Scoping Report

for

Environmental Impact Assessment

(EIA/SIA)

of

Nam Tu (Hsipaw) Hydropower Project

by

Natural Current Energy Hydropower Co Ltd

Prepared by

MyAsia Consulting Co Ltd,
708, 50 Street Condominium,
Botataung Township,
Yangon, Myanmar.

Natural Current Energy Hydropower Co.,Ltd.

နမ့်တူ (သီပေါ်) ရေအားလျှပ်စစ်စီမံကိန်း

နယ်ပယ်အတိုင်းအတာသတ်မှတ်ခြင်းနှင့် လုပ်ငန်းလမ်းညွှန်အစီအရင်ခံစာတင်ပြခြင်း

အကျဉ်းချုပ်အစီရင်ခံစာ

၁။ Natural Current Energy Hydropower Co.,Ltd. သည် ရမ်းပြည်နယ်မြောက်ပိုင်း၊ ကျောက်မဲခရိုင်၊ နမ့်တူမြို့နယ်နှင့် သပေါမြို့နယ်အတွင်းရှိ နမ့်တူမြစ်ပေါ်တွင် ၂၁၀ MW ထုတ်လုပ်နိုင်မည့် ''နမ့်တူ (သပေါ်) ရေအားလျှပ်စစ် ထုတ်လုပ်ရေးစီမံကိန်း'' အား တည်ဆောက် အကောင်အထည်ဖော်ရန် စီစဉ်ဆောင်ရွက်လျက် ရပါသည်။ အဆိုပါ စီမံကိန်းအတွက် ခန့်မှန်းကုန်ကျငွေမှာ အမေရိကန်ဒေါ်လာ ၄၃၈ သန်းဖြစ်ပြီး နှစ်စဉ်လျှပ်စစ်ဓာတ်အား 1,005.48 GWh ထုပ်လုပ်နိုင်မည် ဖြစ်ပါသည်။

၂။ စီမံကိန်းဖော်ဆောင်မည့် Natural Current Energy Hydropower Co.,Ltd. သည် စီမံကိန်း တည်ဆောက်ချိန်နှင့် လည်ပတ်ဆောင်ရွက်ချိန်များတွင် ဖြစ်ပေါ်လာနိုင်သည့် ပတ်ဝန်းကျင်နှင့် လူမှုရေး ဆိုင်ရာ ထိခိုက်မှုများ ဆန်းစစ်ခြင်းလုပ်ငန်း (EIA/SIA) ၊ ပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲမှုအစီအစဉ် (EMP) တွက်ချက်ဖော်ထုတ်ခြင်းလုပ်ငန်းများ ဆောင်ရွက်နိုင်ရန်အတွက် MyAsia Consulting Co.,Ltd. ထံ အပ်နှံဆောင်ရွက်သွားမည်ဖြစ်ပါသည်။ **MyAsia Consulting Co.,Ltd. သည် စီမံကိန်း အကောင်အထည်ဖော်မည့် ကုမ္ပဏီနှင့်ဆက်စပ်ပက်သက်ခြင်းမရှိသည့်အပြင် စီမံကိန်းနှင့် သက်ဆိုင်သော ဝန်ဆောင်မှုလုပ်ငန်းများ (ဥပမာ–ဒီဇိုင်းရေးဆွဲခြင်း၊ အင်ဂျင်နီယာ လုပ်ငန်း များ၊ တည်ဆောက်ရေးလုပငန်းများ၊ ဝယ်ယူရေး လုပ်ငန်းများ) အား ပံ့ပိုးဆောင်ရွက်မှု လုံးဝ မရှိဘဲ ကြားနေတတိယ အတိုင်ပင်ခံ အဖွဲ့အစည်းအဖြစ် ပကတိ အကျိုးစီးပွားခြင်း ဆန့်ကျင် သည့် ဆောင်ရွက်မှုမျိုး (Conflit of Interest) ကင်းစွာဖြင့် ပတ်ဝန်းကျင်နှင့် လူမှုရေးဆိုင်ရာ ဆန်းစစ်ခြင်းနှင့် အစီရင်ခံစာအားပြုစု တင်ပြခြင်းများကိုသာ ဆောင်ရွက် သွားမည်ဖြစ်ပါသည်။** ယခုတင်ပြသော အကျဉ်းချုပ် အစီရင်ခံစာသည် ပတ်ဝန်းကျင်ထိခိုက်မှု ဆန်းစစ်ခြင်းလုပ်ငန်းများ ဆောင်ရွက်ရန်အတွက် လိုအပ်သော နယ်ပယ်အတိုင်းအတာ သတ်မှတ်ခြင်း အဆင့် (Scoping Phase) နှင့် လုပ်ငန်းလမ်းညွှန် (TOR) များ ရေးဆွဲတင်ပြခြင်း အစီရင်ခံစာ ဖြစ်ပါသည်။ ပတ်ဝန်းကျင်နှင့် လူမှုရေးဆိုင်ရာ ထိခိုက်မှုဆန်းစစ်ခြင်း (EIA/SIA) လုပ်ငန်းအား ပတ်ဝန်းကျင် ထိမ်းသိန်းရေး ဦးစီးဌာနမှ ပြဌာန်းထားသော လုပ်ထုံးလုပ်နည်းအခန်း (၅) Chapter (V) ၊ အပိုဒ် (၄၄ မှ ၅၀)

ပါအတိုင်း ဆောင်ရွက်သွားမည် ဖြစ်ပါသည်။ နယ်ပယ်အတင်းအတာ သတ်မှတ်ရာတွင်လည်း အပိုဒ် ၄၇ မှ ၅၄ ပါ လိုအပ်ချက်များ၊ အထူးသဖြင့် အပိုဒ် ၄၉ ပါ အသေးစိတ် လိုက်နာဆောင်ရွက်ရမည့် အချက်များအတိုင်း ဆောင်ရွက်သွားမည်ဖြစ်ပါသည်။

၃။ ပြည်ထောင်စုသမ္မတမြန်မာနိုင်ငံတော်သည် သဘာဝသယံဇာတအရင်းအမြစ်များ ပေါကြွယ်ဝသော်လည်း အရှေ့တောင်အာရှဒေသအတွင်း ဖွံ့ဖြိုးမှုနောက်ကျလျက်ရှိသော တိုင်းပြည်တစ်ခုဖြစ်နေပါသည်။ မြန်မာနိုင်ငံအတွင်း ပြည်သူ ၃၇% သာလျှပ်စစ်မှတ်အား ရရှိကြသဖြင့် တိုက်ရိုက်သက်ဆိုင်သော နိုင်ငံ၏ဖွံ့ဖြိုးတိုးတက်မှုနှင့် ပြည်သူလူထု၏ လူနေမှုအဆင့်မြင့်မားရေးတို့အတွက် အဓိကအဟန့်အတားသဖွယ် တည်ရနေပါသည်။ ထိုကဲ့သို့ လျှပ်စစ်မှတ်အားလုံလောက်စွာမရရှိသောဒေသများမှာ ဆင်းရဲသားအများစုရှိသည့် ကျေးလက်တောရွာများဖြစ်နေပါသည်။ ထို့ကြောင့် မြန်မာနိုင်ငံတော်အစိုးရသည် လာမည့်နှစ် ၂၀ အတွင်း တန်ဖိုးမျှတသော လျှပ်စစ်မှတ်အား ဖြန့်ချီပေးနိုင်ရန်အတွက် လျှပ်စစ်မဟုတ်အားထုတ်လုပရေးလုပ်ငန်းများ ဖွံ့ဖြိုးတိုးတက်စေရန် ရည်ရွယ်ဆောင်ရွက်လျက်ရှိပါသည်။

၄။ ၂၀၁၇ တွင် ထုတ်ပြန်ထားသော စာရင်းများအရ လည်ပတ်လျက်ရှိသော မှတ်အားပေးစက်ရုံများမှ စုစုပေါင်းလျှပ်စစ်မှတ်အား 5389 Mega Watt ထုတ်လုပ်လျက်ရှိပြီး၊ ရေအားလျှပ်စစ်မှတ်အားပေးစက်ရုံများမှ (၆၀း၄၀)% ဖြစ်သော 3255 Mega Watt ထုတ်လုပ်လျက်ရှိပါသည်။ ၂၀၀၈–၂၀၀၉ တွင် ပုဂ္ဂလိကမှ လျှပ်စစ်မှတ်အား တနှစ်ပတ်လုံး ဝင်ရောက်ထုတ်လုပ်ဖြန့်ချီမှု ၆.၂% သာရှိခဲ့ရာမှ ၂၀၁၆–၂၀၁၇ တွင် တစ်နှစ်ပတ်လုံးထုတ်လုပ်မှု၏ ၄၈.၄ % တိုးတက်လာခဲ့ကြောင်း တွေ့ရှိရပါသည်။ လက်ရှိ မြန်မာနိုင်ငံတဝှမ်း ဆောက်လုပ်ဆဲ စီမံကိန်းများတွင် ရေအားလျှပ်စစ်မှ ၁၉၆၂ Mega Watt မှတ်တွေ့မှ ၆၄၈ Mega Watt နှင့် နေရောင်ခြည်စွမ်းအင်မှ ၄၇၀ Mega Watt ဖြစ်ကြောင်း သိရှိရပါသည်။

၅။ အပြည်ပြည်ဆိုင်ရာ ရေအားလျှပ်စစ်စွမ်းအင်အသင်း (International Hydropower Association) ၏ ထုတ်ပြန်ချက်အရ မြန်မာနိုင်ငံသည် နှစ်စဉ်ရေအားလျှပ်စစ်ပမာဏ ၁၄၀၀၀၀ Gega Watt ထုတ်လုပ် နိုင်သော အရင်းအမြစ်ကို ပိုင်ဆိုင်ထားပြီး လက်ရှိတွင် အဆိုပါပမာဏ၏ ၄% ခန့်သာ ထုတ်ယူသုံးစွဲနိုင်သေးကြောင်း သိရပါသည်။ နိုင်ငံတော်အစိုးရသည် ၂၀၃၀ ခုနှစ်တွင် တစ်နိုင်ငံလုံး လျှပ်စစ်မှတ်အား ရရှိနိုင်ရန်၊ ၂၀၂၂ တွင် ၎၅% လျှပ်စစ်အား ရရှိနိုင်စေရန်နှင့် လာမည့်(၁၀)နှစ်အတွင်း နှစ်စဉ် ၅၀၀ မှ ၁၀၀၀ Mega Watt တပ်ဆင်ထုတ်လုပ်ပြီး စုစုပေါင်း ၁၆၆၆၅ Mega Watt

တပ်ဆင်ထုတ်လုပ်ရန် ရည်ရွယ်ခဲ့ပြီး ဖြစ်ပါသည်။ အဆိုပါ ရည်ရယ်ချက်အား အကောင်အထည်ဖော်ဆောင်ရွက်ရာတွင် လျှပ်စစ်ဓာတ်အား ထုတ်လုပ်ရေး နည်းလမ်းအသွယ်သွယ်ဖြင့် ဆောင်ရွက်ရမည် ဖြစ်ရာ လက်ရှိအခွင့်အလမ်းရှိပြီး ရေအားလျှပ်စစ် ထုတ်လုပ်နိုင်သော ရေအရင်းအမြစ်များကြောင့် ရေအားလျှပ်စစ် ဓာတ်အားပေးစက်ရုံများ တည်ဆောက် အကောင်အထည်ဖော်ခြင်းသည် ဦးစားပေး လုပ်ငန်းစဉ်တစ်ရပ် ဖြစ်လာခဲ့ပေသည်။

၆။ ယခုတင်ပြသော စီမံကိန်းသည် ရောဝတီမြစ်ဝှမ်း (Ayeyarwady river basin) အတွင်းရှိ မြစ်လက်တက်တစ်ခုဖြစ်သော မြစ်ငယ်မြစ်၏ မြစ်ညာမြစ်ဝှမ်း (Upper Myit Nge Sub basin) တွင် တည်ရှုပါသည်။ လက်ရှိတင်ပြထားသည့် ရေအားလျှပ်စစ် စက်ရုံတည်ဆောက်ရေး စီမံကိန်းနေရာ၏ မြစ်ညာဖက် (အထက်ဖက်)တွင် မည်သည့် ရေအားလျှပ်စစ်စက်ရုံ တည်ဆောက်ရေး စီမံကိန်းမျှ မရှိကြောင်း တွေ့ရှိရပါသည်။ စီမံကိန်းနေရာ၏ မြစ်အောက်ပိုင်းတွင်မူ ၎င်း Mega Watt ထုတလုပ်လျှက်ရှိသော ၂၀၁၀ တွင် တည်ဆောက် လည်ပတ်ခဲ့သည့် **ရဲရွာရေအားလျှပ်စစ်စီမံကိန်း**ရှိပြီး၊ ၂၈၀ Mega Watt ထုတ်လုပ်နိုင်မည့် **အလယ်ရဲရွာ ရေအားလျှပ်စစ်စီမံကိန်း**မှာ တည်ဆောက်ဆဲ ဖြစ်ပါသည်။ မြစ်ငယ် မြစ်ကြောင်းတစ်လျှောက် အခြားတည်ဆောက်ရန်စီစဉ်နေဆဲ ရေအားလျှပ်စစ် စီမံကိန်းများမှာ ၆၆ Mega Watt ထုတ်လုပ်နိုင်မည့် **ဒီးဒုတ်စီမံကိန်း**၊ ၎၀၀ Mega Watt ထုတ်လုပ်နိုင်မည့် **အလယ်ရဲရွာ စီမံကိန်း**နှင့် ၂၁၀ Mega Watt ထုတ်လုပ်နိုင်မည့် **လမ်လန်း (Lam Lang) စီမံကိန်း**များဖြစ်ကြပါသည်။

စီမံကိန်းဆိုင်ရာတင်ပြချက်

၇။ တင်ပြထားသော ''နမ့ဒူ (သပေါ်) ရေအားလျှပ်စစ် စီမံကိန်း'' သည် နမ့ဒူမြစ်တွင် တည်ဆောက်မည့် လျှပ်စစ်ဓာတ်အား ၂၁၀ Mega Watt ထုတ်လုပ်နိုင်သော Gravity Dam အမျိုးအစားစီမံကိန်းဖြစ်ပါသည်။ စီမံကိန်းတွင် တည်ဆောက်မည့် ရေကာတာသည် ရေပမာဏကုဗမီတာ (၂၅၆.၂၃၃ သန်း) ကို လှောင်နိုင်ပြီး နှစ်စဉ်လျှပ်စစ်စွမ်းအင် 1,005.485 Giga Watt hr (GWhr) (၄၅၈၈ နာရီ) ထုတ်လုပ်နိုင်မည်ဖြစ်ပါသည်။ ရေသိုလှောင်မှုပမာဏကုဗမီတာ ၆၀.၃၉၈ သန်း ထိမ်းသိန်းသိုလှောင်ထားခြိန်တွင် guranted out put မှာ ၃၃.၁၃ Mega Watt ထုတ်လုပ်နိုင်ပါသည်။ စီမံကိန်း၏ ခန့်မှန်းကုန်ကျစရိတ်မှာ **အမေရိကန်ဒေါ်လာ ၄၃၆.၂၈ သန်း**ခန့်ဖြစ်ပြီး၊ စီမံကိန်းတည်ဆောက်ရန် လျာထားအချိန်မှာ **(၆၆)လ** ဖြစ်ပါသည်။ စီမံကိန်းတည်ဆောက်ရခြင်း၏ ရည်ရွယ်ချက်မှာ လျှပ်စစ်

မာတ်အားထုတ်ယူရန်ဖြစ်ပြီး ထွက်ရှိလာသော လျှပ်စစ်စွမ်းအား National grid သို့ ရောင်းချရန် ဖြစ်ပါသည်။

၈။ စီမံကိန်းတည်နေရာမှာ သပေါမြို့၏အနောက်မြောက်ဖက် ၃၀ ကီလိုမီတာအကွာ၊ လားရှိုးမြို့၏ အနောက်တောင်ဖက် ၎၈ ကီလိုမီတာအကွာ၊ မန္တလေးမြို့၏ အရှေ့မြောက်ဖက် ၂၄၉ ကီလိုမီတာ အကွာတွင် တည်ရှိပါသည်။ စီမံကိန်း အနီးပတ်ဝန်းကျင်တွင် နမ့တူမြို့နှင့် ကျောက်မဲမြို့တည်ရှိပြီး ကျောက်မဲခရိုင်အတွင်း တည်ရှိပါသည်။ နမ့တူမြစ်တစ်လျောက်စီမံကိန်းနေရာနှင့် အနီးဆုံးကျေးရွာမှာ မြစ်ညာပိုင်း ၁၆ ကီလိုမီတာ အကွာတွင်ရှိသော လီလူးကျေးရွာတည်ရပါသည်။ စီမံကိန်း တည်ဆောက် လည်ပတ်ရာတွင် ကျေးရွာ (၁)ရွာ ရေနစ်မြုပ်ဧရိယာ (flooded Area) တွင် ပါဝင်နေသဖြင့် အိမ်ခြေ (၄၇)လုံး၊ လူဦးရေ (၂၁၂)ဦး ရွှေ့ပြောင်းရမည်ဖြစ်ပါသည်။ စုစုပေါင်းရေသိုလှောင်မှုကြောင့် ရေနစ်မြုပ်ရ မည့် ဧရိယာမှာ ၈၆၆.၆၉ ဟက်တာ (ha) ဖြစ်ပြီး အဆိုပါဧရိယာတွင် စိုက်ပျိုးအားကောင်းသော လယ်ယာမြေ (cultivated land) ၈၆.၁၂ ဟက်တာ၊ ဥယျာဉ်ခြံမြေ (Plantation) ၄.၂၃ ဟက်တာနှင့် သစ်တောမြေ (forest land) ၅၄၃.၇၁ ဟက်တာတို့ ပါဝင်ပါသည်။ အဆိုပါ ဧရိယာအတွင်း ရေနစ်မြုပ်နိုင်မှုကြောင့် ခန့်မှန်းသစ်ပင်အရေအတက် (၄၃၇၁) ပင်ခန့်ဖယ်ရှားရမည် ဖြစ်ပါသည်။

၉။ စီမံကိန်းတည်ဆောက်မည့်ကာလမှာ (၆၆) လ ဖြစ်ပြီး ပထမ (၂၃)လတွင် ပြင်ဆင်ရေးလုပ်ငန်း များ ဆောင်ရွက်ခြင်း၊ ဒုတိယ(၃၉)လတွင် ပင်မတည်ဆောက်ရေ းဆောင်ရွက်ခြင်းနှင့် နောက်ဆုံး (၄) လ တွင် အပြီးသတ်လုပ်ငန်းများဆောင်ရွက်ခြင်းတို့ ပါဝင်ပါမည်။ စီမံကိန်းတွင် ရေကာတာ (Dam) တည်ဆောက်ခြင်း၊ မာတ်အားထုတ်လုပ်ရေးစက်ရုံ Power House တည်ဆောက်ခြင်း၊ ရေထုတ်ပြွန် တည်ဆောက်ခြင်း (disharge channel) နှင့် တည်ဆောက်ရေး ကာလတွင် မြစ်ရေစီးကြောင်းခေတ ရွှေ့ပြောင်းမည့် ရေကာတမံ (Coffer dam) တည်ဆောက်ခြင်း လုပ်ငန်းများပါဝင်ပါသည်။ တည်ဆောက် ရေးလုပ်ငန်းအတွက် လိုအပ်မည့်ကျောက်တုံး (Rock)၊ ကျောက်ခဲ (Stome)၊ သဲ (Sand) နှင့် မြေကြီး (Soil) များအား စီမံကိန်းအနီးရှိ ကျောက်မိုင်းနှင့် မြစ်၏ လက်ဝဲဘက်လမ်းရှိ သဲတွင်း(၃)ခုမှ ရရှိပါမည်။

စီမံကိန်း၏ပင်မတည်ဆောက်ရေးလုပ်ငန်းများ (Main Structure)

၁၀။ ရေကာတာနှင့် မာတ်အားပေးစက်ရုံတည်ဆောက်ခြင်း

တည်ဆောက်မည့်ရေကာတာသည် ပုံမှန်ကွန်ကရစ်ရေတားတမံ Concrete Gravity type dam ဖြစ်ပြီး အဆင့်သတ်မှတ်ချက်အနေဖြင့် အဆင့် (၂) Grade II, Large type II အမျိုးအစားစီမံကိန်းဖြစ်ပါသည်။

ရေကာတာသည် မြစ်ကိုကန့်လန့် ဖြတ်အနေအထားဖြင့် ၃၀၄ မီတာရှည်ပြီး ရေကာတာ၏ အလယ်တွင် ပင်လယ်ရေ မျက်နှာပြင်အထက် (above sea level) ၄၉၅ မီတာမြင့်ပါမည်။ ရေကာတာ၏ အနိမ့်ဆုံးကြမ်းပြင်သည် ပင်လယ်ရေမျက်နှာပြင် အထက် ၃၈၁ မီတာရှိပြီး ရေကာတာ၏အမြင့်မှာ ၄င်းမှ ၁၁၄ မီတာမြင့်ပါမည်။ ပုံမှန်ရေ၏အမြင့်မှာ ပင်လယ်ရေ မျက်နှာပြင်အထက် ၄၈၅ မီတာ ဖြစ်ပါသည်။

၁၁။ ဓာတ်အားပေးစက်ရုံအစုအဖွဲ့ (Power house Complex) တွင် ပင်မဓာတ်အားပေးစက်ရုံ (Main Powerhouse) ၊ အရံအခန်းများနှင့် ပင်မထိမ်းချုပ်ရေးအဆောက်အဦး (auxiliary rooms & Central Control Building၊ မြစ်အောက်ပိုင်းပင်မဓာတ်အားခွဲတူးမြောင်း (downstream main transformer tunnel၊ လျှပ်စစ်ဆက်သွယ်ရေး တူးမြောင်း busbar tunnel၊ ပန်ကာခန်း (fan room)၊ရေထွက်တူးမြောင်း (tailrace funnel Ongoing line)၊ လေဝင်ထွက်တူးမြောင်း ventilatian tunnel နှင့် တည်ဆောက်ရေးဝင်ရိုး (Working Shaft)၊ လုပ်ငန်းတူးမြောင်း Access tunnel၊ စွန့်ပစ်ရေးတူးမြောင်း drainage tunnel၊ ဓါတ်ကြိုးတူးမြောင်း Cable trouch နှင့် လုံခြုံရေးလမ်းကြောင်း Safe access များ ပါဝင်သည်။

၁၂။ ရေကာတာနှင့်ဓာတ်အားပေးစက်ရုံ တည်ဆောက်ရေး လုပ်ငန်းစဉ်တွင် မြစ်ကမ်းပါးနံရများအား တူးဖော်ခြင်း၊ မြစ်ကြောင်းပိတ်ဆို့ခြင်း၊ ရေလွှဲတမံ တည်ဆောက်ခြင်း၊ မြစကြမ်းခင်းမြေတားခြင်း၊ ကွန်ကရစ် အောက်ခြေပြင်ဆင်ခြင်း၊ ကွန်ကရစ်ဖျော်ခြင်းနှင့် လောင်းခြင်း၊ မြေနှင့်ကျောက်များပြန်ဖုံးခြင်း လုပ်ငန်းများ ပါဝင်ပါသည်။ အဆိုပါ တည်ဆောက်ရေး လုပ်ငန်းစဉ်တွင် မြစ်ကြမ်းခင်းနှင့် ကမ္ဘားနံရံများအား ဖောက်ခွဲခြင်း၊ ကွန်ကရစ်ဖျော်ခြင်း၊ Tower Crame များနှင့် ကွန်ကရစ်လောင်းခြင်း၊ ကွန်ကရစ်ဖျော်စက်များဖြင့် ဖျော်ခြင်း၊ ကွန်ကရစ်ပက်ဖြန်းခြင်း၊ ကျောက်ဆိုင်းတုံးများ (anchor rod) များအတွက် လိုအပ်သော ကျောက်သားချုပ်တန်းများ rock dewel များ တည်ဆောက်ခြင်း လုပ်ငန်းများပါဝင်ပါသည်။

၁၃။ **Turbine နှင့် generator တပ်ဆင်ခြင်း** ။ လျှပ်စစ်ဓာတ်ထုတ်လုပ်ရန်အတွက် ရွေးချယ်ထားသော Turbine မှာ vertical Shaft Francis turbine အမျိုးအစားဖြစ်ပြီး efficiency rating ၉၁.၅၅% ရှိပြီး လျှပ်စစ်ဓာတ်အား ၈၁.၄၃ Mega Watt ထုတ်လုပ်နိုင်ပါသည်။ ရွေးချယ်ထားသော generator မှာလည်း vertical Shaft ဒေါင်လိုက်ဝင်ရိုးရှိသော three phase Synchronous rotating field type ဖြစ်ပြီး ၈၀ Mega watt ထုတ်လုပ်နိုင်ပါသည်။ အဆိုပါအမျိုးအစား turbine နှင့် generator (၃)စုံကြောင့် လျာထား လျှပ်စစ်ဓာတ်အား ၂၁၀ Mega Watt ထုတ်လုပ်နိုင်မည် ဖြစ်ပါသည်။

၁၄။ တည်ဆောက်ရေးကာလမှာ ခန့်မှန်းစုစုပေါင်း ၆၆ လ ကြာမြင့်မည်ဖြစ်ပြီး ပထမ ၂၃ လ ပြင်ဆင်ရေး လုပ်ငန်းများကိုဌင်း၊ ဤ ၃၉ လတွင် ပင်မတည်ဆောက်ရေး လုပ်ငန်းများကို ဌင်းနှင့် နောက်ဆုံး ၄ လ တွင် အပြီးသတ်လုပ်ငန်းများကိုဌင်း ဆောင်ရွက်သွားမည်ဖြစ်ပါသည်။ တည်ဆောက်ရေးကာလအတွင်း ရေလမ်းကြောင်းပြောင်းလဲရန်အတွက် ရေကာတာ၊ ခါတ်အားပေးစက်ရုံ၊ ရေထုတ်ဥမင်လမ်းကြောင်းနှင့် ရေတားတမံများတည်ဆောက်ရပါမည်။

တည်ဆောက်ရေးလုပ်ငန်းများအတွက် မြစ်ရေကြောင်းပြောင်းလဲခြင်း (Diversion)

၁၅။ ရေကာတာပြုလုပ်ရန် ရွေးချယ်ထားသောနေရာမှာ အင်္ဂလိပ်အက္ခရာ V ပုံစံဖြစ်ပြီး မြစကြမ်းပြင်မှာ မီတာ ၃၀ ခန့်သာ ရှိပြီး ဘေးကမ္ဘာနှစ်ဖက်တွင် မတ်ဆောက်သော ကျောက်သား နံရံနှစ်ဖက် ရှိပါသည်။ ထို့ကြောင့် မြစ်ကြောင်းပြောင်းလဲရန်အတွက် မြစ်ရေလမ်းကြောင်းကို ပိတ်ဆို့ပြီး လမ်းလွှဲကို ဖောက်လုပ်ကာ ရေတားတမံ (Offer dam) ပိတ်ဆို့ခြင်းနည်းလမ်းကို ရွေးချယ်ခဲ့ပါသည်။ မြန်မာနိုင်ငံတောအစိုးရ လျှပ်စစ်စွမ်းအင်ဝန်ကြီးဌာန၏ မှတ်ချက်အရ ရေတားတမံအတွက် မြေသားနှင့် ကျောက်သားအားဖြည့် တာတမံဖြင့် ဆောင်ရွက်သွားရမည် ဖြစ်ပါသည်။ အဝင်နှင့်အထွက် ရေပိုလွှဲတူးမြောင်းနှင့် ရေတားတမံ (Offer dam) များအား ရေလွှမ်းမိုးမှုမှ ကာကွယ်ရန်တည်ဆောက်ရပါမည်။ အဝင်ရေပိုလွှဲတူးမြောင်းအတွက် ရေပိုလွှဲတူးမြောင်းနှင့် **မာကျောအောင**စီမံထားသော ရေတားတမံများအတွက် မြေသားဖြင့် တည်ဆောက်ရန် စီစဉ်ထားပါသည်။

စီမံကိန်းဆောင်ရွက်ရာတွင် လိုအပ်မည့်အရင်းအမြစ်များ (resources) အား ခန့်မှန်းတွက်ချက်ခြင်း

၁၆။ တည်ဆောက်ရေးလုပ်ငန်းအတွက် လိုအပ်သောသဘာဝအရင်းအမြစ်များမှာ ကျောက်တုံးကြီးများ (block Stone)၊ ကွန်ကရစ်အကြမ်း (Coarse Concrete) ၊ကျောက်စရစ်များ (fine aggregate)နှင့် မြေသားများဖြစ်ပါသည်။ စုစုပေါင်း လိုအပ်သော ကွန်ကရစ်ထုထည်မှာ ကုဗမီတာ ၅၉၆,၆၀၀ ဖြစ်ပါသည်။ စုစုပေါင်း လိုအပ်သော ကျောက်သားပမာဏမှာ ကုဗမီတာ ၁၂၅၄၀၀၀ ဖြစ်ပြီး ကျောက်စရစ်ခဲအကြီး/အသေး စုစုပေါင်း လိုအပ်ချက်မှာ ကုဗမီတာ ၁၄၇၂၀၀၀ လိုအပ်မည်ဖြစ်ပါသည်။ စီမံကိန်းအနီး ကျောက်မိုင်းမှ လိုအပ်သော ကျောက်တုံးများ၊ ကျောက်များ၊ ကျောက်စရစ်ခဲများကို ရရှိနိုင်ပါသည်။ ရေတားတမံ (Coffer dam) တည်ဆောက်ရန်အတွက် ရေမစိမ့်နိုင်သောမြေ

(injervious soil) လိုအပ်ချက်မှာ ကုဗမီတာ ၃၄၁၀၀၀ ဖြစ်ပါသည်။ တည်ဆောက်ရေး လုပ်ငန်းအတွက် လိုအပ်သော သဲများကို အနီးရှိသဲကျင်း (၃) ခုမှ ရယူမည်ဖြစ်ပြီး ပမာဏမှ ကုဗမီတာ ၄၅၂၀၀ ဖြစ်ပါသည်။

၁၇။ ကွန်ကရစ်လုပ်ငန်းအတွက် လိုအပ်သော ရေပမာဏမှာ ကုဗမီတာ ၅၈၅၀၊ ကျောက်စရစ် ကုဗမီတာ ၃၆၈၀၀၀ ဖြစ်ပြီး စက်ယန္တယားများကို သန့်ရှင်းရေးအတွက် ကုဗမီတာ ၁၄၂၅၀၊ လုပ်သားများသုံးစွဲမှုအတွက် ကုဗမီတာ ၉၉၅၀၀ ဖြစ်ပါသည်။ စီမံကိန်း တည်ဆောက်ရေး လုပ်ငန်းတစ်ခုလုံးအတွက် ရေလိုအပ်မှု စုစုပေါင်းမှာ ကုဗမီတာ ၃၇၉၉,၆၆၀ ဖြစ်ပြီး ရေဆိုးထုတ်လုပ်မှုမှ ပမာဏမှာ ၃၀၃၉၆၈၀ ကုဗမီတာ ဖြစ်ပါသည်။

