(7) 現地調査報告プレゼンテーション資料等

1) 第 1 回現地調査現地報告（2018 年 12 月 7 日）

The PREPARATORY SURVEY FOR THE PROJECT FOR CONSTRUCTION OF HYDROPOWER STATION IN ESPIRITU SANTO ISLAND

NEWJEC

SITE VISIT REPORT **Dec. 7, 2018**

Purpose of Site Survey

Site Survey (Schedule, Site Visit photos)

Findings of Site Survey

- Natural Condition: Topography, Geology
  ~ Topographic / Geological survey plan,Discharge Measurement
- Proposal of Project Layout ~ Alternative-2
- Access Road
- Power Development Planning
- Basic Planning Design for New Hydropower Station
- System Analysis for New Hydropower
- Land Issues
- Consultation Meeting at Luganville [Nov.20 Dec.5, 2018]

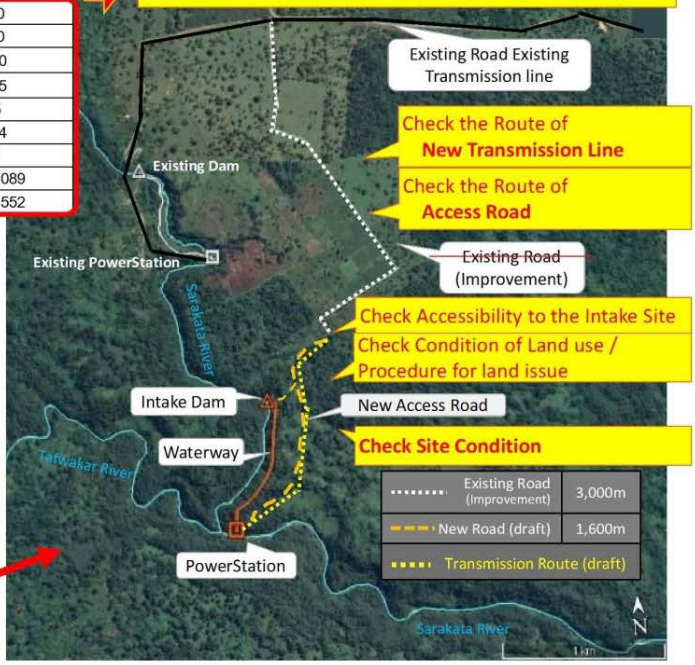
Survey Schedule

1

Purpose of Survey:
Checking Original Planning Project site

Generation type		–	Dam Waterway type, Run-of-River type
Install Capacity	Total	kW	800
	Single	kW	400
Plant Discharge	Total	m^3/s	7.10
	Single	m^3/s	3.55
Head	Gross Head	m	15
	Effective Head	m	13.4
No. of turbine & generator		Unit	2
Annual Energy Production		kWh	5,507,089
Annual Energy Production		kWh	5,066,552

Draft Project Features based on JICA Study in 2017
Planning values will be reviewed in this Survey



2

Site Survey ~ Schedule

Date	Electricity Planning	Social/Environment	Civil Design Team
Nov. 13 (Tue)	Kick-off Meeting at DOE, Meeting with URA (←Move from Fiji on Nov.12, Leaving Japan on Nov.10)		
Nov. 14 (Wed)	Move from Efate to Santo Island, Survey planning PS with JICA, DOE, DOL and VUI		
Nov. 15 (Thu)	Meeting with VUI, Visiting Existing Sarakata PS		
Nov. 16 (Fri)	Meeting at Diesel PS		
Nov. 17-18 (Sat-Sun)	Data collection		
Nov. 19 (Mon)	Meeting with VUI, Visiting Diesel PS, Existing PS		Survey at planning PS site ~ Intake Site
Nov. 20 (Tue)	Planning PS site,TL route	Consultation Meeting (1)	Survey of planning PS site and TL route
Nov. 21 (Wed)	Survey of SS and TL	Survey at planning PS site, Head Tank site, and Intake site	
Nov. 22 (Thu)	Data arrangement	Survey along the Waterway, Access Road route	
Nov. 23 (Fri)	Meeting (VUI, URA)	Check existing Waterway of Sarakata	
Nov. 24-24 (Sat-Sun)	Data arrangement		
Nov. 26 (Mon)	Port Olry (DS), Solar plants	Meeting with DOL	Survey along planning waterway to Intake
Nov. 27 (Tue)	Data collection (VUI)	Meeting with CLMO	Discharge measurement
Nov. 28 (Wed)	Luganville Port	Meeting with VMGD	Luganville Port, Meeting with Contractors
Nov. 29 (Thu)	Preparation of Report	Data collection	Survey along the river for CS survey
Nov. 30 (Fri)	Meeting with VUI, Move to Efate Island	Meeting with DOE, VUI and DOL, stay in Santo	Meeting with VUI Move to Efate Island
Dec. 1-2(Sat-Sun)	Data arrangement		
Dec.3 (Mon)	Meeting with DOE	Meeting with VUI	Meeting with DOE, VMGD,
Dec.4 (Mon)	Preparation of Report	Meeting with DOE, DOL	Meeting with VPMU, DSPPAC
Dec.5 (Mon)	Preparation of Report	Consultation Meeting (2) Move to Efate Island	Meting with ADB/WB, Local Contractors
Dec.6 (Mon)	Meeting with URA	Meeting with DOL, PWD	Meeting with URA , DOW, DOWR, PWD
Dec.7 (Mon)	Meeting with DOE, JICA		
Dec.8 (Mon)	Move to Japan		

PS: Power Station, SS: Substation, TL: Transmission Line, SY: Switch Yard, DS: Diesel PS, CS: Cross-Section
DOE: Department of Energy, MCCA (Ministry of Climate Change Adaptation, Meteorology, Geo-Hazards, Environment),
VMGD: Vanuatu Meteorology & Geo-Hazards, Department, MCCA, DOL: Department of Lands, Ministry of Lands,
CLMO: Custom Land Management Office, Ministry of Justice, URA: Utilities Regulatory Authority, DSPPAC : Department of Strategic Policy Planning and Aid Coordination, VPMU : Vanuatu Project Management Unit, DOWR: Department of Water Resources, Ministry of Lands and Natural Resources , PWD: Public Works Department, Ministry of Infrastructure and Public Utilities

3

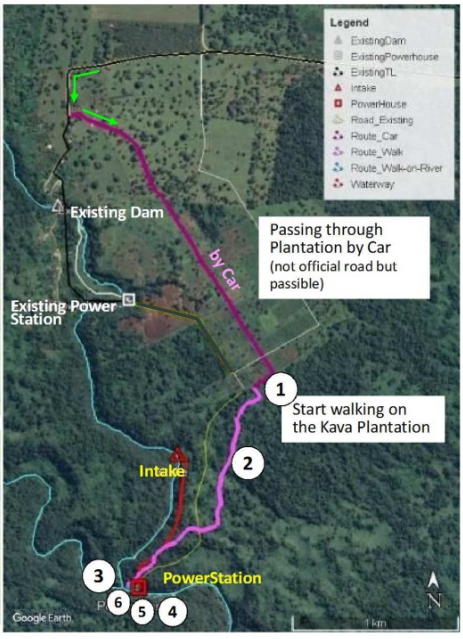
Site Survey for Original planning PS [Nov. 14, 2018]

1: Plantation by Private Company (car is accessible on plantation)
2: Walking route on bushes in the dense forest
3: Confluence of Sarakata and its Tafwakar River (tributary)
4,5,6: View around Powerhouse site (accessed by walk on the River)

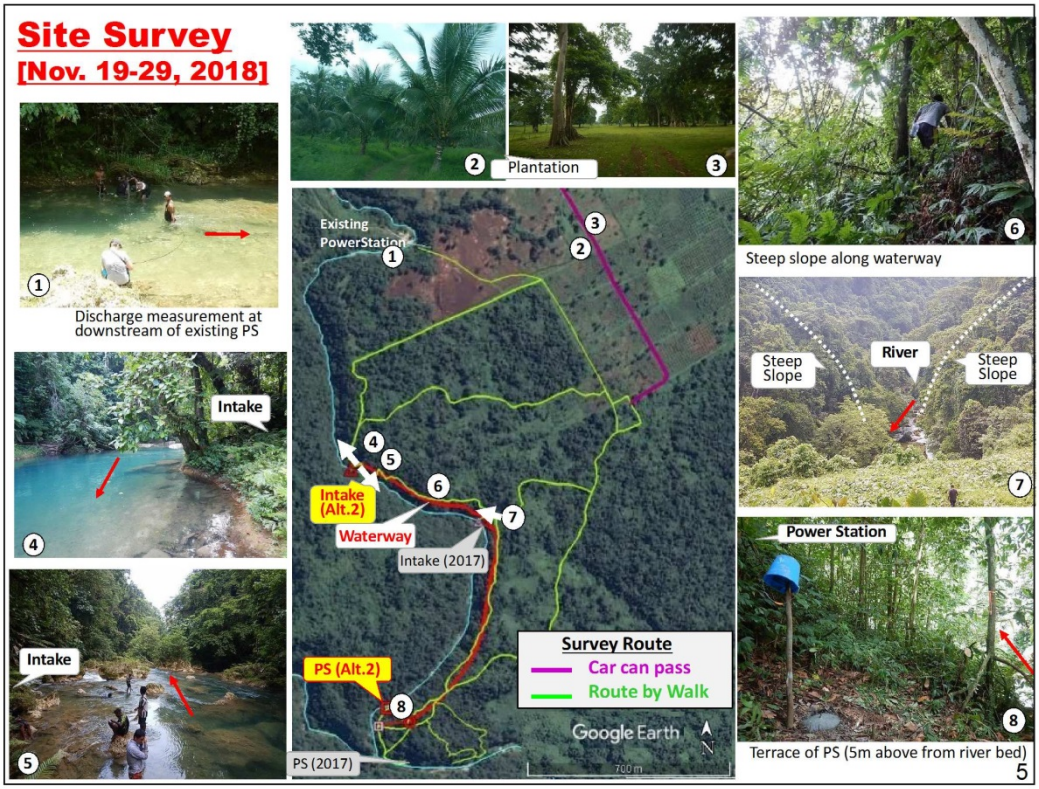
Moving by car in Plantation

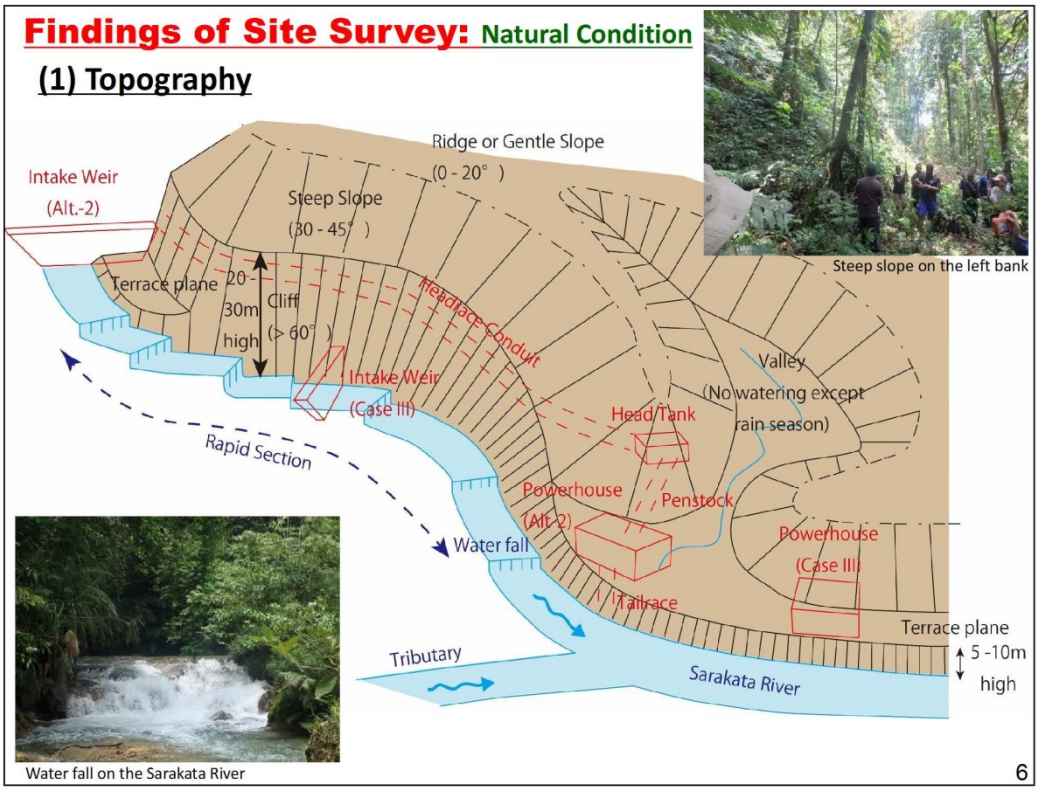
Walking in Bushes

Sarakata River Around PS



4

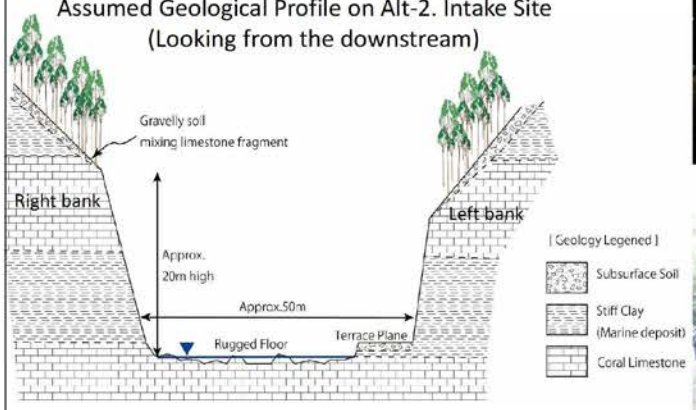

Site Survey
[Nov. 19-29, 2018]
Discharge measurement at downstream of existing PS
Intake
Intake
Plantation
Existing PowerStation
Intake (Alt.2)
Waterway
Intake (2017)
PS (Alt.2)
PS (2017)
Survey Route
Car can pass
Route by Walk
Google Earth
Steep slope along waterway
Steep Slope
River
Steep Slope
Power Station
Terrace of PS (5m above from river bed)
5


Findings of Site Survey: Natural Condition
(1) Topography
Ridge or Gentle Slope
(0 - 20°)
Intake Weir
(Alt.-2)
Steep Slope
(30 - 45°)
Terrace plane
20 - 30m high
Cliff
(> 60°)
Headrace Conduit
Intake Weir
(Case III)
Rapid Section
Valley
(No watering except rain season)
Head Tank
Penstock
Powerhouse
(Alt.2)
Powerhouse
(Case III)
Water fall
Tailrace
Terrace plane
5 -10m high
Tributary
Sarakata River
Steep slope on the left bank
Water fall on the Sarakata River
6

Natural Condition

(2) Geology

Assumed Geological Profile on Alt-2. Intake Site
(Looking from the downstream)



Coral Limestone on the River floor

Stiff Clay on the Left bank

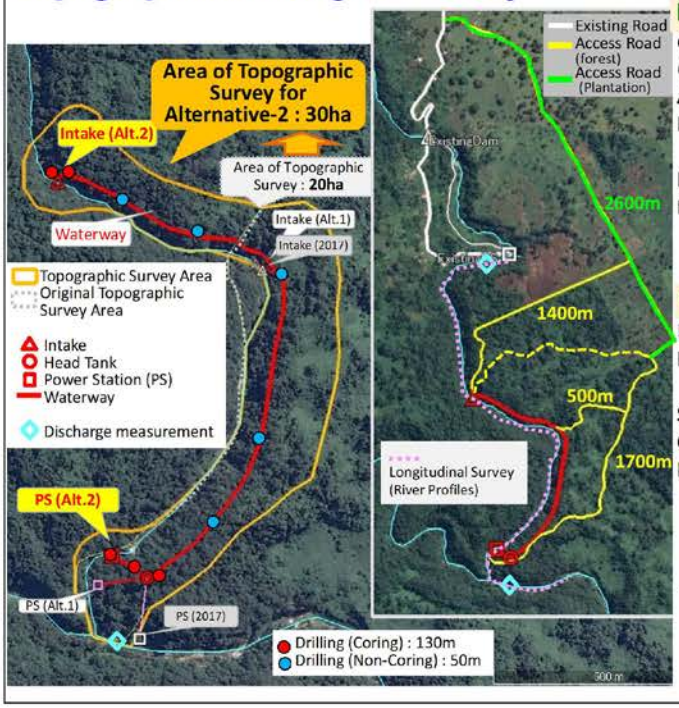
[Geotechnical Key-Points]

- Riverbed consists of coral limestone, it's no problem for the weir foundation.
- River banks show continuous cliff and steep slopes(higher than 20m). A large amount of excavation will be required on the headrace alignment.
- Powerhouse will be situated on terrace plane composed of stiff clay layer. The loading capacity of stiff clay will be confirmed by drilling survey.

7

Natural Condition

Topographic / Geological Survey



Topographic Survey / Route Survey / Discharge Measurement

Cabinet Topographique & Foncier Ltd (CTF)

Area of Topographic Survey: 30ha

Length of Route Survey: 6200 m*

(*: To be confirmed after topographic mapping)

Longitudinal Survey: 3200m

Discharge Measurement:
4time x 2sites

Geological Survey

By Siam Tone Co., Ltd (STC)

Drilling (Coring) : 130m
(Non-Coring) : 50m

SPT (Standard Penetration Test) : 50 Nos.

CBR test along access : 5 Nos.

Laboratory Test:

- **Rock Testing:**
  Unconfined Compression Test,
  Specific gravity,
  Absorption
- **Soil Testing**
  Grain size distribution,
  Atterberg limit,
  Specific gravity,
  Natural water contents

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Natural Condition

Discharge Measurement

1st Discharge Mesurement for Existing Power House (27/11/18 - 10:30AM)

Number		Height (WGS84) meter	Depth meter	Velocity (m/s) 0.20%	0.80%	Vmi	Length meter	Area square meter	Discharge Section (m/s)	Discharge Total (m/s)
Water mark Left	1	144.98	0.00	0.00	0.00	0.00	1.27	0.35	0.07	
di1.10	2	144.57	0.55	0.52	0.31	0.42	1.17	0.79	0.32	
di1.11	3	144.34	0.80	0.63	0.15	0.39	1.41	1.30	0.51	
di1.12	4	144.01	1.05	0.66	0.12	0.39	1.14	1.19	0.53	
di1.13	5	144.08	1.03	0.73	0.28	0.51	1.56	1.61	0.92	
di1.14	6	143.92	1.04	0.77	0.51	0.64	1.35	1.40	0.86	5.18
di1.15	7	144.00	1.03	0.76	0.42	0.59	1.09	1.06	0.69	
di1.16	8	144.10	0.92	0.74	0.70	0.72	1.27	1.16	0.75	
di1.17	9	144.13	0.90	0.57	0.58	0.58	1.03	0.85	0.40	**5.2 m3/s**
di1.18	10	144.30	0.74	0.36	0.39	0.38	1.19	0.62	0.12	
di1.19	11	144.73	0.31	0.02	0.00	0.01	0.42	0.06	0.00	
Water mark Right	12	144.92	0.00	0.00	0.00	0.00				

2nd Discharge Mesurement for Existing Power House (27/11/18 - 11:30AM)

Number		Height (WGS84) meter	Depth meter	Velocity (m/s) 0.20%	0.80%	Vmi	Length meter	Area square meter	Discharge Section (m/s)	Discharge Total (m/s)
Water mark Left	1	144.99	0.00	0.00	0.00	0.00	1.37	0.23	0.05	
di1.103	2	144.54	0.33	0.52	0.44	0.48	1.08	0.52	0.29	
di1.104	3	144.43	0.64	0.66	0.57	0.62	1.18	0.95	0.56	
di1.105	4	144.11	0.97	0.82	0.30	0.56	1.05	1.05	0.67	
di1.106	5	144.04	1.02	0.85	0.58	0.72	1.51	1.60	0.99	
di1.107	6	143.97	1.10	0.63	0.42	0.53	1.24	1.35	0.79	5.55
di1.108	7	143.98	1.07	0.66	0.62	0.64	1.33	1.43	0.88	
di1.109	8	143.99	1.07	0.74	0.45	0.60	1.24	1.23	0.72	**5.5 m3/s**
di1.110	9	144.12	0.91	0.55	0.61	0.58	1.33	1.07	0.52	
di1.111	10	144.34	0.70	0.38	0.41	0.40	1.24	0.43	0.09	
Water mark Right	11	144.92	0.00	0.00	0.00	0.00				

Calculation based on Operation record → **Q: River Discharge : 4.9 m3/s**

Almost fit well

(Culculation)

$Q1 + Q2 + Q3 = Q$

※$Q1$ & $Q3 = 1.8 \times L \times H^{3/2}$

(L=width of weir(m), H=water level(m))

(Specifications)

Intake weir width = 38.1 (m)

Headtank spillway width = 10 (m)

Overflow water level at intake weir = 2.73 (m)

Figure 6-3-4 Image of Culculation Method for Voncersion Flow Rate

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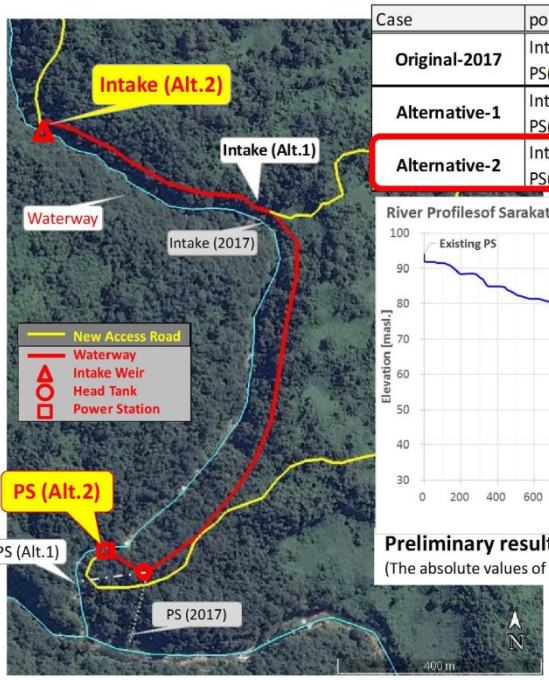
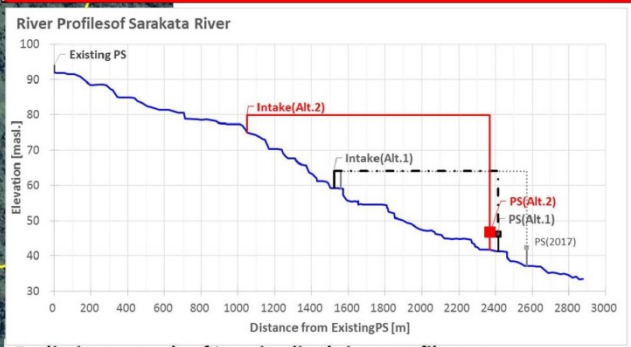
Proposal of Project Layout: Alternative-2



Case	point	Elevation [masl.]		Remarks
Original-2017	Intake(2017)	64.1	Gross Head	Penstock passes
	PS(2017)	42.3	**21.9 m**	valleys
Alternative-1	Intake(Alt-1)	64.2	Gross Head	Penstock slope is
	PS(Alt-1)	46.2	**18.1 m**	gentle
Alternative-2	Intake(Alt-2)	79.9	Gross Head	Larger head can be
	PS(Alt-2)	46.7	**33.2 m**	available

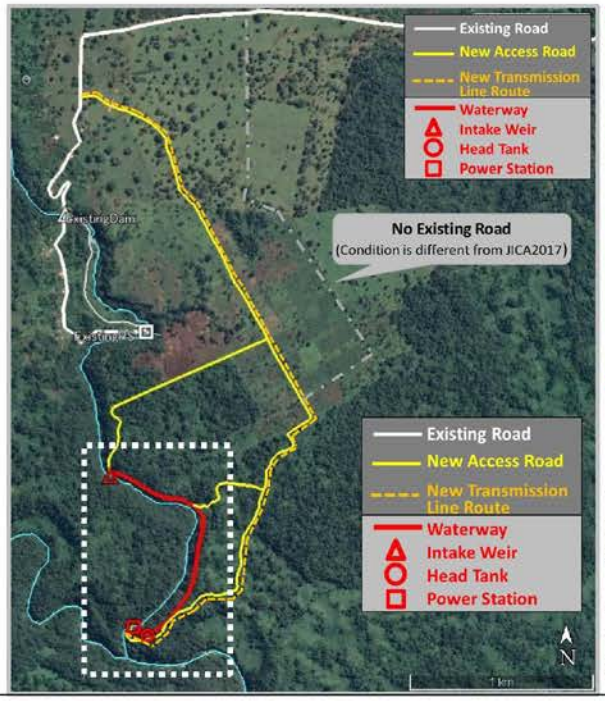


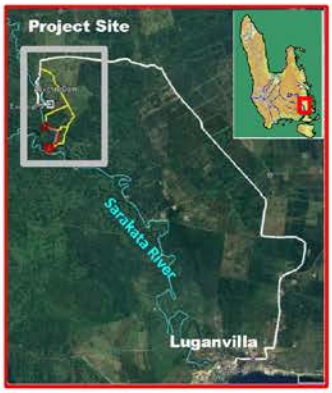
Preliminary result of Longitudinal river profile survey

(The absolute values of elevation will be revised after completion of Bench mark survey)

10

Proposal of Project Layout: Alternative-2





The planning layouts are preliminary, which will be changed during Studies to be proceed.

Routes of Access Road and Transmission Line are based on GPS tracks, which will be updated during studies.

11

Access Road

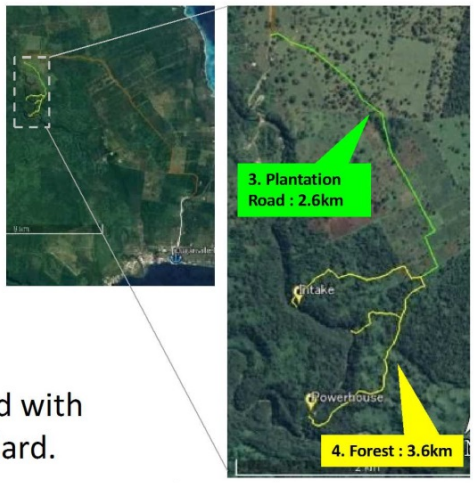
Access Route to the Project Site

12

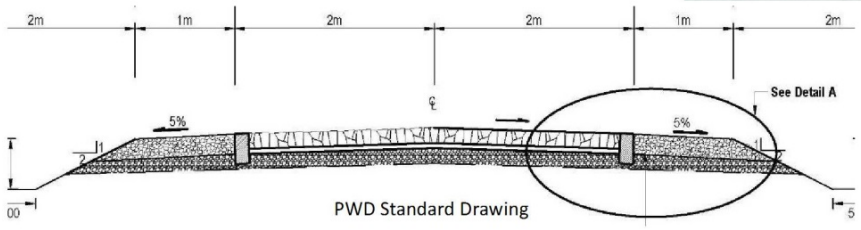
Access Road

Improvement and Construction of Access Roads

Plantation road of 2.6 km will be improved and access road of 3.6 km in forests will be newly constructed.



New access roads will be complied with the stone pavement of PWD standard.



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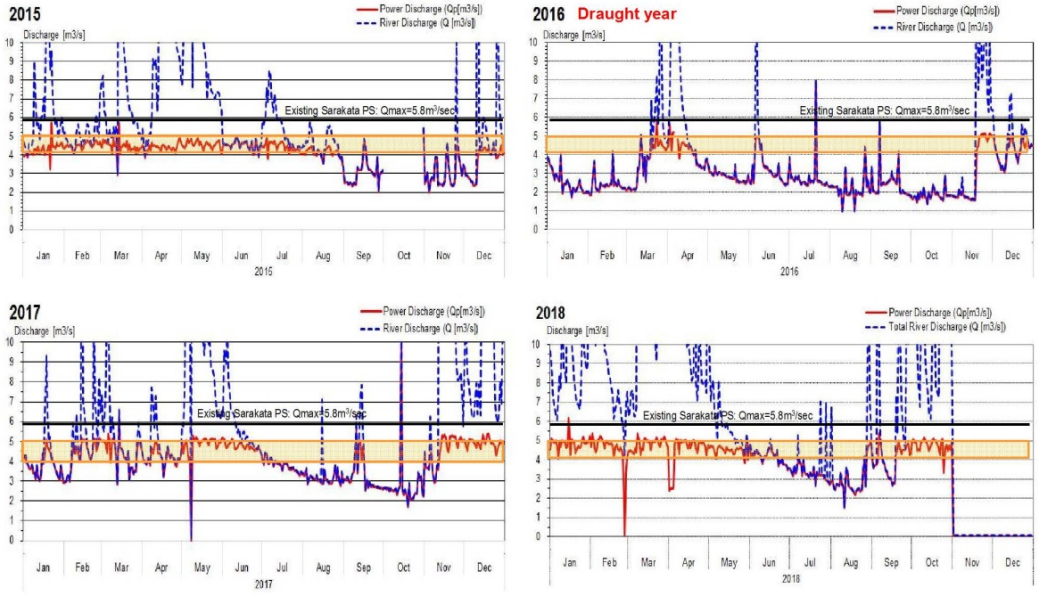
Power Development Planning

River Discharge & Power Discharge (Jan. 2015 ~ Oct. 2018)

River Discharge from January 2015 to October 2018 was calculated by using operation records of Sarakata Hydropower plant.



