, with flu being the most common illness (15%) (**Chart 5-11**).

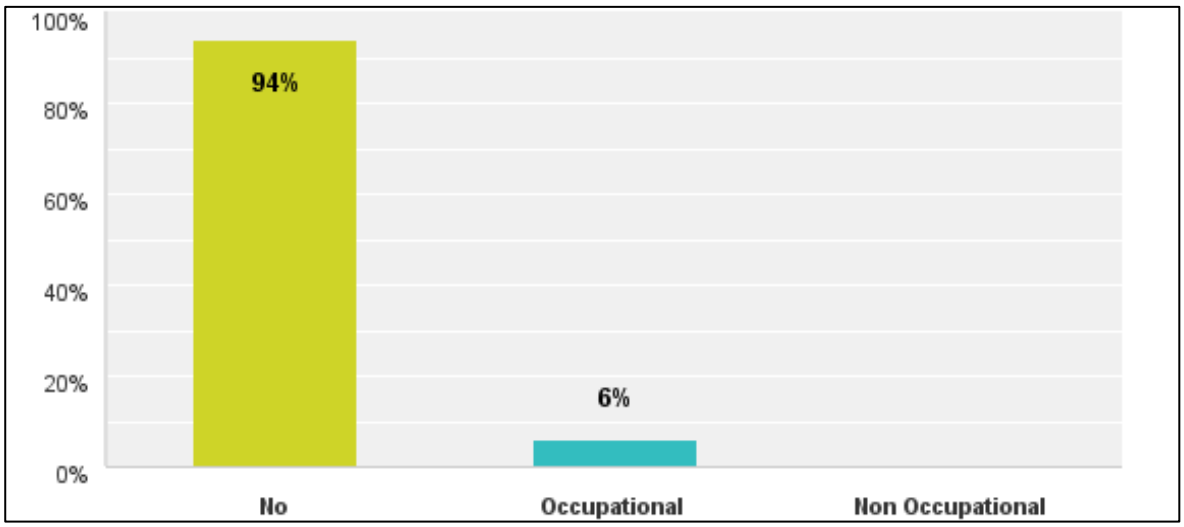
[19] 2014 MPHC Census

Chart 5-11: Health conditions reported by communities in coastal areas near MD-5



According to the Ministry of Health, per 100,000 population, there are 63 hospital beds, 22 midwives, 22 nurses, and 11 medical doctors available in the Tanintharyi Region. 52% of the survey group indicated that health care is available to them. The primary type of health services being used was doctors (94%) followed by midwifes (6%). Almost all (94%) of those surveyed indicated that they had not had any occupational accidents or injuries (**Chart 5-12**). A small percentage (12%) of the survey group had problems with diarrhea in the past month.

Chart 5-12: Occurrence of significant occupational injuries reported in two coastal villages, Myeik



5.6.6.10 Health Statistics

The 2014 census collected information on births and deaths which showed that for every 1,000 children born in Myanmar, 62 die before reaching their first birthday. This rate is higher in rural areas (68) than in urban areas (41). The Tanintharyi Region has a rate of 71 deaths per 1,000 live births.

The under-five mortality rate is 72 at Union level with Tanintharyi have a higher rate at 84.[20] In 2012, at the Union level the leading causes of morbidity in the under-fives were “All other causes” (23.5%) “Diarrhoea and gastroenteritis of presumed infectious origin” (18.5%), and “Acute upper respiratory infections of multiple and unspecified sites” (10.0%). The leading causes of mortality in the under-fives were “All other Causes” (19.9%), “Disorders related to short gestation and low birth weight, not elsewhere classified” (19.0%), and “Birth asphyxia” (14.3 %).[21]

All villagers (100%) surveyed use a mosquito net while sleeping. Based on national surveys, the Tanintharyi Region experience 2166.9 malaria cases per 100,000 people with only 1.2 malaria mortalities per 100,000 people in 2012,[22]

5.6.6.11 Sanitation

In Tanintharyi Region, 68% of the population resides in rural areas. There are generally little sanitation services and access to drinking water in rural areas.

The 2014 Census shows that in the rural areas of Tanintharyi the main sources of drinking water are protected well/spring (38%), unprotected well/spring (26.2 %) and tap water/ piped (9.1%). These sources of drinking water are classified as improved.

The main type of toilet facility in the rural areas of the region is improved pit latrine (water seal), 59% of households surveyed reported using this facility. It is important to note that 20% of rural households do not have a toilet facility in the region. [23]

5.6.6.12 Tourist Attractions and Recreational Areas

In Myanmar, tourism is a relatively recent but developing sector. The number of visitors is increasing yearly, and the government of Myanmar has been encouraging tourism. The total number of tourists is arriving in Myanmar during 2007 – 2012 is shown **Table 5-16**.

[20] 2014 MPHC Census

[21] Annual Hospital Statistics Report 2012 Department of Health Planning in collaboration with Department of Health November 2014 Nay Pyi Taw

[22] Ministry of Health The Republic of the Union of Myanmar, Public Health Statistics 2012

[23] 2014 MPHC Census.

In the 2010-2011 fiscal years, tourists comprised 74% (313,127 arrivals) of overseas visitors to Myanmar.

Table 5-16: Number of Tourist Arrivals in Myanmar, 2007-2012

Year	Total[1]	Tourists[2]				Other Visitors[3]
		Total	by Air	by Sea	by Land	
2007-2008	363,976	288,776	131,784	2,492	154,500	75,200
2008-2009	334,954	255,288	100,439	1,879	152,970	79,666
2009-2010	394,427	298,556	164,000	1,458	133,098	95,871
2010-2011	424,041	313,127	216,861	2,414	93,852	110,914
2011-2012	329,724	228,201	166,022	1,417	60,762	101,523

Source: Central Statistical Organization, Ministry of National Planning and Economic Development, http://www.csostat.gov.mm/S30MA0201.asp

Remark: 1 Includes visitors with visa and daily or overnight travellers with border pass.
2 Visitors with tourist visa only
3 Includes visitors with special re-entry visa, entry visa, entry visa (business, social, gratis official courtesy, multiple journey, gratis diplomatic courtesy and transit) were started from April 2005.

Estimates of tourist visitors in the subsequent years indicate that the number of tourists visiting Myanmar has grown significantly. The numbers quoted vary somewhat between sources, but are in the range 2 million tourist visits in 2013 and 3 million in 2014. This economic sector is continuing to grow.

Tourist attractions in the Tanintharyi Region include islands and beaches. The following areas could have relevance in the context of the wider area of interest relevant to this IEE.

Maungmagan Beach

A beautiful beach in Thanintharyi Region, Maungmagan is a seaside village ten miles north of the town of Dawei. Most people in this region belong to the fishing community, fishing being a traditional livelihood in this area. Maungmagan Beach is used by the fishermen and their fishing boats returning after a night's fishing at sea and for carrying out preparations to go out to sea again in the evening.

Myeik Archipelago

The Myeik Archipelago off the coast of Central Thanintharyi comprises over 800 islands. This area is becoming a top tourist destination. The Lampi Marine National Park is located in the Myeik Archipelago. Lampi MNP was designates as an ASEAN Heritage Park in 2003, an Important Bird Area in 2004 and is considered a Significant MNP in the Indian Ocean. The Myeik Archipelago is very rich in biodiversity and is called the 'Mother Land' of the Moken[24] people. The Myeik Archipelago also has a rich history of maritime trade and piracy with the water around the 800 largely desolate islands believed to conceal hundreds of shipwrecks. The area is attracting increasing numbers of scuba divers who are keen to explore the possibilities of valuable historical sites and artefacts under the sea.

[24] Stakeholder Consultation: Lampi Marine National Park Ecotourism Plan Yangon, 28th May 2015, OIKOS

6. Impact Assessment and Mitigation Measures

6.1 Introduction

This IEE documents a process that identifies, describes, evaluates potential impacts and develops means of mitigating the impacts of a proposed activity on the environment, including socio-economic, cultural and human-health impacts.

This section describes the approach undertaken to evaluate the level of positive or negative impact to environmental and social receptors from activities associated with the planned seismic programme. This description includes the identification of potential impacts and benefits, and the evaluation of their significance.

The mitigation measures form the basis of the Environmental Management Plan (EMP, refer **Chapter 8**) which will be implemented during the project.

6.2 Impact Assessment Approach

This section describes the approach adopted for identifying and assessing impacts on the physical, biological and human environment as relevant to the deepwater offshore exploration activities.

For the purpose of this assessment, key terminology is defined below:

Activity - Components or elements of work associated with the project. For example: seismic vessel operation, transportation of personnel or equipment.
Aspect - An environmental aspect is an element of an activity that can interact with the environment and may have potential to impact on the biological, socio-economic or cultural environment. For example: emissions, waste, noise.
Cumulative impact – Cumulative impacts are effects that act together with other impacts to affect the same receptor, and are commonly understood as the impacts which combine from different projects and which result in an incremental impact larger than the sum of the individual impacts.
Direct impact - Impact that results from a direct interaction between an activity and the receiving environment (e.g. between occupation of an area of seabed and the habitats which are affected).
Factor - The physical, ecological, socio-economic and cultural components of the environment. For example: water quality, marine flora or fauna. In impact assessment terms, Factors may also be described as **Receptors**.
Impact - Any change to the environment, whether adverse or beneficial, resulting from an environmental aspect. Impacts can be direct or indirect.
Indirect impact - Impacts on the environment, which are not a direct result of the project, often produced away from or as a result of a secondary pathway (e.g. development implementation promotes service industries in the region).
Likelihood - The probability or frequency of an environmental impact actually occurring.
Mitigation - Management measure applied to minimize and manage impact.
Residual impact - The level of impact after the application of preventative and mitigation measures.

6.2.1 Screening

An initial screening assessment of the proposed seismic exploration activities was undertaken in accordance with the EIA procedures (ref **Chapter 3**) early in the project development.

The screening assessment concluded that an IEE would be appropriate for the proposed exploration survey programme in Block MD-5. As set out in the EIA Procedures, an IEE Type Project is a Project judged by the Ministry (of Natural Resources and Environmental Conservation) to have some adverse impacts, but of lesser degree and/or significance than those for EIA Type Projects, and readily manageable.

A Project Proposal for the proposed MD-5 activities was submitted to MOGE in February 2015.

6.2.2 Scoping – Identification of Relevant Aspects and Impacts

The identification of potential impacts is carried out prior to any detailed assessment of the relative importance of each issue, the sensitivity of the existing environmental and/or socioeconomic values, or the magnitude of the potential impact, and does not take into account potential mitigation measures.

At this stage of the assessment for the Project, certain issues are screened out because their impact on the environment is identified to be so small as to be irrelevant, or where the potential for impact is determined of little relevance. These issues are not considered further in the assessment process.

6.2.3 Impact Evaluation

The impacts that result from routine (planned) activities are assessed, as are those that could result from credible accidental or unplanned events within the project scope (e.g. a fuel spill) or in the external environment affecting the project.

The approach to assess the significance of potential impacts is discussed briefly below.

6.2.3.1 Assessment of Significance

Assessment of the level of significance requires consideration of the likelihood and impact characteristics (i.e. magnitude of the environmental effect, its geographical scale and duration in relation to the sensitivity of the key receptors and resources considered).

The overall significance is presented through a matrix of sensitivity of the receptor and the magnitude of impact, as shown in **Table 6-1**.

Table 6-1: Significance Matrix for Environmental Impacts

Receptor Sensitivity	Impact Magnitude or Likelihood/Probability		
	Low/Rare	Moderate/Occasional	High/Frequent
Low value/sensitivity receptor or resource, within standards, small local change in human use and quality of life values over a short-term duration, reversible over short-term.	Negligible	Minor	Moderate
Moderate value/sensitivity receptor or resource, within standards, moderate change in human use and quality of life values at moderate level over a long-term duration, reversible over medium-term.	Minor	Moderate	High
High value/sensitivity receptor or resource, exceeding standards, large permanent change in human use and quality of life values at a regional level, long-term or no reversible.	Moderate	High	High

The impact assessment is based on four categories of impact significance level, as described in **Table 6-2**. These inform the level of mitigation that is considered appropriate to be applied for a given impact.

Table 6-2: Categories of Impact Significance

Significance Level	Definition
High	Impact is classified as high and can cause numerous effects. Major impacts affect an entire population or species in sufficient magnitude to cause a decline in abundance and /or change in distribution. Large permanent change in human use and quality of life values over at a national level. Impacts cannot be managed or resolved by any mitigation measures.
Moderate	Impact may result in changes that affect the value of resources and environment. Moderate impacts affect a portion of a population and may bring about a change in abundance and / or distribution but does not threaten integrity of population. Impact may affect moderate change in human use and quality of life values at regional level over a long-term duration. Mitigation measures are required to manage or reduce the potential impacts and monitoring measures are required to determine effectiveness of mitigation measures.
Minor	Impact may result in changes in resources and environment but this change does not decrease value of these resources and environment. Minor impacts affect individuals within a population over a short period of time. Local change in human use and quality of life values over a short-term duration. Impact can be managed and resolved by implementation of general mitigation measures.
Negligible	Impact has no effect.

Source: Adapted from Rossouw (2003) and Sippe (1999).

The degree of significance (categories as defined in **Table 6-2**) depends upon the nature (i.e. type, magnitude, extent/scale, duration and reversibility) of impacts and the importance placed on them. Therefore it is necessary to consider characteristics of a potential impact taking into account standard values, resource/receptor importance, and likelihood of an impact occurring. The criteria used to inform the significance ranking of impacts on a qualitative basis, are provided in **Table 6-3**.

Table 6-3: Criteria used to Inform Impact Significance Determination

Criteria	Detail
Standard Values	• **High** - Potential impact does not meet standards/guidelines. • **Moderate** – Potential impact is likely meet standards/guidelines with appropriate management measures. • **Low** - Potential impact meets standards/guidelines.
Magnitude	• **Major (High)** - impact causing persistent and severe environmental or social damage. • **Moderate** - impact large enough to cause environmental or social damage. • **Minor (Low) -** impact that may cause some minor environmental or social damage.
Extent/Scale	• **Regional** - area of potential impact is > 1km radius from the site boundary. • **Moderate** - area of potential impact is between 100 m and 1 km radius from the site boundary. • **Localised** - area of potential impact is in the project area within a radius of 100 m from the site boundary.
Duration	• **Permanent** – Impact likely to be permanent with no environmental recovery. • **Long Term** - Potential impact occurs over long-term duration (>5 years) before recovery. • **Medium Term** - Potential impact occurs over medium-term duration (1-5 years) before recovery. • **Short term** - Potential impact occurs only during part of project operations or only during a short term project up to one year, before recovery.
Reversibility	• **No Recovery** - Permanent impact. • **Long Term** Recovery - Recovery longer than 5 years after cessation. • **Medium Term** Recovery - Recovery within 1 - 5 yr. after cessation. • **Short Term** Recovery - Recovery within 1 yr. after cessation.
Importance	• **High** – High value/sensitivity receptor or resource, rare or endangered species or habitat impacted on a national or international level. • **Moderate** – Medium value/sensitivity receptor or resource, Impact disturbs an area that has a value for conservation or causes change in species diversity. Impact important on a local or regional level. • **Low** – Low value/sensitivity receptor or resource, impact disturbs degraded area or slightly disturbs area with value for conservation, causes small changes in species and diversity.
Likelihood/Probability	• **High** – Frequent • **Moderate** – Occasional • **Low** - Rare

6.2.4 Identification of Mitigation Measures

A key component of the IEE process is to identify practical ways of avoiding or reducing potentially significant impacts of the proposed exploration survey and related activities. These are commonly referred to as mitigation measures and are incorporated into the proposed project as commitments. Mitigation is aimed at preventing, minimising or managing negative impacts to an acceptable level, and optimising and maximising any potential benefits of the project, where applicable.

Measures to prevent or mitigate (reduce) the severity of potentially significant impacts are developed and linked back to the related activities, as the basis of an Environmental Management Plan (EMP). The EMP brings together the environmental and social management requirements needed to prevent or reduce potential impacts from activities and accidental events, and forms part of the IEE Report and company commitment to the project.

The environmental and social mitigation measures are identified in this Impact Assessment Chapter, and presented with further details of their implementation provided in **Chapter 8**.

6.2.5 Residual Impact

Following the identification of potential environmental and social impacts, their significance is assessed, taking into account those proposed mitigation measures already incorporated into the design of the project and, where appropriate, any further mitigation measures that are considered feasible and justified. Mitigation measures are applied to eliminate or reduce impacts to an acceptable level. These remaining impacts are described as residual impacts.

One objective of the IEE is to understand the significance of these residual impacts that will remain after mitigation measures have been designed into the intended activity and if some form of monitoring or measurement might be justified.

6.3 Environmental and Social Aspects for Assessment

As a result of the screening and scoping processes, a list of aspects (key sources of environmental or social risk) were derived to be of primary relevance to the impact assessment for the proposed MD-5 surveys and supporting activities.

The detailed impact assessment of each aspect is provided in the following **Section 6.4**. A summary of aspects, and their relevant impact considerations, are provided below in **Table 6-4** to **Table 6-6**.

The relevant aspects for the proposed activity include:

- Underwater noise arising from the discharge of underwater airgun arrays and the use of vessel engines for vessel propulsion.
- Electromagnetic pulse emissions from CSEM towed unit.
- Seabed disturbance from deployment, presence and later biodegradation of anchors for the receivers to be used during CSEM activities.
- Artificial lighting from the work and access areas of the support and chase vessels during the survey programme.
- Atmospheric emissions from the operation of vessel combustion engines.
- Routine aqueous discharges of sewage, treated deck drainage and bilge water to the ocean from survey, support and chase vessels.
- Solid waste including food waste arising on board survey, support and chase vessels.
- Physical presence and manoeuvring of the survey and support vessels, including potential interactions with fisheries, shipping and other oil and gas exploration activities, or with fauna.

A summary of the potential environmental/social impacts associated with the aspects listed above include:

- Disturbance to marine fauna including marine mammals (cetaceans and dugongs), turtles, fish and invertebrates.
- Disturbance to the seabed and benthic habitats and communities.
- Reduction air quality from atmospheric emissions as a result of operation of machinery and use of internal combustion engines.
- Reduction in water quality as a result of routine discharges including sewage water, bilge water and solid wastes.
- Marine pollution from accidental discharges of hydrocarbons, chemicals or other hazardous materials.
- Establishment of invasive marine species as a result of ballast water discharge and vessel biological fouling.
- Disturbance to social and community values due to interactions with fishing vessels and shipping.
- Direct and indirect contribution to the Myanmar economy through jobs and income.

Table 6-4: Environmental Aspects

Aspect	Project Activity / Potential Hazard Source	Environmental/Socio Economic Factors	Potential Impact
Underwater Noise emissions	Operation of Airgun array source (seismic source noise)	Marine Fauna	Behavioural and physiological effects on marine mammals (cetaceans), turtles, fish and invertebrates Disturbance to marine mammals (cetaceans), turtles, fish and invertebrates
	Transportation, Equipment & Supplies (vessel-related noise)		
Electromagnetic Pulse Emissions	CSEM unit electromagnetic pulsing	Marine Fauna	Disturbance to fish, cetaceans and sea turtles
Physical presence of marine anchors	Deployment, presence and eventual biodegradation of anchors (Receivers)	Marine Habitats	Seabed disturbance Disturbance of benthic habitats and organisms in the immediate vicinity Smothering of benthic habitat immediately underneath the anchors Changes in local water quality due to biodegradation of concrete blocks
Artificial Light Emissions	Light emissions from vessels during hours of darkness	Marine Fauna	Behavioural effects on marine fauna (birds, turtles and fish)
Atmospheric Emissions	Operation of combustion engines on vessels	Air Quality GHG emissions	Deterioration of local or regional air quality as a result of emissions.
Routine Liquid Discharges	Discharge of sewage waste	Water quality Marine Flora and Fauna	Localised reduction in water quality due to nutrient enrichment
	Discharge of treated water originating from deck drainage systems, bilges and machinery drainage	Water quality Marine flora and fauna	Toxic effects on marine fauna and flora Localised reduction in water quality
Solid Waste Management	Non-Hazardous solid Waste generation onboard vessels	Marine water quality Marine habitat	Deterioration of water quality and marine habitat

Table 6-5: Unplanned or Accidental Events

Aspect	Project Activity / Potential Hazard Source	Environmental/Socio Economic Factors	Potential Impact
Vessel interactions with Marine Fauna	Vessel Collisions	Marine fauna	Physical effects on marine fauna particularly marine mammals (cetaceans)
	Fauna entanglement in towed equipment	Marine Fauna	Physical effects on marine fauna particularly sea turtles
Accidental discharges (hydrocarbon spill)	Fuel spill (due to vessel collisions, refuelling or other equipment or system failure)	Marine Flora and Fauna Marine Habitat Local socio-economic uses	Toxic effects on marine fauna and flora Localised reduction in water quality Indirect effects on offshore fisheries
Accidental Releases (Chemical or Hazardous Waste)	Incorrect handling of chemical or hazardous waste	Marine Flora and Fauna Marine Habitats Local socio-economic uses	Toxic effects on marine fauna and flora Localised reduction in water quality Indirect effects on offshore fisheries
Accidental Introduction of Invasive marine Species (IMS)	Introduction of IMS associated with ballast water discharges or transferred via vessel hull or in-water equipment	Water quality Marine habitat and fauna	Establishment of non-native IMS with potential to affect native marine species

Table 6-6: Social Aspects

Aspect	Project Activity / Potential Hazard Source	Environmental/Socio Economic Factors	Potential Impact
Physical Presence and Maneuvering – Impact on Fisheries	Presence and manoeuvring of survey boat and towed equipment	Fisheries	Fouling of fishing gear as equipment is towed in the water
	Presence and manoeuvring of seismic survey boat and towed equipment)	Fisheries	Displacement of fishing boats, disruption of fishing and/or damage to fishing boats and equipment
Physical Presence – Impact on Shipping	Presence and manoeuvring of survey vessels and tow lines	Shipping	Increased traffic volume in the local area of the planned survey Interaction with shipping leading to disruption of shipping activities, e.g. diversion and some potential delays to third party journeys
Contribution of exploration survey to employment and income	Survey programme	National and local employment and income	Direct and indirect contribution to the Myanmar economy through jobs and income

The assessment of each aspect includes the following:

- Description of the project characteristics
- Evaluation of potential impacts on relevant factors
- Identification of mitigation measures to eliminate or reduce potential impacts
- Residual impacts.

6.4 Environmental Impact Assessment

6.4.1 Underwater Noise

Project Activity / Potential Hazard Source	Environmental/Socio Economic Factors	Potential Impact
Operation of airgun array source (seismic source noise)	Marine Fauna	Behavioral and physiological effects on marine mammals (cetaceans), turtles, fish and invertebrates
Transportation, Equipment & Supplies (vessel-related noise)	Marine Fauna	Disturbance to marine mammals (cetaceans), turtles, fish and invertebrates

6.4.1.1 Project Characteristics

The 3D seismic survey will cover an area in the range approx. 2,600 – 3,500 km^2, in water depths ranging from 2,100 to 2,600 m. The seismic survey vessel will utilise a source array of between 3,500 – 4,500 cubic inches (in^3) capacity that will generate acoustic pulses by periodically discharging compressed air into the water column. The sound pressure level (SPL) emitted by the source array is expected to range from approximately 254 - 260 dB re1µPa within one metre of the source, at frequencies ranging from 5 – 250 Hz. The seismic survey is expected to take max. 2 months to complete.

Project vessels will be driven by propellers which are driven by combustion engines. They may apply thrusters during the operations. A typical survey vessel operating on thrusters is likely to produce frequency band ranges from 1 – 500 Hz at a peak SPL of approximately 170 – 190 dB re1µPa within one metre of the source. Smaller vessels, such as support vessels and chase vessels, operating on normal propulsion, typically produce underwater noise at peak SPL below 150 dB re1µPa (Popper et al, 2014).

6.4.1.2 Impact Assessment

Overview

Potential for impact to marine fauna (including cetaceans, turtles, fish and plankton) from anthropogenic underwater noise is dependent on received noise level, frequency, distance from the source and the physiology of the receptor species. Received noise levels are dependent on signal attenuation, which is influenced by local sound propagation characteristics including the salinity and temperature profile of the surrounding water, water depth, and the type of seabed and its underlying substrate (McCauley 1994).

Potential impacts to marine fauna from underwater noise can be categorized into the following:

- Disturbance leading to behavioural changes i.e. avoidance or displacement from areas of importance such as feeding or breeding, nursery areas;
- Masking or interfering with other biologically important sounds (such as vocalisation, echolocation and sounds produced by predators or prey);
- Direct physical effects on hearing or other organs (injury).

Cetaceans

Section 5.3.4 identified a total of 28 species of cetacean recorded in the waters off Myanmar, comprising 5 species of baleen whale and 23 species of odontocetes (toothed whales). Of the species identified, three species of baleen whale (the Humpback, Fin and Blue whale) and one species of toothed whale (the Sperm whale) are listed as endangered. There is limited information available on the distribution and abundance of marine mammals in Myanmar offshore waters, but it is assumed that cetaceans may be present.

Baleen whales use low frequency sound for vocalization and hearing, in the range of 7 Hz to 22 kHz, while toothed whales use mid to high frequency sound, in the range of 150 Hz to 180 kHz. (Southall et al, 2007). Therefore both groups of cetacean have hearing ranges that are likely to overlap with the frequencies of underwater sound produced by the seismic array (5 – 250 Hz) and vessel noise (1 – 500 Hz).

Available data on marine mammal behavioural responses to pulsed sounds (such as that produced by a seismic array) are highly variable and context specific. However a literature review of the behavioural responses of cetaceans to pulsed sounds found that the range of recommended SPL that could result in possible avoidance in marine mammals is 120 dB to 160 dB re 1 µPa at 1 m (Southall et al, 2007). Southall et al (2007) also predicted that permanent physical injury would occur at 230 dB re 1 µPa.

Studies have indicated localized avoidance behaviour by cetaceans when exposed to low frequency sound pulses (McCauley et al, 2000; Johnson, 2002; Weller et al. 2002), with observational studies from seismic vessels suggesting sighting distances are greater during air-gun operation (Stone, 2003). Migrating humpback whales have been observed changing migration course and speed to avoid operating seismic arrays, however overall migration path did not change and migration was not interrupted (McCauley et al, 2000).

Another potential impact from exposure to elevated underwater noise is masking. However, the seismic array releases sound in pulses and the natural callings of the baleen whales can be heard through gaps in the pulses (Richardson, 2002).

Although the seismic survey will generate SPL that has potential to result in permanent injury to cetaceans (>230 dB re 1 µPa from the seismic airgun array), the sound levels would attenuate below this level within close proximity of the airgun array (generally expected to be less than 50 m from the seismic source (Gausland 2000)). Additionally, there have been no documented cases of cetacean mortality as a result of seismic survey activities (DFO, 2004). It is reasonable to expect that the elevated levels of underwater noise generated by the seismic survey and project vessels may result in behavioural disturbance to cetaceans, such as avoidance (generally expected to be within 10's of km from the seismic source (JASCO 2011). However, any behavioural changes displayed are likely to be localised in extent and of a temporary short-term duration. Therefore, the potential impacts to cetaceans from underwater noise associated with the project are considered to be reversible and of moderate magnitude.

