SANIMA MIDDLE TAMOR HYDROPOWER LIMITED
Shankha Park, Dhumbarahi, Kathmandu, Nepal

MIDDLE TAMOR HYDROPOWER PROJECT (73 MW)

PROGRESS REPORT

(August 2022)

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ABBREVIATIONS AND ACRONYMS

amsl	above mean sea level
BoQ	Bill of Quantities
COD	Commercial Operation Date
CWTW	Chongqing Water and Turbine Work Co. Pvt. Ltd.
Dia,	Diameter
D/s	Downstream
DoED	Department of Electricity Development
EIA	Environmental Impact Assessment
Ele,.	Elevation
EM	Electromechanical
FDC	Flow Duration Curve
FSR	Feasibility Study Report
GoN	Government of Nepal
GWh	Giga Watt hour
HEP	Hydroelectric Project
HM	Hydro mechanical
HRT	Head Race Tunnel
HW	Head Works
IEE	Initial Environmental Examination
IPC	Interim Payment Certificate
INPS	Integrated Nepal Power System
km	Kilometers
kN	Kilo Newton
kV	Kilo Volt
m	Meter
MOEWRI	Ministry of Energy, Water Resources and Irrigation
MW	Mega Watt
MWh	Mega Watt hour
NEA	Nepal Electricity Authority
NPR	Nepalese Rupees
PH	Powerhouse
PPA	Power Purchase Agreement
RCC	Reinforced Cement Concrete
RCOD	Required Commercial Operation Date
RoR	Run of River
Rpm	Revolution per minute
S.N.	Serial Number
SEIA	Supplementary Environmental Impact Assessment
SHEPL	Sanima Hydro and Engineering (P.) Ltd.
SMTHL	Sanima Middle Tamor Hydropower Ltd.
SPV	Special Purpose Vehicle
TL	Transmission Line
ToR	Terms of Reference
TSE	Tamor Sanima Energy Pvt. Ltd.
U/s	Upstream
USD	United States Dollars
VAT	Value Added Tax

1 INTRODUCTION

1.1 BACKGROUND OF THE PROJECT

Middle Tamor Hydropower Project (MTHP), is a run-of river (RoR) project with an installed capacity of 73 MW. The headworks (HW) of the project is located in Phungling Municipality and Phaktanglung Rural Municipality and the Powerhouse (PH) is located in Mikwa Khola Rural Municipality at the right bank of the Tamor River in Taplejung district. The boundary co-ordinates of the project are 87^0 40' 01" E to 87^0 42' 40" E and 27^0 23' 29" N to 27^0 25' 19" N. The nearest black topped approach road from the project site is at Bahanande, on the Mechi Highway (233 km from Charali in Jhapa), 7 km south of district headquarters Phungling Bazar. From Phungling, the project Powerhouse (Thumba village) and Headworks (Mitlung village) sites are accessible via a 15 km and 17 km long separate earthen roads respectively.

Sanima Middle Tamor Hydropower Ltd. (SMTHL) was established as a Special Purpose Vehicle (SPV) Company for the implementation and operation of Middle Tamor Hydropower Project (MTHP). The Generation License of the Project was obtained initially for 54 MW on 5 June 2017, and subsequently the design was revised and generation license for revised capacity of 73MW obtained on 10 December 2018.

SMTHL has implemented the construction work with four major individual contract packages of work with different international and national contractors. All of the four major contracts packages (Main Civil Contract, Hydro-mechanical Contract, Electro-mechanical Contract and Transmission Line Contract) have already been awarded by the SMTHL. The Main Civil, Hydro-Mechanical, Electro-Mechanical and Transmission Line Contractors have been working at the construction site. Beside above major individual Contract packages, the pre-construction and preparatory works, which comprises various works like construction of access roads, up-gradation of existing roads to be used by the project, slope protection works, Tamor crossing bridge in the PH area in Thumba, camp facilities, acquisition of required private lands as well as leasing of public land, arrangement of construction power line and explosives for the tunnel excavation, arrangement of local construction materials and necessary permission form local authorities have been executed by outsourcing different suppliers and local contractors on need basis by SMTHL. The progress of all these activities is described in this report. According to the Power Purchase Agreement (PPA) with Nepal Electricity Authority (NEA) the required commercial operation date (RCOD) of the Project is 17 July 2022 (1 Shrawan 2079) for 73 MW. However, considering initial impact study of COVID-19 on the Project, the RCOD is estimated a delay of 1 year. As per the 3rd PPA amendment signed with Nepal Electricity Authority (NEA) the RCOD of the Project is extended till 16 July 2023 (31 Asadh 2080) for 73MW.

Based on the current Revised Feasibility Study, the installed capacity of the project is 73 MW with the design discharge of 73.71 m^3/s, corresponding to 42.71% exceedance flow. The catchment area of the Project is 2,002 km^2 and the gross head is 132 m. The 50 m long weir has its crest level at 887 m above mean sea level (amsl). The maximum height of weir crest from its original ground level is 10.5 m which diverts the required flow to the Intake. Two undersluice gates maintain the design water level for intake and flush excessive deposits deposited in front of the intake area. Intake comprises of 6 openings to withdraw the design discharge to the Project. The flow from the Intake is conveyed to the gravel trap and successively towards underground settling basin via a concrete cased approach pipe of about 281.52 m length. A 100 m long underground settling basin (with additional 50 m of inlet and outlet chamber) designed with 90% trap efficiency passes the clean water into the headrace tunnel. About 3,367 m long headrace tunnel (concrete lining and shotcrete) with excavated diameter of 6.5 m passes the design discharge to the penstock. Proposed penstock is of 4.5 m (internal diameter) till the branching length of about 264.66 m after which four penstock pipes of internal diameter ranging 2.25 m, 3.18 m, 3.9 m and 4.5 m supplies the water to the powerhouse. Powerhouse is 56.5 m long and 26 m wide with the tail water level at 755 m amsl. Four units of vertical axis Francis turbine each of 18.25 MW capacity have been proposed to generate the designed output of 73 MW. After the power generation (non-consumptive use), the tail water is discharged back to the Tamor River via a 75 m long tailrace culvert. The generated electricity is supplied through a 9 km long 220 kV double circuit transmission line (with 24 towers), to Dhunge Sanghu substation of the Koshi

Corridor which is being constructed by Nepal Electricity Authority (NEA). The estimated annual energy generation as per the PPA is 429.409 GWh. The general layout of the project is shown in Figure 1.

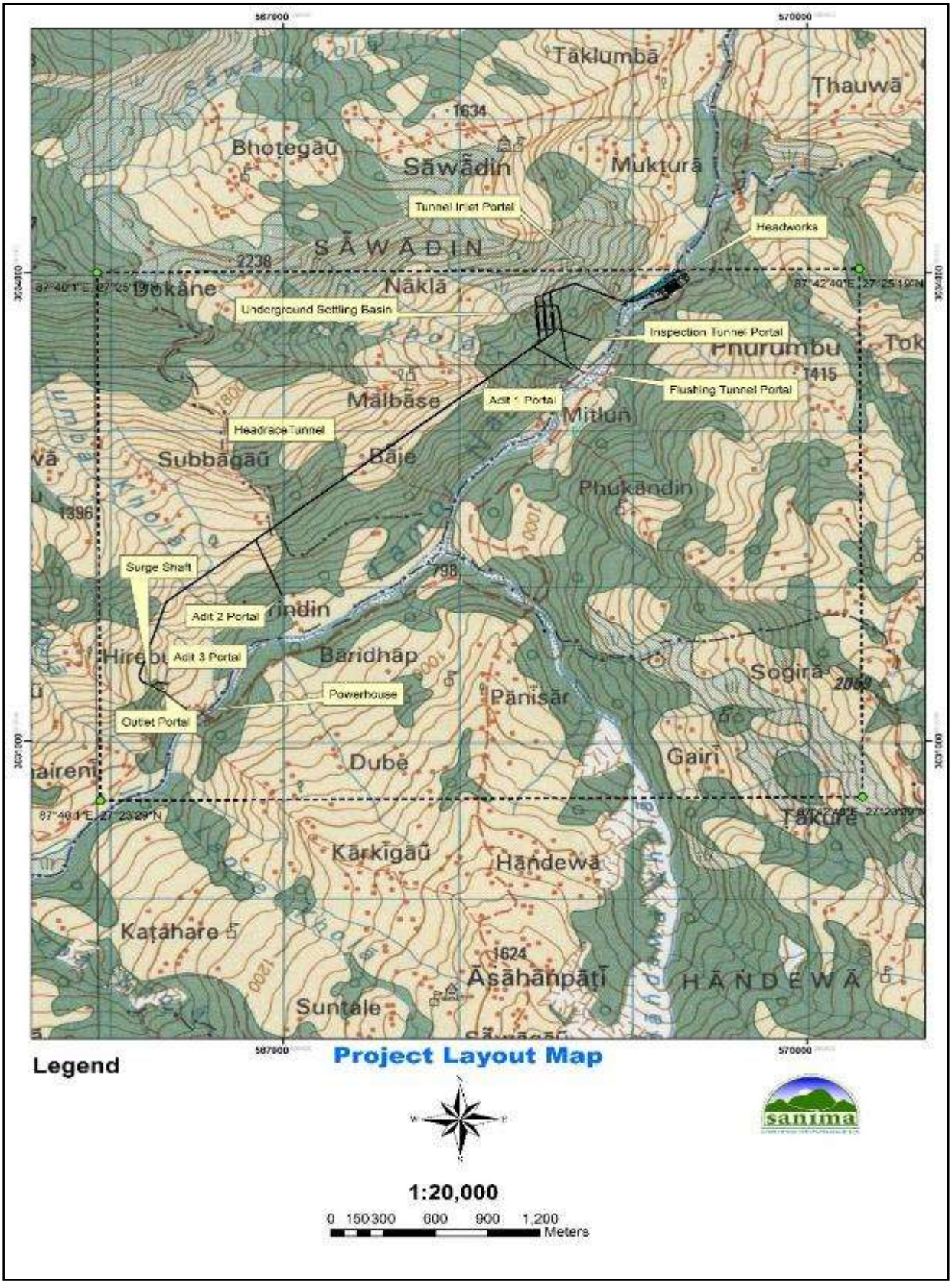


Figure 1: General layout of the Project Structures

1.2 PROJECT KEY INFORMATION

Table 1: Project Key Information

Project Key Data			
Project Name	**Middle Tamor Hydropower Project**		
Project Company Name	**Sanima Middle Tamor Hydropower Limited**		
Installed Capacity	**73 MW**	Annual generation	**429.409 GWh**
Location	Taplejung, Nepal	Main Civil Contract Award	12 April 2018
Date of Generation license	5 June 2017/10 Dec 2018	Date of PPA signing	10 Jan 2017/30 Nov 2018
Revised Project Cost (estimated total)	NPR 13,330 Million	Revised Total equity required (estimated)	NPR 3,332.5 Million
Revised Total debt required (estimated)	NPR 9,997.5 Million	RCOD	13 Sept 2021 for 54MW/ 17 July 2022 for the current capacity (73 MW)
Lenders	NIBL – Lead, Nabil (co-lead), Global IME (Co-lead), NMB, NCC, Laxmi, Nepal SBI, ADBL	Consultant	Sanima Hydro and Engineering Pvt. Ltd.
Main Civil Contractor	Zhejiang First Hydro and Power Construction Group Co. Pvt. Ltd., Zhejiang, China	Hydro-Mechanical Contractor	Machhapuchhre Metal and Machinery Works Pvt. Ltd., Pokhara, Nepal
Electro-Mechanical Contractor	Chongqing Water and Turbine Work Co. Pvt. Ltd. (CWTW), Chongqing, China	Transmission Line Contractor	Cosmic Electrical Engineering Associates Pvt. Ltd., Kathmandu, Nepal
Land Acquired	Tentatively 418 Ropani till date		
Project Input(s) (Resources, Feedstock)	The Project has the design discharge of 73.71m^3/s with installed generating capacity of 73 MW.		
Project Output(s)	429.409 GWh per year will be supplied to the Nepal electricity network, as per the Power Purchase Agreement (PPA) with the Nepal Electricity Authority (NEA)		