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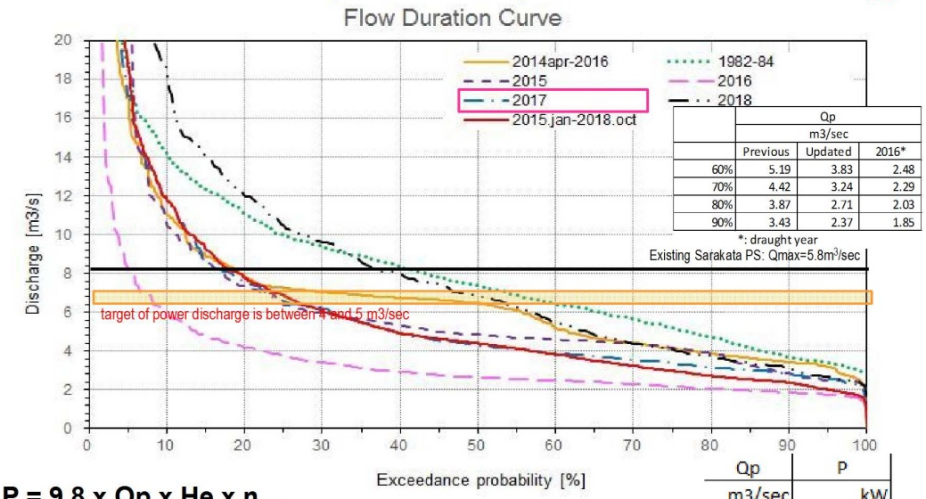
Power Development Planning

Flow Duration Curve, Power Output & Generated Energy



	Qp m3/sec		
	Previous	Updated	2016*
60%	5.19	3.83	2.48
70%	4.42	3.24	2.29
80%	3.87	2.71	2.03
90%	3.43	2.37	1.85

P = 9.8 x Qp x He x η_{tg}

Where, P : Power output (kW)
Qp : Power discharge (m3/sec)
He: effective head (30m, Hg=33.2m)
η_{tg} : efficiency of turbine and generator (0.8)

E = 8,760 x P x FUF

Where, E : Annual Generated Energy (kWh/year)
FUF: Flow utilization factor (%)

Qp m3/sec	P kW
4.0	941
4.5	1,058
5.0	1,176
5.5	1,294
6.0	1,411
6.5	1,529
7.0	1,646

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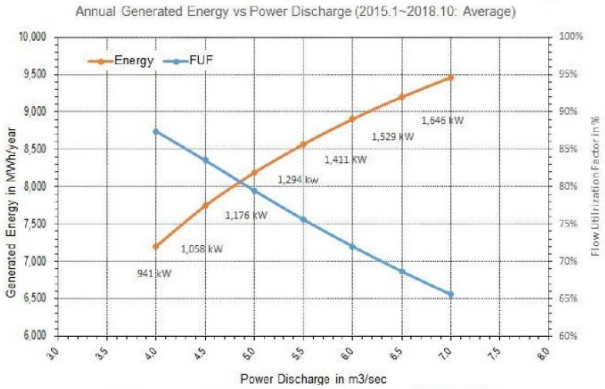
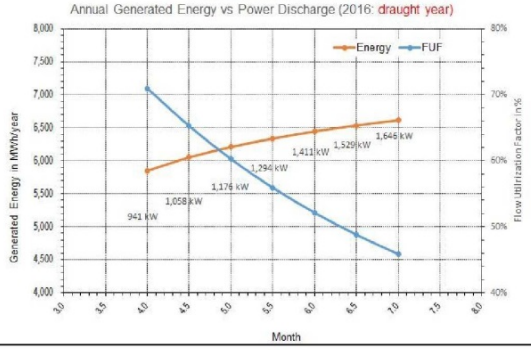
Power Development Planning

Power Discharge VS Power Output & Generated Energy





E = P x 8,760 x FUF
P = 9.8 x Qp x He x η_{tg}
where,
E : Annual generated energy (kWh/year)
P: Power output (kW)
Qp : Power discharge
He: effective head (30m, Hg=33.2m)
η_{tg} : efficiency of turbine and generator (0.8)

Jan. 2015 ~ October 2018

Qp m3/sec	P kW	Energy GWh/year	increment %	FUF %
4.0	941	7,203		87.4%
4.5	1,058	7,745	7.5%	83.5%
5.0	1,176	8,188	5.7%	79.5%
5.5	1,294	8,568	4.6%	75.6%
6.0	1,411	8,904	3.9%	72.0%
6.5	1,529	9,198	3.3%	68.7%
7.0	1,646	9,461	2.9%	65.6%

2016 (Draught year) for reference

Qp m3/sec	P kW	Energy GWh/year	increment %	FUF %
4.0	941	5,848		71.0%
4.5	1,058	6,050	3.5%	65.3%
5.0	1,176	6,207	2.6%	60.3%
5.5	1,294	6,336	2.1%	55.9%
6.0	1,411	6,444	1.7%	52.1%
6.5	1,529	6,535	1.4%	48.8%
7.0	1,646	6,614	1.2%	45.9%

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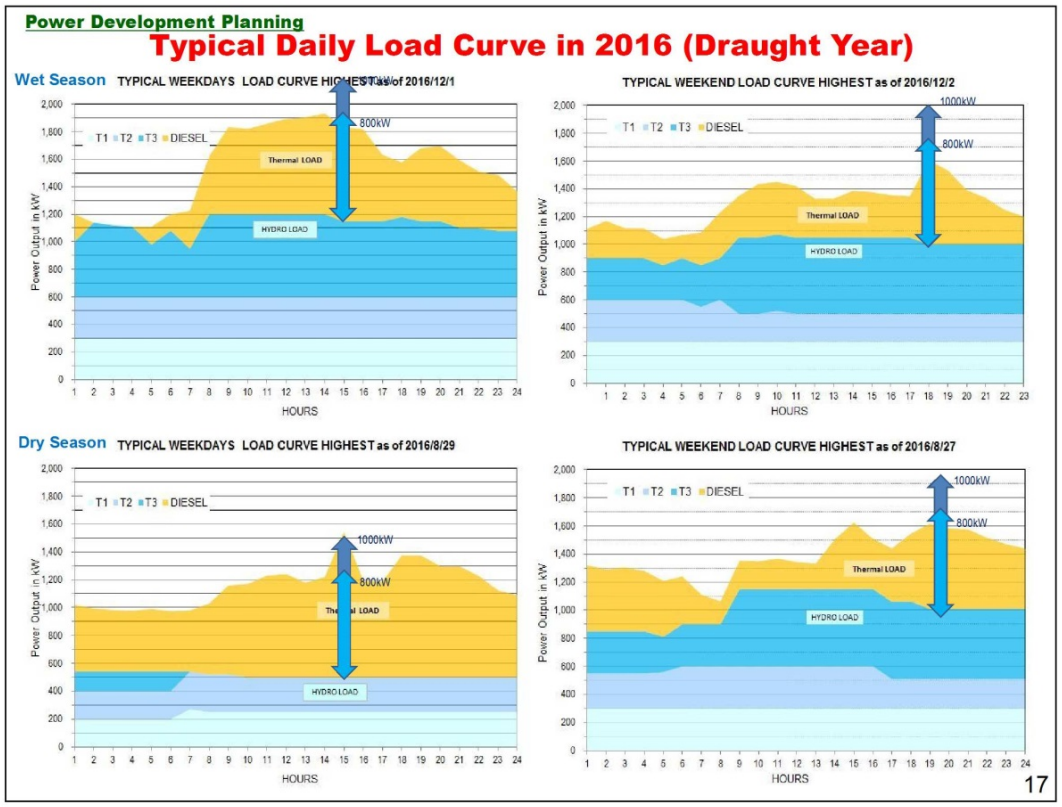
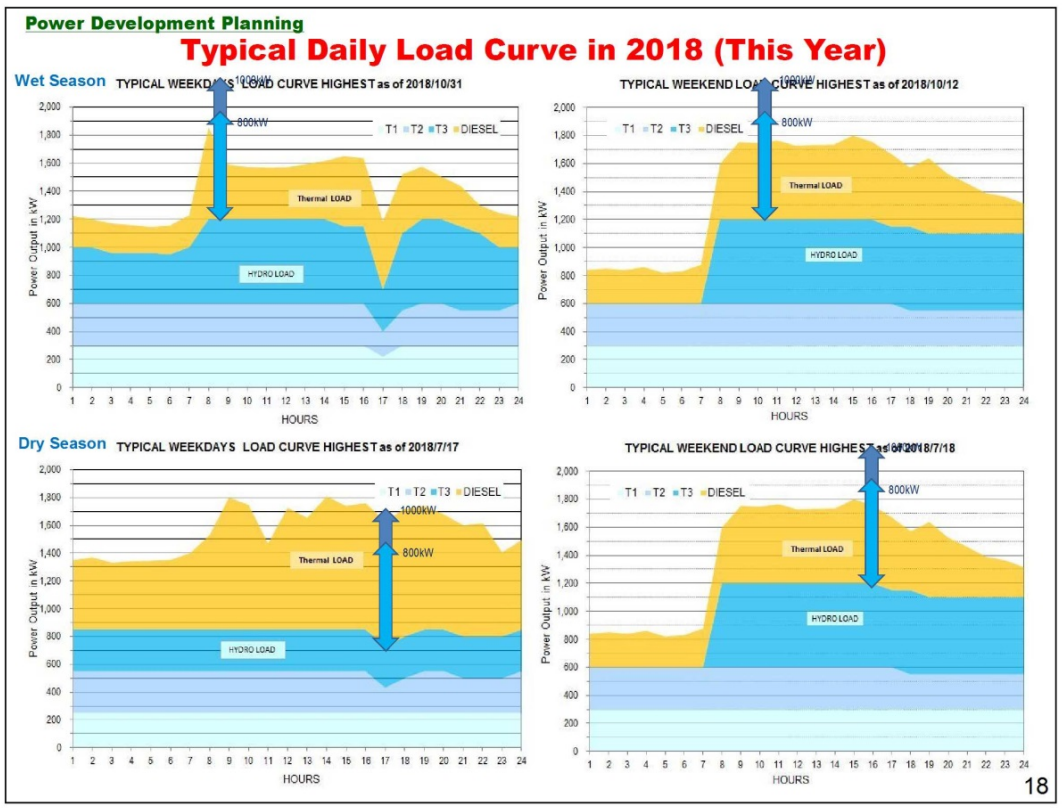
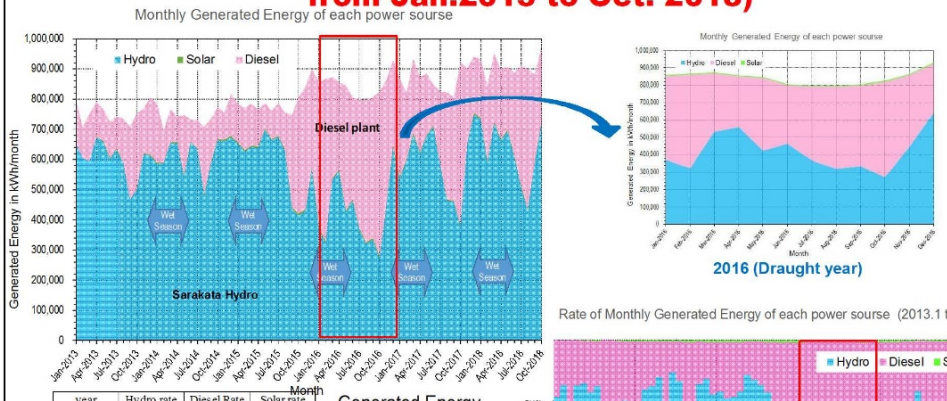

Power Development Planning
Typical Daily Load Curve in 2016 (Draught Year)
Wet Season
TYPICAL WEEKDAYS LOAD CURVE HIGHEST as of 2016/12/1
TYPICAL WEEKEND LOAD CURVE HIGHEST as of 2016/12/2
Dry Season
TYPICAL WEEKDAYS LOAD CURVE HIGHEST as of 2016/8/29
TYPICAL WEEKEND LOAD CURVE HIGHEST as of 2016/8/27
T1 T2 T3 DIESEL
Thermal LOAD
HYDRO LOAD
1000kW
800kW
Power Output in kW
HOURS
17


Power Development Planning
Typical Daily Load Curve in 2018 (This Year)
Wet Season
TYPICAL WEEKDAYS LOAD CURVE HIGHEST as of 2018/10/31
TYPICAL WEEKEND LOAD CURVE HIGHEST as of 2018/10/12
Dry Season
TYPICAL WEEKDAYS LOAD CURVE HIGHEST as of 2018/7/17
TYPICAL WEEKEND LOAD CURVE HIGHEST as of 2018/7/18
T1 T2 T3 DIESEL
Thermal LOAD
HYDRO LOAD
800kW
1000kW
Power Output in kW
HOURS
18

Power Development Planning

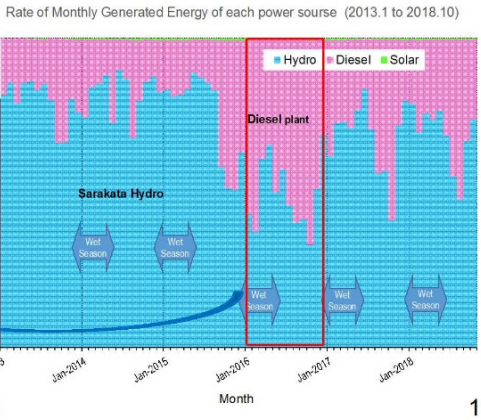
Hydropower Energy VS Diesel power Energy from Jan.2013 to Oct. 2018)

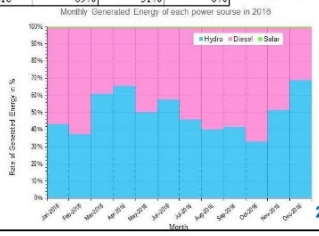


2016 (Draught year)

year	Hydro rate	Diesel Rate	Solar rate
2013	80%	20%	0%
2014	82%	17%	0%
2015	74%	25%	1%
2016	50%	49%	1%
2017	68%	32%	0%
2018	69%	31%	0%

Generated Energy of Diesel power is increasing due to increment of demand





2016 (Draught year)

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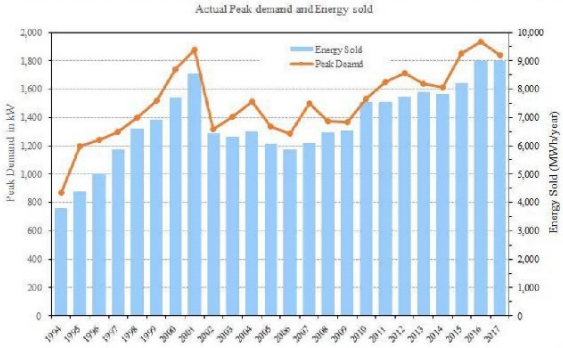
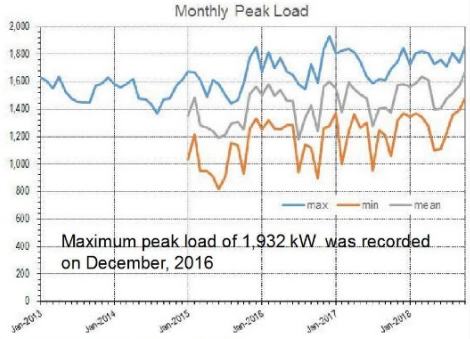
Power Development Planning

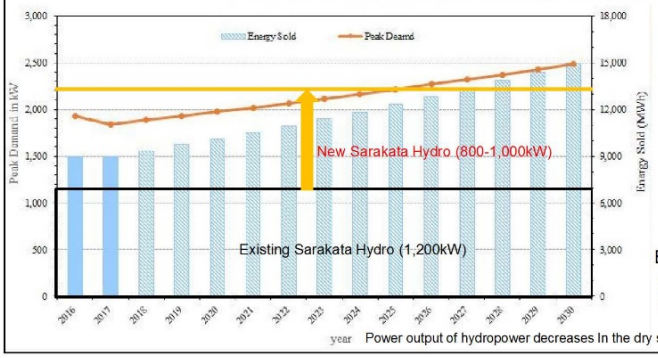
Peak Load and Generated Energy (from Jan.1994 to Oct. 2018)





Maximum peak load of 1,932 kW was recorded on December, 2016

Demand Forecast up to 2030 (Trraial)



Year	Peak Deamd kW	Energy Sold kWh	Energy Sold MWh		
2016	1,932	8,983,224	8,983		
2017	1,842	8,980,144	8,980	2.3%	4.0%
2018	1,885	9,340,766	9,341	2.3%	4.0%
2019	1,929	9,715,870	9,716	2.3%	4.0%
2020	1,974	10,106,037	10,106	2.3%	4.0%
2021	2,020	10,511,873	10,512	2.3%	4.0%
2022	2,067	10,934,005	10,934	2.3%	4.0%
2023	2,115	11,373,090	11,373	2.3%	4.0%
2024	2,165	11,829,807	11,830	2.3%	4.0%
2025	2,215	12,304,866	12,305	2.3%	4.0%
2026	2,267	12,799,001	12,799	2.3%	4.0%
2027	2,320	13,312,980	13,313	2.3%	4.0%
2028	2,374	13,847,598	13,848	2.3%	4.0%
2029	2,429	14,403,686	14,404	2.3%	4.0%
2030	2,486	14,982,106	14,982	2.3%	4.0%

Based on latest 10 year's data,
growth rate of 2.3% per annual for peak load
growth rate of 4.0% per year for generated energy

Power output of hydropower decreases In the dry season

20

Basic Planning Design for New Hydro Power Station

(1) Selection of the Water Turbines

- Large Head / Low Flow Rate → Horizontal axis Francis / Horizontal axis Propeller

(2) Number of Turbines

Number	1 unit	2 unit	3 units	4 units
Synchronized Operation	N.A	++++	++	+
Power generation during Maintenance	+	+++	+++	+++
Erection cost (Size of Turbines and Generator)	+	++	+++	++++
The minimum amount of power generation	+	++	+++	+++
Spares	+	++++	++++	++++
Comprehensive evaluation	Not recommend	Not recommend	Recommend	Recommend

(3) Operation

1) Automatic control of New Hydro Power Station is recommended

- Equip the Sensor such as flow meter, water pressure gauge, in intake gate and entrance valve etc.,
- Automatically controled with the computer module on The New Hydro Power Station

2) To be operated under control from Existing Hydro Power Station is recommended

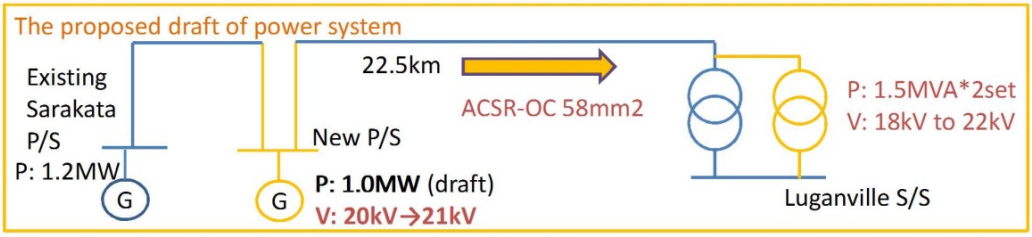
- Connect with using OPGW (optical fiber cable), and perform signal transmission and reception.

  OR
- Receive and transmit signals to and from the New Hydro Power Station from the Existing Hydroelectric Power Station of using a dedicated Firewall & Internet

21

System Analysis for New Hydropower

From information of this survey, considering system conditions (such as line capacity, voltage drop, stability), proposed draft power system is below.



Line Capacity

Distribution line
Necessary capacity :2.2MW (64A) < Existing capacity : 7.4MW (205A)
→ acceptable

Substation transformer
Necessary capacity :2.2MW/0.8=2.75MVA < Capacity after 1set Tr expansion : 3.0MVA → acceptable

Voltage Drop

Since the S/S voltage is nearly the lower limit (18kV) by 20kV step-up Tr voltage , We recommend to the tap of the step up Transformer to 21kV.

In this new Hydro Power project, It is necessary to implement the following items

- ◆ π branch to new P/S after existing line cut off
- ◆ Expansion new power transformer at the luganville S/S
- ◆ Step-up voltages set 21kV (higher voltage) at existing and new P/S

22

Land Issues

The case of existing Sarakata Hydro Station

No proper consultation was conducted and started the construction stage…

When the construction work starts, concerns and doubts have been raised from the landowners and caused long lasting disputes…..

For the 2nd Phase Sarakata Hydro Station

Enhancing public awareness is the key point to work on the land issues!!

What we have done so far….....since we have arrived at Santo Island from 14 Nov….

On 18 Nov 2018, the 1st Consultation Meeting was initiated by DOE
Explained the draft project plan.

8 out of 12 landowners presented and all gave consent of works of the preparatory survey to commence (including topographic survey)

After 2weeks of site survey….

On 5 Dec 2018, 2nd Consultation meeting has conducted and landowners were informed the progress of this site survey. The Landowners committee chose the Chairman .

23

Process of Land Acquisition/Lease

Draft Project Plan (Interested Area)

Announcement to Landowners
(Consultation Meeting)

We are here

Governmental Communication (Japan to Vanuatu)
DOE request DOL to conduct Survey Plan

Survey Plan

Consultation Meeting

Ministry of Land Decides the next procedure

Land Acquisition | Lease?? | Special lease?

What we have done….

1st consultation Meeting (18 Nov):
Announce to the Land Owners with the Draft Project layout (interested area)

After the 2weeks site survey…

2nd Consultation Meeting (5 Dec):
Informed to land owners that all new sites will be within the lease of PRV.

From March 2019….
After the Land Acquisition Act is amended,
Ministry of Land starts process….

Close communication between **Department of Energy** with **Ministry of Land** is required

24

After Survey Plan has made, Ministry of land will decided the following procedure....

Land Acquisition

1. Minister's Notice of the intended acquisition
2. Minister's Decision to acquire the land or an easement for a public purpose
3. Evaluation of land and Determining compensation amount
4. Payment
5. Declaration of Land

Recommended by Acting Director, Dep of Lands.

Lease

~~Lease agreement will be done between Land Owners, Govern ment?????~~

As PRV is alredy leasing the land from Land Owners, the Government can not "Lease" from the Land Owners.

Special Lease

1. Consultation with Land Owners for lease surrender.
2. Negotiate with PRV for lease surrender; access road.
3. Lease preparation for special lease (PRV)
4. PRV transfers the lease back to the Government.

There is high possibility that all proposed site is the lease of the PRV and "special lease" is applicable in this time.

Recommended by Dep of Land, in Santo.

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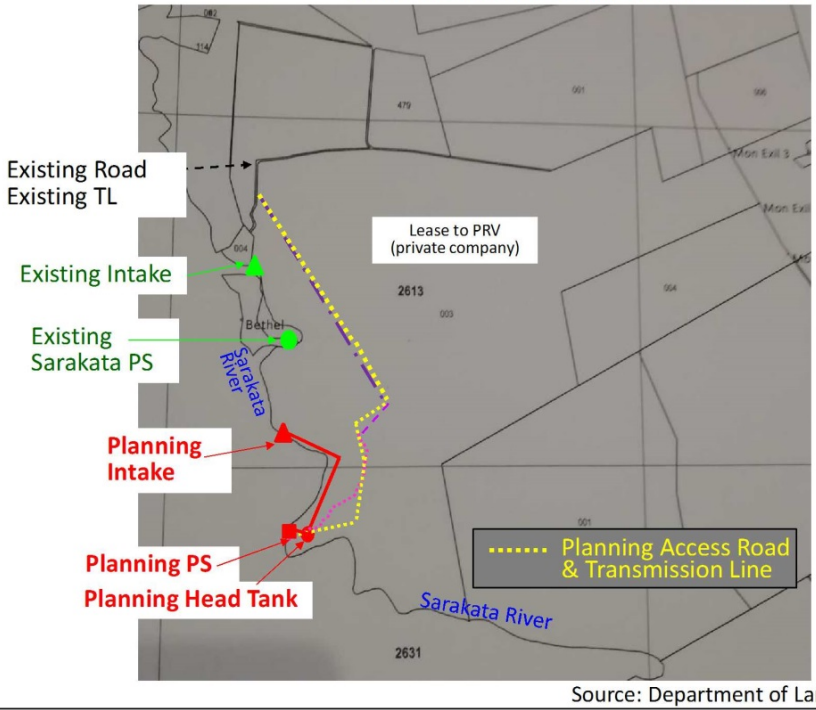
Land Owner's Map

Condition of Land Owner to be Confirmed



Source: Department of Lands

26

Consultation Meeting at Luganville [Nov.20, Dec.5, 2018]

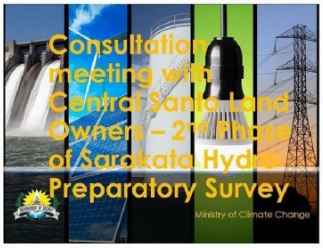
Agenda: Awareness to concerned land owners on the Preparatory Survey works
Presentation: The awareness was conducted by the Government through the DoE
Discussions and Outcome:

- 8 out of the 12 land owner/claimant (representatives) were present at the meeting.
- The awareness was understandable to all, that the project was still at preparatory stage
- All the land owners/claimants present gave their consent on works of the preparatory survey to commence
- A committee was set up straight after the meeting

GOVERNMENT OF THE REPUBLIC OF VANUATU
DEPARTMENT OF ENERGY
PRIVATE MAIL BAG 9067,
LINI HIGHWAY, METEO COMPLEX
NAMBATU, PORT VILA, VANUATU
TEL: (678) 25201 / 533 3840,
E-GOV PH: 3900

GOUVERNEMENT DE LA REPUBLIQUE DU VANUATU
DÉPARTEMENT DE L'ÉNERGIE
SAC POSTALE PRIVEÉ 9067,
LINI HIGHWAY, METEO COMPLEXE
NAMBATU, PORT VILA, VANUATU
TÉL: (678) 25201 / 533 3840,
E-GOV PH: 3900

Consultation meeting with Central Santo Land Owners – 2nd Phase of Sarakata Hydro Preparatory Survey



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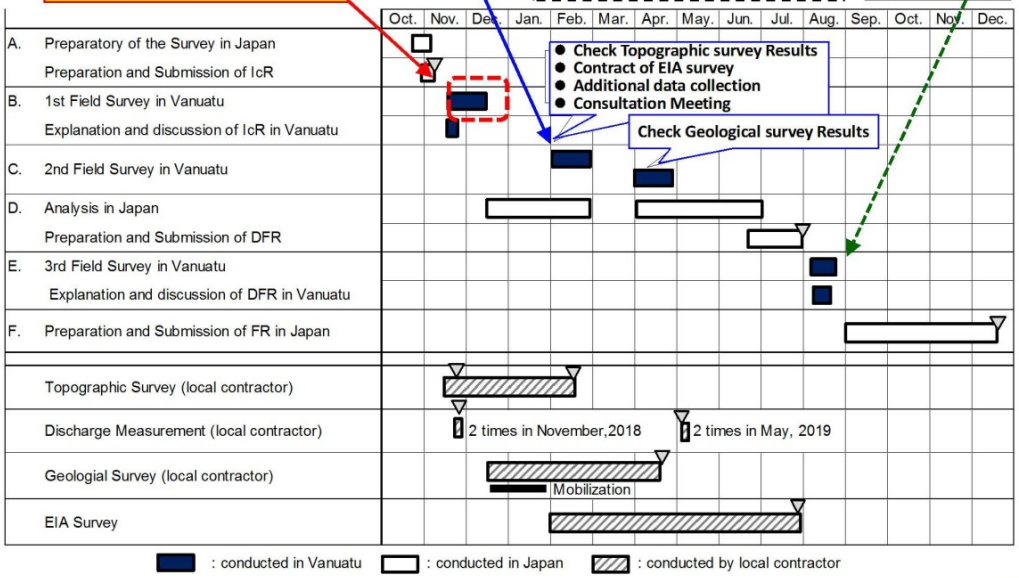
Survey Schedule

1st Field Survey (Nov.~Dec.,2018)
- Confirmation of the Project Site
- ← Site condition
- ← Environmental/Social Consideration

2nd Field Survey (Feb. 2019) (Apr. 2019)

- Planning of the Project
- Operation / Maintenance Plan
- Project Cost
- Concerning Issues
- Risk and Countermeasures
- Evaluation of the Project

3rd Field Survey (Aug. 2019)



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2) 第 2 回現地調査現地報告（2019 年 3 月 1 日）

The PREPARATORY SURVEY FOR THE PROJECT FOR CONSTRUCTION OF HYDROPOWER STATION IN ESPIRITU SANTO ISLAND

SITE VISIT REPORT

Mar.01, 2019

1. Site Survey Schedule

2. Summary of Site Visit
   - 2-1: Access Route and Transmission Line Route
   - 2-2: Borehole locations identified at Site

3. Schedule for the Further Works
   - 3-1: Site survey for Environment and Social Consideration
     - Preparation and arrangement for PEA
     - Preparation condition of Survey Plan
   - 3-2: Survey schedule

1

1. Site Survey Schedule

1	2019/2/14	Thu	Haneda 22:00 (QF026) →Sydney 09:35
2	2019/2/15	Fri	Sydney 11:55→PortVila15:10 (QF375)
3	2019/2/16	Sat	Meeting with Sub-contractor in Port Vila
4	2019/2/17	Sun	Data collection
5	2019/2/18	Mon	Data collection
6	2019/2/19	Tue	Port Vila 14:00 (NF208)-Luganville 15:00 Meeting with VUI, Sub-contractor (geological investigation)
7	2019/2/20	Wed	Site Survey: Instruction of Drilling points (PS, headtank, waterway) Check Topographic map survey, Instruction of Access Route survey
8	2019/2/21	Thu	Site Survey: Instruction of Drilling points (Weir, Settling basin, waterway) Check Topographic map survey, Instruction of Access Route survey
9	2019/2/22	Fri	Meeting with VUI, DOL, Meeting with VUI at DS Site Survey: Instruction of Access Route survey
10	2019/2/23	Sat	Site Survey: Instruction of Drilling Points (waterway)
11	2019/2/24	Sun	Luganville08:00 →PortVila08:50 (NF211)
12	2019/2/25	Mon	Meeting with Sub-Contractor in Port Vila
13	2019/2/26	Tue	Meeting/discussion with DOE
14	2019/2/27	Wed	Meeting/discussion with DOE
15	2019/2/28	Thu	Meeting and discussion with Sub-contractors
16	2019/3/1	Fri	Meeting with JICA, DOE
17	2019/3/2	Sat	PortVila15:20 (NF010/QF376) →Sydney19:15, Sydney21:35 (QF025) →
18	2019/3/3	Sun	→Haneda05:00 (QF025)

PS: Power Station, SS: Substation, TL: Transmission Line, SY: Switch Yard, DS: Diesel PS, CS: Cross-Section
DOE: Department of Energy, MCCA (Ministry of Climate Change Adaptation, Meteorology, Geo-Hazards, Environment),
VMGD: Vanuatu Meteorology & Geo-Hazards, Department, MCCA, DOL: Department of Lands, Ministry of Lands, DEPC : Department of Environmental Protection and Conservation

2

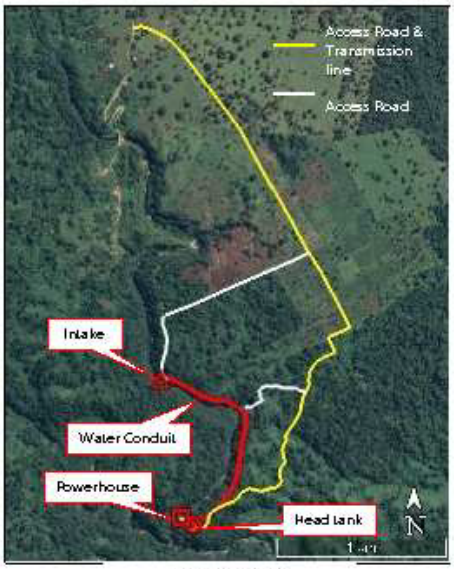
2. Summary of Site Visit

Site Works

- supervised subcontractors for
  - Topographic Survey and
  - Geological Investigation
- confirmed the following items with the subcontractors.
  - Route for Access Road and Transmission Line Route (6 km)
  - Borehole Locations (11 drilling points)

Outline of the project is shown in the right figure.