Dugongs

Dugongs inhabit the Myanmar coast and can be found in groups in shallow water along coastlines, where seagrass is abundant. The nearest area known to be inhabited by dugongs is located over 200 km away from Block MD-5.

Dugongs hear at high frequencies (1-2 KHz), and therefore the low frequency noise associated with the project is unlikely to cause impact. Additionally, elevated levels of underwater noise are not expected to reach areas of dugong habitat in shallow, coastal waters. The potential impacts to dugongs from underwater noise associated with the project are considered to be negligible.

Sea Turtles

There are five species of sea turtle known to be present in Myanmar waters: leatherback turtle, olive ridley turtle, hawksbill turtle, green turtle and loggerhead turtle. All five sea turtle species are classified as critically endangered or endangered. No important sea turtle habitats (including nesting beaches and foraging grounds) are located within Block MD-5. The closest turtle nesting area is at the Lampi Island Marine National Park, located over 200 km from the Block MD-5. It is assumed that individual sea turtles may occasionally transit through Block MD-5.

Studies have indicated that the best underwater hearing range for marine turtles is in the 100-700 Hz range (McCauley, 1994), which overlaps with the frequency range (5 – 250 Hz) expected for the underwater noise arising during the survey.

Studies into the response of captive animals to an approaching seismic array, and scaling these results, indicate that sea turtles will display a general "alarm" response at an estimated 2 km range from an approaching operating seismic airgun array and avoidance behaviour at 1 km (McCauley et al, 2003). Marine turtles could be exposed to noise levels sufficient to cause physical damage if seismic surveys start suddenly with turtles in the close vicinity of the airgun. However, Moein et al. (1994) tested whether hearing sensitivity of caged loggerhead turtles altered after exposure to several hundred pulses within 30-65 m of a single airgun. Hearing was tested before, within a day, then two weeks after exposure. Approximately 50% of the exposed individuals indicated

altered hearing sensitivity when tested within a day of their exposure, but none provided any sign of altered hearing two weeks later, compared to the pre-exposure tests. In circumstances where arrays are already operating (as a vessel is moving along an acquisition line), individuals would be expected to display avoidance behaviour before entering ranges at which physical damage might take place.

Given that the potential presence of sea turtles within Block MD-5 is expected to be limited to a few individuals transiting through as there is no important habitat for sea turtles within or in proximity to Block MD-5 and noise levels unlikely to cause permanent hearing loss, the impacts on sea turtles from underwater noise associated with the project are expected to be local in extent, short-term in duration, reversible, and of minor magnitude.

Fish

The Tanintharyi coastal area is productive in shoaling pelagic fish (e.g. mackerel, sardines, tuna and demersal fishes e.g. snapper, nemipterus, hair tails, sharks, rays and shrimps) (BOBLME, 2011). The area of MD-5 is within an area designated for fishing and used in particular for tuna and other large pelagic species.

The noise levels produced by seismic airgun arrays have the potential to damage the hearing of some species of fish and to cause behaviour disturbance. Two sound detection mechanisms are present in those marine fish species that have the ability to hear: the inner ear system of otolithic bones, and the lateral line system. The latter comprises a series of scales and pores containing sensory cells that run from the gills to the tail fin, that communicate vibrations and pressure differentials from the water column to nerve fibres, allowing the fish to detect relative motion and sound in the aquatic environment.

Many species also use the gas-filled swim bladder in the abdominal cavity for detecting sound. Underwater noise causes the swim bladder gas to vibrate, and links between the swim bladder and the ear allow the sound wave energy to be re-directed to the ear. The use of the swim bladder allows fish to detect sounds with hearing sensitivity increased in species where the ear and swim bladder are more closely connected.

Fish vary widely in their vocalisations and hearing abilities, but generally hear best at low frequencies below 1 kHz (Ladich 2000). Popper et al (2014) suggest the SPL that may result in the potential mortality of fish with no swim bladder is > 213 dB re 1 µPa, and > 207 dB re 1 µPa for species with a swim bladder. Underwater noise produced by the seismic source is expected to attenuate below these levels within approximately 500 m of the source.

Behavioural effects of noise on pelagic and open water fish such as tuna and mackerel may include changes to schooling behaviour and avoidance of the noise source (Simmonds and MacLennan 2005). However, these behavioural impacts to fish assemblages have been found to be minor and temporary in nature (IEC 2003; Boeger et al. 2006). Popper et al (2014) suggest sound exposure levels (SEL) at which behavioural disturbance may occur to fish (with or without a swim bladder) are > 186 dB re 1 µPa2-s (generally expected to be within 10's of km from the seismic source (JASCO 2011).

The distribution of fish spawning grounds in Myanmar offshore waters is not well researched, and details of spawning areas for economic fish species are not available.

Cartilaginous fish (such as sharks and rays) lack a swim bladder and are considered less sensitive to sound than bony fish. The hearing capabilities of the whale shark have not been studied, but it has been suggested that they are likely to be most responsive to low frequency sounds (Myberg 2001). Whale sharks are known to be present in the waters of the Myeik Archipelago (approximately 125 km away), particularly from February to May, and it is assumed that individuals may occasionally transit Block MD-5.

Although the seismic survey will generate SPL that could result in permanent injury to fish (>207 dB re 1 µPa from the seismic array), the sound levels will attenuate below this level within close proximity of the seismic array. It is expected that fish (including sharks and rays) may exhibit some behavioural responses to the elevated levels of underwater noise generated associated with the project. However, the behavioural responses are expected to be restricted to the immediate area, coinciding with avoiding the direct impact of vessels and towed equipment, and no permanent changes in behaviour that could impact on long-term biological or ecological functioning of fish populations expected. Therefore, impacts on fish from underwater noise arising

from the survey activities are expected to be local in extent, short-term in duration, reversible and of minor magnitude.

Invertebrates and Plankton

Invertebrates include jellyfish, brittle star, marine worm, sea cucumber, shrimp, crab, octopus, squid, etc. These have a high sensitivity to elevated levels of underwater noise with low frequencies ranging from 10-250 Hz. Behaviour response can vary, from for example the shaking of a lobster's tail, closing of an ascidians' water tube, to avoidance reaction or startling by squid. Some sedentary organisms that cannot avoid the sound field of an operating array may be within range to receive pathological damage if an array is suddenly initiated nearby (McCauley 1994). However, invertebrate mortality is not expected from exposure to elevated levels of underwater noise (DFO 2004). Given the depth of the exploration activities (2,100 to 2,600 m), benthic organisms will be over 2 km from the noise source. Therefore, impact from noise generated by the project on invertebrate populations is considered negligible.

Underwater seismic noise has been reported to cause pathological effects on fish eggs, larvae and other planktonic organisms in close proximity, within a maximum of ten metres from the airgun, however known effects have only been demonstrated to five metres (McCauley 1994). Therefore, except for larvae, eggs and other planktonic organisms within a few metres of an airgun array, no planktonic organisms are likely to be significantly affected by airgun discharges (McCauley 1994).

Gausland (2003) has estimated the average daily mortality of fish eggs and larvae caused by seismic surveys to be less than 0.018% per day. When compared with the much greater estimates of natural mortality in fish eggs and larvae (5–20% per day), the overall impact of seismic survey related mortality on recruitment to a fish stock is insignificant.

The potential impacts to invertebrates and plankton are likely to be limited to organisms within a few metres of the sound source, and the mortality rates of planktonic organisms reported for seismic surveys is significantly lower than the natural mortality rates reported. Therefore, impacts from elevated levels of underwater noise on invertebrates and plankton are expected to be local in extent, short-term in duration, reversible and of minor magnitude.

6.4.1.3 Management Measures

Impacts from underwater noise caused by vessel and seismic operations can be mitigated through the use of the following mitigation measures:

Code of Conduct

Shell is committed to applying practical measures for managing potential disturbance effects from underwater noise, in the form of a Code of Conduct.

The Code of Conduct for carrying out the marine seismic survey is aligned with the Joint Nature Conservation Committee (JNCC) 2010 *Guidelines for minimising the risk of injury and disturbance to marine mammals from seismic surveys* as adopted by the International Association of Geophysical Contractors (IAGC).

Pre-survey/Survey Planning

- Two dedicated Marine Mammal Observers (MMOs) will be present onboard the seismic vessel during the survey
- The MMOs will be qualified and experienced. As a minimum, the MMOs will have certified training in the implementation of JNCC guidelines (JNCC 2010) and have relevant offshore survey experience.
- The MMOs will be engaged solely in monitoring the implementation of the mitigation and conducting visual observations of mammals during the survey
- The MMO will provide a report within 30 days of completion of the survey to Shell.
- The Contractor will provide a report (including a daily log) to the MMO on the operation of the seismic equipment. This will include details of soft starts and their duration.
- Adherence to this code will be the responsibility of the Survey Contractor.

Pre soft start scan for marine mammals

- The MMO will survey the area for the presence of cetaceans 60 minutes before the onset of the soft start, within 500 m of the seismic source.
- A minimum distance of 500 metres is required between the centre of the array/sound source and the nearest cetacean before soft start can commence.
- If marine mammals are seen within 500 metres of the center of the sound source the start of the sound source(s) should be delayed until they have moved away, allowing adequate time after the last sighting for the animals to leave the area (20 minutes). If the cetaceans do not leave the area it is recommended that the survey vessel alters course to ensure that the animals are outside the 500 meter exclusion zone when soft start commences.
- There should be a 20 minute delay from the time of the last sighting within 500 metres of the source to the commencement of the soft-start.

Soft start procedure

- Power should be built up slowly over at least 20 minutes to give adequate time for marine mammals to leave the vicinity.
- Soft starts should achieve maximum (or desired) output after at least 20 minutes but not significantly longer.
- This build up of power should occur in uniform stages to provide a constant increase in output from the sound source.
- There should be a soft start every time there is a break in the firing sequence longer than 20 minutes
- Soft starts must occur during daylight hours when the MMO can carry out the required pre soft start scan.
- 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.
- If, for any reason, firing of the sound source has stopped and not restarted for at least 20 minutes a full soft start for the appropriate depth should be carried out.
- When time-sharing, where two or more vessels operate in adjacent areas and take turns to shoot to avoid causing seismic interference to each other, all vessels shooting should follow the full soft start procedure for each line started.
- Once the sound source has achieved its maximum output (post soft start) it is not necessary to stop the survey should cetaceans approach the vessel.

Line change

- With the sound source running, if turn-around time between sample lines or stations is greater than the time required to conduct a soft start (including pre soft start scan) for the appropriate water depth, then the sound source should be stopped and a soft start for the appropriate water depth should be used prior to commencing the new line.
- For line changes which take less time than that required to undertake a soft start, the sound source (e.g. full array of airguns) should continue firing during the line turn (e.g. for a site survey line turn of 5 minutes continue firing at full power).

6.4.1.4 Residual Impact

The impacts from underwater noise created by vessels and the seismic survey are expected to be local in extent, short-term in duration, reversible and of moderate magnitude. Taking into account the proposed controls, and the offshore location of the survey (meaning marine fauna can avoid the spread without any adverse effects), the environmental impact significance of seismic operations to possible behavioural and physiological effects on fish, turtles, invertebrates and marine mammals (cetaceans) is determined to be minor.

6.4.2 Electromagnetic Pulse Emissions

Project Activity / Potential Hazard Source	Environmental/Socio Economic Factors	Potential Impact
CSEM unit electromagnetic (EM) pulse emissions	Marine Fauna	Disturbance to fish, cetaceans and sea turtles

6.4.2.1 Project Characteristics

During the CSEM survey a horizontal electric dipole will be towed approximately 30 m above the seabed. Subsurface resistivity is measured by providing an electromagnetic (EM) field from the electric dipole source, and the receiver electrodes which are placed on the seabed. Power is supplied to the dipole through the combined power and tow line from the survey vessel. The electromagnetic fields generated are relatively weak, and at a distance of approximately four metres from the source, are comparable to the Earth's magnetic field.

6.4.2.2 Impact Assessment

Overview

Electromagnetic emissions have been shown to have very little potential for causing adverse impacts to marine fauna because they are very low frequency and because exposure times are of short duration (IAGC 2013). The EM source zone of influence is relatively localised and for a given transit speed the duration of any effects will be temporary Based upon attenuation data provided by the EM industry, studies of the reactions of various marine fauna groups to electric and magnetic fields, it can be concluded that a conservative horizontal "zone of influence" of a typical EM source would be within less than 400 m radius. The time of exposure from a moving source would be in the order of minutes for a stationary or mobile animal.

A review of the available literature suggests that cetaceans, fish (elasmobranchs (sharks, skates and rays)) and sea turtles are the marine fauna groups most likely at risk of potential impacts from EM emissions, give that these fauna groups may use geomagnetic information at various times. Consequently, only impacts relating to these marine fauna groups are discussed below.

Cetaceans

A study of strandings data from the United Kingdom concluded that cetaceans use geomagnetic information for orientation, and that live strandings of toothed and baleen whales have also been correlated with local geomagnetic anomalies (Kirschvink et al. 1986). However, impacts to cetaceans are expected to be negligible, as the duration of exposure to the weak EM signal emitted would be short (in the order of minutes) due to the source being under constant tow, and unlikely to interfere with processes such as orientation. Additionally, geomagnetic information, if used by cetaceans, would have to be based on the Earth's direct current (DC), and this is expected to cancel out any false clues provided by the EM emissions, which is based on an alternating current (AC) source. To date there have been no reported effects to cetaceans as a result of EM emissions (IAGC 2013). Therefore, any potential impacts to cetaceans are considered to be limited in extent, reversible and of minor magnitude.

Fish

Any fish present exactly on a survey line will receive EM pulsing for a short duration. Potentially these pulses may be detected, particularly by elasmobranchs. Elasmobranchs have highly developed electro-receptive organs and are therefore considered the marine fauna group with highest potential to be affected by EM emissions. Elasmobranchs may use naturally occurring electromagnetic information to navigate or to detect less visible prey at close range. However, potential impacts to elasmobranchs are likely to be negligible, given the small zone of influence associated with the electromagnetic source (a radius of approximately 400 m) and time of exposure would be on the order of minutes due to the source being under constant tow.

As noted above, some groups of fauna may use electric or magnetic fields for navigational purposes. However, it is highly likely that these fields would represent only one cue among a suite of navigational cues such as sun angle, olfactory, current strength, and possibly others. A total dependence upon geomagnetic cues likely would

render the system useless during times (e.g. solar storms) or locations of anomalies. In addition, the Earth's electric field is DC whereas most EM surveys emit AC fields.

Sea Turtles

Although it is possible that EM emissions may be detected by sea turtles for short durations, the use of geomagnetic information for navigation in sea turtles is thought to be limited to hatchlings, with little evidence to suggest its use by adult sea turtles. The closest turtle nesting area from Block MD-5 is within the Lampi Island Marine National Park, located over 200 km from the Block MD-5, and it is expected that sea turtle numbers would be limited to individuals occasionally transiting through the Block. Additionally, the conservative zone of influence would only extend approximately 400 m from the seabed in water depths greater than 2,100 m, meaning sea turtles would have to dive to approximately 1,700 m water depth, which is beyond their ability. Therefore, the impacts on sea turtles from EM emissions associated with the project are expected to be local in extent, short-term in duration, reversible, and of minor magnitude.

6.4.2.3 Management Measures

At present, there are no prescribed mitigations specific to EM surveys. Given the water depths of the survey area (greater than 2,100 m deep) cetaceans and sea turtles are not expected to be within the conservative zone of influence which extends 400 m from the source (i.e. beginning at approximately 1,700 m water depth) and will therefore be unaffected by the EM emissions from the CSEM survey. Additionally, any potential impacts to elasmobranchs would be negligible, given the small extent of the zone of influence from the CSEM source (approximately 400 m) and the limited time of exposure due to the constantly moving source. Therefore no further management measures are proposed.

6.4.2.4 Residual Impact

The impacts from EM emissions created by the CSEM survey are expected to be local in extent, short-term in duration, reversible and of minor magnitude. The environmental impact significance of EM emissions to possible disturbance to marine fauna is determined to be negligible.

6.4.3 Physical Presence of Marine Anchors

Project Activity / Potential Hazard Source	Environmental/Socio Economic Factors	Potential Impact
Deployment, presence and eventual biodegradation of CSEM anchors (Receivers)	Marine Habitats	Seabed disturbance Disturbance of benthic habitats and organisms in immediate vicinity Smothering of benthic habitat immediately underneath the anchors Changes in local water quality due to biodegradation of concrete blocks

6.4.3.1 Project Characteristics

During the CSEM survey grids of receivers are placed on the seabed to measure the electromagnetic energy that has propagated through the sea and the subsurface from the dipole. The seabed receivers are connected to biodegradable concrete anchors, each of which has a footprint of approximately 1 m^2. When the survey has been completed, the receivers are disconnected from the anchors and rise to the surface for recovery to the survey vessel. The anchors are left in-situ on the seabed, and are expected to disintegrate in approximately 6 – 8 months. Up to 190 receivers are expected to be deployed per survey area, and upon completion of data acquisition in a given area, will be rolled over to the next survey area, resulting in up to 190 biodegradable concrete anchors left in-situ per survey area.

6.4.3.2 Impact Assessment

Placement of receivers on the seafloor would damage areas where direct contact with the seafloor occurs. On soft bottom, the potential damage is likely to be restricted to small patches of epifauna and infauna; Soft bottom areas where deployments are made would lose benthic organisms (because of burial and crushing), and bottom-feeding fishes would be temporarily displaced from feeding areas. Deterioration of anchors left in-situ

may have the potential to smother some benthic organisms, however the extent would be limited due to the small footprint of individual anchors (approximately 1 m^2). Additionally, recolonization of benthic communities is expected to be rapid.

The project will be completed in deep offshore waters (2,100 – 2,600 m deep) and at least 300 km from the shore. Therefore, it is considered unlikely that sensitive benthic habitat would be present within Block MD-5. Seabed disturbance from anchors left in-situ is expected to be localized in extent and temporary in nature, and no sensitive benthic habitat is expected to occur within Block MD-5. Therefore, the seabed disturbance impacts associated with CSEM receiver deployment are expected to be local in extent, short-term in duration, reversible, and of minor magnitude.

The biodegradation of concrete anchors left in-situ may result in localised reduction of water quality. However, such impacts are expected to be temporary and negligible, as any contaminants would disperse readily, limiting the potential for benthic and bottom dwelling organisms to be exposed to reduced water quality. Therefore, the water quality impacts associated with CSEM receiver anchor biodegradation are expected to be local in extent, short-term in duration, reversible, and of minor magnitude.

6.4.3.3 Management Measures

Impacts from the placing of and presence of anchors on marine habitats can be mitigated through the use of the following mitigation measures:

- CSEM receivers to be placed on the seabed with biodegradable cement anchors that break down in 6 to 8 months.
- Use of small (1.0m x 1.0m x 0.25m), dissolvable concrete weights.

6.4.3.4 Residual Impact

The impacts from seabed disturbance and localised reduction in water quality created by the CSEM survey are expected to be local in extent, short-term in duration, reversible and of minor magnitude.

Taking into account the proposed mitigation measures, the residual environmental impact significance of seabed disturbance is determined to be negligible.

6.4.4 Artificial Light

Project Activity / Potential Hazard Source	Environmental/Socio Economic Factors	Potential Impact
Light emissions from vessels during hours of darkness	Marine Fauna	Behavioural effects on marine fauna (birds, turtles and fish)

6.4.4.1 Project Characteristics

Lighting is required in outdoor areas of the vessel and chase boats to provide a safe working environment for personnel and shipping navigation during hours of darkness. Lighting typically consists of bright white lights. Working lights will be directed into the worksite where required, and impacts from working lights are minimal outside of the area of the vessel.

The amount of lighting emissions emanating from the project vessels will vary according to the size of the vessel and the amount of deck area, as well as with light sources, wavelength and intensity of light sources, location of and/or placement of lighting.

6.4.4.2 Impact Assessment

Artificial lighting has potential to disturb marine fauna that rely on natural light for visual cues. This may include attraction, disorientation or repulsion of seabirds, sea turtles and fish.

The potential presence of sea turtles within Block MD-5 is expected to be limited to a few individuals transiting through. The nearest important habitat for sea turtles is located within the Lampi Island Marine National Park, over 200 km from Block MD-5. Therefore, any potential impacts to sea turtles from artificial lighting are expected to be minor and limited to a small number of individuals, and are therefore expected to be local in extent, short-term in duration, reversible, and of minor magnitude.

Seabirds such as terns, petrels, gulls, skuas, boobies, noddies, frigate birds are commonly observed in marine waters, and are expected to potentially be present in the offshore deepwater block area for feeding either on migration or normal foraging, albeit in low numbers. Given the low numbers of seabirds expected to be present, flexibility of feeding behaviour and the distance from Block MD-5 to any important habitat for seabirds (approximately 125 km to the Myeik Archipelago), any potential impacts to seabirds from artificial lighting are expected to be minor and limited to a small number of individuals, and are therefore considered local in extent, short-term in duration, reversible, and of minor magnitude.

The potential impacts from artificial lighting to other marine fauna, including fish, are expected to be minor, temporary and highly localised in extent, and are therefore considered to be reversible and of minor magnitude.

6.4.4.3 Management Measures

Lighting is a health and safety requirement, and essential for safe navigation at night. Deck lighting will be directed inwards where possible.

6.4.4.4 Residual Impact

The impacts from artificial light to marine fauna as a result of survey activities are expected to be highly localised in extent, short-term in duration, reversible and of minor magnitude. Taking into account the proposed mitigation measures, the residual environmental impact significance is determined to be negligible.

6.4.5 Atmospheric Emissions

Project Activity / Potential Hazard Source	Environmental/Socio Economic Factors	Potential Impact
Operation of combustion engines on vessels	Air Quality GHG emissions	Deterioration of local or regional air quality as a result of emissions

6.4.5.1 Project Characteristics

Air emissions will arise from the operation of the survey vessels, mainly resulting from engine combustion of hydrocarbon fuels. Air pollutants emitted include carbon monoxide (CO), carbon dioxide (CO_2), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), etc. CO_2 associated with the combustion process is a greenhouse gas, considered to contribute to climate change. The survey vessels will be fuelled by fuel oil, either LFO or HFO. Support and chase vessels will most likely be fuelled by marine diesel. Emission calculations have been carried out to estimate the amount of air emissions potentially associated with the survey programme. For this purpose it has been assumed that the main survey vessel has a maximum fuel consumption of 40 tonnes/day. The CSEM vessel is assumed to have a maximum fuel consumption of 20 tonnes/day. The support and chase vessels are estimated to have maximum fuel consumption rate of 10 tonnes/day. The calculations have been based on the following assumptions:

- Seismic survey duration, including mobilisation and demobilisation, of 60 days
- Seismic survey spread consisting of 1 main survey vessel, 1 support vessel and 3 chase boats (max)
- CSEM survey duration, including mobilisation and demobilisation, of 60 days
- CSEM survey spread consisting of 1 main survey vessel and 1 support vessel (max).

6.4.5.2 Impact Assessment

Using standard industry emission factors provided in **Table 6-7**, the air emissions generated by project vessels have been calculated (presented in **Table 6-8**).

Table 6-7: Emissions Factors for Vessel Transportation Fuel Consumption

Transportation type	Emission (te/te fuel)						
	CO_2	CH_4	N_2O	VOC	SO_2	CO	NO_X
Sea Vessel	3.2	0.00027	0.00022	0.0024	0.0000128	0.008	0.059

Source: UK Guidelines for the Compilation of an Atmospheric Emissions Inventory: Environmental Emissions Monitoring System of UK Offshore Operators ," Report A-D-UM-0020, Rev. No. 3, December 1999

Note: te – tonne equivalent

Table 6-8: Estimated Air Emissions for Block MD-5 Seismic and CSEM Survey

Source	Emissions (tonnes)							
	CO_2	CH_4	N_2O	VOC	SO_X	CO	NO_X	Total CO_2 equivalent
Combustion sources								
Transportation 3D Seismic	13,440	1.134	0.924	10.08	0.05376	33.6	247.8	13,734
Transportation CSEM	5,760	0.486	0.396	4.32	0.02304	14.4	106.2	5,886
Total	19,200	1.62	1.32	14.4	0.0768	48	354	19,619

The total CO_2 equivalent GHG emissions expected to be released during the survey programme are estimated to be 19,619 tonnes, as shown in **Table 6-8**. When compared with available data on Myanmar's national CO_2 equivalent GHG emissions of 184,710,000 tonnes in 2012, including land use change (World Resources Institute, Climate Analysis Indicators Tool (CAIT)), the GHG emissions arising from the proposed activities are insignificant (approximately 0.01%).

Atmospheric emissions from fuel combustion have the potential to result in localised air quality reduction. Potential impacts include a localised reduction in air quality, generation of dark smoke and contribution to greenhouse gas emissions. However, these air pollutants are emitted to the atmosphere in a short space of time and in very small quantities, and survey vessels will move continuously in the open sea, approximately 300 km offshore. As a result, these pollutants will be rapidly dispersed and diluted in the atmosphere. Consequently, the impacts associated with atmospheric emissions are expected to be local in extent, short-term in duration, reversible, and of minor magnitude.

6.4.5.3 Management Measures

Impacts from atmospheric emissions can be mitigated through the use of the following measures:

- Adherence to MARPOL 73/78 Annex VI (Regulations for the Prevention of Air Pollution from Ships) requirements as appropriate to vessel class, including:
  - optimisation of fuel use to increase efficiency and minimise emissions;
  - emissions managed by the implementation of a planned maintenance system (PMS).
- Routine inspection and preventive maintenance as per maintenance schedule or recommendation by manufactures to ensure efficiency of all machineries.
- Strictly follow the instruction manual of equipment and machines, and keep them properly maintained.
- Minimise survey delays and vessel operating time to the extent practicable.

6.4.5.4 Residual Impact

The atmospheric emissions arising from the proposed activities are insignificant in the context of the national GHG emissions. Any potential impacts are expected to be local in extent, short-term in duration, reversible and of minor magnitude. Given these impact criteria considerations the environmental impact significance of emissions to air quality is determined to be negligible.

6.4.6 Routine Aqueous Discharges

Activity	Receptor	Potential Impact
Discharge of sewage waste	Water quality Marine habitat and fauna	Localised reduction in water quality due to nutrient enrichment
Discharge of treated drainage water originating from deck drainage systems, bilges and machinery drainage	Water quality Marine habitat and fauna	Toxic effects on marine fauna and flora Localised reduction in water quality

6.4.6.1 Project Characteristics

Aqueous discharges will occur during the seismic programme in varying quantities. Liquid wastes discussed in this section include:

- Sewage
- Bilge / Oily Water

Wastewater from vessels are categorised as grey water and black water, grey water being waste water emanating from wash basins, showers and food preparation, and black water emanating from toilets (sewage). The anticipated flow rate per day calculated using the US Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) estimates is 75 litre/person/day for black water and 110 litre/person/day for grey water, and totals approximately 490 m^3 of black water and 720 m^3 of grey water for a total of 60 days of operation with a maximum crew number of 108. The total wastewater quantity for the CSEM Survey has been estimated to be approximately 230 m^3 of black water and 330 m^3 of grey water for 60 days, with a maximum crew number of 50.