၁၈။ တည်ဆောက်ရေး ကာလတွင် စက်ယန္တယားကြီးများနှင့် တူးဖော်ခြင်း၊ ကွန်ကရစ်လုပ်ငန်းများ ဆောက်ရွက်ခြင်း၊ ကျောက်စရစ် ထုတ်လုပ်ခြင်းနှင့် ရေထောက်ပံ့ခြင်းများကြောင့် စုစုပေါင်းခန့်မှန်းလျှပ်စစ်ဓာတ်အားလိုအပ်ချက်မှာ ၄၅၅၁၀.၄၃ Mega Watt per hours (MWh) ဖြစ်ပါသည်။ လုပ်ငန်းများ လည်ပတ်ချိန်တွင် နှစ်စဉ်လျှပ်စစ စွမ်းအင်လိုအပ်ချက်မှာ **၃၆၀၀.၈၀** MWh / year ဖြစ်ပါသည်။ တည်ဆောက်ရေး ကာလအတွက် စုစုပေါင်းစက်သုံးဆီ (ဒီဇယ်ဆီ) ခန့်မှန်းလိုအပ်ချက်မှာ **၂၈၉၀.၈၄** တန် ဖြစ်ပြီး လုပ်ငန်းများ လည်ပတ်ချိန်တွင် နှစ်စဉ်ဒီဇယ်ဆ လိုအပ်ချက်မှာ **၈၀ kg/ year** ဖြစ်ပါသည်။

၁၉။ သယံဇာတများဖြစ်သော လျှပ်စစ်စွမ်းအင်၊ ဒီဇယ်ဆီနှင့်ရေများ၏ အမှန်လိုအပ်သော ပမာဏအား (EIA/SIA) ဆန်းစစ်သောကာလတွင် အသေးစိတ်တွက်ချက်သွားမည် ဖြစ်ပါသည်။ အဆိုပါ တွက်ချက်မှုများက စီမံကိန်းကြောင့်ဖြစ်ပေါ်လာသော ဖန်လုံအိမ်အာနိသင်ဓာတ်ငွေ့ (Green Houes Gas) ထုတ်လွှတ်မှုအတွက်ပါ တွက်ချက်ပြီး ဖြစ်ပေါ်လာပါလိမ့်မည်။ အဆိုပါတွက်ချက်မှုများကို ကျောက်စရစ်ထုတ်လုပ်ခြင်း၊ ကွန်ကရစ်ဖျော်ခြင်း၊ National Grid သို့ ဓာတ်အားလိုင်းချိတ်ဆက်ခြင်းနှင့် ရေသိုလှောင်ခြင်းစသော စီမံကိန်းဆောင်ရွက်သူ၏ စီမံချက်ပေါ်မူတည်၍ တွက်ချက်ထားခြင်းဖြစ်ပါသည်။

၂၀။ တည်ဆောက်ရေးတွင် အသုံးပြုသည့် ကျောက်စရစ်ထုတ်လုပ်သည့်စနစ်သည် အစပိုင်းတွင် တစ်နာရီ ၂၈၀ တန် ထုတ်လုပ်နိုင်ပြီး နောက်ပိုင်းတနာရီတွင် ၂၃၀ တန် ဖြင့် ထုတ်လုပ်သွားနိုင်ပါသည်။ ကွန်ကရစ်ဖျော်သည့်စနစ်မှာလည်း တစ်နာရီတွင် ကွန်ကရစ်ပမာဏ ၁၅၀ m^3 ထုတ်လုပ်နိုင်ရန်စီစဉ်ထား ပါသည်။ ရေထောက်ပံ့မှုစနစ် (၅) ခု တည်ဆောက်ရန်စီစဉ်ထားပြီး ယင်းတို့တွင် ၁၀၀ m^3 သိုလှောင် နိုင်သော ရေကန် (၃) ကန် နှင့် ၅၀ m^3 သိုလှောင်နိုင်သော ရေကန် (၂) ကန် ပါဝင်

ပါသည်။ စီမံကိန်း ဇရိယာအတွင်း လျှပ်စစ်စွမ်းအင် 4 MWA အသုံးပြုနိုင်သော ၆၆ KVA ဓါတ်အားရုံ (၁) ရုံ တည်ဆောက်သွားမည်ဖြစ်ပြီး ယင်းမှအဆင့် ၆၆ KV ဓါတ်အားလိုင်းဖြင့် မန်စန်ရှိ ၂၃၀ KV ဓါတ်အားရုံသို့ ချိတ်ဆက်ရန်စီစဉ်ထားပါသည်။ ၆၆ KV ဓာတ်အားရုံခွဲမှတဆင့် စီမံကိန်း၏ လျှပ်စစ်ဓာတ်အားအသုံးပြုမည့် နေရာ transformar ၅ နေရာသို့ 11 KV ဓါတ်အားလိုင်း ၅ လိုင်းဖြင့် ပေးပို့မည် ဖြစ်ပါသည်။

စီမံကိန်းဆိုင်ရာ ရွေးချယ်မှုများနှင့် အခြားရေးချယ်နိုင်မှုများ

၂၁။ စီမံကိန်းအကောင်အထည်ဖော်မည့် အဖွဲ့အစည်းသည် စီမံကိန်းရေးဆွဲ အကောင်အထည်ဖော်ရာတွင် စီမံကိန်းဆိုင်ရာ ရွေးချယ်ရန် အချက်များနှင့် ပြောင်းလဲဖြစ်ပေါ်နေသော အခြေအနေ မျိုးစုံပေါ်တွင် အောက်ပါအတိုင်း ရွေးချယ်ဆောင်ရွက်ခဲ့ကြောင်း တွေ့ရပါသည်။ ရွေးချယ်မှု အခြေအနေများအား EIA/SIA ဆန်းစစ်မှုများ ပြုလုပ်ချိန်တွင် အသေးစိတ်ဆန်းစစ်သွားမည်ဖြစ်ပါသည်–

(က) **ရေကာတာ တည်ဆောက်မည့် နေရာနှင့် ရေကာတာအမျိုးအစား (type of Dam) ရွေးချယ်ခြင်း**

စီမံကိန်းရေးဆွဲမှု အစပိုင်းတွင် ရေကာတာ၏နေရာအား လက်ရှိ ရွေးချယ်ထားသော နေရာ၏အောက်ဖက် ၁၅ ကီလိုမီတာအကွာ (သပေါမြို့ နှင့် နီးသောနေရာ)၊ ရေအားလျှပ်စစ်ထုတ်ယူရန် ပို၍သင့်တော်သော နေရာအား ရွေးချယ်ခဲ့ပါသည်။ သို့ရာတွင် အဆိုပါနေရာသည် လူနေထူထပ်သော မိုးတေကျေးရွာအား ရေနစ်မြုပ်နိုင်ခြင်း၊ ကျေးရွာပိုင် လယ်ယာမြေများလည်းရှိခြင်း နှင့် ကျေးရွာများ ရွှေ့ပြောင်းမှုကို ခက်ခဲစွာပြုလုပ်ရနိုင်ကြောင်း တွေ့ရှိခဲ့ရပါသည်။ ထို့ကြောင့် စီမံကိန်းဖော်ဆောင်မည့် အဖွဲ့အစည်းသည် မူလရွေးချယ်ထားသောနေရာ၏ အထက် ၁၉၀၀ မီတာခန့်တွင် အခြားရေကာ တာနေရာ (၂) ခုကို ရွေးချယ်ထားခဲ့ပါသည်။

ရေကာတာ၏ အထက်ပိုင်းတွင် Rock Fill face type ကျောက်သားဖြည့် ရေကာတာ ပုံစံနှင့် သင့်တော်ပြီး ရေကာတာ၏အောက်ပိုင်းသည် Concrete gravity Dam ခေါ် ကွန်ကရစ်သုံး ရေကာတာပုံစံ သုံးစွဲခြင်းကလည်း သင့်တော်ကြောင်း သိရပါသည်။ ရေကာတာ အောက်ပိုင်း တည်ဆောက်ခြင်းအား ရွေးချယ်ရန်ပုံစံ (၃) ခုအပါအဝင်

လက်တွေ့အခြေအနေအရ အောက်ပါအတိုင်း (၄) မျိုးရွေးချယ်နိုင် ကြောင်း သိရပါသည် -

(၁) ရေကာတာအထက်ပိုင်းအား ကျောက်သားဖြည့်ကွန်ကရစ် ရေလှောင်တမံပုံစံ Concrete faced rockfill type Dam.

(၂) ရေကာတာအောက်ပိုင်းပုံစံ (က) - ရေယူစနစ်ပါဝင်သော ကွန်ကရစ် Gravity သုံး ရေကာတာစနစ်၊ လျှပ်စစ်စွမ်းအင်ထုတ်လုပ်မှုစနစ် (Generation System) အား ညာဖက်မြစ်ကမ်းတွင် တည်ဆောက်ပြီး ရေကာတာ အောက်ခြေတွင် စွမ်းအင် ထုတ်လုပ်မှုစနစ် (Power house) ဖြင့် ဆောင်ရက်ခြင်း။

(၃) ရေကာတာအောက်ပိုင်းပုံစံ (ခ) - ရေယူစနစ်ပါဝင်သော ကွန်ကရစ် Gravity သုံး ရေကာတာစနစ်၊ လျှပ်စစ်စွမ်းအင ထုတ်လုပ်မှုစနစ် (Generation System) အား ရေကာတာ၏ တပ်ဆင်ပြီး စွမ်းအင်ထုတ်လုပ်မှုစနစ် (Power house) အား ရေကာတာ၏အောက်ခြေတွင် တည်ဆောက်ခြင်း။

(၄) ရေကာတာအောက်ပိုင်းပုံစံ (ဂ) - ကွန်ကရစ် Gravity သုံး ရေကာတာစနစ်တွင် ရှည်လျားသော ရေယူစနစ်နှင့် ညာဖက်ကမ်းတွင် generation system နှင့် မြေပြင်တွင် power house ဆောက်လုပ်ခြင်း။

ရေကာတာအောက်ပိုင်းပုံစံ (ခ) သည် မြေနှင့်ကျောက်တူးဖော်ခြင်း၊ တူးမြောင်းများတူးဖော်ခြင်း တို့အတွက် အနိမ့်ဆုံး ကုန်ကျစရိတ်သာ ရှိသဖြင့် အဆိုပါပုံစံကိုရွေးချယ်ခဲ့ပါသည်။

(ခ) **ရေကာတာ၏ရေအမြင့်ရွေးချယ်ခြင်း**

ပုံမှန်အခြေအနေတွင်ရှိနေရမည့် ရေအမြင့် ပင်လယ်ရေမျက်နှာပြင်အမြင့် ၄၈၅ မီတာနှင့် ၄၆၂ မီတာ (၂) မျိုးကို ရွေးချယ်ခဲ့ပါသည်။ ရေမျက်နှာပြင်အမြင့်ဆုံး အခြေအနေသည် နှစ်စဉ် လျှပ်စစ်ဓာတ်အား ထုတ်လုပ်မှု ၂၅ Giga Watt hous ပိုမိုထုတ်လုပ်နိုင်ကြောင်း တွေ့ရှိရပါသည်။ သို့သော်လည်း တစ်ဖက်တွင်မြစ်ညာဖက ၌ ရေနစ်မြုပ်နိုင်မည့် ဧရိယာ ပိုမိုလာနိုင် သဖြင့် ပိုမိုများပြားသော လူနေအိမ်ခြေ

ပြောင်းလွှဲရမှုများ ဖြစ်ပေါ်နိုင်ကြောင်း တွေ့ရှိရပါသည်။ ထို့ကြောင့် ရေလမ်းပိုးမှုနဲပါးသော၊ ပြောင်းလွှဲရမှု နည်းပါးသော ပုံမှန် ရေမျက်နှာပြင် အမြင့် ၄၈၅ မီတာကိုသာ ရွေးချယ်ခဲ့ပါသည်။

(ဂ) **တပ်ဆင်မည့် လျှပ်စစ်ထုတ်လုပ်မှုပမာဏကို ရွေးချယ်ခြင်း**

စီမံကိန်း တည်ဆောက်သည့် အဖွဲ့အစည်းသည် တပ်ဆင်မည့် လျှပ်စစ်ထုတ်လုပ်မှု ပမာဏ Installed Capacity (၃) မျိုးအား ရွေးချယ်ခဲ့ပါသည်။ စီမံကိန်း စတင်ရေးဆွဲခဲ့စဉ်က ၂၀၀ Mega Watt အထက် တပ်ဆင်ရန်စီစဉ်ခဲ့ပါသည်။ ရွေးချယ်ရာတွင် ၁၀ MW စီတိုး၍ ၂၀၀ MW ၂၁၀ MW နှင့် ၂၂၀ MW များကို ထည့်သွင်းစဉ်စားခဲ့ပါသည်။ တပ်ဆင်သော MW ပမာဏ များသည်နှင့်အမျှ နှစ်စဉ်လည်ပတ်သည့် နာရီနည်းပါးသော်လည်း ထုတ်လုပ်နိုင်သည့် ခါတ်အားမြင့်တက်နိုင်ကြောင်း တွေ့ရပါသည်။ သို့ရာတွင် တစ်ယူနစ်ထုတ်လုပ်မှုနှင့် ကုန်ကျစရိတ်သုံးစွဲရမှု အနည်းဆုံး ဖြစ်သော ၂၁၀ MW ကိုပင် ရွေးချယ်ခဲ့ပါသည်။

(ဃ) **စွန့်ပစ်ရေထွက်ရှိမှု လုံးဝမရှိသော ရေပြန်လည် သုံးစွဲစနစ်နှင့် ဆွေးမြေ့စေခြင်း။**

ရည်မှန်းထားသော လျှပ်စစ်ဓာတ်အား ထုတ်လုပ်နိုင်ရန်အတွက် ရွေးချယ်ရန် စက်အမျိုးအစားများစွာရှိပါသည်။ ၁၀၅ MW generating Units (၂) လုံးတပ်ဆင်ခြင်း (သို့မဟုတ်) ၈၀ MW Generating Units (၃) လုံးတပ်ဆင်ခြင်း (သို့မဟုတ်) ၅၂.၂ MW generating Units (၄) လုံးတပ်ဆင်ခြင်း များအားရွေးချယ်ခဲ့ပါသည်။ နောက်ဆုံးတွင် လျှပ်စစ်ဓာတ်အား ထုတ်လုပ်ရန် ပိုမိုသေချာပြီး၊ turbine စွမ်းဆောင်ရည် ပိုမိုကောင်းမွန်သော ၈၀ MW generation Unit (၃) လုံးအား ရွေးချယ်ခဲ့ပါသည်။

စီမံကိန်းဆိုင်ရာများအား ပြည်သူလူထုထံချပြရှင်းလင်းခြင်း

၂၂။ စိတ်ကူးရေးဆွဲသည့် အချိန်မစ၍ စီမံကိန်းဆောင်ရွက်မည့် အဖွဲ့အစည်းသည် ပတ်ဝန်းကျင်ရှုအစိုးရ၊ ဒေသအာဏာပိုင်နှင့် ပြည်သူများအား စီမံကိန်းဆိုင်ရာများအား ထိတွေ့တင်ပြခဲ့ပါသည်။

စီမံကိန်းဆိုင်ရာ အချက်အလက်များအား သတင်းစာ၊ လူမှုရေးဆိုင်ရာ စာနယ်ဇင်းနှင့် websites များတွင်လည်း ထည့်သွင်းခဲ့ပါသည်။

၂၃။ EIA အတိုင်ပင်ခံပညာရှင်အဖွဲ့သည် ၂၀၁၇ ခုနှစ် အောက်တိုဘာလအတွင်း ပတ်ဝန်းကျင်နှင့် လူမှုရေးဆိုင်ရာ ထိခိုက်မှုများဆန်းစစ်ခြင်းပြုလုပ်ရန် လိုအပ်သော နယ်ပယ်အတိုင်းအတာသတ်မှတ်ခြင်း အဆင့်တွင် စီမံကိန်းတည်ဆောက်မည့် နေရာသို့ (၄) ကြိမ်သွားရောက်ခဲ့ပါသည်။ အဆိုပါပညာရှင်အဖွဲ့သည် နမ့်တူမြစ်ဖြတ်သန်းရာ သပေါမြို့နယ်၊ နမ့်တူမြို့နယ်နှင့် နမ်ဆန်မြို့နယ်များအတွင်းရှိ affected people သက်ရောက်မှု ခံရသော ပြည်သူများအား ဖော်ထုတ် အတည်ပြုခဲ့ပါသည်။ ထို့အပြင် သပေါမြို့နယ်၊ နမ့်တူမြို့နယ်နှင့် ကျောက်မဲမြို့နယ်များရှိ အစိုးရဌာနဆိုင်ရာ တာဝန်ရှိသူများနှင့်လည်း တွေ့ဆုံ ဆွေးနွေးခဲ့ပါသည်။ နမ့်တူမြို့နယ်နှင့် သီလကျေးရွာများရှိ ဒေသခံ ကျေးရွာသားများနှင့်လည်း တွေ့ဆုံပြီး ၄င်းတို့၏သဘောထားအမြင်များကို ရယူခဲ့ပါသည်။

၂၄။ ၂၀၁၈ ခုနှစ် မေလ ၁၁ ရက်နေ့တွင် လီလးကျေးရွာမှ ကျေးရွာသားများကိုနှင့် တွေ့ဆုံပြီး စီမံကိန်းဆိုင်ရာရှင်းလင်းတင်ပြမှု ပြုလုပ်ခဲ့ပြီး ၂၀၁၈ ခုနှစ် မေလ ၁၂ ရက်နေ့တွင် နမ့်တူမြို့နယ်အတွင်း ဌာနဆိုင်ရာများနှင့်တွေ့ဆုံခဲ့ပါသည်။ ၂၀၁၈ ခုနှစ် ဇူလိုင်လ ၄ ရက်နေ့တွင် မန်ဆန်တွင် နမ့်တူမြို့နယ်၊ လွှတ်တော်ကိုယ်စားလှယ် ဒေါ်နန်းခမ်းအေးနှင့်တွေ့ဆုံ၍ စီမံကိန်းဆိုင်ရာများ ရှင်းလင်းတင်ပြဆွေးနွေးခဲ့ပြီး မြို့နယ်သစ်တောဦးစီးဌာနမှူးပါ တက်ရောက်ခဲ့ပါသည်။ လွှတ်တော်ကိုယ်စားလှယ် ဒေါ်နန်းခန်းအေးက စီမံကိန်းဆိုင်ရာများအပေါ် လေ့လာမေးမြန်းမှုများပြုလုပ်ခဲ့ပါသည်။

၂၅။ ရေကာတာကြံ့ခိုင်မှုနှင့် ရေနစ်မြုပ်မှုသည် မြစ်၏အောက်ပိုင်းနေ ပြည်သူများ စိုးရိမ်သော အချက်ဖြစ်ပါသည်။ အခြားဒေသခံပုဂ္ဂိုလ်များသိရှိလိုသော အကြောင်းအရာမှာ ဖြစ်နိုင်ခြေ ဆန်းစစ်ခြင်းလုပ်ငန်း (Feasibility Survey) ပြုလုပ်နေသည့်အချိန်တွင် (Soil test) မြေဆီလွှာစစ်ဆေးခြင်းပြုလုပ်ရန် မြေနမူနာများ သယ်ဆောင်သွားမှုဖြစ်ပြီး၊ ကုမ္ပဏီသည် ရွှေ သို့မဟုတ် အခြားအဖိုးတန်သတ္တု တူးဖော်ခြင်းလုပ်ငန်း ဆောင်ရွက်ခဲ့ကြောင်း ယူဆမှုများရှိနေခဲ့ပါသည်။

၂၆။ လူထုတွေ့ဆုံမှုများ ပြုလုပ်သည့်အချိန်များတွင် ဒေသခံပြည်သူများ၏ စီမံကိန်းဆိုင်ရာ မကြေနပ်ချက်များကို ဖော်ထုတ် မေးမြန်းခဲ့ပြီး၊ စီမံကိန်းဆောင်ရွက်မည့် ကုမ္ပဏီမှ စီမံထားသောထိခိုက်မှုများ လျော့ကျရေး ကြိုတင်အစီအမံများအား ရှင်းလင်းပြပြီးဒေသခံများ ယုံကြည်မှုရရှိစေရန် ဆောင်ရွက်နိုင်

ခဲ့ပါသည်။ လူထုတွေ့ဆုံမှုများအား ရှင်းလင်းပြပြီး ဒေသခံများယုံကြည်မှုရရှိစေရန် ဆောင်ရွက်ခဲ့ပါသည်။ လူထုတွေ့ဆုံမှုများ မပြုလုပ်မီ ကွင်းဆင်းလေ့လာမှုများ ပြုလုပ်၍လည်း ဒေသခံပြည်သူတို့၏ စိမ်ကိန်း အပေါ်ထားရှိသော သဘောထားဆိုင်ရာအချက်အလက်များ ကောက်ယူခဲ့ပြီး ပြည်သူတို့၏ လူနေမှု ဘဝနှင့် အခြားစီးပွားရေးနှင့် လူမှုရေးဆိုင်ရာ ထိခိုက်မှုများရှိမရှိအပေါ် ဆန်းစစ်မှုများပြုလုပ်ခဲ့ပါသည်။

စီမံကိန်းကြောင့် ဖြစ်ပေါ်လာနိုင်သော အကျိုးကျေးဇူး/သက်ရောက်မှုများ

Positive Impacts of the Project

၂၇။ **ရေအားလျှပ်စစ်၏စီမံကိန်းများတွင် အကျိုးကျေးဇူးများစွာရှိပြီး အောက်ပါတို့ပါဝင်ပါသည်**

(က) တိုက်ရိုက်သို့မဟုတ် သွယ်ဝိုက်သောနည်းလမ်းများဖြင့် ဒေသခံများအတွက် အလုပ်အကင် အခွင့်အလမ်းများရရစေခြင်း၊ အခြားဆက်စပ်လုပ်ငန်းများဖြစ်သော သယ်ယူပို့ဆောင်ရေး transportation ၊ အစားအစာများထောက်ပံ့ရောင်းချခြင်း food-supply၊ ကိရိယာပစ္စည်းများငှားရမ်းခြင်းနှင့် ပြုပြင်ခြင်း (equipment rental and repair) နှင့် လက်လီအရောင်းဆိုင်များဖွင့်လှစ်ခြင်း၊ စသည့်လုပ်ငန်းများလည်းရရှိစေပါမည်။

(ခ) လျှပ်စစ်ဓာတ်အားကို သက်သာသောနှုန်းဖြင့် ထုတ်လုပ်သုံးစွဲနိုင်သဖြင့် ဒေသတွင်းစက်မှုလုပ်ငန်းကဏ္ဍဖွံ့ဖြိုးတိုးတက်စေပါသည်။

၂၈။ တည်ဆောက်ရေးကာလတွင် ဒေသခံပြည်သူ ၁၀၀၀ ဦးခန့် စီမံကိန်းတွင် အလုပ်အကိုင်ရရှိစေပါမည်။ တည်ဆောက်ပြီးစီး၍ လုပ်ငန်းလည်ပတ်သည့်အချိန်တွင်လည်း ဒေသခံပြည်သူလူထုများနှင့် အဖွဲ့အစည်းများ၏လူနေမှုဘဝကို ထိခိုက်မှုမရှိစေဘဲ တိုက်ရိုက်သို့မဟုတ် သွယ်ဝိုက်သောနည်းလမ်းများဖြင့် အလုပ်အကိုင်နှင့် လုပ်ငန်းများပေါ်ပေါက်လာစေမည်ဖြစ်ပါသည်။

စီမံကိန်းကြောင့်ဖြစ်ပေါ်လာနိုင်သည့် ထိခိုက်မှုများနှင့် လျော့ပါးသက်သာစေသော နည်းလမ်းကောင်းများ။

၂၉။ စီမံကိန်းကြောင့် ဖြစ်ပေါ်လာနိုင်သော ထိခိုက်မှုများကိုဖော်ထုတ်ရာတွင် တည်ဆောက်ရေးကာလ Construction Phase နှင့် လုပ်ငန်းလည်ပတ်သော ကာလ Operational Phase ဟူ၍ နှစ်ပိုင်းခွဲနိုင်ပါသည်။

၃၀။ (က) **မြေရှင်းလင်းခြင်းအတွက် သစ်တောရှင်းလင်းခြင်း (Deforestation for land clearonce)**

စီမံကိန်းတည်ဆောက်ရာတွင် ရေကာတာကြောင့် ၈၆၆ ဟက်တာ ရေနစ်မြုပ်မည် ဖြစ်လာဖြင့် ခန့်မှန်း ၉၀၈ ဟက်တာခန့် သစ်တောရှင်းလင်းမှုများ ပြုလုပ်ရပါမည်။ ရေနစ်မြုပ်မှုမရှိမှီ အဆိုပါသစ်တောရှိ သစ်ပင်များကို ခုတ်လှဲရပါမည်။ ခန့်မန်း ရှင်းလင်းရမည့်သစ်ပင် ၄၃၇၁ ပင် ရှင်းလင်းရမည်ဖြစ်ပြီး ၄င်းတို့ အနက် ၄၇၀ မှာ စီးပွားဖြစ်သစ်ပင်များနှင့် ၄၁၄ မှာ ဝါးပင်များဖြစ်ကာ ၂၈၂၀ မှာ သီးနှံပင်များ ဖြစ်ပါသည်။ စုစုပေါင်းသစ်တောဧရိယာ ၅၇၆ ဟက်တာအား စီမံကိန်းအတွက် အသုံးပြုမည်ဖြစ်ပြီး အဆိုပါ ဧရိယာအတွင်းရှိ နို့တိုက်သတ္တဝါအချို့ ဆုံးရှုံး ရမည် ဖြစ်ပါသည်။ အသေးစိတ် အချက်အလက်များကို (EIA/SIA) ဆန်းစစ် ဆောင်ရွက် ချိန်တွင် ထပ်မံဆန်းစစ်လေ့လာသွားမည်ဖြစ်ပါသည်။

(ခ) **မြေဧရိယာအချို့ ရေနစ်မြုပ်ခြင်း (Submergence of land)**

ရေကာတာကြောင့် တည်ဆောက်ရေး ကာလအတွင်း လီလးကျေးရွာ အပါအဝင် စိုက်ပျိုးရေး လပ်ကိုင်နေသော လယ်ယာများ နစ်မြုပ်သွားမည် ဖြစ်သဖြင့် ရွှေ့ပြောင်းအခြေချမှု resettlement များပြုလုပ်ရပါမည်။ စုစုပေါင်း ရေနစ်မြုပ်မည့် ဧရိယာမှာ ၈၆၆ ဟက်တာဖြစ်ပြီး ရေနစ်မြုပ်မှုကြောင့် အိမ်ထောင်စု ၄၇ စု၊ ရွှေ့ပြောင်း အခြေချ ခြင်း၊ အဆောက်အဦးပမာဏ ၁၅၉၀၇ m^3 ခန့်ဖြိုဖျက်စေခြင်း၊ စိုက်ပျိုးမြေ ၁၄၀ ဟတ်တာဆုံးရှုံးစေခြင်းနှင့် လူလုပ်ရေလှောင်ကန်တစ်ခု ဖြစ်ပေါ် စေခြင်းများ ဖြစ်ပေါ်စေပါမည်။ စီမံကိန်း ဆောင်ရွက်မည့် ကုမ္ပဏီသည် ဒေသ အတွင်း တံတား (၄) စင်းအား ထပ်မံတည်ဆောက်ပေးရမည် ဖြစ်ပါသည်။ အသေး စိတ် အချက်အလက်များကို (EIA/SIA) ဆန်းစစ်သည့် ကာလတွင် ထပ်မံ ဆောင်ရွက်သွားရပါမည်။

(ဂ) **မြေတူးဖော်ခြင်းများကြောင့် မြေမျက်နှာသွင်ပြင်ပြောင်းလဲစေခြင်း (Change in topography and excavation)**

စီမံကိန်း တည်ဆောက်ရေး လုပ်ငန်းတွင် ရေတားတမံ တည်ဆောက်ခြင်း၊ ရေကာတာ တည်ဆောက်ခြင်းနှင့် လှိုင်ခေါင်း တူးဖော်ခြင်းများအတွက် မြေသား တူးဖော်ခြင်းနှင့် ကျောက်မိုင်းမှ ကျောက်ထုတ်ခြင်း လုပ်ငန်းများ ပြုလုပ်ရပါသည်။ တည်ဆောက်ဆဲကာလတွင် ရေများကိုလှိုင်ခေါင်း တူးမြောင်းမှတဆင့် လမ်းလွှဲထားမည် ဖြစ်ပါသည်။ တည်ဆောက်ရေး ကာလတွင် ဖြစ်ပေါ်လာမည့် ခန့်မှန်းမြေသား၊ ကျောက်စရစ်နှင့် ကျောက်သားပမာဏစုစုပေါင်းမှာ ၁၈၄၄၀၀၀ m^3 ဖြစ်ပါမည်။ အဆိုပါ ပေါ်ပေါက်လာသော မြေ၊ ကျောက်စရစ်၊ ကျောက် ထပ်မံသုံးစွဲမှု အခြေအနေအား EIA လေ့လာမှုများ ပြုလုပ်မည့်အချိန်တွင် ထပ်မံလေ့လာမည် ဖြစ်ပြီး ပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲမှု အစီအစဉ် (EMP) ဖော်ထုတ်ရေးဆရာတွင် ထည့်သွင်းသွားမည် ဖြစ်ပါသည်။

(ဃ) **ရုပ်ကြွင်းလောင်စာသုံးစွဲမှုကြောင့် ဖန်လုံအိမ်အာနိသင်ဓာတ်ငွေ့ Green House Gas GHG ထုတ်လုပ်မှုဖြစ်ပေါ်စေခြင်း**