1.3 SALIENT FEATURES OF THE PROJECT

Detailed Salient Features of the Project are as mentioned as below:

Table 2: Detailed Salient Features of the Project as per Generation License

Location:	Phurumbu VDC, (Currently: Phungling Municipality), Sawadin VDC, (Currently Phaktanglung Rural Municipality) and Khokling VDC, (Currently Mikwa Khola Rural Municipality), Taplejung District, Eastern Development Region (currently Province No. 1) of Nepal
Purpose of Project:	To supply for domestic use by connecting to national grid
Hydrology:	
Catchment Area	2,002.32 km^2
Average Flow	126.69 m^3/s (minimum monthly flow 19.55 m^3/s)
Design Flow	73.71 m^3/s (42.71% exceedance flow)
90% Exceedance flow	17.98 m^3/s
Design Flood (Q_{100})	2,791 m^3/s
Diversion Dam:	
Type	Concrete gravity dam
Slope	Ogee-profile
Crest Elevation	887 m above msl
Max. Flood Level (100 years return)	895.4 m above msl
Crest Length	60 m
Maximum height	10.5 m (from the Original ground level)
Spillway/Undersluice:	
Type	Submerged with overflow spillway (2@ 5 m x 5 m)
Invert Elevation	874.50 m above msl
Size (B x H)	5.0 m x 5.0 m
Intake:	
Type	Submerged
Number of Orifices	6
Sill Elevation of Orifice	881 m above msl
Top Elevation of Orifice	885 m above msl
Size (B x H)	4.75 m x 4.0 m (each)
Gravel Trap:	
Type	Rectangular, RCC (Continuous)
Particle size to be settled	5 mm-100 mm
Number of Chambers	3
Width (each)	12.00 m
Height	11.85 m
Length	15.00 m
Approach Pipe	
Type	Concrete encased steel pipe
Number	1

Diameter	4.5 m
Total Length (Up to Inlet Portal)	281.52 m and 20 m inside tunnel including Bell-mouth
Longitudinal slope	1:1000 (V:H)
Underground Settling Basin:	
Type	Conventional flushing
Number of bay	3
Approach Tunnel length	360.244 m (average)
Transition length	35 m
Dimension (L x B)	100 m x 13 m (each)
Particle Trap efficiency	90% (*for sediment particles equal to or larger than 0.2 mm*)
Longitudinal slope	1:50
Length from transition up to outlet gate	22.75 m
Length from gate to vertical drop	30.26 m
Converging tunnel length from drop to main tunnel (Average of three)	109.622 m
Inspection Tunnel:	
	Inspection Tunnel (common stretch):
Length	131.758 m
Excavation Diameter	4.9 m
	Inspection Tunnel 1 (to SB inlet):
Length	145.963 m (excluding common stretch)
Excavation Diameter	4.9 m
	Inspection Tunnel 2 (to SB outlet):
Length	289.524 m (excluding common stretch)
Excavation Diameter	4.9 m
Adit-1 (near Nakla Kholsi):	
Length	301.562 m
Excavation Diameter	4.9 m
Sediment flushing tunnel:	
Number	6
Length from inlet to common tunnel	28.72 m (each)
Size(B X H)	2.4 m x 2.4 m
Length of common tunnel up to portal	327.89 m
Slope of the tunnel	1:50
Size (B x H)	2.4 m x 2.9 m
Length of culvert from portal to outlet	52.778 m
Slope of the culvert	1:50
Size of culvert (B X H)	2 m x 2.5 m
Total Sediment flushing length	409.388 m
Headrace Tunnel:	
Length (Excluding settling basin)	3,367 m (up to outlet portal)
Dimensions	Inverted U shape 6.5 m (Excavation Diameter)
Support System	Concrete lining and shotcrete

Surge Shaft:	
Type	Vertical, Underground circular section/ dome type
Height	79.93 m
Diameter	16.00 m (Excavation)
Ventilation tunnel for Surge shaft:	
Length	199.75 m
Size(B X H)	3.5 m X 3.75 m
Slope	1 in 8.69
Penstock:	
Length	264.66 m inclined length of 4.50 m diameter including Bell-mouth up to branching
	After branching,
	11.54 m of 4.5 m diameter including transition
	11.25 m of 3.9 m diameter including transition
	11.47 m of 3.18 m diameter including transition
	153.12m of 2.25 m diameter including transition
	452.04 (Total Length)
Thickness	18 mm to 36 mm thickness
Grade	E-350 (IS 2062 or Equivalent)
Power Facilities:	
Powerhouse Type	Semi-surface
Dimensions (L x B)	56.5 m x 26 m
Gross Head	132 m (887.0 m – 755.0 m above msl)
Net Head	115.59 m
Installed capacity	73 MW (4 x 18.25 MW)
Dry energy	64.90 GWh
Wet energy	364.27 GWh
Annual Net Energy Output	429.409 GWh
Tailrace Culvert:	
Type	RCC, rectangular culvert (double chambered)
Length	75.00 m
Height	5.00 m
Width	4.75 m each
Longitudinal slope	1:500 (V:H)
Maximum Tail water level	755.00 m amsl
Transmission Facilities:	
Transmission line length	9 km
Voltage level	220 kV, Double circuit

1.4 PROJECT KEY DATES

The key dates for the project details are listed in the table below:

Survey License to SHEPL	: 2nd Falgun 2064 (14 Feb 2008)
Transfer of survey license from SHEPL to TSE	: 23rd Ashad 2068 (07 Jul 2011)
EIA approval	: 10th Baisakh 2070 (23 Apr 2013)
SEIA approval for 73MW	: 6th Kartik 2075 (23 Oct 2018)
Grid Connection Agreement	: 25thFalgun 2071 (09 Mar 2015)
Generation license received	: 22nd Jestha 2074 (05 Jun 2017)
Power Purchase Aggreement ofr 54 MW (PPA)	: 26th Poush 2073 (10 Jan 2017)
Power Purchase Agreement (PPA) for additional 20.9 MW	: 14th Mangsir 2075 (30 Nov 2018)
Generation License received for 73 MW	: 24th Mangsir 2075 (10 Dec 2018)
Financial Closure	: 27th Magh 2075 (10 Feb 2019)
Main Civil Contract	: 29th Chaitra 2074 (12 Apr 2018)
Hydro-mechanical Contract	: 26th Ashad 2076 (11 July 2019)
ToR Approval for 220 kV TL Project	: 1st Bhadra, 2076 (18 Aug 2019)
Electro-mechanical Contract	: 7th Poush 2076 (23 Dec 2019)
Transmission Line Contract	: 25th Jestha, 2076 (07 June 2020)
IEE Approval for 220 kV TL Project	: 29th Aashad 2078 (13 July 2021)
Construction License received for 220 kV TL	: 19 Ashoj 2078 (05 October 2021)
Pre-construction Activity	: May, 2017 (Ongoing)
Updated Required Commercial Operation Date	: 30 Aashad 2080 (16 July 2023)

1.5 MAJOR CONTRACT PACKAGES

Five different contract packages have been prepared for the implementation of the Project. Out of them, Package 1 has been awarded to Zhejiang First Hydro & Power Construction Group Co., Pvt. Ltd. of Hangzhou, Zhejiang, China for Main Civil Works Construction on 12 April 2018, Package 2 has been awarded to Machhapuchhre Metal and Machinery Works Pvt. Ltd. for Hydro-mechanical and Penstock on 11 July 2019, Package 3 has been awarded to Chongqing Water and Turbine Work Co. Pvt. Ltd., China on 23 December 2019 , Package 4 has been awarded to Cosmic Electrical Engineering Associates Pvt. Ltd., Nepal on 07 June 2020 and Package 5 has been awarded to Bavari Construction Pvt. Ltd. for the preconstruction and preparatory works.

- Main Civil Works Construction: Civil Contractor → CONTRACT Package 1
- Hydro-mechanical and Penstock: HM Contractor → CONTRACT Package 2
- Equipment (Electromechanical): EM Supplier → CONTRACT Package 3
- Power evacuation/Transmission line : TL Contractor → CONTRACT Package 4
- Pre Constructions/ Preparatory works/ Employer's set up → CONTRACT Package 5

2 PROGRESS UPDATE

At the construction site the Engineer, Sanima Hydro and Engineering Private Limited (SHEPL) has been continuously monitoring the construction activity of the Civil works, the Hydro-mechanical works, the Electro-mechanical works and the Transmission Line works that was awarded by Employer to the individual Contractors. The work progress achieved by the Project till date is described below.

2.1 PRE-CONSTRUCTION WORKS

2.1.1 ACCESS ROAD

The 17 km earthen access road towards the construction site from junction of Mechi Highway (Bahanande) is fully functional. Most of the sections of access roads are constructed by the Project along with upgradation of the existing village roads. The roads were upgraded with necessary filling using the river bed material, construction of side drains and additional construction of gabion and masonry wall structures. The access roads are constructed from the left bank of the Tamor River with two river crossing, one at Powerhouse location and another Headworks location. The access road also passes over the major dry stream (Hangdewa Khola), which occasionally creates blockage in the access road during heavy rainfall in the monsoon season. Beside that there are other few dry streams which need regular maintenance during the time of monsoon flood. The alternative road route from Mitlung to Thumba and a new Bailey bridge at Budidaha is fully operational with minimum maintenance. The management is fully cautious and staying alert of the potential disturbances in the access roads.

2.1.2 CAMP FACILITIES

The construction of the camp facilities in the Headworks area (Simle Camp) and Powerhouse area (Lorindin Camp) have been completed with construction of 8 buildings in Simle and 2 buildings in Lorindin Camp as per the first phase plan. Army Camp and Bunker at Sisne (near Headworks) are also in operation. Besides, regular maintenance and cleaning no major maintenance work occurred. The construction of guardhouse at Headworks (Simle) is completed along with entry gate. Further, the construction of a new camp at the Powerhouse is ongoing. The erection of column of ground floor and concreting works of the first floor slab has already been completed.

Figure 2: Concreting of first floor slab

2.1.3 CONSTRUCTION POWERLINE

The national-grid connected Nepal Electricity Authority (NEA) Substation (S/S) at Phungling (Hiti), Taplejung, has been providing the power necessary for the construction of the Project via a dedicated line from Hiti S/S, which is the nearest power source from the Project area.

Figure 3: Access Road Network at site

The power required for the construction of the Project, as per the load requirements at the headworks, Adit-1 and the powerhouse has been estimated to be approximately 1.7 MVA. To transmit this power, a 17 km long 33 kV construction power line (currently charged at 11 kV) has been constructed from Hiti substation to the powerhouse area and to the headworks area. The construction power line has been in operation since Mangsir 13, 2075 and is being operated with minor maintenance.