The project vessels will routinely discharge bilge water and oily water from the deck drainage system. Bilge water can contain water, oil and low volumes of detergents, solvents, chemicals and solids. Oily water discharge via the deck drainage system may arise from the cleaning or wash-down of equipment.

6.4.6.2 Impact Assessment

Sewage - Discharge black water may lead to nutrient enrichment of the surface waters around the discharge point. However, given the small volumes involved, any impacts to water quality are expected to be temporary and highly localised. Potential impacts to marine fauna are considered negligible. Vessels will be equipped with treated sewage systems. Black water from project vessels will be discharged directly to sea at a distance of over 12 nautical miles from the nearest shore to comply with MARPOL 73/78 (Annex IV) requirements. Therefore, the potential environmental impacts from sewage discharges are considered local in extent, short-term in duration, reversible, and of minor magnitude.

Grey Water – Grey water will be discharged directly to sea at a distance of over 12 nautical miles from the nearest shore to comply with MARPOL 73/78 (Annex IV) requirements. Potential impacts form grey water discharges are likely to be similar to sewage discharges and are therefore considered local in extent, short-term in duration, reversible, and of minor magnitude.

Bilge / Oily Water - Discharge of treated oily water originating from bilges and deck drainage will have similar localised and temporary impacts to water quality. Trace aromatics if present, are toxic to marine plankton in particular, but the degree of exposure in the deepwater mixing environment will mitigate against measurable effects across the study areas. Treated drainage water shall comply with MARPOL 73/78 Annex I requirements, which regulate pollution prevention of vessel and ship drainage (oil content < 15 ppm prior to discharge). Therefore, the potential environmental impacts from bilge and oily discharges are considered local in extent, short-term in duration, reversible, and of minor magnitude.

6.4.6.3 Management Measures

Impacts from liquid waste can be mitigated through the use of the following measures:

Discharge of sewage waste

- Sewage will be treated prior to disposal offshore in accordance with MARPOL regulations (Annex IV).
- Survey and support vessels will have certified/approved sewage treatment plants.

Bilge / Oily Water

- Bilge and drainage water will be collected and treated at the oil/water separator, installed on each vessel, prior to discharge in accordance with MARPOL 73/78 Annex I.
- Bilge and drainage water with oil-in-water content exceeding 15 ppm will be contained and disposed of onshore.
- Bilge and drainage water discharges recorded in the Oil Record Book.

6.4.6.4 Residual Impact

The impacts from liquid wastes to water quality and marine fauna are expected to be local in extent, short-term in duration, reversible and of low magnitude. Given these impact criteria considerations, the environmental impact significance of aqueous discharges associated with the project is determined to be negligible.

6.4.7 Solid Waste Management

Activity	Receptor	Potential Impact
Non-Hazardous solid waste generation onboard vessels	Marine water quality	Deterioration of water quality and marine habitat

6.4.7.1 Project Characteristics

Offshore seismic surveys generally do not produce significant quantities of waste other than conventional ship waste. All waste arising in the course of the two surveys will be classified by type prior to treatment, transport, disposal or recycling. A Waste Management Plan will form part of the Seismic Operator's (Contractor) environmental management and compliance plan. Where practical, waste materials will be recycled.

The survey operations will generate domestic, non-hazardous solid waste, including food waste, cardboard, paper, tin cans and plastic bags.

A general rate of domestic waste production on a ship is approximately 1 kg per person per day. Therefore there will be 108 kg per day generated during the seismic survey and 50 kg per day during the CSEM survey. The total non-hazardous solid waste generated during the seismic survey and CSEM survey is estimated at approximately 9.7 tonnes and 3.0 tonnes, respectively.

Waste will be segregated and disposed as follows:

- Food waste will be segregated and stored in containers in compliance with SOLAS.
- Food waste which can be macerated to <25 mm sized particles, can be discharged in offshore water (greater than 12 nautical miles from the nearest shore) in compliance with MARPOL 73/78 Annex 5 requirements.
- Non-food waste including: Industrial waste and office waste will be stored in containers, labelled, and disposed of on land by an appropriate licensed waste contractor. Biodegradable detergents and products qualified as non-hazardous will be used, where at all possible.
- Solid wastes suitable for disposal using an incinerator may be disposed of in this manner, if incinerators are available on board project vessels.

The potential impacts from an unplanned release of hazardous waste are described in **Section 6.5.3**.

6.4.7.2 Impact Assessment

Discharge of food waste may lead to nutrient enrichment of the surface waters around the discharge point. However, given the small volumes involved, any impacts to water quality are expected to be temporary and highly localised. Potential impacts to marine fauna are considered negligible.

Accidental discharge of solid wastes (e.g. cardboard, paper, tin cans and plastic bags) may cause impacts to marine fauna, such as fish, sea turtles or cetaceans becoming entangled in plastics. However, volumes of solid waste generated by the survey are low, and solid waste will either be disposed of through the vessel incinerator where possible, or segregated and stored for onshore disposal. Additionally, only low numbers of individual sea turtles and cetaceans would be expected to be transiting through the survey area, limiting the potential for any impacts.

Therefore, the potential environmental impacts from solid waste management are considered local in extent, short-term in duration, reversible, and of minor magnitude**.**

6.4.7.3 Management Measures

Management of solid waste will be undertaken by in accordance with Shell standards. For each solid waste type generated the most appropriate method of management will be determined and documented in a Waste Management Plan.

Impacts from general non-hazardous waste contamination can be mitigated through the use of the following measures:

- A Waste Management Plan for the operations will be developed and implemented by the survey contractor(s).
- Waste will be segregated into recyclable and non-recyclable wastes where practicable, and stored in clearly marked containers for transport and disposal.
- All garbage will be disposed of in accordance with MARPOL 73/78 Annex V.
- Incinerators used aboard the survey and support vessels will be compliant with MARPOL / IMO requirements.
- Food wastes will be macerated to a maximum particle size 25mm prior to being discharged to sea.
- Hazardous waste inventory will form part of the waste management plan.
- Any hazardous waste materials will be handled and stored in accordance with the corresponding Material Safety Data Sheet (MSDS).
- All project vessels will have a garbage management plan, in accordance with IMO Guidelines.
- If required by vessel class, project vessels will also carry a garbage record book in accordance with MARPOL 73/78 Annex V.

6.4.7.4 Residual Impact

The impacts from solid waste management to water quality and marine fauna are expected to be local in extent, short-term in duration, reversible and of low magnitude. Given these impact criteria considerations, the environmental impact significance of solid waste management associated with the project is determined to be negligible.

6.5 Unplanned or Accidental Events

6.5.1 Vessel Interactions with Marine Fauna

Project Activity / Potential Hazard Source	Environmental/Socio Economic Factors	Potential Impact
Vessel Collisions	Marine Fauna	Physical effects on marine fauna particularly marine mammals (cetaceans)
Fauna entanglement in towed equipment	Marine Fauna	Physical effects on marine fauna particularly sea turtles

6.5.1.1 Project Characteristics

The seismic survey is expected to involve up to two survey vessels, a support vessel and up to three chase vessels, and is expected to take approximately 60 days to complete. The survey vessel(s) will tow approximately 10 – 12 seismic streamers. The CSEM survey is expected to involve a survey vessel only, and will take approximately 60 days to complete.

The project vessels operating in Block MD-5 may present a potential hazard to marine mammals (cetaceans) and other large marine fauna. Impacts from vessel interactions with marine fauna can be minimal, such as behavioural change, or severe, such as mortality resulting from vessel collisions.

There is also the potential for marine fauna, particularly sea turtles, to become entangled in the tail buoys that are attached to the end of each seismic streamer.

6.5.1.2 Impact Assessment

Vessel strikes have been known to cause the mortality of marine fauna; notably, turtles (Hazel and Gyuris 2006; Hazel et al. 2007) and cetaceans (Laist et al. 2001; Jensen and Silber 2003). For both whales and turtles, the risk of lethal collision is a function of the abundance of animals in the area of operations, speed of vessel, probability of a collision actually occurring and the probability of that collision being fatal.

Cetaceans

The likelihood of a vessel striking a cetacean is positively correlated with vessel speed. Similarly, the risk of a collision causing death increases as the vessel speed increases (Laist et al. 2001, Jensen and Silber 2003).

Project vessels operating within Block MD-5 are likely to be travelling at about 7 - 9 km/hr (4 - 5 knots), therefore, the chance of a vessel collision resulting in a lethal outcome within the survey area are low. This is supported by information presented in Jensen and Silber (2003), who identified only two known instances of vessel collision with cetaceans when the vessel was travelling at less than 6 knots. According to the data of Vanderlaan and Taggart (2007), it is estimated that the risk of mortality to cetaceans following a collision at a speed of 4 knots is less than 10 per cent.

It is assumed that cetaceans may pass through Block MD-5 as they migrate to other areas for resting and/or breeding. However, their presence is expected to be limited to a few individuals transiting through. Therefore, the impacts to cetaceans from vessel interactions associated with the project are expected to be slight in extent, short-term in duration, reversible, and of minor magnitude.

Sea Turtles

Studies have shown that turtles are less likely to flee from a fast moving vessel; hence, they are at greater risk of collision from a fast moving vessel than from a slow moving vessel (Hazel et al. 2007). There is no available data regarding the likelihood of fatality from vessels striking turtles, however, it is reasonable to assume that with higher speeds there is a greater risk of mortality.

Sea turtles may also become entangled with tail buoys on the end of seismic streamers. The seismic survey will utilise up to 12 streamers, however these will be fitted with turtle exclusion devices to minimise the potential for sea turtle entanglement.

Given that the potential presence of sea turtles within Block MD-5 is expected to be limited to a few individuals transiting through, and that there is no important habitat for sea turtles within, or in proximity to Block MD-5, the impacts on sea turtles from vessel interactions associated with the project are expected to be local in extent, short-term in duration, reversible, and of minor magnitude.

6.5.1.3 Management Measures

Impacts from vessel interactions with marine fauna can be mitigated through the use of the following mitigation measures:

- The Code of Conduct outlined in **Section 6.4.1.3**, in particular the management measures relating to the use an MMO onboard source vessels, including any vessel or towed equipment interactions with marine fauna will be recorded and reported in the MMO report.
- Survey vessels will generally be travelling at low speed, between approximately 7 – 9 km/hr (4 – 5 knots).
- Tail buoys on seismic streamers will be fitted with turtle exclusion devices if their design requires it.

6.5.1.4 Residual Impact

The impacts from vessel interactions with marine fauna as a result of survey activities are expected to be local in extent, short-term in duration, reversible and of low magnitude. Taking into account the proposed mitigation measures, the residual environmental impact significance of vessel interactions with marine fauna is determined to be minor.

6.5.2 Accidental Discharges (Hydrocarbon Spills)

Project Activity / Potential Hazard Source	Environmental/Socio Economic Factors	Potential Impact
Fuel spill due to vessel collision Fuel spill due to refueling incident or other equipment or system failure	Marine Flora and Fauna Marine Habitat Local socio-economic uses	Toxic effects on marine fauna and flora Localised reduction in water quality Indirect effects on offshore fisheries

6.5.2.1 Project Characteristics

Project vessels will use and store a number of different hydrocarbons including fuel, hydraulic oil and lubricating oil. Potential hydrocarbon spills may include small spills on the deck of project vessels, spills during refuelling activities and a spill from a ruptured fuel tank as a result of a vessel collision.

Small deck spills of hydraulic oil or lubricating oils

Spills on deck can occur from accidental spills from stored hydrocarbons/harmful chemicals or equipment present on the deck. Project vessels require storage of small quantities of lubricating oils, hydraulic fluid, streamer fluid or other harmful chemicals on the vessel. Hydraulic fluid is also contained in hoses and lines and on hydraulic equipment, such as cranes or winches. Storage areas are typically set up with primary and secondary containment. Releases from equipment, if they do occur, are predominantly from the failure of hydraulic hoses.

Small spills of fuel during refuelling

During the survey, project vessels will require refuelling, and this may occur within Block MD-5.

A refuelling spill may result from a partial or total failure of a bulk transfer hose or fittings during refuelling, due to operational stress or other integrity issues, could spill fuel oil to the deck and/or into the marine environment, in the order of less than 50 L, based on the likely volume of a bulk transfer hose (assuming complete loss of hose volume prior to shutdown). Larger spills may eventuate, if upon the partial or total failure of the bulk transfer hose, there was also a failure in procedure to shutoff fuel pumps. Industry experience indicates such spills are typically in the order of 8 m^3 to 10 m^3.

Loss of fuel from a ruptured fuel tank resulting from a vessel collision

A vessel collision between project vessels and/or a third party vessel could result due to the following hazards:

- Failure of navigation systems
- Loss of communications between vessels
- Adverse weather
- Errant third party vessel including commercial shipping or fishing vessels

Survey vessels can have a fuel storage capacity in excess of 1,000 m^3 that is distributed through a number of isolated tanks. Fuel storage is typically distributed through multiple isolated tanks located mid-ship and individual tanks can range in size up to approximately 250 m^3. The survey vessels (both seismic and CSEM survey) are expected run on either light fuel oil (LFO) or heavy fuel oil (HFO).

There will be at least one support vessel and up to three chase vessels utilised throughout the seismic survey. Support vessels and chase vessels are typically smaller in size than the survey vessel(s), however it is assumed their largest tank volume is approximately 250 m^3. Support vessels and chase vessels are likely to utilise marine diesel oil (MDO).

The volume of fuel lost to the marine environment is likely to be less than the volume of the largest tank due to the following factors:

- If ruptured below the water line, the ruptured tank would leak only as far down to the level equivalent to the water line.
- The contents of the ruptured tank can be transferred to other fuel tanks on the vessel.

Given the offshore location of the survey (approximately 125 km from the nearest landfall with the Myeik Archipelago), vessel grounding is not considered a realistic hazard.

6.5.2.2 Impact Assessment

There is limited potential for significant environmental impacts as a result of small deck spills and refuelling spills, given the offshore location distant from important areas for marine fauna, deep offshore waters (over 2,100 m deep) and the small spill volumes. Additionally, small spills of hydraulic oil, lubricating oil and marine diesel oil would be expected to rapidly evaporate, disperse and degrade in the open ocean.

A larger release of fuel associated with a vessel collision and subsequent fuel tank rupture would be likely to result in a localised and temporary toxic impact to biota that reside in, or transit, the surface layer of the water column. A spill of this size has the potential to impact air breathing species in the vicinity of the release point, including cetaceans and turtles, which risk inhaling or contacting the fuel oil if they surface in a spill. However, the extent and duration of potential exposure would be limited as the species are likely to move from the area. Seabirds would also be at risk, should they contact the surface hydrocarbon, as oiling of feathers can lead to the loss of buoyancy and the potential for hypothermia. Given the water depths of the survey area (2,100 m to 2,600 m) and the buoyant nature of fuel oil when spilt onto the sea surface, impacts to marine sediments and benthos are not expected.

The potential impacts from a surface spill of fuel oil to fish and fisheries are expected to be localised. Impacts may include exclusion of fishers from areas where they would normally fish due to the presence of fuel oil slicks. Direct impacts to fish are unlikely, as a surface spill of fuel oil is not expected to readily entrain or dissolve into the water column. Given the distance offshore (approximately 300 km), impacts to other socio-economic sensitivities are not expected.

During the survey, the seismic vessel will be accompanied by support vessels (one support vessel and up to three chase vessels) who will maintain a Safety Zone in which the survey vessels can operate safely without risk of collision. These mitigation measures will provide advance notice to vessels to avoid the area and to temporarily detour around the seismic area, subsequently reducing the probability of accidental collisions and associated oil and diesel spills.

The survey vessel will be equipped with a Shipboard Oil Pollution Emergency Plan (SOPEP) that outlines actions necessary to stop or minimize oil discharge and mitigate its effects to the environment.

The survey area is located in deep offshore waters, distant from any important habitat for marine fauna, including cetacean breeding and aggregation areas, sea turtle nesting and internesting areas, and seabird rookeries. Fishing effort is also expected to be low in the vicinity of the survey area relative to the more intense fishing activity nearshore. Additionally, any hydrocarbon spills associated with the survey are likely to be small in volume, with the potential for impacts restricted to the localised area of the release location. Therefore, the impacts to marine fauna and socio-economic sensitivities as a result of hydrocarbon spills associated with the project are expected to be local in extent, short-term in duration, reversible, and of minor magnitude.

6.5.2.3 Management Measures

Impacts from hydrocarbon spills resulting from deck spills, refuelling incidents or vessel collision can be mitigated through the use of the following measures:

- Adherence to the requirements of the International Regulations for Preventing Collisions at Sea 1972 (COLREGS) Part B – Steering and Sailing (Rules 4-19) and Part C – Lights and Shapes (Rules 27) as appropriate to vessel class, including:
    - Crew trained in accordance with COLREGS steering and sailing rules to prevent vessel collisions, including maintaining a proper look-out to prevent the risk of collision and maintaining a safe speed at all times to allow for avoidance of collisions;
    - Display appropriate lights and warning signals on all vessels to prevent accidental collision.
- At least 30 days prior to vessel mobilization, coordinate with MOGE, who will issue “Notice to Mariner” regarding project activities to appropriate parties (i.e. Department of Fisheries, Ministry of Livestock and Fisheries, and Marine Police Force).
- Establish a safety zone around the seismic and CSEM vessels.
- Use of chase vessels to warn other vessels/shipping of the navigation hazard posed by the survey vessels and towed equipment.
- Any vessel collision incidents will be reported to the appropriate authorities in Myanmar (e.g. MONREC, the DMA and the Myanmar Navy).
- Detailed records will be maintained of all vessel collision incidents.
- Develop and implement Shipboard Oil Pollution Emergency Plan (SOPEP), kept onboard vessels, and conforming to MARPOL.
- Weather reports received daily on the survey vessels.
- Adverse weather contingency plan.
- Refuelling at sea undertaken in daytime only and will follow standard operating procedures.
- All hydrocarbons stored on deck will be stored in secured storage area.
- Crew will have received training in, and be competent in, their emergency response roles, as appropriate.
- Provide spill clean-up kits and training for designated rapid response team to clean up any spills.
- Appropriate medical care will be provided, clean-up will be carried out, and incident or accident reports will be filed.
- All oil spills (>80L) will be documented and reported to MONREC.
- Hydrocarbon spill containment and recovery equipment will be available near hydrocarbon storage.
- Procedures for response to hydrocarbon spills will be detailed in Shell’s ERP.

6.5.2.4 Residual Impact

The impacts from a hydrocarbon spill as a result of deck spills, refuelling incidents or a vessel collision to marine fauna and socio-economic sensitivities as a result of survey activities are expected to be local in extent, short-term in duration, reversible and of minor magnitude. Taking into account the proposed mitigation measures, the residual environmental impact significance of hydrocarbon spill is determined to be moderate.

6.5.3 Accidental Releases (Chemical or Hazardous Waste Spill)

Project Activity / Potential Hazard Source	Environmental/Socio Economic Factors	Potential Impact
Incorrect handling of chemical or hazardous waste	Marine Flora and Fauna Marine Habitats Local socio-economic uses	Toxic effects on marine fauna and flora Localised reduction in water quality Indirect effects on offshore fisheries

6.5.3.1 Project Characteristics

The project vessels store and use a variety of hazardous materials, including:

- Chemical containers
- Medical Waste
- Oily Waste (spent lube oils, etc.)
- Chemical Waste (batteries, obsolete chemicals).

All hazardous waste will be stored in appropriate labelled containers in a designated area on the vessels. After the end of the project, any hazardous waste will be transported to shore and disposed of by a licensed hazardous waste contractor. Documentation confirming appropriate safe disposal of hazardous waste (e.g. receipts from licensed waste management subcontractors) will be retained.

6.5.3.2 Impact Assessment

These materials have the potential to adversely impact the marine environment if accidentally released in significant quantities. Chemicals e.g. solvents and detergents will typically be stored in small containers of 10-30 litre capacity and stored / used in internal areas where any leak or spill would be retained on board and cleaned up in accordance with the Shipboard Oil Pollution Emergency Plan (SOPEP) and associated spill clean-up procedures. Some spills may occur when small containers of chemicals are being used in open areas, where there is a risk of some entering the sea if spilled. The realistic worst-case volume would be 30 litres.

Chemicals and hazardous waste materials present potential risk of spills to the environment and spillage could affect air quality, seawater quality, and marine fauna. Offshore/open water marine fauna such as marine mammals, sea turtles and seabirds may be affected if they come into direct contact with a chemical or hazardous waste spill, however the affected area would be highly localised. Impacts to marine sediments and benthos are not expected, given the depth of the survey area (2,100 m to 2,600 m).

Given the small volumes and highly localised area of the potential chemical or hazardous waste release, the impacts to marine fauna are expected to be local in extent, short-term in duration, reversible, and of minor magnitude.

6.5.3.3 Management Measures

The impact of a chemical or hazardous waste/materials spill will be reduced by using the following mitigation measures:

- All chemicals/hazardous materials handled and disposed of in accordance with MARPOL 73/78 Annex III.
- Environmental induction for all personnel on survey vessels.
- Proper training in the use and handling of the relevant chemicals and standard safety procedures implemented by all contractors.
- Appropriate medical care will be provided, clean-up will be carried out, and incident or accident reports will be filed.
- Provide spill clean-up kits and training for designated rapid response team to clean up any spills.
- Store all chemicals in secured storage area.
- All chemical and hazardous wastes will be segregated into clearly marked containers prior to onshore disposal.

- All storage facilities and handling equipment will be in good working order and designed in such a way as to prevent and contain any spillage as far as practicable.
- The survey and support vessels have implemented and tested SOPEP, and copies are kept aboard vessels.
- All hazardous substances will have MSDS in place that is readily available on board.
- Spill response bins/kits will be located in close proximity to chemical/Hazardous materials storage areas for prompt response in the event of a spill or leak. The kits will be checked for their adequacy and replenished as necessary prior to the commencement of activities and on a regular basis thereafter. Identified personnel will be trained in use of this equipment.
- Detailed records will be maintained of all accidental releases/discharges of chemicals/hazardous materials.

6.5.3.4 Residual Impact

The impacts from an unplanned release of chemicals or hazardous waste to marine fauna and socio-economic sensitivities as a result of survey activities are expected to be highly localised in extent, short-term in duration, reversible and of low magnitude. Taking into account the proposed mitigation measures, the residual environmental impact significance is determined to be minor.

6.5.4 Accidental Introduction of Invasive Marine Species (IMS)

Project Activity / Potential Hazard Source	Environmental/Socio Economic Factors	Potential Impact
Introduction of IMS associated with ballast water discharges or transferred via vessel hull or in-water equipment	Water quality Marine habitat and fauna	Establishment of non-native IMS with potential to affect native marine species

6.5.4.1 Project Characteristics

The use (intake, storage and discharge) of seawater ballast is a standard operation in the management of vessel stability for many vessels. It is possible that IMS can be taken in with the intake of seawater into ballast tanks, survive within ballast tanks and then discharged with the ballast water within Block MD-5. This can lead to the introduction of IMS if the environmental conditions at the point of release are suitable.

Biofouling on vessels hulls, on other external/internal niche areas, and on equipment routinely immersed in water all pose a potential risk of translocating marine species. If these species become dislodged or reproduce whilst attached, this can lead to the introduction of IMS.

6.5.4.2 Impact Assessment

IMS are marine plants or animals that have been introduced into a region beyond their natural range and have the ability to survive, reproduce and establish founder populations. IMS tend to establish on new substrate from fragments and are capable of asexual and sexual reproduction that aids rapid colonisation, resulting in potential to alter habitat, displace native species, and in some case predate on native species. If IMS establishment was to occur, any impacts are likely to be permanent, given the difficulties associated with eradication.

However, the deep offshore waters associated with Block MD-5 are not considered conducive to the establishment of IMS, due to the depth (2,100 m to 2,600 m), distance from shore (approximately 125 km to the nearest landfall and 300 km to the mainland coast) and lack of substrate available for IMS to attach to. Therefore the establishment of IMS is highly unlikely, and poses no threat to marine fauna, flora and habitats as a result of the survey activities.

6.5.4.3 Management Measures

The potential impact from establishment of IMS will be reduced by using the following mitigation measures:

- Compliance with the International Convention for the Control and Management of Ships' Ballast Water and Sediments (as appropriate to vessel class) (IMO 2004); as applied to all vessels being mobilised from international waters, which includes:
  - All ballast water exchanges conducted more than 50 nm from land and in greater than 200 m water depth.
  - Ballast water exchange records maintained.
  - An IMS risk assessment will be taking place, and on the basis of its outcome, management measures will be implemented commensurate with the level of risk.
- To manage the potential risk of biofouling, the following measure will be implemented:
  - Vessels (of appropriate class (>400t)) to have a current International Anti Fouling System (IAFS) Certificate, as per the International Convention on the Control of Harmful Anti fouling Systems on Ships (IMO 2001).

6.5.4.4 Residual Impact

No impacts from accidental IMS establishment as a result of survey activities are expected considering the very low probability of IMS having suitable substrate in the deep offshore waters, and the residual environmental impact significance is determined to be minor.

6.6 Social Impact Assessment

The purpose of this assessment is to evaluate the potential social impacts from the project on local and national stakeholders including communities and businesses.

Given the deepwater offshore nature of the exploration activities, the social impact assessment is focused on assessment of potential impacts from the project on the following socio-economic values:

- Fisheries
- Shipping, and
- Employment and income.

The location of the seismic activities is several hundred kilometres offshore. There is no operation of vessels within marine conservation areas, ecological reserves or National Heritage Areas. As a result there will be no effect on potential quality of life values associated with historical, archaeological or cultural resources.

6.6.1 Impact on Fisheries

Project Activity / Potential Hazard Source	Environmental/Socio Economic Factors	Potential Impact
Presence and manoeuvring of survey boat and towed equipment	Fisheries	Fouling of fishing gear as equipment is towed in the water.
Presence and manoeuvring of seismic survey boat and towed equipment)	Fisheries	Displacement of fishing boats, disruption of fishing and/or damage to fishing boats and equipment.

6.6.1.1 Project Characteristics

The proposed programme of exploration activities will take place at sea, in deep waters and several hundred kilometres from shore. The main survey vessel will be mobilising out of an international port or Yangon. There will be between 1-2 trips per month for refuel / resupply runs by support vessels between Block MD-5 and the shore base either in Ranong or Yangon.

The seismic survey programme is estimated to take approximately 60 days, and the subsequent CSEM acquisition approximately 60 days.

The survey programme involves vessels with limited manoeuvrability towing extensive strings of equipment. The seismic survey spread will be supported by a supply vessel and several chase vessels, whereas the CSEM survey may or may not be operating without any additional vessel support.