စီမံကိန်း၏ တည်ဆောက်ရေး ကာလတွင် စက်ယန္တရားကြီးများ၊ စက်ကိရိယာများစွာ အသုံးပြုမည်ဖြစ်သဖြင့် ရုပ်ကြွင်းလောင်စာ(ဒီဇယ်ဆီ)များစွာ အသုံးပြုရမည် ဖြစ်ပါသည်။ တည်ဆောက်ရေး ကာလအတွင်း ခန့်မှန်းစုစုပေါင်း ရုပ်ကြွင်းလောင်စာဆီ ၂၈၉၁ တန်ခန့် သုံးစွဲရန် လိုအပ်မည် ဖြစ်ပါသည်။ ထို့အပြင် လျှပ်စစ်သုံးစွဲမှု ကလည်း GHG ထွက်ရှိမှုကို သွယ်ဝိုက်သော နည်းအားဖြင့် တိုးမြှင့်စေမည် ဖြစ်ပါသည်။ တိကျသောတွက်ချက် မှုများအား EIA လေ့လာမှုများ ပြုလုပ်ချိန်တွင် ထပ်မလေ့လာမည်ဖြစ်ပြီး ပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲမှု အစီအစဉ်(EMP) ဖော်ထုတရေးဆွဲရာတွင် ထည့်သွင်းသွားမည် ဖြစ်ပါသည်။

(c) **တည်ဆောက်ရေးကာလတွင် လျှပ်စစ်သုံးစွဲမှု**

ကျောက်စရစ်ထုတ်လုပ်ခြင်းကဲ့သို့ တည်ဆောက်ရေး ကာလအတွင်းရှိ ဆောက်လုပ်ရေး လုပ်ငန်းများမှာ လျှပ်စစ်ဓာတ်အား သုံးစွဲမှုများရှိပါသည်။ တည်ဆောက်ရေး ကာလအတွင်း ခန့်မှန်းလျှပ်စစ်ဓာတ်အား သုံးစွဲမှုမှာ ၄၅၅၁၁၀ MWhr ရှိလာမည် ဖြစ်ပါသည်။ ထိုသို့ လျှပ်စစ်ဓာတ်အား သုံးစွဲခြင်းများကလည်း သွယ်ဝိုက်သော နည်းဖြင့် လေထုအတွင်းသို့ GHG များ ထုတ်လွှတ်မှု ဖြစ်ပေါ်စေပါသည်။

တိကျသော တွက်ချက်မှုများအား EIA လေ့လာမှုများ ပြုလုပ်ချိန်တွင် ထပ်မံလေ့လာမည်ဖြစ်ပြီး ပတ်ဝန်းကျင် ဆိုင်ရာ စီမံခန့်ခွဲမှု အစီအစဉ် (EMP) ဖော်ထုတ်ရေးဆွဲရာတွင် ထည့်သွင်းသွားမည် ဖြစ်ပါသည်။

(စ) **ရေအရင်းအမြစ်များကုန်ဆုံးစေခြင်း**

တည်ဆောက်ရေးကာလအတွင်း ကွန်ကရစ်လုပ်ငန်းများ၊ ကျောက်စရစ် ထုတ်လုပခြင်း လုပ်ငန်းများ၊ ဆေးကြောခြင်းနှင့် လုပ်သားများ ၏ တကိုယ်ရည် သုံးစွဲမှုများကြောင့် ရေသုံးစွဲမှုလွန်စွာ မြင့်မားတတ်ပါသည်။ ကွန်ကရစ်လုပ်ငန်းများအတွက် ရေလိုအပ်မှုပမာဏ ၅၈၅၀ m^3 ၊ ကျောက်စရစ်လုပ်ငန်းအတွက် ၃၆၈၀၀၀ m^3 ၊ စက်ယန္တရားဝန်ဆောင်မှုနှင့် ဆေးကြောမှုများအတွက် ၁၄၂၅၀ m^3 နှင့် လုပ်သားများ တကိုယ်ရည် အသုံးပြုမှုအတွက် ၉၉၅၀၀ m^3 အသီးသီးလိုအပ်ပါသည်။ ထို့ကြောင့် စုစုပေါင်းရေလိုအပ်ချက် မှာ ၃၇၉၆၆၀၀ m^3 ဖြစ်ပါသည်။ တိကျသော တွက်ချက်မှုများအား EIA လေ့လာမှုများပြုလုပ်ချိန်တွင် ထပမံလေ့လာမည်ဖြစ်ပြီး ပတ်ဝန်းကျင် ဆိုင်ရာ စီမံခန့်ခွဲမှု အစီအစဉ် (EMP) ဖော်ထုတ် ရေးဆွဲရာတွင် ထည့်သွင်းသွားမည် ဖြစ်ပါသည်။

(ဆ) **ရေဆိုးများဖြစ်ပေါ်စေနိုင်ခြင်း**

တည်ဆောက်ရေးကာလအတွင်း အထက်တွင်ဖော်ပြ ခဲ့သည့်အတိုင်း နည်းလမ်းပေါင်းစုံဖြင့် ရေသုံးစွဲမှု များပြားမည ဖြစ်ပါသည်။ ပုံမှန်အားဖြင့် ရေတိုးသိုးစွဲမှု၏ ၈၀% ရေဆိုးထွက်ရှိမှုကို ဖြစ်ပေါ်စေပါသည်။ ထို့ကြောင့် တည်ဆောက်ရေးကာလအတွင်း စုစုပေါင်းရေဆိုးပမာဏ ၃၀၃၉၈၅၀ m^3 ထွက်ရှိ လာစေနိုင်ပါသည်။ တိကျသော တွက်ချက်မှုများအား EIA လေ့လာမှုများ ပြုလုပ်ချိန်တွင် ထပမံလေ့လာမည်ဖြစ်ပြီး ပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲမှု အစီအစဉ် (EMP) ဖော်ထုတ်ရေးဆွဲရာတွင် ထည့်သွင်းသွားမည် ဖြစ်ပါ သည်။

(ဇ) **အမှိုက်များထွက်ပေါ်လာစေခြင်း (Solid Waste Generation)**

တည်ဆောက်ရေး ကာလအတွင်း ရွှေ့ပြောင်းလုပ်သား ထောင်နှင့်ချီ၍ ကာလရှည်လာရောက် အလုပ်လုပ်ကိုင်ကြမည် ဖြစ်သဖြင့် အမှိုက်ပမာဏ ကြီးစွာ ဖြစ်ပေါ်စေ

ပါမည်။ တည်ဆောက် ရေးလုပ်ငန်းတွင် အသုံးပြုမည့် စက်ကိရိယာများ၏ ထုတ်ပိုးပစ္စည်းများကလည်း အမှိုက်များ ဖြစ်ပေါ်စေပါသည်။ နေ့စဉ် အမှိုက် ၃ တန်ခန့် ထွက်ရှိမည်ဟုခန့်မှန်းပါသည်။ ထွက်ရှိလာသော အမှိုက်များတွင် အစား အစာ စွန့်ပစ်ပစ္စည်းကဲ့သို့ organic ပစ္စည်းများနှင့် သတ္တုစက္ကူနှင့် ပလပ်စတစ် ကဲ့သို့ ပြန်လည်အသုံးပြုနိုင်သော (Recycle) ပစ္စည်းများသည် စုစုပေါင်း အမှိုက်ပမာဏ၏ ၃ပုံ ၂ပုံခန့် ရှိနိုင်ပါသည်။ ထို့ကြောင့် နေ့စဉ်စွန့်ပစ်ပစ္စည်း ဖျက်ဆီးရမည့် အမှိုက်ပမာဏ (၁) တန်ခန့် ဖြစ်ပါသည်။ တိကျသော တွက်ချက်မှု များအား EIA လေ့လာမှုများပြုလုပ်ချိန်တွင် ထပ်မံလေ့လာမည်ဖြစ်ပြီး ပတ်ဝန်းကျင် ဆိုင်ရာ စီမံခန့်ခွဲမှုအစီအစဉ် (EMP) ဖော်ထုတ်ရေးဆွဲရာတွင် ထည့်သွင်းသွားမည် ဖြစ်ပါ သည်။

(စ) **တည်ဆောက်ရေးလုပ်ငန်းများကြောင့် အသနှင့် လေထုညစ်ညမ်းခြင်း**

တည်ဆောက်ရေး ကာလတွင် အသုံးပြုမည့် Impact hammers တူကြီးများ၊ Cranes ဝန်ချီစက်များ၊ generator မီးစက်များကြောင့် အသံဆူညံမှုများကို ဖြစ်ပေါ်စေပါသည်။ ဆူညံမှု အပြင်းဆုံး ဖြစ်ပေါ်မှုကို ကျောက်မိုင်းခွဲခြင်းနှင့် မြေတူးခြင်းများမှ ဖြစ်ပေါ် စေပြီး အခြားစက်ယန္တယားကြီးများ၏ mechanical နှင့် Hydrolic transmission Actuation System (စက်မှုနှင့် စွမ်းအားမြင့်ချောဆီကြားခံစနစ်) ဆက်စပ်ဖြစ်ပေါ်လာ သော အသံများမှာ ယာယီနှင့် ပြတ်တောင်း ပြတ်တောင်းသာ ဖြစ်ပေါ်လေ့ရှိပါ သည်။ မြေတူးခြင်း၊ ဖောက်ခွဲခြင်း၊ ကျောက်စရစ်ထုတ်လုပ်ခြင်းနှင့် သယ်ယူပို့ဆောင် ရေး လုပ်ငန်းများကြောင့် ဖုန်မှုန်များ ထွက်ပေါ်လာစေပြီး တည်ဆောက်ရေး လုပ်ငန်း စဉ်အတွင်း လေထုညစ်ညမ်းမှုကို ဖြစ်ပေါ်စေပါသည်။ တိကျသော တွက်ချက်မှုများ အား EIA လေ့လာမှုများ ပြုလုပ်ချိန်တွင် ထပ်မံလေ့လာမည်ဖြစ်ပြီး ပတ်ဝန်းကျင် ဆိုင်ရာစီမံခန့်ခွဲမှု အစီအစဉ် (EMP) ဖော်ထုတ်ရေးဆွဲရာတွင် ထည့်သွင်းသွားမည် ဖြစ်ပါသည်။

(ည) **ရွှေပြောင်း လုပ်သားများကြောင့် ပြည်သူ့ကျန်းမာရေးဆိုင်ရာ ပြဿနာများ ဖြစ်ပေါ်လာစေနိုင်ခြင်း**

တည်ဆောက်ရေး ကာလအတွင်း လုပ်ငန်းဆောင်ရွက်မှု အမြင့်ဆုံးအချိန်တွင် ရွှေပြောင်းလုပ်သားအင်အား ၃၀၀၀ မှ ၃၅၀၀ ခန့်အထိ ရောက်ရအလုပ်လုပ်ကြမည် ဖြစ်ပါသည်။ အဆိုပါအခြေအနေက ပြည်သူ့ကျန်းမာရေးဆိုင်ရာ ပြဿနာများဖြစ်သော အရေပြားရောဂါများ၊ လိင်မှတစ်ဆင့် ကူးစက်တတ်သော ရောဂါများ၊ သန့်ရှင်းမှု မရှိခြင်းကြောင့်ဖြစ်သော ရောဂါများ ဖြစ်ပေါ်စေနိုင်ပါသည်။ စီမံကိန်းတည်ဆောက်မည့် ကုမ္ပဏီသည် ကျောက်မိုင်း အနီးနှင့် မြေသားရယူမည့် နေရာအနီး လုပ်သားတည်းခိုဆောင်များ ဆောက်လုပ်ထားပြီး ဖြစ်ပါသည်။ အဆိုပါလုပ်သား ရိပ်သာများအား ရေကာတာ အနီးနေရာတွင် တည်ဆောက်ထားပြီး ဖြစ်သော်လည်း လိုအပ်သောမြေနှင့် ကျောက်သားများကို အခြားနေရာများတွင်လည်း ရရှိနိုင်သေးသဖြင့် စီမံချက်ကို ပြုပြင်ပြောင်းလဲမှုများ ဖြစ်ပေါ်လာနိုင်ပါသည်။ တိကျသော တွက်ချက်မှုများအား EIA လေ့လာမှုများ ပြုလုပ်ချိန်တွင် ထပ်မံလေ့လာမည်ဖြစ်ပြီး ပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲမှု အစီအစဉ် (EMP) ဖော်ထုတ်ရေးဆွဲရာတွင် ထည့်သွင်း သွားမည် ဖြစ်ပါသည်။

၃၁။ **လုပ်ငန်းလည်ပတ်ဆောင်ရက်ချိန်တွင် ဖြစ်ပေါ်နိုင်သော ဆိုးကျိုးသက်ရောက်မှုများ**

(က) **မြစ်အောက်ပင်းကမ်းစပ်များတွင် အနည်အနှစ်များ ပို့ချမှုလျော့ပါးသွားနိုင်ခြင်း**

ရေကာတာ တည်ဆောက်လိုက်ခြင်းကြောင့် ပုံမှန်အနည်အနှစ်များ ရေစီးနှင့် အတူပါသွားမည့်အစား နှစ်စဉ်အနည်အနှစ်ပို့ချမှုပမာဏ ၂၀၆၆ သန်း m^3 အား ပိတ်ဆို့ထားမည် ဖြစ်ပါသည်။ လက်ရှိ ရေဆွဲထားသော ရေကာတာ ဒီဇိုင်းတွင် အဆိုပါ ပိတ်ဆို့နေသော အနည်အနှစ်များအား အချိန်မှန် ဖောက်ထုတ်နိုင်မည့် ထွက်ပေါက် တစ်ခုပါဝင်ပါသည်။ အဆိုပါ အနည်အနှစ်များ စီးဆင်းမှုနှင့် ၄င်းတို့ကြောင့် ဖြစ်ပေါ်လာမည့် နောက်ဆက်တွဲ အခြေအနေများအား EIA လေ့လာမှုများ ပြုလုပ်ချိန်တွင် ထပ်မံလေ့လာမည် ဖြစ်ပြီး ပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲမှု အစီအစဉ် (EMP) ဖော်ထုတ်ရေးဆွဲရာတွင် ထည့်သွင်းသွားမည် ဖြစ်ပါသည်။

(ခ) **မြစ်အောက်ပိုင်းသို့ စီးဆင်းမည့် ရေစီးရေလာ လျော့ပါးသွားနိုင်ခြင်း**

ရေကာတာ တည်ဆောက်ခြင်းကြောင့် မြစ်ကြောင်း တစ်လျှောက် စီးဆင်းလာသော မြစ်ရေစီးဆင်း ရပ်တန့်သွားပြီး ရေကာတာအောက်ပိုင်းသို့ ဆက်လက်စီးဆင်းရာတွင် လည်း လုံလောက်သော ယခင်စီးဆင်းနေကျ ရေစီးနှုန်းကိုရောက်ရှိနိုင်ခြင်း မရှိတော့ ပေ။ ရေများကို ထိမ်းသိန်းထားပြီး မကြာခဏလွှတ်ပေးခြင်းကြောင့် မြစ်၏ဇလဗေဒ ကို ပြောင်းလဲစေပါမည်။ တို့ကဲ့သို့ မြစ်ရေစီးနှုန်း နည်းပါးသွားခြင်းကြောင့် ဖြစ်ပေါ် လာမည့် သက်ရောက်မှုများ၏ တိကျသော တွက်ချက်မှုများအား EIA လေ့လာမှုများ ပြုလုပ်ချိန်တွင် ထပ်မံလေ့လာမည်ဖြစ်ပြီး ပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲမှု အစီအစဉ် (EMP) ဖော်ထုတ်ရေးဆွဲရာတွင် ထည့်သွင်းသွားမည် ဖြစ်ပါသည်။

(ဂ) **ရေနေသတ္တဝါများအား ထိခိုက်နိုင်မှု (Disturbance of aquatic Life)**

ရေကာတာကြောင့် ရေလှောင်ကန်တစ်ခု ဖြစ်ပေါ်လာခြင်းကြောင့် ရေ၏ အပူချိန် ပြောင်းလဲခြင်း၊ ရေစီးရေလာ ပြောင်းလဲခြင်း၊ သိုလှောင်ရေကြောင့်ရေ၏ အရည် အသွေးပြောင်းလဲလာခြင်းတို့ ဖြစ်ပေါ်စေပြီး မြစ်အတွင်း မူလရှိနေသော ငါးနှင့် အခြားရေနေ သတဝါများ ရွှေ့ပြောင်းသွားနိုင်ပါသည်။ ရေကာတာ၏ ပိတ်ဆို့မှု ကြောင့် ရေကာတာ အထက်ပိုင်းနှင့် အောက်ပိုင်းရှိ ငါးများ ဖြတ်သန်းသွားလာ နိုင်ခြင်း မရှိတော့ကြောင်း တွေ့ရမည်ဖြစ်ပါသည်။ မှတ်တမ်းများအရ နမ့ဝတူမြစ် အတွင်း မျိုးတုံးပျောက်ကွယ်နိုင်အောင် ခြိမ်းခြောက်ခံနေရသော Threatened Species များမရှိဘဲ ခရီးဝေးကူးခတ် သွားရောက်၍ မျိုးပွားသော ငါးမျိုးများ travelling long distance Species များလည်းမရှိကြောင်း သိရပါသည်။

(ဃ) **ရေကာတာ၏ဘေးကင်းမှုနှင့် မတော်တဆဖြစ်နိုင်မှုများ**

(Dam Safety and accidents)

ရေကာတာ၏ အောက်ဖက် မြစ်ကမ်းတလျှောက် နေထိုင်ကြသော ပြည်သူများ အတွက် ရေကာတာ၏ ဘေးကင်းလုံခြုံမှုလည်း အထူးစိုးရိမ်မကင်းဖြစ်သော အချက် ဖြစ်ပါသည်။ ရေကာတာ ကျိုးပေါက်ခြင်းကြောင့် ရေလွှမ်းမိုးမှုကဲ့သို့ ကပ်ဘေး

ဆိုးများ ဖြစ်ပေါ်စေနိုင်ပါသည်။ ရေကာတာ၏ ကြံ့ခိုင်မှုနှင့်ပတ်သတ်၍ တိကျသော တွက်ချက်မှုများအား EIA လေ့လာမှုများ ပြုလုပ်ချိန်တွင် ထပ်မံလေ့လာမည် ဖြစ်ပြီး ပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲမှု အစီအစဉ်(EMP)ဖော်ထုတ်ရေးဆွဲရာတွင် ထည့်သွင်းသွားမည် ဖြစ်ပါသည်။

(c) **လျှပ်စစ်ဓါတ်အားသုံးစွဲမှု**

ဓါတ်အားပေးစနစ်၏ စွမ်းအင်ထုတ်လုပ်သောအိုင်း (Power house) သည်လည်း လည်ပတ်နေသောအဆင့်တွင် လျှပ်စစ်ဓါတ်အားသုံးစွဲ မည်ဖြစ်ပြီး နှစ်စဉ်ခန့်မှန်း လျှပ်စစ်ဓါတ်အားလိုအပ်ချက်သည် ၃၆၀၀ MWhr ဖြစ်ပါသည်။ လိုအပ်သော လျှပ်စစ်ဓါတ်အားပမာဏ၏ တိကျသော တွက်ချက် မှုများအား EIA လေ့လာမှုများ ပြုလုပ်ချိန်တွင် ထပ်မံလေ့လာမည် ဖြစ်ပြီး ပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲမှု အစီအစဉ် (EMP) ဖော်ထုတ်ရေးဆွဲရာတွင် ထည့်သွင်းသွားမည် ဖြစ်ပါသည်။

(d) **ရေလှောင်ကန်အတွင်းရှိ ရေများအငွေ့ပျံဆုံးရှုံးနိုင်ခြင်း**

(Water evaportaion Losses from reservoir

ရေလှောင်ကန် အတွင်းရှိရေများ ရေငွေ့ပျံခြင်း ဖြစ်ပေါ်စေနိုင်ပါသည်။ အငွေ့ပျံဆုံးရှုံးနိုင်သော ရေပမာဏအား အပြည်ပြည်ဆိုင်ရာ ရေအားလျှပ်စစ် အသင်း International Hydropower Association နှင့် ကမ္ဘာ့စားနပ် ရိက္ခာနှင့် စိုက်ပျိုးရေးအဖွဲ့ food and Agricultural Organization (FAO) တို့မှ ထုတ်ပြန်ထားသော လက်စွဲလမ်းညွှန်အတိုင်း တွက်ချက်ဖော်ထုတ်ရမည် ဖြစ်ပါသည်။

၃၂။ ရေကာတာသက်တမ်းကုန်ဆုံးခြင်းနှင့် လည်ပတ်မှုရပ်ဆိုင်းခြင်း

ရေကာတာသက်တမ်း ကုန်ဆုံး၍ လည်ပတ်မှုများ ရပ်ဆိုင်းပါက ရေတားတမံ အစိတ်အပိုင်းများကို ဖယ်ရှားရှင်းလင်းပစ်ပြီး စက်ပစ္စည်းများအား ပြန်လည်အသုံးပြုနိုင်ရန် ရောင်းချရပါမည်။ ပြန်လည် အသုံးပြု၍မရသော စက်ပစ္စည်းများအား သံရိုင်းစျေးဖြင့် ရောင်းချရန် ပုံဖျက်ပြုပြင် ထုတ်ပိုးရပါသည်။ တည်ဆောက်ရေး ကာလတွင် ဖြစ်ပေါ်ခဲ့သော ပြဿနာများသည် ရှင်းလင်း ဖျက်သိမ်းချိန်တွင်လည်း ပြဿနာအဖြစ် ပြန်လည်ထွက်ပေါ်လာတတ်ပါသည်။ ရှင်းလင်း ဖျက်သိမ်းမှုကြောင့် ဖြစ်ပေါ်လာနိုင်သည့် ထိခိုက်မှုများအတွက် တိကျသော တွက်ချက်မှုများအား EIA လေ့လာမှုများ ပြုလုပ်ချိန်တွင်

ထပ်မံလေ့လာမည်ဖြစ်ပြီး ပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲမှု အစီအစဉ် (EMP) ဖော်ထုတ်ရေးဆွဲရာတွင် ထည့်သွင်းသွားမည် ဖြစ်ပါ သည်။

၃၃။ အခြေအနေအကြောင်းအရင်းတစ်ခုခုကြောင့် စီမံကိန်းကို သက်တမ်းမပြည့်မီ ရပ်ဆိုင်းဖျက်သိမ်း ရပါကတပ်ဆင်ထားသော စက်ကိရိယာများအနက် သက်ရှိများကြောင့် ပျက်စီးသွားနိုင်သည့် ပစ္စည်းများ မှလွဲ၍ ကျန်ပစ္စည်းများကို ရေ့ပြောင်းဖျက်ဆီးခြင်းများ ပြုလုပ်ရပါမည် ။ဘေးအန္တရာယ် ဖြစ်နိုင်သော စွန့်ပစ်ပစ္စည်းများအားလည်း ရေရှည်ဖွံ့ဖြိုးတိုးတက်စေသော ရည်ရွယ်ချက်ဖြင့် ဖော်ထုတ်မှု ပြုလုပ်ထားခဲ့ရပါမည်။

နယ်ပယ်အတိုင်းအတာသတ်မှတ်ခြင်းနှင့် လုပ်ငန်းလမ်းညွှန်အတွက် ဆန်းစစ်မှုတင်ပြချက်နိဂုံး

၃၄။ စီမံကိန်း၏ တည်ဆောက်ရေးကာလ (Construction Phase) နှင့် လည်ပတ်သည့်ကာလ (Operation phase)တို့တွင် သက်ရောက်မှုများရှိကြောင်း တွေ့ရှိရသော်လည်း EIA/ SIA ဆန်းစစ်မှု ပြုလုပ်ချိန်တွင် ဖော်ထုတ်တင်ပြမည့် ပတ်ဝန်းကျင်ဆိုင်ရာစီမံခန့်ခွဲမှု အစီအစဉ် (EMP) အတိုင်း ပုံမှန်စောင့်ကြည့်မှုများဖြင့် ကောင်းစွာစီမံခန့်ခွဲနိုင်ပါသည်။ စီမံကိန်းတွင် လိုအပ် သော ရေပမာဏကို ထိမ်းသိန်းနိုင်စေရန်အတွက် အနုဇီဝကိုအခြေခံထားသည့် နည်းပညာသုံး (Micro biological based technology) ရေဆိုးသန့်စင်စနစ် အသုံးပြုရန်အတွက် တိုက်တွန်းထား သည်။ ပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲမှု အစီအစဉ် (EMP) ၌လည်း တည်ဆောက်ရေးကာလ အတွက် လေထုအရည်အသွေး၊ ရေချိုအရည်အသွေးနှင့် အသံဆူညံမှုအဆင့်များကို တတိယ ပါတီခါတ်ခွဲခန်းတွင် ပုံမှန်စမ်းသပ်မှုများ ပြုလုပ်ခြင်းဖြင့် ပတ်ဝန်းကျင် ထိမ်းသိန်းရေးဆိုင်ရာ လိုက်နာဆောင်ရွက်ရမည့် အချက်များကို ဆောင်ရွက်နေကြောင်း သေချာစေရပါမည။

၃၅။ တည်ဆောက်ရေး ကာလနှင့် လုပ်ငန်းလည်ပတ်မည့် ကာလများတွင် အောက်ဖော်ပြပါ ပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲမှုအစီအစဉ် (EMP) တွင် ပါဝင်သင့်သော အချက်များအား ဦးစားပေး ဆောင်ရွက်ရန် တိုက်တွန်းထားပါသည်။

(က) အပြည်ပြည်ဆိုင်ရာလမ်းညွှန်ချက်များအတိုင်း ပြည့်စုံသော (Sediment Management Plan) အနည်အနှစ်များ စီမံခန့်ခွဲမှု အစီအစဉ်အတိုင်း ဆောင်ရွက်ရန်။

(ခ) စွန့်ပစ်ရေဆိုးများကို ပြန်လည်သန့်စင် သုံးစွဲနိုင်သော အနုဇီဝနည်းပညာသုံး စီမံခန့်ခွဲမှု အစီအစဉ်အတိုင်း ဆောင်ရွက်ရန်။

(ဂ) နှစ်စဉ်ဖြစ်စေ၊ နှစ်ဝက်တစ်ကြိမ်ဖြစ်စေ ထင်ရှားသော တတိယပါတီ ခါတ်ခွဲခန်းဖြင့် လေထု၊ ရေထုနှင့် အသံအရည်အသွေးများကို တိုင်းတာစောင့်ကြည့်မှု ပြုလုပ်ရန်။

(ဃ) ရုပ်ကြွင်းလောင်စာနှင့် ရေချိုတို့ကို ထိရောက်စွာသုံးစွဲနိုင်မှု ရှိမရှိ ၆-လ တကြိမ် စစ်ဆေးပြီး စောင့်ကြပ်ကြည့်ရှု ထိမ်းချုပ်ရန်။

(င) ၆-လ လျှင် တစ်ကြိမ် ဘေးအန္တရာယ်ကြိုတင် ကာကွယ်ရေးနှင့် အရေးပေါ် အခြေအနေအတွက် ကြိုတင်ပြင်ဆင်ထားမှုများအား စစ်ဆေးကြပ်မတ်ရန်။

(စ) လုပ်သားများ၏ တည်းခိုဆောင်များနှင့် သန့်ရှင်းရေး ဆောင်ရွက်ထားမှုအား အချိန်မှန် စစ်ဆေးကြပ်မတ်ရန်။

(ဆ) ရွှေ့ပြောင်း လုပ်သားများအား အချိန်မှန် ဆေးစစ်မှုများ ပြုလုပ်ပေးရန်။

(ဇ) ဝန်ထမ်းများအား ပတ်ဝန်းကျင်နှင့် ရေရှည်တည်တံ့စေသည့် လုပ်ငန်းစဉ်ဆိုင်ရာ သဘောတရားများ Environment & Sustainability parameter များကို ပုံမှန်သင်ကြားပေးခြင်းမျိုး ဆောင်ရွက်ရန်။

၃၆။ သိရှိလမ်းညွှန် အတည်ပြုနိုင်ပါရန် လေးစားစွာဖြင့် တင်ပြအပ်ပါသည်။

Executive Summary

Natural Current Energy Hydropower Co., Ltd (NCE) Limited is planning to set up 210 MW hydroelectric power project on Nam Tu River in Namtu Township and Hsipaw township by the name Nam Tu (Hsipaw) Hydropower Project by Natural Current Energy Hydropower Co Ltd. The estimated project cost is around 436 Million United states dollars with an estimated annual power generation of 1,005.48 GWh.

The project owner, Natural Current Energy Hydropower Co., Ltd has engaged the consultants, MyAsia Consulting Co., Ltd to perform the Environmental and Social Impact Assessment (EIA/SIA) study and formulate the Environmental Management Plan (EMP) for the project construction and operation. MyAsia Consulting Co Ltd neither hold any stake in the project development company nor they have been providing any other services for the project such as Design, Engineering, Construction, and Procurement and hence, do not have any conflict of interest to work as third-party consultant for EIA/SIA study and reporting. This report is for the scoping phase of the EIA/SIA study to establish the terms of reference (ToR) for the assessment. The EIA/SIA study will be as per the chapter V of the EIA Procedure that cover the paragraphs 44 to 70. The scoping phase requirements will be as per the paragraphs 47 to 54 with the paragraph 49 elaborately detailing the requirements.

Myanmar, a country with abundant natural resources is one of the least developed country in the South east Asian region. The major factor that directly drive the development and improving livelihoods is the access to electricity where Myanmar lags behind with just 33% electrification. This coverage of access to power is worse in the rural areas where the people are even poorer. Hence the government aims to increase the generation of power rapidly to provide affordable power to the people within the next two decades.

As per the statistics as on start of the year 2017, Myanmar has a total installed capacity of 5,389 MW of which hydropower contribute 3,255 MW (60.40%). The private participation in the electricity sector has been growing from a meagre 6.2% of the annual generation in 2008-09 to a whopping 48.4% of the annual generation in 2016-17. The under-construction power projects in Myanmar now is about 1,692 MW from hydropower, 649 MW from Gas and 470 MW from Solar power.

As per the International Hydropower Association, Myanmar has utilized only 4% of its hydropower potential of 140,000 GWhrs/year. The target set for this growth is to add 500-1000MW per year for the next ten years to have a total installed capacity of 16,665MW and to have at least 75% electrification by 2022 and have complete coverage by 2030. The plans made to meet these targets in power generation by various modes of which hydropower is given priority given the water resources available for the country.

The proposed project falls in the Upper Myit Nge sub basin of the Ayeyarwady river basin. There are no hydropower projects that are planned upstream of the proposed project. The Yeywa Dam of installed capacity 790 MW is commissioned and operational since 2010 in the Myit Nge river and the Upper Yeywa dam of installed capacity 280 MW is under construction. The other planned projects in the Myit Nge river are Dedoke Hydro (66MW), and Middle Yeywa hydropower project (700) and Lam Lang (210MW).

Project Description

The proposed hydropower project named "*Namtu (Hsipaw) Hydropower Project*" with an installed capacity of 210 Megawatt (MW) is a gravity dam project on the river Namtu. The project dam will have a maximum storage capacity of 256.233 Million cubic metre (m^3) of water and an estimated average annual energy generation output of 1,005.485 Giga Watt hours (GWhr) with 4,788 hours of annual operation. The guaranteed output of the project is 33.13 MW with a regulating water storage of 60.398 Million m^3. The project estimated cost is 436.28 Million United States Dollars (USD) with an estimated construction period of 66 months. The project is only intended for the power generation and the power generated will be exported to Myanmar power grid.