Site photographs and location maps are attached to the following pages.



Outline of Project

3

2-1: Access Road and Transmission Line Route

- Access Road from existing road to Powerhouse / Weir / Waterway was confirmed based on Topographic Condition and Land Use
- New Transmission Line will be the same route as Access Road


① Workshops
Distance between workshops is approx.19m. Gantry can be moved


② Entrance of plantation
Access road passes between pastureland and plantation


③ Access in plantation
Access road passes through coconuts plantation


④ Access to dam
Access road passes through bushes on steep slope

Access Road (L=6.0km)

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2. Summary of Site Visit

2-2: Borehole Locations (1)around Intake / Powerhouse

DB1:Intake weir

DB2:Intake (Sand basin)

HB1:Head tank

PB1:Penstock

PB2:Powerhouse

PB3:Powerhouse (Tailrace)

Borehole Locations around Intake and Powerhouse

2. Summary of Site Visit

2-2: Borehole Locations (2) Water Conduit

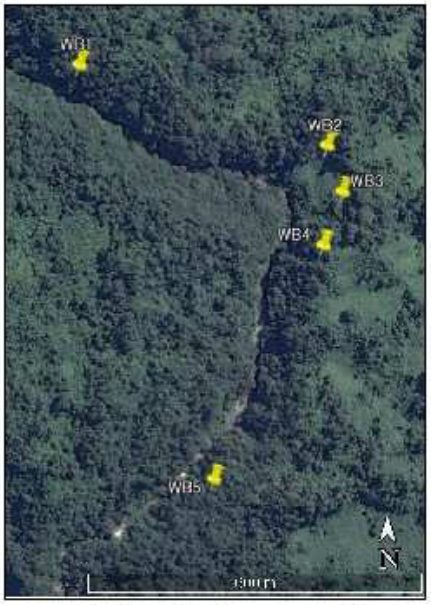
WB1:Water conduit No.1

WB2:Water conduit No.2

WB3:Water conduit No.3

WB4:Water conduit No.4

WB5:Water conduit No.5



Borehole Locations for Water Conduit

3. Survey Schedule for Further Works

3-1: Site survey for Environment and Social Consideration

2019/3/4	Mon	
2019/3/5	Tue	
2019/3/6	Wed	
2019/3/7	Thu	
2019/3/8	Fri	
2019/3/9	Sat	
2019/3/10	Sun	
2019/3/11	Mon	Tokyo →Australia
2019/3/12	Tue	Australia →PortVila
2019/3/13	Wed	Meeting with DOE, DEPC
2019/3/14	Thu	Meeting with NOL / Contract preparation
2019/3/15	Fri	Meeting with NALFFB / Contract preparation
2019/3/16	Sat	Data Collection
2019/3/17	Sun	Data Collection
2019/3/18	Mon	Meeting with relevant authorities / Contract preparation
2019/3/19	Tue	Meeting with relevant authorities / Contract preparation
2019/3/20	Wed	Meeting with relevant authorities / Contract preparation
2019/3/21	Thu	Contract with sub-contractor for ESC survey
2019/3/22	Fri	Meeting with DOE & sub-contractor
2019/3/23	Sat	Data Collection
2019/3/24	Sun	PortVila17:10 (NF208) →Luganville18:00
2019/3/25	Mon	Site Survey / Meeting with Sanma Environment and Extension Office
2019/3/26	Tue	Site Survey / Meeting with Sanma Land Department
2019/3/27	Wed	Site Survey / Meeting with Sanma Environment and Extension Office
2019/3/28	Thu	Luganville →PortVila
2019/3/29	Fri	Meeting with DOE & sub-contractor
2019/3/30	Sat	PortVila →Sydney →
2019/3/31	Sun	→Haneda

The schedule will be finalized after information from DEPC (Department of Environment Protection and Conservation).

Start PEA (Preliminary Environment Assessment)

TOR of EIA (Environmental Impact Assessment) will be prepared by DEPC (Department of Environmental Protection and Conservation)

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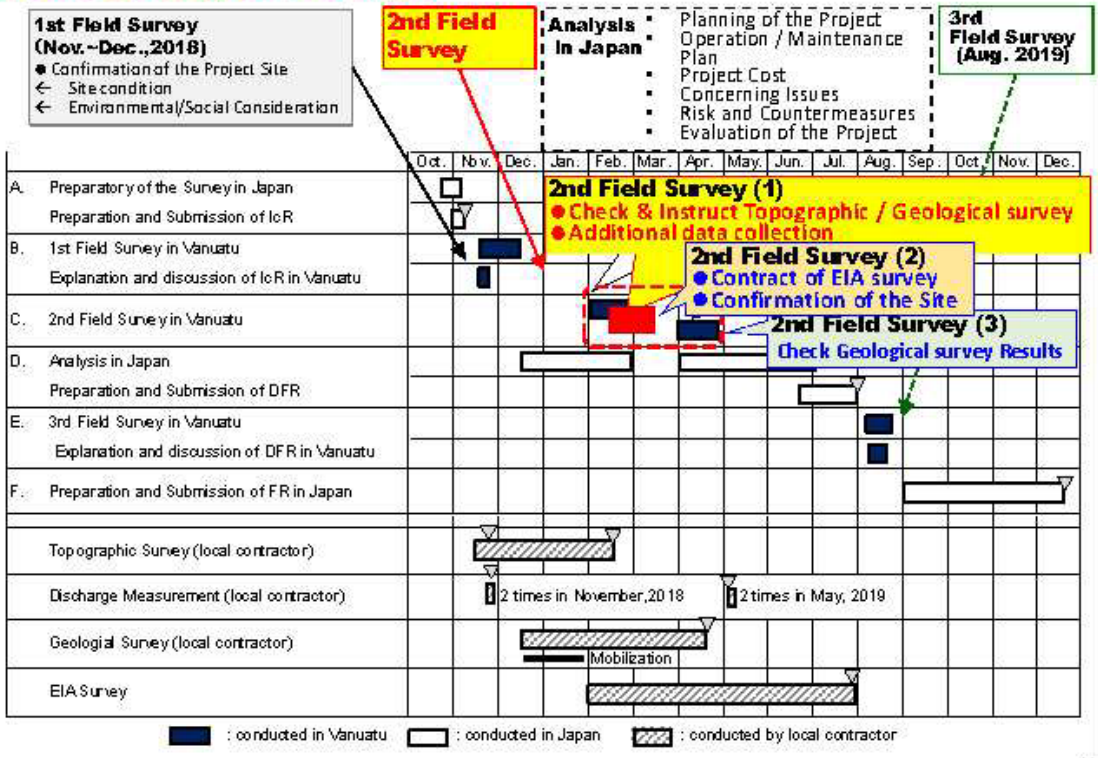
3-2: Survey Schedule



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3) 第 3 回現地調査（環境社会配慮）現地報告（2019 年 3 月 29 日）

The PREPARATORY SURVEY FOR THE PROJECT FOR CONSTRUCTION OF HYDROPOWER STATION IN ESPIRITU SANTO ISLAND

March, 2019

Environmental and Social Consideration

1. Site Schedule

2. Summary of the Activities
2-1: Environmental & Social Consideration
2-2: Land Acquisition Process
2-3: Others

3. Schedule for the Further Works

1

1. Site Survey Schedule

1	2019/3/11	Mon	Tokyo Narita 19:30 → Brisbane 5:40 (QF062)
2	2019/3/12	Tue	Brisbane 9:00 → PortVila 14:05 (QF377)
3	2019/3/13	Wed	Meeting with JICA
4	2019/3/14	Thu	Meeting with Department of Energy (DOE)
5	2019/3/15	Fri	Meeting with Department of Environment (DEPC) / Department of Land (DOL)
6	2019/3/16	Sat	Data Collection
7	2019/3/17	Sun	Data Collection
8	2019/3/18	Mon	Meeting with Sub-Contractor / Contract preparation
9	2019/3/19	Tue	Meeting with Department of Water
10	2019/3/20	Wed	Meeting with Department of Forestry
11	2019/3/21	Thu	Meeting with DEPC / Contract preparation
12	2019/3/22	Fri	Contract preparation
13	2019/3/23	Sat	PortVila17:10 → Luganville18:00 (NF208)
14	2019/3/24	Sun	Data Collection
15	2019/3/25	Mon	Site Survey / Meeting with VUI
16	2019/3/26	Tue	Site Survey
17	2019/3/27	Wed	Site Survey / Meeting with Sanma Environment and Extension Office Luganville 18:40 → Port Vila 19:30 (NF209)
18	2019/3/28	Thu	Contract preparation
19	2019/3/29	Fri	Contract with sub-contractor for ESC survey / Meeting with DOE & sub-contractor / JICA
20	2019/3/30	Sat	PortVila 15:20 → Sydney 19:15 (QF376), 21:35 →
21	2019/3/31	Sun	→Haneda 5:00 (QF025)

2

2. Summary of the Activities
2-1: Environmental & Social Consideration

Contract for the Survey

(1) Contract for the EIA and Social survey

- PEA report and TOR for EIA Survey were submitted by DEPC.
- Contract for the EIA and Social survey with consultant was done on 28th March 2019.
  Name: Bani's Environmental Consultants (Mr. Ernest Bani)
  Contact: 774-7030/564-6309, baniconsulting582@gmail.com

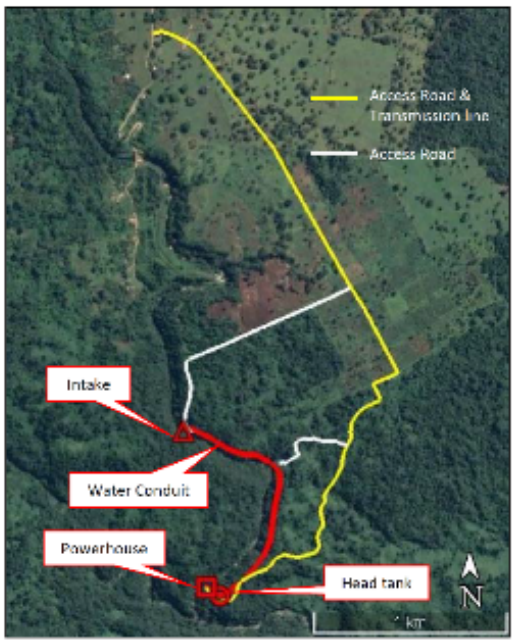
(2) Commencement of the EIA and Social Survey

- Survey will start from April
- Before site survey, Consultation Meeting will be held.

2. Summary of the Activities
2-1: Environmental & Social Consideration

Items of the EIA Survey

Category	Impacted Item on JICA Guidelines
Pollution	Air pollution
	Water pollution
	Waste
	Soil contamination
	Noise and Vibration
	Ground subsidence
	Odor
	Sediment quality
Natural Environment	Protected area
	Ecosystem
	Hydrology
	Topography and geology



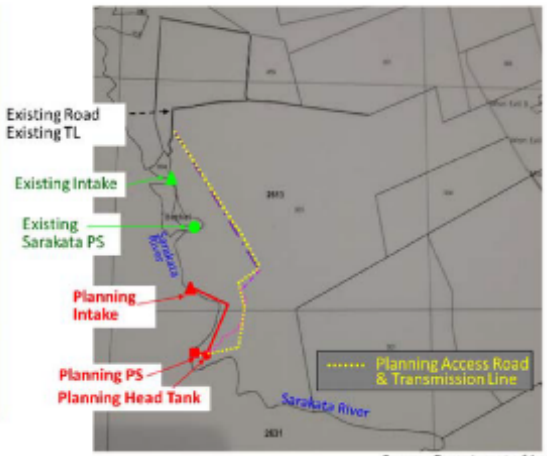
Outline of Project

2. Summary of the Activities
2-1: Environmental & Social Consideration

Items of the Social Survey

- Survey required by based on JICA Guideline
- JICA survey will be conducted with EIA survey

1. Identify possession status for land required
2. Determine areas by possession status
3. Understand socio-economic status of "Project Affected Persons (PAFs)"
4. Identify the eligibility of PAFs and develop compensation framework
5. Valuate benefits before/after the project



Source: Department of Lands

5

2. Summary of the Activities
2-1: Environmental & Social Consideration

Items of the Social Survey

Compensation & assistance for Project-affected Persons

- Compensation and assistance:
  - Shall be developed in accordance with Vanuatu's laws and international guidelines (JICA, World Bank);
  - Shall reflect demands of the Project Affected Persons (PAPs); and
  - Shall be provided before the construction with a full agreement between PAPs and the GoV.

- The framework for compensation/assistance will be developed in the next stage.

Note: The project is realized after an official agreement between the GoV and GoJ.

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2. Summary of the Activities
2-1: Environmental & Social Consideration

Consultation Meeting for EIA & Social Survey

1st Meeting (beginning of April 2019)

- Before the implementation of the Survey
- To share expected construction works of this project and environmental & social impact
- To explain the survey contents and schedule

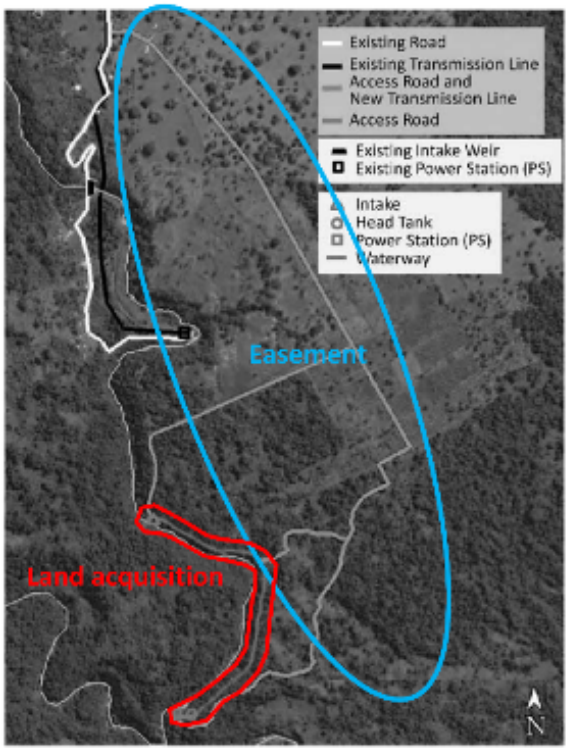
2nd Meeting (July 2019)

- After the preparation of Draft Final Report of the survey
- To explain the assessment result, mitigation measures and monitoring plan

7

2. Summary of the Activities
2-2: Land Acquisition Process

1) Request letter from MOCC to MOL for promotion of land acquisition was submitted.
2) Land acquisition process will be started from April 2019.
3) Survey Plan will be carried out within second quarter (April - June) 2019.
4) Access road should be managed as easement.
5) DOL shall negotiate directly with PRV, not land owners, for the economical compensation of properties along the easement.
6) Public Notice is not needed for easement process.
7) Survey for access road and project road by CTF will be completed on beginning of April.



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2. Summary of the Activities
2-2: Land Acquisition Process

Future Process

(1) Intention to acquire land or easement

- MOL prepares the Public Notice for the intension of the MOL to acquire the project land for national interest purposes and for easement of the access road.
- Public Notice must be more than 30 days and accompanied with a sketched plan
- Any objection is acceptable during this period.

(2) Declaration to acquire land/easement

- MOL prepares the Public Notice for the declaration that the Government is acquiring the land and creating an easement.
- Public Notice must be supported by the proper approved survey plan.

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2. Summary of the Activities
2-2: Land Acquisition Process

(3) Assessed Compensation

- MOL values and assesses the land value, and prepares the Public Notice for the assessed compensation.
- Public Notice must be during 30 days and any objection is acceptable during this period.
- If MOL receives the appeal, MOL re-assesses the value of compensation then he re-determine the value for compensation.
- If the interested parties are not happy with re-determination, they have 28 days to appeal to the Supreme Court , and the Supreme Court decision is final.

(4) Payment and Order

- Payment is conducted with observation of Ministry of Finance and Economic Management.
- MOL must issue an Order for possession and this Order is also used for land registration.

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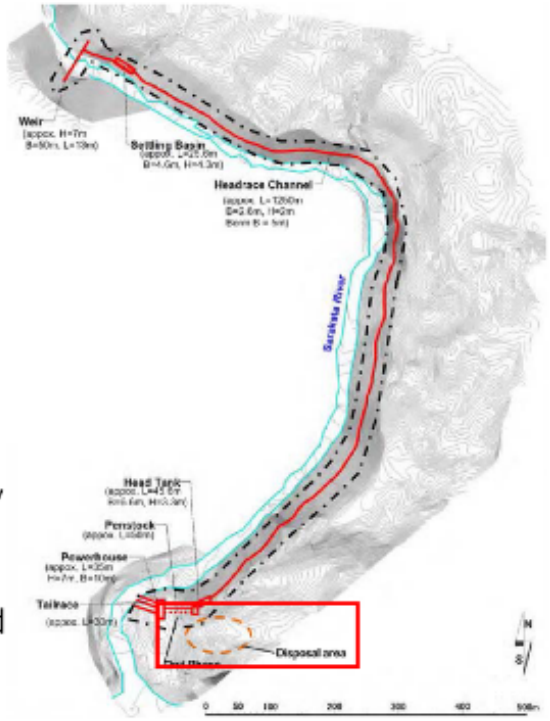
2. Summary of the Activities
2-2: Land Acquisition Process

Land for disposal area

- Area for disposal / storage of the waste (construction waste, residual soil and cutting tree/grass)
- Permanent or Temporary ??
- Land Acquisition or Lease or Easement??
- Environmental measurement (ex; turbid water control) is needed.
- In case waste is carried to landfill in Luganville, cost for carrying may be high.
- Ex). Soil should be used for another project and Organic should be used for biomass energy



2. Summary of the Activities
2-3: Others

(1) Application for water works & water use

- Officer of Department of Water Resources explained that DOE needs to apply for "Water-Works Permit" before construction and "Water-Use License" before operation of facilities.

(2) Cutting trees

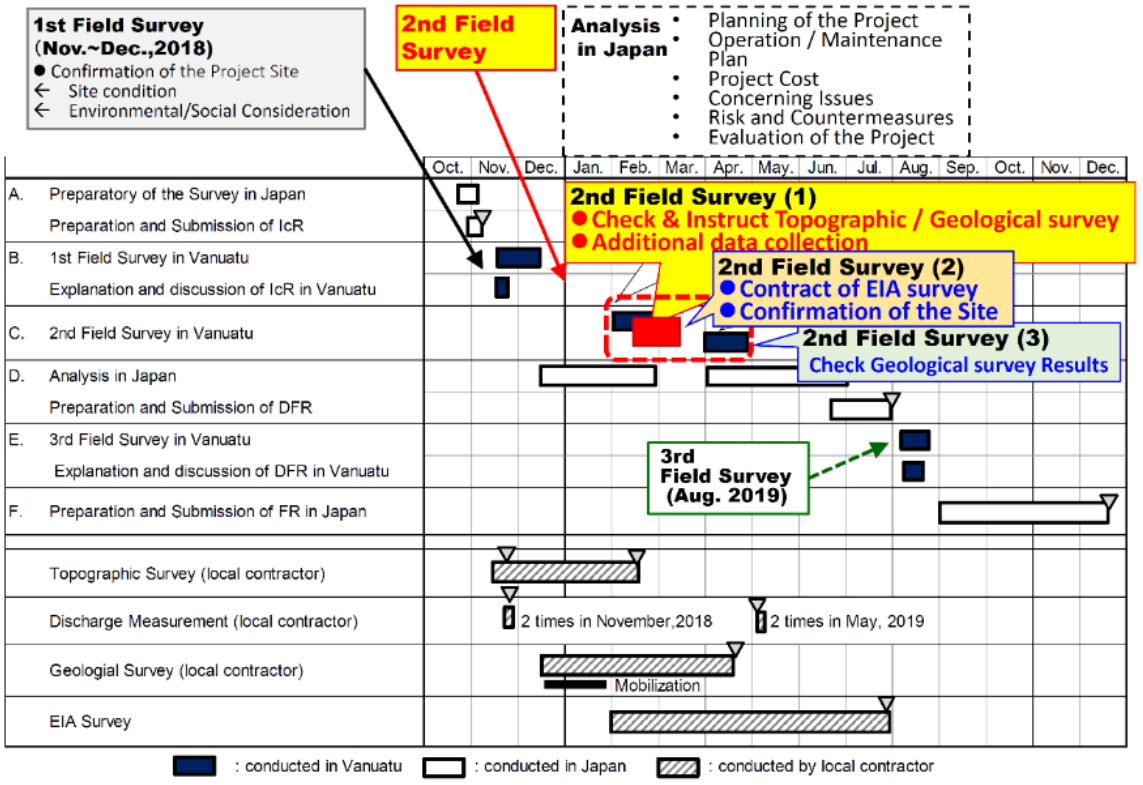
- Tree and another plants belong to the Land.
- When we need to cut trees, we compensate to Land owner or lease owner for it.

3. Schedule for Further Works

EIA & SIA Survey

Items	2019							
	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
PEA Implementation								
TOR publish								
Negotiate and Contract of Contractor								
1st Consultation Meeting for EIA & SIA								
Survey Implementation								
Draft final Report								
2nd Consultation Mee ting for EIA & SIA								
Modifying and Finalizing of Report								
Report Approval								

3. Schedule for Further Works



4) DOD　Web 会議（2020 年 10 月 8 日）

On-line Conference of explanation of Draft Report on Preparatory Survey

Agenda

October 8, 2020

10:00 - : Introduction of participants
10:10 - : Opening speech（JICA, DOE）
10:10 - : Outline of Project Scheme

- Basic design for civil facilities, transmission line facilities, substation equipment and access road
- Construction program & implementation schedule
- Operation & maintenance and management of the new hydroelectric power plant including soft component
- Q&A

11:10– : Environmental and Social Consideration and Land Matters

- Implementation of EIA, its approval procedures, JICA guidelines, land acquisition process and construction permission and hydroelectric power operation permission (with DEPC)
- Status of Land acquisition and Procedures, necessary procedures of land acquisition, preparation of disposal area, and necessary procedures such as acquisition of Water Work Permit and Water Use License (with DOL)
- Q&A

On-line Conference of explanation of Draft Report on Preparatory Survey

11:30 –: Japan's Grant, Q & A

- Japan's Grant Aid procedures and the scope of the works to be undertaken by the Recipient Country, project implementation organization
- Q & A

12:00 – : GCF

- Updates on GCF Project
- Q & A

12:30 – : Sign Minutes of Discussion (MOD)
Lunch time

13:30 –: spare time

PREPARATORY SURVEY
FOR
THE PROJECT FOR THE CONSTRUCTION OF HYDROPOWER STATION IN ESPIRITU SANTO ISLAND

October, 2020

NEWJEC Inc.
CTI Engineering International Co., Ltd.

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PREPARATORY SURVEY FOR THE PROJECT FOR CONSTRUCTION OF HYDROPOWER STATION IN ESPIRITU SANTO ISLAND

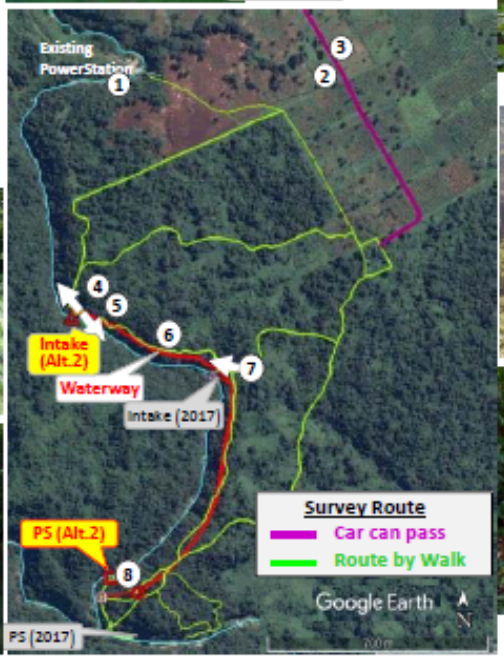
Preparatory Survey Report (Draft)

October, 2020

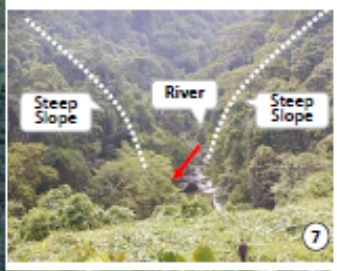
Table of Content

Site Reconnaissance [Nov. 19-29, 2018]

Discharge measurement at downstream of existing PS



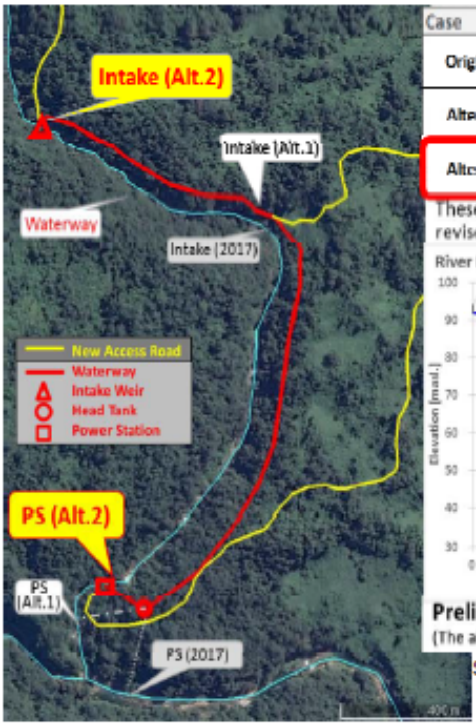
Steep slope along waterway



Terrace of PS (5m above from river bed)

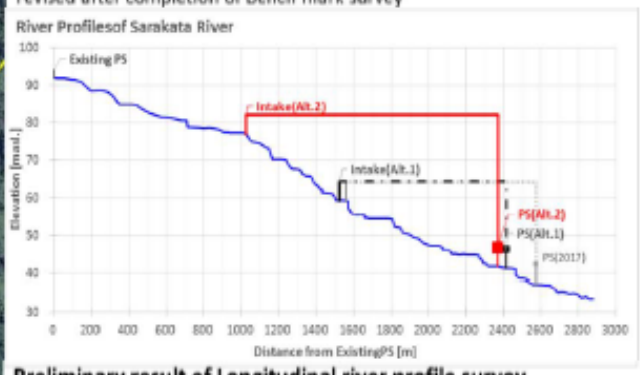
General Plan & Profile of New Sarakata Hydropower Project

Based on site reconnaissance and river profile survey, alternative project layout having higher head in steep river gradient section was identified, which realizes 1,000kW-class hydropower project.



Case	point	Elevation [masl.]		Remarks
Original-2017	Intake(2017)	64.1	Gross Head	Penstock passes
	PS(2017)	42.3	21.9 m	valleys
Alternative-1	Intake(Alt 1)	64.2	Gross Head	Penstock slope is
	PS(Alt 1)	46.2	18.1 m	gentle
Alternative-2	Intake(Alt 2)	82.0	Gross Head	Larger head can be
	PS(Alt 2)	46.7	35.2 m	available

These values are tentative and absolute values of elevation will be revised after completion of Bench mark survey



Preliminary result of Longitudinal river profile survey

(The absolute values of elevation will be revised after completion of Bench mark survey)

Selection Points of Optimum Project Layout are as follows:

- ✓ Steep river slope section
- ✓ No influence of backwater to the existing Sarakata river HEPP

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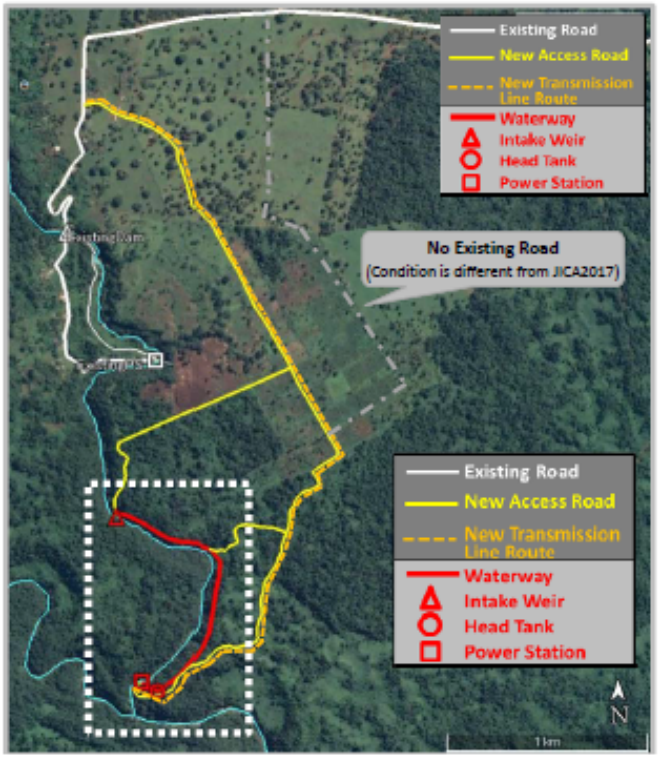
General Layout of New Sarakata Hydropower Project

The Project consists of 1,000kW-class hydropower plant, access road, 20kV transmission line and equipment enhancement of Luganvilla substation.