In respect of the seismic survey, chase vessels will be able to remove any static debris in the path of the survey, which may include fishing equipment if present.

6.6.1.2 Impact Assessment

Myanmar's territorial fishing zone is within 12 nautical miles offshore, whereas the exclusive economic zone (EEZ) extends 200 nautical miles offshore. The total marine fisheries area in Myanmar including the exclusive economic zone (EEZ) is about 486,000 square kilometres.

The Department of Fisheries (DoF) controls fishing activities and issues licenses within two fishing zones (inshore and offshore). Block MD-5 straddles four offshore fishing licence blocks (E13, E14, E20, E21). Tuna and large pelagic fishing occurs in the deep offshore waters in the broad vicinity of the block area.

The fishery sector is the fourth largest contributor to Myanmar's GDP, 9.1% in 2005-2006 and 7.6% in 2006-2007 and plays an important role in contributing to the country's social and economic status. The Tanintharyi coastal area is productive in shoaling pelagic fish (e.g. mackerels, sardines, tuna and demersal fishes e.g. snappers, nemipterus, hair tails, sharks, rays and shrimps).

Impacts to fisheries during the surveys may result from temporary access restrictions for fishing activities within the area of operations. This may result in fishing boats having to suspend fishing activities temporarily, and to remove fishing equipment from the project area to avoid entanglement and damage. Taking into account the low level of fishing intensity in the deepwater offshore zones (**Chapter 5**), and distance from the source vessels, potential noise impacts on commercial fisheries activities are not expected. As summarised in **Section 6.4.1**, behavioural effects of noise on pelagic and open water fish such as tuna and mackerel are minor and temporary in nature (IEC 2003; Boeger et al. 2006). Popper et al (2014) suggest sound exposure levels (SEL) at which behavioural disturbance may occur to fish expected to be within close proximity to the seismic source.

The area of the survey is located far from shore, and fishing would be limited to large vessels. According to MFF information, currently foreign vessels are being allowed to fish for tuna as local Myanmar vessels cannot conduct tuna fishing. There are large long lining foreign tuna vessels fishing around Coco Island and Myeik Archipelago in the Andaman Sea. Therefore it is possible that international fishing vessels will be operating in these deep waters and thereby present in the area during the time of the survey.

The survey vessels have limited manoeuvrability when towing survey equipment, and any disruption of survey lines would be detrimental to the overall success of the survey. There are also safety hazards in fishing gear and fishing boats becoming entangled in the towed gear. Therefore chase vessels will be engaged to liaise with fishermen and fishing vessels to make sure that appropriate engagement and notification is provided to maintain safety.

6.6.1.3 Management Measures

A Request for Notice to Mariners will lodged with MOGE and a Notice issued to fisheries associations and other relevant parties prior to the survey to inform them of the location and timing of the planned survey.

A mobile exclusion zone will be applied by the survey contractor to prevent interaction with other vessels (e.g. cargo vessels, fishing vessels). The vessel captain will monitor the exclusion zone via radio and remote tracking systems. Chase boats will be deployed behind and ahead of the survey vessel to liaise with other vessels and fishermen working in the area, scout the survey lines and identify and log the location of any obstacles (including debris) and will clear the area of debris in the water that could come into contact with and damage the streamer cables.

In summary, the following mitigation measures will be applied:

- At least 30 days prior to vessel mobilization, a "Notice to Mariner" will be issued to appropriate parties (i.e. Department of Fisheries, Ministry of Livestock and Fisheries, and Myanmar Navy).
- Consultation with relevant fishing groups through the Myanmar Fisheries Federation and the Department of Fisheries.
- Chase vessels will be used during the seismic survey to monitor and communicate with fishing vessels in the area.
- Adherence to COLREGS Part B – Steering and Sailing (Rules 4-19) and Part C – Lights and Shapes (Rules 27) as appropriate to vessel class, including:
    - Crew trained in accordance with COLREGS steering and sailing rules to prevent vessel collisions, including maintaining a proper look-out to prevent the risk of collision and maintaining a safe speed at all times to allow for avoidance of collisions;
    - Display appropriate lights and warning signals on all vessels to prevent accidental collision.

6.6.1.4 Residual Impact

The impacts of the project on fisheries are expected to be local in extent, short-term in duration, reversible and of low magnitude.

Taking into account the proposed controls, the environmental impact significance of the proposed operations to disturb offshore fisheries is determined to be minor.

6.6.2 Impact on Shipping

Project Activity / Potential Hazard Source	Environmental/Socio Economic Factors	Potential Impact
Presence and manoeuvring of survey vessels and tow lines	Shipping	Increased traffic volume in the local area of the planned survey Interaction with shipping leading to disruption of shipping activities, e.g. diversion and some potential delays to third party journeys

6.6.2.1 Project Characteristics

For the duration of the survey programme activities, there will be project vessels at sea in or around the Block MD-5 area. This may represent a marginal increase in vessel traffic. The survey activities are location specific (targeting the acquisition area in the block), and the main survey vessels move slowly and have restricted and limited manoeuvrability. Support vessels will be occasionally transiting between Block MD-5 and the shore base either in Ranong or Yangon, as required for resupply / refuelling or crew change.

6.6.2.2 Impact Assessment

Most shipping routes in the Andaman Sea are travelled by small and medium commercial ships. Shipping routes are generally near the coastline, therefore only light traffic would be anticipated around the project area, as it is located in the deep offshore area. There is a major oil tanker lane to the Malacca Strait located in the Andaman Sea as shown in **Figure 6-1**. As presented in **Chapter 5** (**Figure 5-25**), existing shipping data shows primary activity occurring west and east of the Block MD-5.

The presence and limited manoeuvrability of a survey vessel, should it be on a collision course with commercial shipping during the survey, will mean that a more manoeuvrable vessel i.e. the third party vessel will have to take diverting action to avoid collision. Under the IMO Convention on the International Regulations for Preventing Collisions at Sea (COLREGS), 1972, a seismic survey vessel that is engaged in surveying is defined as a 'vessel restricted in its ability to manoeuvre' which requires that other power-driven and sailing vessels give way. The potential impact of this would be a temporary diversion to a ship's route between ports.

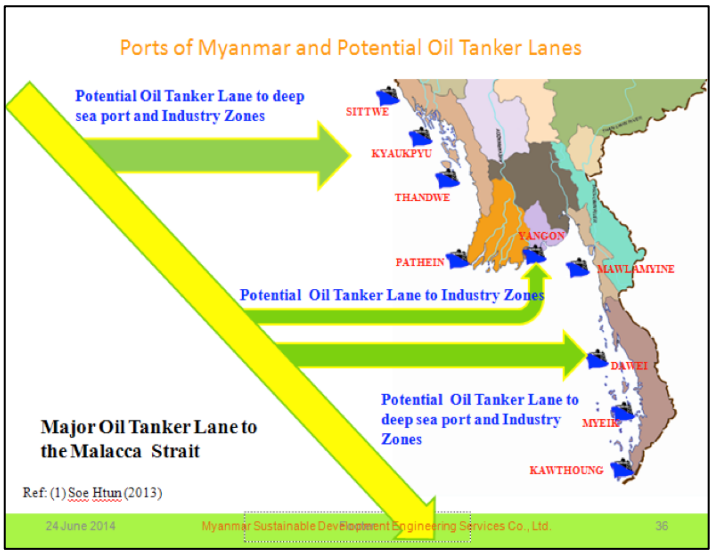


Figure 6-1: Major Oil Tanker Lane Shipping Route to the Malacca Strait

The exploration survey has potential to interact with other shipping in the vicinity of the offshore block and during transit. In a worst-case, an accidental collision between the survey vessel and other vessels/boats may occur, resulting in injuries, loss of life, and releases of polluting substances such as fuel oil and other possible cargoes.

6.6.2.3 Management Measures

The management measures for shipping are aligned with those defined for fisheries in the previous section. Vessels will be required to comply with international laws for maritime navigation, and advance notification through a “Notice to Mariners” to other vessel users will be enforced.

In addition to the Notice to Mariners, during the survey activities, the seismic vessel will be accompanied by support vessels that are responsible for maintaining a Safety Zone in which the seismic vessel can operate safely.

These mitigation measures will provide advance notice to ships to temporarily reroute their navigational lanes and subsequently reduce potential accidental collisions.

In summary, impacts to shipping will be mitigated through the use of the following measures:

- Adherence to COLREGS Part B – Steering and Sailing (Rules 4-19) and Part C – Lights and Shapes (Rules 27) as appropriate to vessel class, including:
  - Crew trained in accordance with COLREGS steering and sailing rules to prevent vessel collisions, including maintaining a proper look-out to prevent the risk of collision and maintaining a safe speed at all times to allow for avoidance of collisions;
  - Display appropriate lights and warning signals on all vessels to prevent accidental collision.
- At least 30 days prior to vessel mobilization, a “Notice to Mariner” regarding project activities to appropriate parties (i.e. Department of Fisheries, Ministry of Livestock and Fisheries, and Myanmar Navy).
- Establish a mobile and temporary safety zone around the seismic vessels – coordinated by the captain of the survey vessel.
- Use chase vessels to liaise with approaching shipping in the project area to prevent accidental collision.

6.6.2.4 Residual Impact

The impacts from the 3D seismic and CSEM surveys on shipping in and around MD-5 are expected to be local in extent, short-term in duration, reversible and of low magnitude. The residual impact significance is concluded to be minor.

6.6.3 Employment and Income

Project Activity / Potential Hazard Source	Environmental/Socio Economic Factors	Potential Impact
Survey programme	National and local employment and income	Direct and indirect contribution to the Myanmar economy through jobs and income

6.6.3.1 Project Characteristics

Dedicated international survey vessels will be utilized for this programme. Support and chase vessels are expected to be supplied by the international survey contractor.

The seismic survey vessel is expected to mobilize out of an international port e.g. Singapore, or Yangon. It will be self-sufficient, and, if any further supplies become necessary, support will be obtained from the supply vessels as required.

Waste generated during the seismic survey on the seismic survey vessel and other vessels will be managed and disposed of through the contractor's logistical support.

Shell Myanmar Energy Pte Ltd has established a local office in Yangon to support the deepwater exploration programme offshore Myanmar. There is currently 10 full time and 2 part time direct and indirect staff in Yangon supporting the exploration venture. The future employment of Myanmar staff will depend on the outcome of the exploration programme.

6.6.3.2 Impact Assessment

The crews on the offshore survey and support vessels are generally employed by the survey contractor, or other subcontractors. Shell will also place a small number of specialist staff as representatives on the vessels. These jobs are technical and skilled positions. Apart from Shell's Yangon office, no direct local employment is expected to be generated from the proposed project. Impacts to employment may result from seismic survey activities.

It is currently anticipated that the MD-5 survey activities will be supported from Ranong in Thailand, or from Yangon. During the period of the surveys there may be 1 or 2 contractor personnel working at this shore-based location.

During the seismic survey, the crew and specialists working on the seismic vessel will be accommodated onboard the vessel. Likewise the crew of the support and chase vessels will be accommodated on their respective vessels. Crew changes will be conducted ship-to-ship at approximately five week intervals. Crew will fly into and out of Ranong / Yangon and be transported out to the field by the support vessel. With regular connections from international airports to port, it is expected that crew changes will be swift with limited socioeconomic impact.

6.6.3.3 Management Measures

Beyond the staff employed at the Yangon office, no further mitigation is planned.

6.6.3.4 Residual Impact

There has been a positive, albeit potentially temporary short-term socio-economic impact of the early exploration programme in MD-5. The impact is limited to Yangon.

6.7 Summary Impact Table

Table 6-9 to **Table 6-11** summarise the potential impacts identified during the assessment of the 3D seismic and CSEM survey activities. All impacts are concluded to be readily manageable through standard operating procedures and/or through appropriate mitigation measures.

Table 6-9: Summary of Environmental Impact Conclusions

Aspect	Activity	Potential Impact	Impact Characteristics	Magnitude	Residual Significance
Underwater Noise	Operation of airgun array source (seismic source noise)	Behavioral and physiological effects on marine mammals (cetaceans), turtles, fish and invertebrates	Localised, short-term, reversible	Moderate	**Minor**
	Transportation, Equipment & Supplies (vessel-related noise)	Disturbance to marine mammals (cetaceans), turtles, fish and invertebrates			
Electromagnetic Pulse Emissions	CSEM unit electromagnetic pulsing	Disturbance to fish, cetaceans and sea turtles	Localised, short-term, reversible	Minor	**Negligible**
Physical Presence of Marine Anchors	Deployment, presence and eventual biodegradation of CSEM anchors (Receivers)	Seabed disturbance Disturbance of benthic habitats and organisms in immediate vicinity. Smothering of benthic habitat immediately underneath the anchors Changes in local water quality due to biodegradation of concrete blocks	Localised, short-term, reversible	Minor	**Negligible**
Artificial Light	Light emissions from vessels during hours of darkness	Behavioural effects on marine fauna (birds, turtles and fish)	Highly localised, short-term, reversible	Minor	**Negligible**
Atmospheric Emissions	Operation of combustion engines on vessels	Deterioration of local or regional air quality as a result of emissions	Localised, short-term, reversible	Minor	**Negligible**
Routine Aqueous Discharges	Discharge of sewage waste	Localised reduction in water quality due to nutrient enrichment	Localised, short-term, reversible	Low	**Negligible**
	Discharge of treated oily water originating from deck drainage systems, bilges and machinery drainage	Localised reduction in water quality due to nutrient enrichment Toxic effects on marine fauna and flora			
Solid Waste Management	Non-Hazardous solid Waste generation onboard vessels	Deterioration of water quality and marine habitat	Localised, short-term, reversible	Low	**Negligible**

Table 6-10: Summary of Unplanned Impact Conclusions

Aspect	Activity	Potential Impact	Impact Characteristics	Magnitude	Residual Significance
Vessel Interactions with Marine Fauna	Vessel Collisions Fauna entanglement in towed equipment	Physical effects on marine fauna particularly marine mammals (cetaceans) and sea turtles	Localised, short-term, reversible	Low	**Minor**
Accidental discharges (hydrocarbon spill)	Fuel spill (due to vessel collision, refuelling or other equipment or system failure)	Toxic effects on marine fauna and flora Localised reduction in water quality Indirect effects on offshore fisheries	Localised, short-term, reversible	Minor	**Moderate**
Accidental Release (Chemical or Hazardous Waste)	Incorrect handling of chemical or hazardous waste	Toxic effects on marine fauna and flora Localised reduction in water quality Indirect effects on offshore fisheries	Highly localised, short-term, reversible	Low	**Minor**
Accidental Introduction of Invasive Marine Species (IMS)	Introduction of IMS associated with ballast water discharges or transferred via vessel hull or in-water equipment	Establishment of non-native IMS with potential to affect native marine species	Localised, medium term	Minor	**Minor**

Table 6-11: Summary of Social Impact Conclusions

Aspect	Activity	Potential Impact	Impact Characteristics	Magnitude	Residual Significance
Physical presence – Interaction with Fisheries	Presence and manoeuvring of survey boat and towed equipment	Fouling of fishing gear as equipment is towed in the water	Localised, short-term, reversible	Low	**Minor**
	Presence and manoeuvring of seismic survey boat and towed equipment)	Displacement of fishing boats, disruption of fishing and/or damage to fishing equipment			
Physical Presence – Impact on Shipping	Presence and manoeuvring of survey vessels and tow lines	Increased traffic volume in the local area of the planned survey Interaction with shipping leading to disruption of shipping activities, e.g. diversion and some potential delays to third party journeys	Localised, short-term, reversible	Low	**Minor**
Survey Programme	National and local employment and income	Direct and indirect contribution to the Myanmar economy through jobs and income	Positive, short-term	Low	**Negligible Positive**

6.8 Conclusion

The impact assessment presented in this IEE has addressed the potential environmental and social aspects relevant to the deepwater offshore context of the proposed exploration survey programme in Block MD-5. The planned seismic and CSEM activities will be short-term and temporary (less than 60 days each), with a limited environmental and social footprint and minimal shore-based interaction.

Overall, it is concluded that the MD-5 exploration survey programme is considered to be acceptable and readily manageable taking into account the following:

- The project will be undertaken in accordance with relevant legislative requirements, standards, industry guidelines and Shell corporate expectations for responsible environmental management (**Chapter 2** and **Chapter 3**);
- The very localised nature and scale of operations associated with the programme (**Chapter 4**);
- The project location (i.e. deep, open offshore waters) and distance to key values and sensitivities (**Chapter 5**);
- All environmental impacts and risks for the project are demonstrated to be manageable, with application of appropriate mitigation measures (as presented in this **Chapter 6**);
- Clear definition of appropriate and measureable mitigation measures (**Chapter 8**) to manage the environmental and social aspects associated with the survey programme, with clear roles and responsibilities for effective implementation; and
- Stakeholder consultation (**Chapter 9)** has demonstrated broad support for the proposed activities.

The EMP presented in **Chapter 8** includes provisions for measuring its effectiveness through review and audit of the contractor's performance, to ensure that Shell's objectives for environmental and social performance are being met and commitments are implemented.

7. Cumulative Impacts

The objective of the cumulative impact assessment is to identify those environmental, social or health aspects that may not on their own constitute a significant impact but when combined with impacts from past, present or reasonably foreseeable future activities associated with this and/or other projects, result in a larger and more significant impact(s).

The screening and assessment of planned and unplanned project related activities to identify potential environmental or social aspects assisted to highlight potential areas where cumulative impacts could possibly occur. This includes consideration of impacts on key receptors including marine fauna and associated habitats, water quality, air quality, and key socio-economic values (fishing and shipping) relevant to the offshore block.

An evaluation of the potential for cumulative impacts or impact interactions has been carried out for the aspects and impacts highlighted in **Chapter 6**. The assessment has considered activities (projects) scheduled to occur in the study area and where there may be a potential for cumulative impacts or impact interactions to arise. Due to the characteristics and location of the MD-5 activities, in combination with the size of the offshore exploration blocks, this evaluation has been restricted to considering seismic surveys in blocks neighbouring MD-5. The impacts considered are summarised below:

- Cumulative impact of temporary reduction in available fishing area, and
- Cumulative impact of underwater sound on sensitive marine fauna.

Potential for Simultaneous Operations (Andaman Sea)

As a result of the 2013 Myanmar offshore licensing round, exploration survey programmes are likely to take place in the vicinity of MD-5 (see **Figure 7-1**) to fulfil PSC work programmes. Shell has through liaison with other offshore operators sought to ascertain the potential for simultaneous seismic operations associated with this. As a result of this, the following has been considered:

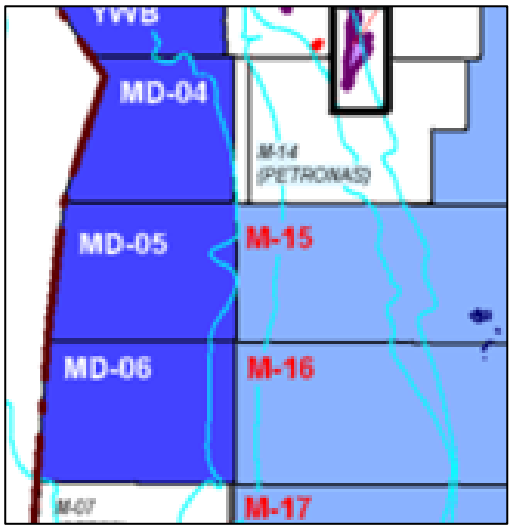


Figure 7-1: Adjacent Blocks

Block	Operator	Activity	Expected Period of Survey
MD-5	Shell	Seismic survey	November- December 2015
		CSEM survey	Q3/Q4 2016
MD-4	ENI	Seismic survey	No schedule available at the time of writing
M-15	Canadian Foresight	Seismic survey	No schedule available at the time of writing

On the basis of Shell's current survey schedule and the status of the contracting activities, it is assumed that Shell will be commencing their Andaman Sea seismic survey programme early in the season i.e. early November until end December 2015. Although there is currently no survey schedule available for Blocks MD-4 and M-15, a conservative assumption has been made that activities could commence in one of the blocks within the same timeframe. An assessment has therefore been carried out on the potential cumulative impacts arising as a result of a seismic survey activity occurring in a neighbouring block at the same time as Shell's MD-5 activities.

It should be noted two surveys would not be undertaking seismic surveys in proximity to each other, due to the potential for noise interference to affect seismic data quality. Concurrent surveys usually require a minimum separation distance of at least 50 km between any two operating seismic survey vessels.

Cumulative impact of temporary reduction in area available for fishing

On the basis of information acquired during the IEE studies, it is expected that fishing activity in this area is limited, however, there is a potential for tuna fishery to occur. The potential for impact on this fishery as a result of the seismic survey in Block MD-5 occurring at the same time as a similar survey taking place in Block MD-4 or Block M-15 has been considered.

The seismic program in MD-5 will temporarily restrict the total area available for fishing within a transient rectangular exclusion zone of approx. 2 km x 10 km, or less than 1 per cent of the area of the Block at any one time for a duration of approx. 2 months. Subject to early notification through marine notices as well as in-field fisheries liaison by the chase vessels, it will be possible for fishing vessels to avoid the area of the survey and continue to fish in the area throughout this period. Similarly, a survey in a neighbouring block may have an equal potential for fishing to be diverted away from the immediate area around that survey vessel and streamers.

As these offshore blocks are very large, and any temporarily unavailable area will only represent a small percentage of the total area available, the potential cumulative impact of the MD-5 a seismic survey and a similar survey being conducted in a neighbouring block at the same time is therefore expected to be insignificant. The CSEM survey, currently is scheduled to commence in Q3 2016, will also result in a temporary but transient reduction in total available fishing area within the block for a period up to 2 months. As no other surveys in neighbouring blocks are expected or known to occur at the time of the CSEM survey, the potential for cumulative impact is concluded to be negligible.

Cumulative impact of underwater noise on sensitive marine fauna

Although the offshore blocks are very large, there is potential for cumulative impact or impact interaction on marine fauna, particularly mammals in the event that more than one seismic survey is conducted at any one time in neighbouring blocks.

As stated above, the possibility of more than one survey operating at any one time in Block MD-5 and a neighbouring block cannot be ruled out. This could result in a doubling of the total area within the two blocks affected by increased noise disturbance. There is also potential for an increase in the noise levels experienced by sensitive marine fauna should the surveys be conducted in close proximity of each other.

There are several reasons why a certain distance should be maintained between simultaneous seismic surveys to minimise the potential for cumulative impact. One is to minimise the potential for impact interactions associated with the soft start procedure which is designed to limit the disturbance by allowing animals to move away from the survey, but in the event the surveys are carried out in close proximity of each other this compromises the effectiveness of the mitigation. The second is to limit the potential impact for additional disturbance or injury due to an increase in absolute noise levels experienced by fauna in close proximity to two simultaneous high energy sources. The likelihood of this occurring is minimal, as this will also compromise the quality of the geophysical data being acquired. Survey operators liaise with each other to make sure that a certain distance is maintained between simultaneous seismic surveys. Should it not be possible, the two operators will work out procedures for simultaneous operations to eliminate or minimise the potential for noise interference and data corruption. Measures such as a time-sharing arrangement where, over a 24 hour period

each vessel will acquire for a period of 12 hours whilst the airgun arrays of the other vessel are shut down, would effectively mitigate any potential cumulative impact.

It is currently expected that in the event that surveys occur at the same time, two seismic surveys will never be less than 50 – 100 km apart.

The potential cumulative impact on sensitive fauna of two concurrent surveys is therefore predicted to be of a behavioural nature, and is concluded to be temporary and transient.

Residual Impact

Taking into account the above assessment of potential interactions from activities in adjacent blocks to MD-5, the cumulative impact of underwater sound on fishing interests and sensitive marine fauna is ranked as having a low residual impact.

8. Environmental Management Plan (EMP)

8.1 Introduction

This chapter describes how the environmental mitigation measures identified and described in **Chapter 6** will be incorporated into the survey design and subsequently implemented throughout the duration of the surveys, in the form of an Environmental Management Plan (EMP).

The EMP represents a commitment by Shell to ensure that the mitigation measures are translated into operational plans and procedures by the survey contractors as appropriate. These detailed plans and procedures will be developed by the seismic contractor in consultation with Shell, and will require Shell sign-off. Shell's on-board representative is accountable to Shell management for the effective implementation of the EMP during the survey programme, and the ultimate responsibility and accountability for its implementation lies with Shell's Venture Lead.

This EMP outlines the measures for ensuring and demonstrating that the IEE mitigation measures are translated into actions. It will also serve as the high level guide for dealing with unforeseen circumstances during the project operations, such as changes to survey methodology or unforeseen environmental conditions. It also sets out the requirement for emergency planning in the event of accidents or incidents with potential to affect the environment.

The EMP includes provisions for measuring its effectiveness through review and audit of the contractor's performance, to ensure that Shell's objectives for environmental and social performance are being met and commitments are implemented.

The Project will comply with the laws and regulations stated by MONREC and other respective ministries and departments and will follow the Environmental, Health, and Safety General Guidelines, 2007, International Finance Corporation, World Bank Group prior to the release of the national environmental quality standards and guidelines by Ministry of Natural Resources and Environmental Conservation (MONREC), Myanmar guidelines.

8.2 EMP Objectives

In principle, the EMP is an overview of how the mitigation and management measures identified in this IEE will be implemented, and has the following key objectives:

- Compliance with Myanmar and international law, international standards, oil and gas industry best practice and Shell' requirements;
- Provide an inventory of all mitigation measures (see **Table 8-1**) identified in the IEE report to enable their incorporation into the planning and execution of the proposed seismic survey;
- Provide details of monitoring and reporting associated with the mitigation measures;
- Set out the necessity emergency response requirements required to minimise potential for pollution in the event of an emergency arising during the survey.

8.3 Plans and Procedures

Shell through its contractual relationship will require the survey contractor(s) to develop detailed plans and procedures and demonstrate compliance with the EMP. These plans and procedures include but are not limited to the following:

- Code of Conduct for minimising disturbance to marine mammals
- Spill Response Plan
- Waste Management Plan, and
- Fisheries Liaison.

Plans and procedures are routinely included in the survey vessels' standard methods of operation.

The issue-specific management plans are discussed below.

8.3.1 Code of Conduct

The main objective of the Code of Conduct is to ensure that acoustic disturbance to marine mammals is kept to a minimum and is consistent with the JNCC (2010) 'Guidelines for minimising the risk of injury and disturbance to marine mammals from seismic surveys' as adopted by the International Association of Geophysical Contractors (IAGC). Procedures to be applied are also of benefit to mitigate impacts on other marine fauna, including turtles.

A Marine Mammal Observer (MMO) will be on watch throughout during daylight hours. The function of the MMO will be to identify and monitor the presence of marine mammals and turtles in the area and to advise the seismic vessel operators when measures should be taken to reduce potential impacts to these species. These measures will comply with the JNCC Guidelines.