The location of the project is around 30 kilo metre (km) North West of Hsipaw, 78 km South West of Lashio and 249 km North East of Mandalay. Nam Tu and Kyaukme are the other townships near to the project area and the area is in the Kyaukme District. The nearest village is Li Lu that is around 16 km upstream of the proposed project dam site. The project will need to rehabilitate a village of 47 households and a population of 212 people due the flooding by the reservoir. The total area of land that will be submerged due to the project reservoir is 866.69 hector (ha.) that includes cultivated land of 86.12 ha, plantation of 4.23 ha and forest land of 543.71 ha. This will result in removal of 4,371 trees in the above specified area under submergence.

The construction of the project is estimated as 66 months, of which the first 23 months are for the preparations, next 39 for the main construction and the last 4 months for the completion. The construction consists of a dam, powerhouse, discharge channels and cofferdams during the construction period to divert the water. The rocks, stones, sand and soil required for the construction will be sourced from nearby quarry and three burrows located on the left bank of the river.

Main Structures of the Project

Dam and Powerhouse- The Dam to be built is a normal concrete gravity type dam and is classified as Grade II, Large (2) type project. The maximum length of the dam is 304 m across the river with an elevation of 495 metre above sea level at the crest of the dam. The lowest elevation of the foundation surface is 381 m making the maximum height of the dam as 114 m. normal water level is 487 m.

The powerhouse complex consists of main powerhouse, auxiliary rooms & central control building, downstream main transformer tunnel, busbar tunnel, fan room, tailrace tunnel, ongoing line, ventilation tunnel, and working shaft, access tunnel, drainage tunnel, cable trench and safe access

Construction of the water retaining Dam and the Power House requires excavation of the river banks, river closure and cofferdam construction, River bed excavations, Foundation treatment, Concrete mixing and placing, and earth rock backfill. These construction activities for the dam and powerhouse involves blasting the rocks on the banks and riverbed by drilling and blasting, concrete mixing plant operation, concrete placing by tower cranes and buckets, mortar mixer operations, concrete spraying and rock dowel construction for anchor rod.

Turbine and generator- The turbines selected for the power generation are Francis turbines of vertical shaft type with 71.43MW output with an efficiency rating of 91.55%. The generator selected is three phase synchronous, vertical shaft, rotating field type with 70MW output power. Three such turbine-generator units form the proposed hydropower project to give a total installed capacity of 210MW.

The construction of the project is estimated as 66 months, of which the first 23 months are for the preparations, next 39 for the main construction and the last 4 months for the completion. The construction consists of a dam, powerhouse, discharge channels and cofferdams during the construction period to divert the water.

Diversion of the river for construction

The riverbed at the proposed dam site is V shaped with a width of around 30m and is flanked by steep mountains on either side. Hence, the selected method is non-stage river closure by cofferdam and tunnel diversion for the construction of the project dam. As per the review comments made by the Ministry of Electric Power of the Myanmar government, earth-rock fill cofferdams are adopted for the water retaining. For the inlet and outlets of the flood discharge tunnels, coffer dams are required for protection. For the inlet tunnel, a rigid cofferdam and for the outlet tunnel, an earthwork cofferdam is planned.

Resource consumption estimates for the project operation

The natural material used for the construction contain the block stones, coarse concrete, fine aggregate and earth material. The total concrete requirement is 596,600m^3. The calculated requirement of the rocks for the project is 1,254,000m^3 and the concrete coarse and the fine aggregate required is 1,472,000m^3. The nearby quarry can supply the block rocks, concrete coarse and the fine aggregate. The construction quantities of the impervious soil material for the cofferdam is about 34,100m^3. The cofferdam is temporary construction and will be removed. The three burrows nearby can supply the soil required for filling. The required soil quantity is 45,200m^3.

The estimated water requirement is 5,850 m^3 for Concrete, 3,680,000 m^3 for aggregate, 14,250 m^3 for machine service and cleaning, and 99,500 m^3 for use of the workers personal use. The total water requirement for the construction phase is estimated as 3799,600m^3 and the estimated waste water generation will be around 3,039,680m^3.

The total electricity consumption estimate for the construction period is 45,709.43 Megawatt hours (MWh) due to the operation of heavy machinery for the excavation, concreting, aggregate processing and water supply. The annual energy required for the operation phase of the project is 3,600.80 MWh/year. The total diesel fuel required for the construction period is estimated as 2,890.84 tonnes and the diesel requirement during the operational phase is only 80kg/year.

The resource estimation of the electricity, diesel and the water usage to be validated during the EIA study phase. This calculation also will determine the extent of Greenhouse Gas emissions the project will have. The plans made by the project owner to meet these requirements are by aggregate processing system, concrete missing system, drawing grid power and having water storage at site.

There will be an aggregate processing system of through put capacity of 280 tonnes per hour (t/h) and a finished capacity of 230 t/h. The concrete mixing system planned has a capacity of 150m^3 per hour. A total of five water supply systems are planned for the project of which three are 100m^3 pools and other two are 50m^3. A 66kV substation with a power load of 4MWA is to be built near the project site that is connected to the 230kV substation at Man Sam in Hsipaw through a 66kV line. 11kV transmission lines are to be connecting this 66kV substation to the five 11kV transformers at site.

The project selection and alternatives

The various project alternatives and scenarios considered by the project owner while planning the development are as below. The selection has to be validated during the EIA study phase.

1. Dam site selection and type of dam- In the initial plan of the project development, the site selected was around 15 km downstream (close to Hsipaw) of the selected site that had favourable water head for generation. However, this site development will have resulted in submergence of a highly populated village tract Moe Tay in Hsipaw township and their agricultural fields nearby and resettlement would have been difficult to be performed. Hence the project owner selected two sites that are 1900m apart in the upstream of this site for comparison for the selection of the dam axis.

The Rockfill face type is suitable for the upper dam site and concrete gravity dam is suitable for the lower dam site. The lower dam site has three different type of schemes to be chosen from. Hence the total scenarios compared are four as below

a) Upper dam site with Concrete faced Rockfill type dam
b) Lower Dam site Scheme I- Concrete gravity dam with headrace & generation system on right bank and powerhouse in the dam toe.
c) Lower Dam site Scheme II-Concrete gravity dam with headrace & generation system in the dam, and powerhouse in the dam toe.
d) Lower dam site Scheme-III-Concrete gravity dam with long distance headrace & generation system on the right bank and ground powerhouse

The earth rock excavation and the tunnel excavation requirement are lowest for the Lower dam site scheme II and hence this alternative was selected.

2. Water level for the dam- They compared two heights of elevations 487m and 492m for the normal water level. The higher water level can give an additional power generation of around 25 Gigawatt hours (GWh) annually. However, the submergence of the basin is also increased with additional water storage causing resettlement of more households. The normal water level of 487m was selected to avoid more submergence and resettlement.

3. Selection of installed capacity- The project owner considered three different scenarios of choosing the total installed capacity. The initial review had prompted them to look for a project that has an installed capacity above 200MW. The compared the options with a 10MW increase and compared 200MW, 210MW and 220MW. The Annual generation

increases with the installed capacity with the annual operating hours coming down. Hence they have selected the 210MW capacity as the cost per unit is lowest in that case.

4. Water recycling for zero discharge and composting- The generation of the total installed capacity can be met by various options such as two generating units of 105MW each, three generating units of 70MW each, or four units of capacity 52.5MW. The comparison of the guaranteed output and the efficiency of the turbines are most suited for the three units of 70MW option and hence it was selected.

Public Consultation about the project

Since the concept stage of the hydropower project, the project owner has kept the government, local authorities and the surrounding neighbourhood about the progress of the project without fail. They have taken initiatives to have the news about the project being published in newspapers, social media platforms and websites.

The EIA consultants, MyAsia Consulting Co Ltd have made four visits since October 2017 for the scoping phase of the assessment of environmental and social impacts of the project. They have made identified the affected people as the people near the river in the townships of Hsipaw, Namtu and Nahmsan. The meetings were held with government officers in Hsipaw, Namtu and Kyaukme. The villagers of Lilu and Namtu were visited and their views were taken.

A public meeting was conducted for the villagers of Lilu on 11 May 2018 and the Namtu on 12 May 2018. The meeting was done with the member of Parliament for Namtu, Daw Nang Kham Aye on 4th July 2018 where the forest township officer for Namtu also attended. They had reviewed the project progress and provided their concerns about the project development.

The safety of the dam structure and the fairness in compensation for the submerged area are major worries of the people in the affected zone of the project. Some of the people also raised concerns about the soil being taken away for testing as they think the project developer could be mining for gold or other precious metals.

The public hearings during the EIA study to focus on discussing the identified issues and to provide confidence to the public on the mitigating measures that the project developer has planned. The field surveys to be conducted prior to the public hearing to capture the perception of the villagers on the project and to assess the impact on the people as far as livelihood and other social parameters are concerned.

Positive Impacts of the Project

The hydropower project has many positive impacts such as

- Improvement of the livelihoods of the local population in terms of direct and indirect employment from construction and related activities such as transportation, food supplies, equipment repair and rentals, and retail business
- Development of the industrial sector in the region as a whole due to availability of electricity at affordable process.

The construction phase of the project is expected to employ around 1,000 villagers in the area directly. Once operational, the project will provide more work/jobs to the local people, directly and indirectly all the while not disrupting the livelihood of people and communities.

The Negative Impacts of the Project and the mitigating measures

The negative impacts of the project can be classified as the impacts during the construction phase and the operational phase.

Negative impacts during the Construction phase

1. Deforestation for land clearance- The project construction requires deforestation of around 905 Ha of land of which 866 Ha are due to submergence by the reservoir. The trees in the submerged area will have to be cut off before the water is filled. The deforestation estimation is a total of 4,371 trees of which 470 are commercial trees, 2,820 are fruit trees, and 141 are bamboos. The total forest land used up by the project is 576 Ha which will be loss of habitat for some of the terrestrial mammals. To be surveyed further in the EIA study phase.

2. Submergence of land- The reservoir created during the construction of the dam structure will submerge land that cover the village of Lilu and the agricultural fields causing resettlement. The total area of submergence will be 866 Ha of land causing resettlement of 47 households, destruction of 15,904 m^2 of buildings, destruction of 140 Ha of agricultural land and generation of a large artificial lake. Four bridges will have to be rebuilt by the developer. To be surveyed further in the EIA study phase.

3. Change in Topography and excavations- The project construction will have excavation of the soil from the identified burrows and rock from the quarry to be used in the coffer dams, and the dam structure. The water will be diverted through tunnel to the downstream area. The total spoils from construction to be disposed is 1,844,074 m^3 of soil, stones and rocks. The reuse of the spoils to be studied further in the EIA study phase and management plans to be formulated.

4. Greenhouse Gases (GHG) Emission from the fossil fuels used-The project construction phase will use lot of fossil fuel powered machines and equipment of which almost all of it will be Diesel. The estimated fossil fuel consumption is 2,891 tonnes of diesel during the construction phase. The use of electricity also will result in indirect energy emissions and this GHG emission is additional to the emission from the fossil fuel usage. The estimations to be validated and management plans for conservation to be formulated as part of the EIA study phase.

5. Electricity usage during the construction phase- The power source for many of the construction activities such as aggregate crushing will be grid connected electricity; the estimated electricity usage is 45,710 MWhrs for the construction period. The use of electricity also results in the indirect emissions of greenhouse gases to the atmosphere. The estimations to be validated and management plans for conservation to be formulated as part of the EIA study phase.

6. Depletion of water resources- The water use for the construction operations will be very high for activities such as concreting, aggregates, cleaning, and personal use of workers. The estimated water requirement is 5,850 m^3 for Concrete, 3,680,000 m^3 for aggregate, 14,250 m^3 for machine service and cleaning, and 99,500 m^3 for use of the workers personal use. The total water requirement is estimated as 3799,600m^3. The estimations to be validated and management plans for conservation to be formulated as part of the EIA study phase.

7. Waste water generation- The construction period has heavy water usage for various activities as listed above. The use of water eventually causes wastewater generation to the extent of 80% of the usage. The estimated waste water generation will be around 3,039,680m^3 of waste water during the construction phase. The estimations to be validated and management plans for control of the wastewater to be formulated as part of the EIA study phase.

8. Solid waste Generation- The migrant workers in large numbers living in the area for the long period of construction will result in large quantities of solid waste. The packaging material used for the material used in construction phase also will create solid waste. The estimated solid waste generation is around 3 tonnes per day. The generated waste will have organic component such as the food waste and the recyclable material such as metal, paper and plastic that will make up around two third of the total waste generated. The rest of the waste generated has to be disposed and will be around 1 tonne per day. The estimations to be validated and management plans for control the solid waste to be formulated as part of the EIA study phase.

9. Noise and Air pollution from the construction activities- The construction phase will make use of a variety of equipment such as Impact hammers, cranes, generators, compressors, pumps and earth movers that will generate noise whilst operations. The most widespread source of noise in the construction phase will be the blasting and excavation activities and Other sources of noise associated with the equipment include the mechanical and hydraulic transmission actuation systems that can sometimes produce high sound levels. Construction related noises are usually of a temporary duration and relatively intermittent.

   The excavation, blasting, aggregate crushing and transportation along with other activities such as concreting will generate dust particles to the air hampering the air quality in the construction area. The management plans for control of noise and air emissions to be formulated as part of the EIA study phase.

10. Public Health issues due to migrant workers- The project construction period will have migrant workers in large numbers to the level of 3,000 to 3,200 at the peak of construction. This can create health issues such as epidemics, sexually transmitted diseases, and poor sanitation related diseases. The project owner has already started building up workers accommodation near the identified site for rock quarry and soil burrows. They had already constructed near to the dam site; however, the soil and rock parameters were found to be better at a different place and hence changed th plan. The management plans for control of the potential issues to be formulated as part of the EIA study phase.

Negative Impacts during the Operational phase

1. Starvation of sediment for the downstream banks- The dam structure will block 2,066 Million m^3 of sediments every year which otherwise would have been flowing with the water downstream. There is a bottom orifice designed for the dam structure to flush the sediment out periodically. The sediment flow and effect to be studied in detail and a management plan to be formulated in the EIA study phase.

2. Reduction in water flow to the downstream- The dam structure will result in the water being blocked and the downstream areas not being fed with enough flow of water as it used to have. The holding of water and the intermittent release in between will affect the downstream river hydrology. The effect to be studied in detail during the EIA study process.

3. Disturbance to aquatic life- The generation of a large artificial lake will make the fishes and other aquatic biota in the river to move away because of the change in water temperatures, water flow and other properties of a moving water to stored water. The dam structure will also block the movement to upstream and downstream for the fishes. There are no threatened species of fishes in the Namtu river and none of the species in the river has the characteristics of travelling long distances to breed.

4. Dam safety incidents- The dam safety is of serious concern to the people who live in the downstream area. The breach of the dam may result in a catastrophic disaster. The dam safety to be studied in detail during the EIA study phase.

5. Electricity usage-The powerhouse operation will need power for its operations and the estimated requirement is 3,600MWhrs per year. The estimation is to be validated and an Environmental Management Plan (EMP) to be formulated to monitor the consumption.

6. Water evaporation losses from the reservoir- The reservoir will have evaporation losses due to stored static water. The estimation to be done as per the guidelines of the International Hydropower Association and the Food and Agricultural Organisation (FAO).

Decommissioning/Post Closure

Upon closure or decommissioning of the project, the dam structure will have to be demolished and the machines and the equipment shall be sold for reuse elsewhere. When the equipment is found to be non-usable, it will be scrapped. The issues anticipated as that in the construction phase will be anticipated in the dam demolition. The decommissioning issues to be estimated during the EIA study phase.

In the unlikely event of abandoning the project before its life, all the equipment that is not bio degradable shall be removed and disposed. The hazardous waste remaining shall be disposed in a sustainable manner.

Scoping Phase Assessment Conclusion

The project during the construction and operational phase will have environmental impacts that can be managed effectively by regular monitoring through the environmental monitoring plans (EMP) that is to be developed during the EIA study phase. It is recommended that the project use micro biological based technology for waste water treatment to conserve the water. The EMPs require the construction phase to periodically test the air quality, freshwater quality, and noise levels, through a recognized third-party laboratory to ensure compliance to the environmental requirements.

Recommended actions to be points in the EMPs during the construction and operational phase

- A comprehensive sediment management plan as per the international guidelines
- Use of Micro Biological based technology, preferably Membrane Bio reactor (MBR) for waste water recycling plant
- Yearly/Half yearly testing of the air quality, ground and surface water quality, noise levels by a recognized third-party testing laboratory
- Half Yearly audits to monitor the efficient use of fossil fuels and water
- Half Yearly audit of the preventive maintenance and the emergency preparedness
- Periodic audits of the workers accommodation and sanitation
- Periodic medical check-up for the migrant workers
- Regular training for the staff on environmental and sustainability parameters

2.0 Context of the Project

The purpose of this report is to establish the Scope for the Environmental and social Impact Assessment (EIA/SIA) and reporting for the 210 MW hydroelectric power project on Nam Tu River near Hsipaw township by the name Nam Tu (Hsipaw) Hydropower Project by Natural Current Energy Hydropower Co Ltd. The estimated project cost is around 436 Million United states dollars with an estimated annual power generation of 1,005.48 GWh.

2.1 Presentation of the Project and its justification

Myanmar, a country with abundant natural resources is the least developed country in the South east Asian region. The major factor that directly drive the development and improving livelihoods is the access to electricity where Myanmar lags behind by just 33% electrification. This coverage of access to power is worse in the rural areas where the people are even poorer. Hence the government aims to increase the generation of power rapidly to provide affordable power to the people within the next two decades.

As per the statistics as on start of the year 2017, Myanmar has a total installed capacity of 5,389 MW of which hydropower contribute 3,255 MW (60.40%). The rest of the power in the country is generated by Gas with total capacity of 1,920 MW (35.6%), Coal with a total of 120 MW (2.2%) and Diesel with a capacity of 94.3 MW (1.75%). The private participation in the electricity sector has been growing from a meagre 6.2% of the annual generation in 2008-09 to a whopping 48.4% of the annual generation in 2016-17. The under-construction power projects in Myanmar now is about 1,692 MW from hydropower, 649 MW from Gas and 470 MW from Solar power.

As per the International Hydropower Association, Myanmar has utilized only 4% of its hydropower potential of 140,000 GWhrs/year. The target set for this growth is to add 500-1000MW per year for the next ten years to have a total installed capacity of 16,665MW and to have at least 75% electrification by 2022 and have complete coverage by 2030. The plans made to meet these targets in power generation by various modes of which hydropower is given priority given the water resources available for the country. The Ayeyarwady river basin is almost entirely within Myanmar and almost half of the Than Lwin river basin lies in Myanmar.

The project is planned on the upper section of the Nam Tu river and is located north east of Hsipaw town. The location of the project was changed to around 10 miles upstream to avoid flooding agricultural fields of a populated village. The project is expected to contribute towards meeting the power requirements of the region which otherwise is underdeveloped. It will also provide jobs and livelihoods to local people who face unemployment and widespread poverty.

2.2 Related Projects and Developments

Currently there are 29 medium and large hydropower projects with a total installed capacity of 3,298 MW and another six projects with a total capacity of 1,564 MW are under construction. The government has received proposals for hydropower development for projects totalling around 43,000 MW capacity which includes this project.

Out of these 29 operating hydropower projects, 12 projects with a total installed capacity of 1,474 MW have been built by the Ministry of Electricity and Energy (MoEE), 3 projects with a capacity of 144 MW by the Ministry of Agriculture, Livestock and Irrigation (MoALI) and another 7 projects totalling 492 MW by MoEE and MoALI in cooperation. 13 of these dams are multipurpose dams with irrigation and hydropower (12 MW - 280 MW).

Another 3 projects have been built by foreign developers in joint venture with MoEE and the private developers from Myanmar have built 4 projects. The 10.5 MW Mali Creek hydropower plant completed in 2006 built to provide power to Myitkyina in Kachin State was the first local private sector development. The second private player involved project was a large-scale project with 600 MW capacity built in 2009 named Sweli Hydro Power Project with Foreign investment. This project was built by YUPD, PRC, in joint venture with the MoEE. Since then, private sector has completed 677 MW (238 MW by local developers and 339 MW by foreign developers). There are currently six hydropower projects with a total installed capacity of 1,564 MW under construction in Myanmar. The 1,050 MW Shweli 3 hydropower plant in the Ayeyarwady Basin is the largest project under construction.

There are 8 river basins in Myanmar of which the Ayeyarwady basin and the Than Lwin Basin cover the maximum area. The Ayeyarwady Basin that includes the Chindwin river has 14 existing hydro projects with a total installed capacity of 2,100 MW, 3 under construction with a capacity of 1,372 MW and another 32 under planning stage totalling 24,605 MW. The Thanlwin Basin has 4 projects now with 302 MW of total capacity, 2 projects with a total of 81 MW are under construction and another 15 are planned with a total of 16,110 MW. The Sittaung basin has 9 operating projects with a capacity of 810 MW and 3 planned projects of total capacity 410 MW.

Basin Name	**Ayeyarwady**		**Than Lwin**		**Sittaung**		**Mekong**		**Others**		**Total**	
Projects	**MW**	**Nos**	**MW**	**Nos**	**MW**	**Nos**	**MW**	**Nos**	**MW**	**Nos**	**MW**	**Nos**
Existing	2,100	14	302	4	810	9	66	1	20	1	3,298	29
Construction	1,372	3	81	2	-	-	-	-	111	1	1,564	6
Planned	24,605	32	16,110	15	410	3	714	7	2,010	12	43,849	69
Total	**28,077**	**49**	**16,493**	**21**	**1,220**	**12**	**780**	**8**	**2,141**	**14**	**48,711**	**104**

Table 1: The list of river basin wise hydropower projects in Myanmar

There are currently 69 identified hydropower projects being developed in Myanmar totalling an installed capacity of 43,849 MW. If all the planned projects are completed, the river basins of Ayeyarwady and Thanlwin would have around 28,077 MW (58% of all hydropower) and 16,493 MW (34%) respectively.

2.3 Presentation of the Project Proponent and the EIA Consultant

Natural Current Energy Hydropower Co Ltd is the project developer for the 210 MW project. They also have another hydropower project in planning stage in the Mekong river basin. The directors of the organisation are into infrastructure development projects such as highways and renewable energy projects. They are registered with the DICA with the registration number 3813/2013-14.

Details of the Project Owner-Natural Current Energy Hydropower Co Ltd	
Item	**Description**
Name	U Thet Oo, Managing Director
DICA Registration	3813/2013-14
Address	Building No-3, Room No 303, Corner of Kabar Aye Pagoda road & Pyi Road, 8 Mile junction, Mayangone Township, Yangon
Telephone	09-2005951, 09-25824339, 09-788886999
E-mail	ncehydropower@gmail.com

Table 2: The contact details of the project owner

The EIA Consultant

The consultant engaged for the EMP formulation is MyAsia Consulting Co Ltd, based in Myanmar specialising in advisory services related to Environment, Sustainability, Health & Safety and Climate change. The team has vast experience in assessment of environmental and climate change mitigation projects across South Asian countries. The EIA/SIA study will be as per the chapter V of the Myanmar EIA Procedure that cover the paragraphs 44 to 70.

The EIA consultant MyAsia Consulting Co Ltd do not hold any stake in the project and the team doing the study is not related to any of the members of the project team. No members in the team and/or any employee of MyAsia consulting Co Ltd have provided any other services for the design, construction or consulting services to the project owner Natural Current Energy Hydropower Co Ltd. The EIA consultant has no conflict of interest in performing the EIA/SIA study.

EIA Consultant Team for the EIA/SIA Study- MyAsia Consulting Co Ltd	
Name	**Expertise and role**
Mr Syju Alias	EIA & Climate change, ISO 14001, OHSAS 18001, Hydropower
Mr Imran Ustad	EIA & Climate Change, Environmental Management, Hydropower
Dr Mon Myat	Local customs, Environmental Law, Biodiversity, livestock, water treatment and quality
Mr VP Kuriakose	Construction expert
Mr Lyju Elias	Meteorology, Hydrology expert
Dr Win Zan	Public Health
Mr Peter Shwe Thein	Forest Resources Expert
Dr Mini P Mathai	Botany, Bio Technology, Plant species

Table 3: The EIA consultant team that performed the EIA study

2.4 Presentation of the Associate Organisations

2.4.1 Laboratory (including accreditations)

Water quality measurement is done by AMD[1], the representative of Australian Medical & Diagnostics (Australia) and is an expert in water treatment design, supply and installation. They have more than 200 installations in Myanmar that include large drinking water manufacturers, United Nations Children's Emergency fund (UNICEF)[2] projects, boutique hotels and housing estates. They have a state of the art laboratory to test the water quality in line with the international standards.

The air quality and noise measurements were done by Green EHSS Consulting Co Ltd[3]. They provide services related to baseline monitoring of environmental parameters to a wide range of Industries in Myanmar, Singapore and Canada. They are affiliated to GHG Accounting-Canada[4].

Soil investigations are done by the Yunnan Institute of Water resources and Hydropower Research.

2.4.2 University

The experts from the *Yunnan Institute of Water Resources & Hydropower Engineering Investigation, Design and Research* performed the investigation, research and made the

[1] http://www.amdmyanmar.com/
[2] https://www.unicef.org/
[3] http://greenehss.com/our-services.html
[4] http://www.ghgaccounting.ca/

detail Project report for the hydropower project. The report was revised since the location of the project was moved around 5 miles upstream to avoid flooding the village.

The Department of Botany in Mahatma Gandhi University (MG University), Kerala, India was consulted for the EIA study. Dr Mini P Mathai[5], the Chairman of the Botany Board-MG University and Head of the Department-Botany gave her expertise related to the plant species in the tropical regions, effect of change in hydrology on its development and existence. She is Member of the team which won the ICAR team award for outstanding multi-disciplinary team research in Agriculture and Allied Sciences, 1994 - 96 given by Indian Council of Agricultural Research, Government of India.

2.5 Presentation of the health expert and health impacts of the project

The health impacts of the project are sanitation and water borne diseases from the effect on water quality due to migrant work force, the effluent discharge, respiratory diseases from effect on air quality from the air emissions from the use of fossil fuels and hearing problems from noise impacts from the machine operation. The public health expert for the project is Dr Win Zan, MBBS, from Institute of Medicine, Yangon. He has experience of working as the public health expert for many development projects that include the mining and seismic studies. Dr Mon Myat, another team member and a veterinary doctor and an expert for water quality and the biodiversity has assessed the effect on public health and health of animals, fishes and livestock.

The project study made use of the data and reports by international organisations such as United Nations Development Program (UNDP), United Nations Children's Emergency fund (UNICEF), United Nations Framework Convention for Climate change (UNFCC)[6], World Health organisation (WHO)[7], Food and Agricultural Organisation (FAO), International Union for Conservation of Nature (ICUN)[8] and International Finance Corporation (IFC)[9].

[5] http://thecochincollege.edu.in/index.php/site/faculty/10/#visible
[6] http://unfccc.int/2860.php
[7] http://www.who.int/en/
[8] http://www.iucn.org/
[9] http://www.ifc.org/

3.0 Overview of the Policy, Legal and Institutional Framework

3.1 Overview of Corporate Environmental and Social Policies

The project Developer, Natural Current Energy Hydropower Co Ltd has their core values aimed at sustainable development to provide affordable power to Myanmar. The organisation has vision to make development without compromising the health, safety and environmental parameters. They are into renewable power projects sector and have always been considered the commitment to environment and society as of prime importance to co-existence for the development of local people.

The organisation has appropriate systems and process in place to ensure compliance with the policy and with statutory provisions, including addressing grievances. Divisional / Chief Executives, through members of the respective Management Committees, ensure implementation of this policy. Compliance with the Policy is being regularly monitored and evaluated by the top management during their yearly reviews.

3.2 Overview of Policy and Legal Framework in Myanmar

The relevant ministries in Myanmar establish the regulations required for each sector and these ministries also have the responsibility of making policies, strategic plans, sector specific action plans. The sector-based policies and draft laws that are made by the previous government are not entirely approved and adopted for implementation by the current government and hence many of the laws are still in the draft phase. The Myanmar National Energy Policy is one such document that is still under development.

Myanmar National Energy Policy

In 2014, a draft National Energy Policy (2014) was formulated with the following objectives related to hydropower and power generation:

1. To implement a short-term and long-term comprehensive energy development plan based on systematically investigated data on the feasible potential energy resources that can be practically exploited, considering minimum impact on the natural and social environment;
2. To implement programs by which the local population could proportionally enjoy the benefit of energy reserves discovered in their areas; and
3. To implement programs on a wider scale, utilizing renewable energy resources such as wind, solar, hydropower, geothermal and bio-energy for sustainable energy development in Myanmar.

National Electricity Master Plan

The electricity generation mix suitable for Myanmar is being developed by the MOEE as the National Electricity Master Plan (NEMP). The power development plan will be made as per this Master plan for the countrywide electrification.

Environmental Impact assessments

The policy of the government is to make development in a sustainable manner taking into account the environmental and social parameters; and to enable this the government has taken keen interest in making relevant legal framework. Any organisation that develops a project in Myanmar, has to comply with the Environmental Conservation Law of 2012 and Environmental Conservation Rules of 2014. The overall responsibility of reviewing the environmental Impact assessments is with the Environmental Conservation Department (ECD) of the Ministry of Natural Resources and Environmental Conservation (MONREC).

The EIA study will be as per the EIA Procedure[10] and the Environmental Quality (Emissions) Guidelines dated 29/12/2015. The chapter V of the procedure specifies the requirements for the EIA/SISA study that covers the paragraphs 44 to 70 of the Procedure. The scoping phase requirements are provided in the paragraphs 47 to 54 with the paragraph 49 elaborately detailing the requirements. The EIA investigation is covered in the paragraphs 55 to 61 and the EIA reporting is the paragraphs 62 and 63. The third-party consultant confirm that they will follow the requirements of the EIA procedure. The sector specific emission guidelines with acceptable threshold values/limits with respect to the degradation of the air quality, water quality, land and noise levels for each sector is provided in this Environmental Quality (Emission) Guidelines. The guidelines published by the IFC is in line with these Guidelines. The section 2.1 for *energy sector development* in this Emission Guidelines is the relevant section applicable or the proposed hydropower project additional to the General emission guidelines. The applicable areas cover the transmission and distribution of power.

The procedure for public participation in the EIA process is still under development and only a draft version is available. The ministry along with their consultants have done several sounds of stakeholder consultations to improve this document.