- Hydropower plant:
  Intake weir, settling basin, headrace channel, headtank, penstock, powerhouse, tailrace
  1,000kW=500kW x 2 unts
- Transmission line:, length=4.0 km
  (new powerplant ~ existing power plant)
- Access road: length=3.2 km, width=3m
  (new power house/ intake weir ~ existing road)
- Lugenvilla S/S: 1,500kVA transformer

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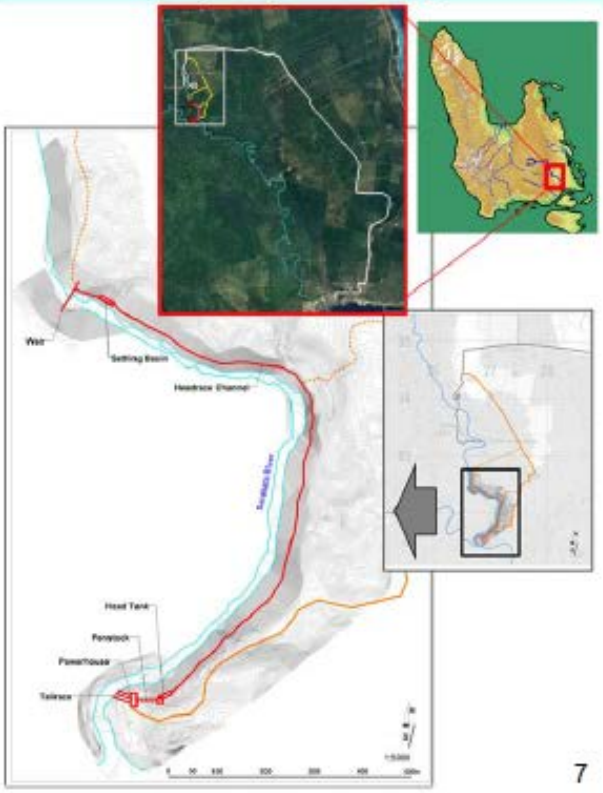
General Layout and Features of New Hydropower Project

Power Generation Type		Run-of-River type	
Installed Capacity	Total	kW	1,000
	Single	kW	500
Plant Discharge	Total	m^3/s	4.2
	Single	m^3/s	2.1
Head	Gross Head	m	33.0
	Effective Head	m	32.3
Number of Turbine & Generator		unit	2
Annual Power Generation		MWh	9,020



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Access Route from new P/H to the Existing Road

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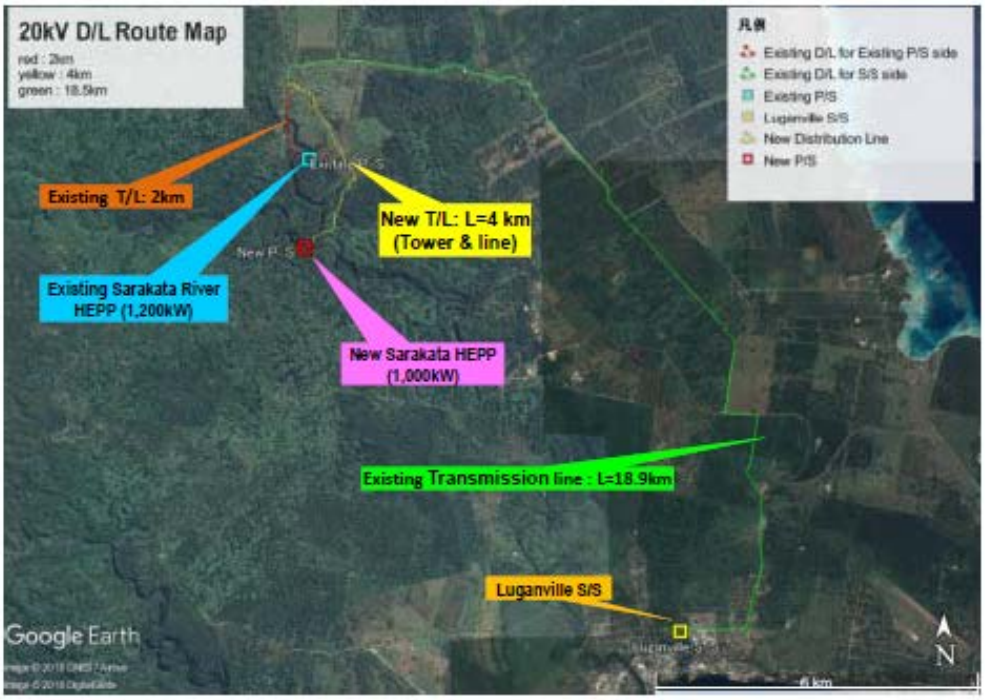
20kV Transmission Line Route from new P/H to Lugenville S/S



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General Topography of Project Site


Steep slope on the left bank

Water fall on the Sarakata River

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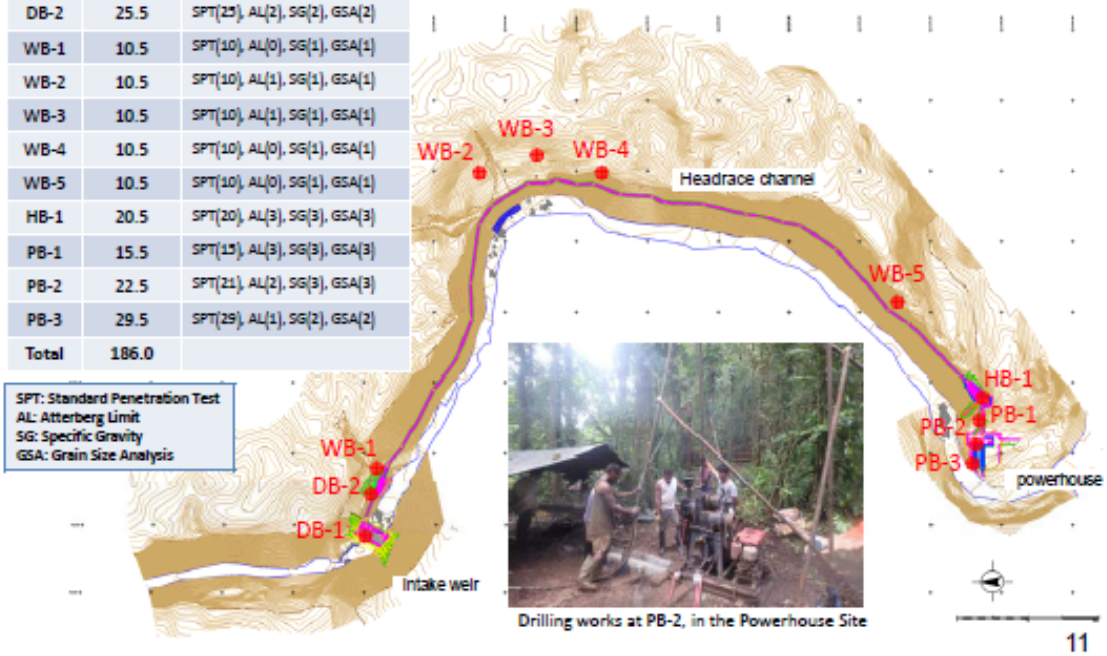
Geological Investigations

(1) Location of Boring

BH.No	Depth(m)	Soil / Rock Test
DB-1	20.0	SPT(18), AL(3), SG(3), GSA(3)
DB-2	25.5	SPT(23), AL(2), SG(2), GSA(2)
WB-1	10.5	SPT(10), AL(0), SG(1), GSA(1)
WB-2	10.5	SPT(10), AL(1), SG(1), GSA(1)
WB-3	10.5	SPT(10), AL(1), SG(1), GSA(1)
WB-4	10.5	SPT(10), AL(0), SG(1), GSA(1)
WB-5	10.5	SPT(10), AL(0), SG(1), GSA(1)
HB-1	20.5	SPT(20), AL(3), SG(3), GSA(3)
PB-1	15.5	SPT(15), AL(3), SG(3), GSA(3)
PB-2	22.5	SPT(21), AL(2), SG(3), GSA(3)
PB-3	29.5	SPT(29), AL(1), SG(2), GSA(2)
Total	186.0	

SPT: Standard Penetration Test
AL: Atterberg Limit
SG: Specific Gravity
GSA: Grain Size Analysis



Drilling works at PB-2, in the Powerhouse Site

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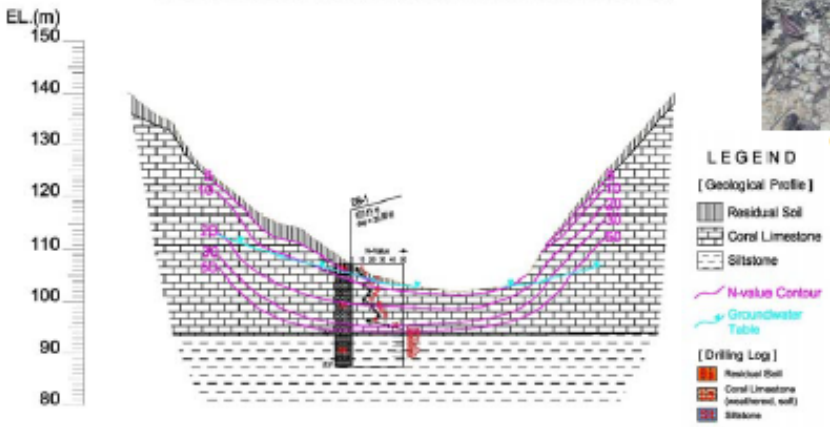
Geological Investigations

(2) Geologic Condition, Intake Site

Assumed Geological Profile on Alt-2. Intake Site
(Looking from the upstream)

GEOLOGICAL PROFILE ALONG THE INTAKE WEIR




Coral Limestone on the River floor

[Geotechnical Key-Points]

- Riverbed consists of gravelly coral limestone which has 10 – 20 of N-values above 5m deep, on Alt-2 Intake Site.
- The right bank shows continuous cliff and steep slopes (higher than 20m). A large amount of excavation will be.
- Coral limestone having 20 of N-value will possibly underpin the weir with no trouble.

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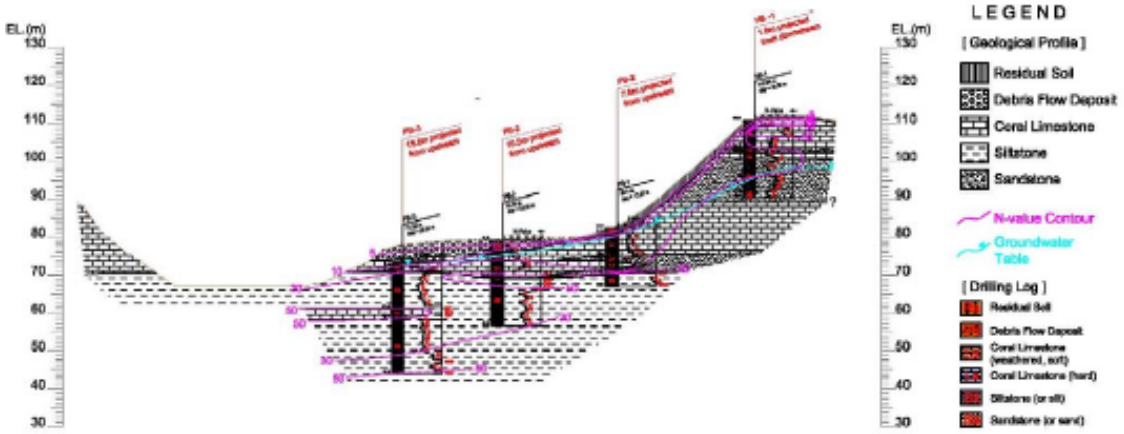
Geological Investigations

(3) Geologic Condition, Powerhouse Site

Assumed Geological Profile along Head Tank To Tailrace
(Looking from the Downstream)



[Geotechnical Key-Points]

- At the Head tank, a massive coral limestone appears within 3m deep.
- An anchor block at the lower part of the penstock is located, N-values exceed 10 at 2m deep but certainly exceed 20 at 12m deep.
- A thick siltstone layer continues deeper than 30m in depth. The siltstone has N-values ranging from 20 to 30.

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Discharge Measurement

In order to verify the calculation value, discharge measurement was conducted

5.2 m3/s

5.5 m3/s

Almost fit well

Calculation based on Operation record →Q: River Discharge : 4.9 m3/s

(Culculation)

$Q1 + Q2 + Q3 = Q$

※$Q1$ & $Q3 = 1.8 \times L \times H^{3/2}$

(L=width of weir(m), H=water level(m))

(Specifications)

Intake weir width = 38.1 (m)
Headtank spillway width = 10 (m)
Overflow water level at intake weir = 2.73 (m)

Figure 6-3-4 Image of Culculation Method for Voncersion Flow Rate

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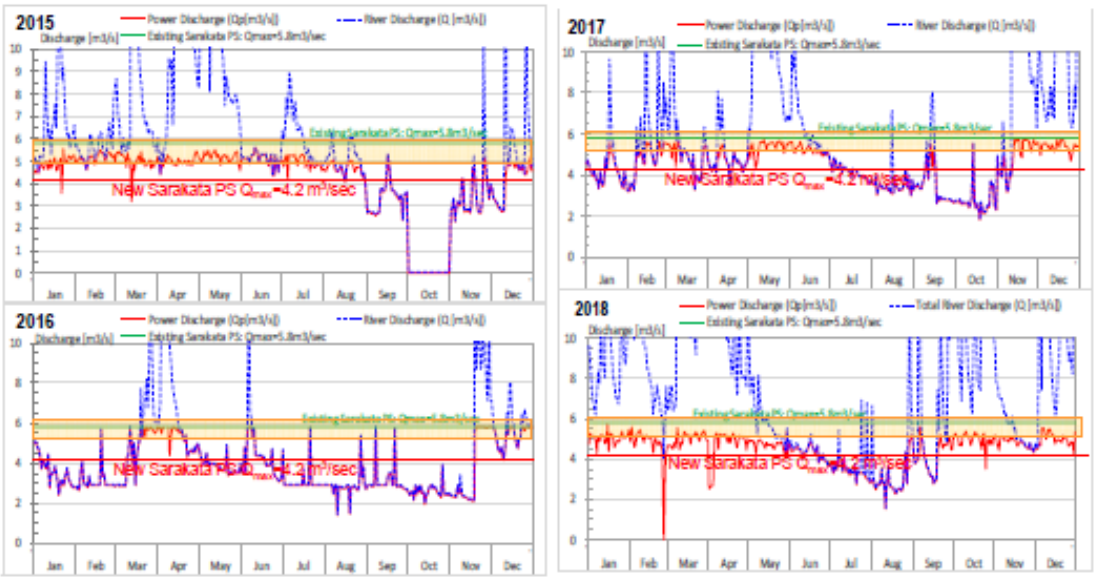
Daily River Discharge based on Operation Records at Intake

River Discharge from January 2015 to October 2018 was calculated by using operation records of existing Sarakata River Hydropower plant.

From 2015 to 2018



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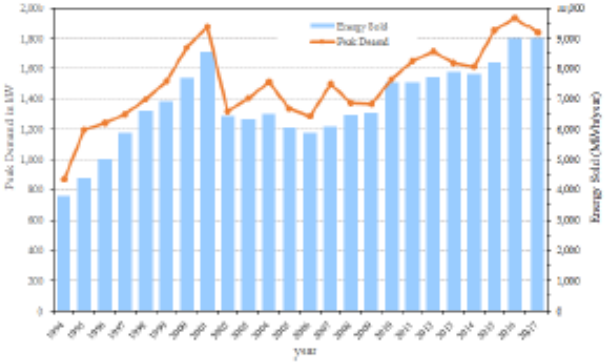
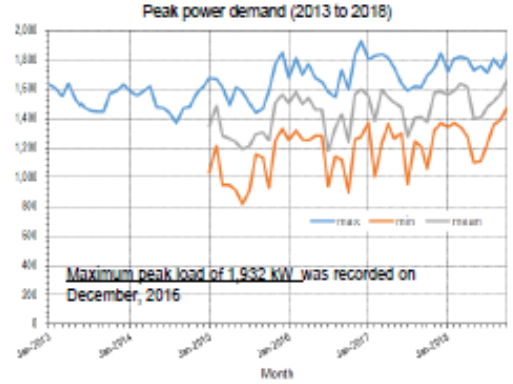
Peak Load and Generated Energy

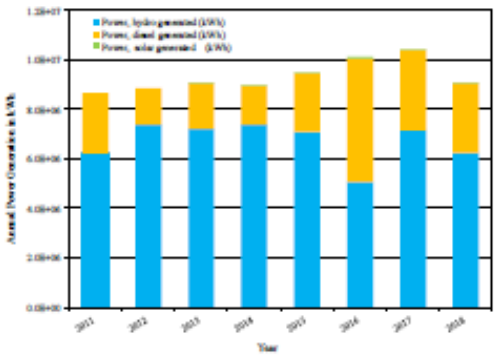
Peak power demand and Annual sales generated energy (1994 to 2017)



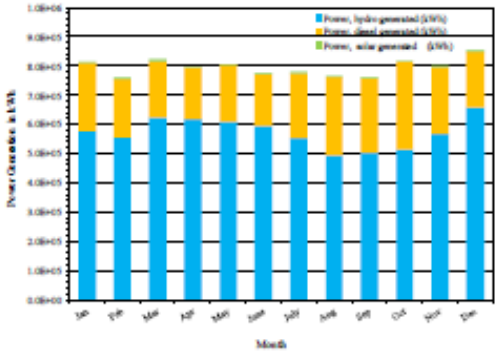
Peak power demand (2013 to 2018)



Annual Power Generation of Various Power Sources (2011 to 2018)



Monthly Average Power Generation Various Power Source (2011 to 2018)



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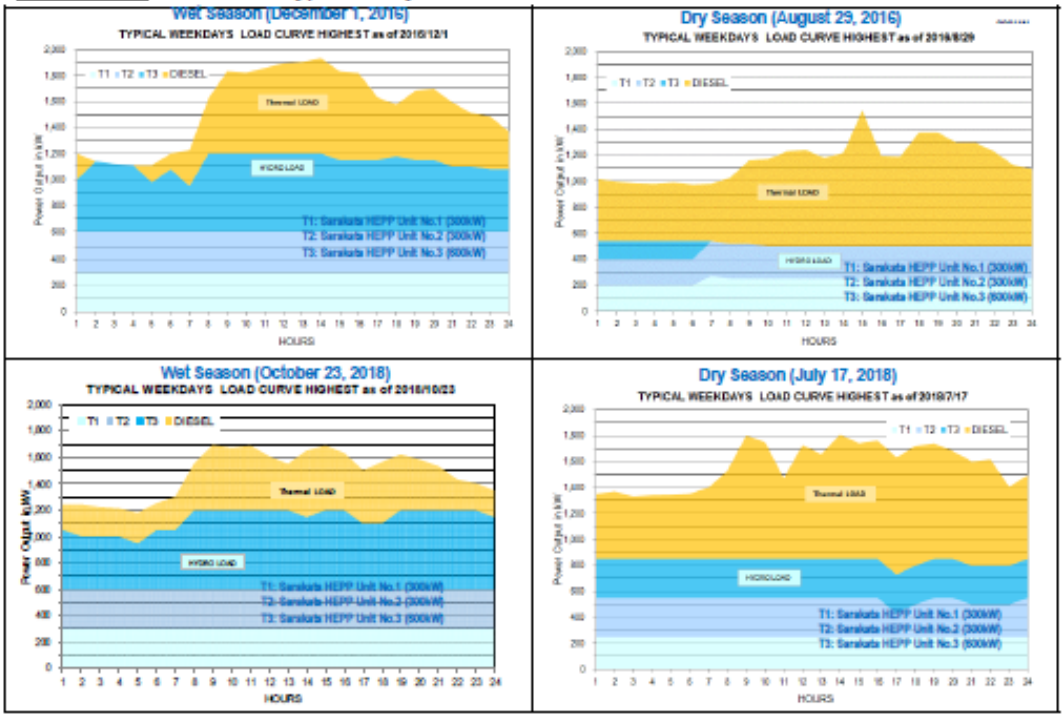
Typical Daily Load Curve in Wet and Dry Seasons

The peak hour occurs in the daytime and a large amount of thermal generation is required in dry season as shown in typical daily load curves below.



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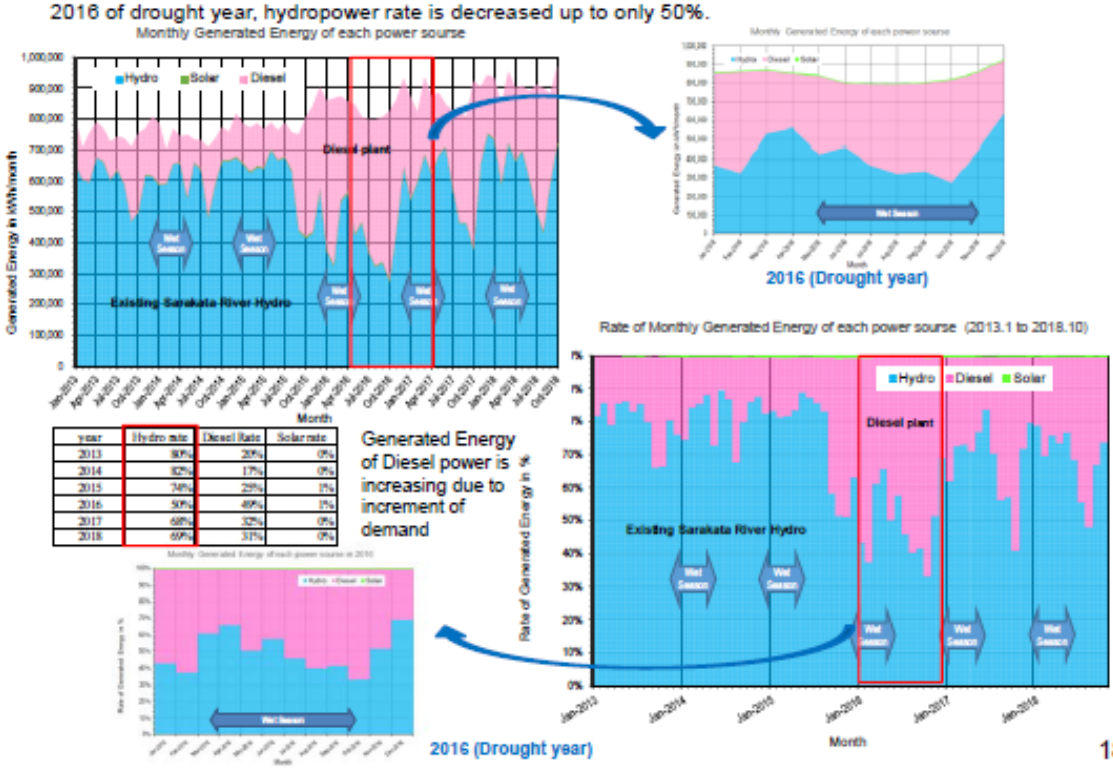
Hydropower Energy vs Diesel power Energy from 2013 to 2018

Rate of Hydro energy (Sarakata HEPP) is being decreased to around 70% as shown below. Especially in 2016 of drought year, hydropower rate is decreased up to only 50%.



year	Hydro rate	Diesel Rate	Solar rate
2013	80%	20%	0%
2014	82%	17%	0%
2015	74%	25%	1%
2016	50%	49%	1%
2017	68%	32%	0%
2018	69%	31%	0%

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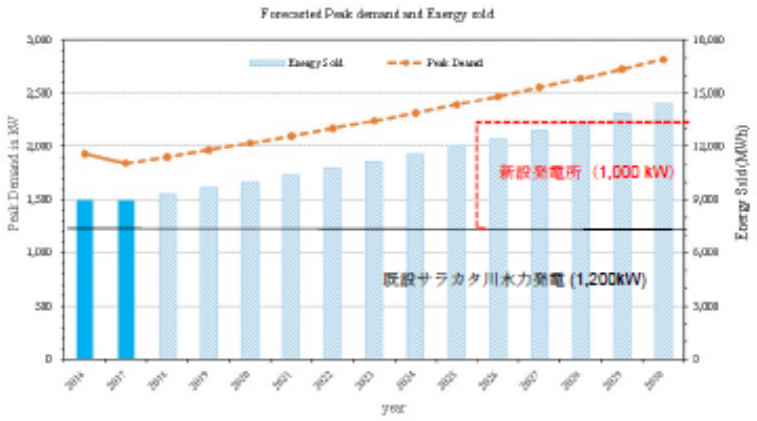
Power Demand Forecast

In the last 10 years (2018~2017), peak power demand and annual sales generated energy have increased at the rate of 3.3 % and 3.7% respectively. The power demand forecast up to 2030 was conducted using these rates. Peak demand of 2030 is assumed to be 146 % more than the existing one, i.e. around 2,800 kW, and the annual sales of generated energy is assumed to be 160 % more than existing one, i.e. around 14,400 kWh/year.



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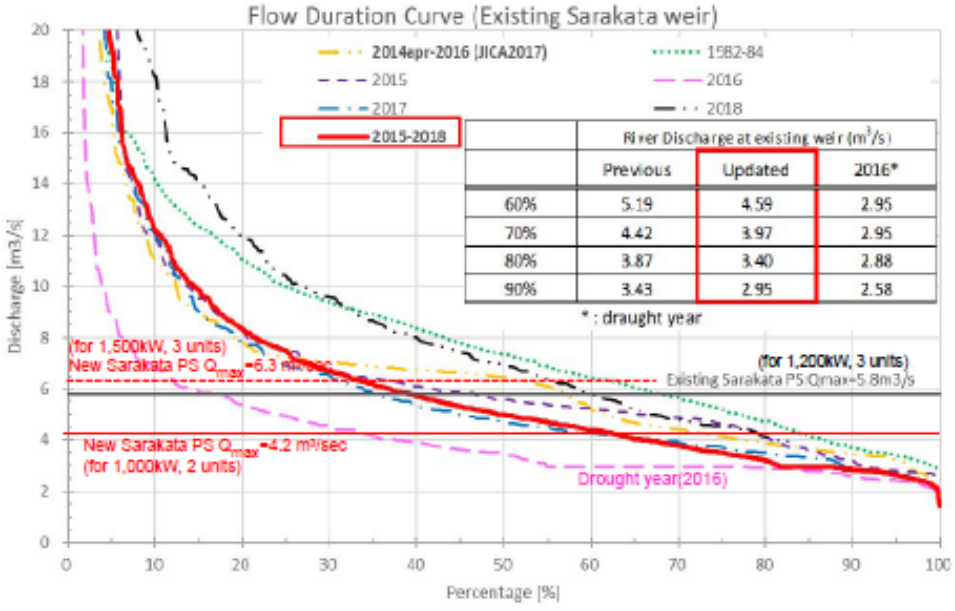
Duration Curve at Intake Weir

Updated duration curve applied to this scheme is obtained by using the river flow based on the operation records from 2015 to 2018



	River Discharge at existing weir (m^3/s)		
	Previous	Updated	2016*
60%	5.19	4.59	2.95
70%	4.42	3.97	2.95
80%	3.87	3.40	2.88
90%	3.43	2.95	2.58

* : draught year

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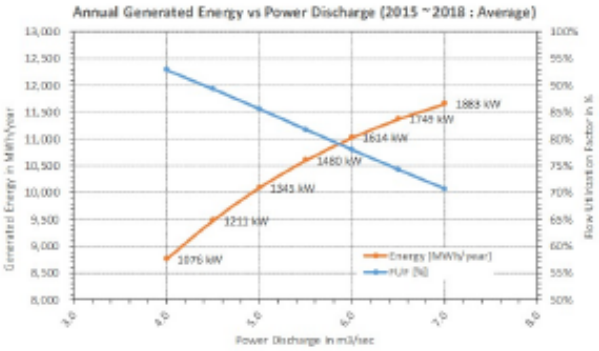
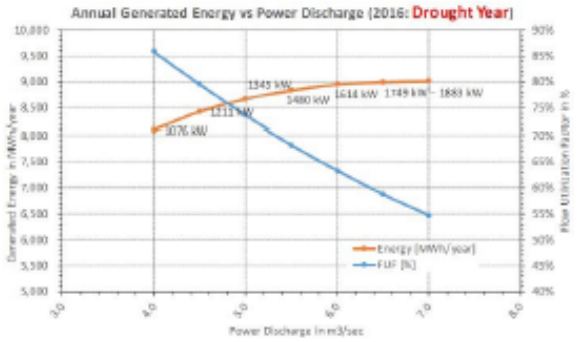
Power Discharge vs Power Output & Generated Energy

Maximum power discharge was determined by means of duration curve by using the river flow based on the operation records from 2015 to 2018 for 1,000kW-scale generation plan.