The MMO will record any fishing and shipping activity in the area. In this regard, the MMO on watch will keep a daily log of survey location, survey activities, observation effort and all sightings using a standard reporting form.

The JNCC Guidelines have been developed to minimise the impact on marine mammals from seismic surveys, but are also relevant for basking shark and turtles. In deep waters (>200m), they require a 60 minute watch for marine mammals within 500 m of the seismic source prior to commencement of operation (deployment of the array). If marine mammals are present, seismic operations will be delayed until the animals move out of range (at least 20 minutes since the last sighting).

The MMO will be trained and knowledgeable of the marine mammal and turtle species that may be encountered in Block MD-5. Given the planned duration of the survey, it is likely that the MMO personnel will change during the survey.

On completion of the survey the MMO will submit a report to Shell summarising their observations and including all relevant data.

8.3.2 Marine Pollution Response Plan

The seismic survey contractor will be required to develop a plan and procedures to be implemented by the Vessel Captains in the event of a pollution incident at sea. These will include a Shipboard Oil Pollution Emergency Plan (SOPEP) and include procedures to record and report any incidents.

Shell will require that any oil or chemical spills to water will be reported to Shell's onboard representative and that regular updates will be issued to Shell.

The likelihood of a fuel spill will be minimised by implementing specific fuel loading and transfer procedures (e.g. defining metocean criteria when re-fuelling operations are permitted and restricting such an activity to daylight hours). Personnel will be trained to respond to spills and Tier 1 clean-up equipment will always be available onboard the survey vessel.

8.3.3 Waste Management Plan and Procedures

These will be developed for the survey by the contractor to establish procedures for the storage, collection and disposal of waste, including liquid and solid waste and hazardous and non-hazardous wastes. Certain wastes will need to be brought ashore from the seismic vessels and consequently the plan will describe the waste transfer and disposal strategy to a suitable onshore location.

The final onshore destination for disposal of the waste (with associated procedures for such disposal and site monitoring) will be included once the destination site is confirmed.

The survey ships will operate according to a Garbage Management Plan based on MARPOL 73/78 Annex V/Regulation 9 requirements (compulsory from 1 July 1998, and revised as of 1 January 2013). The purpose of the plan is to give all crew guidance on shipboard waste handling and storage procedures. The plan includes a list of persons specifically designated to oversee the process. The Chief Officer is responsible for overall implementation of plan procedures. According to this plan, no solid waste other than food waste may be disposed at sea, even though such disposal might be allowed under MARPOL. Onboard waste collection and storage locations will be designated.

8.3.4 Fisheries Liaison Plans and Procedures

Other vessels navigating area will be informed of the survey and its schedule through a Marine Notice which will be published prior to the survey. Procedures will be put in place for the fisheries liaison to be carried out by the chase boats under the overall supervision of the Captain of the survey vessel.

Procedures will also be established to deal with incidences where fishing vessels are in the survey area during the survey or their gear is found in the path of the survey vessel.

Further procedures will be put in place to avoid any interactions with other shipping. All incidents will be recorded with appropriate details (e.g. time, date, nature of incident).

8.4 Implementation of the EMP

8.4.1 Survey Contractor

The survey contractor(s) will be required to include the following provisions to ensure that the EMP is implemented onboard:

- Clearly defined roles and responsibilities for the execution of the EMP requirements in their operational documents (e.g. vessel captain, survey supervisor / Party Chief and MMO);
- Ensure that all crew are familiar with the environmental protection procedures;
- Appropriate reporting and remedial action procedures to ensure that any incidents are reported promptly and dealt with effectively;
- Audit, assessment and revision of the EMP as required.

Shell will review and approve the contractor EMP documentation, and will have a client representative onboard to monitor compliance.

8.4.2 Roles, Responsibilities and Cost of Implementation

Prior to commencing the survey, the EMP and the associated commitment register will be provided to the contractor. The contractor will prepare a health, safety and environmental plan for the survey. This plan shall detail how the contractor's organisation will implement the EMP and demonstrate compliance with its requirements. Where the contractor relies on existing vessel procedures, these shall be cross referenced in the HSE plan.

Once the survey commences, the Vessel Captain and Party Chief will be directly responsible for implementing the EMP on board the vessel. A Shell survey representative will be on board at all times, and will be responsible for periodic check and making sure that the EMP is implemented. Shell Myanmar Energy Pte Limited's Venture Lead in Yangon will be accountable to MOGE and the ECD for the implementation of the EMP on board the survey vessel.

Shell and their contractors operate to international HSE standards, considered to be integral to good management. Therefore, there are no additional costs in the implementing the internationally recognised environmental and social standards associated with emissions management and waste management on board the vessels.

However, there are two areas within the EMP which requires additional funding and organisations, namely:

- Fisheries liaison, and
- Mitigation to minimise disturbance of marine mammals.

The additional cost to the project of fisheries liaison over and above the cost of the guard vessels are:

- Fisheries consultation – part of IEE consultation
- Community feedback/grievance procedures.

These costs are borne directly by Shell Myanmar and are in total approx. USD 20,000 for the Andaman Sea block.

Marine mammal mitigation costs are estimated to approx. USD 60,000 for the Andaman Sea seismic survey. The MMOs will be employed directly by Shell, and the cost of reporting are included in this estimate.

The compilation of post survey monitoring information will be carried out by Shell staff at no extra cost.

8.5 Commitments Register

The commitments register set out in **Table 8-1** below specifies all the measures identified in the impact assessment process set out in **Chapter 6**. These mitigation measures aim to avoid, minimise and reduce potential environmental, social and other impacts and enhance project benefits, as identified in the IEE document. Shell is ultimately responsible for ensuring that the commitments shown in **Table 8-1** are implemented during the project operations.

This commitments register is intended to be a standalone document and read in conjunction with the full text of the accompanying IEE document which provides important context and background, as well as describing the impacts which the listed measures aim to mitigate or manage, and the residual impact which may remain. If any changes to these mitigation measures become necessary, this commitments register will be updated accordingly. Although other documents have been or will be compiled in relation to the project and the IEE, this commitments register is the exclusive and authoritative record of the mitigation measures proposed.

The mitigation measures provide an appropriate level of response to the key risks and impacts associated with the project, and take into account applicable policies and legislation, guidelines and standards, and industry good practice. The mitigation measures are designed to be practical, implementable and auditable.

Table 8-1: Commitments Register

Environmental Aspects

Aspect	Activity	Potential Impact	Mitigation measures	Location	Duration	Responsibility
Underwater Noise	Operation of Airgun array source (seismic source noise) Transportation, Equipment & Supplies (vessel-related noise)	Behavioural and physiological effects on marine mammals (cetaceans), turtles, fish and invertebrates	**Code of Conduct –** aligned with the JNCC (2010) 'Guidelines for minimising the risk of injury and disturbance to marine mammals from seismic surveys' as adopted by the International Association of Geophysical Contractors (IAGC). **Pre-survey / Survey Planning** • Two dedicated Marine Mammal Observers (MMOs) will be present onboard the seismic vessel during the survey. • The MMOs will be qualified and experienced. As a minimum, the MMOs will have certified training in the implementation of JNCC guidelines (JNCC 2010) and have relevant offshore survey experience. • The MMOs will be engaged solely in monitoring the implementation of the mitigation and conducting visual observations of mammals during the survey. • The MMO must submit a report within 30 days of completion of the survey to Shell. • The Contractor must provide a report (including a daily log) on the operation of the seismic equipment that will indicate the soft starts and their duration to the MMO. • Adherence to this code of practice is the responsibility of the Survey Contractor. **Pre soft start scan for marine mammals** - aligned with the JNCC (2010) 'Guidelines for minimising the risk of injury and disturbance to marine mammals from seismic surveys' as adopted by the International Association of Geophysical Contractors (IAGC). • The MMO should survey the area for the presence of cetaceans 60 minutes before the onset of the soft start, within 500 m of the seismic source. • A minimum distance of 500 metres is required between the centre of the array/sound source and the nearest cetacean before soft start can commence. • If marine mammals are seen within 500 metres of the centre of the sound source the start of the sound source(s) should be delayed until they have moved away, allowing adequate time after the last sighting for the animals to leave the area (20 minutes). If the cetaceans do not leave the area it is recommended that the survey vessel alters course to ensure that the animals are outside the 500 metre exclusion zone when soft start commences. • There should be a 20 minute delay from the time of the last sighting within 500	Survey area	Prior to and throughout survey	Seismic Contractor

Aspect	Activity	Potential Impact	Mitigation measures	Location	Duration	Responsibility
			metres of the source to the commencement of the soft-start. **Soft start procedure** • Power should be built up slowly over at least 20 minutes to give adequate time for marine mammals to leave the vicinity. • Soft starts should achieve maximum (or desired) output after at least 20 minutes but not significantly longer. • This build up of power should occur in uniform stages to provide a constant increase in output from the sound source. • There should be a soft start every time there is a break in the firing sequence longer than 20 minutes. • Soft starts must occur during daylight hours when the MMO can carry out the required pre soft start scan. • 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. • If, for any reason, firing of the sound source has stopped and not restarted for at least 20 minutes a full soft start for the appropriate depth should be carried out. • When time-sharing, where two or more vessels operate in adjacent areas and take turns to shoot to avoid causing seismic interference to each other, all vessels shooting should follow the full soft start procedure for each line started. • Once the sound source has achieved its maximum output (post soft start) it is not necessary to stop the survey should cetaceans approach the vessel. **Line change** • With the sound source running, if turn-around time between sample lines or stations is greater than the time required to conduct a soft start (including pre soft start scan) for the appropriate water depth, then the sound source should be stopped and a soft start for the appropriate water depth should be used prior to commencing the new line. • For line changes which take less time than that required to undertake a soft start, the sound source (e.g. full array of airguns) should continue firing during the line turn (e.g. for a site survey line turn of 5 minutes continue firing at full power).			

Aspect	Activity	Potential Impact	Mitigation measures	Location	Duration	Responsibility
Physical Presence of marine anchors	Deployment, presence and eventual biodegradation of CSEM anchors (Receivers)	Seabed disturbance Disturbance of benthic habitats and organisms in immediate vicinity Smothering of benthic habitat immediately underneath the anchors Changes in local water quality due to biodegradation of concrete blocks	• CSEM receivers to be placed on the seabed with biodegradable cement anchors that break down in 6 to 8 months. • Use of small (1.0 m x 1.0 m x 0.25 m), dissolvable concrete weights.	Survey area	During CSEM survey activities	CSEM Contractor
Artificial Light	Light emissions from vessels during hours of darkness	Behavioural effects on marine fauna (birds, turtles and fish)	• Deck lighting will be directed inwards where possible.	Seismic Area	Seismic Program	Seismic & CSEM Contractors
Atmospheric Emissions	Operation of internal combustion engines on vessels	Deterioration of local or regional air quality as a result of emissions	• Adherence to MARPOL 73/78 Annex VI requirements as appropriate to vessel class, including: o optimisation of fuel use to increase efficiency and minimise emissions; o emissions managed by the implementation of a planned maintenance system (PMS). • Routine inspection and preventive maintenance as per maintenance schedule or recommendation by manufactures to ensure efficiency of all machineries. • Strictly follow the instruction manual of equipment and machines, and keep them properly maintained. • Minimise survey delays and vessel operating time to the extent practicable.	Survey area and vessels	During survey	Seismic & CSEM Contractors
Routine Aqueous Discharges	Discharge of putrescible/ sewage waste	Localised reduction in water quality due to nutrient enrichment	• Sewage will be treated prior to disposal offshore in accordance with MARPOL regulations (Annex IV). • Survey and support vessels will have certified/approved sewage treatment plants.	o Survey area and vessels	o During survey	Seismic & CSEM Contractors
	Discharge of treated oily water originating from bilges and machinery drainage	Toxic effects on marine fauna and flora Localised reduction in water quality	• Bilge and drainage water will be treated and disposed of in accordance with MARPOL 73/78 Annex I. • Bilge and drainage water with oil-in-water content exceeding 15 ppm will be contained and disposed of onshore. • Bilge and drainage water discharges recorded in the Oil Record Book.	Survey area and vessels	During survey	Seismic & CSEM Contractors

Aspect	Activity	Potential Impact	Mitigation measures	Location	Duration	Responsibility
Solid Waste Management	Non-hazardous solid waste generation onboard vessels	Deterioration of water quality and marine habitat	• A Waste Management Plan for the operations will be developed and implemented by the survey contractor(s). • Waste will be segregated into recyclable and non-recyclable wastes where practicable, and stored in clearly marked containers for transport and disposal. • All garbage will be disposed of in accordance with MARPOL 73/78 Annex V. • Incinerators used aboard the survey and support vessels will be compliant with MARPOL / IMO requirements. • Food wastes will be macerated to a maximum particle size 25 mm prior to being discharged to sea. • Hazardous waste inventory will form part of the waste management plan. • Any hazardous waste materials will be handled and stored in accordance with the corresponding Material Safety Data Sheet (MSDS). • All project vessels will have a garbage management plan, in accordance with IMO Guidelines. • If required by vessel class, project vessels will also carry a garbage record book in accordance with MARPOL 73/78 Annex V.	Survey area and vessels	During survey	Seismic & CSEM Contractors

Unplanned Events

Aspect	Activity	Potential Impact	Mitigation measures	Location	Duration	Responsibility
Vessel interactions with marine fauna	Vessel Collisions Fauna entanglement in towed equipment	Physical effects on marine fauna particularly marine mammals (cetaceans) and sea turtles	• The Code of Conduct outlined in Section 6.4.1.3, in particular the management measures relating to the use of an MMO onboard seismic vessels, including any vessel or towed equipment interactions with marine fauna will be recorded and reported in the MMO report. • Survey vessels will generally be travelling at low speed, between approximately 7 – 9 km/hr (4 – 5 knots). • Tail buoys on seismic streamers will be fitted with turtle exclusion devices if their design requires it.	Survey area and vessels	During survey	Seismic & CSEM Contractors

Accidental discharges (hydrocarbon spill)	Fuel or oil spill (due to vessel collisions, refuelling or other equipment or system failure)	Toxic effects on marine fauna and flora
		Localised reduction in water quality
		Indirect effects on offshore fisheries
			• Adherence to the requirements of the International Regulations for Preventing Collisions at Sea 1972 (COLREGS) Part B - Steering and Sailing (Rules 4-19) and Part C - Lights and Shapes (Rules 27) as appropriate to vessel class, including:
			  ○ Crew trained in accordance with COLREGS steering and sailing rules to prevent vessel collisions, including maintaining a proper look-out to prevent the risk of collision and maintaining a safe speed at all times to allow for avoidance of collisions;
			  ○ Display appropriate lights and warning signals on all vessels to prevent accidental collision.
			• At least 30 days prior to vessel mobilization, coordinate with MOGE, who will issue "Notice to Mariner" regarding project activities to appropriate parties (i.e. Department of Fisheries, Ministry of Livestock and Fisheries, and Marine Police Force).
			• Establish a safety zone around the seismic and CSEM vessels.
			• Use of chase vessels to warn other vessels/shipping of the navigation hazard posed by the survey vessels and towed equipment.
			• Any vessel collision incidents will be reported to the appropriate authorities in Myanmar (e.g. MONREC, the DMA and the Myanmar Navy).
			• Detailed records will be maintained of all vessel collision incidents.
			• Develop and implement Shipboard Oil Pollution Emergency Plan (SOPEP), kept onboard vessels, and conforming to MARPOL.
			• Weather reports received daily on the survey vessels.
			• Adverse weather contingency plan.
			• Refuelling at sea undertaken in daytime only and will follow standard operating procedures.
				Survey area and vessels	During survey	Shell & Contractors

Aspect	Activity	Potential Impact	Mitigation measures	Location	Duration	Responsibility
			• All hydrocarbons stored on deck will be stored in secured storage area. • Crew will have received training in, and be competent in, their emergency response roles, as appropriate. • Provide spill clean-up kits and training for designated rapid response team to clean up any spills. • Appropriate medical care will be provided, clean-up will be carried out, and incident or accident reports will be filed. • All oil spills (>80 L) will be documented and reported to MONREC. • Hydrocarbon spill containment and recovery equipment will be available near hydrocarbon storage. • Procedures for response to hydrocarbon spills will be detailed in Shell's ERP.			
Accidental Releases (Chemical or Hazardous Waste)	Incorrect handling of chemical or hazardous waste	Toxic effects on marine fauna and flora Localised reduction in water quality Possible impacts to worker health from hazardous materials Indirect effects on offshore fisheries	• All chemicals/hazardous materials handled and disposed of in accordance with MARPOL 73/78 Annex III. • Environmental induction for all personnel on survey vessels. • Proper training in the use and handling of the relevant chemicals and standard safety procedures implemented by all contractors. • Appropriate medical care will be provided, clean-up will be carried out, and incident or accident reports will be filed. • Provide spill clean-up kits and training for designated rapid response team to clean up any spills. • Store all chemicals in secured storage area. • All chemical and hazardous wastes will be segregated into clearly marked containers prior to onshore disposal. • All storage facilities and handling equipment will be in good working order and designed in such a way as to prevent and contain any spillage as far as practicable. • The survey and support vessels have implemented and tested SOPEP, and copies are kept aboard vessels. • All hazardous substances will have MSDS in place that is readily available on board.	Survey area and seismic vessel	During the survey	Shell & Contractors

Aspect	Activity	Potential Impact	Mitigation measures	Location	Duration	Responsibility
Accidental Releases (Chemical or Hazardous Waste) (Cont.)	Incorrect handling of chemical or hazardous waste (Cont.)	Toxic effects on marine fauna and flora Localised reduction in water quality Possible impacts to worker health from hazardous materials Indirect effects on offshore fisheries (Cont.)	• Spill response bins/kits will be located in close proximity to chemical/Hazardous materials storage areas for prompt response in the event of a spill or leak. The kits will be checked for their adequacy and replenished as necessary prior to the commencement of activities and on a regular basis thereafter. Identified personnel will be trained in use of this equipment. • Detailed records will be maintained of all accidental releases/discharges of chemicals/hazardous materials.	Survey area and seismic vessel	During the survey	Shell & Contractors
Accidental introduction of invasive marine species (IMS)	Introduction of IMS associated with ballast water discharges or transferred via vessel hull or in-water equipment	Establishment of non-native IMS with potential to affect native marine species	• Compliance with the International Convention for the Control and Management of Ships' Ballast Water and Sediments (as appropriate to vessel class) (IMO 2004); as applied to all vessels being mobilised from international waters, which includes: o All ballast water exchanges conducted more than 50 nm from land and in greater than 200 m water depth. o Ballast water exchange records maintained. • An IMS risk assessment will be taking place, and on the basis of its outcome, management measures will be implemented commensurate with the level of risk. • To manage the potential risk of biofouling, the following measure will be implemented: o Vessels (of appropriate class (>400t)) to have a current International Anti Fouling System (IAFS) Certificate, as per the International Convention on the Control of Harmful Anti fouling Systems on Ships (IMO 2001).	Survey area and vessels	During survey	Seismic & CSEM Contractors

Social Aspects

Aspect	Activity	Potential Impact	Mitigation measures	Location	Duration	Responsibility
Physical presence – Interaction with Fisheries	Presence and manoeuvring of survey boat and towed equipment	Fouling of fishing gear as equipment is towed in the water	• At least 30 days prior to vessel mobilization, a "Notice to Mariner" will be issued to appropriate parties (i.e. Department of Fisheries, Ministry of Livestock and Fisheries, and Myanmar Navy). • Consultation with relevant fishing groups through Myanmar Fisheries Federation and the Department of Fisheries. • Chase vessels will be used during the seismic survey to monitor and communicate with fishing vessels in the area. • Adherence to the COLREGS Part B – Steering and Sailing (Rules 4-19) and Part C – Lights and Shapes (Rules 27) as appropriate to vessel class, including: ○ Crew trained in accordance with COLREGS steering and sailing rules to prevent vessel collisions, including maintaining a proper look-out to prevent the risk of collision and maintaining a safe speed at all times to allow for avoidance of collisions; ○ Display appropriate lights and warning signals on all vessels to prevent accidental collision.	Offices and communities concerning the project and survey area	Approximately one month before the project begins and during the survey	Shell and Contractors
	Presence and manoeuvring of seismic survey boat and towed equipment)	Disruption of fishing and fishing vessels and/or damage to fishing equipment				
Physical presence – Interaction with Shipping	Presence and manoeuvring of survey vessels and tow lines	Increased traffic volume in the local area of the planned survey Interaction with shipping leading to disruption of shipping activities, e.g. diversion and some potential delays to third party journeys	• Adherence to COLREGS Part B - Steering and Sailing (Rules 4-19) and Part C - Lights and Shapes (Rules 27) as appropriate to vessel class, including: ○ Crew trained in accordance with COLREGS steering and sailing rules to prevent vessel collisions, including maintaining a proper look-out to prevent the risk of collision and maintaining a safe speed at all times to allow for avoidance of collisions; ○ Display appropriate lights and warning signals on all vessels to prevent accidental collision. • At least 30 days prior to vessel mobilization, a "Notice to Mariner" regarding project activities to appropriate parties (i.e. Department of Fisheries, Ministry of Livestock and Fisheries, and Myanmar Navy). • Establish a mobile and temporary safety zone around the seismic and CSEM vessels – coordinated by the captain of the survey vessel. • Use chase vessels to liaise with approaching shipping in the project area to prevent accidental collision.	Offices and communities concerning the project and survey area	Approximately one month before the project begins & during the survey	Shell and Contractors
Survey programme	National and local employment and income	Direct and indirect contribution to the Myanmar economy through jobs and income	• Beyond the staff employed at the Yangon office, no further mitigation is planned.	Offices and communities concerning the project and survey area	Before the project begins & during the survey	Shell and Contractors

8.6 Environmental Management Governance

8.6.1 Shell Commitment to Environmental Management

Shell is committed to ensuring that its business operates in an environmentally responsible manner, consistent with established industry best practice.

The Company's Environmental Policy and commitment is previously provided in **Chapter 4** of this IEE.

8.6.2 Management of Contractors

In accordance with its corporate governance and assurance processes, Shell will ensure that the seismic contractor has a comprehensive Health, Safety and Environmental Management System (HSEMS) in place and that it is properly implemented throughout the course of the project. Shell will require the contractor to carry out activities in accordance with the principles of the Shell's HSE Control Framework, and in doing so the Contractor needs to establish a similar system of managing health safety and environmental matters.

The main survey Contractors and their subcontractors will be required to operate in accordance with Shell HSSE&SP policies and will be responsible for implementing the EMP as set out in this report.

8.6.3 Roles and Responsibilities

For the effective implementation of the EMP the key roles, responsibilities and accountabilities are outlined below. Vessel-based roles and responsibilities are further detailed in **Table 8-2**.

Shell Venture Lead – Yangon

- The Venture Lead is accountable for the full implementation of the EMP for the MD-5 survey programme.
- The Venture Lead is responsible for ensuring that there are adequate resources, including competent personnel, to implement the arrangements specified in the EMP.
- Although the seismic vessel is owned and operated by a Contractor, the Venture Lead will be accountable for the technical integrity of vessels and equipment to be used during the surveys.

Shell Safety, Environment and Social Performance Manager

- The Safety, Environment and Social Performance Manager is the custodian of the EMP and advises the Venture Lead and the Contract Holder for the survey on the compliance requirements associated with the plan.
- The SE&SP Manager is responsible for coordinating and verifying the adequacy of Shell's assurance activities associated with the survey contracts including the associated vessels and equipment.

Shell Site / Vessel Representative

- The Shell representative onboard the survey vessel has accountability for the implementation of EMP on the vessel itself during the survey program.
- The Site / Vessel Representative shall is responsible for ensuring that employees and contractors personnel under their supervision are fully competent to carry out tasks allocated to them, including emergency response preparedness capabilities.
- In the execution of HSE-critical activities, the Site / Vessel Representative is responsible and accountable for overseeing the identification and implementation of HSE controls by the Vessel Contractor, such that harm to people, environment, asset and reputation are eliminated and/or minimised.
- The Site / Vessel Representative shall, in turn, delegate the responsibility for the implementation of the HSE Management System in their respective site / vessel, including agreed HSE objectives, plan and target to the respective Supervisors and/or Team Leaders within the site / vessel.
- In addition, the Site / Vessel Representative shall also meet the HSE roles, responsibilities and accountabilities as specified in their respective position description.

Shell Site / Vessel HSE Representative

- The Shell HSE representative on the survey supports the Shell Vessel Representative in HSE management assurance. In this position, the Shell HSE representative liaises with the Contractor's HSE liaison/Focal Point.
- The Shell HSE representative will support and advise the Contractor's HSE representatives and other staff in the implementation of Shell specific standards, and will review the Contractor's compliance with these requirements including EMP on an ongoing basis.
- The Shell HSE representative is responsible for ensuring that any matters of non-compliance with the EMP or any other Shell SHE requirements are brought to the attention of the contractor via the Shell Representative, and to support the Contractor in the development and implementation of measures required to achieve compliance.

Contractor Captain – Vessel Master

- The Contractor Captain is responsible to ensure the safe execution of all operations of the survey vessel, including overall contractor responsibility for HSE management aboard the survey vessel.
- The Captain is responsible to ensure the vessel management system and procedures are implemented, including appropriate control and mitigation measures to minimise potential environmental / social effects resulting from vessel operations.
- The Captain will establish and maintain radio contact with other vessels in the survey area and adjacent waters, to maintain safe operational distance and notifications.
- The Captain will immediately notify the Shell Site / Vessel Representative of any incidents/activities arising from vessel operations that are likely to have a negative impact on the management objectives detailed in this EMP.
- The Captain will have overarching responsibility for contractor compliance with this EMP, supporting plans and procedures (including SOPEP, Waste Management Plan and Emergency Response Plan).

Contractor – Party Chief

- The Party Chief reports to the Contractor Captain, and oversees the execution of the seismic survey activities in accordance with contractor obligations.
- The Party Chief reviews trip planning and logistical arrangements prior to mobilisation.
- The Party Chief undertakes daily toolbox meetings and ensures that onsite risk assessments are undertaken to manage operational risks.
- Reports as soon as practicable to the Contractor Captain, Contractor HSE Adviser and Shell Site / Vessel Representative of any incidents that occur during execution of the field work scope.
- This role has responsibility for facilitating field debriefs, including action items focused on continuous improvement as required.
- The Party Chief undertakes field operations reporting, including Daily Operations Reports (DORs).

Contractor HSE Manager

- The Contractor HSE Manager shall have the responsibility and accountability in driving the implementation of HSE Management System within his respective site / vessel of responsibility.
- The Contractor HSE Manager is responsible and accountable for providing the required advice on HSE, towards attaining full compliance to the requirement of the HSE Management System within their respective site / vessel of responsibility.
- The Contractor HSE Manager is responsible for engagement/contact on HSE matters with regulatory authorities and industry associations within their respective site / vessel of responsibility.

- The Contractor HSE Manager is responsible for maintaining an HSE assurance program, including for Contractors, to support the effective implementation of the HSE Management System within site / vessel of responsibility.
- The Contractor HSE Manager is responsible for maintaining an effective crisis management and emergency response capabilities within site / vessel of responsibility.
- In addition, the Contractor HSE Manager shall also meet the HSE roles, responsibilities and accountabilities as specified in their respective Position Description.