Figure 4: Construction Powerline

Figure 5: Employer's residential camp at Headworks (Simle)

Figure 6: Employer's residential camp at Powerhouse (Lorindin)

2.2 MAIN CIVIL WORKS

The Main Civil Works Contract was awarded to Zhejiang First Hydro and Power Construction Group Co. Ltd., China (1st Hydro) on April 12, 2018. The construction of main civil works started from March 2019. Currently, the Main Civil Contractor has completed concreting works at weir, stilling basin and carrying out concreting works of conveyance tank, powerhouse and tailrace culvert section along with excavation of underground works from the adit, outlet and settling basins through Nepali subcontractors. Undoubtedly, the construction schedule has been affected, but efforts are being made to manage the delay and complete the Project within the extended RCOD.

2.2.1 MAJOR RESOURCES AVAILABLE AT THE SITE

The major resources (manpower, machineries and materials) engaged for the construction and management of the MTHP is presented in this chapter. Contractor's resources are based on the reports made available by the Contractor on monthly basis. The Employer has been supporting the Main Civil Contractor to secure an uninterrupted supply of those materials and continuation of the construction activities of the Project. The Employer has been facilitating the Contractor by negotiating with various concerned parties like the government bodies, local levels, communities and material suppliers, transporters and sub-contractors. The joint efforts have made it possible to continue the construction despite the direct and indirect hurdles caused by COVID-19. Despite these efforts of the Employer and Contractor, some work fronts and desired milestones of the Project have been affected which shall be compensated by additional working hours and mobilizing resources.

Table 3: List of Equipments of Main Civil Contractor at site

S.N.	Name	Specification/Model	Quantity	Remarks
1.	Excavator	0.5m^3 and above 1.2m^3	8	Only 4 operational
2.	Loader	Above ZL40	5	Only 2 operational
3.	Dump truck	20T	10	Only 7 operational
4.	Pickup truck	Mahindra Bolero	5	Only 3 operational
5.	Agitator	7m^3	3	
6.	Mucking Machine		1	For Flushing Tunnel
7.	Concrete batching plant	0.35 m^3 and 0.75 m^3	3	
8.	Steel processing equipment		1	
9.	Vibrator		6	
10.	Electric welder		4	
11.	Butt Welder	UN1-150	1	
12.	Generator	50 KW	2	
13.	Diesel Generator	500KW	2	
14.	Diesel Generator	100KW	2	
15.	Water pump	200 m^3/h	4	
16.	Electric air compressor	22 m^3/min and 13 m^3/min	8	
17.	Diesel air compressor	13 m^3/min	1	
18.	Concrete Horizontal Tank	2m^3	1	

S.N.	Name	Specification/Model	Quantity	Remarks
		$1m^3$	1	
19.	Downhole drill	100C	3	
20.	Hand drill	YT-28	30	Rock Cutting
21.	Dry concrete ejector	PZ-7D	4	
22.	Plasma cutting machine	LGK-120T	4	
23.	Concrete wet spraying trolley	GHP16C and GYP-90	3	
24.	Threading Machine	HGS-40	1	
25.	Tower crane	160T.m	1	
26.	Crawler crane	50T	1	
27.	Screening system	Whole set	1	
28.	Crusher	75KW	1	5-10mm aggregate
29.	Centrifugal pump	TSWA5, 7	4	

2.2.2 HEADWORKS

The construction works of weir and stilling basin has been completed as of June 2022 along with downstream floodwall. The main civil contractor is carrying out concreting works at the headworks region through Nepali sub-contractors. Till date almost 99% of concrete works at undersluice, 98% at intake (orifice structure), 96% at u/s floodwall, 96% at gravel trap and 95% at intake canal has been completed. The construction of conveyance tank has already begun and almost 39% concreting works has been completed. The excavation works, foundation concreting works and erection of concrete encased approach pipe is in progress. The details of construction work area are described hereunder.

Figure 7: Aerial view of Headworks

2.2.1.1 INTAKE AND GRAVEL TRAP

More than 8,170 m^3 of concrete has been poured at intake structure till date. About 4,607.48 m^3 and 2,559.24 m^3 of concrete (C25 & C35) has been poured at gravel trap and intake canal till date which is almost 96% and 95% of concreting works of the structures respectively. The rebar installation and concreting works at the piers of the gravel trap in going on. Also, the steel lining works and concreting has been completed at all three culverts.

Figure 8: Intake and Undersluice section from downstream

Figure 9: Rebar and concrete works in gravel trap exit piers

Figure 10: A view of concreting works at trash passage

Table 4: Work Progress at Intake (orifice), gravel trap and intake canal

Structure	Total volume	Completed volume	% Complete
Intake (Orifice)	8,397.68	8,168.17	98%
Intake canal	2,704.64	2,559.24	95%
Gravel trap	4,808.93	4,607.48	96%

2.2.1.2 U/S FLOODWALL

Till date, about 2,818.00 m^3 of concrete has been poured at the upstream floodwall. The concreting works at the inclined slab of the u/s floodwall in going on. In addition, the backfilling works is being carried out simultaneously. About 96% of concreting works has been completed in U/S floodwall.

Table 5: Work Progress at U/s floodwall

Total volume	Completed volume	% Completed	% Remaining
2,944.12	2,818.00	96%	4%

2.2.1.3 D/S FLOODWALL

The concrete works at D/S floodwall was completed on June, 2020. Contractor has already backfilled the hillside of D/S Floodwall.

2.2.1.4 WEIR AND STILLING BASIN

The construction of stilling basin has been completed on the month of May 2022 whereas the construction of weir main body has been completed on June 2022. Almost 17,342.23 m^3 concrete in weir, 10,847.81 m^3 concrete at stilling basin and 2,096.30 m^3 at u/s slab and cutoff was poured.

In conclusion, 30,086.34 m^3 volume of concreting works was carried out at weir and stilling basin section. Further, the curtain grouting works at the upstream slab has already been completed.

Table 6: Progress made at Weir Section

S.N	Structure	Estimated Quantity (m^3)	Progress (m^3)	%Completed
1	Weir Body	17,342.23	17,342.23	100%
2	Stilling Basin	10,847.81	10,847.81	100%
3	U/S Slab and Cutoff	2,096.30	2,096.30	100%
	Total	**30,086.34**	**30,086.34**	**100%**

2.2.1.5 UNDERSLUICE

Till date, almost 19,272 m^3 of concrete has been poured in the Undersluice portion. About 99% of concreting works has already been completed in the undersluice portion till date. Only a small section of the fish ladder is remaining.

Figure 11: Aerial view of headworks with completed weir to the right

2.2.1.6 CONVEYANCE TANK

Till date, about 3,121.60 m^3 of concrete has been poured at the conveyance tank section. The concreting works at the base slab and side walls of the structure in going on. About 39% of concreting works has been completed in the conveyance tank section.

Table 7: Work Progress at U/s floodwall

Total volume	Completed volume	% Completed	% Remaining
8,021.71	3,121.60	39%	61%

Figure 12: A view of conveyance tank from downstream

Figure 13: Conveyance tank

Figure 14: Erection of concrete encased approach pipe

Figure 15: Main weir body (Completed)

2.2.3 UNDERGROUNDS WORKS

The progress in tunnel excavation was severely affected after the outbreak of COVID-19 due to transportation hindrance, shortage of explosives and deployment of military from Project site to different location. To avoid complete shutdown of the tunnel works due to impact of ever spreading COVID-19, main civil contractor carried out the excavation of HRT and surge shaft through Nepali sub-contractors. The excavation works and rock support works at settling basin sites are also being carried out by a Nepali subcontractor. However, the excavation progress at settling basins are yet to gain the desirable momentum.

The breakthrough of Headrace Tunnel (HRT) was achieved on July 15, 2022 at a chainage of 1,545.37 m from the starting point. Currently, the invert concreting works and rock bolts installation in HRT are being carried out from adit and outlet. Further, the excavation of surge shaft was completed on the first week of July. The concreting works at the base slab has already been completed and the rebar installation works and concreting of side walls in going on.

Further, crown stabilization works and invert blasting at settling basins is ongoing. Regarding the safety of the employees and smooth excavation works, the Employer has rented a Boomer machine which is currently being operated by the Main Civil Contractor for the excavation of settling basins. Till date, about 94% by length of the entire underground network has been excavated along with necessary supports works. The progress by volume is about 77% due to excavation of the Settling Basins with much large cross section (i.e. 150 m x 13.5 m x 17.5 m) in benching form. About 6,200 m length out of 6,626 m of the tunnel network has been excavated till date.

APPROACH/INLET PORTAL

The excavation of approach tunnel (247.055 m) has been completed in the month of January, 2020. About 50-75 mm thick shotcrete and rock bolt have been installed in all section of Approach Tunnel as the initial support.

1. APPROACH TUNNEL 01

Total length of approach tunnel 01 is 186.33 including 35 m inlet transition zone 01. The excavation of Approach tunnel 151.26 m has been completed on February 11, 2020. About 50-75 mm thick shotcrete and rock bolt have been installed in all sections of Approach Tunnel 01 as initial supports. The excavation of inlet transition zone 01 has been completed, in the benching form from crown level. Final steel reinforced shotcrete of 150 mm thick has been applied in the Approach tunnel 01.

2. APPROACH TUNNEL 02

The length of approach tunnel 02 is 148.17 m including 35 m long inlet transition zone 02. The excavation of approach tunnel 02 has been completed on February 24, 2020. About 50-75 mm thick shotcrete and rock bolt have been installed in all sections of approach tunnel 02 as initial supports. The excavation of inlet transition zone 02 has been completed, in the benching form from crown level.

3. APPROACH TUNNEL 03

The length of approach tunnel 02 is 166.50 m including 35 m long inlet transition zone 02. The excavation of approach tunnel 03 has been completed on February 24, 2020. About 50-75 mm thick shotcrete and rock bolt have been installed in all sections of approach tunnel 02 as initial supports. The excavation of inlet transition zone 03 has been completed, in the benching form from crown level.

4. SETTLING BASIN BAY 01

The settling basin bay 01 is 100 m long along with 35 m long inlet transition zone and 15 m long outlet transition zone. The settling basin bay is 13.5 m wide and 17.5 m high. The Contractor has already achieved breakthrough in SB-01 at the crown level and is carrying out excavation work of the settling basin in benching form from crown level along with the crown stabilization works and application of initial supports. The volumetric excavation progress at SB-01 is about 31%.

5. SETTLING BASIN BAY 02

The settling basin bay 02 is 100 m long along with 35 m long inlet transition zone and 15 m long outlet transition zone. The settling basin bay is 13.5 m wide and 17.5 m high. The Contractor is carrying out the application of supports at the crown. The Contractor has already achieved breakthrough in SB-02 at the crown level and. The volumetric excavation progress at SB-02 is about 31%.

6. SETTLING BASIN BAY 03

The settling basin bay 03 is 100 m long along with 35 m long inlet transition zone and 15 m long outlet transition zone. The settling basin bay is 13.5 m wide and 17.5 m high. The Contractor is carrying out the application of supports at the crown. About 110 m progress by length (average) has been achieved including inlet and outlet transition zone. The volumetric excavation progress at SB-03 is about 22%.

With this, the Contractor has already excavated almost 28% of earthwork volume in these three fronts of settling basin. The Contractor has already begun excavation at the invert to reach design depth.