2015 ~ 2018

Qp [m³/sec]	P [kW]	Energy [MWh/year]	increment [%]	FUF [%]
4.0	1,076 (970)	8,763	0.0%	92.9%
4.5	1,211 (1,100)	9,481	8.2%	89.4%
5.0	1,345 (1,220)	10,095	6.5%	85.7%
5.5	1,480 (1,340)	10,604	5.0%	81.8%
6.0	1,614 (1,460)	11,029	4.0%	78.0%
6.5	1,749 (1,580)	11,377	3.1%	74.3%
7.0	1,883 (1,710)	11,663	2.5%	70.7%

$E = P \times 8{,}760 \times FUF$

$P = 9.8 \times Qp \times He \times \eta_{tg}$

where,

E : Annual generated energy (kWh/year)
P: Power output (kW)
Qp : Power discharge
He: effective head (30m, Hg=33.2m)
η_{tg} : efficiency of turbine and generator (0.8)

2016 (Drought year) for reference

Qp [m³/sec]	P [kW]	Energy [MWh/year]	increment [%]	FUF [%]
4.0	1,076 (970)	8,089	0.0%	85.8%
4.5	1,211 (1,100)	8,433	4.2%	79.5%
5.0	1,345 (1,220)	8,677	2.9%	73.6%
5.5	1,480 (1,340)	8,836	1.8%	68.2%
6.0	1,614 (1,460)	8,952	1.3%	63.3%
6.5	1,749 (1,580)	8,998	0.5%	58.7%
7.0	1,883 (1,710)	9,018	0.2%	54.7%

( ): rated power output, including 10% margin

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Optimization Study of New Hydropower Plant (1)

Comparison Study of various power discharge was conducted by using unit construction cost of JPY/kWh

		1,000kW	2 units	3 units			1500kW		
Q (m3/sec)	4.0	4.2	4.5	5.0	5.5	6.0	6.3	6.5	7.0
He (m)	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3
Total P (kW)	1,076	1,130	1,211	1,345	1,480	1,614	1,695	1,749	1,883
Total P (kW) rated	970	1,020	1,100	1,220	1,340	1,460	1,540	1,580	1,710
E(MWh/year)	8,763	9,061	9,481	10,095	10,604	11,029	11,244	11,377	11,663
Number of unit	2	2	2	3	3	3	3	3	3
Unit P (kW)	485	510	550	407	447	487	513	527	570
Civil works	1,832.6	1,852.1	1,881.2	2,010.4	2,060.1	2,109.9	2,139.7	2,168.4	2,239.5
Direct cost	1,243.5	1,256.6	1,276.4	1,364.0	1,397.8	1,431.6	1,451.8	1,471.3	1,519.5
Generation facility	740.7	751.4	767.4	838.3	865.7	893.0	909.4	925.1	964.2
Access road	265.6	265.6	265.6	265.6	265.6	265.6	265.6	265.6	265.6
Indirect cost etc.	589.2	595.4	604.8	646.3	662.3	678.3	687.9	697.1	720.0
Architecture works	104.4	104.4	104.4	156.6	156.6	156.6	156.6	156.6	156.6
Direct cost	83.2	83.2	83.2	124.8	124.8	124.8	124.8	124.8	124.8
Indirect cost etc.	21.2	21.2	21.2	31.8	31.8	31.8	31.8	31.8	31.8
Purchase and Installation of Equipment	1,239.5	1,287.0	1,363.0	1,490.6	1,604.5	1,718.5	1,794.4	1,858.7	2,002.6
Generating equipment	1,203.4	1,249.5	1,323.2	1,447.2	1,557.8	1,668.4	1,742.1	1,804.6	1,944.3
Transformer (Luganville S/S)*1	80.0	80.0	80.0	93.3	93.3	93.3	93.3	106.7	106.7
Transmission line (L=6km)	229.3	229.3	229.3	229.3	229.3	229.3	229.3	241.6	261.5
General administrative cost	36.1	37.5	39.7	43.4	46.8	50.1	52.3	54.2	58.4
Additional 20kV T/L (L=20.5km)	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0
Total Construction cost	3,176.5	3,243.5	3,348.6	3,657.6	3,821.3	3,985.0	4,090.8	4,183.7	4,398.7
Total Construction cost incl. 20kV T/L	3,476.5	3,543.5	3,648.6	3,957.6	4,121.3	4,285.0	4,390.8	4,483.7	4,698.7
Construction Cost per kWh	362.5	358.0	353.2	362.3	360.4	361.3	363.8	367.8	377.1
Construction Cost per kWh incl. 20kV T/L	396.7	391.1	384.8	392.0	388.7	388.5	390.5	394.1	402.9

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Optimization of 500 kW scale Expansion Plan (1)

Optimum expansion plan is examined by means of duration curve using the river flow based on the operation records from 2015 to 2018

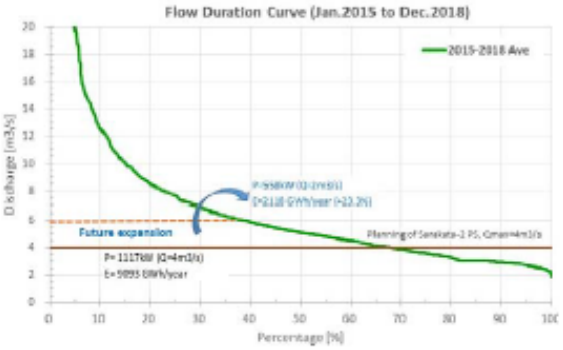
Average (2015 ~ 2018)

Qp [m3/sec]	P [kW]	Energy [MWh/year]	increment [%]	FUF [%]
1.5	419	1,714	18.8%	81.8%
2.0	558	2,118	23.3%	78.0%
2.5	698	2,458	27.0%	74.3%

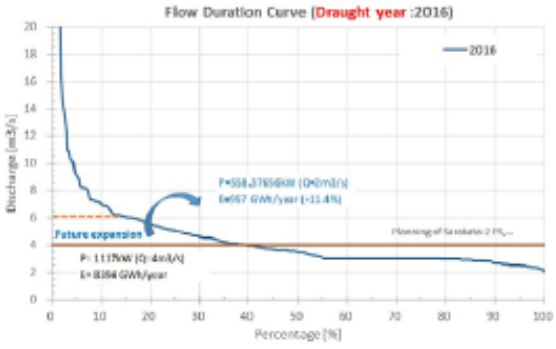
2016 (Drought year) for reference

Qp [m3/sec]	P [kW]	Energy [MWh/year]	increment [%]	FUF [%]
1.5	419	813	9.7%	68.2%
2.0	558	957	11.4%	63.3%
2.5	698	1,069	12.7%	58.7%

Remarks: *1: FUF after the construction of expansion scheme



Power discharge and annual available generated energy of 500 kW scale expansion plan (2015~2018)



Power discharge and annual available generated energy of 500 kW scale expansion plan (drought year of 2016)

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Optimization of 500 kW scale Expansion Plan (2)

Construction coverage of the expansion plan (future Unit No.3 of 500kW) during the construction of a new plant is determined considering the following aspects.

Civil facility	new plant construction	expansion construction	(a)	(b)	(c)	(d)	(e)
Intake weir*1	all works incl. expansion	No work	-	-	-	-	-
Intake	all works incl. expansion	No work	○	○	○	○	○
Settling basin	all works incl. expansion	No work	○	○	○	○	○
Headrace (Open channel)	all works incl. expansion	No work	○	○	○	○	○
Head tank	all works incl. expansion	No work	○	○	○	○	○
Spillway	all works incl. expansion	No work	○	○	○	○	○
Penatock	No.1 & 2	No.3		○			○
Foundation of power house	all works incl. expansion	No work	○	○	○	○	○
Power house building	Works for No.1 & No.2 Units	Works for No.3 Unit					○
Site preparation of power house	all works incl. expansion	No work	○	○	○	○	○
Tailrace and Outlet	Works for No.1 & No.2 tailrace	Works for No.3 tailrace facility		○			○
Transmission line	Works excl. expansion	Works for additional capacity		○			
Substation facility	Works excl. expansion	Works for additional capacity		○			
Turbine and generator	No.1 & No.2 units	No.3 unit		○			
Control and protection equipment	No.1 & No.2 units	No.3 unit		○			

(a)	To minimize the stoppage duration of the new power generation during expansion construction
(b)	To shorten the construction duration of expansion scheme
(c)	To largely reduce the construction cost of the expansion scheme
(d)	Not necessary to carry out repair and replacement works caused by deterioration during expansion construction
(e)	Design changes of expansion scheme will not occur even though the expansion construction is conducted earlier

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Optimization Study of New Hydropower Plant (2)

Present scheme (1,000kW) including expansion work and expansion work (500kW)

	Present scheme incl. expansion (1,000 kW)	Expansion work (500 kW)	After Expansion work (1,500 kW)	Rate of present scheme to all works (%)
Q (m3/sec)	4.2	2.1	6.3	
He (m)	32.3	32.3	32.3	
Total P (kW)	1,130	565	1,695	
Total P (kW) rated	1,020	510	1,540	
E(MWh/year)	9,061	2,111	11,172	
Number of unit	2	1	3	
Unit P (kW)	510	510	513	
Civil works	2,085.3	68.1	2,153.4	96.8%
Direct cost	1,414.9	46.2	1,461.1	96.8%
Generation facility	879.5	37.4	916.9	95.9%
Access road	265.6	0.0	265.6	100.0%
Indirect cost etc.	670.4	21.9	692.3	96.8%
Architecture works	104.4	52.2	156.6	66.7%
Direct cost	83.2	41.6	124.8	66.7%
Indirect cost etc.	21.2	10.6	31.8	66.7%
Purchase and Installation of Equipment	1,287.0	525.4	1,812.4	71.0%
Generating equipment	1,249.5	510.1	1,759.6	71.0%
Transformer (Luganville S/S)*1	80.0	40.0	120.0	66.7%
Transmission line (L=6km)	229.3	0.0	229.3	100.0%
General administrative cost	37.5	15.3	52.8	71.0%
Additional 20kV T/L (L=20.5km)	0.0	300.0	300.0	0.0%
Total Construction cost	3,476.7	645.7	4,122.4	84.3%
Total Construction cost incl. 20kV T/L	3,476.7	645.7	4,422.4	78.6%
Construction Cost per kWh	383.8	305.8	369.0	
Construction Cost per kWh incl. 20kV T/L	383.7	305.8	395.8	

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Power Generation Plan

Head tank WL	105.1m
Tailrace pit WL	in operation 72.2m (for Maximum power discharge) in stopping 71.5m
Gross head	32.9m(for Maximum power discharge)
Maximum power discharge	4.2m³/sec (total of 2 units)
Effective head	32.3m
Maximum power output	1,100 kW*1 (each unit 565kW*1, combined efficiency of turbine and generator η= 0.85) *1: considering around 10% margin for 1,000kWscale

		2015	2016	2017	2018	Average
Jan	MWh/month	841	689	793	841	791
Feb	MWh/month	759	559	730	758	702
Mar	MWh/month	841	759	824	841	816
Apr	MWh/month	814	814	807	814	812
May	MWh/month	841	771	841	841	823
Jun	MWh/month	-	750	814	799	787
Jul	MWh/month	841	589	812	696	734
Aug	MWh/month	838	563	689	585	669
Sep	MWh/month	636	569	637	751	648
Oct	MWh/month	-	487	505	841	611
Nov	MWh/month	632	585	793	814	706
Dec	MWh/month	766	841	841	841	822
Annual	MWh/year		7,975	9,085	9,420	8,922
FUF [%]			80.56%	91.78%	95.17%	90.13%

Drought year

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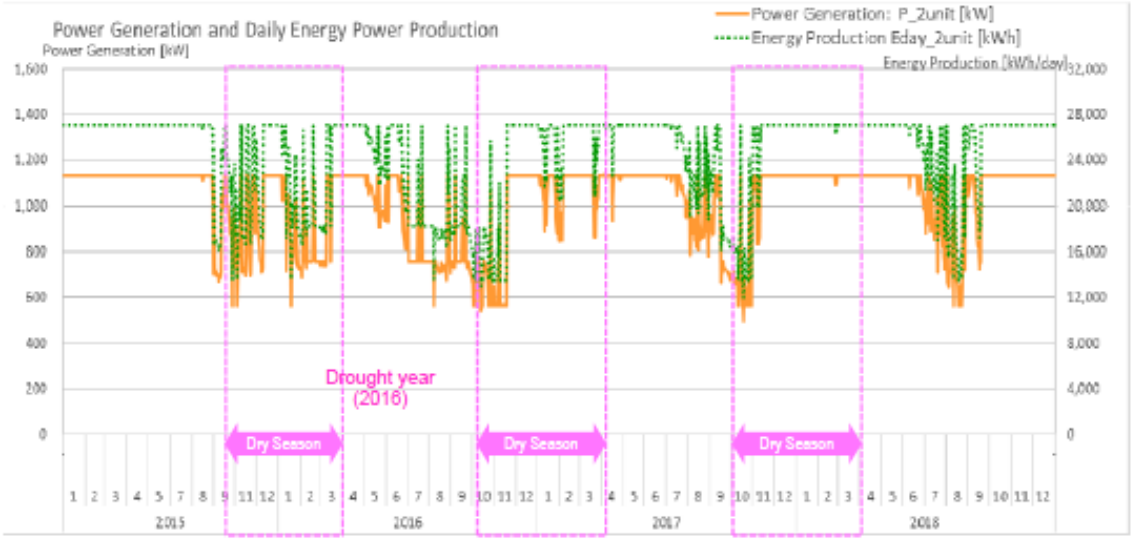
Power Generation Plan

Power output and energy production of a new Sarakata hydropower plant were calculated by the river flow based on the operation records from 2015 to 2018.



Calculation results of generated energy based on duration curve of each year (2015~2018)

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Basic Design of Civil Facilities (1)

(1) Overall Plan

Civil facilities of the new hydroelectric power plant consist of the intake weir, sand settling basin, headrace channel, head tank, penstock, spillway, tailrace and powerhouse.
The power discharge of 4.2 m^3/sec for two (2) units of hydraulic turbines is taken from the river and transmit it to the turbine, and release it back to the river.
The main components of civil engineering facilities are shown below.

Components	Specifications
Intake weir	H=12.5m, W=57.8m
Sand settling basin	L=27.25m, H=4.1m, W=7m
Headrace channel	Single line, L=1.2km, W=2m, H=2m, Slope=1/500
Head tank	L=39m, H=3.9m, W=8m
Penstock and spillway	ID1,500mm-ID1,100mm, L=59.8m / ID1,500mm-ID1,100mm, L=43.0m
Tailrace channel	2 lines, No.1 L=m, W=1m, H=1.8m, Slope=1/100, No.2 L=m, W=1m, H=1.8m, Slope=1/100
Building of powerhouse	Two-storied reinforced concrete building, total floor area: 350m^2

Civil and building structures are designed in conformity with Japanese standards so as to ensure adequate stability, structural mechanics and durability.

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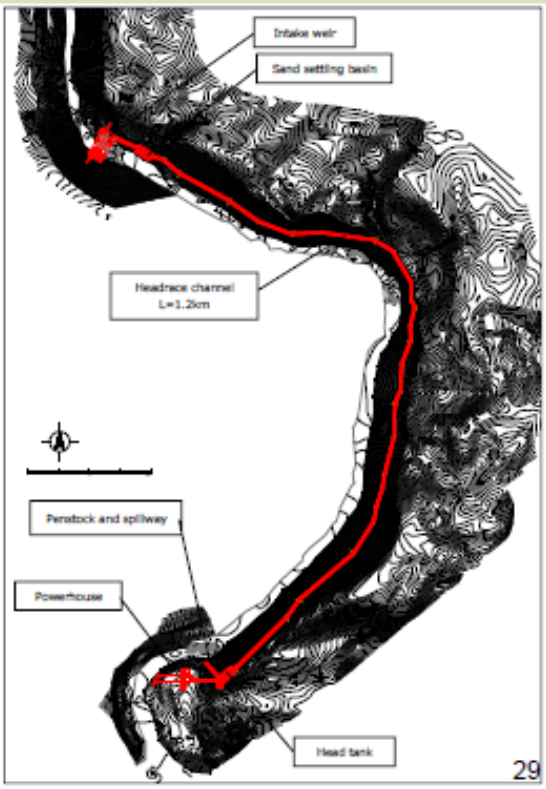
Basic Design of Civil Facilities (2)

(2) Layout Plan

1. The location of the intake weir was determined in order to achieve the higher head and to prevent back water from adversely affecting the existing hydropower plant at the upstream.
2. The headrace channel is laid out on the left bank of the river, to keep a longitudinal slope of 1/500 between the intake weir and head tank.
3. The length of the channel is approximately 1.2km. The powerhouse is located at the foot of a mountain ridge where the head tank is set out.



General Plan

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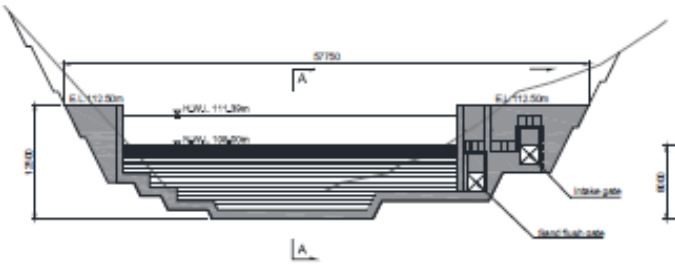
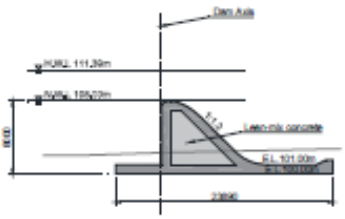
Basic Design of Civil Facilities (3)

(3) Intake Weir



Downstream profile



Section A-A

Type of weir	concrete gravity
Gate facilities	intake gate: sluice gate 2m x 2m sand flush gate: sluice gate 2m x 2m
Weir height	12.50m
Crest length	57.75m
Slope gradient	Vertical at upstream, 1:1.0 at downstream
Normal water level	EL.108.00m
Flood water level	EL.111.39m
Seismic coefficient	0.15 in horizontal, 0 in vertical

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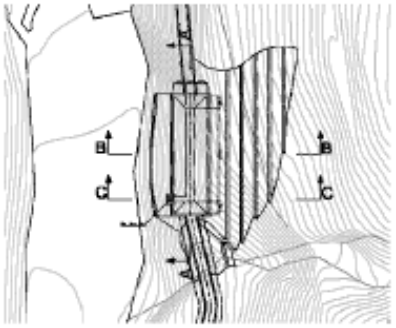
Basic Design of Civil Facilities (4)

(4) Sand Settling Basin

Plan

Section A-A



- The sand settling basin (7.0m in width, 27.25m in length and 4.10m in depth) is located 60 m downstream from the intake.
- The capacity of the sand settling basin is designed to settle earth and sand contained in the water flow required for the maximum power discharge considering the future extension.
- The sand settling basin has a deversoir to control the specified power discharge.

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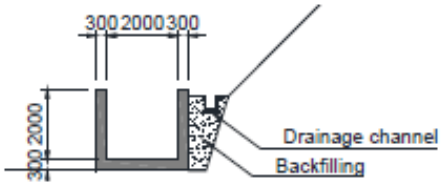
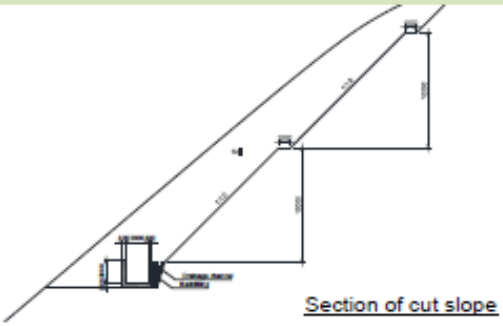
Basic Design of Civil Facilities (5)

(5) Headrace Channel



Section of headrace channel



Section of cut slope

- Headrace channel is designed as a reinforced concrete structure, which is capable of resisting loads applied due to earth, water and earthquake.
- The gradient of the channel is decided to prevent the accumulation of soil. The design power discharge is set to satisfy the design power discharge for the future extension.

Type of channel	open channel with a rectangular cross-section
Material of channel	Reinforced concrete
Length	1,207m
Gradient	1/465～1/500
Roughness coefficient	0.015
Discharge section	2.0m in width, 2.0m in height
Water depth	1.XXm (for 2 units) 1.57m (for 3 units expansion)

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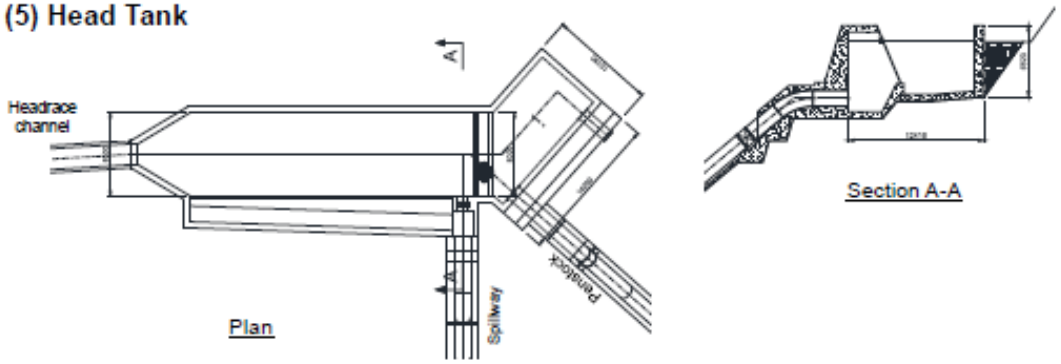
Basic Design of Civil Facilities (5)

(5) Head Tank



- The head tank (8.0m in width, 39.0m in length and 3.90m in depth) is located between the headrace channel and penstock.
- The capacity of the head tank is designed to secure the water flow required for the maximum power discharge for the future extension, i.e. 3 units in case that the water flow is suddenly reduced because the intake gate or headrace channel is blocked by floating logs or falling soils and rocks.
- The surplus water is overflowed to the spillway.

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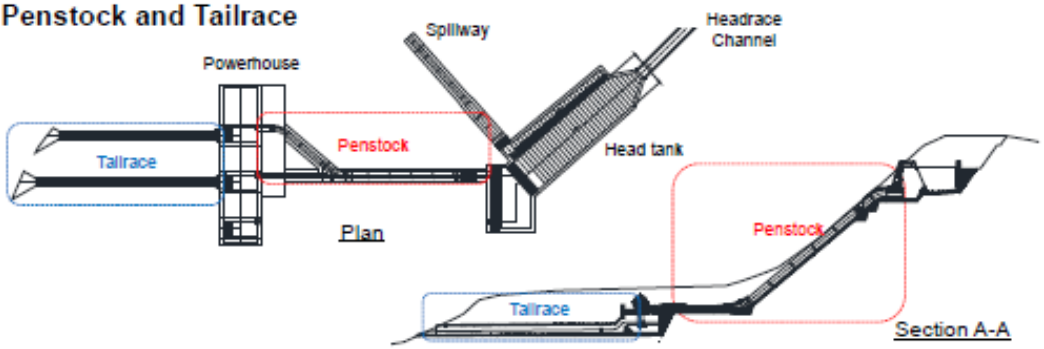
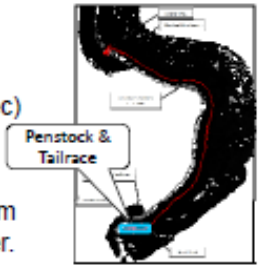
Basic Design of Civil Facilities (6)

(6) Penstock and Tailrace



- The penstock is designed for the design power discharge of 2 units ($4.20m^3/s$).
- The penstock branches off into two (2) pipes from the head tank, and then connects to the hydraulic turbines in the powerhouse.
- Design conditions of the penstock are shown below.
  Inside diameter before branch: 1.50m (Q = $4.2m^3$/sec, v = 2.38 m/sec)
  Inside diameter after branch: 1.10m (Q = $2.1m^3$/sec, v = 2.21m/sec)
  Pipe thickness: 6 mm (minimum required value)
- The tailraces are designed to be box culverts of 1.0m in width and 1.8m in height which gradients are 1/100 to discharge water back to the river.



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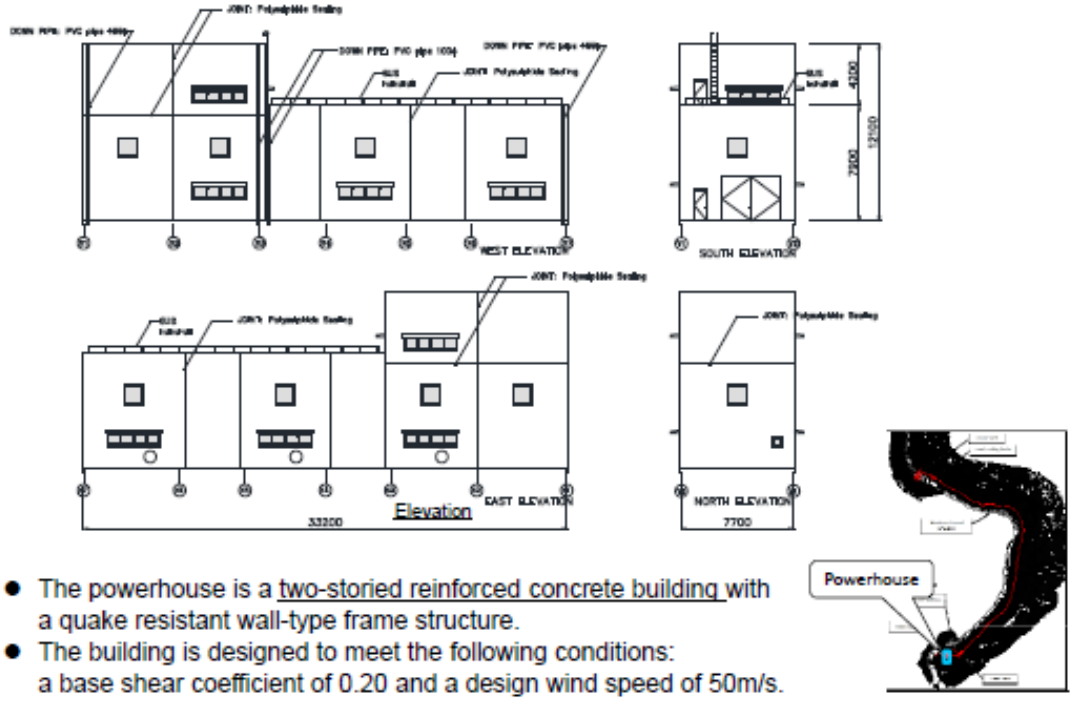
Basic Design of Civil Facilities (7)

(7) Powerhouse Building



- The powerhouse is a two-storied reinforced concrete building with a quake resistant wall-type frame structure.
- The building is designed to meet the following conditions:
  a base shear coefficient of 0.20 and a design wind speed of 50m/s.

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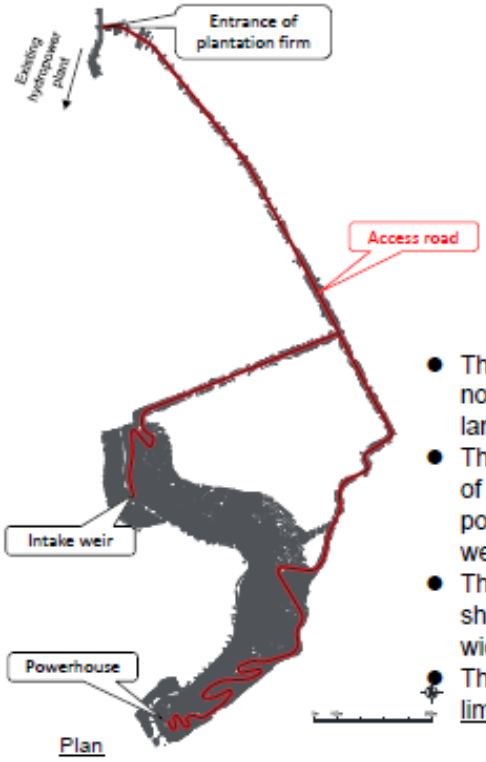
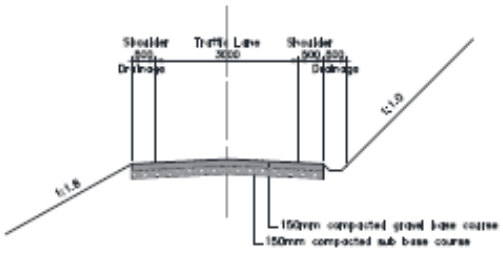
Access Road Plan



Plan



Typical Cross-section

- The route of the access road starts at the local road in the north, and it passes through the plantation farm and forest land, and ends at the intake weir and powerhouse.
- The total road length is about 6.2km including the distance of 4.7km between the entrance of plantation farm and powerhouse, and 1.5km between the junction and intake weir.
- The roadway width includes a traffic lane of 3.0m, two shoulders of 0.5m width each, and two drainages of 0.5m width each.
- The road has macadam pavements with local, coral limestone.

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Construction Plan

- A headrace channel and access road are constructed in and around a deep V-shaped valley. therefore, a large volume of surplus soil, estimated to be more than 300,000 m^3, will be dug out from the construction site. Such remarkable feature makes this project difficult.

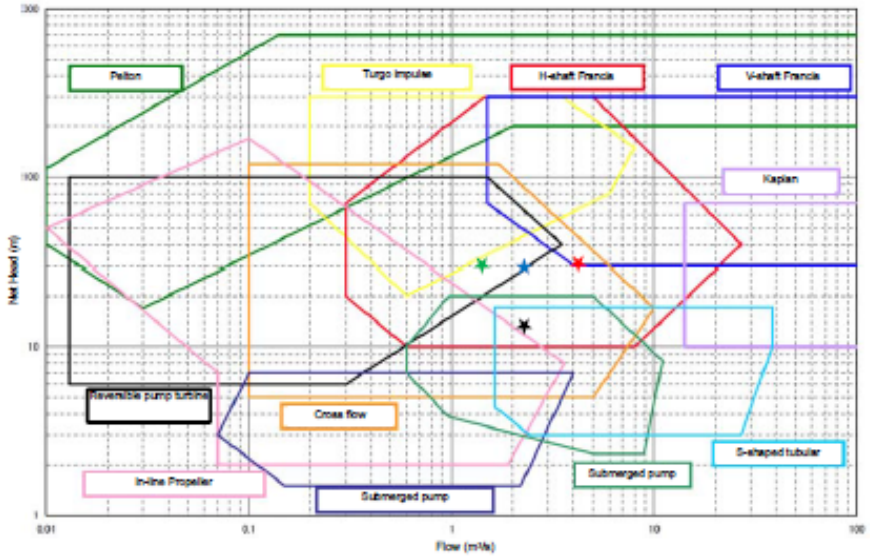
1. Temporary soil yard (Disposal area)
   A large temporary soil yard for surplus soil is needed near the project site. Concerned parties such as PRV, DOE and DOL conducted consultation meeting to deal with the issue of temporary soil yard for surplus soil

2. Construction period
   A large amount of earthwork requires a long period of time. The construction period is estimated to be around 43 months.

Basic Design for Electro-mechanical Equipment (1)

(1) Selection of the Water Turbines

Large Head/ Low Flow Rate → Horizontal axis Francis / Horizontal axis Propeller



(Source: Guidebook on Hydro Valley Planning (Ministry of Economy, Trede and Industry, Japan)

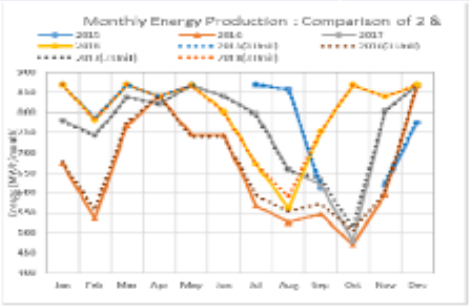
★: H-shaft Francis 1-Unit
★: H-shaft Francis 2-Unit
★: H-shaft Francis 3-Unit
★: H-shaft Propeller 2-Unit x 2-Row

Basic Design for Electro-mechanical Equipment (2)

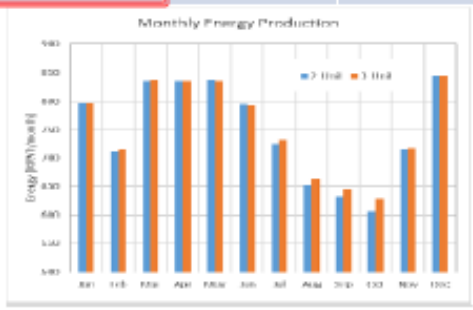
(2) Comparison of Number of Turbines

2 unit case is more appropriate than 3 unit case in consideration of cost-effectiveness because the difference of energy production is minimal and cost of 2 unit case is cheaper .