Contactor HSE Liaison/Focal Person

- Contractor HSE Liaison/Focal Person is an employee appointed to coordinate HSE matters for their delivery and execution of the exploration program. This will be a vessel-based role during the main survey activities.
- Contractor HSE Liaison/Focal Person will be responsible for the following:
  - Disseminating HSE information with all relevant personnel in the contractor team, including sub-contractors;
  - Coordinating the provision of HSE advice and reporting to Shell;
  - Tracking the implementation and closure of HSE action items;
  - Tracking the implementation of HSE training and inductions;
  - Compiling and submitting HSE performance reports (e.g. incident report, man-hours); and
  - Coordinating and/or conducting HSE briefing to new staff and transferees within the contractor team.

Marine Mammal Observer (MMO)

- The primary role of an MMO is to act as an observer for marine mammals and to recommend appropriate vessel response prior to and during the commencement of seismic activity should any marine mammals be detected.
- The MMO will advise the Captain / Vessel Master on the procedures set out in the JNCC guidelines and to provide advice to ensure that the survey programme is undertaken in accordance with the guidelines.
- Specific task responsibilities will include the recording of observations of marine fauna and monitor and reporting on compliance with the Code of Conduct as committed to in this EMP.

Table 8-2: Vessel-based Roles and Responsibilities

Position	Role	Responsibilities	Specific Tasks
Shell Site / Vessel Representative	Oversight	• Overall accountability for the implementation of the EMP during the survey program • Oversight of contractor performance, including audit and review	• Review of Contractor HSE and operational performance • Reporting of issues / concerns to Shell management team • Provision of input to crew inductions / awareness • Promote culture of HSE commitment in line with Shell company expectations
Contractor Captain	Vessel Operation	• Ensure the safe execution of all operations of the survey vessel, including overall contractor responsibility for HSE management aboard the survey vessel	• Ensure the vessel management system and procedures are implemented • Establish and maintain radio contact with other vessels in the survey area and adjacent waters, to maintain safe operational distance and notifications. • Maintain contractor compliance with this EMP, supporting plans and procedures (including SOPEP, Waste Management Plan and Emergency Response Plan)
Contractor Party Chief	Supervision	• Responsible for supervising the execution of the seismic survey activities in accordance with contractor obligations	• Review trip planning and logistical arrangements prior to mobilisation • Provide copies of documents, records, reports and certifications (as requested by Shell) in a timely manner to assist in compliance reporting • Undertake daily toolbox meetings and ensures that onsite risk assessments are undertaken • Undertake field operations reporting
Contractor HSE Liaison / Focal Person	Responsibility for HSE Monitoring and Reporting	• Ensure the coordination of HSE commitments on vessel • Oversee implementation of HSE commitments, including training and awareness	• Coordinate provision of HSE advice to all relevant personnel • Oversee implementation of waste management obligations, as defined in Garbage Management Plan • Monitor and report on progress in the implementation of SOPEP to manage risk of accidental releases • Report on contractor progress in achieving HSE objectives
Catering Supervisor	Monitoring	Responsible for complying with obligations to manage kitchen wastes in accordance with Garbage Management Plan	• Keep clean galley / mess and disposal site • Record canteen waste and remove all kitchen waste daily from galley / mess • Report on progress in accordance with Garbage Management Plan
Marine Mammal Observer (MMO)	Observer / Adviser	Responsible for monitoring the presence of marine mammals fauna in the area, and to advise the seismic vessel operators when measures should be taken in accordance with JNCC guidelines	• Record observations of marine fauna and monitor and report on compliance with the Code of Conduct as committed in this EMP

8.6.4 HSE Communication

Consultation on HSE issues shall include:

- Pre-trip briefing
- Daily pre-start meetings
- Toolbox talks
- Daily operations reports
- Post-survey debrief sessions

Pre-trip briefing

The Party Chief will conduct a briefing with the survey crew to discuss the scope and schedule of the trip, as well as HSE expectations, the commitments in this EMP, and specific requirements in accordance with the Contract. This briefing will be held prior to mobilisation and will include representatives from any subcontractor organisations. HSE induction will be carried out at each crew change.

Daily Pre-start meetings

A daily pre-start meeting will be held with all field personnel, prior to the start of shift to help maintain the safe execution of the shifts planned tasks. These meetings will discuss the operational tasks for the day, safety considerations associated with these, signing on to HSE documentation and any new information that can be provided to the field team.

This includes sharing of HSE-related information, e.g. incidents, unsafe acts and unsafe conditions, housekeeping (including deck / waste management), lessons learnt, etc.

Toolbox talks

Toolbox talks will be held before each major new task is carried out. The aim of these talks is to refresh personnel on the relevant job steps, and to identify any new hazards that may have not been previously identified. All personnel involved in the task are to attend the toolbox talks.

Daily Operations Reports

The Party Chief will provide regular reports to shore-based Shell and contractor management team on the day's progress, weather considerations, any HSE observations / lessons learnt, and forward plan for the following day.

Post-survey Debrief Sessions

It is expected that, at the conclusion of the marine survey activities, Shell and its contractor will evaluate the program, including sharing of observations and learnings in HSE management. This will include a summary of performance against the commitments in this EMP.

8.6.5 Training and Competency

Shell, as part of its contracting process undertakes assessments of a proposed contractor's environmental management system and core competencies to determine adherence to Shell expectations. This assessment is undertaken as part of contractor screening, engagement and pre-mobilisation process.

The purpose is to identify training needs appropriate to the offshore marine survey scope, and check that such training is provided so that personnel are competent to work in a safe and environmentally responsible manner. All relevant training, inductions and qualifications will be recorded in a training register and available to Shell.

Project Induction

All project personnel including subcontractors either visiting or working on the vessel during field activities shall undertake a project HSE induction. The induction shall be conducted by the Shell Contract Holder or a delegate and will include:

- An introductory briefing of the survey schedule, scope of activities;
- An overview of the general HSE considerations that may be encountered during the survey;
- Environmental commitments as outlined in this EMP;
- Contractor HSE policy and procedures which shall satisfy all guidelines and/or operating standards provided by Shell, including alignment with Shell's Life Saving Rules;
- Cultural awareness; and
- Overview of emergency response requirements, including protocol for responding to and reporting any accidental releases.

Skills and Competency

The vessel contractor will be required to confirm that all personnel will have appropriate qualifications and experience in executing the seismic program.

An up-to-date training matrix will be maintained to define corporate and site/activity-specific environmental training and competency requirements, including environmental stewardship responsibilities for specific roles.

A training needs analysis will be conducted to confirm the training requirements for each field role. Training records for all field personnel will be maintained by the contractor in the project training matrix.

Minimum training requirements for offshore surveys typically include:

- TBOSIET (Tropical Basic Offshore Safety Induction and Emergency Training) or equivalent Sea Survival Training, or Facility Abandonment and Sea Survival;
- A current offshore medical / fitness-for-work check;
- Drug and Alcohol check (in accordance with contract obligations);
- Helicopter Underwater Escape Training (HUET) if personnel are required to transfer via helicopter;
- Vessel crew qualifications, appropriate to the vessel class.

For this program, specialist qualifications will be required for the role of Marine Mammal Observer. Only appropriately qualified and experienced MMOs (that have completed certified training in the implementation of JNCC guidelines) will be utilised for the seismic program subject of this IEE.

New-to-Vessel Personnel

It is expected that, during the course of the survey program, there may be the requirement to change out crew members, introducing the need to ensure new personnel are aware of their obligations.

Any inexperienced personnel, temporary labour or new to site employees will be supervised and monitored until they are deemed competent by relevant vessel personnel and are fully aware of the hazards and required controls associated with their assigned role.

Subcontractors

Should the survey contractor engage third-party companies in executing the survey activities, the same HSE expectation is required of those subcontractor organisations. Subcontractors are responsible for the communication of their HSE Plans to their employees. Subcontractors shall check records that are kept of all induction, HSE Plan and Safe Work Method training. Subcontractors shall check certificates and licences etc. are documented in appropriate records and will provide copies of relevant training and certifications to the Contractor HSE Manager / HSE Focal Person on request.

Shell is responsible for vetting and approving the vessels and its crew prior to mobilisation.

8.6.6 Audit and Review

Shell has in place a process of regular audit and review checks, to ensure that environmental performance commitments are being undertaken.

Audits are scheduled on a timely basis to verify that operations conform to regulations, policy and site-specific procedures, verify that monitoring practices are effective, and identify procedure changes that can improve effectiveness.

Specific objectives of auditing include:

- Ensuring that environmental and social management measures to achieve management objectives are being implemented, reviewed and where necessary amended;
- Any potential non-conformances and opportunities for continuous improvement are identified and auctioned;
- Ensuring that all environmental and social management objectives have been met before completing the activity; and
- Providing a feedback loop on learnings and improvement opportunities.

For this survey program, an inspection of the vessels will be carried out before or during the survey, to ensure that procedures and equipment are in place to enable compliance with this EMP and supporting plans and procedures.

In addition, copies of this EMP will be distributed aboard the vessels. Part of the role of the Shell Site / Vessel Representative will be to monitor the contractor’s implementation of the measures as defined in this EMP.

8.7 Data Management and Dissemination

There are several mitigation commitments that are likely to generate information that is of potential value to the wider community. This will include information from MMO observations of marine mammal or turtles, but may also include data regarding bathymetry, major seabed structures and seawater quality. It is recognised by Shell that this data may have value with regard to improving the understanding of the baseline environment in Myanmar waters and thereby informing future impact assessments and/or national environmental policy.

Shell will, subject to consultation with all relevant Myanmar Government agencies consider data dissemination, accounting for data ownership and confidentiality issues and providing relevant stakeholders with data in a format that is of value to them as appropriate.

8.8 Change Management

There are inevitably information gaps and uncertainties that remain regarding the proposed seismic survey and the impact assessment process at the time of completing this IEE report. Shell has introduced a clear and transparent 'Management of Change' (MoC) procedure to address such gaps and uncertainties as they are resolved.

The typical schedule and logistics requirements associated with the marine surveys are well understood, which enables all of the potentially significant impacts to be identified and assessed. However, where uncertainty or change does present itself it will need to be dealt with in a structured and transparent way. This MoC process requirement will be reflected in the survey EMP.

8.9 Monitoring and Reporting

This monitoring will include:

- Monitoring and reporting of marine mammal presence during the survey;
- Observation and records of fisheries activities;
- Monitoring and reporting in the event of non-routine incidents (e.g. an accidental release of a hazardous substance);
- General ship's logs (see Shell's standard EMP for seismic) for fuel usage, vessel / shipping interactions, wastes, etc.

A summary of the environmental monitoring measures and associated reporting relevant to the offshore seismic program are presented in **Table 8-3**.

Monitoring measures and reporting detailed in **Table 8-3** will be summarised in a monitoring report in accordance with section 95 of the Environmental Impact Assessment Procedure (Government of the Republic of the Union of Myanmar Ministry of Natural Resources and Environmental Conservation, 2014). The monitoring report will be submitted to MONREC at the end of the survey. In addition, this monitoring report will be made publicly available on a Project website.

Table 8-3: Environmental Monitoring Measures

Environmental Factors	Monitoring Measures	Reporting	Duration and Frequency of Monitoring	Location	Budget	Responsible Party
Air quality	Ship's engine maintenance logs Fuel usage log	Summary report - end of survey.	Throughout the project period	Survey Vessel	Within Project budget	Contractor
Marine Mammals	Visual monitoring	Record observations of marine fauna observations in standard log sheets.	Daylight hours throughout the project period	Project area	Within Project budget	Contractor
		Collect and prepare monitoring report to be submitted to MONREC (within 1 month following project completion).	After survey completion	Project area	Within Project budget	Shell
Fisheries	Visual monitoring and direct engagement	Record type, number, and GPS position of fishing equipment that were removed from survey lines each day (if any).	Throughout the project period	Project area	Within Project budget	Contractor
		Record any complaints and follow the outcome.	Throughout the project period	Project area	Within Project budget	Contractor
Shipping	Watch-keeping – in accordance with international maritime practice	Bridge logs.	Throughout the project period	Project area	Within Project budget	Contractor (Vessel Master)
Wastes	Daily checks/ inspections	Waste records: hazardous and non-hazardous waste volume by type daily.	Throughout the project period	Project area	Within Project budget	Contractor
Non-routine incidents	Record any oil spill incidents during the survey	Number and details of any environmental incidents (incident logs).	Throughout the project period	Project area	Within Project budget	Contractor
		Collect and prepare monitoring report of any oil spill >80 L in size to be submitted to MOGE and MONREC (within 1 month following project completion).	Throughout the project period	Project area	Within Project budget	Contractor

8.10 Emergency Response Plan

An Emergency Response Plan (ERP) will be established for emergency situations that may arise during the activities. The plan will give guidance on actions and lines of communication in the event of an emergency and outline the respective responsibilities of Shell and the contractor. The operational control of the emergency will be the seismic contractor's responsibility.

Of particular relevance to this EMP, Shell will review the ERP relative to any environmental impacts / risks that have been identified for the project, ensuring that personnel understand their responsibilities and the notification and reporting processes required in the event of an environment or other emergency.

It is expected that the ERP will include, but not be limited to, the following scenarios (as detailed in **Chapter 4**):

- Fire
- Abandon ship scenario / evacuation
- Security incident
- Extreme weather, including cyclone or tsunami
- Collision / vessel grounding
- Rescue or workboat emergency recovery
- Man Overboard (MOB) / search
- Medical evacuation (Medevac)
- Fatality
- In-water emergency (e.g. loss of propulsion or steering)
- Fuel/chemical spill (with reference to Vessel SOPEP)

Core elements to be addressed in the ERP will include:

- Clear chain-of-command and responsibilities for the Emergency Response Coordinator and supporting team;
- Description of Emergency Response Plan be documented and posted;
- Emergency response drills and competencies;
- Definition of equipment required and where it will be located;
- Responsibilities of individual crew members in an emergency scenario, and training / competency requirements;
- Definition of organizations to be contacted (management, client, contractors, etc.) and contact details
- Protocol for handling notifications / announcements;
- Reporting procedures required for government agencies by both the contractor and Shell.

A test or drill will be conducted to ensure that effective emergency response preparedness is in place, appropriate for the survey scope.

Vessel Emergency Response Organisation

The vessel contractor shall establish the Vessel Emergency Response Organisation to respond to emergency that may occur at the vessels.

The Vessel Emergency Response Team responds to all emergencies occurring on the vessel. In cases where additional resources and technical support are required, these shall be identified and responded appropriate to the event.

To ensure and maintain emergency response preparedness, the Vessel Emergency Response Team shall be provided with the required training and exercises.

8.11 Public Consultation and Disclosure

Chapter 9 provides a full summary of the engagement program undertaken as part of the IEE process. A stakeholder engagement program has formed part of the IEE studies conducted in respect of the proposed MD-5 activities. The key elements of the program consisted of providing relevant information to local regulatory authorities and communities about the proposed activities, and engaging with them on the potential impacts and associated mitigation measures.

Shell recognizes that consultation and disclosure is an ongoing process. Accordingly, follow-up engagement will take place prior to project implementation. This engagement will be focused on providing up to date information and making sure that there are opportunities for communication between the local authorities and communities on relevant aspects of the project. Direct liaison with fishermen at sea to minimise potential for interaction with fishing will be facilitated throughout the survey in accordance with the measures defined in this EMP. In addition a formal marine notice will be issued to alert all relevant sea users prior to the commencement of the survey.

Prior to both the initiation of seismic activities, Shell will undertake the following activities prior to and during the proposed operations:

- Provide for dissemination of information, and
- Maintain feedback and community attitudes.

Handling of Stakeholder Complaints

A Community Feedback Mechanism will be established, and feedback log will be maintained by Shell throughout the duration of the project.

Complaints will be addressed following the procedure outlined in the flowchart below.

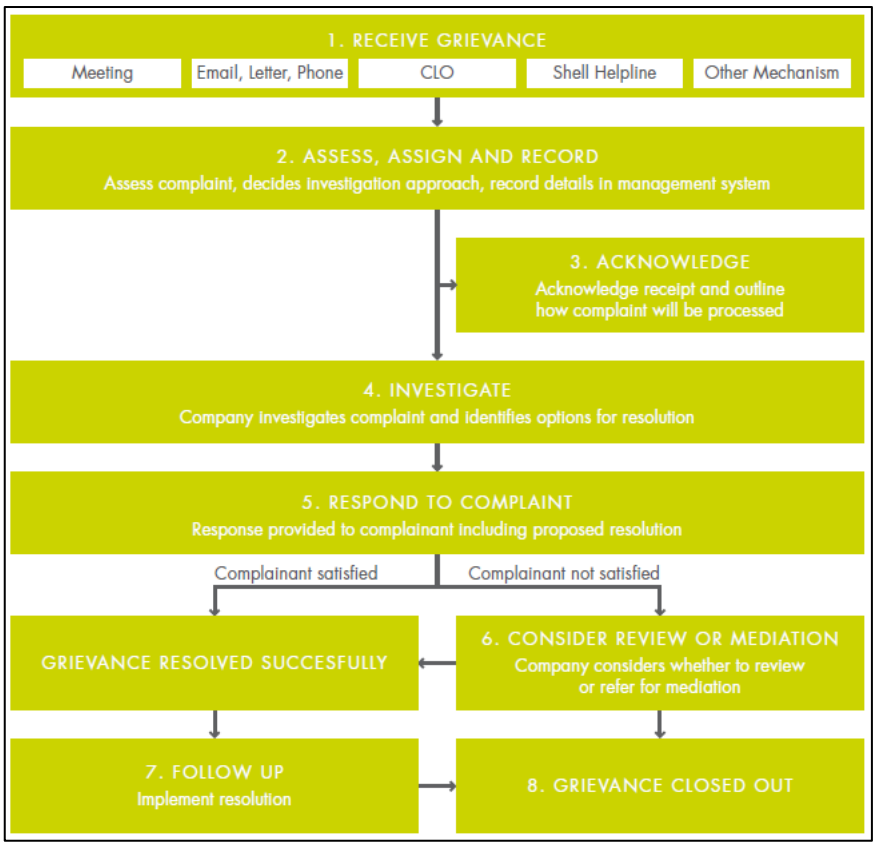


Figure 8-1: Typical Community Feedback Mechanism

9. Public Consultation and Disclosure

The key elements of the impact assessment related consultation are concentrated around ensuring that stakeholders are fully informed of the proposed project activities and that the views of stakeholders are taken into account where relevant. This may include making changes to the project design to accommodate stakeholder input where applicable and possible, and then report this in the IEE. The overall objective is to ensure the assessment is robust, transparent and has considered the full range of issues or perceptions, and to an appropriate level of detail.

A stakeholder engagement programme has formed part of the IEE studies conducted in respect of the proposed MD-5 activities. The key elements of the programme consisted of providing relevant information to local regulatory authorities and communities about the proposed activities, and engaging with them on the potential impacts and associated mitigation measures. This, in combination with requesting input and proposals from anyone that might be affected directly or indirectly by the proposed project activities, have allowed community representatives and authorities to influence and to gain knowledge and understanding of the project and its associated aspects and impacts before it takes place. The specific targets and objectives of Shell's stakeholder consultation program included the following:

- Identification of potential stakeholders relevant to the offshore deep water exploration survey activities including any supporting onshore (port) infrastructure;
- Identification of stakeholders who may be able to contribute to data gathering and validation to inform the IEE;
- Seeking input in the identification of key environmental, social, human rights, health and economic issues which need to be considered;
- Establishing lines of communication and increasing the level of understanding between the operation and its stakeholders;
- Gaining an understanding of local communities, their assets, rights, priorities, concerns, needs, expectations and perceptions; and
- Where relevant, identifying and considering potential environmental and social performance indicators, which have relevance for both stakeholders and the operation.

The stakeholder engagement for this IEE study consisted of four key activities, namely focus group meetings, key informant interviews, household socio-economic and attitude surveys, and traditional ecological knowledge surveys. In addition to engagement with representatives from local coastal communities, there was consultation with Government agencies at Union, Regional and local levels, and with fishing industry representatives where this was considered relevant to the offshore deep water nature of the proposed exploration survey activities.

Input from stakeholders consulted during this IEE have been considered and incorporated into the project design and mitigation measures as presented in the EMP. This section outlines how the consultation process was conducted and presents the key findings. A summary table of issues raised and how these are addressed is provided in **Table 9-2**.

9.1 Initial Consultation

In order to inform early screening and scoping of the impact assessment process, some stakeholder consultation with relevant individuals and organizations was undertaken at an early stage and before the PSC was in place. This consultation was used to collate publicly available information about the Myanmar offshore marine environment. A list of the stakeholders contacted is provided in **Table 9-1.**

The consultation was carried out through a procedure set out below:

1 The organization was contacted to introduce IEM.

2 The organization was informed that IEM would like to meet with them and discuss the offshore area of Myanmar.

3 A meeting or interview was conducted with key people in each organization. Availability of data relevant to the offshore environment was discussed and opinions/concerns/recommendations noted.

4 Notes of meetings, including opinions/concerns/recommendations were prepared.

Table 9-1: Initial Stakeholders Consulted

No.	Organization	Type of Group	Relevance to IEE	Consultation Approach
1	Myanmar Fisheries Federation	Potentially Directly Affected	Engaged as key industry representative. MFF was founded in 1989 as one of the highest national level non-profit making organization with a view to encourage and promote the fishing industries of Myanmar. Also to inform knowledge of any FADs (fish attraction devices) off coast of Myanmar.	Key Informant Interview and Small focus group discussion on marine environmental information / data gaps
2	Myanmar Marine Biological Association (MMBA) and Marine Science Association Myanmar (MSAM)	Interested Party – Marine Scientist Association / Research Group	MMBA's area of focus is on the biological aspects of the marine environment. MMBA members consist of marine scientists from three universities in Myanmar located in Pathein, Myeik and Mawlamyaing. Mawlamyaing University is the focal point for marine science research in Myanmar.	Key Informant Interview and Small focus group discussion on marine environmental information / data gaps
3	Biodiversity and Nature Conservation Association (BANCA)	Interested Party – NGO	BANCA is one of the major organizations active in Myanmar in the field of biodiversity conservation and sustainable development.	Key Informant Interview and Small focus group discussion on marine environmental information / data gaps
4	Myanmar Bird and Nature Society (MBNS)	Interested Party – NGO	MBNS focus on protection, research and public education in relation to Myanmar ecotourism in the areas of bird watching and important bird area conservation.	Key Informant Interview and Small focus group discussion on marine environmental information / data gaps

9.2 IEE Consultation Process

A consultation process aligned with the objectives stated in the EIA procedures was conducted as part of the IEE studies. This process involved: providing information including brochures and information sheets about the proposed project to regional and local authorities, interest groups including industry associations, local coastal communities and others, and direct engagement through focused consultation meetings with the key stakeholders at Union, Regional and local levels.

Earlier consultation (see **Section 9.1**) was followed up and general engagement held with MOGE and the Environmental Conservation Department (ECD) of the Ministry of Natural Resources and Environmental Conservation (MONREC) on the EIA process to be undertaken. This has included an initial EIA screening process and the submission by Shell to MONREC of a Project Proposal for the exploration programme to be conducted in MD-5. The purpose of the Project Proposal was to inform ECD that on the basis of the screening, Shell considered that the project EIA process should be focused around an Initial Environmental Examination

(IEE). This IEE level of assessment would be appropriate for this proposed activity that does not have significant adverse environmental or social impacts, for which appropriate mitigation measures can readily be applied.

Starting in March 2015 and continuing through to the submission of the IEE, a focused consultation program was conducted by a joint IEE team including consultants from IEM/EQM, and representatives from Shell and MOGE where appropriate. The local consultation program conducted in the Tanintharyi Region in respect of the MD-5 exploration survey IEE included:

1. Meeting in Dawei with the Chief Minister, Tanintharyi Region. At this meeting were also the Finance Minister and the Director of the Chief Minister's Office.
2. Meeting with the Regional Minister of Energy, Tanintharyi Region
3. Meeting in Dawei with the Director of Forest Department for Tanintharyi Region, Head of Myanmar Port Authority,
4. Meeting in Myeik with Myeik Township Authority – Administration Head Officer, District Fisheries Officer of Department of Fisheries for Myeik District, Executive Committee Member from Myanmar Fishery Federation, and Officer of Environmental Conservation Department, MONREC, Tanintharyi Region.
5. Meeting with the Myanmar Fishery Federation (MFF) and representatives of the Department of Fisheries, Myeik Township and District.
6. Meeting with communities in two coastal villages in the Myeik Township area.

Focus Group meetings were held in the two villages and included Key Informant Interviews, Socio-economic surveys and Traditional Ecological Knowledge surveys. Shell intends to re-engage both with regional and local authorities, fisheries interests and local community representatives prior to commencing the survey programme, and issues raised will be closed out as part of these follow-up meetings, please see **Table 9-2**. The meetings will be conducted prior to any activities commencing offshore. Further detail on this is given in **Section 9.3.2**.

A detailed socio-economic survey was completed for 70 village households across the two villages. The focus group discussions and socio-economic surveys were completed with 66 individuals from Ye Pone and Shar Taw Wa Villages, Ka Lwin, Myeik, Tanintharyi. While distant to the offshore Project location, Myeik is located on the part of the Myanmar coastline nearest Block MD-5. The two villages were selected on the basis that they represented communities on or near the coast and with direct and/or indirect ties with the local fishing industry. In this way they could be considered typical and representative of villages which may potentially have members of the community fishing offshore in deep water, and they could also potentially be affected by offshore development activities, should these occur sometime in the future.

IEM's socio-economic survey team consisted of staff from IEM/EQM including a senior socio-economic expert, two supervisors, two trained biodiversity technicians, and six socio-economic technicians trained by IEM.

Five Key Informant Interviews were conducted with village leaders and health providers. Traditional Ecological Interviews were also carried out in the two villages with the objective of obtaining relevant information on local fisheries and biodiversity.

9.3 Consultation Process

Potential issues of concern to authorities and communities were identified by the survey team through the above engagement, as well as through:

- Experience of project team from past projects in other regions;
- Input from Shell; and
- Meetings with and input from ECD (MONREC) and MOGE.

9.3.1 Presentation of the Project Proposal to Ministry of Natural Resources and Environmental Conservation

At the commencement of the IEE studies, Shell met with the ECD (MONREC) to present the Shell organisation and the proposed project including its timeline. MONREC and MOGE provided advice in terms of the impact assessment process and the necessary consultation process to include local and regional authorities and representatives of local communities.

9.3.2 Focus Groups

In the focus group meetings information was provided about the location and characteristics of the proposed project in Block MD-5, the water depth in the area, and a discussion followed on whether local fishermen were likely to be fishing in the area of the survey. There were also discussions with fisheries officials and representatives in relation to the status of scientific research that has been done on the effects of seismic operations on marine life such as fish, invertebrates, turtles, and marine mammals. A copy of the English and Myanmar language brochure handed out during focus group meetings are included in **Appendix B**.