Figure 1: Legal Framework in Myanmar for EIA projects

[10] http://www.myanmar-responsiblebusiness.org/resources/environmental-impact-assessment-procedures.html

There are many sector specific procedures and guidelines related to the Electric Power Generation Sector that will apply to the project. The laws relating to the hydropower projects are as below.

Energy/electricity
Electricity Law (2014)
Land
Land Acquisition Act (1894)
Vacant, Fallow, Virgin Lands Management Law (2012)
Farmland Law (2012)
Water
Conservation of Water Resources and Rivers Law (2006)
Environment
Environmental Conservation Law (2012)
Environmental Conservation Rules (2014)
National Environmental Quality (Emissions) Guidelines (2015)
Environmental Impact Assessment Procedures (2015)
Disaster risk reduction/climate change
Myanmar Action Plan for Disaster Risk Reduction (2017)
Investment
Myanmar Investment Law (2016)
Foreign Investment Law (2012)
Myanmar Investment Rules (2017)
Intended Nationally Determined Contribution – INDCs (2015)

Table 4: The laws relating to Hydropower projects in Myanmar

The project owner also has committed to the local authorities that they will employ the local people during the construction phase as well as the operational phase as far as practically possible.

3.3 International Conventions, Treaties and Agreements

Myanmar is a member of ASEAN (Association of South East Asian Nations) and are neighbours with India and China, two of the largest economies in the world. Many of Myanmar's rivers originate in other countries and flow out to other countries. There are three river basins in Myanmar that spreads to other neighbouring countries, namely the Ayeyarwady, Thanlwin and Mekong.

The proposed hydropower project relates to Ayeyarwady river, the most important river for Myanmar that lies almost entirely in the country. The two major tributaries of the river, the Maykha and the Malikha originates in China and a sub-tributary from India feeds Malikha. The flow of Ayeyarwady outside of Myanmar is only 0.3% of the total flow and the river basin area outside of Myanmar is only 9% (5% area is in China and other 4% is in India). The river basin crosses the states/regions of Ayeyarwady, Bago, Chin, Kachin, Magway, Mandalay, Nay Pyi Taw, Rakhine, Sagaing, Shan and Yangon.

The project is planned on the River Nam Tu that feeds the River Myit Nge which joins the Ayeyarwady River in Mandalay. The project area lies within the sub basin of Upper Myit Nge in Shan state. There are no treaties or agreements relates to water sharing or dam construction between Myanmar and other countries on this part of the Ayeyarwady river and/or its river basin. Further, there are no agreements between Shan state and other states/regions of Myanmar that relates to the water sharing and/or dam construction.

3.4 Myanmar Government institutional framework

The Energy and Power sectors administration is under the Ministry of Electricity and Energy (MOEE), that includes the hydropower projects. The Department of Hydropower Planning (DHPP) and Department of Hydropower Implementation (DHPI) has the responsibility for the hydropower projects in Myanmar.

The National committees that are relevant to the hydropower projects are

- National Environmental Conservation and Climate Change Central Committee (NECCCCC);
- National Water Resource Committee (NWRC); and
- National Land Committee.

These committees are chaired by one of the two vice presidents and include the union level minister of the most relevant sector. They are relevant to hydropower and demonstrate the cross-cutting nature of developing hydropower in Myanmar.

The National Environmental Conservation and Climate Change Central Committee (NECCCCC) is made to control the adverse effects to the environment from various sectoral development in the country and the resulting Climate change. This committee is chaired by the Minister of MONREC and the committee secretary is the Director General of ECD, supported by a central working committee composed of representatives from six technical working committees. The state and region level representatives are also present.

National Water Resources Committee (NWRC) is to develop the National Water Resources Policy (NWP), National Water Law and a framework for Inland Water Resource Management (IWRM) for the watersheds, rivers, lakes and reservoirs, groundwater aquifers and coastal and marine waters throughout the country. This committee has 20 members and have representatives from the ministries such as Agriculture, Border Affairs, Electric Power & energy, Livestock & Irrigation, Natural Resources & Environmental Conservation, Planning & Finance and Transportation & Communications. It also includes the mayors of the cities Yangon, Mandalay and Nay Pyi Taw, director generals of the relevant departments and Water Resource experts.

As per the Land Acquisition Act (1894), acquisition of land for the projects or any other use is the responsibility of the General Administration Department (GAD) at the township level. The land ownership lies with the government in Myanmar and there is no private property. The people who use the land are to be paid compensation in exchange of the takeover for projects.

3.5 International Policies, guidelines and standards

The hydropower project design is as per the Myanmar Hydropower standards, the National Electric Power Industrial standard of PRC, Hydropower Sustainability Assessment Protocol (HSAP). The project design is as per the high standards of sustainable development that is followed globally.

The Standards, guidelines and recommendations made by the international bodies such as the International Hydropower Association (IHA), World Commission on Dams (WCD), International Finance corporation (IFC), International Centre for Environmental Management (ICEM), International Water Management Institute (IWMI), and United Nations Framework Convention for Climate Change (UNFCCC) is used.

The standards used also covers the quality (ISO 9001:2015), environmental (ISO 14001:2015) and health standards for building and construction, efficient and low energy consuming designs, Occupational Health & Safety of the employees (OHSAS 18001:2007), and the general environment. The design of the project will incorporate these requirements.

4.0 Project Description and Alternatives

4.1 Presentation of the Project and Description of Alternatives

The proposed hydropower project named "*Namtu (Hsipaw) Hydropower Project*" with an installed capacity of 210 Megawatt (MW) is planned to be constructed on the Nam Tu river near Hsipaw township in Shan state of Myanmar. The project will have a maximum storage capacity of 256.233 Million cubic metre (m^3) of water and an estimated average annual energy generation output of 1,005.485 Giga Watt hours (GWhr) with 4,788 hours of annual operation. The guaranteed output of the project is 33.13 MW with a regulating water storage of 60.398 Million m^3. The project estimated cost is 436.28 Million United States Dollars (USD) with an estimated construction period of 66 months. The project is only intended for the power generation and the power generated will be exported to Myanmar power grid.

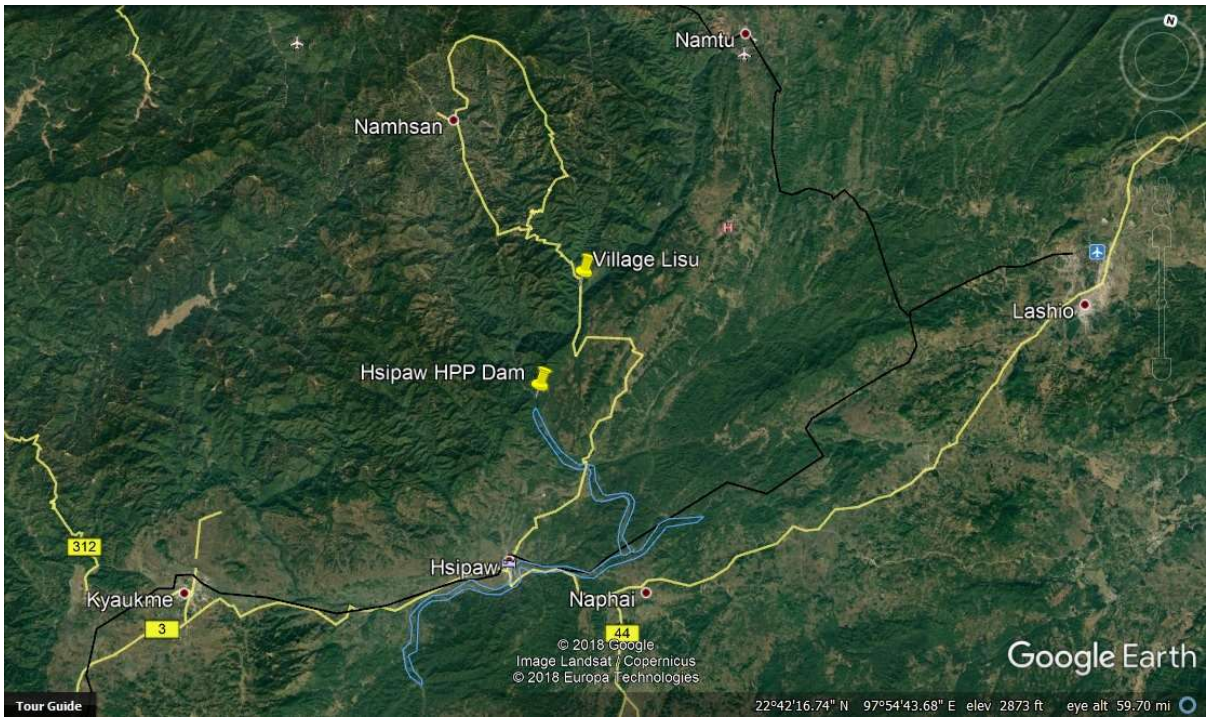

Figure 2: Geographical map of the project location from Google Earth

The location of the project is around 30 kilo metre (km) North West of Hsipaw, 78 km South West of Lashio and 249 km North East of Mandalay. Nam Tu and Kyaukme are the other townships near to the project area and the area is in the Kyaukme District. The nearest village is Li Lu that is around 16 km upstream of the proposed project dam site.

Nam Tu river belongs to the Ayeyarwady river system and is the upstream part of the Myit Nge River, a tributary of the Ayeyarwady River. The river stream run from North to South from the towns Kyukok, Mussur, Moe Yun, Nam Moh Kyan and Nam Tu from where the name of the river is used as Nam Tu river. The stream further flows southwards through Hsipaw and Nam Lan and then moves westwards to join the Myit Nge River. Myit Nge runs

towards North towards Mandalay and later join the Ayeyarwady River. The project area is classified in the Ayeyarwady river basin and the sub basin of the project is Upper Myit Nge.

The project when operational can contribute to meet the power requirements of the power deficient regions. Myanmar currently lags in electrification and this lack of infrastructure hinders the growth and development of the country and its people. There are no hydropower projects that are planned upstream of the proposed project. The Yeywa Dam of installed capacity 790 MW is commissioned and operational since 2010 in the Myit Nge river and the Upper Yeywa dam of installed capacity 280 MW is under construction. The other planned projects in the Myit Nge river are Dedoke Hydro (66MW), and Middle Yeywa hydropower project (700) and Lam Lang (210MW).

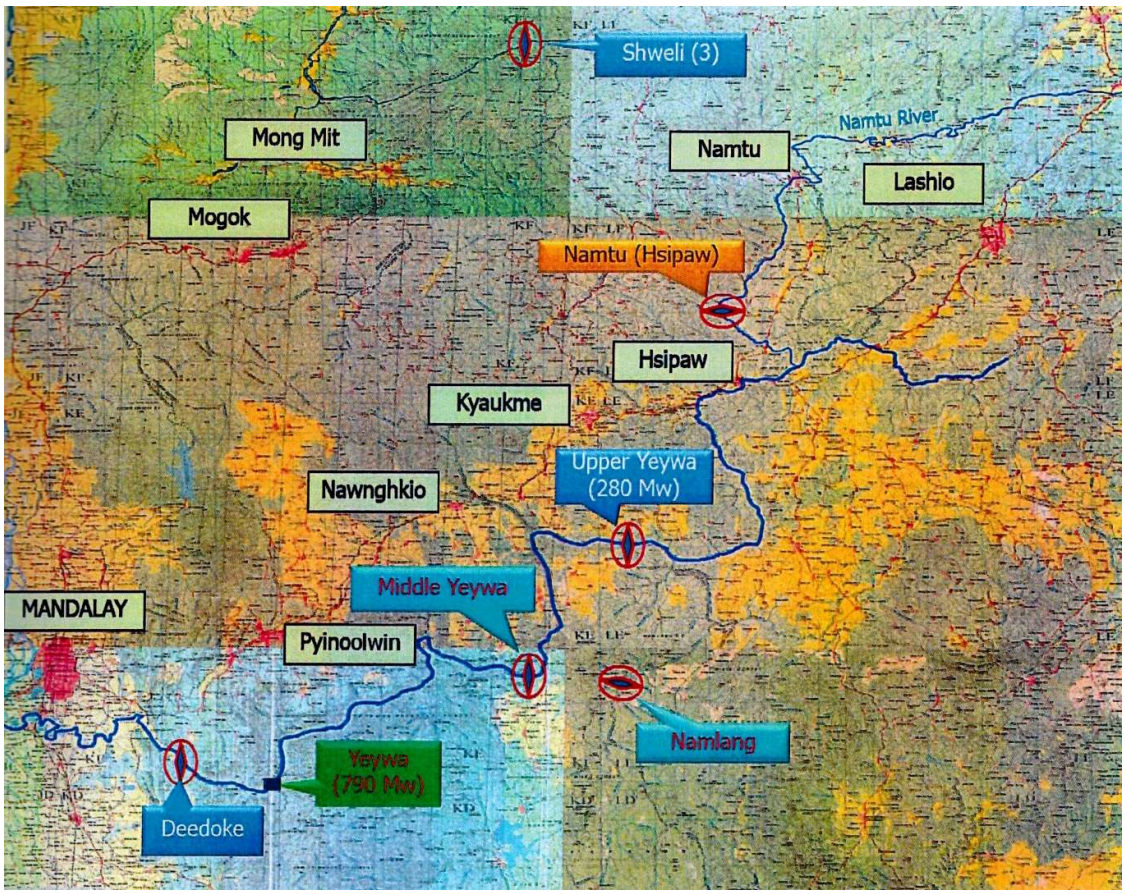

Figure 3: The other hydropower projects in the Myit Nge river

The basin of the reservoir to be formed is spread along the latitudes 22^0 42' to 23^0 50' and the longitudes 97^0 03' to 98^0 22. The discharge area is 6,820 square kilometre (km^2) and the mean annual discharge is 200 cubic metre per second (m^3/s). The river course of the project has a length of 40 km with an average gradient of 2.5%. The project will need to rehabilitate a village of 47 households and a population of 212 people due the flooding by the reservoir. The total area of land that will be submerged due to the project reservoir is 866.69 hector (ha.) that includes cultivated land of 86.12 ha, plantation of 4.23 ha and forest land of 543.71 ha. This will result in removal of 4,371 trees in the above specified area under submergence.

The rocks, stones, sand and soil required for the construction will be sourced from nearby quarry and three burrows located on the left bank of the river.

Figure 4: The proposed location for the dam.
Latitude $22^0$45' 27" North, Longitude 97^0 17' 27" East

The Dam

The Dam to be built is a normal concrete gravity type dam and is classified as Grade II, Large (2) type project. The maximum length of the dam is 304 m across the river with an elevation of 495 metre above sea level at the crest of the dam. The lowest elevation of the foundation surface is 381 m making the maximum height of the dam as 114 m. normal water level is 487 m. The dam consists of 15 monolith sections numbered from left bank to the right as 1 to 15. Section numbers 3 and 15 are 22-metre-long and all other 13 sections are 20-metre long.

The five sections numbered 1 to 5 are on the left bank intended for water retaining non-overflow area. The width of the crest in these sections is 9m. The slope of the upstream section is vertical from the top till to the elevation of 440m above sea level and below that, the section has a slop of 1:0.2. The slope on the downstream side is vertical from the crest till to the elevation of 483.837m, below which there is a slope of 1:0.78. The Gas Insulated switchgear (GIS) room and the central control room are located at the Dam toe of the sections 3 and 4 and the elevator shaft is at the toe of section 5 to meet the transportation requirements from crest to the power house. The service valve shaft is also planned at the section 5.

The three sections 6, 7 and 8 are overflow dam monoliths with each of them with one gated crest overflowing orifice that is 13-metre-wide and 14-metre-high at the elevation of

478m. The three inlets are from these three monoliths with the bottom elevation of 448.5m. The inlets consist of a trash rack, butterfly valve and the penstock. The trash rack is 6-metre-wide and 30-metre-high, the diameter of the butterfly valve and the pipe is 5m.

The section monolith 9 has the flood discharge and sand flushing bottom orifice with a bottom elevation of 420m. The dimension of the orifice is 5m wide and 6m high. The maximum discharge volume is 858.6m^3/s. The six sections numbered 10 to 15 on the right bank are the water retaining monoliths with a crest width of 9m. The slope at the upstream section is vertical and the slope at the downstream side is vertical till the elevation of 484.186m after which it has a slope ratio of 1:0.78.

Dam & Reservoir characteristics			
Item	**Parameter**	**Unit**	**Value**
Dam dimension	Dam height max	m	114.00
	Dam crest length	m	304.00
	Dam crest width	m	10.00
	Dam crest elevation	m	495.00
Water levels	Normal water level	m	487.00
	Design flood level	m	489.94
	Check flood level	m	491.86
	Dead water level	m	478.00
Storage	Storage under dead water level	Million m^3	157.453
	Storage under normal water level	Million m^3	217.851
	Storage under check flood level	Million m^3	256.233
Discharge	Discharge under check flood level	m^3/s	8,113.00
	Max discharge at crest overflow orifice	m^3/s	4,143.40
	Discharge for power generation	m^3/s	309.00
	Max discharge at flushing orifice	m^3/s	856.60
orifice size	Size of crest overflow orifice-3 numbers (width X height)	m X m	13X14
	size of flushing orifice-1 number (width X height)	m X m	5X6
	Size of intake-3 numbers (width X height)	m X m	6X30
	Controlled discharge area in cross section	km^2	6,820
Sediment discharge	Ave annual suspended sediment discharge	10,000 t	284.20
	Ave annual bed sediment discharge	10,000 t	56.80
	Ave annual sediment discharge	10,000 t	341.00

Table 5: Dam and reservoir characteristics

Powerhouse

The location of the powerhouse is in the underground on the left bank of the main stream of the river and is about 100m downstream of the dam complex. The powerhouse complex consists of main powerhouse, auxiliary rooms & central control building, downstream main transformer tunnel, busbar tunnel, fan room, tailrace tunnel, ongoing line, ventilation tunnel, and working shaft, access tunnel, drainage tunnel, cable trench and safe access. The main powerhouse is 85.95m long, 18.7m wide and 48.45m height and is installed with the three generating units spaced at 20m in between with vertical shaft 70MW Francis turbine. There are five floors to this complex with the bottom elevation of 385.471m and roof elevation of 428.3m. The five floors are Draft tube floor at 385.471m, spiral casing, Turbine floor at 395.5m, Intermediate floor at 403.8m, and Generator hall at 408.5m.

Power station area elevation in Metre	
Check flood level	413.3
Design flood level	411.5
Minimum tail water level	403.0
Normal tail water level	404.5
Installation elevation unit	395.5
Main generator elevation	408.5
Turbine elevation	398.9
Transformer room elevation	408.5
GIS room elevation	482.9

Table 6: The power station area elevations

There are two access tunnels; one for inlet and other for outlet. The bottom elevations of the tunnels are 417m and 408.5m respectively for inlet and outlet.

Turbine and generator

The water heads of the project are from 55.9m to 84m, for which Francis turbines are better suited and hence the project designers selected it with the vertical shaft type. The selected model is HLA883-LJ-330 with a rated head of 78m, 71.43MW output with an efficiency rating of 91.55%. Three such generator units form the proposed hydropower project to give a total installed capacity of 210MW. The rated discharge of the turbine is 101.97m3/s with a rated speed of 200 rotations per minute (rpm). The total weight of the turbine is around 230 tonnes and has a runner diameter of 3.30m.

The generator selected is three phase synchronous, vertical shaft, rotating field type with the model number SF70-30/7000. The output power is 70MW at a rated voltage of 13.8 kilowatt (kW) and rated current of 3445 Ampere (A). The rated speed is 200 rpm and the power factor is 0.85 with lagging. The rated efficiency is 98% with a frequency of 50 Hertz (Hz). The total weight is around 525t with the rotor hub weighing 260t.

Turbine model	HLA883-LJ-330
Turbine type	Francis turbine- Vertical
Rated capacity in MW	71.43MW
Rated speed in rpm	200
elevation of installation	395.5m
Rated unit flow in m3/s	101.97
Generator Model	SF70-30/7000
Rated capacity in MW	70MW
Rated power factor	0.85 lagging
Rated voltage in KV	13.8KV

Table 7: The Turbine and generator details in the project

Construction Plan for the Project

The construction of the project is estimated as 66 months, of which the first 23 months are for the preparations, next 39 for the main construction and the last 4 months for the completion. The construction consists of a dam, powerhouse, discharge channels and cofferdams during the construction period to divert the water.

Diversion of the river for construction

The rainy season in the region is from May to November and hence considered to be the flood season and the December to April is considered the dry season for the formulation of the construction plan. A 30-year-old flood standard with the peak discharge of 2,525 m3/s is considered for the wet season and a 10-year flood standard with a corresponding peak discharge of 642 m3/s is considered for the dry season.

The riverbed at the proposed dam site is V shaped with a width of around 30m and is flanked by steep mountains on either side. Hence, the mode of channel diversion or stage diversion is not feasible and the selected method is non-stage river closure by cofferdam and tunnel diversion for the construction of the project dam. The proposed project is grade II, its dam structures are of grade I, main structures are grade 2, secondary structures are grade 3 and temporary structures are grade 3. As per the review comments made by the Ministry of Electric Power of the Myanmar government, earth-rock fill cofferdams are adopted for the water retaining.

For the inlet and outlets of the flood discharge tunnels, coffer dams are required for protection. The diversion and the flood discharge tunnel are grade 4 temporary structure.

For the inlet tunnel, a rigid cofferdam and for the outlet tunnel, an earthwork cofferdam is planned.

As per the site conditions regarding the topography and hydrology, the diversion procedures for the construction of the dam are as below

Diversion period	Peak discharge	Upstream water retaining structure	Upstream water level	Flood regulating storage	Discharge structure	Maximum discharge
	m^3/s		m	$10,000m^3$		m^3/s
July 1st year- November 2nd year	1719	Cofferdam at tunnel inlet	0	0	River stream	1719
November 2nd year- December 2nd year	154	Closure dike	401.85	0	Diversion & Tunnels	154
December 2nd year- April 3rd year	642	Upstream cofferdam	413.89	195.1	Diversion & Tunnels	611.34
May3rd year- November 3rd year	2,525	Upstream cofferdam	433.83	1,518.9	Diversion & Tunnels	2,358
December 3rd year- April 4th year	642	Upstream cofferdam	413.89	195.1	Diversion & Tunnels	611.34
May 4th year- February 6th year	2,748	Dam	436.58	1,834.3	Diversion & Tunnels	2,516

Table 8: The river diversion procedure for the construction period

1. July of the 1st year to November of the 2nd year

The construction of the diversion and the flood discharge tunnel works along with the excavation of the riverbank slopes at the dam site will be done during this period. The existing riverbed will be used for the discharge and the cofferdams at the diversion and the tunnel inlet and outlet will be used for retaining the water. By the end of November of the 2nd year of construction and from there on, the diversion and the flood discharge tunnels shall be used for the discharge.

2. November to December of the 2nd year

The filling of the closure dike is planned during this period. In the start of December in the 2nd year, the river closure will be done and the water will be discharged through the diversion and flood discharge tunnels.

3. December of the 2nd year to the April of the 4th year

The excavation of the dam foundation pit, concrete placing and consolidation grouting of the foundation will be carried out in this period. Cofferdams will be retaining the water and the diversion & flood discharge tunnels will be discharging the water.

4. May of the 4th year to November of the 5th year

The dam under construction will be filled for the elevation that is higher than the top elevation of the cofferdams; hence, the dam will be used for the water retaining with the diversion and flood discharge tunnels used for the discharge. The concrete placing of the dam will be completed during this period.

Cofferdams and Diversion channels

The selected type of the diversion and flood discharge tunnel is 12m wide, 15m high with inverted U shape cross section. This provide a maximum discharge of 2,358m^3/s with a water level for flood at the elevation 433.83m and a cofferdam height of 35.5m. The flood discharge tunnel is arranged to be on the right bank of the river with an inlet bottom elevation of 403m and an outlet elevation of 400.44m. The tunnel consists of open channel sections at the inlet and outlet, a gate chamber section and tunnel body. The total length of the tunnel is 746.5m with the tunnel body section length of 640m. The open channel sections are 45m and 61.5m at the inlet and outlet respectively.

	Peak discharge m^3/s	Water level (m)	crest elevation (m)	foundation elevation (m)	Height of cofferdam (m)
Tunnel Inlet	1,719	410.54	412	403	9
Tunnel outlet	1,719	407.96	409	401	8

Table 9: The details of the cofferdams for inlet and outlet tunnels

The cofferdams at the inlet and outlet tunnels for diversion and discharge are required for protection against the flood. The inlet cofferdam is made of rubble concrete structure arranged along the river bank with a crest width of 1m and height of 9m. The upstream side is vertical and the downstream side will have a slope of 1:0.5. The outlet cofferdam is reserved rock and earth rockfill combined type with a crest width of 6m and height of 8m. The upstream side has a slope of 1:1.5 and the downstream side has a slope of 1:1.

Cofferdam	Crest length (m)	Water level (m)	Crest elevation (m)	Height (m)
Upstream	122.998	433.83	435.00	35.50
Downstream	67.932	409.28	410.50	15.50

Table 10: The details of the upstream and downstream cofferdams

The cofferdams for upstream and downstream are of earth rockfill structure. Both the cofferdams have gravel overburden of 5m thickness with maximum water retaining heads of 34.33m and 14.3m respectively for upstream and downstream. They are provided with a clay core for seepage and filled with rock filled debris. The dam crest is 6m wide for both the cofferdams and the crest length is 122.998m and 67.932m respectively for upstream

and downstream cofferdams. The slope for the both cofferdams are 1:2 on both the sides and are with a maximum height of 35.5m and 15.5m respectively for upstream and downstream structures.

Material Sourcing for the project Construction

Item	Unit	Dam	Power House	Diversion & Flood Discharge	Access Tunnel	Coffer Dam	Total
Earth excavation	m^3	1,428,442	-	143,194	5,855	4,719	1,582,210
Tunnel removal	m^3	3,369	-	219,641	61,043		284,053
Concrete	m^3	413,754	46,049	115,528	21,291		596,622
Rubble concrete	m^3	570,321	-	-	-	3,942	574,263
Shotcrete	m^3	9,081	-	9,427	2,089	87	20,684
Rebar	t	5,090	3,792	9,172	2,373		20,427
Steel	t	42	435	1,856	315		2,648
Curtain grouting	m	28,580		-	-		28,580
Backfill grouting	m^2	994		12,262	8,438		21,694
Consolidation grouting	m	23,033		22,938	6,642		52,613
Grouting-transverse joint	m^2	46,213					46,213
Grouting-longitudinal joint	m^2	16,853.					16,853
Contact grouting	m^2	14,066					14,066
Anchor cable	Nr	2,061	-	1,050	-		3,111
Water stop	m	4,757	3,513	4,444	2,385		15,099
M7.5 masonry	m^3			347	-		347
Anchor bolt	Nr	10,691		29,202	20,656		60,549
Pipe shed	Nr	162		960	1,213		2,335
Gate	set	8		-	-		8
Debris filling	m^3	15,751		7,353	-	229,978	253,082
Clay filling	m^3					34,139	34,139
HP jet grouting	m	-		-	-	940	940
Cofferdam	m^3	-		-	-	132,020	132,020

Table 11: Bill of Quantities for the project

The natural material used for the construction contain the block stones, coarse concrete, fine aggregate and earth material. The total concrete requirement is 596,600m^3 of which the rubble concrete is 574,300m^3, shotcrete about 20,700m^3 and M7.5 masonry is about 400m^3.

The calculated requirement of the rocks for the project as per the concrete values above is 1,254,000m^3. The concrete coarse and the fine aggregate required is 1,472,000m^3. The nearby quarry can supply the block rocks, concrete coarse and the fine aggregate. The rocks will be excavated by the bench blasting method using QZL-100X scaffolding, open aired, down the hole with a bench height varying from 9m to 12m.

The construction quantities of the impervious soil material for the cofferdam is about 34,100m^3. The cofferdam is temporary construction and will be removed. The three burrows nearby can supply the soil required for filling. The required soil quantity is 45,200m^3.

The rock quarry identified is located on the mountain on the left bank in the downstream of the proposed dam site. The rocks are limestones intercalated with white dolomites, that is distributed at the elevations from 515m to 685m. The upper covering of the quarry are eluvium debris sand soil and rock blocks with rolling stones. The quarry is evaluated by sample testing for its quality. The Alkaline activity of the sample is performed with the accelerated mortar bar method and the expansion ratio for 14 days is within 0.1% and hence the aggregate is non-reactive. It is as per the Chinese Standard DL/T5151-2014[11]-*Code for Aggregates of Hydraulic Concrete*.

The block rocks are hard rocks with high intensity and can meet the quality requirements of the construction. The coarse concrete aggregates have a fineness modulus (FM) ranging from 2.89 to 3.58 and belong to the medium coarse sand category and can be used in the construction. The overall quality of the fine aggregate is also good for the construction.

All three burrow areas identified for the soil are on the left bank of the river. Burrow I is located near the farmland on the left bank of the dam site at elevations ranging from 765m to 788m covering an area of 72,000m^2. The surface layer is brown yellow and brown red cultivated soil and clay with loose structure of thickness between 0 to 0.5m. The lower part is eluvium and diluvium deposits with brownish red clay with crushed stones. The structure is medium dense to dense with thickness varying from 4.5m to 9m. The sub terrane layer is D layer with highly withered limestone with dolomites. The groundwater burial depth is from 10m to 20m.

The burrow II is located in the Hsipaw farmland on the left bank of the dam site and the west area. Its distributed on the slope of the mountain with elevations ranging from 760m to 785m and covers an area of about 146,000m^2. Surface layer is brownish yellow and brownish red cultivated soil and clay with a thickness of 0.4m to 0.6m. The lower useful later is 3.5m to 8m thick with eluvium and diluvium deposits and brownish red clay. The sub terrane layer is D layer with highly withered limestone with dolomites. The groundwater burial depth is from 10m to 20m.

[11] http://www.gbstandards.org/mobile/GB_List-m.asp?id=63654

The burrow III is located in the left bank of the dam site in the upstream area at elevations ranging from 1,150m to 1,220m covering an area of around 20,000m^2. The surface layer is greyish yellow humus soil with loose structure and the thickness varies from 0.1m to 0.8m. The useful lower layer has thickness ranging from 2m to 7m with a medium dense structure. The sub terrane layer is O layer with withered shale, quartz sandstone with mudstone.

The quality was evaluated by sample testing; the plasticity index for burrow area I and II varies from 13.9 to 23.6 and for burrow II it varies from 16.8 to 23.8 and hence meet the requirements. The permeability coefficient varies from $17X10^{-6}$ to $2.8X10^{-6}$ that meet the requirements. The natural moisture content in the burrow I and II varies from 31% to 35.5% and for the burrow area III, it varies from 21.5% to 25.1%. The optimum moisture for the first two burrows ranges from 29.7% to 33.2% and for the third burrow it is from 21.4% to 26.7%. The compacted dry unit weight of the soil is lower than the natural dry unit weight that satisfies the requirements. The soil falls under the medium compressible category.