	H-shaft Francis 1 unit	H-shaft Francis 2 units	H-shaft Francis 3 units	H-shaft Propeller 2 x 2 = 4 units
Synchronized operation	N.A	++++	++++	+++
Power reduction during maintenance and accident	+	++	++++	+++
Price of Turbine (affordability)	++++	+++	+	+
Cost of transportation/ erection (affordability)	+	+++	+++	+++
Operation efficiency during drought	+	++	+++	++
Amount of spare parts (general versatility)	+	++	+++	+++
Comprehensive evaluation	8	16	18	15



Monthly energy production with 2 units and 3 units



Monthly energy production : average of 2015 - 2018

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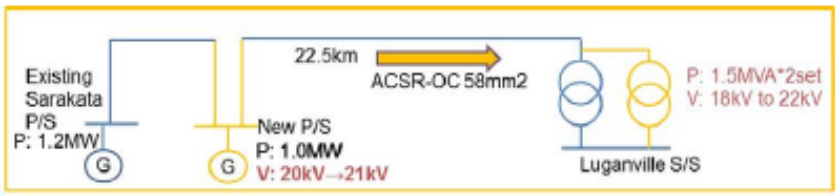
Basic Design for Electro-mechanical Equipment (3)

(3) Operation system

- A π branch will be performed between the existing Sarakata River Hydroelectric Power station and the existing Substation as shown in the figure below.



Study results:

- The protection of the three-branch transmission line becomes complicated.
- The total power output can be confirmed by receiving the power generated at the existing Hydroelectric Power station at the new Hydroelectric Power station.
- Local communication Network system (IP-VPN/3G4G/Microwave) low reliability.
  ……Outbreak of Signal err and Time Lag.
- Security measures (firewall) are required to use the external network.
- The CCTV image transfer method, shall be necessary to consider remote control network.

➢ a remote supervisory control operated by means of an automatic control operation system from the existing Sarakata river hydroelectric power plant.
➢ the remote control operation from the existing power plant by means of Optical Fiber Complex Overhead Ground Wire (OPGW),

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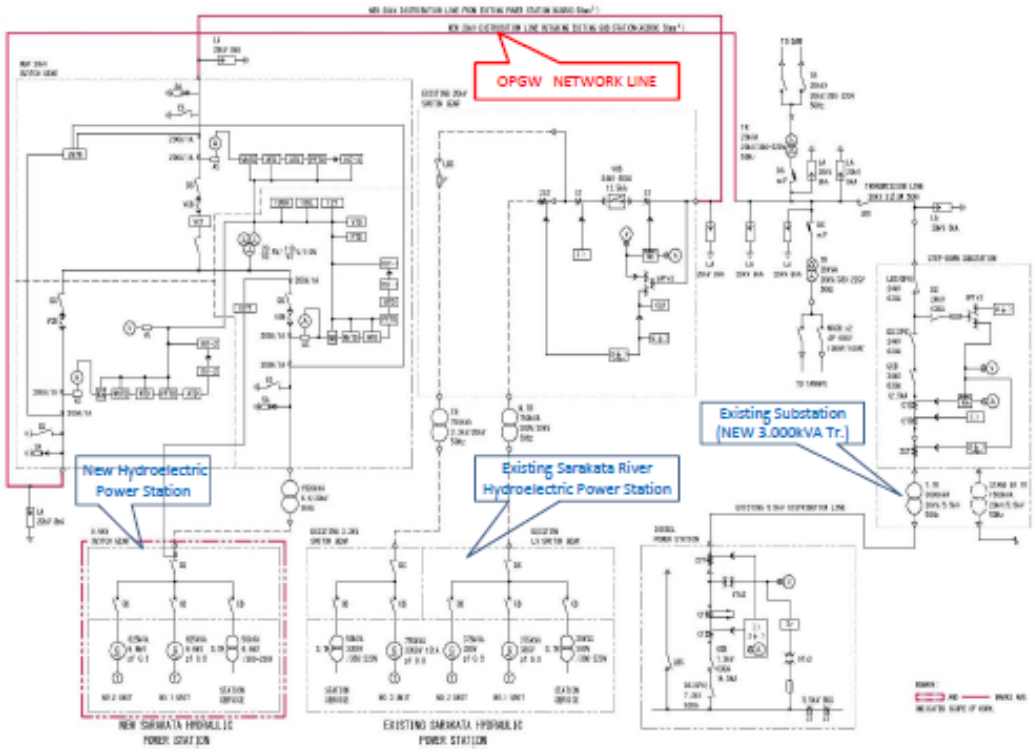
Power System Facilities



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Remote control System (SCADA)

Remote Control System (SCADA)

The basic configuration of the remote control system is as follows:

- The New Hydroelectric Power Station will be operated from Existing Hydroelectric Power Station.
- Existing Hydroelectric Power Station will be operated manually as before.
- Not connected in the new remote control system because of concern that the existing operation/control/protection system will be affected.
- The operation console (CPU) has two systems (Regular use/Standby use).
- Totally 4 operation consoles (CPU) at the Existing Hydroelectric Power Station and the New Hydroelectric Power Station.
- The Interface panel will be installed to connect to The operation console (CPU) assuming that CCTV, Control equipment and measuring equipment, etc. will break or become old(Maintenance).

<<This will increase the reliability and quality of the New Hydroelectric Power Station for power generation.>>

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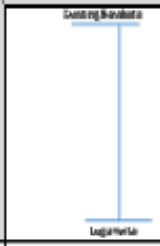
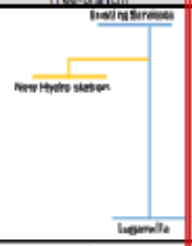
Grid Connection for New Hydropower Plant

Grid connection plan to connect the new hydropower plant to existing 20kV transmission line was examined considering reliability, feasibility, environmental and social impact and cost. π-branch connection is to be applied.

		Existing	Plan 1 (Tee-branch)	Plan 2 (π-branch)	Plan 3 (Connection to existing P/S)
Power System Diagram					
Reliability	Power System		◆	+++	++++
	During Construction		++++	++++	+++
Feasibility	Transmission Line(T/L) Route		++++	++++	++
	Power station(P/S) Feeder Facility		++++	++++	+
Environmental Social Impact			++++	+++	+
Cost			++ need communication system	++++	+++
Total Estimation			++	++++ (recommend)	++

Comparative study of alternatives to connect the new hydropower plant

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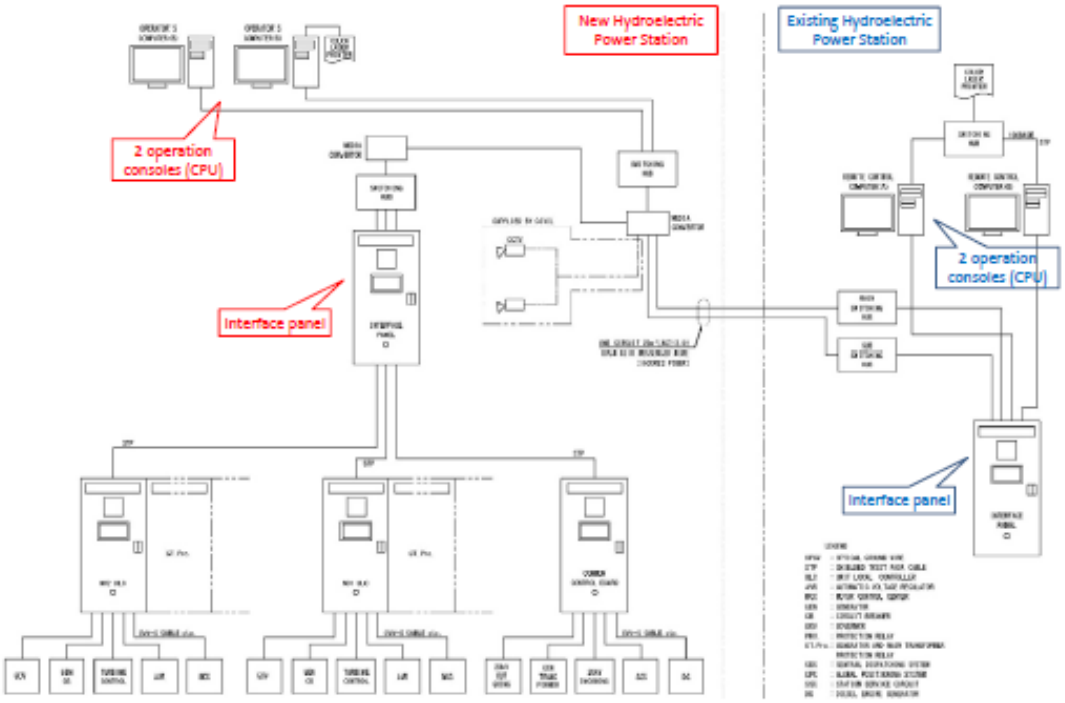
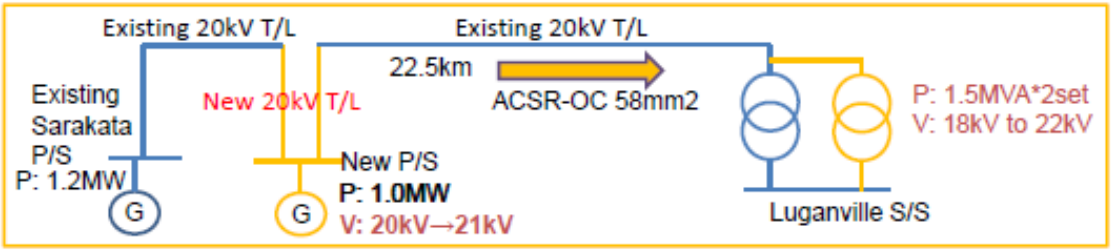
Remote control System (SCADA)



Power System Analysis for New Hydropower Plant

Power system after the operation of 1,000kW new hydropower plant is examined based on line capacity, voltage drop and stability.



Line Capacity

Distribution line
Necessary capacity :2.2MW (64A) < Existing capacity : 7.4MW (205A)
→ acceptable

Substation transformer
Necessary capacity :2.2MW/0.8=2.75MVA < Capacity after 1set Tr expansion : 3.0MVA → acceptable

Voltage Drop

Since the S/S voltage is nearly the lower limit (18kV) by 20kV step-up Tr voltage , We recommend to the tap of the step up Transformer to 21kV.

In this new Hydro Power project, It is necessary to implement the following items

- π branch to new P/S after existing line cut off
- Expansion new power transformer at the Luganville S/S
- Step-up voltages set 21kV (higher voltage) at existing and new P/S

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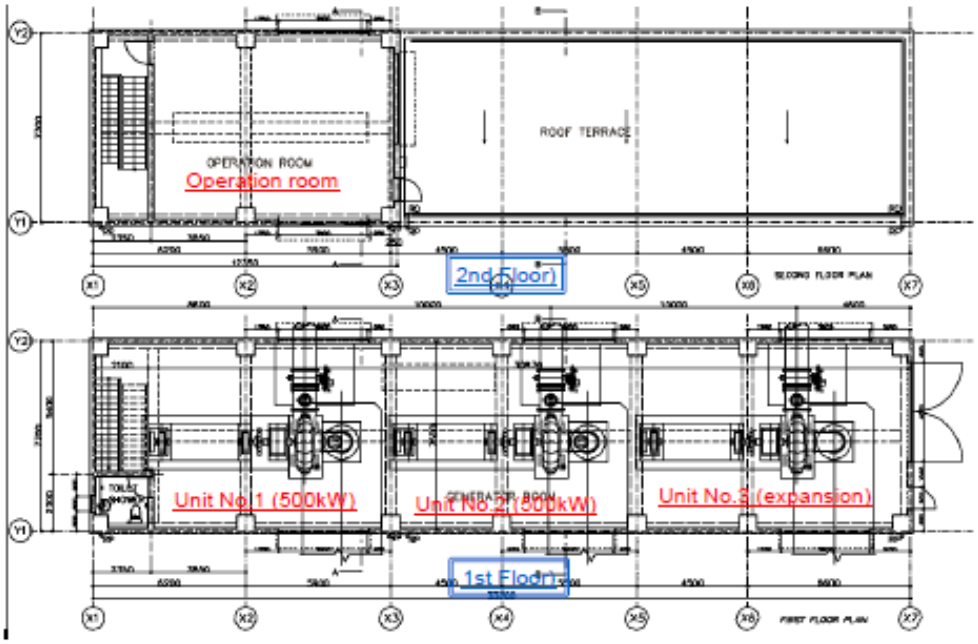
Arrangement of Turbine and Generator (1)



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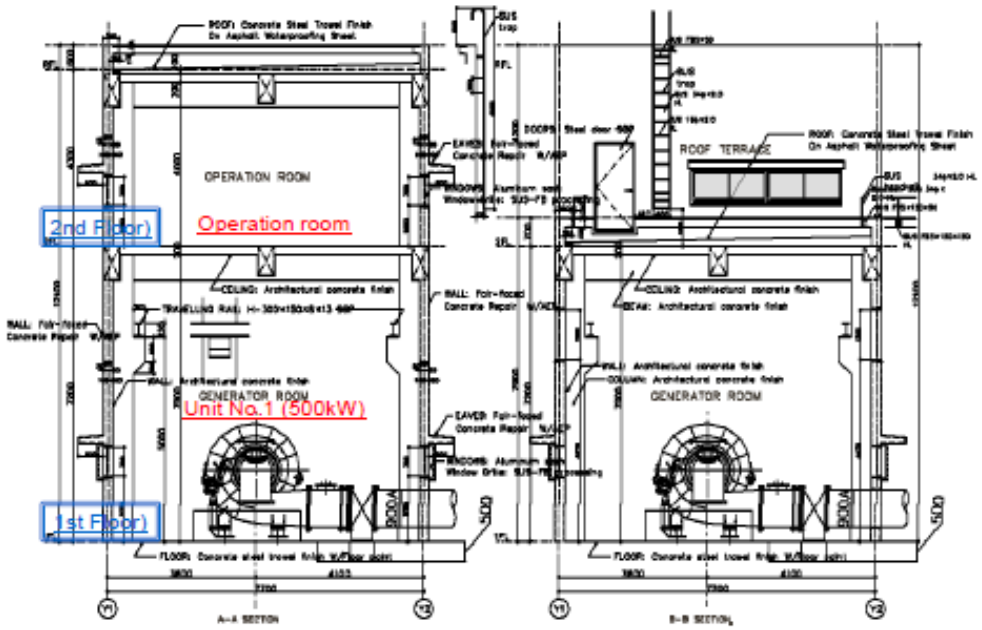
Arrangement of Turbine and Generator (2)



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General Feature of Hydropower Generating Equipment

1.	Hydraulic Turbine	
	a. Quantity	2
	b. Type	Horizontal-shaft, Francis
	c. Power	550 kW
	d. Speed	500 rpm
	e. Discharge	2.10 m3/s
	f. Rated head	32.3m
2.	Synchronous Generator	
	a. Quantity	2
	b. Type	synchronous
	c. Power	690kVA
	d. Power factor	0.8
	e. Voltage	6,600V, three (3) phases
	f. Speed	500rpm
	g. Frequency	50Hz
3.	Power Transformer	
	a. Quantity	1
	b. Type	Self-cooled, outdoor, oil-immersed
	c. Power	1500kVA
	d. Voltage	6.6/20kV, three (3) phases
4.	20kV Switchgear	
	a. Quantity	1

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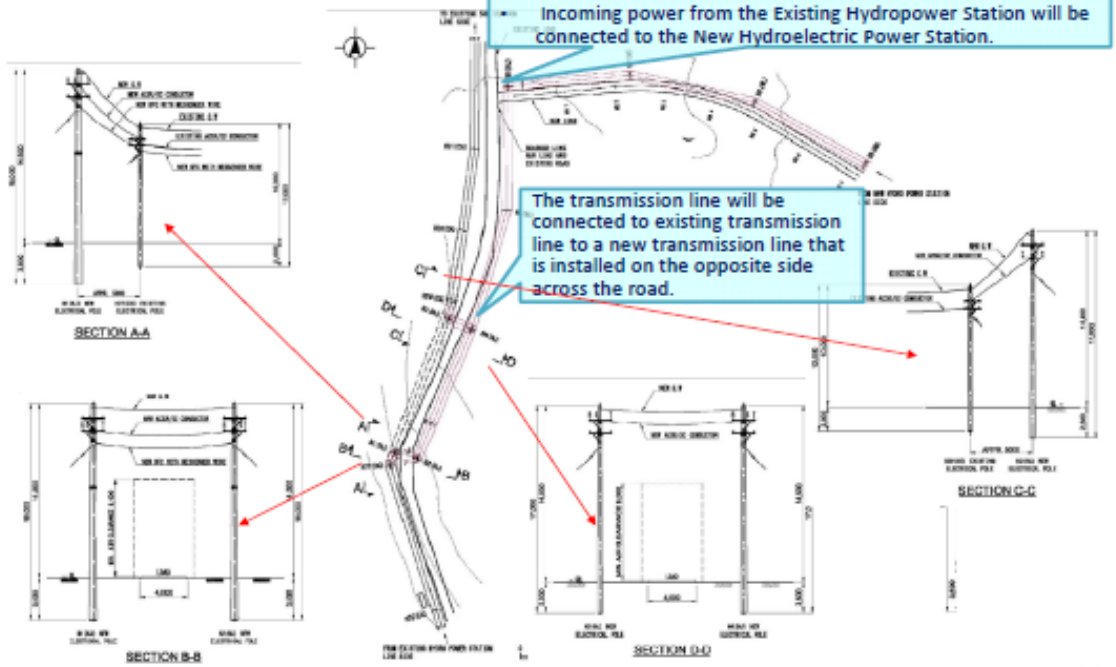
20kV Transmission Line

Grid-interconnection Scheme

- Cutting the existing 20kV transmission line by π.
- Existing transmission line to the existing substation will be connected to the New Hydropower Station.
- Incoming power from the Existing Hydropower Station will be connected to the New Hydroelectric Power Station.

The transmission line will be connected to existing transmission line to a new transmission line that is installed on the opposite side across the road.



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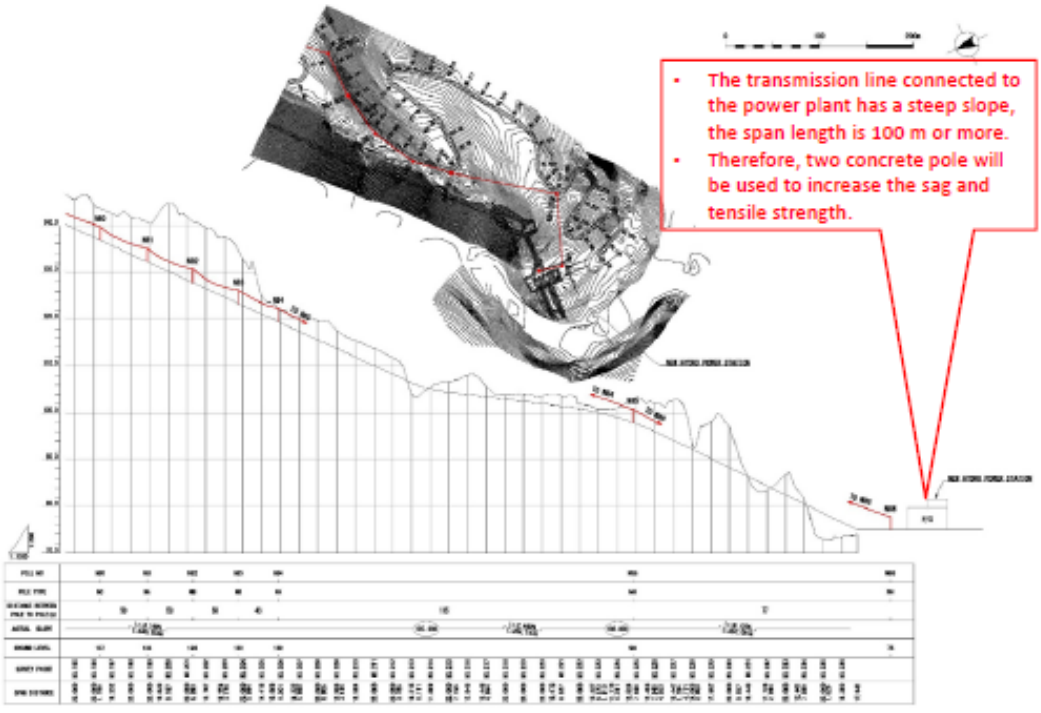
20kV Transmission Line

- The transmission line connected to the power plant has a steep slope, the span length is 100 m or more.
- Therefore, two concrete pole will be used to increase the sag and tensile strength.



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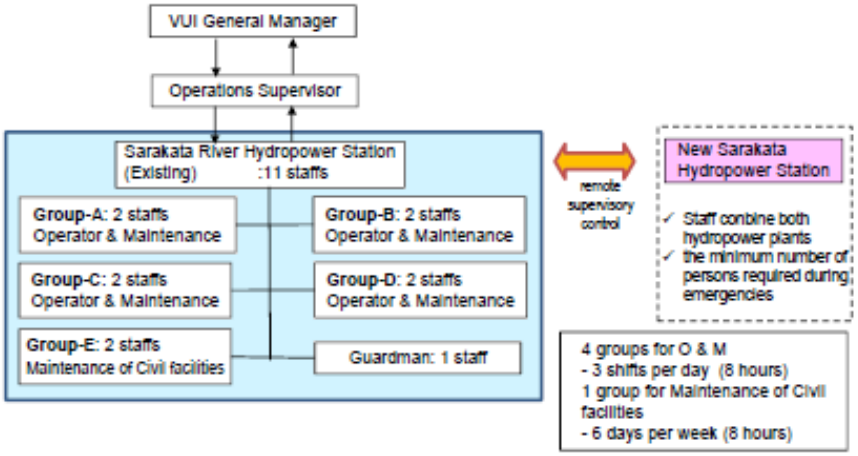
Operation & Maintenance of Hydropower Plant

- The new hydroelectric power plant is planned to be a remote supervisory control operated by means of an automatic control operation system from the existing Sarakata river hydroelectric power plant.
- Operation and monitoring of the new power plant can be done by using control, monitoring and measuring devices.
- Manpower for the operation and maintenance of the new power plant is equivalent to the minimum number of persons required during emergencies



Operation and Maintenance Cost

年度		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
	単位										商業運転						
年間発電電力量	MWh	10,122	10,482	10,343	10,620	11,012	11,418	11,839	12,276	12,729	13,198	13,685	14,190	14,713	15,256	15,819	16,404
ディーゼル発電	MWh	5,008	3,299	3,408	3,776	4,158	4,554	4,965	5,392	5,834	4,063	2,310	2,061	1,831	1,620	1,801	2,005
太陽光発電所	MWh	60	48	58	68	78	88	98	108	118	128	138	148	158	168	178	188
水力発電	MWh	5,054	7,135	6,776	6,776	6,776	6,776	6,776	6,776	6,776	9,007	11,237	11,981	12,724	13,468	13,839	14,211
売電電力																	
電力料金	VT/kWh	40.52	36.29	38.52	38.52	43	43	44	44	45	45	45	45	45	45	45	45
売電電力量	MWh	8,983	8,980	9,311	9,655	10,011	10,380	10,763	11,160	11,572	11,999	12,441	12,900	13,376	13,869	14,381	14,913
売電料金収入	1000VT	364,000	325,889	358,674	371,904	430,470	446,348	473,575	491,042	520,726	539,933	559,848	580,498	601,909	624,111	647,131	671,075
発電コスト																	
ディーゼル発電																	
燃料単価	VT/liter	72.9	77.0	90.0	95.0	100.0	106.0	106.0	106.0	106.0	106.0	106.0	106.0	106.0	106.0	106.0	106.0
燃料費	1000VT	111,023	88,603	89,337	109,976	128,360	140,591	153,285	166,459	180,129	125,452	71,309	63,630	56,526	50,018	55,605	61,889
機材保守費	1000VT	11,102	8,860	8,934	10,998	12,836	14,059	15,329	16,646	18,013	12,545	7,131	6,363	5,653	5,002	5,560	6,189
予備品購入費	1000VT	24,464	25,220	29,836	30,673	31,526	32,397	33,284	34,190	35,114	36,056	37,017	37,998	38,998	40,018	41,058	42,119
水力発電																	
機材保守費	1000VT																
予備品購入費	1000VT	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	22,000	22,000	22,000	22,000	22,000	22,000	22,000
運営管理費	1000VT	176,562	174,273	197,459	201,408	205,436	209,545	213,735	218,010	222,370	226,818	231,354	235,981	240,701	245,515	250,425	255,434
小計	1000VT	335,152	308,956	337,565	365,054	390,157	408,591	427,633	447,305	467,627	422,871	368,812	365,972	363,877	362,552	374,648	387,631
小計（燃料、機材保守費除く）	1000VT	213,027	211,493	239,294	244,080	248,962	253,941	259,020	264,206	269,484	284,874	290,372	295,979	301,699	307,532	313,483	319,553
基金																	
サント基金（1 VT/kWh）		8,983	8,980	9,311													
政府基金（2 VT/kWh）		17,966	17,960	18,623													
Green Tree基金（2 VT/kWh）					0	20,022	20,760	21,526	22,320	23,143	23,997	24,882	25,800	26,752	27,738	28,761	29,826
収支（1）		1,898	-19,847	-6,825	6,856	20,291	16,996	24,415	21,417	29,956	93,064	166,154	188,726	211,281	233,821	243,721	253,619
電気料金DN/kWh下げるための原資	1000VT										29,996	62,205	64,500	66,879	69,346	71,903	74,564
水素発電機設置工の積立	1000VT											40,000	40,000	40,000	40,000	40,000	40,000
収支（2）	1000VT										63,068	63,949	84,226	104,402	124,475	131,818	139,055

Soft Component (1)

Objective of Soft Component

VUI, which manages the power supply business under the concession system, shall establish a sustainable management system for proper operation, maintenance and management of the new power plant, in addition to the optimum operation of the existing Sarakata River power plant. As a result, reduction of electricity fee is to be achieved by maximizing the reduction of the fuel consumption.

Item	Work Items
Establish proper methods for the inspection and maintenance of generation equipment	1. preparation of Inspection and maintenance manuals for generation equipment 2. daily operation record 3. maintenance and repair records 4. preparation of Ledger of facility, spare parts and equipment
Establish proper methods for inspection and maintenance of civil facilities	1. preparation of Inspection and maintenance manuals for civil facilities 2. OJT by using manual 3. daily inspection records 4. maintenance and repair records
Strengthen optimum operation of the existing and the new hydroelectric power plants and strengthen the ability to deal with malfunctions, troubles and accidents.	1. formulation of optimum operation scheme of existing and new hydroelectric power plants 2. application of optimum operation 3. Prepare response manual in case of accident and emergency 4. On-the-job training for each case study by using the manual 5. Middle and long term maintenance plan
Establishment of Monitoring System	1. Periodic monitoring system for generation equipment, transmission line and distribution facilities 2. Periodic monitoring of electricity bill and green energy fund

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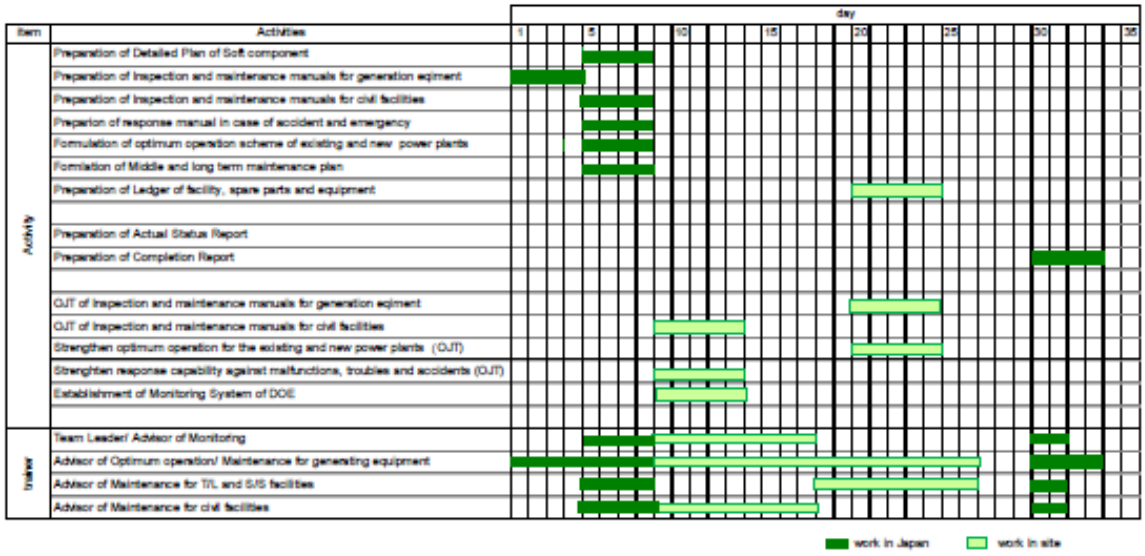
Soft Component (2)

Schedule of Soft Component



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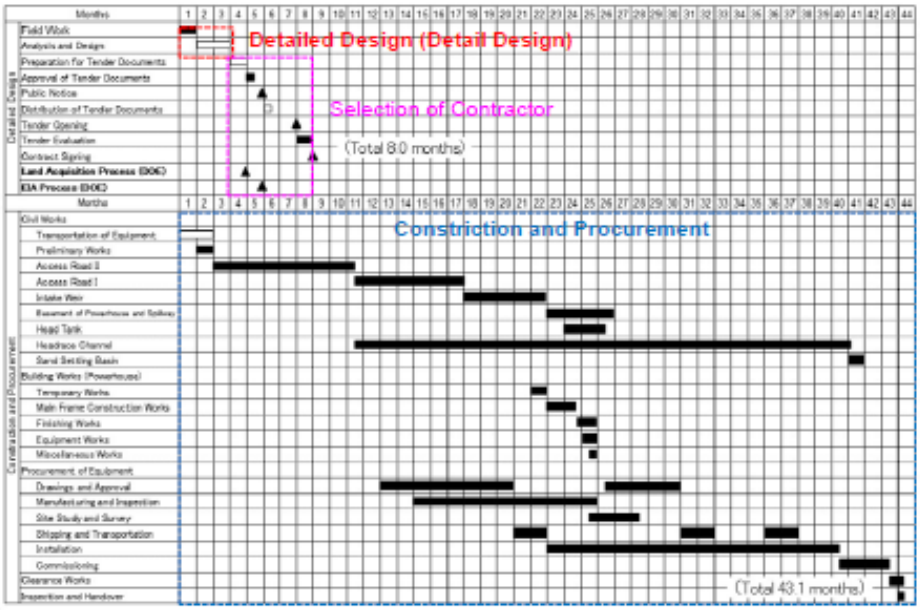
Implementation Schedule

There are three (3) stages in the Project:

- Detailed design (3 months)
- Selection of contractor including the preparation of tender document, announcement of tender, evaluation of tender (5 months)
- construction (civil and building works) and procurement. (43 months)



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Procurement for Equipment & Construction Materials

Procurement of equipment

Items	Country of origin			Reasons for procurement place	Procurement ways
	Vanuatu	Japan	Third countries		
Hydraulic turbine generator		O		For comprehensive operation and maintenance	Marine transportation from Japan
Distribution equipment		O		For comprehensive operation and maintenance	Marine transportation from Japan
Substation equipment		O		For comprehensive operation and maintenance	Marine transportation from Japan
SCADA		O		For comprehensive operation and maintenance	Marine transportation from Japan
Transmission line		O		Not locally available	Marine transportation from Japan

Procurement of construction materials

Items	Country of origin			Reasons for procurement place	Procurement ways Vanuatu
	Vanuatu	Japan	Other countries		
Cement	O				
Reinforcing bar	O				
Formwork material	O				
Coarse aggregate	O		O	Depending on the required quality	Marine transportation from Japan or other countries
Fine aggregate	O				
Penstock			O	Not locally available	Marine transportation from Japan
Gate and screen			O	Not locally available	Marine transportation from Japan
Steel door and aluminum sash			O	Not locally available	Marine transportation from Japan

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Procurement for Equipment

The country of origin for the equipment being procured for the Project shall be fundamentally considered as shown in the following Table.