In a meeting with the fishing industry representatives in Myeik, local representatives requested that Shell, IEM and EQM return to Myeik to meet for a second time with the fisheries association, and that together with MFF from Yangon participate in this meeting. That would enable a more in-depth discussion on the scientific aspects and possible effects of seismic activities on fish and fisheries.

In a meeting with MFF in Yangon, the project team was provided with information on a USAID capacity building project on sustainable seafood development being conducted in cooperation with MFF, and also on the linkage between Pathein University, Yangon University and University of Arizona on fisheries research matters. MFF mentioned data from the two major Dr Fridtjof Nansen research vessel surveys, supported by the Norwegian Government. The MFF sought information on whether Shell would be able to support MFF by providing data.

The MFF noted that it would be possible that tuna fisheries would be conducted in the area of MD-5. MFF also informed the project team that they had recently held a meeting with fishermen to discuss potential effects of seismic operations. MFF stated that it has a priority to monitor the fishery resource. MFF also advised that Yangon University and Mawlamyaing University represent the centres for fisheries research in Myanmar.

Prior to initiating community meetings, the support and approval for village meetings were obtained through consultation meetings with the Chief Minister and key Township Officials. Key project information was provided at these meetings on the proposed project and on the IEE process. The local engagement activities were facilitated by MOGE through contacting local officials at Regional, Township and village level, who again made arrangements for meetings. MOGE participated in each focus group meeting and addressed all relevant questions.

The community meetings in each of the two selected coastal villages were facilitated through the head Monk, who was given a prior briefing on the project, the IEE process, the company (Shell) and the planned consultation with representatives from the village. Both village meetings began with an introduction by a member of the EQM team. Shell then provided a description of the planned project. The consultants then discussed the IEE including the environmental and social aspects and impacts being evaluated. Shell sought input from the villagers on the project and encouraged the villagers to give a view on their needs for support in terms of possible CSR activities. This feedback is being considered during the development of the CSR program. Following the more formal part of the meetings, the consultants conducted the detailed survey interviews as outlined in **Chapter 5**.

Meeting with Government Officials

Focus Group Discussion with Villagers

Question and Answer Session

Figure 9-1: Focus Group Meeting Photographs

9.3.3 Key Informant Interviews

Key informant interviews (5) were conducted with Village Leaders; the Village Medical Officer and the Village Education Officer in the two selected coastal village. Targeted subsets of the socio-economic and attitude survey questions were used as a basis for the Interviews.

The analysis of the information gathered has shown the data collected from key informants was consistent with the socio economic and attitude data collected from the villagers. The key informants interviewed had not previously been aware of the planned offshore exploration survey activities, but acknowledged that this project could be of importance to the community. On the basis of the information received, the key informants expressed support for the project.

The majority of key informants considered health care and education priority development initiatives in the local area.

9.3.4 Socio-economic, Health and Opinion Surveys

A total of 70 household socio-economic, health and opinion surveys were conducted in the two villages.

Questionnaires collected socio-economic, health and opinion information as well as the opinions and understanding of Shell's planned exploration programme. The surveys were conducted subsequent to the focus group meetings.

The socio-economic survey was designed to focus on gaining household member information and attitudes on:

- The structure and demographics of the households;
- Household living standards, employment, income, social and economic conditions;
- Household and individual health;
- Information on the natural environment and human use of the environment, including information on local fisheries; and
- Attitudes on the potential impacts of the project should the exploration activities lead to oil and/or gas discoveries with potential for future development and oil and/or gas production.

9.3.5 Issues Raised

The key issues raised during the consultation programme are set out in **Table 9-2**.

Table 9-2: Summary of Issues and Concerns Raised During Consultation

Issue/Concern	Raised by	How will this be addressed
Impact assessment should be thorough and carried out to international standards	Government officials/staff and civil society organisations	IEE study carried out in accordance with Myanmar Regulations and international best practice.
Compliance with EMP	Government officials/staff and civil society organisations	EMP to be implemented by Contractor. Shell will ensure that the Contractors management systems being applied to the surveys will reflect the requirements of the EMP and Company representatives on-board will review and assess compliance throughout the activities.
Impact on fishing	Government officials/staff, national and local fishing associations, members of the community	Application of relevant pollution prevention measures throughout the surveys and proactive and in-the-field fisheries liaison.
Impact on Marine Mammals	Government officials/staff	Application of JNCC standards for minimising underwater noise disturbance of marine mammals. Maintaining distance between surveys, should they occur in nearby blocks at the same time.
Adequate information, lack of community engagement	Government officials/staff, national and local fishing associations, members of the community	Consultation programme implemented. Targeted pre-mobilisation engagement to be carried around the time of survey mobilisations. Marine notices to be issued in advance of surveys.
Local fishing representatives requested that Shell, IEM and EQM return to Myeik to meet with the fisheries association, together with MFF from Yangon to have a more in-depth discussion on the scientific aspects and possible effects of seismic activities on fish and fisheries	Myeik Fishing Representatives	Follow up meetings are being organized with the Myeik Fisheries Association and MFF to provide additional information and discussion on the scientific aspects and possible effects of seismic activities on fish and fisheries.
The MFF sought information on whether Shell would be able to support MFF by providing data	MFF	Shell will share all available data with MFF.
MFF noted that it would be possible that tuna fisheries would be conducted in the area of MD-5	MFF	Shell will continue to engage with MFF and representatives of the tuna fisheries to provide information on the planned seismic program.

Public Involvement Team at Chief Ministers Office

Focus Group Meetings with Villagers

Focus Group Meetings with Government Officials

Figure 9-2: Public Involvement Photographs

9.4 Socio-economic, Health and Opinion Surveys

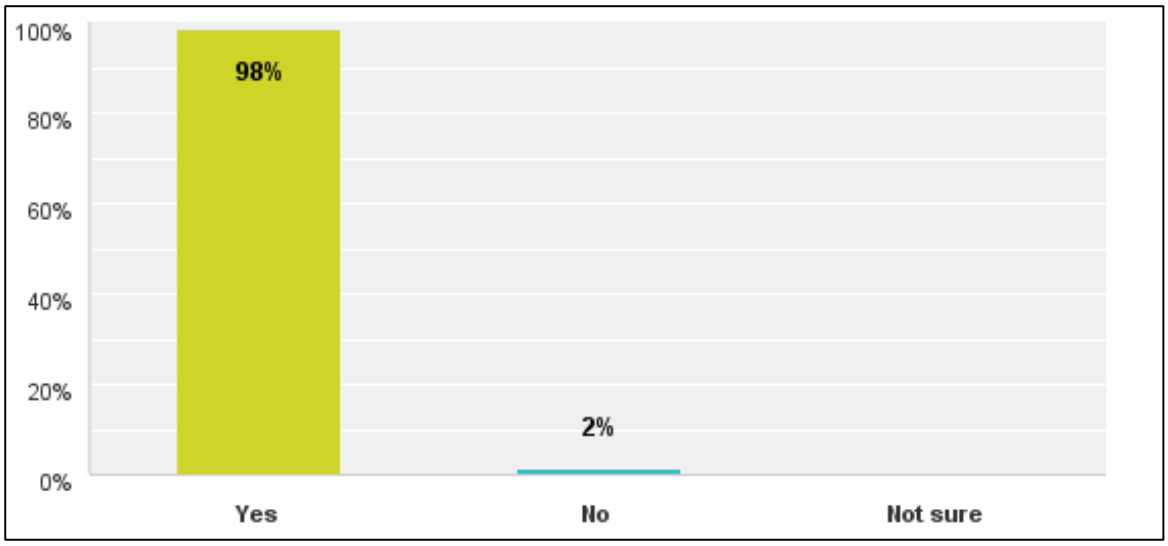
The socio-economic, health and opinion survey questionnaires consisted of 97 questions. The results have been analysed and discussed further in **Chapter 5**. A summary is provided below.

9.4.1 Opinions about the Project

Of the villagers interviewed, 77% of the responders had learned of the project from the community leader, and 16% had learned of this project from surveyors and interviewers. Of those interviewed, 53% of participants indicated that this project is important to the community, while of this total, 24% considered it as very important, and 23% considered it as extremely important.

Of those interviewed, 98% agree with the proposed deep offshore seismic survey (**Chart 9-1**).

Chart 9-1: Offshore Seismic Project Agreement

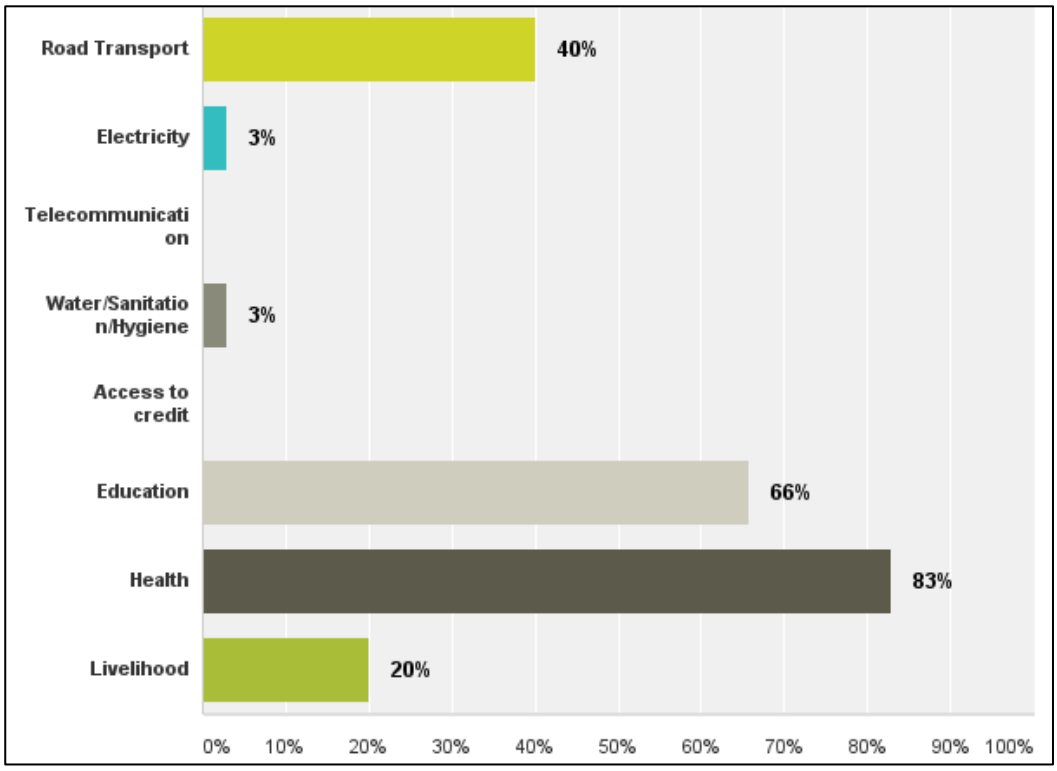


When asked how the project could potential impact them, 69% were unaware, 12% indicated that they were concerned that the project would impact employment, while 8% were concerned that the project would impact fishing.

9.4.1.1 What is the priority development initiative for your community?

The interviewees were asked what they considered to be the the priority development initiative for their community. The majority (83%) considered health a priority development initiative, while 66% considered education to be a priority development initiative, with 40% placing importance on road transport (**Chart 9-2**).

Chart 9-2: Community Priority Development Initiatives



9.4.2 Issues Raised by Community Stakeholders

The opinion survey results identified the opinions of the level of impact potentially caused by the deep offshore exploration programme. This can assist Shell in understanding how the stakeholders view the project, and guide the provision of further information about the project to improve the local understanding of the likely effect of the project.

Interviewees were asked what in their opinion would be the positive and negative impacts of the project. The results are presented in **Table 9-3** below, with the number of replies perceived to be of significance highlighted in red.

Table 9-3 : Opinions of Potential Impacts of the Project

Answer Options	Very negative	Negative	Slightly negative	No effect	Slightly positive	Positive	Very positive
Soil Quality	1	1	0	59	5	0	0
Surface water quality	0	1	13	52	0	0	0
Ground water quality	0	2	11	47	6	0	0
Air Quality	0	1	6	59	0	0	0
Noise	0	1	0	65	0	0	0
Forestry and conservation areas	0	1	0	65	0	0	0
Agriculture/Farming Areas	0	1	0	65	0	0	0
Local animals	0	0	1	65	0	0	0
Pasture	0	0	1	65	0	0	0
Aquatic animals	1	2	14	49	0	0	0
Local Fisheries	1	10	6	48	0	0	0
Local Livestock	0	10	1	55	0	0	0
Local Vegetation	0	1	1	62	0	1	0
Local Industry	0	0	1	65	0	0	0
Local Transportation	0	0	1	54	0	11	0
Local Price	0	0	1	60	0	5	0
Recreation	0	0	3	58	0	5	0
Local Economy	0	0	10	44	7	5	0
Housing	0	0	1	54	6	5	0
Health	0	0	0	49	8	8	0
Education	0	0	0	37	17	12	0
Spiritual	0	0	0	49	9	8	0
Safety	0	0	0	57	1	8	0
Crime	0	0	0	58	0	8	0
Family Structure	0	0	0	59	0	6	0
Job opportunities	0	0	0	45	6	15	0
Income	0	0	0	37	7	22	0
Scenery	0	0	0	48	3	15	0
Local culture	0	0	1	58	0	6	0
Religious Building	0	0	0	55	0	8	0
Cemetery	0	0	0	59	0	5	0
Historic buildings/sites	0	0	0	59	0	5	0

Note: Those numbers highlighted in red are considered to be significant.

The villagers surveyed did not perceive any of the issues as very negative or very positive. There was an overweight of perceptions of neutral to negative impact on local fisheries and local livestock, whereas the responders tended to perceive impacts on local transportation, health, education, spiritual, safety, crime, income, job opportunities, scenery, and religious buildings as neutral to positive.
One outcome of this is that, Shell in their planning of the Project will re-engage at local level prior to the activities taking place to make sure accurate information is given to the public prior to project initiation.

9.5 Future Consultation and Disclosure

It is acknowledged by Shell that there are advantages of continuing the dialogue around the project, and follow-up engagement will take place prior to project implementation. This engagement will be more targeted and smaller in extent than the first consultation phase, and will be focused on providing up to date information and making sure that there are opportunities for communication between the local authorities and communities on relevant aspects of the project. To ensure that potential concerns are addressed in a timely fashion, direct liaison with fishermen will be conducted at sea to avoid or minimise potential for interaction with fishing will be facilitated throughout the survey as described in **Chapter 6** and **Chapter 8**. In addition, a formal marine notice will be issued to alert all relevant sea users prior to the commencement of the surveys.

A Community Feedback Mechanism is being established. This will be operational in advance prior to the surveys commencing, and a community feedback log will be maintained by Shell throughout the life cycle of the project.

9.6 Corporate Social Responsibility

Shell defines Corporate Social Responsibility (CSR) as the contribution of skills and/or resources to a host society/community to provide lasting benefit to the host society and/or the environment and to Shell. CSR programmes may take many forms including financial assistance, in-kind donations (such as surplus equipment or materials), volunteering and sharing of expertise.

Shell sees CSR as a key element of being a good neighbour in all the countries where the company operates. CSR is closely linked to the local context for the company's activities and to potentially affected communities in areas of activity. As such, social investment would normally be concentrated in areas that complement Shell's business and that meet the needs of the community.

Shell aims to be recognised by Government and other local stakeholders in Myanmar as contributing to society, with the country and communities around our operations sharing the value of opportunities arising from Shell's presence. The company seeks to achieve this in future oil and gas operations by operating practices such as local content policies, and in the future through training and internships where possible. Other opportunities can be generated through small scale social investment. CSR activities will be based on international best practice applied to locally relevant topics (in line with the IEE) and will be conducted in an atmosphere of transparency.

Shell is currently evaluating the potential for working with local partners for CSR activities in Myanmar and will continue its engagements with various stakeholders, including authorities, development agencies, communities and civil society organizations to implement sustainable CSR programmes.

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Appendix A. Environmental Laws in Myanmar

Sector	Relevant Laws in Myanmar
Administrative	The Territorial Sea and Maritime Zones Law, 1977
	The Emergency Provisions Act, 1950
	The Essential Supplies and Services Act, 1947
	The Police Act, 1945
	The Poisons Act, 1919
	The Explosive Substances Act, 1908
	The Towns Act, 1907
	The Village Act, 1907
	The Yangon Police Act, 1899
	The Explosives Act, 1887
	The Penal Code, 1861 of Offences Affecting the Public Health, Safety, Convenience, Decency and Morals
Agriculture and Irrigation	The Fertilizer Law, 2002
	The Plant Pest Quarantine Law, 1993
	The Pesticide Law, 1990
	The Embankment Act, 1909
	Underground Water Act, 1930
Culture	The Protection and Preservation of Cultural Heritage Region law, 1998
Forestry and Natural Resources	The Protection of Wild Life, Wild Plants and Conservation of Natural Areas Law, 1994
	The Forest Law, 1992
Environmental	The Environmental Conservation Law, 2012
	Environmental Conservation Rules, 2014
Public Health	The National Food Law, 1997
	The Traditional Drug Law, 1996
	The Prevention and Control of Communicable Disease Law, 1995
	The Narcotics Law, 1993
	The National Drug Law, 1992
	The Union of Myanmar Public Health Law, 1972
	Private Health Act, 2007
	The Penal Code of Offences Affecting the Public Health, Safety, Convenience, Decency and Morals (1861)

Sector	Relevant Laws in Myanmar
Occupational Health and Safety	Factory Act, 1951 (safe and healthy workplaces)
	Employment and Training Act 1950
	Workmen's Compensation Act
	Shops and Establishment Act, 1951
	Leave and Holidays Act, 1951
	Minimum Wage Act 1949
	Payment of Wages Act 1936
	Social Security Act 1954
	Trade Dispute Act 1929
Tourism	The Myanmar Hotel and Tourism Law, 1993
Industrial	Myanmar Special Economic Zone Law, 2011
	Dawei Special Economic Zone Law, 2011
	The Private Industrial Enterprise Law, 1990
	The Factories Act, 1951
	The Oilfields (Labours and Welfare) Act, 1951
	The Petroleum Act, 1934
	The Oilfields Act, 1918
Investment	The Foreign Investment Law, 2012
Fisheries and Aquaculture	The Freshwater Fisheries Law, 1991
	The Myanmar Marine Fisheries Law, 1990
	The Law Relating to Aquaculture, 1989
	The Law Relating to the Fishing Rights of Foreign Fishing Vessels, 1989
	The Law Amending the Law Relating to the Fishing Rights of Foreign Fishing Vessels, 1993
	The Law Amending the Myanmar Marine Fisheries Law, 1993
Science and Technology	The Atomic Energy Law, 1998
	Science and Technology Development Law (Law No. 5/94, 1994)
Transportation	The Highways Law, 2000
	The Motor Vehicles Law, 1964
	(The Law Amending the Motor Vehicles Law of 1964 enacted in 1989)
	The Myanmar Aircraft Act, 1934
	The Inland Steam Vessels Act, 1917
	The Ports Act, 1907
	The Defile Traffic Act, 1908
	The Yangon Port Act, 1905
	The Canal Act, 1905
	The Obstruction in Fairways Act, 1881
Land Use	Land Acquisition Act, 1894

Appendix B. Public Consultation Documents

ကိုဆိုပါသည်

- ကျွန်ုပ်တို့သည် မြန်မာရေနံနှင့်သဘာဝဓါတ်ငွေ့လုပ်ငန်း(MOGE)၊ Shell ၊ IEM/EQM မှ ကိုယ်စားလှယ်များ ဖြစ်ပါသည်။
  ဒီနေ့ တွေ့ဆုံရသော
  ရည်ရွယ်ချက်မှာ ဒေသခံလူမှုA ဖွဲ့A စည်းများကို
  A ဆိုပြုထားသည့်စီမံကိန်းA ၊ နှင်းလင်တင်ပြရန် ၊
  သင့်တို့ဘက်မှသိလိုသည့် မေးခွန်းများမေးရန်
  ၊ စောင့်ကြည့်လေ့လာမှုများပြုလုပ်ရန်
  နှင့် ဝေဖန်ချက်များ ပေးရန်ဖြစ်ပါသည်။

- Shell ကုမ္ပဏီသည် သင်နှင့်ပတ်သက်သည့်A ချက်A လက်များ၊ သင့်မေးခွန်းများကို A လေးA နက်စဉ်းစားပြီး စီမံကိန်းA ကောင်းA ထည်ဖေါ်သည့်လုပ်ငန်းစဉ်တွင် ထည့်သွင်းဆောင်ရွက်ပေးပါလိမ့်မည် ။

ထပ်မံသိလိုသောသတင်းအချက်အလက်

လူထုတွေ့ဆုံပွဲပြီးသည့်နောက် မေးခွန်းများနှင့်အကြံပြုချက်များ ရှိပါသေးလျှင် အောက်ဖော်ပြပါလိပ်စာသို့ မေးမြန်းအကြံပြု နိုင်ပါသည်။

Shell ကနဦးပတ်ဝန်းကျင်စစ်ဆေးအကြံပေးပညာရှင်

ယာယီလိပ်စာ:

အမှတ် 134/A သံလွင်လမ်း ရွှေတောင်ကြား (၁) ရပ်ကွက်

ဗဟန်းမြို့နယ် (စာတိုက်သေတ္တာA မှတ် (729)၊ ရန်ကုန်၊ မြန်မာ။

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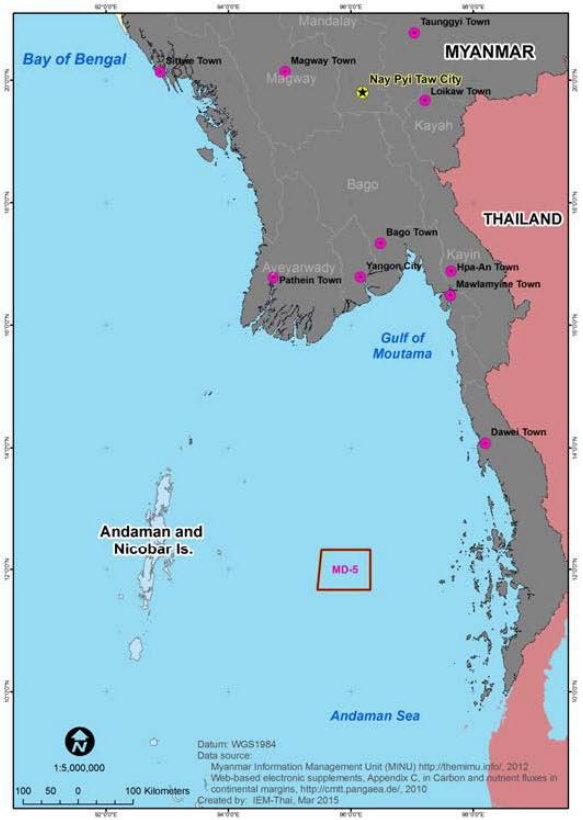
မြန်မာကမ်းလွန်ရေနံ လုပ်ကွက် MD-05 3D ရေနံရှာဖွေခြင်း



စီမံကိန်းရည်ရွယ်ချက်

A ဆိုပြုထားသည့် ရေနက်ပိုင်းရေနံရှာဖွေခြင်းရည်ရွယ်ချက်မှာ သုံးဖက်မြင် (3D) A သံလိုင်းများ A သုံးပြုခြင်းဖြင့် ရေနက်ပိုင်းပင်လယ်မျက်နှာပြင်မှ သတင်းA ချက်A လက်များစုဆောင်းခြင်း ဖြစ်ပါသည်။

စုဆောင်းရရှိသည့် သတင်းA ချက်A လက်များကို ပင်လယ်ကြမ်းပြင် ေA ဂက်ဘူမိဗေဒမြေပုံများဆွဲ၍ ရေနံနှင့်သဘာဝဓါတ်ငွေ့ရှိနိုင်မည် A လားA လာကို ဆုံဖြတ်သွားပါမည်။

စီမံကိန်းဖေါ်ပြချက်

ကမ်းလွန်လှုပ်ရှားမှုများ

- လုပ်ကွက် MD-05 A တွက်A ဆိုပြုထားသည့် ရှာဖွေလေ့လာရေး A စီA စည်သည် သုံးဘက်မြင်ရေနံရှာဖွေခြင်းနည်းပညာနှင့် နောက်ဆက်တွဲ ထိန်းချုပ်လျှပ်စစ်သံလိုက်လှိုင်းဖြင့်ရှာဖွေခြင်းနည်းပညာတို့ ပါဝင်ပါသည်။
- ရေနံရှာဖွေခြင်းလေ့လာချက်များကို သဘော်ကြီးတစ်စင်းနှင့်A တူ A ထောက်A ကူသဘော်ငယ်လေးများဖြင့်ပါ ဆောင်ရွက်သွားပါမည်။
- လေ့လာရေးA စီA စည်ကို ရာသီနှစ်ခုကြာေA ဘင် နှစ်ခါခွဲ၍ ဆောင်ရွက် ပါမည်။
- ရေနံရှာဖွေရေး/ထောက်ပံ့ရေးသဘော်များကို ရနောင်း-ထိုင်းဆိပ်ကမ်းများမှ ပြန်လည်ထောက်ပံ့ပါလိမ့်မည်။
- စီမံကိန်းကို မြန်မာနိုင်ငံ၏ တည်ဆဲဥပဒေများ ၊ A ပြည်ပြည်ဆိုင်ရာ

ရည်ရွယ်ထားသည့် စီမံကိန်းကာလ

Shell ကုမ္ပဏီသည် သုံးဖက်မြင်ရေနံရှာဖွေခြင်းကို MD-05 လုပ်ကွက်များတွင် ၂၀၁၅ နှစ်ကုန်ပိုင်း/၂၀၁၆ နှစ်ဆန်းပိုင်းတွင် စတင်ရန်ရည်ရွယ်ပါသည်။ A ရိုန် ၄ လမှ ၆ လA ထိကြာမြင့်ပါမည်။

ထိန်းချုပ်လျှပ်စစ်သံလိုက်လှိုင်းဖြင့်ရေနံရှာဖွေခြင်းကို ၂၀၁၆ ခုနှစ်ဒုတိယနှစ်ဝက်တွင် စတင်ရန်ရည်ရွယ်ပါသည်။ သုံးဖက်မြင်ရေနံရှာဖွေခြင်းနည်းပညာကိုဖြင့် ရှာဖွေတွေ့ရှိထားသည့်နေရာတွင် ဆက်လက်ရှာဖွေခြင်းဖြစ်ပါသည်။ A ရိုန် ၃ လခန့် ကြာမြင့်ပါမည်။

သုံးဖက်မြင် (3D) ရေနံရှာဖွေရေးယာဉ် နှင့် လုပ်ငန်းဆောင်တာများ

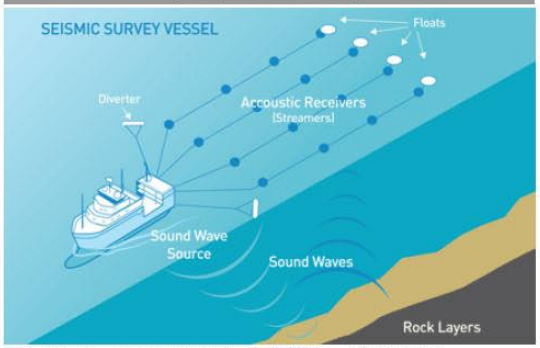
Source: Shell, 2015

လှုပ်ရှားမှုများ

ပုံမှန်သုံးဘက်မြင်ရေနံရှာဖွေရေး၏A ကျိုးဆက်မှာ ေA ဂက်ဖော်ပြပါA တိုင်းဖြစ်ပါသည်။

- MD-05 လုပ်ကွက်များတွင် ရေနံရှာဖွေရေးသဘော်များနှင့် A ထောက်A ကူပြုသဘော်ငယ်များ ရွှေ့လျားခြင်း
- ရေနံရှာဖွေခြင်းကိရိယာများA သုံးပြုခြင်း
- သတင်းA ချက်A လက်ထည့်သွင်းခြင်း (ရာသီဥတုဖောက်ပြန်သည့် A ရိုန်၊ ပစ္စည်းကိရိယာပြင်ဆင်သည့်A ရိုန် A စရှိသည့် သဘော်ရပ်ထားသည့်A ရိုန်မှလွဲ၍)
- လုပ်ငန်းဇရိယာမှပစ္စည်းကိရိယာများ၊ ယာဉ်များပြန်လည်သိမ်းဆည်းခြင်း

လုပ်ငန်းဆောင်တာများ



Source: http://energytomorrow.org/energy-101/offshore-drilling/seismic-surveys-why-and-how

စီမံကိန်းနယ်ပယ်

- ရေနံရှာဖွေခြင်းA ား မြန်မာကမ်းရိုးတန်းမှ 300km ခန့် A ဝေးတွင် ရှိသော လိုင်စင်ရ MD-05 လုပ်ကွက်များတွင် လုပ်ဆောင်ပါမည်။,
- ၂,၁၀၀ m နှင့် ၂,၆၀၀ m A တွင်းရေနက်ပိုင်းတွင် ရေနံရှာဖွေခြင်း လုပ်ငန်းကို လုပ်ဆောင်ပါမည် ။

Source: Insituto Oikos & Banca, 2011, BOBLME, 2015

ကာကွယ်ထိန်းသိမ်းထားသည့်နယ်ပယ်များ

- လေ့လာရေးနယ်ပယ်A တွင်း(သို့) A နီးတစ်ပိုက်တွင် စိုးရိမ်ရသည့် (သို့)ကာကွယ်ထားသည့်နယ်ပယ်များ မရှိကြပါ။
- စီမံကိန်းနှင့်A နီးဆုံး ရေကြောင်းကာကွယ်ထားသည့်နယ်ပယ် သည် လမ်ပိကျန်းA မျိုးသားပန်းခြံ ဖြစ်ပါသည်။
- လမ်ပိကျန်းA မျိုးသားပန်းခြံသည် MD-05 လုပ်ကွက်များ၏ A ရှေ့တောင်ဘက်မှခန့်မှန်းခြေ ၂၀၀ km A ဝေးမှာ ရှိပါသည်။

WELCOME

- Representatives from MOGE, Shell and IEM / EQM would like to meet with you. The purpose of the meeting is to describe the proposed project specifics to members of the local community, and offer you the opportunity to ask questions and make observations and provide comments.
- SHELL will consider your questions, concerns and input during the project design process.