The comprehensive analysis shows that the soil in the eluvium and diluvium of first two burrows are silty soil with higher clay content and moisture content high in the low-level areas. The soil of the third burrow is silty soil containing gravel and high clay content. The soils are good to be used in the project construction. However, the project developer has identified another site around 13km downstream of the dam site with better suitable parameters and hence moving the workers accommodation and the burrows.

Main Construction works

Dam and Powerhouse-Construction of the water retaining Dam and the Power House requires excavation of the river banks, Closure and cofferdam construction, River bed excavations, Foundation treatment, Concrete mixing and placing, M7.5 stone masonry construction, Shotcrete concreting, anchor rod construction and earth rock backfill.

These construction activities for the dam and powerhouse involves blasting the rocks on the banks and riverbed by drilling and blasting, excavation using the $3m^3$ and $2m^3$ excavators, transportation of material using 10t trucks, one HZS150 concrete mixing plant operation, concrete placing by tower cranes and buckets, $0.35m^3$ mortar mixer operations, concrete spraying by HPZ6T concrete sprayer, rock dowel construction for anchor rod.

Access Tunnel-Access tunnel construction involves rock tunnel excavation by full face drilling and blasting method, making the concrete lining, and backfill grouting. These activities also will be using the concrete mixing plant and use dump trucks for transportation.

Equipment & Machinery Installation-The installation of the electromechanical equipment includes installation of bridge crane, hydraulic turbine, generator, thrust bearing and electrical equipment etc. They will be transported by special transportation equipment from the manufacturers location to the warehouse. The gate and hoist are transported from the manufacturers to the site warehouse for storage by special trailers, pulled by hoisters and installed manually assisted by hoisting cranes of 50t.

Safety Monitoring system-The safety monitoring of the dam is managed by equipment and instruments installed for monitoring the external and internal deformation, bedrock deformation, stress-strain and temperature, uplift pressure, bypass seepage and seepage amount observation. The embedded method of placing the equipment at the time of concreting is planned.

Construction Access Transportation

The transportation of material and machinery to the site is by rail and road modes. The external goods for the project include cement, steel, timber, explosive material, metal structures, mechanical and electrical equipment, construction machinery and supplies for the workforce. The largest item transported is the bridge crane with a length of 19m, width of 2.5m and height of 2.4m and weighing 30t. The heaviest single item to be transported in the Generator rotor that weighs 35t.

Roads will have to be built for the onsite access as provided in the table below. There will be four new permanent roads built for the project with the lengths 4.5km, 2.1km, 1.4km and 3.6km at different points and an existing road of 10km will be expanded and renovated for use. Additional to this, 9 new temporary roads of length varying from 04km to 2.6km shall also be made.

Item	Sr No	Category	Length (km)	Start Position	End Position
Permanent road	DL-1	Expansion	10	Existing road	Living Quarter
	DL-2	New	4.5	Living Quarter	Temporary bridge-1
	DL-3	New	2.1	Temporary bridge-1	Main access tunnel inlet
	DL-4	New	1.4	DL-2	Left bank dam crest
	DL-5	New	3.6	Existing road	DL-2
Temporary road	DL-6	New	2.6	Temporary bridge-1	Diversion & tunnel inlet
	DL-7	New	1.1	DL-6	Right bank dam crest
	DL-8	New	0.5	DL-7	Right Dam abutment
	DL-9	New	1.5	Right bank dam crest	Diversion & tunnel inlet
	DL-10	New	0.9	Temporary bridge-1	Spoil Area-2
	DL-11	New	0.4	Inlet of main access tunnel	Dam foundation
	DL-12	New	0.8	DL-2	Spoil Area-1
	DL-13	New	0.6	DL-2	Middle of quarry
	DL-14	New	1.5	DL-2	Bottom of quarry

Table 12: The list of roads built for the site access

3 temporary bridges also shall be made for the transportation with the span 90m, 90m and 30m. They will be with steel structure and will be designed for 20t Trucks and 100t trailers. The two 90m bridges will be located downstream of the Namtu river and the 30m bridge is as the outlet bridge crossing the diversion and flood discharge tunnel.

Construction Plant Facilities

Aggregate Processing System-The aggregate processing system is planned for producing the required 1,472,000m^3 of coarse concrete and fine aggregate for the project. The facility is manual processing and will be located 2km downstream of the dam site. The processing method includes a 3-section crushing and 2 grade screening; the primary crushing is open and the secondary and fine crushing is in the closed production system. The system will have a through put capacity of 280 tonnes per hour (t/h) and a finished capacity of 230 t/h. One set of PE-900X1200 type jaw crusher is designed for primary crushing and one set of 1750 cone crusher is provided for secondary and fine crushing. Additionally, one set of PEX-250X1000 type jaw crusher and one set of PF ϕ 1250X1000 impact crusher is planned for fine crushing.

Concrete Mixing System-The required concrete for the project is 596,600m^3 of which 574,300m^3 is buried concrete and 20,700m^3 is shotcrete. To meet this requirement, a mixing system is laid out in a centralised way to produce and supply for each stage of the construction as per the need. It is designed for a peak concrete placing strength of 40,500m^3 per month of dam and powerhouse. The selected type is HZS150 that has a capacity of 150m^3 per hour.

Equipment repairing system- The maintenance and repair of the machinery needs to be made available at site as there is no repairing facilities available nearby. The panned location is the construction work area in the downstream on the left bank. This will also have fabrication facilities to make the penstock and other metal structures at site from tiles. Additionally, the work area also will have workshop for wood work and the reinforcements.

Air, Water and Power for the construction-The compressed air requirements for the project is met by use of two 40m^3 per minute compressors and three 20m^3 per minute compressors. The 40m^3/min compressors will be arranged for the diversion and flood discharge tunnel construction and the left and right dam abutment for construction of barrage bank slope and foundation pit. Two of the 20m^3/min compressor is for the rock quarry and the other third one is for the inlet of main access tunnel.

A total of five water supply systems are planned for the project of which three are 100m^3 pools and other two are 50m^3. A 100m^3 pool each is provided on the left bank and right bank of the dam and are fitted with two sets of IS65-40-250 type single stage centrifugal pumps. The aggregate processing and the concrete mixing system is provided with a 100m^3 pool fitted with one IS65-50-200 type single stage centrifugal pump. The pool at the quarry has 50m^3 capacity and is fitted with one IS65-40-315 type single stage centrifugal pump. The workers living quarters has a 50m^3 pool with IS80-50-200 type single stage centrifugal pump.

A 66kV substation with a power load of 4MWA is to be built near the project site that is connected to the 230kV substation at Man Sam in Hsipaw through a 66kV line. 11kV transmission lines are to be connecting this 66kV substation to the five 11kV transformers at site. The transformers for the left bank and right bank are 630kVA, and 1000kVA respectively, the aggregate processing and the concrete mixing system has an 800kVA transformer and the quarry and the living quarters each have a 500kVA transformer making a total transformer capacity of 3,430kVA. The 66kV transmission lines are 30km long and the 11kV lines are 3.8km long.

Source of Use	Electricity (kWh)	Diesel (kg)
Construction period		
Earth rock construction machinery	6,094,589	2,227,677
Concrete construction equipment	8,746,839	-
Aggregate processing system	27,022,372	-
Comprehensive processing	1,544,117	-
Production water supply	767,403	-
Construction Access	-	663,163
Production building	920,274	-
Living buildings	613,835	-
Total cumulative	**45,709,429**	**2,890,840**
Operation period (Annual consumption)		
Hydraulic Machinery	1,064,000	-
Electrical Equipment	2,516,000	80
Metal structure equipment	20,800	-
Total per year	**3,600,800**	**80**

Table 13: The fuel and power requirements for construction & operation

The total electricity consumption estimate for the construction period is 45,709.43 Megawatt hours (MWh) due to the operation of heavy machinery for the excavation, concreting, aggregate processing and water supply. The diesel fuel required for the construction period is 2,890.84 tonnes.

The annual energy required for the operation of the project is 3,600.80 MWh/year and the diesel requirement is 80kg/year.

Spoils from Construction and Balancing

The construction of the dam result in generation of lot of soil and rocks that are not usable in the project and hence will need to be kept aside. To meet this, two spoil areas are being planned around 4km downstream.

The total open earth rock excavation for the project construction result in spoils of 1582,200m^3, the tunnel excavation contributes about 284,100m^3 and the spoils generated from the quarry is 250,900m^3. The total resulting spoils from the project is 1996,100m^3 is to be stored in the two spoil areas.

Category	Structure Item	Dam	Power House	Diversion & discharge tunnel	Cofferdam	Rock quarry	Total
Excavation (m^3)	Open earth-rock excavation	1428,442	0	88,306	4,719	0	1521,467
	Rock Tunnel excavation	3,369	20,979	168,432	0	0	192,780
	Demolition of buildings	0	0	0	132,020	0	132,020
	Total	**1431,811**	**20,979**	**256,738**	**136,739**	**0**	**1846,267**
Utilization (m^3)	Cofferdam Filling	229,978	0	0	0	0	229,978
	Earth rock backfill	15,751	0	7,353	0	0	23,104
	Total	**245,729**	**0**	**7,353**	**0**	**0**	**253,082**
Waste Spoil (m^3)	Spoil Volume	1186,082	20,979	249,385	136,739	250,889	1844,074
	Spoil area-1	652,345	20,979	249,385	136,739	250,889	1310,337
	Spoil area-2	533,737	0	0	0	0	533,737

Table 14: The earth-rock balancing for the project construction

The land resettlement and rehabilitation

The project construction requires the land acquisition for the building of the dam, powerhouse and other structures. The total area required for the Hsipaw hydropower project is 37.89ha that include the 32.39 ha of forest land, 3.53 ha of dry land and 1.97 ha of water surfaces.

The project will result in creation of a large reservoir at its normal water level of 487m above sea level with a storage of 217.85 Million m^3 of water. This will submerge vast stretch of land that cover the forest land, cultivated land and the houses. The total area submerged under the reservoir will be 866.69 ha.

The total land acquisition required for the project including both the project area and the flood area is 957.96 ha of which 904.58 ha is to acquired permanently and the rest 53.38 ha to be acquired temporarily.

Land	Permanent Land (ha.)			Temporary Land (ha.)	Total (ha.)
	Flood area	Project	Total		
Paddy fields	47.02	0	47.02	0	47.02
Dry Land	39.10	3.53	42.63	15.71	58.34
Rubber Plantation	4.23	0	4.23	5.05	9.28
Forest Land	543.71	32.39	576.1	32.62	608.72
Residence land	2.73	0	2.73	0	2.73
Roads	2.76	0	2.76	0	2.76
Water surface	227.14	1.97	229.11	0	229.11
Total	**866.69**	**37.89**	**904.58**	**53.38**	**957.96**

Table 15: The land acquisition details for the project

The reservoir inundation and impact zone have an area of 866.69 ha, that include paddy fields of 47.02 ha, 39.10 ha of dry land, 4.23 ha of rubber plantations, 543.71 ha of forest land, 2.73 ha of resident lands, 2.76 ha of roads, and 227.14 ha of water surface and flood plains area.

This reservoir coverage will submerge the location of 47 households where 212 people live, 15,902 m^2 of buildings, 4,371 trees (of which 2,820 are fruit trees), 5.52 km of roads and four bridges that need to be rebuilt. All the 47 houses that needs resettlement are from the village Li Lu in Nahmsan township that is located around 15 km upstream of the dam site near a bridge that needs to be rebuilt. The total estimated cost of resettlement and rehabilitation is 34.63 Million USD.

Parameter	Unit	Value
Resettlement families	households	47
Resettlement people	persons	212
House Inundation	m^2	15,904
Fruit trees	number	2,820
Commercial Trees	number	470
Bamboo	number	141
Banana and plantain	number	940
Length of 4 bridges to be built	m	495
Resettlement cost	Million USD	34.63

Table 16: Cost of resettlement for the project

The reservoir basin that will be under the submergence needs to be cleaned by clearing the trees and other vegetation maintaining a maximum height of 0.3m from the ground, removing the buildings and other structures and hygienic cleaning of the reservoir inundation zone. The dumps, toxic substance warehouses and graves will not be removed. The felling of trees is required for an area of 547.94 ha and the cleaning area is 6.49km^2 of cut over lands and 15,904m2 of buildings. 94 parts require hygienic cleaning. The floating debris such as dead trees, shrubs, straws etc shall be removed from the area. Faeces and waste shall be land filled with a minimum thickness of 1m or transported out.

This cleaning shall be done in two stages; the first stage will be before the closure of the cofferdam and before the first year of construction and to be carried out within the elevation level of the upstream of the cofferdam. The second stage is full cleaning of the overall reservoir area that will be submerged under water and should be completed 3 months before the reservoir impoundment.

4.2 Comparison and selection of the Project Alternatives

The project owner with an aim to develop renewable energy projects in Myanmar to meet the energy deficit of the country was looking forward to development of hydropower projects as the country has tremendous potential that is underutilized. They had engaged consultants to survey potential dam sites in the Shan state that has many rivers running through less populated mountainous terrain. They had finally narrowed down to few sites in the Namtu river where there is no existing and planned project.

The baseline scenario is "*not developing the hydropower project and leaving the river as it is*". The alternative scenarios for the projects are in the project owner's decision to change the initial plans they had for the project development. This include the selection of the dam site and type of dam, selection of the water level for the dam, selection of the installed capacity and number of generating units.

Project Alternatives

1. Dam site for the project and the type of Dam-

In the initial plan of the project development, the site selected was around 15 km downstream (close to Hsipaw) of the selected site that had favourable water head for generation. However, this site development will have resulted in submergence of a highly populated village tract Moe Tay in Hsipaw township and their agricultural fields nearby and resettlement would have been difficult to be performed. Hence the project owner selected two sites upstream of this site in Namtu township for comparison for the selection of the dam axis.

These two sites compared were 1,900m apart and were called the Upper Dam site and Lower dam site for comparison. The upper dam site is in a U-shaped valley with the river width ranging from 35m to 58m, whereas the lower dam site valley is V shaped and is narrower with width ranging from 22m to 49m. The geological structure, stratum lithology is more or less same for both the sites. The upper dam site has 3 and 2 gullies developed on the left and right bank of the river respectively with perennial drainage and the river bed is strongly withered. The lower dam site has only one shallow gully and the river bed is not withered; the lower dam site is favourable from a physical geological perspective. The thickness of the permeable layer is less for the lower dam site making it favourable as far as leakage is concerned. The Rockfill face type is suitable for the upper dam site and concrete gravity dam is suitable for the lower dam site. The lower dam site has three different type of schemes to be chosen from. Hence the total scenarios compared are four as below

e) Upper dam site with Concrete faced Rockfill type dam
f) Lower Dam site Scheme I- Concrete gravity dam with headrace & generation system on right bank and powerhouse in the dam toe.
g) Lower Dam site Scheme II-Concrete gravity dam with headrace & generation system in the dam, and powerhouse in the dam toe.
h) Lower dam site Scheme-III-Concrete gravity dam with long distance headrace & generation system on the right bank and ground powerhouse

The upper dam site with the rockfill concrete face type dam will need 2297,000m^3 of rockfill filling and will need 7,187t of welded steel pipe. The three schemes of the lower dam site do not require any rock filling; but the concrete requirement will be much higher than the upper dam site type. The earth rock excavation and the tunnel excavation requirement are lowest for the Lower dam site scheme II with lesser use of welded pipes and rebars. The comparison is provided below. The construction material requirements and the impacts to the environment will be minimum for the Lower dam site scheme II scenario and hence the project owner has chosen that alternative for dam site and dam type.

Item	Unit	Upper Dam site	Lower dam site		
			Scheme-I	Scheme-II	Scheme-II
Earth-rock excavation	10,000m^3	180.41	153.70	142.90	172.50
Rock tunnel excavation	10,000m^3	36.28	49.10	2.80	47.75
Concrete	10,000m^3	79.74	120.05	115.60	128.60
Rockfill filling	10,000m^3	229.72	0	0	0
Welded steel pipes	t	7,187	2,449	263	3,287
rebar	t	17,446	17,725	9,710	22,063
Anchor cable	pieces	2,061	3,361	2,061	2,580
Curtain grouting	m	404,100	39,200	28,600	75,000
Consolidation grouting	m	35,800	53,200	27,100	65,000
Filling grouting	m^2	34,100	21,000	4,300	72,000

Table 17: The comparison of the dam sites and dam type

2. Water level for the dam-

The project owner had to decide on the normal water level of the dam considering the submergence as well as the water storage for regulation. They compared two heights of elevations 487m and 492m for the normal water level. The higher water level can give an additional power generation of around 25 Gigawatt hours (GWh) annually. However, the submergence of the basin is also increased with additional water storage causing resettlement of more households.

The scenario with the water level of 487m will submerge a total area of 866.69 ha that include 47.02ha of paddy fields, 39.1 ha of dry land, 4.23 ha of rubber plantations, 543.71 ha of forest land, 2.76 ha of roads and 227.14 ha of water areas. This will result in resettlement of 47 households with a population of 212 people, destruction of 4,371 trees and 15,904m^2 of buildings and rebuilding four bridges of length 495m.

In the case of the alternative scenario of 492m water level, the submerged area will be 992.33 ha of land with more forest land going under water. The total forest land submerged is 648.29 ha which is 104.58 ha more than the previous scenario. The number of households for resettlement will increase to 107 with a total population of 482, that is more than twice the resettlement in the previous scenario. The submergence will result in destruction of a total of 9,951 trees, 41,230m^2 of buildings and the length of the four bridges to be rebuilt will be 540m.

The amount of environmental damage and disturbance to livelihoods are much higher for the scenario with the water level elevation of 492 and hence the project owner decided to choose the lower water level of 482m for the project. The cost of resettlement also is increased by 9.24 Million USD in the higher water level against an additional power generation of around 25 GWh.

3. Selection of the installed capacity of the Project

The project owner considered three different scenarios of choosing the total installed capacity. The initial review had prompted them to look for a project that has an installed capacity above 200MW. The compared the options with a 10MW increase and compared 200MW, 210MW and 220MW.

Comparison of installed capacity				
Parameter	**Unit**	**200 MW**	**210 MW**	**220 MW**
Installed capacity	MW	200	210	220
Firm Output	MW	33.126	33.129	33.132
Average Annual energy	GWh	981.36	1005.51	1027.95
Energy-Flood season	GWh	749.04	773.11	795.49
Energy-Dry season	GWh	232.32	232.4	232.46
annual operating hours	hours	4907	4788	4673

Table 18: The comparison of installed capacity

The Annual generation increases with the installed capacity with the annual operating hours coming down. The increase in generation is around 24 GWh from 200mW to 210MW and around 25GWh from 210MW to 220 MW. The increase in generation during the dry season is only 75MWh and 65MWh respectively for the two comparisons. The investment required for 200MW and 210MW are not very different and the cost per kW is almost same. However, the additional investment required for increasing capacity to 220MW is much higher and the cost per kW is higher for 220MW. Hence the project owner chose to go with the 210MW of installed capacity.

4. Selection of number of generating units-

The generation of the total installed capacity can be met by various options such as two generating units of 105MW each, three generating units of 70MW each, four units of capacity 52.5MW each and so forth. If two units are used, the firm output will only be 31.6% of the rated output of the unit can be obtained. If three units are used the firm output will be 47.3% of the rated output. The turbine ideal for the type of head is stable operation range of mixed flow-a vertical shaft Francis turbine shall be generally having a firm output of more than 45% at least and hence the number of units have to be at least three. Hence the two units option were ruled out. The ease of construction will be lesser for three generating units than four sets and hence three units of 70MW was chosen by the project owner for the generation system.

Parameter	Project Activity	Alternative to Project
Geographical conditions	Current location	Other location
Economic feasibility	Medium	High
Deforestation	Low	Medium
Ease of docking of boats	Easy	Medium
Water Pollution	Low	Medium
Water Consumption	Low	High
Solid waste disposal	Low	High
Dredging	Nil	Low
Employment contribution	Medium	Medium
Project owner expertise	Medium	Medium
Construction feasibility	Moderate	Difficult
Development of region	High	High

Table 19: comparison of alternatives

The project owner has compared the economic feasibility, environmental feasibility, employment generation, contribution to country's economy and environmental impacts in both the scenarios and has made a decision to implement the project

5.0 Description of the Environment

5.1 Setting the study limits

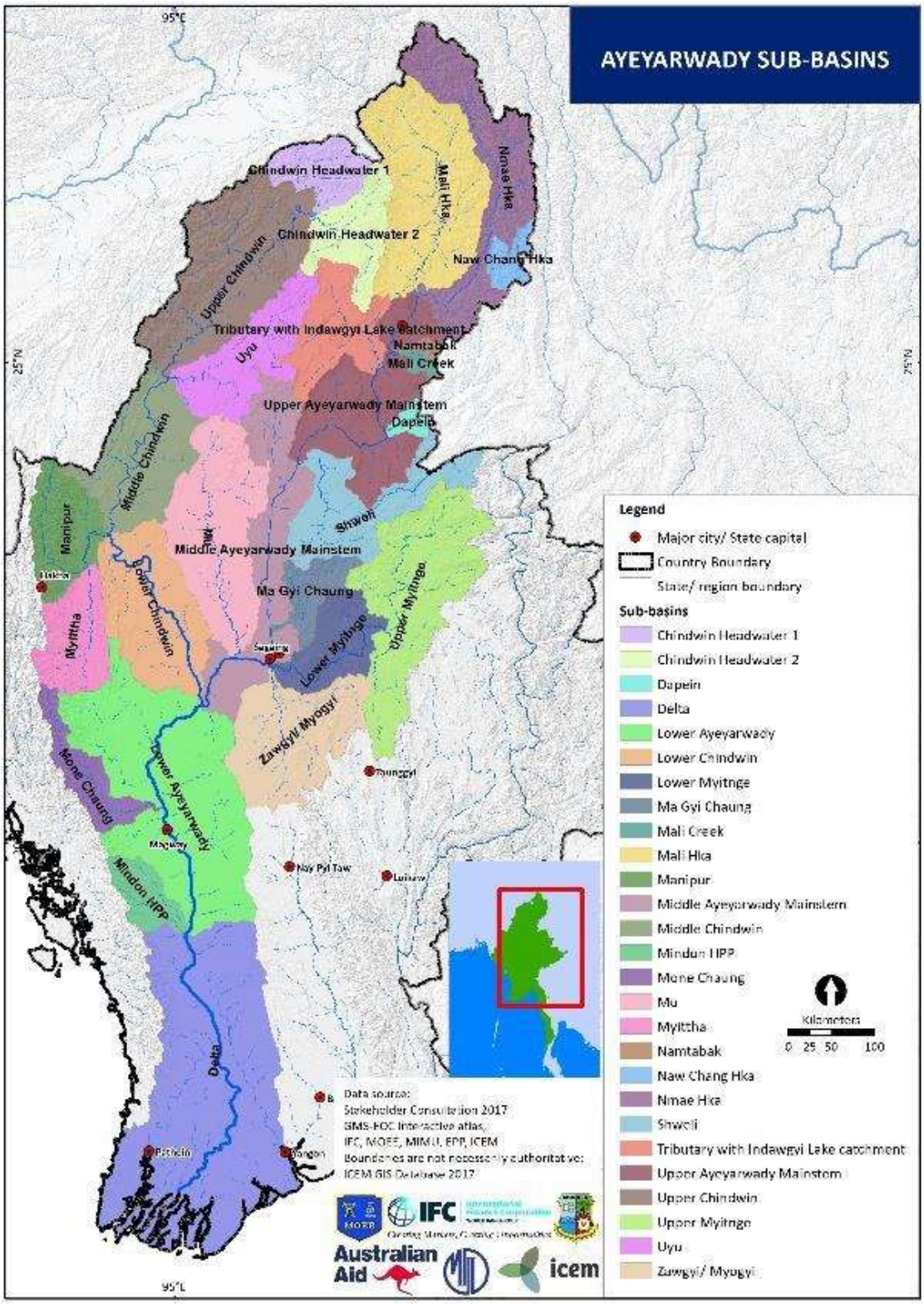

Figure 5: Ayeyarwady River Basin

The project is planned in the Nam Tu River that feeds the Myit Nge River located North east of the Hsipaw township. The area falls in the Upper Myit Nge sub-basin of the Ayeyarwady river basin. The EIA study is limited to the sub basin of Upper Myit Nge as the effect of the project is confined to the area of the sub basin.

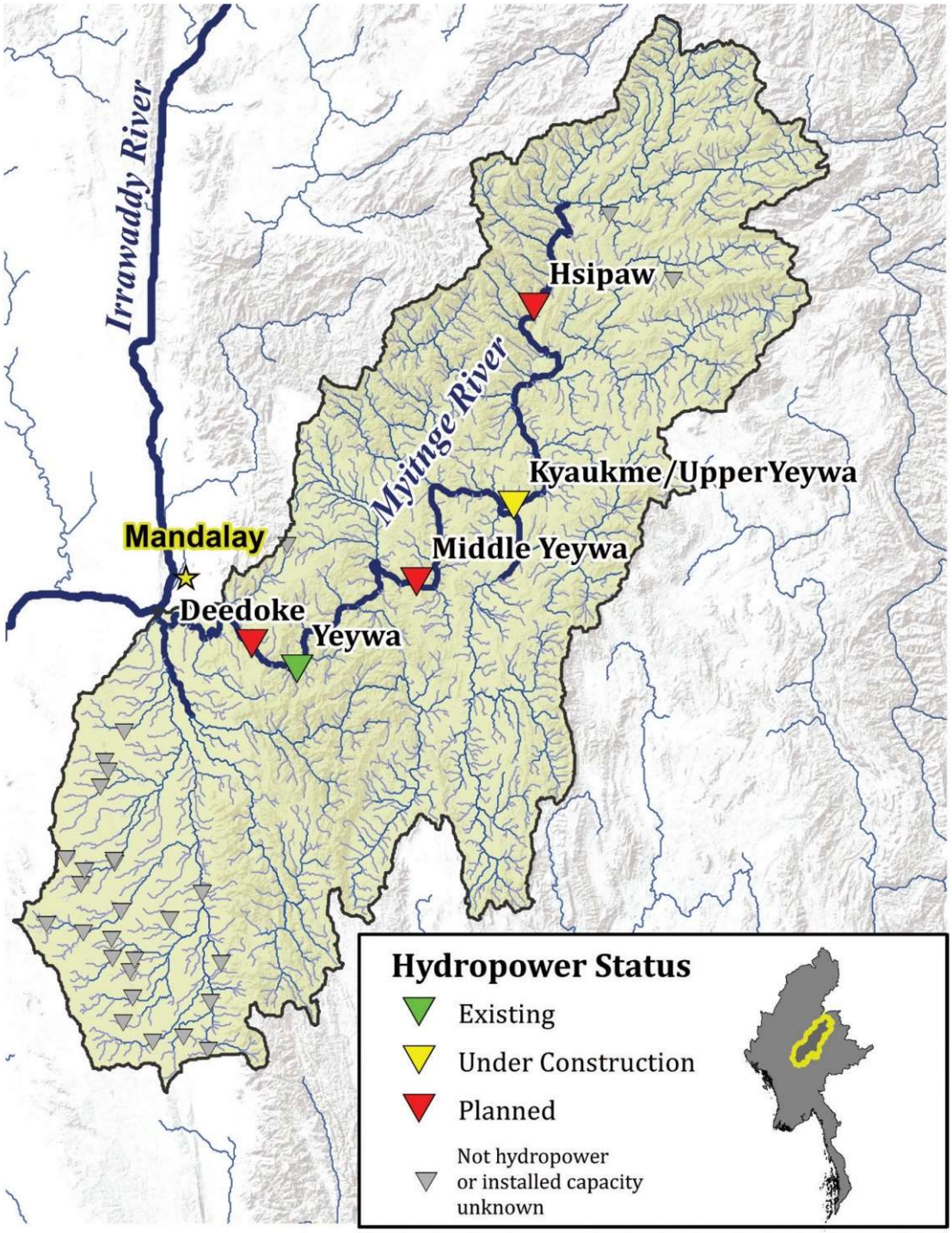

Figure 6: The Upper Myit Nge sub Basin

5.2 Physical Components

The project area falls in three townships Namtu, Hsipaw and Nahmsan in the Kyaukme district of Shan state in Myanmar. The dam site falls in the Namtu township, the submerged area falls in Namtu township as well as borders of Nahmsan township and the downstream of the river goes to Hsipaw township. The township Lashio is also near to the project area.

Climate and Meteorology

The climate of the region is classified as warm and temperate with winter dry and hot summer (Cwa as per Köppen Geiger climate classification[12]). The coldest month is January and hottest is May. The majority of the rainfall happens between May to October with July having the maximum rainfall and January being the driest month.

Main Climate		Precipitation		Temperature	
A	Equatorial	W	Desert	h	Hot Arid
B	Arid	S	Steppe	k	Cold Arid
C	Warm Temperate	f	Fairly Humid	a	Hot Summer
D	Snow	s	Summer Dry	b	Warm Summer
E	Polar	w	Winter Dry	c	Cool Summer
		m	Monsoonal	d	Extremely continental
				F	Polar Frost
				T	Polar Tundra

Table 20: The Köppen-Geiger climate classification system

Township	Temperature			Precipitation		
	Min	Max	Ave	Min	Max	Total
Namtu	15.7	26.3	22.3	4	325	1,604
Hsipaw	16.9	27.4	23.4	2	261	1,338
Nahmsan	10.5	20.4	16.6	4	381	1,998
Lashio	14.3	25	20.7	5	306	1,549

Table 21: The climate data of the townships near to the project site[13]

[12] http://koeppen-geiger.vu-wien.ac.at/
[13] https://en.climate-data.org

Hsipaw-The township is 25 km away from the dam site. The average annual temperature is 23.4°C and the rainfall here averages 1,338 mm. The driest month is January, with 2 mm of rain. Most precipitation falls in July, with an average of 261 mm. May is the warmest month of the year with temperature averaging 27.4 °C. In January, the average temperature is 16.9 °C and is the coldest month.

Namtu- The township is around 30 km away from the dam site and most of the project affected zone with the dam site, submerged area and downstream area falling in the township. The average annual temperature is 22.3°C and the rainfall here averages 1,604 mm. The driest month is January, with 4 mm of rain and July is the wettest with 325mm rain. May is the warmest month of the year with a temperature 26.3 °C on average. In January, the coldest month of the year, the average temperature is 15.7 °C.

Nahmsan- The parts that will be submerged also lies in the township of Nahmsan with the village to be relocated, Li Lu. The township centre is away from the project area and has the climate as Cwb under the Köppen-Geiger climate classification system. The average temperature is 16.6°C and the average annual rainfall is 1,998mm. January is the coldest month at 10.5°C and June is the hottest at 20.4°C The driest month is January with 4mm rain and the wettest is July with 381mm.