7. HEADRACE TUNNEL (HRT)

3,369 m long headrace tunnel with an excavation size of 6.5 m x 6.5 m joins the Connecting tunnels at Headworks with the penstock pipe at outlet. The breakthrough of the headrace tunnel was achieved on July 15, 2022 at a chainage of 1+545.37 meters from the starting point.

HRT from Adit-01
About 1,545.37 m was excavated from Adit-01 in the Headrace Tunnel section up to the breakthrough point. About 31.77 m was excavated in the month of July 2022 till the final blast. The main civil contractor is carrying out the invert cleaning works from the adit for the base concreting of the tunnel.

HRT from the Outlet end
The total excavation progress of HRT from outlet is 1,824.59 till July, 2022. About 20.55 m excavation was carried out in the month of July only. The application of final layer of rock bolts is being carried out from the outlet region.

Total length (m)	Excavated from Adit 01 (m)	Excavated from Outlet (m)	Total Excavation (m)	Completion %
3,370	1,545.37	1,824.59	3,370	100%

8. CONNECTING TUNNEL SETTLING BASIN TO HRT

Connecting tunnel-01
132.334 m progress by length has been achieved in the excavation of connecting tunnel-01. The rock support work with rock bolt installation and shotcreting is in progress. Excavation of 15 m long outlet transition zone 01 also competed along with primary support works.

Connecting tunnel-02
About 113.25 m of excavation work have been carried out from the connecting tunnel-02 so far. The rock support works with rock bolt installation and shotcreting is in progress. Excavation of 15 m long outlet transition zone 02 also competed along with primary support works.

Connecting tunnel-03
104.6 m progress by length has been achieved in the excavation of connecting tunnel-03. The rock support work with rock bolt installation and shotcreting is in progress.

9. SEDIMENT FLUSHING TUNNEL

The Contractor is actively carrying out the excavation works in the sediment flushing tunnel. The Contractor has excavated about 292.9 m till the end of August 2022 along with rock supports works. In this month, 38.4 m has been excavated with average pull length of 1.32m.

10. VENTILATION TUNNEL

The excavation of ventilation tunnel up to 199.7 m has been completed in the month of March 2020. About 50-75 mm thick shotcrete and rock bolt have been installed in all sections of Approach Tunnel as an initial support. The steel ribs have been installed as per site conditions.

11. SURGE SHAFT

The excavation for the widening works of Surge shaft to its design diameter of 16.4 m has already been completed up to the entire depth of 79.93 m from the top level of the crown. The installation of supports of 6 m long, 32 mm dia. rock bolt and 75 mm thick steel fiber shotcrete has already been completed. The concreting works has already been completed at the base of the surge shaft whereas the contractor is carrying out the rebar installation works and concreting works at the side walls of the surge shaft.

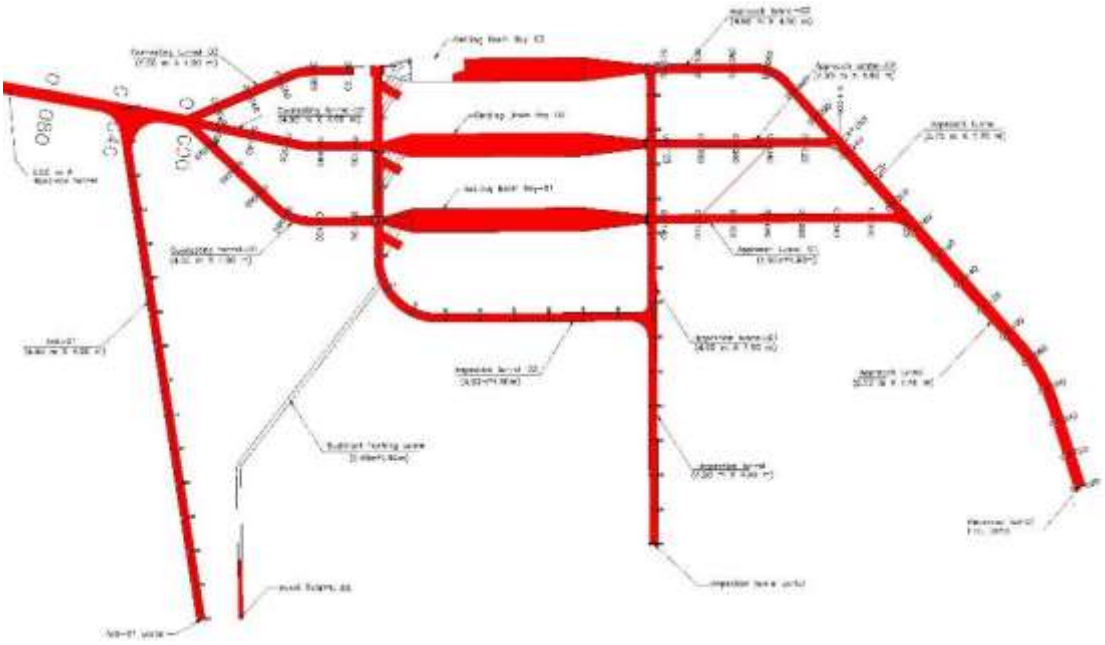


Figure 16: Schematic diagram of underground works near headworks

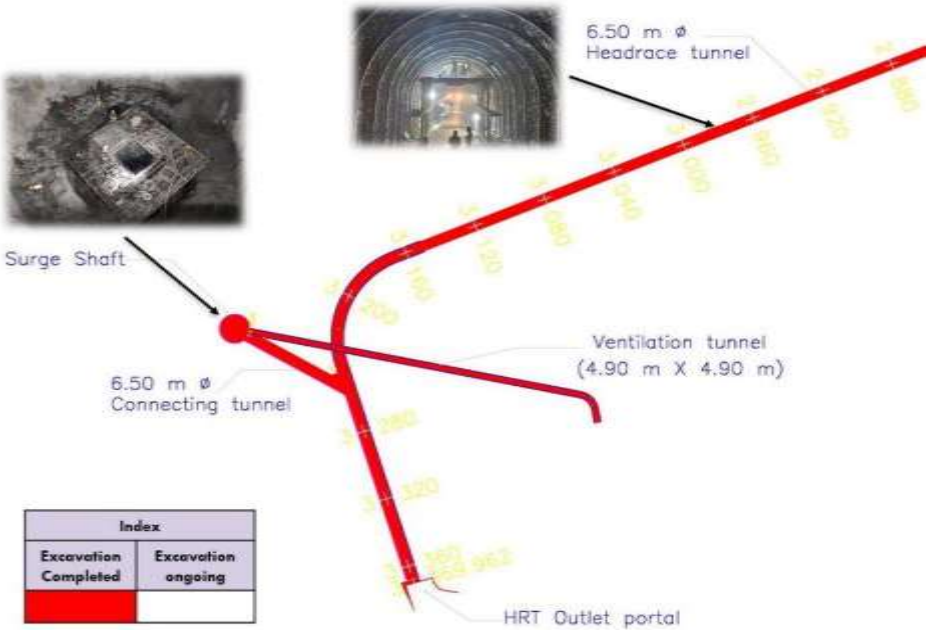


Figure 17: Schematic diagram of underground works near powerhouse

Figure 18: A view of HRT breakthrought at chainage 1+545.37

Figure 19: Celebration of HRT breakthrough

Figure 20: Celebration of HRT breakthrough at outlet portal

Figure 21: Rebar layout at the HRT invert

Figure 22: Concreting works at HRT invert

Figure 23: Excavation works at flushing tunnel

Figure 24: A view of Main Flushing Tunnel and first branch towards SB-01

Figure 25: A view of excavation of Settling basin 01

Figure 26: A view of excavation of Settling basin 02

Figure 27: Shotcreting works at Settling Basin 03

Figure 28: Formwork instalation for the concreting of surge shaft

S.N	Tunnel		Total Length (m)	Excavated length (m)		Total Volume (m3)	Excavated Volume (m3)	Remaining Volume (m3)	Status
1	Approach Tunnel from Inlet		247.06	247.06		9,292.92	9,292.92	-	**Completed**
2	Approach Tunnel-01		151.34	151.34		3,363.12	3,363.12	-	**Completed**
3	Approach Tunnel-02		113.17	113.17		2,505.37	2,505.37	-	**Completed**
4	Approach Tunnel-03		131.50	131.50		3,025.22	3,025.22	-	**Completed**
5	Settling Basin Bay-01		150.00	150.00	150.00	29,669.13	9,244.79	20,424.34	**Crown Support**
6	Settling Basin Bay-02		150.00	150.00	150.00	29,669.13	9,244.79	20,424.34	**Crown Support**
7	Settling Basin Bay-03		150.00	110.50	108.40	29,669.13	6,508.07	23,161.06	**Crown Support**
8	Connecting Tunnel-01		138.30	132.35		3,002.49	2,867.36	135.12	**Pending**
9	Connecting Tunnel-02		117.37	112.50		2,749.25	2,638.66	110.59	**Pending**
10	Connecting Tunnel-03		121.32	104.60		2,630.97	2,251.25	379.72	**Pending**
11	Inspection Tunnel-01		274.67	274.67		6,068.56	6,068.56	-	**Completed**
12	Inspection Tunnel-02		289.52	289.52		7,420.23	7,420.23	-	**Completed**
13	Adit-01		299.47	299.47		6,782.49	6,782.49	-	**Completed**
14	Sediment Flushing Tunnel		506.36	292.90		3,600.00	2,073.73	1,526.27	**Active**
15	Gate Shaft (Inspection Tunnel to SB)		66.00	SB-gate		4,551.86	1,466.97	3,084.89	**Pending**
16	Connecting Tunnel to Surge Shaft		70.20	70.20		2,765.88	2,765.88	-	**Completed**
17	Surge Shaft		79.93	79.93 m from crown		16,880.38	16,880.38	-	**Completed**
18	Ventilation Tunnel		199.75	199.75		2,560.64	2,560.64	-	**Completed**
19.1	HRT	From Adit	3,369.96	1545.37		133,248.58	61,359.74	-	**Completed**
19.2		From Outlet		1824.59			71,888.85		**Completed**
Total			**6,625.92**	**6198.44**		**299,455.35**	**230,209.03**	**69,246.33**	
				93.55%				**76.88%**	
				Completed by length				**Completed by Volume**	

2.2.4 POWERHOUSE

For excavation and concreting works at Powerhouse area, the Contractor (1st Hydro) has employed Nepali workers through a Nepali sub-contractor company. Till date the concreting works at the superstructure of powerhouse and tailrace floodwall has been completed whereas, the concreting works at the foundation, manifold block and tailrace culvert is being carried out.

2.2.3.1 PENSTOCK, ANCHOR BLOCKS AND SADDLE SUPPORT

The Contractor is carrying out the excavation works for the penstock, anchor blocks and saddle support with installation of branch pipes and bifurcation pipes along the penstock alignment. Till date, more than 90,000 m^3 of earthwork has already been excavated. Further, the main civil contractor is carrying out rebar installation works and concreting works of the manifold blocks simultaneously with the hydro-mechanical contractor as the installation of the bifurcation and branch pipes is completed. Till date almost 1,533.09 m^3 of concrete has already been poured in the manifold region.

2.2.3.2 POWERHOUSE

Till date, about 7,848.06 m^3 of concrete has been poured in the powerhouse which is almost 88.74% of concrete progress. The second stage concreting works for the installation for rail track has also been completed. Also, embedded concrete up to generator casing at unit 1 has already been completed whereas the 3rd stage embedding concrete at unit 2 has been completed after the installation of pit liner. Further, the installation of truss for roof as well as CGI sheets has begun.