ITEM	Country of Origin		
	Japan	Vanuatu	Other
Hydropower equipment			
Turbine	O		
Generator	O		
Inlet Valves	O		
Generator Circuit Breaker Cubicle	O		
6.6 kV/380-220V, Station Service Transformer Cubicle	O		
DC Battery panel	O		
Low Voltage Power Supply Panel	O		
1,500 kVA 6.6kV /20kV Step-up Transformer	O		
147kN Overhead Travelling Crane	O		
Emergency Diesel Engen Generator	O		
6.6 kV Disconnecting Switch Cubicle	O		
Out Going/ /In Coming Feeder Switchgear	O		
Turbine/generator Control System	O		
SCADA System	O		
20kV Existing Substation Equipment			
3,000KVA, 20kV/5.5 kV, Step-Down transformer	O		
AC.DC Supply Distribution Box, 100V DC System	O		
20kV New Distribution line			
Power conductor (ACSR-OC 58 mm2)	O		
Overhead Grounding Wire	O		
Optical Fiber Cable (22 mm2)	O		
Electric line pole	O		
Insulators Set and Fittings	O		

All equipment of the hydropower generation, substation and transmission line are premised on Japanese-made supply.

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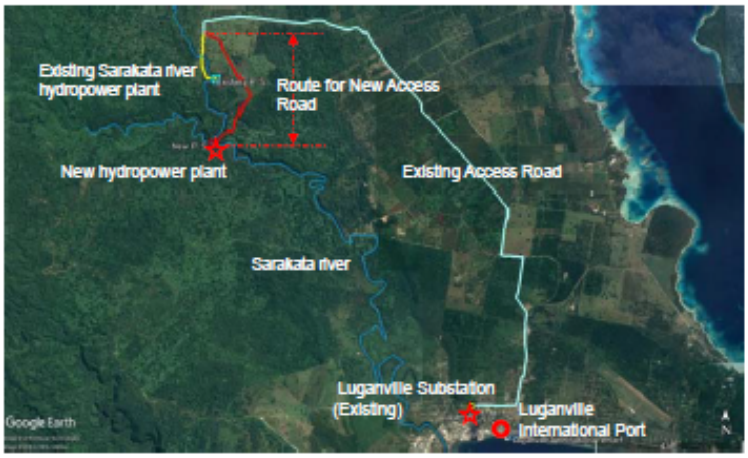
Transportation of Equipment from Japan

The equipment required for hydropower plant, transmission line and substation procured in Japan will arrive at the Luganville International Port in Santo Island, Vanuatu. The target sites are located in Canal-Fanafo area, which is located about 25km from the port.

The access road to existing Sarakata river hydropower plant can be used. It is well maintained, however the repair work is required in the rough road section. The new access road is to be constructed in the last 5km to the new powerhouse.



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Inland transportation

Luganville International Port

Luganville International Port

Existing Road Condition

Existing Asphalt Road

Existing Macadam Road

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Obligation of Vanuatu Side

Cost borne by the Vanuatu side

Contents	VUV
Site acquisition/ Compensation for land users and owners/ land rent for disposal area if necessary	60,375,000
Repairs and maintenance expenses for existing access roads	2,247,000
Preparation and provision of lands for stockyard and parking place	105,000
Preparation and provision of lands for site offices	105,000
Commission related to Banking Arrangement (B/A) and Authorization to Pay (A/P)	3,790,000
Customs clearance of the products at ports of disembarkation in Vanuatu	3,500,000
Approval of EIA (Conditions of approval should be fulfilled, if any) and securement of the necessary budget for implementation	100,000
Obtaining the planning, zoning, building, and water works permit	50,000
Preparation and provision of lands for temporary disposal area for surplus soil	1,208,000
Total	71,480,000

1 VUV = JPY 1.01

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Project Evaluation

Preconditions

(1) Land Acquisition and Easement

The land for the power station including part of the access roads will be acquired, and the easement of the access roads and transmission line route will be obtained.

(2) Environmental Approval

DOE will obtain an EIA approval from DEPC.
It was confirmed that there was no living area for residents in the Project area, and no resettlement of residents occurred.

(3) Tax Exemption Procedure

DOE, as a responsible agency, will perform tax exemption procedure of customs duties and value added tax (VAT) for this Project.

(4) Permission for Construction

For the construction works in the river (construction of the weir), "Water work permit" should be required from DOWR.

(5) Power Generating Operation License, etc.

Before the operation of the power plant, it is necessary to obtain "Water Use License" from DOWR.

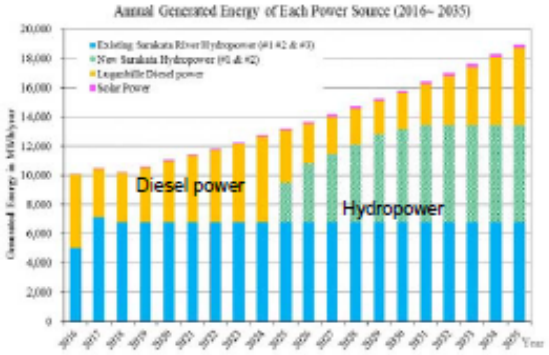
Project Evaluation

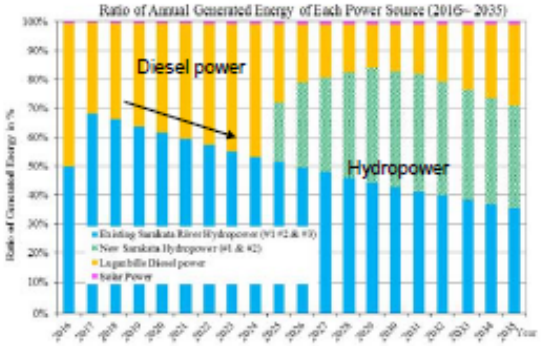
(6) Forecast of Balance of Power Supply and Demand

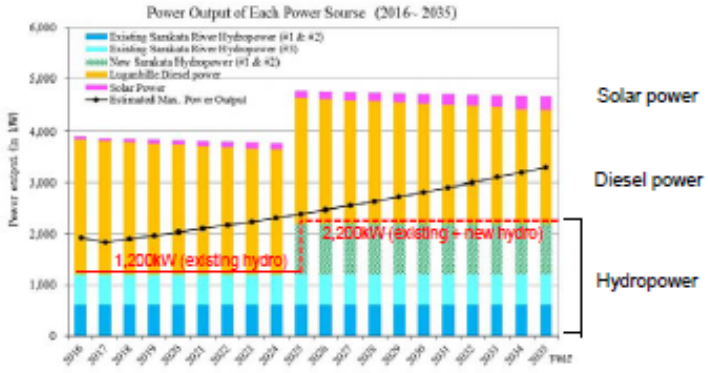
Forecast of balance of power and demand was carried out up to 2035 under the following conditions.

- Annual increase rate of peak power output is 3.3% and one of electric energy sales is 3.7%
- Electric energy sales are calculated 10% such as transmission loss, collection of electricity bill etc. less than avairable generated energy based on a rate of actual generated energy and electric energy sales.
- Annual decrease rate of power output of diesel power plants is assumed to be 1%.
- Annual increase of generated energy of solar power is assumed to be 10 MW/year.
- Annual generated energy of the existing Sarakata River hydropower plant is 6,776MWh/year based on average of actual generated energy from 2011 to 2017.
- Annual generated energy of a new Sarakata hydropower plant is 7,435MWh/year (available generated energy 8,992MWh/year X (10/12)) considering 2 month operation per year stoppage due to periodical maintenance and accidents etc. Electric energy sales is assumed to be 6,692MWh/year, which is 10% reduction of the generated enrgy.
- Commercial operation will start from June 2025. After 3 years from commercial operation all generated energy become electric energy sales with 10% reduction.
- For defficiency of energy generated from hydropower and solar power diesel power plants are to be operated. Diesel volume per kWh is 0.29 liter/kWh. Unit price of diesel fuel is asumed to be 90 VUV/liter in 2018, 100 VUV/liter in 2019 and 106 VUV/liter after 2020.

Project Evaluation







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Project Evaluation

Relevance

(1) Increase the renewable energy ratio in Vanuatu

the existing and new hydropower stations constructed by Japan's grant aid project will supply most of the electricity demand as the main power source.

(2) Reduce dependence on imported fuels and reduce electricity tariff

The existing and new hydropower stations will cover most of the peak demand and base load power demand.

(3) Contribute to climate change countermeasures by reducing dependence on imported fuel

(4) Contribute to rural electrification projects

The Vanuatu government established a 2 VUV/kWh National Green Energy Fund (GEF) in 2019.

(5) Consistent with the hybrid island concept

This project will be implemented as a part of supporting the achievement of low-carbon development through continuous implementation, in line with this "Hybrid Island Concept".

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Project Evaluation

Effectiveness

Quantitative Effect

The target year is 2028, three (3) years after the commencement of commercial operation.

(1) Electric power sales by new hydropower station

(2) Reduction in fuel cost for diesel power generation

(3) Renewable energy ratio

(4) Reduction of greenhouse gasses

(5) Electricity tariff reduction and source of green energy fund

Quantitative Effects

Index name	Standard value (2017)	Target Value (2028) [3 years after the completion of the Project]
Electric power sales (MWh/year)	6,776 MWh/year	13,770 MWh/year (total of existing and new hydro)
Reduction of greenhouse gasses (ton/year)	—	624,915 ton/year
Fuel cost for diesel power generation (kliter/year)	-	2,013 kliter/year

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Project Evaluation

Effectiveness

Qualitative effect

(1) Promoting the use of renewable energy, which contributes to improved economic/social development and reduction of greenhouse gas emissions

(2) Diversification of electric power supply sources

(3) Achievement of a stable energy supply

(4) Expansion of power supply area and improvement of public services

(5) Improvement of public security and promotion of community activities

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Major Undertakings to be taken by each Government [1/2]

No.	Items	To be covered by Grant	To be covered by Vanuatu Side
1	To secure land necessary for the implementation of the Project and to clear the sites		○
2	To construct/procure the following facilities/equipment		
	1) Construction of facilities	○	
	2) Procurement of equipment	○	
	3) Installation of gates and fences in plantation		○
3	To provide facilities for distribution of electricity, water supply and drainage and other incidental facilities necessary for the implementation of the Project outside the sites		
	1) Electricity		
	a. Processing application for the distributing power line to the site		○
	b. Drop wiring and internal wiring within the site	○	
	c. Main circuit breaker and transformer	○	
	2) Water supply and drainage		
	a. Water supply system within the site (receiving and tanks)	○	
	b. Drainage system (for toilet sewer, common waste, storm drainage and others) within the site	○	
	3) Road		
	a. Road within the site (access road)	○	
	b. Road outside the site		○
	5) Furniture		○

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Major Undertakings to be taken by each Government [2/2]

No.	Items	To be covered by Grant	To be covered by Vanuatu Side
4	To ensure prompt unloading and customs clearance of the products at ports of disembarkation in Vanuatu and to assist internal transportation of the products		
	1) Marine transportation of Products from Japan to Vanuatu	○	
	2) Tax exemption and custom clearance of Products at the port of disembarkation		○
	3) Internal transportation from the port of disembarkation to the project site	○	
5	To ensure that customs duties, internal taxes and other fiscal levies, which may be imposed in Vanuatu with respect to the purchase of the products and the services, are exempted		○
6	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into Vanuatu and stay therein for the performance of their work		○
7	To ensure that the Facilities and the products are maintained and used properly and effectively for the implementation of the Project		○
8	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project		○
9	To bear the following commissions paid to the Japanese bank for banking services based upon the B/A		○
	1) Advising commission of A/P		○
	2) Payment commission		○
10	To give due environmental and social consideration in the implementation of the Project.		○

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Obligations of Recipient Country [1/2]

	Obligations of the recipient country	Allocation of Responsibilities
1	Acquisition and free provision of land (Generation facilities) necessary for the project.	DOE is the responsible agency and will coordinate with DOL
2	Lease right and free provision of land (Transmission line and access road) necessary for the project.	DOE is the responsible agency and will coordinate with DOL
3	Acquisition and free provision of land necessary for the temporary facilities and land clearance	DOE is the responsible agency and will coordinate with VUI
4	Provision of free temporary soil yard necessary for the project.	DOE is the responsible agency and will coordinate with DOL
5	Provision of free disposal sites required for the waste soil and waste materials	DOE is the responsible agency and will coordinate with DEPC and Local government
6	Provision of free storage site necessary for the equipment and materials.	DOE is the responsible agency and will coordinate with VUI
7	Maintenance and repair of existing access roads outside of the project	DOE is the responsible agency and will coordinate with Local government
8	Provision of free appropriate disposal sites necessary for the waste water and waste oil.	DOE is the responsible agency and will coordinate with DEPC and Local government
9	Bearing of commissions applied by the bank in Japan for banking services based upon the Bank Arrangement (B/A) (ex; Payment of bank commission)	DOE is the responsible agency
10	Application and acquisition of permission required for construction.	DOE is the responsible agency and will coordinate with the relevant agency

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Obligations of Recipient Country [2/2]

	Obligations of the recipient country	Allocation of Responsibilities
11	All expenses and prompt execution of unloading and customs clearance at the airport and the port of disembarkation in the recipient country	DOE is the responsible agency
12	Ensuring presence test of equipment and materials by experts and technical transfer to operators and maintenance staff for proper operation and maintenance	DOE is the responsible agency and will coordinate with VUI
13	Assignment of counterparts specialized for the project.	DOE is the responsible agency
14	Accommodating of Japanese nationals and/or nationals of third countries, including persons employed by the agent whose services may be required in connection with the components such facilities, as may be necessary for their entry into the recipient country and stay therein for their works	DOE is the responsible agency
15	Ensuring that customs duties, internal taxes and other fiscal levies that may be imposed in the recipient country with respect to the purchase of the components and to the employment of the agent will be exempted by the Government of recipient country	DOE is the responsible agency and will coordinate with relevant agency
16	Proper and effective operation and maintenance of the facilities and equipment that is provided under the Grant Aid Program.	VUI shall implement under control of DOE, which is the responsible agency
17	All expenses, other than those covered by the Grant Aid Program and its accrued interest, necessary for the purchase of the components as well as the agent's fees.	DOE is the responsible agency
18	Compliance to environmental and social considerations for the Grant Aid Program	DOE is the responsible agency and will coordinate with DEPC

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PREPARATORY SURVEY
FOR
THE PROJECT FOR THE CONSTRUCTION OF HYDROPOWER STATION IN ESPIRITU SANTO ISLAND

Environmental & Social Consideration
Land Acquisition for the Project

October, 2020

NEWJEC Inc.
CTI International Co., Ltd.

Environmental & Social Consideration
Land Acquisition Plan

Today's Topic

1. To confirm the handling of Temporary Soil Yard
2. To re-confirm the schedule of EIA approval
3. To confirm the contents of Land Acquisition Plan
4. To re-confirm the schedule of land acquisition process

Environmental & Social Consideration

Undertakings for Temporary Soil Yard

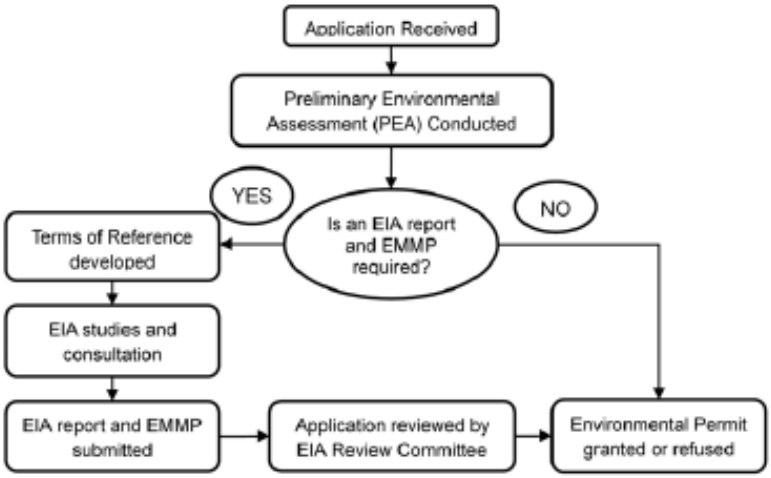
In case proposed Temporary Soil Yard is prepared by Vanuatu side, following items shall be taken by Vanuatu side

- ✓ To secure the 7ha land (leased from PRV)
- ✓ Location shall be aside the access road (separated 2~3 locations are available if needed)
- ✓ To clear the site (felling and rough leveling of ground)
  ⇒ Estimated cost: 1,200,000 VUV
- ✓ PEA and/or EIA for the temporary soil yard
- ✓ All works shall be completed before the notice of tender

Environmental & Social Consideration

EIA for Temporary Soil Yard

- All EIA procedure must be conducted by DOE with a new environmental consultant
- JICA team can provide the materials of application form, EIA report and EMMP (Environmental Management and Monitoring Plan)



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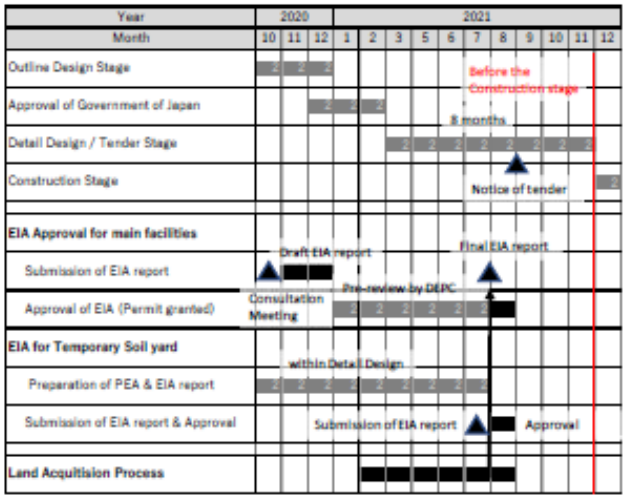
Environmental & Social Consideration

Schedule

- Consultation meeting on/after October 2020
- Submission of Draft EIA report to DOE, and to DEPC for reviewing within 2020
- Submission of final EIA report after land acquisition process
- Deadline of the EIA approval is before the notice of tender
- PEA/EIA for temporary Soil Yard should also be approved before the notice of tender



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Land Acquisition Plan

Types of Loss and compensation Coverage (typical matrix)

Types of Loss	Application	Definition of Affected Persons	Compensation Coverage
Land for Permanent Use (Land for Main Facilities and Access road)	Acquired land and Easement land	Lessor/ Lessee/ Customary Landholder/ Land user (4 landowner & PRV)	Compensation in market value base
		Illegal settlers without legal rights (not expected)	Compensation for non-land assets (agricultural products, trees, structures and etc.) in the land affected by this project.
Land for Temporary Use (Land for temporary soil yard)	Land to be used during construction	Lessor/ Lessee/ Customary Landholder/ Land user (PRV)	Necessary to agree with landholders or affected persons. Affected landholders and persons shall be paid for an agreed lease expense. After use, the land shall be returned to owners after restoration of the land to its original condition.
Agricultural Products and Trees (Land for Main Facilities and Access road)	Agricultural products and trees in affected land	Owners of agricultural products or trees (regardless with or without legal/ customary rights) (4 landowner & PRV)	Harvest notification of agricultural products and trees is issued before land acquisition. If harvest is impossible, compensation is made in monetary form based on market price.
Unforeseen or Unintended Impacts	Impacts revealed by the detailed design	Affected residents	Complying with JICA guidelines for other cases which are not covered by the above points

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Land Acquisition Plan

Cost Estimate for Land Acquisition Implementation

Item		Amount (Vatu)	Note
Assets (Land)	Land (Permanent Use)	33,000,000	Estimated based on valuation (replacement cost) by DOL.
	Land (Temporary Use)	7,000,000	Tentative price. This depends on the negotiation between the leaseholder and the DOE.
	Subtotal (1)	40,000,000	
Compensation/ Support	Agricultural products/ Trees	8,318,000	Estimated based on Agriculture Compensation Policy.
	Livelihood Support / Support for Socially Vulnerable Households	0	-
	Inconvenience Fee	400,000	To PRV
	Subtotal (2)	8,718,000	
Total (3)		50,000,000	Approximately (1) + (2)
Plan Activity Cost	(4)	7,500,000	15% of Total (3) (round-off)
Physical Contingency	(5)	2,875,000	5% of Total (3) + (4) (round-off)
Grand Total		60,375,000	(3) + (4) + (5)

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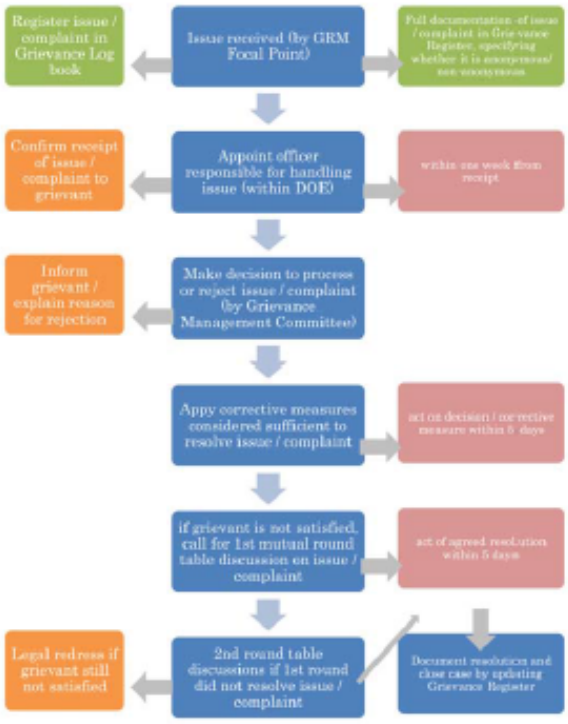
Land Acquisition Plan

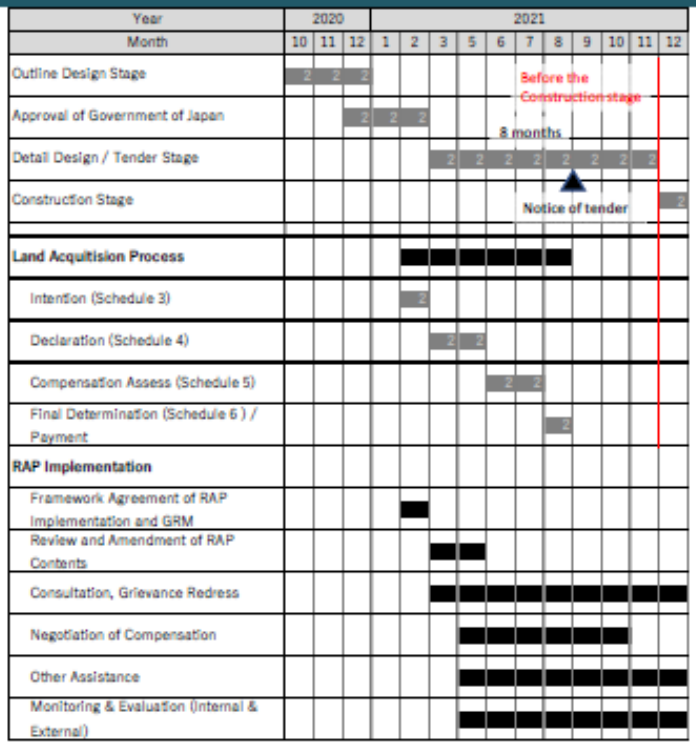
Grievance and Complaints Redress Mechanism (GRM)

- Duration of each stage will be agreed with the DOE and communities when grievance happened
- The GRM Focal Point is selected by DOE and will work with DOE officers to support the handling of complaints
- The Grievance Management Committee, is comprised of members from GRM Focal Point, the DOE offices supporting the handling of complaints, representatives from the Project development.



Land Acquisition Plan

Land Acquisition Plan Schedule

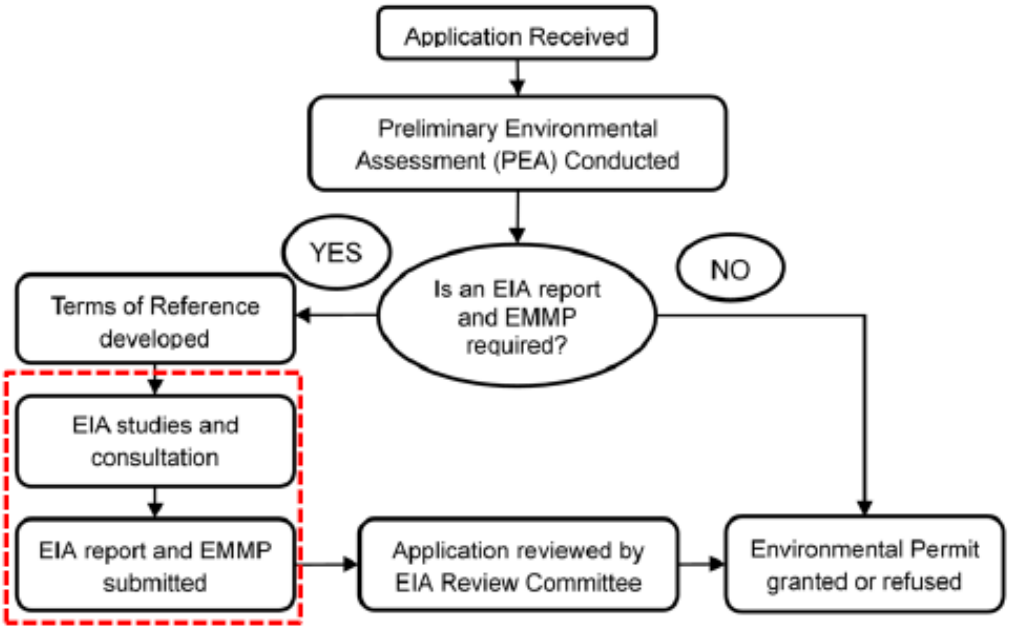


Environmental & Social Consideration

Already Confirmed Contents from here

Environmental & Social Consideration

Environmental Impact Assessment (EIA) Process in Vanuatu



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Environmental & Social Consideration

Result of EIA Studies (Pollution)

Items	Evaluation		Reason
	Before/ During Construction	Operation	
Air pollution	B-	D	[Before/During Construction] Ambient air quality will be affected by the dust and emission gas generated during the earth works etc., but its impact will be limited due to the limited number of heavy machines and trucks, and limited project area. [Operation] Generation of the dust and emission gas is not expected by the operation of the hydropower facilities.
Water pollution / Bottom sediment	B-	D	[Construction] Excavation/embankment work within/along the river and the construction of intake weir could worsen river water quality during the construction period. Rainfall during or just after above work could also cause turbid water. [Operation] Generation of the water pollution and turbid water is not expected during the operation phase of the hydropower facilities.
Waste	B-	D	[Construction] Construction waste such as excavated soil, concrete debris, organic waste and soil including organic waste will be generated. And, general waste would be generated from construction workers but the impacts caused by it would be very limited. [Operation] Little general waste will be generated but its impact is not expected.
Noise and Vibrations	B-	D	[Construction] Construction work by heavy machines and trucks will affect to noise and vibrations. [Operation] Noise and Vibration of generator will be limited since the generator will be installed in the building.

A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C: Extent of positive/negative impact is unknown (Examination is needed. Impacts may become clear as study progresses.)
D: No impact is expected

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Environmental & Social Consideration

Result of EIA Studies (Natural)

Items	Evaluation		Reason
	Before/ During Construction	Operation	
Protection area	D	D	There is no protected area inside/around the project site.
Ecosystems	B-	D	[During Construction] Earth works and construction of conduit and access road would have negative impacts to plants and animals inside the project area. [Operation] impacts to ecosystems by the operation of the hydropower facilities is not expected.
Hydrology	B-	B-	[Construction] Temporally damming and excavation of the riverbed could have impact on the hydrology of the downstream. [Operation]Decreasing of water flow volume between intake and hydropower house is expected by the withdrawing of water but its impact will be limited since amount of intake will be managed.
Geographical features	B-	D	[Construction] Geographical impacts by the earth works of headrace conduits and access road construction would be expected. [Operation] Negative impacts are not expected.

A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C: Extent of positive/negative impact is unknown (Examination is needed. Impacts may become clear as study progresses.)
D: No impact is expected

Environmental & Social Consideration

Result of EIA Studies (Social environment)

Items	Evaluation		Reason
	Before/ During Construction	Operation	
Land acquisition and resettlement	B-	D	[Pre-construction] No households need to be resettled, but a certain area of land is needed to be permanently acquired or temporarily used. And, Compensation and support for land, structures, trees and crops would be estimated and implemented based on the Land acquisition plan during the preconstruction.
Local economies	B+/-	D	[Construction] The project will bring about some benefits such as job creation and economic opportunities to sell foods/goods to workers, while a part of farmland/plantation will lose that area. [Operation] Compensation for the farmland/plantation would be done.
Land use	B-	D	[Construction] A part of farmland/plantation cannot temporarily or permanently be used by the construction of access road. [Operation] Compensation for the farmland/plantation would be done
Water use	D	D	Since there is not river water supply around the project site, water use will not be limited.
Existing social infrastructures and Services	B-	B+	[Construction] The wiring connection between new cable and exiting cable will cause a problem such as power failure. [Operation] After the operation, hydropower facilities will contribute to stable power supply in Santo Island.
Cultural heritage	D	D	There is no cultural heritage inside/around the project site.