Lashio- The township is 78km away from the project site. The annual precipitation is 1,549mm and the average temperature is 20.7°C. The maximum rain happens in July with 306mm and January is the driest with 5mm rain. The coldest month is January with 14.3°C and hottest is May with 15°C.

The climate data available in Meteoblue for the geographical coordinates of the project site shows the similar pattern as that of Namtu, Hsipaw and Lashio with very slight variance in values. The Meteoblue climate diagrams are based on 30 years of hourly weather model simulations and available for every place on Earth. They give indications of typical climate patterns and expected conditions (temperature, precipitation, sunshine and wind).

Lithology and Soil

Figure 7: The rocks on the banks of the river; left and right banks-Dam site

Geomorphology risk is ranked 5 (maximum is 5) for the Upper Myit Nge sub basin in the baseline assessment of the hydropower assessment by IFC.

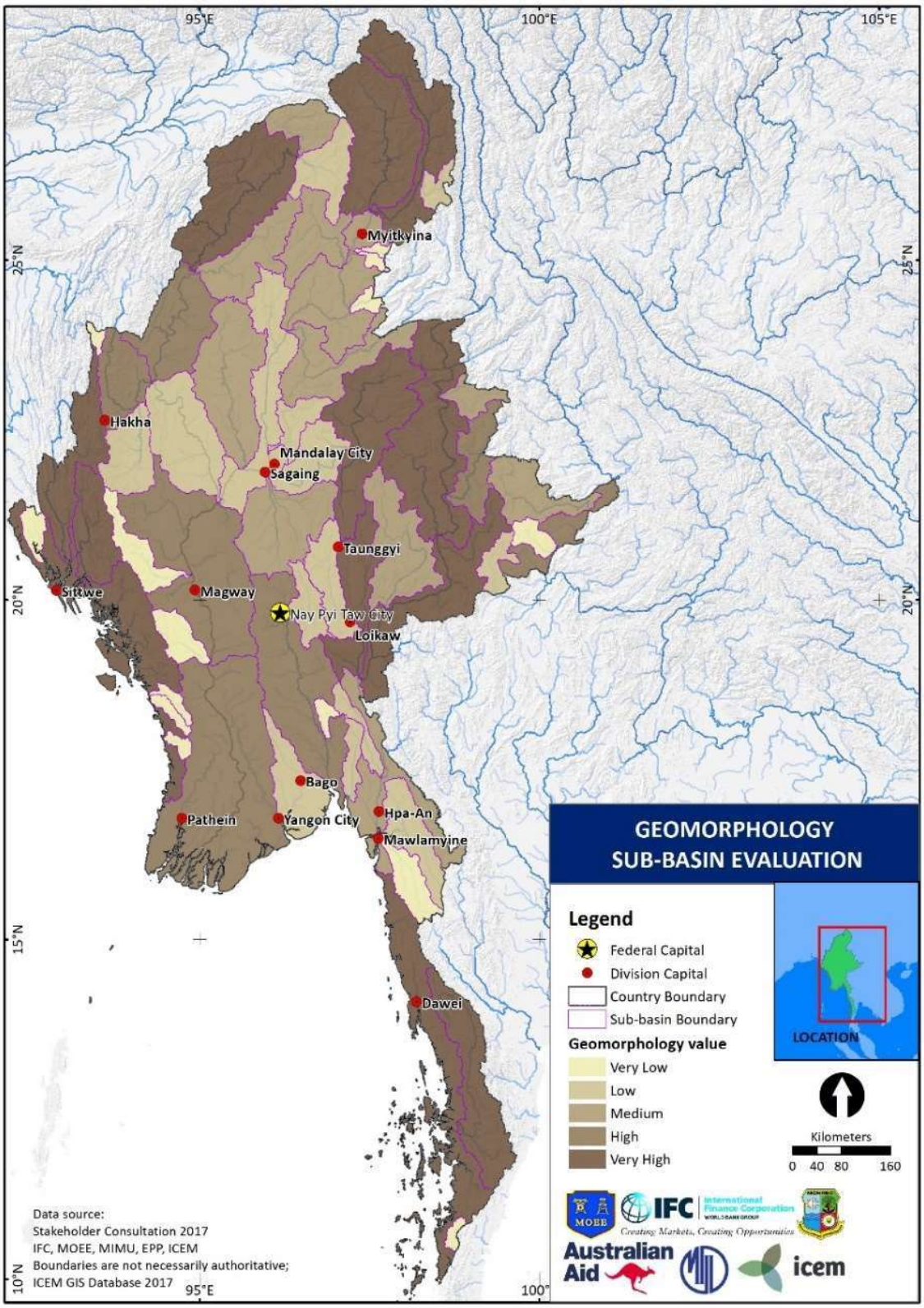

Figure 8: The geomorphology map of Myanmar

The Cenozoic erathem- The Holocene era series in the region is mainly the alluvial and proluvial variegated sand and gravels along with silty sand and boulders, eluvial and diluvial reddish brown, gravels, sandy soil and clay with rubbles in crushed form. Alluvium and proluvium are distributed on the valley terrace, eluvium and diluvium are distributed on the mountain slopes. The thickness ranges between 0.5m to 30m. The older quaternary era in the Pleistocene series is old alluvium, gravels and clay that are distributed on both the banks of the river outside the project area like Lashio with thickness ranging from 10m to 180m.

The Mesozoic era formations in the area are massive grey and white quartz sandstones containing feldspars with a thickness ranging from 50m to 780m, Kalaw reds and its substances distributed in the area with thickness of 300m to 2,300m, Purplish red mudstone and sandstone intercalated with conglomerate and calcirudyte with thickness from 80m to 1,170m and Grey and silt limestone, dolomite, calcerous siltstone and siltpelite at a thickness of 153m to 2,100m.

Metamorphic rocks are distributed in the north western and central parts of the area. Magmatic rocks as intrusive and veins are distributed in the central and western areas and are scattered with acid veins, pegmatic veins, granite and quartz veins.

The Namtu river flows in the project area for about 120km with a width ranging from 30m to 100m and the riverbed elevation ranges between 390m to 500m. The river has steep mountains on either side with elevations ranging from 700m to 1,100m. The soil on the banks of the river are mainly reddish brown with silt and clay with high moisture content. To be studied in detail during the EIA study phase.

Topography-

Figure 9: The view of the river from elevation of 800 metre on the left bank

Figure 10: The elevation maps of the project dam site in Zonum Maptool

Figure 11: The elevation map of the village Li Lu (15km upstream) in the Zonum Maptool

The project site is part of the southern extension of the Baiyi mountainous area in the Shan plateau known for its steep slopes. The Namtu river flows in between steep mountain on either side; the river is 255km long with the project area covering around 120km. The width of the river is around 30m to 100m in the area and the elevation of the river bed ranges from 390m to 500m.

The submergence caused by the dam will raise the water level to 495m and since the sides are of steep mountains with elevation crossing 1000m, the flooding will be only on either side of the banks. The topography and elevation maps are available from satellite-based data sourcing websites such as Google Earth Pro and Zonum map tool.

Seismic Status-

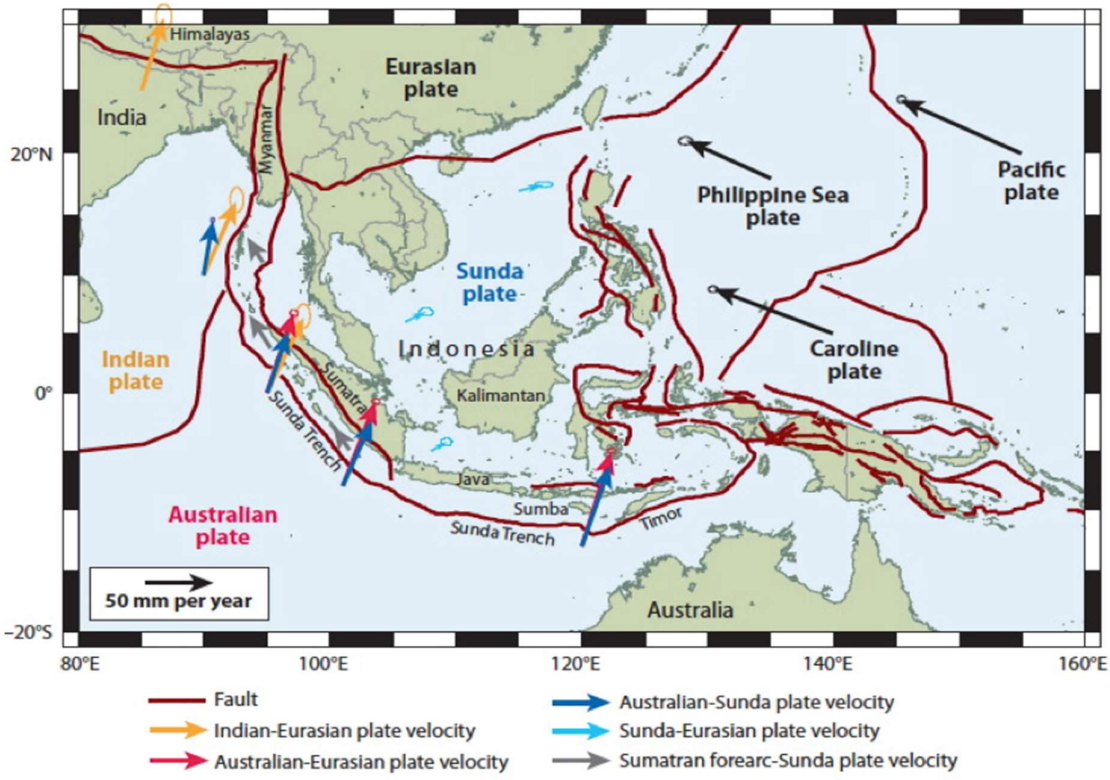

Figure 12: The seismic plates in South East Asia[14]

Myanmar is located in a tectonic plate boundary region[15] where the Australian, Indian, Eurasian, and Sunda Plates meet, with a major fault structure “Sagaing Fault line” running north-south up the middle of the country. The project area is located in the west of Shan state Fault Block, adjoining central fault block of Myanmar in the west, next to Shenzha-Tengchong fault block in the north and connecting with Sanjiang Indosinides brunchfault area in the east and the south.

[14] http://onlinelibrary.wiley.com/doi/10.1002/2016JB012923/full
[15] http://tectonicsofasia.weebly.com/burma-plate.html

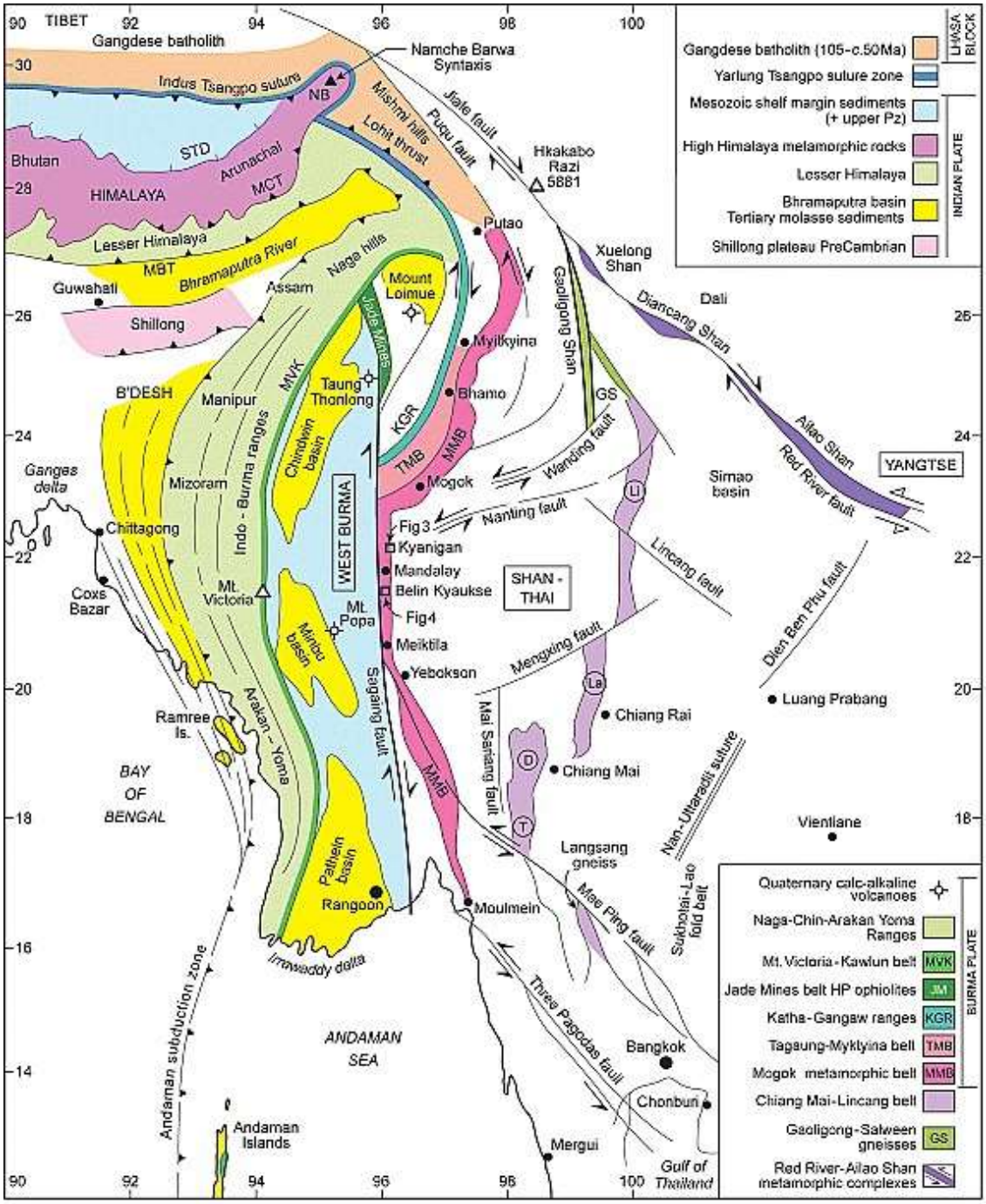

Figure 13: The Geological tectonic map of Myanmar with fault lines

The project area lies in the northeast region of the Shan-Thai-Malay plate that is part of the Quinghai-Tibet-West Indochina plate. This plate joins the Indian plate to the western side and borders the South China-East Indochina plate to the east. The 200km long Momeik Fault (also called Nanting Fault) that lies 100km north of Lashio township intersects the Sagaing Faultline. The 150km Kyaukme Fault (also known as Yunyang-Dazhai fault). The project area lies in the land mass that is within the Sagaing Faultline

and these two faults. Sagaing Faultline, Momeik fault and Kyaukme fault are around 140km, 50km and 20km respectively away from the project area.

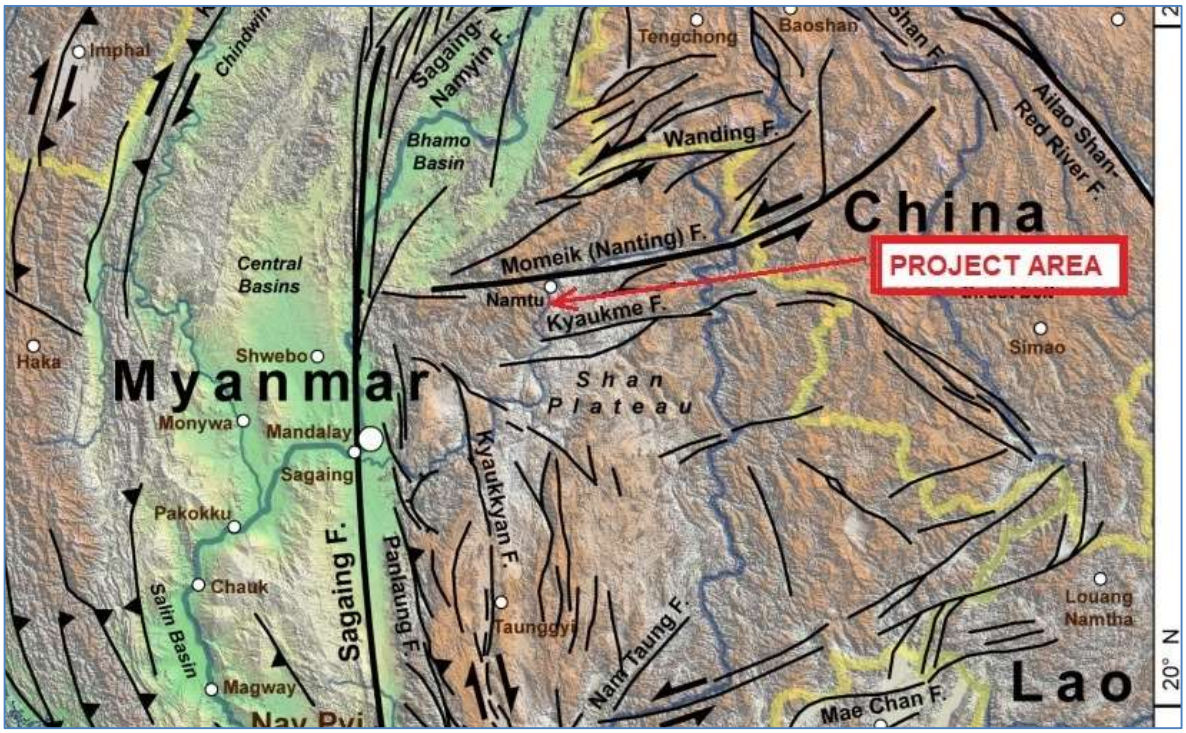

Figure 14: The Faults and the project area

The Momeik fault and the Kyaukme fault has the largest impact on stability of the structures in the project area. From the Geological analysis conducted from 2014 to 2016 of the quaternary sediments, fracture materials, landforms and deformation characteristics, there is no active faults in the project site. From the review of major earth quakes in Myanmar in the last 100 years, there have been none near to the project area. The seismic study to be done in detail during the EIA study phase.

Hydrology

The Namtu river is part of the Ayeyarwady river system and is the upstream part of the river Myit Nge that is a tributary of Ayeyarwady river. The main stream of Namtu flows from North to south direction passing through the townships Kyukok, Mussur, Moe Yun, Nam Moh Kam, Namtu, Hsipaw and Namlan and joins the Myit Nge river. Myit Nge flows towards North west direction and after Mandalay, it joins the Ayeyarwady river. The stretch near Namtu to till it joins Myit Nge is called as Namtu.

The average annual flow of Namtu taking account the data from 1957 is 200m^3/s. The maximum flow happens during the monsoon period with the months of July and august averaging 434 m^3/s and 455 m^3/s. The period from December to May is the dry period with the month of April having only 51.6 m^3/s of waterflow. The maximum recorded discharge in the last 55 years is 2,300 m^3/s on 15th October 1992.

From the historical records of the floods, the Jiazhong hydrological station has recorded floods in 1883, 1942, 1946, 1948, 1952 and 1953 in the Shweli river that is adjacent to the Namtu river basin area with similar climatic conditions and characteristics. The flood in 1946 was the largest since 1883 with a discharge of 4,4,50 m^3/s. The probable maximum Flood (PMF) for the Hsipaw Hydropower project is calculated as 8,113 m^3/s. The design flood characteristics for the project to be validated during the EIA study.

Figure 15: The consultants at the left bank of the dam site

The lowest elevation on the dam axis is 400.73m and the water level at peak discharge is 412.22m in the natural river without the dam. When the reservoir is filled up, the normal pool level submergence will be up to 46km upstream with an elevation of 505.80m and the surface area will be 866.69ha. This will require the resettlement of a village Li Lu about 15km upstream of the dam site on the right bank with a population of 212 people in 47 households.

The water will be diverted during the construction period on through tunnels on the right bank of the river to join back the river downstream. Cofferdams are used at the inlet and outlet of the tunnels, and also there will be upstream and downstream cofferdams for water retention. When the project is operational, the crest overflow orifice and the bottom sediment orifice will be the water discharge points of the dam with a maximum discharge of 4,143m^3/s and 856.6m^3/s.

Sediment

The rivers are a source of sediments to the floodplains in the downstream that make it fertile. The Ayeyarwady river system supply the required silt sediments to the more than half of Myanmar in the range of 365 Million tonnes per year (Mt/year) to 385Mt/year. The river Myit Nge contributes only 5 Mt/year that is only 1% of the total sediment carried by

Ayeyarwady river. Namtu river is even smaller part of the Myit Nge river and the calculated sediment load of the river is 3.41 Mt/year with 2.842 Mt/year of fine sediments and the rest 0.56Mt/year as bed load. The sediment transport modulus is estimated as 500t/km^2 with the bed load being 20% of the suspended load discharge. This estimation is based on the analysis of sediment data at each station in the basin of Lung Chuan Chiang-Shweli river basin.

The sediment transport modulus of the Myit Nge river is estimated as 200t/km^2 in the baseline assessment for the strategic Environmental assessment of the hydropower sector in Myanmar by the International finance Corporation (IFC). Since the former estimation has a higher value of sediment modulus, that value is considered for the EIA assessment as a conservative approach.

The dam constructed will block the water and the downstream areas will be starved for sediments. The storage-sediment ratio is high at 83 which means heavy sediment deposition and the sand trapping rate is 65.80%. The annual inflow of the sediments is 3.1391 Million m^3 per year depositing 2.066 Million m^3. In 50 years of operation, the dam will have sediment deposit of 103.305 Million m^3 of sediments at the dam structure up to 65.4m at an elevation of 466.66m. The sediment flushing orifice designed has a bottom elevation of 420m to release the sediments being accumulated.

The sediment deposition and flushing management has to be studied in detail during the EIA study and a sediment management plan is to be developed as an EMP.

Noise Levels-

Figure 16: village Li Lu on the right bank of the river-15km upstream of dam site Latitude 22^{0}51' 24" North, Longitude 97^0 18' 21" East

The area where the project structure and facilities are being constructed is a remote uninhabited location with very limited human activity and hence the sound levels are well within the acceptable noise levels. Noise was mapped with hand held device at the dam site, sites that are 2km upstream and downstream of the dam site and the workers accommodation area and was found to be within 55 decibel (dB). The noise levels at the village Li Lu was found to be between 60dB to 70dB as there is a road that has medium traffic.

The construction time will result in very high noise levels due to the blasting and excavation activities and will be a significant impact to the environment. Noise Management Plan to be formulated as part of the EMP.

Air quality

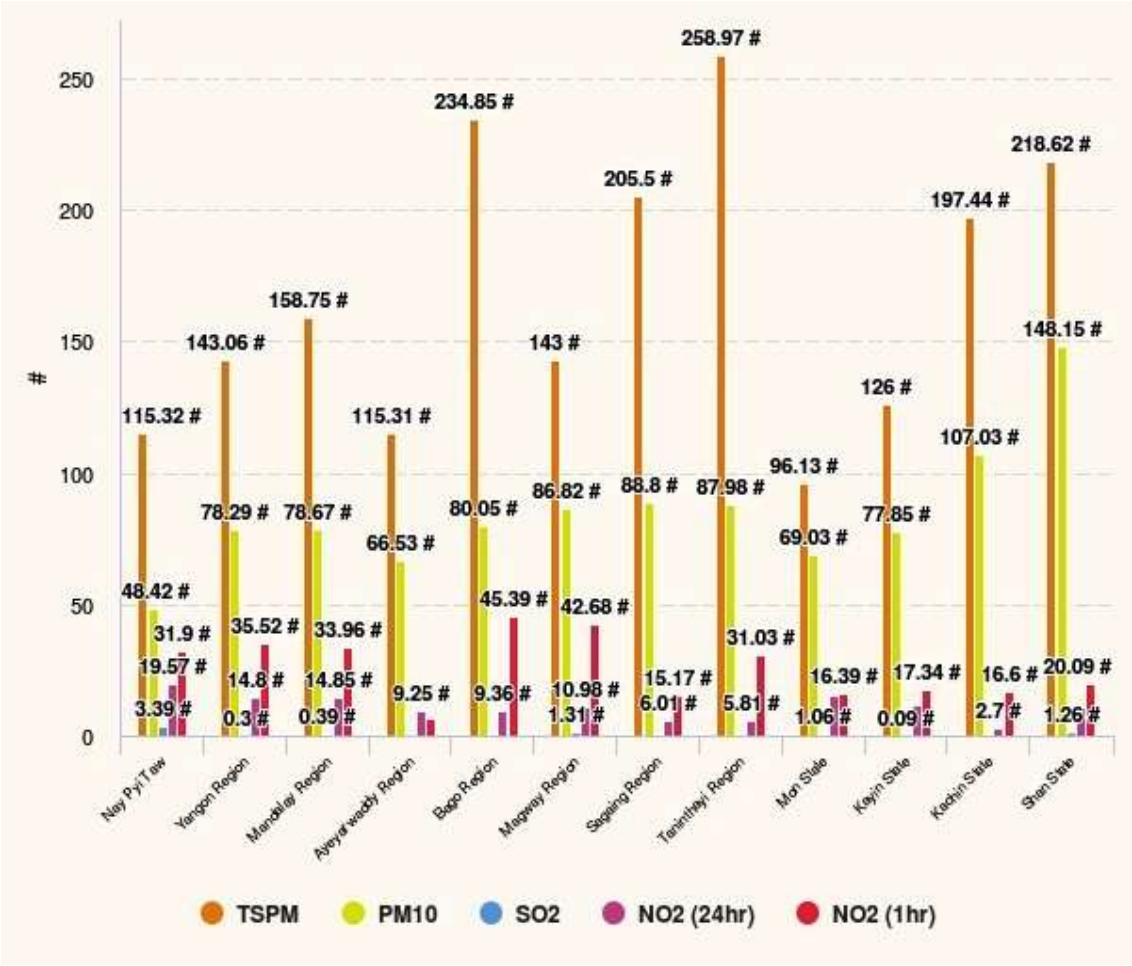

Figure 17: Average air quality in Myanmar (Myanmar Environmental resource portal)[16]

The air quality measured data available in the Myanmar Environmental portal shows the Shan state performing poor compared to most of the other regions of Myanmar. However, the project site is very remote and is not comparable with the survey. The basic air quality

[16] http://mya.gms-eoc.org/

monitoring was done with the same points where the noise levels were monitored. The air quality levels were found to be well within the WHO requirements. Air quality of the area to be tested using third party laboratory during the EIA study phase. The locations to be covered are the dam site, upstream and downstream areas with points selected at around 1km and 2km away on either side, the workers accommodation area, village Li Lu, and Namtu.

The project being developed in an uninhabited area, the quality of air now can be described as fresh. The construction phase is expected to generate dust pollution from the movement of vehicles and use of other equipment that uses fossil fuels that emit exhaust gases to the atmosphere. In the operation phase, the air quality is going to be affected by the increased human activity in the dam site. An Air quality management plan to be formulated as part of the EMP.

The physical components of the project area to be studied in detail during the EIA/SIA investigation phase with particular emphasis on geomorphology, sediments and hydrology that includes validating the design parameters of the dam related to the seismic resistance.

5.3 Biological Components

The International Union for Conservation of Nature (ICUN)[17] publishes a red list in which they classify the level of threat to extinction faced by a species. The categorisation used by ICUN is version 3.1[18] now and is summarised below. The EIA/SIA report also used the same notation and classification used by the ICUN to express the endangered species in the Project area.

Classification	Notation
Extinct	EX
Extinct in the wild	EXW
Critically endangered	CR
Endangered	EN
Vulnerable	VU
Near Threatened	NT
Least concern	LC
Data Deficient	DD
Not Evaluated	NE

Table 22: ICUN classification and notations

The project area is in a pristine forest area located near to the Namtu township. Tanintharyi Marine corridor is a key biodiversity area (KBA) identified under high priority by Wildlife Conservation Society (WCS) in their Myanmar program.

Terrestrial Mammals

There are 77 species of terrestrial mammals of Myanmar listed in the ICUN of which 3 are critically endangered, 19 are endangered, 23 are vulnerable and 15 are near threatened. The three critically endangered species of terrestrial mammals are

Sl No	Scientific Name	Common name	Status in Myanmar
1	Dicerorhinus sumatrensis[19]	Sumatran Rhinoceros	Probably extinct
2	Rhinoceros sondaicus[20]	Javan Rhinoceros	Probably extinct
3	Rhinopithecus strykeri[21]	Myanmar Snub-Nosed Monkey	260-330 numbers

Table 23: Critically endangered terrestrial mammals in Myanmar

[17] https://www.iucn.org/
[18] http://www.iucnredlist.org/static/categories_criteria_3_1
[19] http://www.iucnredlist.org/details/6553/0
[20] http://www.iucnredlist.org/details/19495/0
[21] http://www.iucnredlist.org/details/13508501/0

None of these terrestrial mammals are found in the project affected area. The terrestrial mammals in the upper Myit Nge sub basin are listed as low risk category by the baseline study[22] by World bank. The grade given is 1 out of 5 for terrestrial mammals.

Forest cover and Vegetation

The project development will result in submergence of 866.69 Ha of land and another 37.89 Ha of land for Dam structures and other related buildings. The total forest cover taken over by the project is 576.1 Ha. The estimated number of trees lost will be 4,371 of which 470 are commercial trees, 141 are bamboo, 2,820 are fruit trees and 940 are banana.

The extend of the forest cover loss to be studied in detail during the EIA study phase.

Aquatic Biota and Habitats

The aquatic biota in the river are graded as 2 out of 5 as per the baseline study by the world bank on the Upper Myit Nge sub basin. There are no riverine key biodiversity areas in the sub basin and there are no threatened species of fishes in the Namtu river as per this baseline study. The fish species to be studied in detail for the EIA study.

The biological components of the projects and its effect are to be studied in detail during the EIA/SIA study.

[22] https://www.ifc.org/wps/wcm/connect/f6aaa8d3-0954-4357-8648-bb5e5221d336/Final_Sub-basin+evaluation.14.02.18_Final+%281%29.pdf?MOD=AJPERES

5.4 Socio-Economic Components

Figure 18: The bridge across the Namtu river near the Lilu village

The project dam structure area does not have any people living in. The reservoir of the project will submerge lots of land that include the agricultural land and the Lilu village. The affected are the people living in Lilu, Namtu, Hsipaw and Manshan.

As per the last census[23], Shan state has a population of 5,824,432 of which 2,910,710 are male and the rest 2,913,722 are female. The density of population is only 37.4 persons per km^2 and 76% of the people live in rural areas. The project area falls in the Kyaukme district and are spread in the townships of Namtu, Hsipaw and Nahmsan. The population of the townships are 50,423 with 11,641 households in Namtu, 176,158 with 37,906 households in Hsipaw and 72,204 with 13,685 households in Nahmsan with the female population being more than the male population. The female headed households are 21% in Hsipaw, 27.5% in Namtu and 28.3% in Nahmsan. The rural population is high in these three townships with Nahmsan having just 5.7% population in the urban area; the urban population is 11.9% in Hsipaw and 26.4% in Namtu. All three townships have more than 50% dependency ratio, mostly due to the high child dependency ratio; the child dependency ratio in Namtu and Nahmsan is above 50%.