2.2.3.3 TAILRACE FLOODWALL AND TAILRACE CULVERT

The tailrace section of the project consists of tailrace chamber, tailrace culvert and tailrace floodwall. The construction of tailrace floodwall has been completed on February 2021. About 1,326.52 m^3 of concrete has been poured in the tailrace floodwall region. The contractor has already completed concreting works at tailrace chamber and making necessary preparation for concreting of tailrace culvert. The contractor has already completed about 86.11% of concreting works at tailrace culvert. About 1,691.14 m^3 of concrete has been poured in tailrace culvert region.

Table 8: Progress of concreting at Powerhouse and tailrace culvert

Structure	Total volume	Completed volume	% Complete
Powerhouse	8,843.78	7,848.06	88.74%
Tailrace culvert	1,963.93	1,691.14	86.11%
Penstock	9,776.56	1,533.09	15.68%

Figure 29: Backfilling works at manifold

Figure 30: Top view of powerhouse

Figure 31: An aerial view of Powerhouse

Figure 32: Casting of generator casing at unit 01

Figure 33: Rebar installation for generator casing at unit 02

Figure 34: Concreting works for tailrace culvert

Figure 35: Roof installation works

Figure 36: A view of truss installation works

2.3 HYDRO-MECHANICAL WORKS

The Contract for Hydro-mechanical (HM) works has been awarded to Machhapuchhre Metal and Machinery Works (P) Ltd. The HM works were started from August 2019 from the headworks of the construction area.

Till date erection of radial gate frame has been completed. Erection of overhead steel lining parts has been completed at right and left breast walls of undersluice. Installation of embedded parts of Intake gate hoisting, TRCM and railing at top slab of intake has been completed. Fabrication of steel plate for extension of bed load sluice culvert has been completed by the HM Contractor. Similarly, fabrication of steel pipes is ongoing. A total of 96 approach pipes (100%) has been rolled and welded. Fabrication of 3 units of bends of headrace pipe and 4 units of bends of branch pipes has been completed along with Visual Testing, DPT Testing as well as UT Testing. Fabrication of all 3 units of bifurcations have been completed whereas unit 2 and unit 3 bifurcation has already been installed at the site. All four-unit diffuser have been fabricated as well as installed. The HM Contractor has been carrying out the fabrication works of bends and penstock pipes at his workshop and completed the fabrication of penstock pipes.

Currently, the installation of intake gates are ongoing at the headworks area and interface works are being carried out at the Powerhouse along with the installation of approach pipes at headworks and branch pipes and bifurcations of the penstock at the powerhouse region. Further, steel lining works at the gravel flushing culvert is being carried out by the HM contractor. Also, the fabrication works radial gates of undersluice are under process at the factory of the contractor located in Pokhara.

2.3.1 HUMAN RESOURCES, EQUIPMENT AND MATERIALS DETAIL

Table 9: Human Resources (HM Contractor)

S.N	Description	Nos
1	Mechanical Engineer	2
2	Admin / Accountant	1
3	Supervisor	2
4	Rolling Machine Operator	1
5	Crane Operator	2
6	Driver	1
7	Kitchen Staff	2
8	Storekeeper	1
9	Welder	7
10	Fitter	4
11	Helper	11
12	Electrician	1
13	Sand Blaster	2
14	Painter	2
15	QC Officer	1
TOTAL		**40**

Table 10: Equipment and Materials Status (HM Contractor) at the end of July

S.N	Description	Quantity
1	DG 40 KVA	1
2	Endopower Crane 14T	1

S.N	Description	Quantity
3	Mobile Crane 25T	1
4	Mobile Crane 20T	1
5	Mahendra Bolero	1
6	Welding Machine	10
7	PUG cutting machine	3
8	Grinding machine	10
9	Hand drill machine	1
10	Jack Hammer	1

2.3.2 STEEL LINING

Steel Lining work has been completed at Intake, undersluice, bed load sluice and gravel flushing gated section.

2.3.3 HM WORKS AT GRAVEL FLUSHING GATES AND STOPLOGS

Erection of gates and stoplog frame at gravel flushing section is ongoing according to Civil Contractor work schedule. Erection of draft tube gate frame has been completed along with the embedded parts of hoisting mechanism. Erection of trash passage gate frame has been completed along in accordance with Civil Contractor work schedule.

Table 11: Detail of work progress of gates and stoplogs

S.N.	Description	Work status				Remarks
		1st Stage Embedded Parts	2nd stage embedded parts	Main Body		
				Fabrication	Erection	
Gates						
1	Undersluice Gates	All Complete	All Complete			
**2	Intake Gates	All Complete	All Complete	All Complete	2 Nos complete	Main Roller and Guide Roller N/A
3	Bedload sluice gates	All Complete	All Complete			3 units of gate panel have arrived at site.
4	Fish Passage Gate	All Complete				
5	**Trash Passage Gate					1st stage and 2nd stage embedded parts available at site
**6	Gravel Flushing Gates	Ongoing	Ongoing			Erection of 1st stage and 2nd stage embedded parts all complete in accordance to Civil Contractor Schedule
7	Setting Basin Inlet gates					
8	Settling Basin Flushing Gates					

S.N.	Description	Work status				Remarks
		1st Stage Embedded Parts	2nd stage embedded parts	Main Body		
				Fabrication	Erection	
9	Adit Bulk Head Gates					
10	Draft Tube Gates	All Complete	All Complete			Erection of embedded parts of gates have been completed along with the embedded parts of hoisting.
Stoplogs						
1	Undersluice Stoplogs	All Complete	All Complete			
2	Bedload sluice Stologs	All Complete	All Complete			
**3	Trash Passage Stopogs					Sill beam on one unit has been erected.
**4	Gravel Flushing Stoplogs	Ongoing	Ongoing			Erection of 1st stage and 2nd stage embedded parts all complete in accordance to Civil Contractor Schedule
5	Settling Basin Flushing Stoplogs					
6	Tailrace Stoplogs					

2.3.4 TRASHRACKS

Table 12: Detail of work progress of trashrack

S.N.	Description	Work status		Remarks
		Embedded Parts	Main Body	
1	Intake Trashrack	Complete on 5 units	Complete on 5 units	Site has been cleared by the Civil Contractor for erection of 1 panel
2	Bedload sluice Trashrack			
3	Conveyance Tank Trashrack	Ongoing		Works done in accordance with Civil Contractor Schedule
4	Settling Basin outlet Trashrack			

Figure 37: Installation of steel plates at trash passage

2.3.5 STEEL PIPES AND OTHERS

HEADRACE STRAIGHT PIPELINE

Internal Diameter: 4.5 m
Thickness: 16 mm

Table 13: Detail of work progress of Headrace Pipe

Straight Pipes	Up to previous month	This Month
Cutting	96	X
Rolling	96	X
Fitting	96	X
Welding	96	X
Inspection	96	X
Blasting	96	X
Painting	96	X
Transportation to the storage yard	29	X

Figure 38: Installation of approach pipe

HEADRACE BENDS

Internal Diameter: 4.5 m
Thickness: 16 mm
Note: Fabrication of headrace bend has been completed.

Table 14: Detail of work progress of Headrace Bends

Bends	Up to Previous Month		
	Bend 01	**Bend 02**	**Bend 03**
Cutting	√	√	√
Rolling	√	√	√
Fitting	√	√	√
Welding	√	√	√
Inspection	√	√	√
Blasting	√	√	√
Painting	√	√	√
Transportation	X	X	X
Erection	X	X	X

Note: Only first layer of painting has been carried out and the final layer of painting will be done once the erection work is completed.

Figure 39: Fabrication of bellmouth

PENSTOCK PIPES

Internal Diameter: 4.5 m
Thickness: 16 mm to 36 mm

Table 15: Detail of work progress of Penstock Pipes

Straight Pipes	Up to previous month	This Month
Cutting	141	X
Rolling	118	X
Fitting	59	X
Welding	59	X
Inspection	59	X
Blasting	54	X
Painting	54	X
Transportation	20	X

The contractor has started to transport penstock pipe to powerhouse location.

Figure 40: A view of brach pipe of penstock installation

REDUCERS

Internal Diameter: 2.25 m to 2.00 m
Thickness: 20 mm

Table 16: Detail of work progress of Reducers

Reducer	Reducer 01	Reducer 02	Reducer 03	Reducer 04
Cutting	√	√	√	√
Rolling	√	√	√	√
Fitting	√	√	√	√
Welding	√	√	√	√
Inspection	√	√	√	√
Blasting	√	√	√	√
Painting	√	√	√	√
Transportation	√	√	√	√
Erection	√	√	√	√

Till date the erection of all 4 units reducer has been completed at the site along with the erection of branch pipe.

BRANCH PIPES

Internal Diameter: 3.90 m to 2.25 m
Thickness: 20 mm to 32 mm

Table 17: Detail of work progress of Branch Pipes

Branch Pipes	Up to previous month
Cutting	29
Rolling	25
Fitting	25
Welding	22
Inspection	18
Blasting	18

Branch Pipes	Up to previous month
Painting	18
Transportation	18
Erection	18

Erection of branch pipes have been complete on 3 units and on 1 unit around 15 m (Dia: 2.0m and thickness: 20 mm) have been completed.

BRANCH BENDS

Internal Diameter: 2.25 m
Thickness: 20 mm
Fabrication of reducer has been completed. Erection of Branch bend No 04, 03 and 02 has been completed and No 01 will be erected once the Civil Contractor provide the site.

Table 18: Detail of work progress of Branch Bends

Branch Bends	Branch Bend 01	Branch Bend 02	Branch Bend 03	Branch Bend 04
Cutting	√	√	√	√
Rolling	√	√	√	√
Fitting	√	√	√	√
Welding	√	√	√	√
Inspection	√	√	√	√
Blasting	√	√	√	√
Painting	√	√	√	√
Transportation	√	√	√	√
Erection	X	√	√	√

Fabrication of reducer has been completed. Erection of branch bend have been ongoing. Till now erection of Nos 3 of branch bend have been completed along with the branch pipe. Welding of Nos 2 of branch bend have been completed and Nos 1 is ongoing. Erection of Nos 1 will be started once the site will be handover by the Civil Contractor.

BIFURCATIONS

Table 19: Description of Bifurcation

Unit	Inlet Diameter (m)	Outlet Diameter 1 (m)	Outlet Diameter 2 (m)	Thickness (mm)
1	4.50	3.90	2.25	36
2	3.90	3.18	2.25	30
3	3.18	2.25	2.25	25

Fabrication of Unit 1 and Unit 2 has been completed at site. Fabrication of Unit 3 has been already delivered to the site. Further erection of bifurcation Unit 3 have been completed and welding work is nearing its completion. Similarly, erection of bifurcation Unit 2 have been completed and welding work is ongoing. Erection of bifurcation Unit 1 will be started once the site is cleared by the main Civil Contractor.

Table 20: Detail of work progress of Bifurcation

Bifurcation	Unit 1	Unit 2	Unit 3
Cutting	√	√	√
Rolling	√	√	√
Fitting	√	√	√
Welding	√	√	√
Inspection	√	√	√
Blasting	√	√	√
Painting	√	√	√

Bifurcation	Unit 1	Unit 2	Unit 3
Transportation	√	√	√
Erection	X	√	√
Complete Handover	X	X	X

2.3.6 DIFFUSER:

Plate thickness: 12 mm
Estimated Weight of each unit: 25.79 Tons

Note: Erection of diffuser has been completed on all the units at powerhouse location and 5.79 Ton has been certified from the provisional amount.