ADDITIONAL INFORMATION

If you have questions and/or comments after the Public Meeting, you can submit them in writing to:

SHELL INITIAL ENVIRONMENTAL EXAMINATION (IEE) ADVISOR:

Temporary Address:

No 134 / A, Than Lwin Road

Golden Valley Ward (1)

Bahan Township (GPO Box 729)

Yangon, Myanmar

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E-mail: ron@iem-thai.com ; www.iem-thai.com

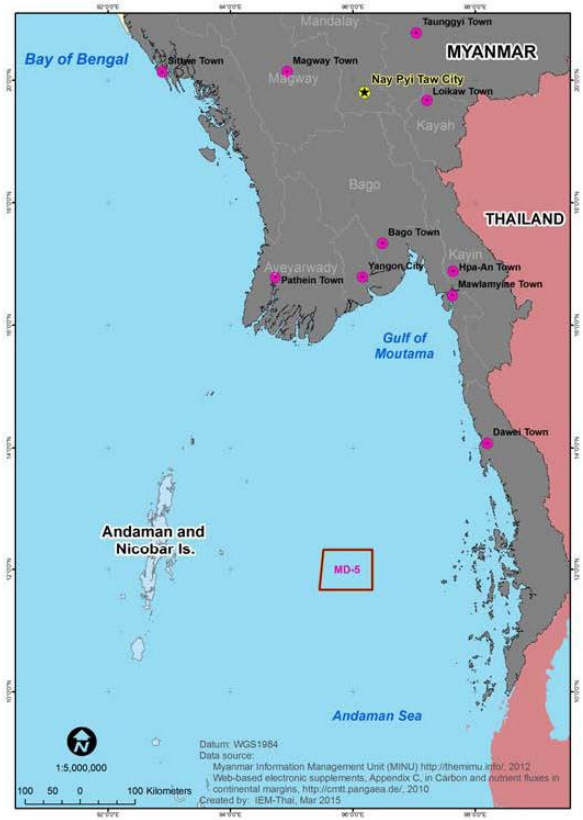
In collaboration with:

Environmental Quality Management Co. Ltd.
797, 1003A, MAC Tower
Ph. 959-50-16606, 951 561417
E-mail: ohnmarmay@gmail.com

Deep water Offshore Myanmar

Block MD-05

3D Seismic Survey



PURPOSE OF THE PROJECT

The main purpose of the proposed deep-water exploration survey is to collect information about the subsurface by using sound waves in a 'seismic (3D) survey'.

The data collected will be used to map geological structures under the seabed, to help determine if there are potential oil or gas carrying prospects present.

PROJECT DESCRIPTION

Offshore activities

- The exploration survey programme proposed for Block MD-05 consists of a 3D seismic survey followed by a smaller targeted Controlled Source Electro-Magnetic (CSEM) survey.
- The surveys are carried out by a vessel with assistance of smaller support vessels.
- The survey programme may be conducted in two phases over two seasons.
- The seismic / support vessels will re-supply from Ranong, Thailand port.

The project is designed to comply with all applicable Myanmar regulations and International standards.

TENTATIVE PROJECT SCHEDULE

Shell expects to start the 3D seismic survey in Block MD-05 in in late 2015/early 2016. The 3D seismic survey will take between 4 to 6 months to complete.

The CSEM survey is expected to take place in the second half of 2016, concentrating on the areas identified from the initial processing of the data acquired in the 3D survey. The CSEM survey will take 3 months to complete.

3D SEISMIC VESSEL & OPERATIONS

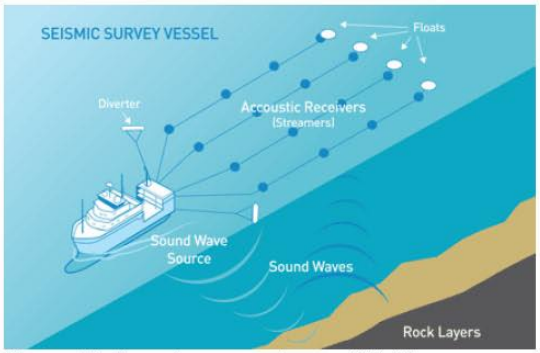
Source: Shell, 2015

ACTIVITIES

The sequence of a typical 3D survey is as follows:

- Mobilisation of vessels including survey vessel and support vessels to the survey area (MD-05).
- Deployment of towed equipment (air gun array and streamers)
- Data acquisition (except when vessels may be kept on standby due to adverse weather conditions, equipment repair etc.); and
- Retrieval of equipment and demobilisation from the area.

SOURCE OPERATIONS



Source: http://energytomorrow.org/energy-101/offshore-drilling/seismic-surveys-why-and-how

PROJECT AREA

- The survey will be carried out in one license block (MD-05), which is located approximately 300 km from the Myanmar coastline.
- The seismic operations will be conducted in deep waters between 2,100 m and 2,600 m.

Source: Insituto Oikos & Banca, 2011, BOBLME, 2015

PROTECTED AREAS

There are no sensitive or protected areas in or near the area of the surveys.

The Marine Protected Area (MPA) nearest the project activity is Lampi Island National Park.

The Lampi Island National Park is located approximately 200 km to the southeast of Block MD-05.

Appendix C. TIE LINE ADDENDUM

Addendum to the MD-5 Exploration Survey Programme Initial Environmental Examination IEE

This Addendum has been prepared in respect of a minor addition to the survey programme to be conducted within Offshore Licence block MD-5 in the Andaman Sea. The addition consists of a seismic tie line to the Yetagun field. This will be done once the MD-05 survey is completed.

Background

There has been limited oil and gas exploration conducted in the deep-water areas offshore Myanmar, and the 3D survey data currently being acquired by Shell in Block MD-05 will provide important information. Once the seismic data has been processed, it needs to be interpreted. If regional geological data or information acquired from previously drilled wells can be used in this interpretation it may contribute towards a better understanding of the subsurface geology, however, there is no well information available from within or adjacent to MD-05. Therefore, a tie line extending from MD-05 will allow the acquired 3D seismic data in the block to be calibrated against regional subsurface data from existing wells in the nearby Yetagun gas field.

Description

At the end of the MD-05 survey operations the survey vessel will run one single survey line from MD-05 to the Yetagun gas field. It is currently expected that the tie line will be completed in approx. 2 days around the end of December. The survey vessel will then stop firing the airguns, and sail to the Bay of Bengal where it will commence the 3D survey in Blocks AD-09 and 11.

The tentative survey lines are shown in Figure 1 below:

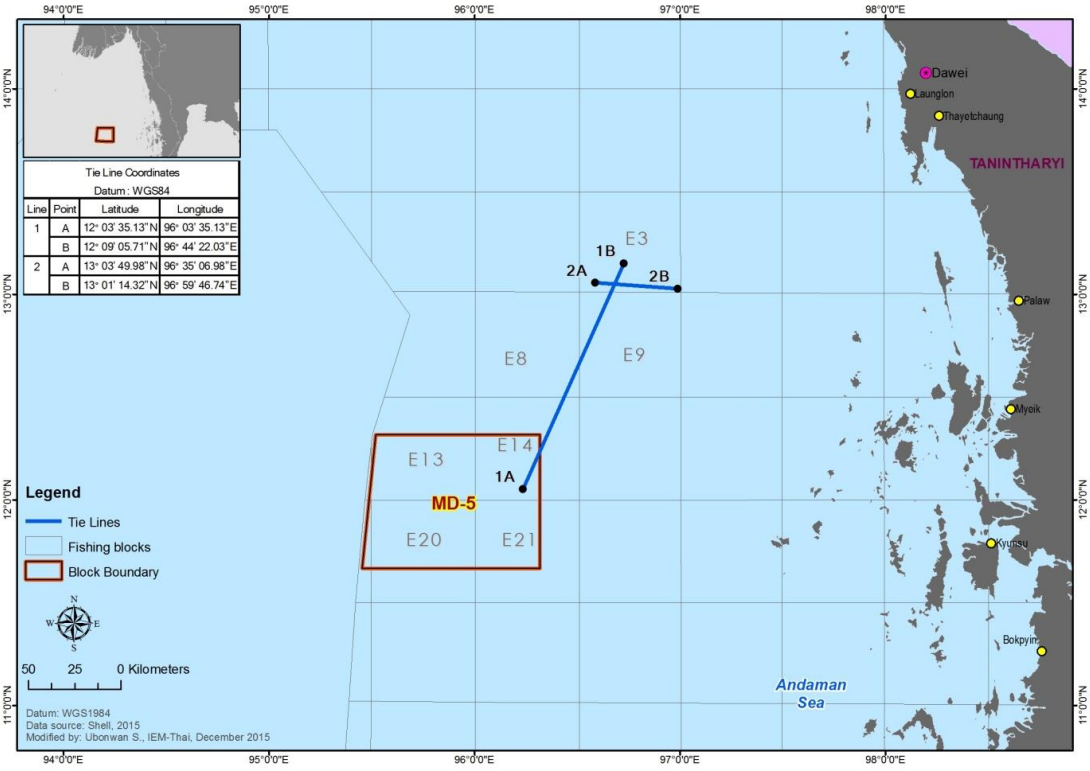


Figure 1 MD-05 – Yetagun tie line

The tie line will be run as a continuation to the MD-05 survey with the same vessel and equipment. The vessel will depart from the north-eastern part of MD-05 and survey along an approx. 150 km line in north-easterly direction to the Yetagun field (From 1 A to 1B, Fig 1). Once there, it will continue and run an approx. 50 km line in an east west direction (from 2A to 2B and back, Fig. 1). The speed of the vessel will be approximately 4.5. – 4.8 knots and the incremental survey work will be completed within two days. There may be minor adjustments to these position of the lines in order to gain efficiency and to avoid obstructions in the Yetagun field area. However, the total line length will be approximately the same.

There are no changes to the equipment or specification of the survey over and above that presented in the MD-05 Exploration Survey IEE.

Receiving environment – additional information

The survey line will start in approx. 2,500 metres water depth and progress in a direction of gradually shallower water until it reaches the Yetagun field, in approx. 80 m water depth. The line will start within fishing block E14 (1A I, Fig 1), and run through blocks E8/E9 and finish in E3/E4.

Information received from representatives of the Operator of the Yetagun gas field indicates that there is only very occasional fishing in the area, which is in excess of 80 metres water depth which in fishing terms would be considered deep water.

Smaller coastal and local fishing boats are not known to fish in these relatively deep offshore areas.

Incremental impact – environmental and social

The survey tie-line to Yetagun is of limited extent and short duration in comparison with the survey coverage and duration in MD-05. The increment in line km is approximately 5 per cent, and in survey time, the increment is approximately 3 per cent. No significant environmental or socioeconomic aspects associated with the incremental line have been identified, and on the basis of a review of the survey activities it is concluded that the overall environmental and social impact of the incremental line is insignificant. An impact assessment summary is attached in the Table1.1 Addendum below.

There are no other seismic surveys planned to be carried out in this offshore region during late December 2015, and no potential or incremental cumulative impact have been identified.

Mitigation / EMP

The mitigation measures set out in the EMP will be implemented in full for the tie-line. Each of the mitigation measures are equally relevant for the tie line as they are for the MD-05 survey. In addition, ongoing communication with the Operator of the Yetagun field will be taking place during the operations to ensure there are no additional risks of collision or entanglement of survey streamers in the vicinity of the field facilities.

There are no changes to the EMP.

Table 1.1 Addendum: Summary of Environmental Impact Conclusions – Tie Line to Yetagun

Aspect	Activity	Potential Impact	Mitigation Measures	Impact Characteristics	Magnitude	Residual Significance	Change to impact / Mitigation Plan
Underwater Noise	Operation of airgun array source (seismic source noise) Transportation, Equipment & Supplies (vessel-related noise)	Behavioural and physiological effects on marine mammals (cetaceans), turtles, fish and invertebrates Disturbance to marine mammals (cetaceans), turtles, fish and invertebrates.	• Code of Conduct – aligned with the JNCC (2010) 'Guidelines for minimising the risk of injury and disturbance to marine mammals from seismic surveys' as adopted by the International Association of Geophysical Contractors (IAGC).	Localised, short-term, reversible	Moderate	**Minor**	**No change**
Electromagnetic Pulse Emissions	None						
Physical Presence of Marine Anchors	None						
Artificial Light	Light emissions from vessels during hours of darkness	Behavioural effects on marine fauna (birds, turtles and fish).	• Deck lighting will be directed inwards where possible.	Highly localised, short-term, reversible	Minor	**Negligible**	**No change**

Atmospheric Emissions	Operation of combustion engines on vessels	Deterioration of local or regional air quality as a result of emissions.	• Adherence to MARPOL 73/78 Annex VI (Regulations for the Prevention of Air Pollution from Ships) requirements as appropriate to vessel class, including:
			  ○ optimisation of fuel use to increase efficiency and minimise emissions;
			  ○ emissions managed by the implementation of a planned maintenance system (PMS).
			• Routine inspection and preventive maintenance as per maintenance schedule or recommendation by manufactures to ensure efficiency of all machineries.
			• Strictly follow the instruction manual of equipment and machines, and keep them properly maintained.
			• Minimise survey delays and vessel operating time to the extent practicable.
				Localised, short-term, reversible	Minor	**Negligible**	**No change**

Routine Aqueous Discharges	Discharge of sewage waste	Localised reduction in water quality due to nutrient enrichment	• Sewage will be treated prior to disposal offshore in accordance with MARPOL regulations (Annex IV). • Survey and support vessels will have certified/approved sewage treatment plants.	Localised, short-term, reversible	Low	**Negligible**	**No change**
	• Discharge of treated oily water originating from deck drainage systems, bilges and machinery drainage	• Localised reduction in water quality due to nutrient enrichment • Toxic effects on marine fauna and flora	• Bilge and drainage water will be treated and disposed of in accordance with MARPOL 73/78 Annex I. • Bilge and drainage water with oil-in-water content exceeding 15 ppm will be contained and disposed of onshore. • Bilge and drainage water discharges recorded in the Oil Record Book.				

Aspect	Activity	Potential Impact	Mitigation Measures	Impact Characteristics	Magnitude	Residual Significance	Change to impact / Mitigation Plan
Solid Waste Management	• Non-Hazardous solid waste generation onboard vessels	• Deterioration of water quality and marine habitat.	• A Waste Management Plan for the operations will be developed and implemented by the survey contractor(s). • Waste will be segregated into recyclable and non-recyclable wastes where practicable, and stored in clearly marked containers for transport and disposal. • All garbage will be disposed of in accordance with MARPOL 73/78 Annex V. • Incinerators used aboard the survey and support vessels will be compliant with MARPOL / IMO requirements. • Food wastes will be macerated to a maximum particle size 25mm prior to being discharged to sea. • Hazardous waste inventory will form part of the waste management plan. • Any hazardous waste materials will be handled and stored in accordance with the corresponding Material Safety Data Sheet (MSDS). • All project vessels will have a garbage management plan, in accordance with IMO Guidelines. • If required by vessel class, project vessels will also carry a garbage record book in accordance with MARPOL 73/78 Annex V.	Localised, short-term, reversible	Low	**Negligible**	**No change**

Addendum to Table 1.2: Summary of Unplanned Impact Conclusions – Tie Line to Yetagun

Aspect	Activity	Potential Impact	Mitigation Measures	Impact Characteristics	Magnitude	Residual Significance	Change to impact / Mitigation Plan
Vessel Interactions with Marine Fauna	Vessel Collisions Fauna entanglement in towed equipment	Physical effects on marine fauna particularly marine mammals (cetaceans) and sea turtles	• The Code of Conduct outlined in Section 6.4.1.3, in particular the management measures relating to the use of MMO onboard source vessels, including any vessel or towed equipment interactions with marine fauna will be recorded and reported in the MMO report. • Survey vessels will generally be travelling at low speed, between approximately 7 – 9 km/hr (4 – 5 knots). • Tail buoys on seismic streamers will be fitted with turtle exclusion devices if their design requires it.	Localised, short-term, reversible	Low	**Minor**	**No change**

Accidental discharges (hydrocarbon spill)	Fuel spill (due to vessel collision, refuelling or other equipment or system failure)	Toxic effects on marine fauna and flora
		Localised reduction in water quality
		Indirect effects on offshore fisheries
			• Adherence to the requirements of the International Regulations for Preventing Collisions at Sea 1972 (COLREGS) Part B - Steering and Sailing (Rules 4-19) and Part C - Lights and Shapes (Rules 27) as appropriate to vessel class, including:
			  ○ Crew trained in accordance with COLREGS steering and sailing rules to prevent vessel collisions, including maintaining a proper look-out to prevent the risk of collision and maintaining a safe speed at all times to allow for avoidance of collisions;
			  ○ Display appropriate lights and warning signals on all vessels to prevent accidental collision.
			• At least 30 days prior to vessel mobilization, coordinate with MOGE, who will issue "Notice to Mariner" regarding project activities to appropriate parties (i.e. Department of Fisheries, Ministry of Livestock and Fisheries, and Marine Police Force).
			• Establish a safety zone around the seismic and CSEM vessels.
			• Use of chase vessels to warn other vessels/shipping of the navigation hazard posed by the survey vessels and towed equipment.
			• Any vessel collision incidents will be reported to the appropriate authorities in Myanmar (e.g. MONREC, the DMA and the Myanmar Navy).
			• Detailed records will be maintained of all vessel collision incidents.
			• Develop and implement Shipboard Oil Pollution Emergency Plan (SOPEP), kept onboard vessels, and conforming to MARPOL.
			• Weather reports received daily on the survey vessels.
			• Adverse weather contingency plan.
			• Refuelling at sea undertaken in daytime only and will follow standard operating procedures.
			• All hydrocarbons stored on deck will be stored in secured storage area.
			• Crew will have received training in, and be competent in, their emergency response roles, as appropriate.
			• Provide spill clean-up kits and training for designated rapid response team to clean up any spills.
			• Appropriate medical care will be provided, clean-up will be carried out, and incident or accident reports will be filed.
			• All oil spills (>80L) will be documented and reported to MONREC.
			• Hydrocarbon spill containment and recovery equipment will be available near hydrocarbon storage.
			• Procedures for response to hydrocarbon spills will be detailed in Shell's ERP.
				Localised, short-term, reversible	Minor	**Moderate**	**No change**

Aspect	Activity	Potential Impact	Mitigation Measures	Impact Characteristics	Magnitude	Residual Significance	Change to impact / Mitigation Plan
Accidental Release (Chemical or Hazardous Waste)	Incorrect handling of chemical or hazardous waste	Toxic effects on marine fauna and flora Localised reduction in water quality Indirect effects on offshore fisheries	• All chemicals/hazardous materials handled and disposed of in accordance with MARPOL 73/78 Annex III. • Environmental induction for all personnel on survey vessels. • Proper training in the use and handling of the relevant chemicals and standard safety procedures implemented by all contractors. • Appropriate medical care will be provided, clean-up will be carried out, and incident or accident reports will be filed. • Provide spill cleanup kits and training for designated rapid response team to clean up any spills. • Store all chemicals in secured storage. • All chemical and hazardous wastes will be segregated into clearly marked containers prior to onshore disposal. • All storage facilities and handling equipment will be in good working order and designed in such a way as to prevent and contain any spillage as far as practicable. • The survey and support vessels have implemented and tested SOPEP, and copies are kept aboard vessels. • All hazardous substances will have MSDS in place that is readily available on board. • Spill response bins/kits will be located in close proximity to chemical/Hazardous materials storage areas for prompt response in the event of a spill or leak. The kits will be checked for their adequacy and replenished as necessary prior to the commencement of activities and on a regular basis thereafter. Identified personnel will be trained in use of this equipment. • Detailed records will be maintained of all accidental releases/discharges of chemicals/hazardous materials.	Highly localised, short-term, reversible	Low	**Minor**	**No change**
Accidental Introduction of Invasive Marine Species (IMS)	Introduction of IMS associated with ballast water discharges or transferred via vessel hull or in-water equipment	Establishment of non-native IMS with potential to affect native marine species	• Compliance with the International Convention for the Control and Management of Ships' Ballast Water and Sediments (as appropriate to vessel class) (IMO 2004); as applied to all vessels being mobilised from international waters, which includes: o All ballast water exchanges conducted more than 50 nm from land and in greater than 200 m water depth; o Ballast water exchange records maintained. o An IMS risk assessment will be taking place, and on the basis of its outcome, management measures will be implemented commensurate with the level of risk. • To manage the potential risk of biofouling, the following measure will be implemented: o Vessels (of appropriate class (>400t)) to have a current International Anti Fouling System (IAFS) Certificate, as per the International Convention on the Control of Harmful Anti fouling Systems on Ships (IMO 2001).	Localised, medium term	Minor	**Minor**	**No change**

Addendum to Table 1.3: Summary of Social Impact Conclusions – Tie Line to Yetagun

Aspect	Activity	Potential Impact	Mitigation Measures	Impact Characteristics	Magnitude	Residual Significance	Change to impact / Mitigation Plan
Physical presence – Interaction with Fisheries	Presence and manoeuvring of survey boat and towed equipment	Fouling of fishing gear as equipment is towed in the water.	• At least 30 days prior to vessel mobilization, a "Notice to Mariner" will be issued to appropriate parties (i.e. Department of Fisheries, Ministry of Livestock and Fisheries, and Myanmar Navy). • Consultation with relevant fishing groups through Myanmar Fisheries Federation and the Department of Fisheries. • Chase vessels will be used during the seismic survey to monitor and communicate with fishing vessels in the area. • Adherence to COLREGS Part B - Steering and Sailing (Rules 4-19) and Part C - Lights and Shapes (Rules 27) as appropriate to vessel class, including: o Crew trained in accordance with COLREGS steering and sailing rules to prevent vessel collisions, including maintaining a proper look-out to prevent the risk of collision and maintaining a safe speed at all times to allow for avoidance of collisions; o Display appropriate lights and warning signals on all vessels to prevent accidental collision.	Localised, short-term, reversible	Low	**Minor**	**No change**
	Presence and manoeuvring of seismic survey boat and towed equipment)	Disruption of fishing and fishing vessels and/or damage to fishing equipment					**No change**
Physical Presence – Impact on Shipping	Presence and manoeuvring of survey vessels and tow lines	Increased traffic volume in the local area of the planned survey Interaction with shipping leading to disruption of shipping activities, e.g. diversion and some potential delays to third party journeys	• Adherence to COLREGS Part B - Steering and Sailing (Rules 4-19) and Part C - Lights and Shapes (Rules 27) as appropriate to vessel class, including: o Crew trained in accordance with COLREGS steering and sailing rules to prevent vessel collisions, including maintaining a proper look-out to prevent the risk of collision and maintaining a safe speed at all times to allow for avoidance of collisions; o Display appropriate lights and warning signals on all vessels to prevent accidental collision. • At least 30 days prior to vessel mobilization, a "Notice to Mariner" regarding project activities to appropriate parties (i.e. Department of Fisheries, Ministry of Livestock and Fisheries, and Myanmar Navy). • Establish a mobile and temporary safety zone around the seismic vessels – coordinated by the captain of the survey vessel. • Use chase vessels to liaise with approaching shipping in the project area to prevent accidental collision.	Localised, short-term, reversible	Low	**Minor**	**No change**
Survey Programme	National and local employment and income	Direct and indirect contribution to the Myanmar economy through jobs and income	• Beyond the staff employed at the Yangon office, no further mitigation is planned.	Positive, short-term	Low	**Negligible Positive**	**No change**

IEM JACOBS

Report completed by IEM and Jacobs