The people around the project zone are predominantly Shan tribes, and some ethnic Myanmar race; most of them are followers of Buddhism as a religious faith. The livelihoods of the people are largely based on farming. The Lilu village that will be submerged when the dam is constructed has 47 households with a total population of 212. The people in the village are mostly ethnic Myanmar.

[23] https://themimu.info/sites/themimu.info/files/documents/Report_Shan_State_Census_Report_MOIP_May2015.pdf

The other village in the Namtu township that is near to the project area has 60 households with a population of 270 people. Additional these, many other villages that are dependent on the river Namtu is also considered as the affected people

Township	Village tract	Location	Population	Villages Affected
Namtu	Pang Hswat	Upstream	608	Nar Tee
				Pang Kut
				Pang Hswat
				Nam Yi Mu
				Nyaung Pan Hla
	Chaung Hsar	Downstream	1,816	Chaung Hsar
				Man Yan
				Tar Pu
				Yae Oe
				Man Li
	Kyu Hswat	Upstream	926	Lai Sa Pyee
	Hko Mo	Upstream	940	Hko Mo Lower
				Nam Hkum Long
	Nam Taung Kone	Upstream	1,359	Nam Taung Kone
				Ho Kat
				Loi Ping
				Pan Tha Pyay
Nahmsan	Lilu	Upstream	532	Lilu
				Mar Ping
	Nam Len	Upstream	3,798	Man Ngaing Upper
				Man Ngaing Lower
				Pang Taung Upper
				Pang Taung Lower
Hsipaw	Moe Tay	Downstream	4126	Moe Tay
				Kun San Leik
				Man Mai

Table 24: The villages affected by the proposed hydropower project

The socio-economic components for the project comprise of the current status and effect of the project in terms of direct and indirect employment generation. This covers the social profile, demographics, economic activity and livelihoods, jobs, health, infrastructure, housing, water use, roads and transportation, agriculture, aquaculture, small scale industries, tourism, and religion. Among the 17 states and regions of Myanmar, the northern Shan State[24] is ranked 15th in poverty with a poverty rate of 37.4%[25] against a national average of 25.6%. The literacy rate[26] for the project area is 67.5% for Hsipaw, 67.5% for Namtu and 73.75 for Nahmsan. The female literacy rate is Hsipaw, Namtu and Nahmsan is 62.5%, 63.7% and 66.9% respectively.

The affected villages in the three townships are listed above. The total population of the village tracts are available in the 2014 Census. Out of these villages, only the village Lilu in the Lilu village tract in Nahmsan township needs to be resettled. Except the village tracts of Chaung Hsar in Namtu township and Moe Tay in Hsipaw township, all other village tracts are in the upstream section of the dam structure. The two village tracts in the downstream are the only village tracts in the Namtu river till it touches Myit Nge river. The villages of the Chaung Hsar village tract is far off from the Namtu river; however, they are considered since they are also dependent on the Namtu river.

Administrative organisations and limits

The project area falls in the townships of Namtu, Hsipaw and Nahmsan in the Kyaukme district of Northern Shan state with more than half the project affected area falling in Namtu township. The affected villages are listed in the table 24 above. The downstream affected area lies both in Namtu and Hsipaw townships and the upstream affected area lies within Nahmsan and Namtu. Only a small part of the total submerged area falls in the Nahmsan township. The village Lilu is in Nahmsan township.

The administrative organisations related to the project are the general administration, fisheries, agriculture, environmental conservation and forestry and the electric power department.

Vulnerable and minority groups

The Northern Shan state has many ethnic tribes such as Shan, Palaung and Wa living in; the project affected zone also has a mix of people from many ethnicities. There are armed groups that are in conflict with the National army creating an insurgent scenario. The active groups are the Shan state Army (SSA) and Ta'ang National Liberation Army (TNLA) of which the latter has not signed the National Ceasefire Agreement (NCA). However, both the groups are members of the Northern alliance that does not recognize the NCA. Moreover, the township of Nahmsan is Palaung administered area.

The Ethnic Nationalities Affairs Centre (ENAC)[27], an independent resource, training, and education centre supporting the peace process and development of democratic institutions in Burma has already made its recommendations to the Union government promoting a

[24] http://www.undp.org/content/dam/myanmar/docs/Publications/PovRedu/MMR_FA1_TargetingVulnerabe.pdf
[25] https://www.unicef.org/myanmar/Shan_State_Profile_Final.pdf
[26] https://themimu.info/sites/themimu.info/files/documents/Report_Shan_State_Census_Report_MOIP_May2015.pdf
[27] http://www.burmaenac.org/

federal system of democracy for peace. They have been holding extensive consultations with the armed ethnic groups. The part involving natural resources and energy, hydropower development is a significant matter. The population and demographics of the ethnic tribes, and the effect on the minority tribes to be studied in detail during the EIA study phase. The effect of the conflicts to the hydropower project and vice versa is to be studied.

Population and communities

The population of the three townships in the project affected zone are 50,423 from 11,641 households in Namtu, 176,158 from 37,906 households in Hsipaw and 72,204 from 13,685 households in Nahmsan with the female population being more than the male population. This population is a mix of many tribes and ethnicities with the Shan tribes comprising the majority. The population of the people in the villages that are dependent on the river are 14,105 as listed in the table 24 above. The population and demographics to be studied in detail in the EIA study phase.

Health Profile

In Myanmar, the general state of health care[28] can be described as poor with the spending on health care in the country being less than 3% of the GDP. The public healthcare facilities lack basic facilities and related equipment. The location being in the remote part of hilly region of Northern Shan state, the condition is worse in comparison. The region fares slightly worse than the national averages in almost every parameter in health.

In the project affected villages, the people have access to toilets and access to clean drinking water. The project induced migration by the workforce during the construction period can result in health issues if the sanitation and public health are not well managed. The people migration and the sanitation plan to be studied in detail during the study phase.

Energy sources

The sources of energy for the people living nearby are grid connected electricity, electricity from diesel generators, fossil fuels, firewood and agricultural waste. The Yaywa hydro project resulted in electrification of many of the villages in the area, there are still places where the electricity has not reached. The project will result in more electrification of many villages across the Northern Shan state.

Agriculture

The nearby villages farm paddy, bananas, corn, rubber and pineapple as the common crop. The project will submerge 47 Ha of paddy fields, 86 Ha of other crops and 4.23 Ha of rubber plantations. The northern Shan state is known for organic oranges; but the project area does not have any such farms. The project has little effect on the organic orange farms that are away from the site. The mapping of the agricultural land that will get affected in the project to be done during the field surveys during the EIA study phase.

[28] http://www.who.int/gho/countries/mmr.pdf?ua=1

Fisheries/Aquaculture

The area is a hilly terrain with forest cover and is sparsely inhabited; there are no fisheries and aquaculture projects in the project area.

Tourism

Shan state is known for the tourists coming in and the township of Hsipaw has some considerable tourist arrivals; there are few villas and cottages that cater to the overseas tourists. The project will have little effect on the tourism sector.

The socio-economic components of the projects and its effect are to be studied in detail during the EIA/SIA study.

5.5 Cultural Components

The area is sparsely populated; however, the three townships have considerable population with Hsipaw being the ancient city of the Shan kingdom. The town has many monasteries and old important cultural structures; however, the project has very little impact on the cultural components of the area.

Figure 19: Baw Kyo Pagoda in Hsipaw near the banks of the Myit Nge river

5.6 Visual Components

The Dam site will have its aesthetic parameters disrupted during the construction due to excavation activities. After the construction is over, the creation of a reservoir also will change the appearance of the site. However, these aesthetic parameters have very little significance as there is no identifiable affected parties.

6.0 Preliminary Environmental Impact Assessment and Mitigation Measures

6.1 Methodology and Approach

The methodology and approach applied for the preliminary identification and assessment of impacts is from interaction and observation during the four visits made to the project site since October 2017, review of data about the project, the review of the records of the public interaction the project owner had, the published news articles in national and international newspapers and websites, the past experience from other projects and research about the project activity. The project owner has cleared some areas for construction of the workers accommodation buildings near to the dam site with a rock quarry and three soil burrows nearby. Now, they are changing the location to a different place since the rock quarry and the soil is of better quality at a different location.

6.2 Identification of Environmental Impacts

The project is expected to have both positive and negative impacts to Environment and Society. The major potential sources of impacts expected to be experienced are

1. Deforestation and tree cutting- The reservoir submergence will cover 866 Ha of land and hence, this area will be cleared before water is filled. Out of this, 544 Ha is forest land. Further, another 37.83 Ha of land will be cleared for dam structure and associated buildings of which 32.39 Ha is forest land. This will result in habitat loss for the animals, and reduction in the forest cover.

2. Submergence of land- The dam reservoir created will submerge 866 Ha of land causing resettlement of 47 households, destruction of 15,904 m^2 of buildings, destruction of 140 Ha of agricultural land and generation of a large artificial lake. Four bridges will have to be rebuilt by the project developer.

3. Starvation of sediment for the downstream banks- The dam structure will block 2,066 Million m^3 of sediments every year which otherwise would have been flowing with the water downstream. There is a bottom orifice designed for the dam structure to flush the sediment out periodically.

4. Reduction in water flow to the downstream- The dam structure will result in the water being blocked and the downstream areas not being fed with enough flow of water as it used to have. The holding of water and the intermittent release in between will affect the downstream river hydrology.

5. Disturbance to aquatic life- The generation of a large artificial lake will make the fishes and other aquatic biota in the river to move away because of the change in water temperatures, water flow and other properties of a moving water to stored water. The dam structure will also block the movement to upstream and downstream for the fishes. There are no threatened species of fishes in the Namtu river and none of the species in the river has the characteristics of travelling long distances to breed.

6. Change in Topography and excavations- The project construction will have excavation of the soil from the identified burrows taken and depositing in the disposal area once

the coffer dams are broken. The rock from the quarry will be taken as aggregates and to fill in the dam structure. The total spoils to be disposed is 1,844,074 m^3 of soil, stones and rocks.

7. Greenhouse Gases (GHG) Emission from the fossil fuels used-The project operations use lots of fossil fuels during the construction phase for the machines. The estimated consumption is 2,891 tonnes of diesel during the construction phase. The use of electricity also will result in indirect energy emissions and this GHG emission is additional to the emission from the fossil fuel usage.

8. Electricity usage during the construction phase- The construction period uses the grid electricity for many activities; the estimated electricity usage is 45,710 MWhrs for the construction period and 3,600 MWhrs/year for operation.

9. Depletion of water resources- The construction operations will consume water for concreting, aggregates, cleaning, and personal use of workers. The estimated water requirement is 5,850 m^3 for Concrete, 3,680,000 m^3 for aggregate, 14,250 m^3 for machine service and cleaning, and 99,500 m^3 for use of the workers personal use. The total water requirement is estimated as 3799,600m^3.

10. Waste water generation- The heavy water use will also generate a large quantity of waste water. The estimated waste water generation will be around 3,039,680m^3 of waste water during the construction phase.

11. Solid waste Generation- The migrant workers in large numbers living in the area for the long period of construction will result in large quantities of solid waste. The estimated solid waste generation is 3 tonnes per day. The generated waste will have organic component such as the food waste and the recyclable material such as metal, paper and plastic that will make up around two third of the total waste generated. The rest of the waste generated has to be disposed and will be around 1 tonne per day.

12. Noise and Air pollution from the construction activities- The blasting, drilling, excavation, concreting etc will generate heavy noise and emission of dust particles to the air resulting in noise and air pollution.

13. Public Health issues due to migrant workers- The project construction period will have migrant workers in large numbers to the level of 3,000 to 3,200 at the peak of construction. This can create health issues such as epidemics, sexually transmitted diseases, and poor sanitation related diseases.

14. Dam safety incidents- The dam safety is of serious concern to the people who live in the downstream area. The breach of the dam may result in a catastrophic disaster.

15. Job creation and livelihoods for local people-The project will provide employment opportunities to the local people in the form of direct employment in the dam construction, and indirectly in the form of related works such as road transportation, supply of materials and food items, and other services related to utilities. The power generated will result in more electrification and development of more business enterprises and industrial establishments.

6.3 Key Environmental Impacts and Mitigation Measures

6.3.1 Pre-construction phase

The preconstruction activities for the project are field surveys, feasibility studies and tests made for the construction that includes the EIA/SIA study. This phase will result in excavation for soil samples, consumption of fossil fuels for transportation. The impacts are negligibly small.

6.3.2 Construction Phase

1. Deforestation for land clearance- The project construction requires deforestation of around 905 Ha of land of which 866 Ha are due to submergence by the reservoir. The trees in the submerged area will have to be cut off before the water is filled. The deforestation estimation is a total of 4,371 trees of which 470 are commercial trees, 2,820 are fruit trees, and 141 are bamboos. The total forest land used up by the project is 576 Ha which will be loss of habitat for some of the terrestrial mammals. To be surveyed further in the EIA study phase.

2. Submergence of land- The reservoir created during the construction of the dam structure will submerge land that cover the village of Lilu and the agricultural fields causing resettlement. The total area of submergence will be 866 Ha of land causing resettlement of 47 households, destruction of 15,904 m^2 of buildings, destruction of 140 Ha of agricultural land and generation of a large artificial lake. Four bridges will have to be rebuilt by the developer. To be surveyed further in the EIA study phase.

3. Change in Topography and excavations- The project construction will have excavation of the soil from the identified burrows and rock from the quarry to be used in the coffer dams, and the dam structure. The water will be diverted through tunnel to the downstream area. The total spoils from construction to be disposed is 1,844,074 m^3 of soil, stones and rocks. The reuse of the spoils to be studied further in the EIA study phase and management plans to be formulated.

4. Greenhouse Gases (GHG) Emission from the fossil fuels used-The project construction phase will use lot of fossil fuel powered machines and equipment of which almost all of it will be Diesel. The estimated fossil fuel consumption is 2,891 tonnes of diesel during the construction phase. The use of electricity also will result in indirect energy emissions and this GHG emission is additional to the emission from the fossil fuel usage. The estimations to be validated and management plans for conservation to be formulated as part of the EIA study phase.

5. Electricity usage during the construction phase- The power source for many of the construction activities such as aggregate crushing will be grid connected electricity; the estimated electricity usage is 45,710 MWhrs for the construction period. The use of electricity also results in the indirect emissions of greenhouse gases to the atmosphere. The estimations to be validated and management plans for conservation to be formulated as part of the EIA study phase.

6. Depletion of water resources- The water use for the construction operations will be very high for activities such as concreting, aggregates, cleaning, and personal use of workers. The estimated water requirement is 5,850 m^3 for Concrete, 3,680,000 m^3 for aggregate, 14,250 m^3 for machine service and cleaning, and 99,500 m^3 for use of the workers personal use. The total water requirement is estimated as 3799,600m^3. The estimations to be validated and management plans for conservation to be formulated as part of the EIA study phase.

7. Waste water generation- The construction period has heavy water usage for various activities as listed above. The use of water eventually causes wastewater generation to the extent of 80% of the usage. The estimated waste water generation will be around 3,039,680m^3 of waste water during the construction phase. The estimations to be validated and management plans for control of the wastewater to be formulated as part of the EIA study phase.

8. Solid waste Generation- The migrant workers in large numbers living in the area for the long period of construction will result in large quantities of solid waste. The packaging material used for the material used in construction phase also will create solid waste. The estimated solid waste generation is around 3 tonnes per day. The generated waste will have organic component such as the food waste and the recyclable material such as metal, paper and plastic that will make up around two third of the total waste generated. The rest of the waste generated has to be disposed and will be around 1 tonne per day. The estimations to be validated and management plans for control the solid waste to be formulated as part of the EIA study phase.

9. Noise and Air pollution from the construction activities- The construction phase will make use of a variety of equipment such as Impact hammers, cranes, generators, compressors, pumps and earth movers that will generate noise whilst operations. The most widespread source of noise in the construction phase will be the blasting and excavation activities and Other sources of noise associated with the equipment include the mechanical and hydraulic transmission actuation systems that can sometimes produce high sound levels. Construction related noises are usually of a temporary duration and relatively intermittent.

   The excavation, blasting, aggregate crushing and transportation along with other activities such as concreting will generate dust particles to the air hampering the air quality in the construction area. The management plans for control of noise and air emissions to be formulated as part of the EIA study phase.

10. Public Health issues due to migrant workers- The project construction period will have migrant workers in large numbers to the level of 3,000 to 3,200 at the peak of construction. This can create health issues such as epidemics, sexually transmitted diseases, and poor sanitation related diseases. The project owner has already started building up workers accommodation near the identified site for rock quarry and soil burrows. They had already constructed near to the dam site; however, the soil and rock parameters were found to be better at a different place and hence changed th plan. The management plans for control of the potential issues to be formulated as part of the EIA study phase.

6.3.3 Operation Phase

1. Starvation of sediment for the downstream banks- The dam structure will block 2,066 Million m^3 of sediments every year which otherwise would have been flowing with the water downstream. There is a bottom orifice designed for the dam structure to flush the sediment out periodically. The sediment flow and effect to be studied in detail and a management plan to be formulated in the EIA study phase.

2. Reduction in water flow to the downstream- The dam structure will result in the water being blocked and the downstream areas not being fed with enough flow of water as it used to have. The holding of water and the intermittent release in between will affect the downstream river hydrology. The effect to be studied in detail during the EIA study process.

3. Disturbance to aquatic life- The generation of a large artificial lake will make the fishes and other aquatic biota in the river to move away because of the change in water temperatures, water flow and other properties of a moving water to stored water. The dam structure will also block the movement to upstream and downstream for the fishes. There are no threatened species of fishes in the Namtu river and none of the species in the river has the characteristics of travelling long distances to breed.

4. Dam safety incidents- The dam safety is of serious concern to the people who live in the downstream area. The breach of the dam may result in a catastrophic disaster. The dam safety to be studied in detail during the EIA study phase.

5. Electricity usage-The powerhouse operation will need power for its operations and the estimated requirement is 3,600MWhrs per year. The estimation is to be validated and an Environmental Management Plan (EMP) to be formulated to monitor the consumption.

6. Water evaporation losses from the reservoir- The reservoir will have evaporation losses due to stored static water. The estimation to be done as per the guidelines of the International Hydropower Association[29] and the Food and Agricultural Organisation (FAO)[30].

6.3.5 Decommissioning/Post Closure

Upon closure or decommissioning of the project, the dam structure will have to be demolished and the machines and the equipment shall be sold for reuse elsewhere. When the equipment is found to be non-usable, it will be scrapped. The issues anticipated as that in the construction phase will be anticipated in the dam demolition. The decommissioning issues to be estimated during the EIA study phase.

In the unlikely event of abandoning the project before its life, all the equipment that is not bio degradable shall be removed and disposed. The hazardous waste remaining shall be disposed in a sustainable manner.

[29] https://www.hydropower.org/sites/default/files/publications-docs/hydropower_sustainability_assessment_protocol_-_july_2018.pdf
[30] http://www.fao.org/3/a-bc814e.pdf

7.0 Public Consultation and Disclosure

7.1 Methodology and Approach

The EIA consultant has made site visit to the project affected areas four times since October 2017 and has had interactions with the elected representatives, village heads, villagers, and local authorities related to the project. The field surveys were made to survey the project sites and reviewed the designs and other project related data, communications with the stakeholders and the publicly available information published in newspapers and websites.

The project owner has kept continuous communication with the local NGOs and the local government authorities disclosing the details of the project, development plans and has taken keen interest to have the progress disclosed in the form of publishing in social media platforms and websites.

7.1.1 Identification of stakeholders and groups affected by the project

The stakeholders identified for the project activity are the people living in the surrounding area, the local government departments related to electric power, forests, agriculture, irrigation and fisheries, civil societies and NGOs in the region and the ethnic minority groups in the area.

Figure 20: With the villagers in Lilu

The affected townships due to the hydropower project are Namtu, Hsipaw and Nahmsan with the village Lilu is significantly affected with the need for resettlement. Parts of Namtu are also affected as many of the agricultural land that is going to eb submerged belongs to the local people. The people who live in the downstream area of Hsipaw township are also significantly affected as the dam will regulate the waterflow to the downstream area.

Since the project has an effect on the economy and numerous people, the elected representatives of the region were also consulted. Additionally, the local authorities in the government departments mentioned above were consulted to arrive at the findings of the scoping report.

7.1.2 Conducting public consultations

The method of public consultation is interaction with the people in the project affected zones, and local government departments. An open forum was conducted to the villagers of Lilu in December 2017 and May2018 and to the elected parliament member of Namtu township, Daw Naung Khan Aye in Manshan in July 2018. Another public forums are planned to be conducted in Hsipaw, Namtu, and Lilu to address the concerns and provide information to the stakeholders during the EIA study.

The EIA consultants, MyAsia Consulting Co Ltd have been visiting the project area since October 2017 for the assessment of environmental and social impacts and has made four field surveys so far as the scoping phase of the project and has held sessions with the villagers to discuss the possible issues of developing the hydropower project.

Dates of meetings	Location and attendees of meeting
16 Oct 2017	Hsipaw with the Local Authorities
17 Oct 2017	Namtu with the local authorities
1 Dec 2017	Hsipaw with the Local Authorities
2 Dec 2017	Namtu with the local authorities
3 Dec 2017	Lilu village and Namtu township with the local people
11 May 2018	Namtu with the local authorities
12 May 2018	Lilu village and Namtu township with the local people
4 July 2018	Manshan with Daw Nang Kham Aye

Table 25: The socio-economic surveys and public stakeholder meetings conducted

7.1.3 Disclosure

The project owner has kept continuous communication with the local NGOs and the local government authorities disclosing the details of the project, development plans and has

taken keen interest to have the progress disclosed by interaction with the neighbourhood villagers.

Figure 21: With Daw Nang Kham Aye, the MP of Namtu and Forest Township officer

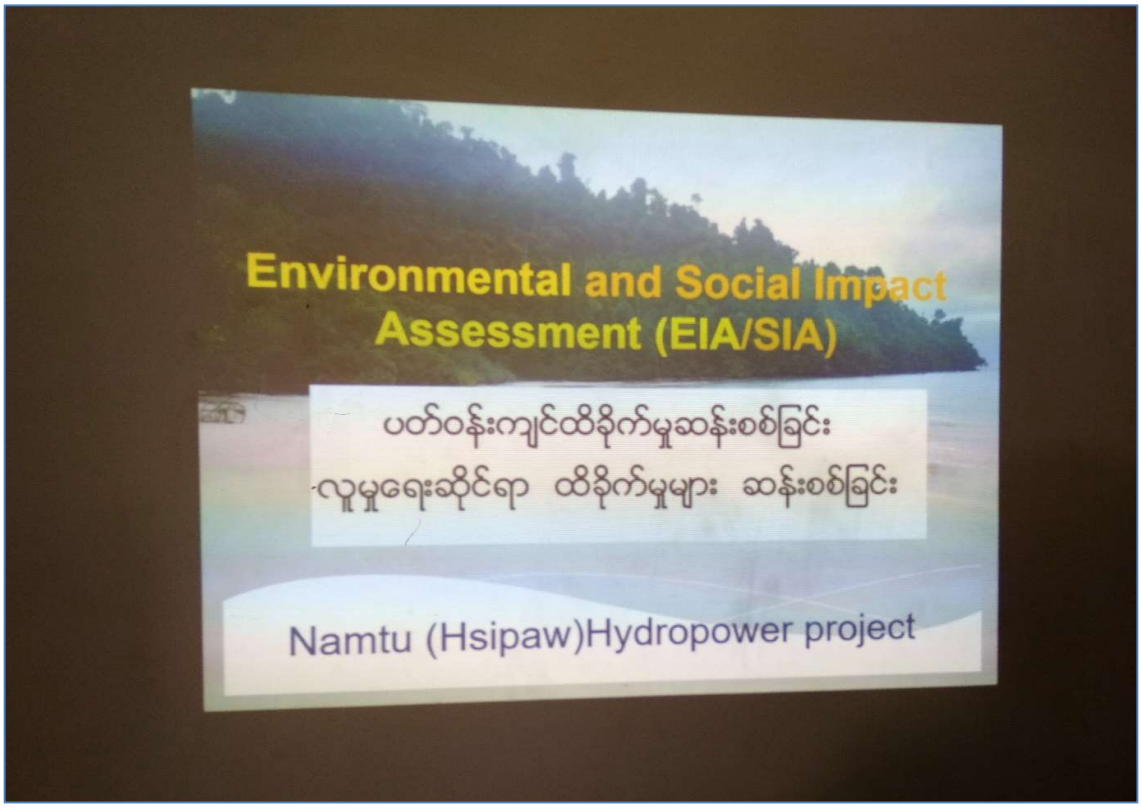

Figure 22: The presentation to Member of Parliament on 4th July 2018 t Manshan

7.2 Summary of the Consultation Activities undertaken

7.2.1 Overview of the consultation activities

The government officials, regulators and the authorities are very much aware of the hydropower project progress. The villagers in Lilu village are well informed about the hydropower project. The EIA consultant has published the project on-going study in their website and social media platforms on 5th July 2018 after the site visit. The government offices interacted during the scoping phase were as below

Name	Designation	Departments
U San Min Htut	Deputy Township Officer	General Administration- Hsipaw
U saw Min Htway	Township Officer	Power Distribution-Hsipaw
U Aung Lwin	Senior Engineer	Yaywa Hydropower project
U Khaing Nyunt	Assistant Director	Forest Conservation-Kyaukme District
Daw Nang Kham Aye	Member of Parliament	Namtu, Northern Shan State

Table 26: Meeting with the authorities and NGOs

The EIA consultant met with the staff of the project and reviewed the data and documents related to the project design, construction plan, quality control, project progress management, work log sheets and the safety and environmental parameters.

7.2.2 Summary of the opinions of the persons consulted

The presentations and the demonstration of the project and the project progress were performed to the attendees and it was observed that the project developer has kept the communication channel active with the neighbouring people and the officials. The local authorities met are aware of the project developments and are looking forward to the start of the operations that is expected to improve the livelihoods of the region.

The authorities had expressed their dissatisfaction about construction of the workers accommodation near the dam site. The ministry of Natural Resources and Environmental Conservation (MONREC) had sued the project developer and they paid penalty for the offence.[31]. The project owner then decided to move the workers accommodation to a site owned by them in a different location. The rock quarry and the soil burrows near to the new site was found to be of better quality than the previous one.

The safety of the dam and the compensation for the submerged area are major worries of the people in the affected zone of the project. Additional to these concerns, the project owner had taken soil for testing from the project area to assess the feasibility of construction. Some of the people had raised their apprehension about the possibility of mining for precious metals or gems by the project owner.

[31] https://www.pyithuhluttaw.gov.mm/?q=node/7701

The consultation with the government departments related to the project was undertaken by the EIA consultant. They had made visits to the MIC and DICA to gather information about the project and also had interviewed the officers to get their perception on the island resort project.

7.3 Results of Consultations during project scoping

7.3.1 Issues identified by the stakeholders and groups affected by the project

The major concerns raised by the villagers are relating to the resettlement of the people who are to be moved; they are concerned that they may not be compensated as expected by the project developer. The resettlement and compensation plan to be reviewed in detail to assess the social impact.

The people are also concerned about the safety of the dam structure that a breach of the dam by the flooding river can be catastrophic to people who live in the downstream section up to even 50 miles. The seismic study made by the project developer needs to be validated and the design of the dam structure to be evaluated for the safety parameters during the EIA study phase.

The villagers were found to be happy about the jobs that will be created for the construction activities and the indirect jobs due to the food supplies to the workers and the transportation of materials. The people are hopeful that the added electricity from the project will boost the overall development of the region with more industrial enterprises.

7.3.2 How these issues were taken into account

The EIA study to cover the key issues raised by the people. The fear of safety of the dam, the fairness in resettlement and compensation, management of migrant workers in large numbers are the socially important issues that re identified as important for the scoping phase. Th EIA study should cover these factors and plan mitigating measures all the while keeping the affected people informed in all stages of the work. It is also important to clear the apprehensions and misunderstandings if any about the project development.

The pubic hearings planned to be conducted at Hsipaw, Namtu and Lilu that will include the elected representatives, government officials form the departments of Forest, agriculture, electric power, general administration, irrigation, and fisheries and the officers from the Yaywa project in the downstream of the river.

7.4 Recommendations for consultation to be undertaken during EIA

The EIA/SIA study will have detail interactions that include a survey with the related government department officials and the people to assess their perception about the project. The study aims to cover the change in trade and commerce, job creations, and corporate social responsibility initiatives from the project proponent.

The open forum that is planned to be done will have invitations sent to government officials, villagers in Lilu, Namtu and Hsipaw, trade and merchant associations seeking their participation in the discussion on the project, its impacts and the concerns of the people.

Conclusions and Recommendations

The hydropower project will result in direct and indirect employment to local public, provision of better livelihoods for the villagers in the project area and will improve the overall economy, trade and commerce of the region. This project is aimed mostly at the contribution to economy by electrification.

The project will drive the objective of the union government related to electrification and the clean energy development in the rural areas of Myanmar

The negative impacts of the projects identified in the scoping phase are the

- Submergence of 866 Ha of land,
- Vegetation removal and tree felling,
- Resettlement of people and agricultural fields,
- Dam safety,
- Sediment blockade by the dam,
- Water regulation to the downstream,
- Heavy use of national resources such as water, diesel and electricity,
- Pollution of water, air and noise,
- Social & health issues from migrant workers in large numbers

The EIA study phase to formulate proper mitigation measures incorporated in the environment Management Plan (EMP) to control the above listed issues to an acceptable level.

The measures to reduce these impacts are by changing the construction methodology, use of membrane bioreactor for waste water recycling, composting of the solid waste generated and regular maintenance schedule to reduce the consumption of electricity and fossil fuels. Recommended actions to be points in the EMPs during the construction and operational phase

- A comprehensive sediment management plan as per the international guidelines
- Use of Micro Biological based technology, preferably Membrane Bio reactor (MBR) for waste water recycling plant
- Yearly/Half yearly testing of the air quality, ground and surface water quality, noise levels by a recognized third-party testing laboratory
- Half Yearly audits to monitor the efficient use of fossil fuels and water
- Half Yearly audit of the preventive maintenance and the emergency preparedness
- Periodic audits of the workers accommodation and sanitation
- Periodic medical check up for the migrant workers
- Regular training for the staff on environmental and sustainability parameters

The EIA/SIA study and reporting should cover the extent of the above mentioned negative impacts and also assess the social impact on the local population with reference to their livelihoods.