Table 21: Detail of work progress of Diffuser

Description	Unit 1	Unit 2	Unit 3	Unit 4
Cutting	√	√	√	√
Fabrication	√	√	√	√
Welding	√	√	√	√
Inspection	√	√	√	√
Painting	√	√	√	√
Transportation	√	√	√	√
Erection	√	√	√	√

2.3.7 ADDITIONAL WORKS

Additionally, flushing pipe at weir section has been added. The length of each unit is 15.76m and there are 2 units of weir flushing pipes. Both fabrication and erection of pipes has been completed.

Figure 41: Fabrication of radial gates

Figure 42: Fabrication of intake gate

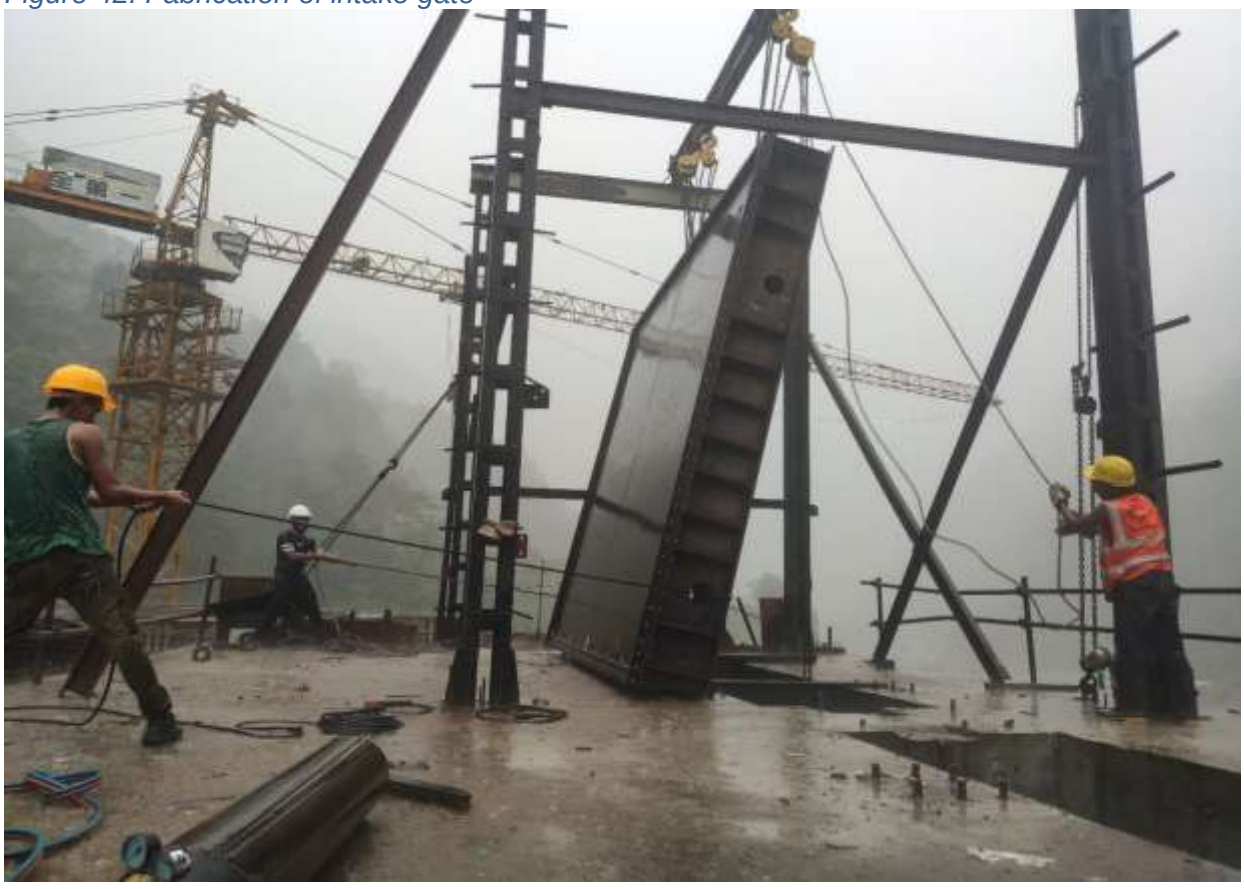


Figure 43: Lifting of intake gate Unit 2 for erection

2.4 ELECTRO-MECHANICAL WORKS

The design, fabrication, assembly, supply and installation of electro-mechanical works of MTHP are under the scope of the Contract with Chongqing Water Turbine Works. Co. Ltd. (CWTW), China. Under this scope CWTW is responsible for all electro-mechanical works starting from the end of penstock until the pickup gantry of switchyard accommodating four units of vertical Francis turbine with all corresponding generating units, control and protection systems, battery backups, internal power consumption transformers, power transformers, excitation transformers, SCADA and communication system as per NEA's grid code requirements, the overhead crane, butterfly valves for each unit feeding penstock.

The EM contractor has already completed almost 90% fabrication works at various factories in China, which includes the design, fabrication and testing of generator sets, runner, shaft, etc. Till date, the EM contractor has delivered almost 66% of the equipment which includes most of the turbine parts, generator parts, EOT crane accessories, etc.

Moreover, the 7th lot shipment of EM equipment has been delivered, unloaded and stored at the Project site, which includes all the turbine parts including spare runner, generator sets for 2 units along with its accessories. 8th lot of shipment mostly containing switchyard imbedded parts, governor, excitation panels etc. has been shipped from the port and due to arrive at Calcutta port soon.

The EM Contractor officially mobilized its manpower and resources to the site for installation works on February 09, 2021. The camp and warehouse setup work has been completed. The installation of draft tube elbow in all 4 units has been completed along with the first stage embedded parts and pipes. Due to the spread of COVID-19 pandemic, the EM Contractor, also a Chinese company, could not mobilize its national workers at site and thus has been working also with a Nepali subcontractor with minimum impact on the instalaltion works. The Nepalese sub-contractor,JADE, swiftly mobilized its manpower and carried out spiral case instalaltion works of all the units along with other imbedded parts and pipes. However, the contractor now has mobilized its project manager including its technical manpower mostly engineers of both mechanical and electrical background in the site and as of this date, the installation works is smoothly being carried out, where almost 30% erection and installation works have already been completed at the site.

2.4.1 HUMAN RESOURCES OF EM CONTRACTOR

The Contractor has mobilised its personnel at site for the installation works and has following manpower at present.

Table 22: Human resources of EM Contractor

S. N.	Designation	Number
1	Project Manager	1
2	Electrical Engineer	2
3	Mechanical Engineer	2
4	Installation Engineer	2
5	Mechanical Supervisor	2
6	Translator	1
7	Semi-skilled manpower	5
8	Helper	10
Total		**23**

2.4.2 MANUFACTURING WORKS

As of the date Turbine parts for unit 3 and 4 such as distributor are 80% complete, similarly manufacturing of runner and shaft are 60% and 40% complete. Further, generator parts for unit 3 & 4 such as stator, lower bracket, rotor, upper bracket are 60%, 70%, 50% and 60% complete respectively.

The manufacturing of electromechanical equipment such as governor is 90% complete and is planned to be shipped in next lot of shipment. Further, the eighth lot of shipment which will mainly contain equipment such as stator winding, governors, excitation control cabinets, ventilation and air conditioner, diesel generators, anchor bolts (foundation bolts) for switchyard is planned to be dispatched in this month.

Figure 44: Transformer being factory tested(Contractor's factory in China)

Figure 45: Governor ready for delivery (Contractor's factory in China)

Figure 46: A view of Transformer and switchgear (Contractor's factory in China)

Figure 47: Instrument transformer being factory tested (left) and Lot 7 Hydraulic system of MIV (right) at Contractor's factory in China

Figure 44: MIV being manufactured at Contractor's factory in China

2.4.3 INSTALLATION WORKS

After the installation and commissioning of EOT crane major installation works have been carried out. The spiral case cone and the case itself of unit 3 and unit 4 were aligned and installed. Further, various installation work has been carried out by the Electro-Mechanical Contractor aligned with civil construction works, which includes embedded cooling pipes, ventilation pipes, firefighting system, lubrication pipes, electrical pipes etc. spiral case and pit liner are among few work fronts that are opened and installation are being carried out rigorously. Further, in the upcoming coming days, contractor plans to begin turbine parts installation, load test of EoT crane, completing welding of unit 3.

Figure 48: Aerial View showing all four spiral cases and EOT crane

Figure 49: Installation of spiral case using EOT crane after cone installation

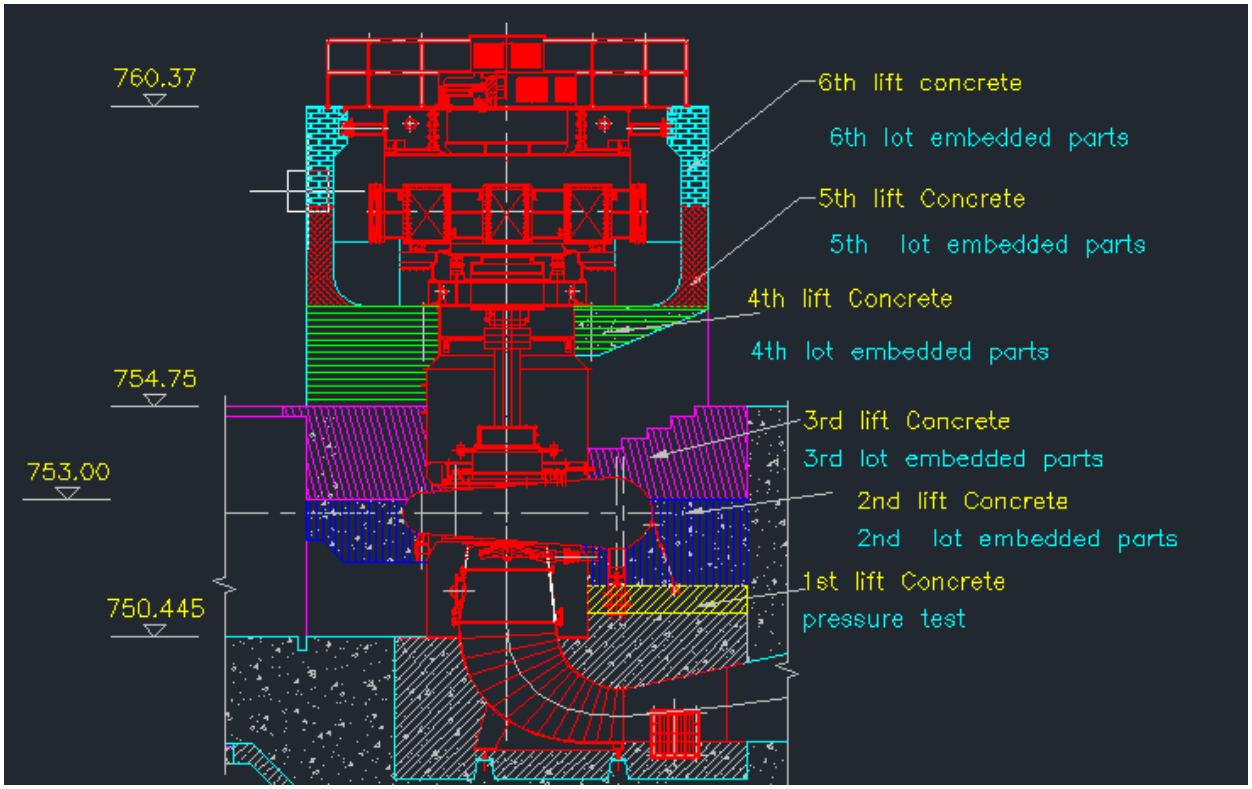


Figure 50: Picture showing installation interface between Civil and EM Works

2.4.3.1 INSTALLATION OF COOLING WATER PUMP

The cooling water pumps have been installed in the floor of level 750.445 m. A total of 6 pumps and a water filter with valves have been installed.