A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C: Extent of positive/negative impact is unknown (Examination is needed. Impacts may become clear as study progresses.)
D: No impact is expected

Environmental & Social Consideration

Result of EIA Studies (Other)

Items	Evaluation		Reason
	Before/ During Construction	Operation	
Working conditions (work safety)	B-	D	[Construction] There would be accidents, injuries and health problems at the construction sites especially along river side. [Operation] Problems related to working safety are not expected.
Accidents	B-	D	[Construction] There would be traffic accidents, involving local people, during the construction work. [Operation] Accidents are not expected.
Global warming	B-	B+	[Construction] A limited amount of greenhouse gas (GHG) will be emitted by the construction, but its impacts are limited. [Operation] Amount of the fossil fuel use and generation of GHG will be reduced by the shift of power generation method.

A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C: Extent of positive/negative impact is unknown (Examination is needed. Impacts may become clear as study progresses.)
D: No impact is expected

Environmental & Social Consideration

Environmental Management and Monitoring Plan (EMMP)

Items	Monitoring item	Parameter / Indicator	Location	Frequency	Responsible	Budget
Pre-construction						
Land acquisition, compensation payment and other support	Compensation for land and other assets	Area of land acquisition and lease Number of assets	Project area	Once before construction	DOE	Land acquisition monitoring
	Complaints resolutions	Grievance and Complaints Redress Mechanism (GRM) log book	Project area	Time of complaints	DOE	Land acquisition monitoring
Construction phase						
Accident and incident	Complaint (in general such as noise, traffic jam, and accidents)	Records of complaints	Project area	Time of complaints	Contractor DOE	Construction cost
Air Pollution	Equipment and automobiles in good shape	Regular inspection and maintenance (daily check sheet/work report)	Project area	Daily	Contractor	No cost
	Air quality	Level of dust (visual observation)	Project area	Daily	Contractor	Construction cost
	Mitigation measures such as sprinkling water, washing tires	Records on water sprinkling/ washing (check sheet/work report)	Project area	Daily	Contractor	Construction cost
Air pollution/ noise & vibrations	Equipment and automobiles with less emission gas and noise	Number of Automobiles with certification on site		As appropriate	Contractor	No cost
Water pollution	Surface water quality	Suspended Substance (SS) (by portable water quality meter) oil & grease (observation)	Discharge point / Upper& lower of river	Weekly	Contractor	Construction cost
	Condition of turbidity measures work	Condition of function and damage (visual inspection)	Project area	Daily	Contractor	Construction cost

Environmental & Social Consideration

Environmental Management and Monitoring Plan (EMMP)

Items	Monitoring item	Parameter / Indicator	Location	Frequency	Responsible	Budget
Construction phase						
Waste	Management of excavated soil, concrete debris and others	Proper storage nor not (check sheet/work report) / Reuse or not (check sheet/work report)	Project area	Monthly	Contractor	Construction cost
	Management of general waste	Records of waste disposal	Project area	Monthly	Contractor	Construction cost
Bottom sediment/ Ecosystem	Mitigation measures	Mitigation measures are done or not (check sheet/work report)	Project area	Weekly	Contractor	Construction cost
Hydrology	Condition of steep slope	Condition of steep slope along river (visual inspection)	Project area	Weekly	Contractor	Construction cost
Work conditions	Occupational Safety&Health plan	Availability of OHS Plan	Project area	Monthly	Contractor	Construction cost
	Meetings and trainings	Number of meetings and trainings				
	Occurrence of accidents	Records of accident and injuries				
Accident/ Traffic congestions	Traffic management Plan	Availability of TMP	Project area	Monthly	Contractor	Construction cost
	Implementation of TMP	Availability of guard, signboard, and so on (activity records)	Project area	Monthly	Contractor	Construction cost
Operation phase						
Hydrology	River channel	River channel is changed or not	Between intake / power house	Twice a year (Dry & Wet)	DOE	Operational cost

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Environmental & Social Consideration

Draft Environmental and Social Monitoring Form (1/5)

1. Response/Actions to Comments and Guidance from Government Authorities and the Public

Monitoring Item	Monitoring Results during Report Period
Number and contents of formal comments made by the public	
Number and contents of responses from Government agencies	

2. Pollution

1) Air Quality

Item	Unit	Situations of Dust Based on the observation	Monitoring Point	Frequency
Dust	-	1. Good 2. Acceptable level 3. Bad	Construction site	Daily

2) Surface Water Quality

Item	Unit	Measurement Point			Standards for Contract	Referred Standards	Frequency
		Discharge point of the turbid water	Down-stream of Sarakata river	Up-stream of Sarakata river			
Suspended Substance (SS)	mg/l			-	200	Japan's standard	weekly
Oil & grease	Yes/No			-	observed		

3) Waste (Construction waste)

Date: Item: Waste Management Mark: "✔" if management is done as required

Location	Kind of waste	Volume of waste (m3)	Final disposal or reuse	Stored at designated place	Waste separation	Remark

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Environmental & Social Consideration

Draft Environmental and Social Monitoring Form (2/5)

4) Mitigation Measures

Date: Mark: "✔" if mitigation measure is done

No	Item	Monitoring Site	Mitigation measure is done or not Conditions of facilities	Remarks	Frequency
1	Check the conditions of vehicles (dust & noise control)				Daily
2	Sprinkling (dust control)				Daily
3	Washing tires (dust control)				Daily
4	Condition of temporary cofferdam				Daily
5	Condition of sedimentation pond/drainage				Daily

3. Natural Environment

1) Ecosystems / Bottom sediment

Item	Monitoring Site	Monitoring Results during Report Period	Measures to be Taken	Frequency
Clearance activities (visual inspection)				Weekly
Management of top soil (visual inspection)				Weekly

2) Hydrological Situation

Item	Monitoring Site	Monitoring Results during Report Period	Measures to be Taken	Frequency
Impact of construction work on steep slope (visual inspection)				Weekly
Impact of operation of hydropower facilities on river channel (visual inspection)				Twice a year (Dry & Wet season)

Environmental & Social Consideration

Draft Environmental and Social Monitoring Form (3/5)

1) Land acquisition

Pre-Construction phase

Resettlement, Land expropriation, and compensation for assets and crops (monthly report)

Item		Planned Total	Unit	Month/Year		Month/Year		Month/Year		Month/Year		Month/Year		Expected completion date	Responsible organization
				Qty	%	Qty	%	Qty	%	Qty	%	Qty	%		
1.Update PAPs list and Final Asset Valuation															DOL
1-1	Identification of final PAHs*	-	HH Business												
1-2	Announcement to Affected people	-	Time												
1-3	Inventory survey and final cost estimation for expropriation	-	Time												
1-4	Consultation meeting times	-	Time												
1-5	Agreement signed by PAHs*	-	HH Business												
2. Progress of resettlement															
2-1	Resettlement of household	-	HH												
3. Progress of land acquisition															DOL
3-1	Permanent land acquisition Customary land	13,000	m2												
3-2	Permanent land acquisition Leased land	337,000	m2												
3-3	Temporary land use Leased land	70,000	m2												
4.Progress of compensation in cash															DOL
4-1	Agricultural Products	140	num.												
4-2	Trees	73	num.												
4-3	Livestock	100	num.												
5. Complain and Grievance Redress N/A Cases			Case												
5-1	Solved cases		Case												
5-2	Unsolved cases		Case												

Environmental & Social Consideration

Draft Environmental and Social Monitoring Form (4/5)

Record of Complain and Grievance Management

No	Date	Complain and Grievance from PAPs	Solution / Result / Any actions to be taken

Consultation meetings

No	Date	Sector	Nos of Participants	Key agenda and result of discussion

2) Livelihood

Before Construction

Item	Monitoring Results during Report Period	Measures to be Taken	Frequency
Priority in Employment			Monthly
Other employment			Monthly

3) Safety Management (Health and Occupational Safety)

Safety management plan

Pre-construction phase

	Safety management plan is prepared and submitted	Approved by the Consultant	Remarks
Date			

Training programs

No		Date	Training	Agenda	Participant
1					
2					

During Construction

Safety management

Date:

No	Item	Result	Remarks
1	Number of meetings organized since the previous monitoring		
2	Safety gear distribution (%)		
3	Keep records of accidents and injuries properly (Yes/No)		
4	Installation of fences, assignment of guards (Yes/No)		

Environmental & Social Consideration

Draft Environmental and Social Monitoring Form (5/5)

Record of Accidents

No	Date	Details of accidents	Solution / Result / Any actions to be taken

4) Other checklist

Date: Mark: "✔" if mitigation measure is done

No	Item	Monitoring Site **	Mitigation measure is done or not	Remarks
1	Communities get the information on the construction schedule			
2	Communities know get the information of traffic management			
3	Installation of signboard			
4				

5) Record of Complains

No	Date	Complains	Solution / Result / Any actions to be taken

Environmental & Social Consideration

1st & 2nd Consultation Meeting on Nov.&Dec.2018 @ Sanma Province Chamber

Purpose	• To obtain the understanding and agreement through the explanation of the project background. • To explain the project and land issue caused by the project
Participant	DOL in Santo, Officers of Sanma province, DOE、VUI, Land owners
Result	• Communication framework between land owners and DOE was confirmed • Project Committee and its role were established in order to communicate related to the project and hire the local



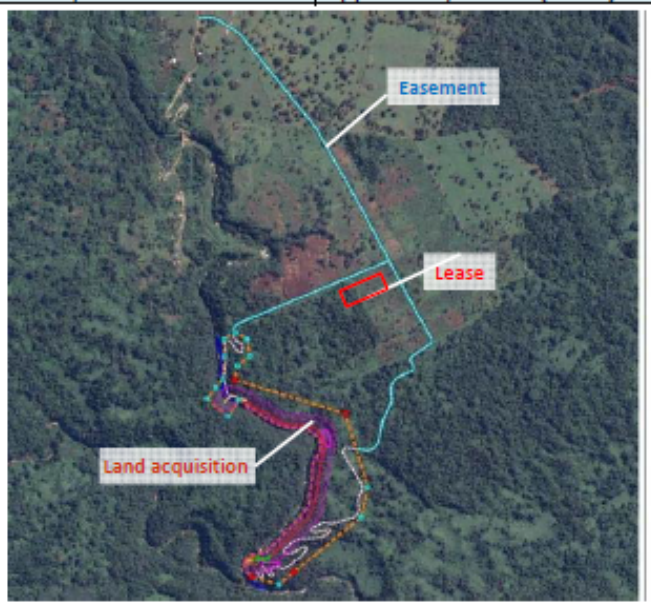
Environmental & Social Consideration

3rd Consultation Meeting on Jun. 2019 @ Santo (Natoto Village)

Purpose	• To explain contents of the environmental and social survey • To share the benefit and problems regarding hydropower facility
Participant	Local residents
Result	• Interesting and intension to support for the project were received • It has been agreed that any information concerning the proposed project must be communicated through the committee established with land owning group


Land Acquisition for the Project

	Location	Required area	Remarks
Land Acquisition	Main facilities construction site around Intake to Powerhouse	Approx. 350,000m2 (35ha)	
Lease from PRV	Temporary soil yard beside access road	Approx. 70,000m2 (7ha)	Negotiation with PRV
Easement	Access road / Transmission line	Approx. 79,000m2 (7.9ha)	



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Land Acquisition for the Project

Process Summary

Intention to acquire land and/or easement (1st PN, Schedule 3)

- MOL prepares the Public Notice (PN) for the intension of the MOL to acquire the project land for national interest purposes and for easement of the access road.
- PN accompanied with a sketched plan must be more than 30 days and any objection is acceptable during this period.

Declaration to acquire land/easement (2nd PN, Schedule 4)

- MOL prepares the PN for the declaration that the Government is acquiring the land and creating an easement.
- PN must be supported with the proper approved survey plan.

Assessed Compensation (3rd PN, Schedule 5)

- MOL values and assesses the land value, and prepares the PN for the assessed compensation.
- PN must be 30 days and any objection is acceptable during this period.
- If MOL receives the appeal, MOL re-assesses the value of compensation then re-determines the value for compensation.

Final Determination / Payment and Order

- Payment is conducted with observation of Ministry of Finance
- MOL must issue an Order for possession and this Order is also used for land registration.

Components for GCF – Concept Note
(Santo Island RE100%)

NEWJEC, JICA survey team
Oct., 8th, 2020

Project Objective

Over all Goal: Achieving 100% renewable energy in Vanuatu Islands
(National Energy Road Map Goals are targeting RE 100% by 2030)

Objective: Achieving 100% renewable energy in Luganville grid system in Santo Island

※This project will be conducted as a pilot project for the over all goal

Draft Program

No.	Project	M.USD	Source
1	New Hydropower (Sarakata2) : 1,000 kW	35	Japan
2	Expansion of Existing Hydropower (Sarakata1) : 300 kW	2	VUI
3	Transmission Line from Sarakata to Luganville	3	GCF(1)
4	PV	*	GCF(2)
5	Battery	*	GCF(3)
6	TA (Technical Assistance)	*	GCF(4)

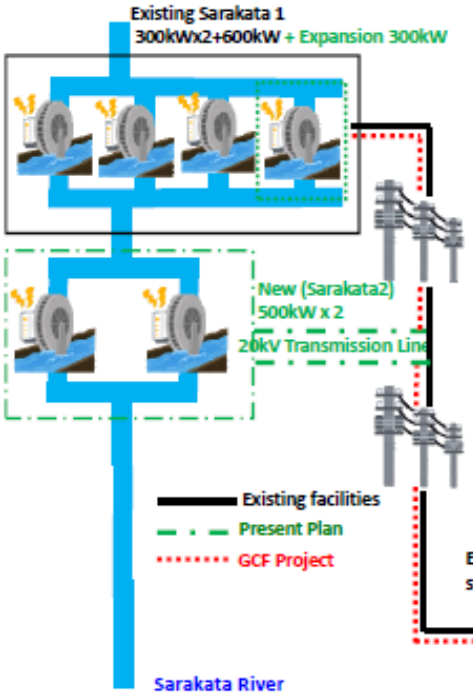
No.4, 5 * : Scenario-A and B will be studied for combination of PV and Battery

---

Summary – comparison of GCF project

Scenario				Scinario-00	Scenario-A	Scenario-B
				Present Plan	Present Plan + TL + PV + Battery [<10MUSD for SAP]	Present Plan + TL + PV + Battery
Existing (Sarakata-1)			kW	1,200	1,200	1,200
Existing Plan	Expansion of Sarakata-1		kW	300	300	300
	New Sarakata-2		kW	1,000	1,000	1,000
GCF	*Add TL from Sarakata to Luganville			-	*	*
	Installed Capacity	Battery	kW	0	500	2,000
		PV	kWac	0	1,000	5,400
Total Capacity including existing hydropower			kW	2,500	4,000	9,900
RE rate (%) with 2018 discharge	RE rate [%]			92%	98%	100%
	RE 100% day (24hr/day RE100%)			127-day	292-day	365-day
	Max. hourly Percentage of PV+Battery			0%	37%	54%
RE rate (%) with 2016 discharge (dry year)	RE rate (%)			81%	92%	100%
	RE 100% day			38-day	156-day	365-day
	Max. Percentage of PV+Battery			0%	43%	63%
Draft Cost (MUSD)						
	(0) Sarakata-2 Extention					
	(1) Transmission Line			0.0	3.0	3.0
	(2) Battery			0.0	2.0	11.0
	(3) PV			0.0	4.0	21.0
	(4) TA			0.0	1.0	3.0
	Total (MUSD)			0.0	10.0	38.0
Remarks					- NOT RE100% even for 2018 discharge - Lower cost flow lower target - Grid stability is moderate	-RE100% even for Driest year (2016) - High cost for RE100% - Grid stability is low because of high PV+battery rate

Overview of Projects



Present Plan

(Sarakata2 (1000kW) + Sarakata1 expansion (300kW))

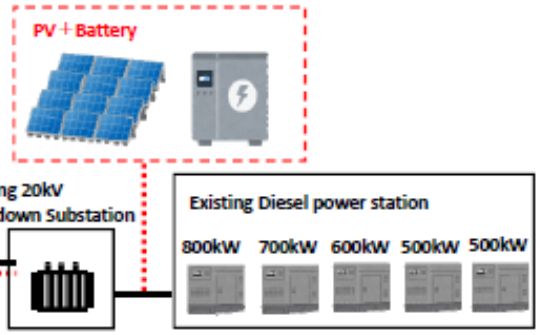
+

Scenario-A: for SAP (<10MUSD)

+ Transmission Line (Sarakata – Luganville)
+ PV 1,000 kW,
+ Battery: 500 kW x 3.0 hr = 1,500 kWh

Scenario-B: for RE100% even for the driest year

+ Transmission Line (Sarakata – Luganville)
+ PV 5,400 kW,
+ Battery: 2,000 kW x 6.0 hr = 12,000 kWh



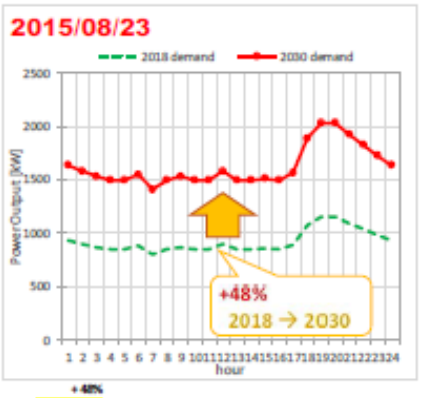
3

Assumed Condition for Study

- Assume Power Supply 2018 ＝ Demand 2018
- 2030 Demand assumption
  - Demand growth 3.3%/year → Increase 48% from 2018 to 2030
  - (Hourly demand of 2030) = (Hourly demand of 2018) x 1.48
- 2030 Demand & Supply Calculation
  - Supply : Existing Sarakata1(1200kW) + Expanded Sarakata1 (300kW) + New Sarakata2 (1,000kW) + PV + Battery
  - Loss : 10 %

Year	Peak Deamd	Energy Sold	estimated growth rate Peak Deamd
	kW	kWh/year	%
2016	1,932	8,983,224	2.30%
2017	1,842	8,980,144	2.30%
2018	1,903	9,311,374	3.30%
2019	1,966	9,654,822	3.30%
2020	2,032	10,010,937	3.30%
2021	2,099	10,380,188	3.30%
2022	2,169	10,763,059	3.30%
2023	2,241	11,160,051	3.30%
2024	2,315	11,571,687	3.30%
2025	2,392	11,998,506	3.30%
2026	2,471	12,441,067	3.30%
2027	2,553	12,899,953	3.30%
2028	2,638	13,375,764	3.30%
2029	2,726	13,869,128	3.30%
2030	2,816	14,380,695	3.30%
total growth rate	145.8%	160.1%	

Source: Site Survey Report (June, 2019)
Assuming demand growth rates for peak (kW) as 3.3 % and energy production (kWh) as 3.7%)



Peak Demand 2,800 kW

4

Effectiveness of Installation of Additional Transmission Line

Scenario				Scenario-00	Scenario-01
				Present Plan	Present Plan + Additional Transmission Line
Existing (Saraiata-1)			kW	1,200	1,200
Existing Plan	Expansion of Saraiata-1		kW	300	300
	New Saraiata-2		kW	1,000	1,000
GCF	*Add TL from Saraiata to Lagamvile			-	To be added
	Installed Capacity	Battery	kW	0	0
			kWh	0	0
		PV	kWac	0	0
			kWp	0	0
Total Capacity including existing hydropower			kW	2,500	2,500
RE Generation			MWh/yr	16,461	16,222
Diesel Generation			MWh/yr	2,621	2,031
RE rate (%) Ave.4yr 2015-2018 discharge	RE rate [%]			86%	89%
	Fuel Cost [M.USD/year]			0.67	0.52
	RE 100% day (24h/day RE100%)			62-day	114-day
	Max. hourly Percentage of PV+Battery (hopefully < 40%)			0%	0%

- Improve the Stability and Reliability,
- Reduce the Electric Transmission Loss, (assumed to be reduced : 10% → 5%)

and

- Enhance the Resilience against Natural Disasters such as Cyclones

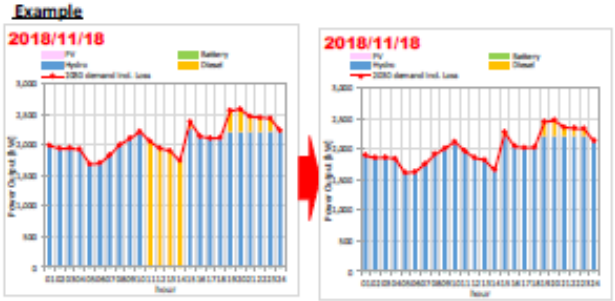
This project aims to support paradigm shifts in both

"Mitigation" = Reduce GHG Emission (Using RE instead of Fossil Fuel)

and

"Adaptation" = Increase Climate Change Resilience

Example



Japanese Grant Aid

Grant Aid Procedure

1) **Preparatory Survey**
   - The Survey conducted by JICA, using (a) Japanese consulting firm(s).
2) **Appraisal & Approval**
   - Appraisal by the Government of Japan (GOJ) to see whether or not the project is suitable for Japanese Grant scheme, based on the Survey report and JICA, and Approval by the Japanese Cabinet
3) **Authority for Determining Implementation**
   - The Project, once approved by the Cabinet, becomes official with the Exchange of Notes (E/N) signed by between the GOJ and a recipient country
4) **Grant Agreement (the G/A)**
   - Agreement concluded between JICA and a recipient country
5) **Implementation**
   - Implementation of the Project on the basis of the G/A, JICA assists the recipient country in such matters as preparing tenders, contracts and so on.

Japanese Grant Aid

Grant Aid Scheme (1)

(1) The E/N and the G/A
After the Project is approved by the Cabinet of Japan, the E/N will be singed between the GOJ and the Government of Vanuatu (GOV) to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and GOV to define the necessary articles, in accordance with the E/N, to implement the Project, such as payment conditions, responsibilities of GOV, and procurement conditions.

(2) Selection of Consultants
In order to maintain technical consistency, the consulting firm(s) which conducted the Survey will be recommended by JICA to the recipient country to continue to work on the Project's implementation after the E/N and G/A.

(3) Eligible source country
Under the Japanese Grant, in principle, Japanese products and services including transport or those of the recipient country are to be purchased. The Grant may be used for the purchase of the products or services of a third country, if necessary, taking into account the quality, competitiveness and economic rationality of products and services necessary for achieving the objective of the Project. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm are limited to "Japanese nationals", in principle.

(4) Necessity of "Verification"
GOV or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals, in principle. Those contracts shall be verified by JICA. This "Verification" is deemed necessary to fulfill accountability to Japanese taxpayers.

Japanese Grant Aid

Grant Aid Scheme (2)

(5) Major undertakings to be taken by the Government of the Recipient Country

In the implementation of the Grant Project, the recipient country is required to undertake such necessary measures. GOJ requests GOV to exempt all customs duties, internal taxes and other fiscal levies such as VAT, commercial tax, income tax, corporate tax, resident tax, fuel tax, but not limited, which may be imposed in the recipient country with respect to the supply of the products and services under the verified contract, since the Grant fund comes from the Japanese taxpayers.

(6) "Proper Use"

GOV is required to maintain and use properly and effectively the facilities constructed and the equipment purchased under the Grant, to assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Grant.

(7) "Export and Re-export"

The products purchased under the Grant should not be exported or re-exported from the recipient country.

(8) Banking Arrangements (B/A)

a) GOV or its designated authority should open an account under the name of GOV in a bank in Japan (the Bank), in principle. JICA will execute the Grant by making payments in Japanese yen to, in principle, cover the obligations incurred by GOV or its designated authority under the Verified Contracts.

b) The payments will be made when payment requests are presented by the Bank to JICA under an **Authorization to Pay (A/P)** issued by GOV or its designated authority.

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Japanese Grant Aid

Grant Aid Scheme (3)

(9) Authorization to Pay (A/P)

GOV should bear an advising commission of A/P and payment commissions paid to the Bank.

(10) Environmental and Social Considerations

GOV must carefully consider environmental and social impacts by the Project and must comply with the environmental regulations of the recipient country and JICA Guidelines for Environmental and Social Consideration (April, 2010) .

(11) Monitoring

GOV must take their initiative to carefully monitor the progress of the Project in order to ensure its smooth implementation as part of their responsibility in the G/A, and must regularly report to JICA about its status by using the **Project Monitoring Report (PMR).**

(12) Safety Measures

GOV must ensure that the safety is highly observed during the implementation of the Project.

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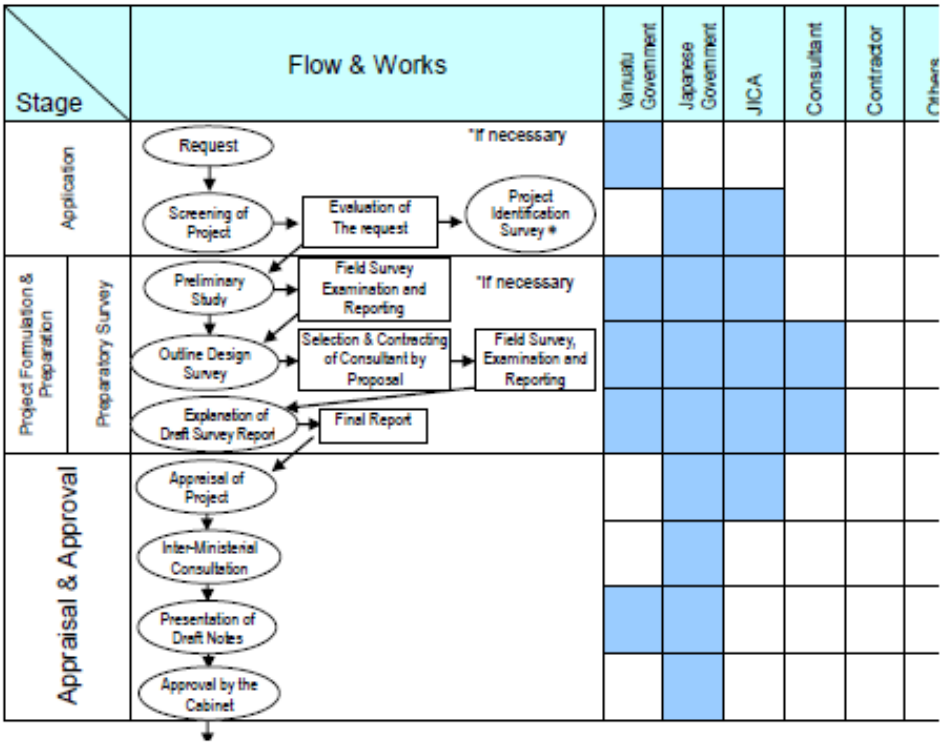
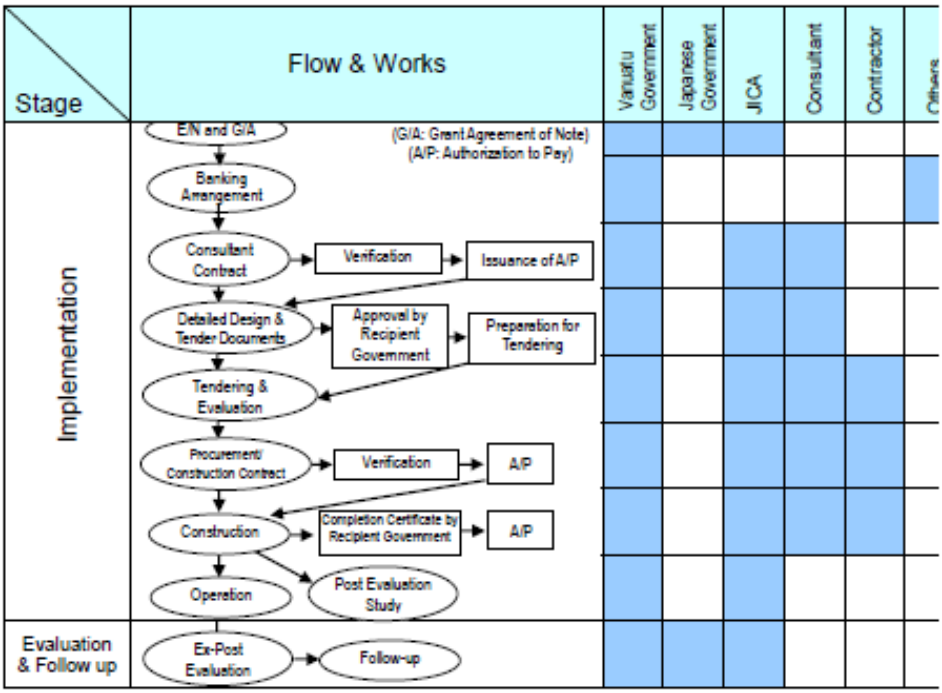
Japanese Grant Aid

FLOW CHART OF JAPANESE GRANT PROCEDURES (1/2)



Japanese Grant Aid

FLOW CHART OF JAPANESE GRANT PROCEDURES (2/2)



Japanese Grant Aid

Major Undertakings to be taken by each Government (1/2)

No.	Items	To be covered by Grant	To be covered by Vanuatu Side
1	To secure land necessary for the implementation of the Project and to clear the sites		○
2	To construct/procure the following facilities/equipment		
	1) Construction of facilities	○	
	2) Procurement of equipment	○	
	3) Installation of gates and fences in plantation		○
3	To provide facilities for distribution of electricity, water supply and drainage and other incidental facilities necessary for the implementation of the Project outside the sites		
	1) Electricity		
	a. Processing application for the distributing power line to the site		○
	b. Drop wiring and internal wiring within the site	○	
	c. Main circuit breaker and transformer	○	
	2) Water supply and drainage		
	a. Water supply system within the site (receiving and tanks)	○	
	b. Drainage system (for toilet sewer, common waste, storm drainage and others) within the site	○	
	3) Road		
	a. Road within the site (access road)	○	
	b. Road outside the site		○
	5) Furniture		○

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Japanese Grant Aid

Major Undertakings to be taken by each Government (2/2)

No.	Items	To be covered by Grant	To be covered by Vanuatu Side
4	To ensure prompt unloading and customs clearance of the products at ports of disembarkation in Vanuatu and to assist internal transportation of the products		
	1) Marine transportation of Products from Japan to Vanuatu	○	
	2) Tax exemption and custom clearance of Products at the port of disembarkation		○
	3) Internal transportation from the port of disembarkation to the project site	○	
5	To ensure that customs duties, internal taxes and other fiscal levies, which may be imposed in Vanuatu with respect to the purchase of the products and the services, are exempted		○
6	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into Vanuatu and stay therein for the performance of their work		○
7	To ensure that the Facilities and the products are maintained and used properly and effectively for the implementation of the Project		○
8	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project		○
9	To bear the following commissions paid to the Japanese bank for banking services based upon the B/A		○
	1) Advising commission of A/P		○
	2) Payment commission		○
10	To give due environmental and social consideration in the implementation of the Project.		○

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