Figure 51: A view of water cooling pumps and the filter

2.4.3.2 INSTALLATION OF AIR COMPRESSOR SYSTEM

Various components for air compressor equipment room has been shifted and are being installed at this time. The air compressor tanks have been installed in its foundation and various pipes are being connected through.


Figure 52: A view of air compressor room

2.4.3.3 EOT CRANE INSTALLATION

The electrical commissioning of EOT crane has been carried out, which is the major milestone of Electro-Mechanical Works. After the completion of roofing in Bay 1 – electrical commissioning of the crane had been carried out. The crane was driven from bay 1 to bay 5 at various speed levels, safety & connections were checked accordingly.

All the brake adjustment works are completed and waiting for the full load test which shall be carried out after necessary arrangement.

Figure 53: EOT crane being commissioned with small load

Figure 54: Electrical connection works of EOT crane

Figure 55: EOT crane being commisioned with the medium load

2.4.3.4 INSTALLATION OF TURBINE EMBEDDED PARTS

All the Stay ring has been placed inside the pit including its segments and taper sections. As of this date all the respective segments of the spiral case including its tapered section have been assembled and welded in all four units. However, final welding for unit 3 and unit 4 remains. The contractor has projected to complete the welding of unit 3 at the end of this month.

After the final welding, pressure test for unit 1 and unit 2 has been successfully completed. Further, final concreting of the pit of unit 1 has been completed and third stage concreting of unit 2 has also been completed. Furthermore, various embedded pipes of cooling, lubrication has been installed along with its pit liner.

The contractor plans to prepare the installation of turbine parts in coming days. Following table shows the latest status of work progress of Spiral case installation works:

Table 23: Table showing work progress of Spiral case installation

Unit	Stay ring placement	Tapered pipe placement	Segment Assembly	Welding	UT	Pressure Test
1	Yes	Yes	Yes	Completed	Completed	Completed
2	Yes	Yes	Yes	Completed	Completed	Completed
3	Yes	Yes	Yes	Completed	Not Ready	Not Ready
4	Yes	Yes	Yes	On-going	Not Ready	Not Ready

Figure 56: Installation of bottom part of Pit Liner at Unit 1

Figure 57: View of Pitliner after third lift concrete

2.4.3.5 INSTALLATION OF GENERATOR EMBEDDED PARTS

Pipes and plates embedment of unit 1 generator has been started. Foundation whole for stator and lower bracket has been reserved.

Figure 58: Installation of colling pipes for stator

Figure 59: Installation of Pit liner at Unit 2

Figure 60: View of Pit Liner after fourth lift concreting

Figure 61: Installation of embedded plates of generator

2.4.3.6 INSTALLATION OF AUXILIARY SYSTEM EMBEDDED PARTS

Pipes and parts embedment of various auxiliary system such as ventilation pipes, electric pipes are ongoing in parallel with the civil works.

Figure 62: A view of all four units

Figure 63: View of Unit 1 generator Pit ready for concreting

2.5 TRANSMISSION LINE WORKS

The Contract has been signed with Cosmic Electrical Engineering Associates Private Limited for Check survey, Design, Supply, Manufacturing, factory testing (inspection and approval by the Employer), Delivery, Erection/ Installation and Testing & Commissioning of all necessary works for completion of a revised length of a 9 km long, 220 kV D/C transmission line on June 07, 2020. The 220 kV transmission line with 24 towers will start from the switchyard of Middle Tamor Hydropower Project and will be connected in the interconnecting bay of Dhunge-Sanghu sub-station being constructed by NEA in Taplejung.

Till date, the Contractor has completed check survey, soil investigation works, design, procurement of the tower parts, and construction of tower foundations and is currently carrying out tower erection works. All the materials such as tower parts, insulators, accessories and conductors have been imported and are safely stored at site.

The construction license of the transmission line has been acquired. The land acquisition works for 23 tower angle points (AP) has been completed and the land acquisition works is only left for AP17 which is the government land. Necessary forest clearance work is ongoing at AP17 and is being followed up rigorously.

The erection of stub and foundation concreting works have been completed in 21 locations which is almost 88% of total foundation works. The Contractor has planned to start foundation works at AP21 very soon. The rest AP17 and AP01 shall be started after necessary clearances. On the other hand, the tower erection works have already completed at 20 locations which is around 83% of the total erection works. Further, the contractor is now preparing for stringing activities after the RoW is cleared which is in process.

The transmission line route map is shown in figure below.

Figure 64: Transmission line route map

2.5.1 HUMAN RESOURCES OF TL CONTRACTOR

Table 24: Human Resources TL Contractor

S.N.	Designation	Total Number
1	Construction Manager	1
1	Civil Engineer	1
2	Senior Surveyor	1
3	Assistant Civil Supervisor	1
4	Driver	1
5	Cook	1
6	Rebar workers	6
7	Labors	35
	Total	**47**

Table 25: Equipment of TL Contractor

S.N.	Name of equipment	Quantity
1	Excavator	1 Nos
2	Tractor Trolley	2 Nos
3	Bolero Camper	1 Nos
4	Jack Hammer	1 Nos
5	Rock Drill	1 Nos
6	Compactor	1 Nos
7	Vibrator	2 Nos
8	Generator	2 Nos

2.5.2 CONSTRUCTION WORKS

The Contractor is carrying out foundation works as well the erection works of designated transmission line. As of this date following table shows the progress made so far.

Table 26: Summary of Transmission Line works progress

S.N.	Description	Total	Unit	Completed	% Completed
1	Land Procurement works	24	Nos	23	96%
2	Foundation Works	24	Nos	21	88%
3	Tower Erection Works	24	Nos	16	83%
4	Stringing Works	10	Km	0	0%

The stringing work is yet to be carried out by the Contractor and has planned to start after the festive season.

The Transmission line work progress till now is satisfactory and is in line with our expected commercial operation date. ROW clearance work has also commenced with the dedicated team built for Row clearance works.

Table 27: Details of Transmission Line works

S. N.	Tower No.	Land Procured	Excavation Completed	Foundation Completed	Protection Work	Tower Erection	Stringing	Remarks
1	AP1	Yes	No	No	No	No	No	Our land, Dead End
2	AP2	Yes	Yes	Yes	No	Yes	No	Erection completed
3	AP3	Yes	Yes	Yes	Yes	Yes	No	Erection completed
4	AP4	Yes	Yes	Yes	Yes	Yes	No	Erection completed
5	AP5	Yes	Yes	Yes	Yes	Yes	No	Erection completed
6	AP6	Yes	Yes	Yes	No	Yes	No	Erection completed
7	AP7	Yes	No	No	Yes	Yes	No	Erection completed
8	AP8	Yes	Yes	Yes	No	Yes	No	Erection completed
9	AP9	Yes	Yes	Yes	Yes	Yes	No	Erection completed
10	AP10	Yes	Yes	Yes	Yes	Yes	No	Erection completed
11	AP11	Yes	Yes	Yes	Yes	Yes	No	On-going erection
12	AP12	Yes	Yes	Yes	Yes	Yes	No	Erection completed
13	AP13	Yes	Yes	Yes	Yes	Yes	No	Erection completed
14	AP14	Yes	Yes	Yes	Yes	Yes	No	Erection completed
15	AP15	Yes	Yes	Yes	Yes	Yes	No	Erection completed
16	AP16	Yes	Yes	Yes	Yes	Yes	No	Erection completed
17	AP17	No	No	No	No	No	No	Government Land
18	AP18	Yes	Yes	Yes	No	Yes	No	Erection completed
19	AP19	Yes	Yes	Yes	Yes	Yes	No	Foundation completed
20	AP20	Yes	Yes	Yes	Yes	Yes	No	Foundation completed
21	AP21	No	No	No	No	No	No	Open for foundation
22	AP22	Yes	Yes	Yes	No	Yes	No	Foundation Completed
23	AP23	Yes	Yes	Yes	No	Yes	No	Foundation Completed
24	AP24	Yes	Yes	Yes	No	Yes	No	Foundation completed

Figure 65: A view of AP16

Figure 66: View of erected towers from right bank of Tamor

Figure 67: A view of AP 05

Figure 68: A view of AP10 along with protection works

Figure 69: Erected last tower at AP24 and tower of NEA (left)

Figure 70: A view of RoW clearance

Figure 71: Interconnection bay at Dhunge-sanghu substation (NEA Project)

Figure 72: An aerial view of Dhunge-sanghu substation (NEA Project)

2.6 FINANCIAL PROGRESS TILL DATE

The total project cost of Middle Tamor is **NPR. 13,330,000,000** (In words. Nepalese Rupees Thirteen Billion Three Hundred Thirty Million only). Out of the total project cost, the total equity portion is NPR. 3,332,500,000, whereas the total debt required is NPR. 9,997,500,000. The promoter's equity portion, which bears 70% of the total equity i.e. NPR 2,332,750,000 (In words. Nepalese Two Billion Three Hundred Thirty-Two Million Seven Hundred Fifty Thousand only) has been fully paid up and the share lagat has already been registered in the Office of the Company Registrar (OCR). Necessary arrangements for the debt portion has been made through a consortium of 8 commercial banks led by Nepal Investment Bank Ltd.

Out of the total Contract amount, 61% has already been paid to the Main Civil Contractor till date against the works performed as per the Contract. The amount is paid on the basis of raised Interim Payment Certificate (IPC) by the Contractor. Till date, payment against 20 IPCs have been already disbursed to the Main Civil Contractor whereas the Contractor is in process of raising IPC 21. Similarly, 54% of the Contract amount has been paid to the Hydro-Mechanical Contractor till IPC 4 out of design and procurement portion. All required Steel plates have been purchased by the Employer. 55% of the Contract amount has already been paid to the Electro-Mechanical Contractor against the bills of supply portion for the dispatch of 7 lots EM equipment after the receipt at site and advance paid against Advance payment guarantee (APG). Further, about 78% of the total Contract amount have been provided to the TL Contractor against the bills up to IPC#05 and advances against IPC#06.

Table 28: Financial Progress of Major Contract Packages Till Date

Major Contract Packages	% Expense till date	% Remaining Budget
Main Civil Works	**61%**	39%
Hydro-Mechanical Works	**54%**	46%
Electro-Mechanical Works	**55%**	45%
Transmission Line Works	**78%**	22%

The total financial expenditure of the Project till date is about **57%** out of the total project cost.

Particulars	% Expense till date	% Remaining Budget
Financial Progress of MTHP	**57%**	**43%**

3 OCCUPATIONAL HEALTH SAFETY AND ENVIRONMENT (OHSE)

Safety protocol against COVID- 19 has been prepared and strictly implemented at the Project site. To maintain health safety of the all the employees, the Employer has been providing suitable and relevant personal protective equipment (PPE) on daily basis. Two dedicated health care workers have been permanently employed by the Employer to maintain health and safety of the employees.

In addition, regular screening of headworks and powerhouse site workers are being carried out by the OHSE team by measuring temperature and general health check up to screen out the symptoms related to COVID-19. New workers are allowed at site only after conforming COVID negative test prior to reaching site. To avoid any potential risk at the underground works, the Contractor safety personnel have been instructed to continually make the employees aware of potential hazards relating to drilling and blasting activities inside the tunnel and the control measures that they are to adhere. Further, periodically safety induction training is being conducted at site to the workers of contractors and sub-contractors. The foreman in charge have been instructed to continually monitor his team during entry and exit from the tunnel. Fire extinguishers have been strategically placed in areas where high temperature works are being performed. Regular oxygen level and lightening is being monitored at the underground work fronts. The employer has facilitated telecom facilities to communicate inside the tunnel structures. All members of the technical team have been advised to be cautious when entering hazardous areas. Extra efforts to ensure the safety of visitors have been well implemented. Instructions are given to the technical team to continue to follow safe working practices to keep possible incidents to a bare minimum.

4 IMPACT OF COVID-19 ON THE PROJECT

4.1 FIRST WAVE OF COVID-19 FROM MARCH 2020

The pandemic situation due to outbreak of COVID-19 in late December 2019 was a major challenge to the work progress at site. For effective control of spreading this fatal epidemic, China locked down its territory from January 23, 2020. Since the Main Civil Contractor of the Project is a Chinese company (Zhejiang First Hydro), the machineries, accessories for repair and maintenance as well as various construction equipment and materials could not be imported from China by the Contractor since January and thus the Project was affected much before the Government of Nepal took measures to restrict the spread of virus in the country. The nationwide lockdown imposed by the Government effective from March 24, 2020 in Nepal further caused a severe restriction in materials transport, availability of local human resources and overall inconvenience for smooth working in the Project.

Thanks to multiple joint efforts from the Employer, the Engineer and the Contractor, even during the period of extreme lockdown, the Contractor was not forced to completely shut down the construction works and a reasonable progress could be achieved in areas as instructed by the Engineer, especially at the Headworks. Such commendable efforts by the Employer and the Contractors prevented a significant loss of structural and financial damages.

However, dangerous spread of the pandemic across Nepal and unavailability of vaccines made the Chinese workers increasingly restless and concerned about their health and safety. The Main Civil Contractor requested the Employer for a complete shutdown of project so that they could return to China for preventive measures and return after vaccination. However, in the Monthly Coordination meeting held on September 25, 2020 the Employer and Engineer rejected the request of the Contractor for a complete shutdown and suggested to proceed with the construction works employing Nepali Sub-Contractors for excavation of tunnel and excavation and concreting of Powerhouse and Tailrace floodwall. Almost all Chinese workers had gone home for vaccination. Until their return the Main Civil Contractor had been carrying out tunnel excavation from the adit and outlet, surge shaft and excavation and concreting of Powerhouse components through Nepali subcontractors. However, the first batch of 20 vaccinated Chinese managers arrived at site and work fronts at the gravel trap, intake and settling basins resumed from late March 2021 with the manpower of the sub-contractors. Although these efforts from all parties prevented a complete shutdown of the Project and also helped make some reasonably possible progress on several construction fronts, the momentum of construction process was lost and the planned progress could not be achieved.

Due to various logistical problems created by the first wave of the pandemic, the organization and planning of construction works were disrupted and thus, construction of undersluice/ intake and associated hydro-mechanical works couldn’t be completed as planned before the arrival of first flood of the monsoon (July 2020). The flood washed off the cofferdam much earlier than anticipated rendering the entire partially constructed undersluice structure under water. The weir construction works that were originally scheduled in the dry season of 2020 has already been delayed and is resumed by re-coffering the area in the dry season of 2021.

4.2 SECOND WAVE OF COVID-19 FROM APRIL 2021

As the construction works was gaining momentum and the Project team was working on future measures to minimize the duration of the already caused delay on these fronts and its financial impact, the second wave of the COVID-19 pandemic hit Nepal. Due to an alarming rate of rise in cases of COVID infection, the Government of Nepal decided to impose prohibitory order from Baisakh 16, 2078 (April 29, 2021). This further affected the construction progress of the Project, which was gradually getting on track from the impact of first wave.

The Employer jointly with the Engineer and the Contractors, with the prior experience from the first wave, prepared isolation centers, kept stock of medicines and followed proper safety

guidelines to face the serious challenge posed by the second wave of COVID. The construction works were carried out taking high safety precautions to cover the already endured delay. Despite following all safety measures and periodic testing of all employees working at the site facilitated by the Employer, almost 110 members working at the site tested positive in a mass PCR testing. Out of these, 4 members from the Employer and 106 members from the Main Civil Contractor (including 14 Chinese workers and 92 workers from Nepali sub-contractors) were found COVID positive. The workers and staffs, who tested positive, were properly isolated in the isolation centers prepared by the Employer and the Contractor with adequate medical support and personal care. The entire construction site was immediately sealed and construction activities were halted until the infection situation came completely under control.

Almost all of the construction work fronts have been resumed since mid-July, 2021. The second wave has certainly hampered the desired progress at the site. With uncertainty of the effect of the COVID's variants in Nepal, the Employer, the Engineer and the Contractor are highly concerned about the construction progress, health and safety of their employees and have been working to minimize further delay in construction. The Chinese workers, who did not return from China after vaccination, have been replaced by Nepali workers through sub-contractual arrangements by the Main Civil Contractor and work at all required fronts are active and going on smoothly.

Repeated temporary pauses in the construction activities caused by the pandemic certainly affected the overall organization, planning and execution of the project work. Considering the effect of COVID-19 pandemic on many hydro projects under construction in the country, the Government through Nepal Electricity Authority had decided to grant a maximum of one-year extension of Required Commercial Operation Date on demand from projects that needed such time compensation. We have been granted the extension of one year. Thus, the revised RCOD of the Project is Ashadh 31, 2080 (16 July 2023). In view of the current pace of the progress on various work fronts in the Project, we are confident that the Project will be comfortably completed by this RCOD.

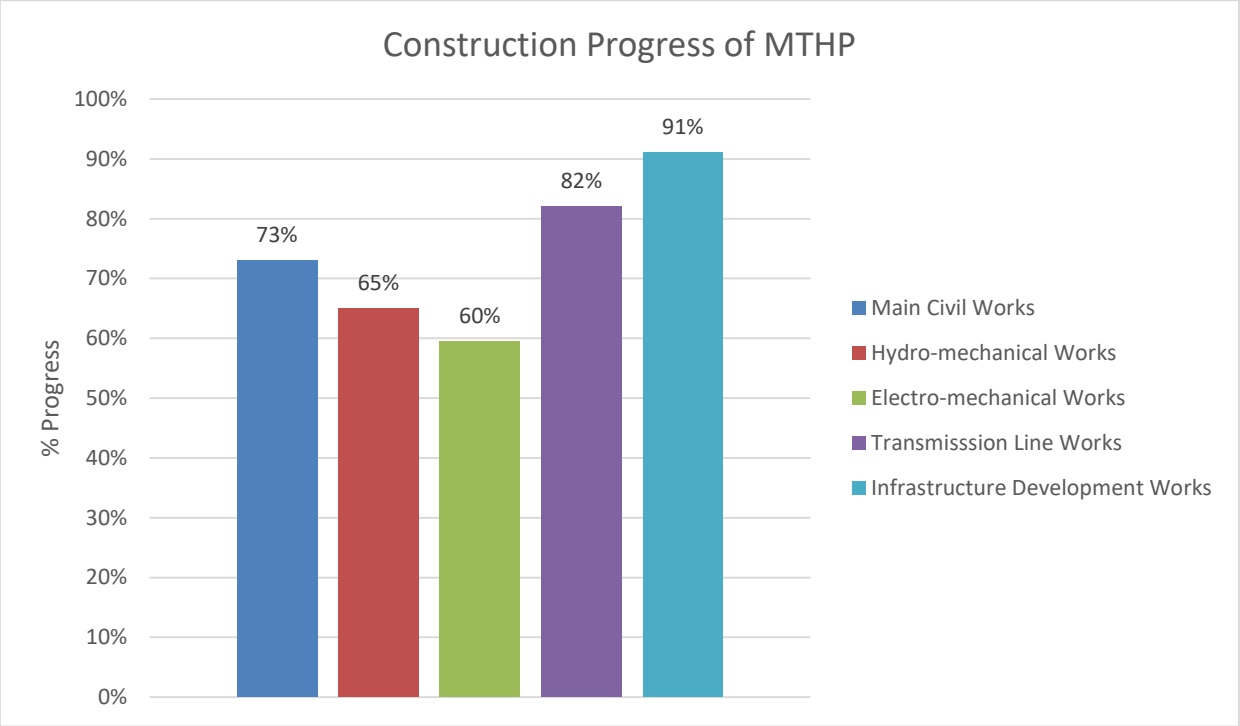
5 CONCLUSION AND RECOMMENDATION

The progress in Main Civil works is about 73% whereas in Hydro-mechanicals works is almost 65%. Further, the progress in Electro-mechanical works and Transmission Line works is 60% and 82% respectively.

Table 29: Work progress summary chart

S.N.	Major Contract Packages	Project Weightage	Physical Progress out of 100%
1	**Main Civil Works**	**66%**	**73%**
1.1	*Headworks and Temporary River Diversion*	*25%*	*80%*
1.2	*Powerhouse and Penstock*	*7%*	*63%*
1.3	*Underground Works (HRT and Settling Basin)*	*30%*	*69%*
1.4	*General Items*	*4%*	*82%*
2	**Hydro-mechanical Works including Procurement of steels**	**6%**	**65%**
2.1	*Contract amount*	*5%*	*62%*
2.2	*Procurement of steel plates*	*1%*	*98%*
3	**Electro-mechanical Works**	**13%**	**60%**
4	**Transmission Line Works**	**2%**	**82%**
5	**Infrastructure Development Works**	**13%**	**91%**
	Overall Construction Progress		**74%**

As outlined above, despite all difficulties faced by the Project due to COVID-19, about **74%** of construction progress has been achieved till date. Although the desired level could not be reached, the progress is still satisfactory in these times of great challenges. The unforeseen geological surprises, physical constraints of excavation in large caverns and long tunnel excavation cycle are major drag to the construction pace. To overcome these problems, the Employer has extended supports to the Main Civil Contractor for mobilization of additional equipment, like two Boomers, Batching Plant, Grouting Machines, Robotic Shotcrete machine, Generators, dump trucks, excavators, loaders, etc.



The Management is fully aware of various challenges and has been working hard to overcome them in collaboration with the Engineer, Contractors, Subcontractors, Suppliers, Transporters, as well as concerned public authorities, Ministry of Energy, Ministry of Forest and Environment, Department of Electricity Development, Nepal Electricity Authority, various local governments and the consortium of lending banks. Taking into account possible lockdowns by the Central and Local Governments in the event of another COVID outbreak, efficient mechanism has been enforced to ensure that sufficient stock of cement, rebars and other construction materials are stocked well before such events; new subcontractors have been employed; strict health and safety protocols have been implemented and several isolation centers have been constructed at the Project site. These joint efforts have been quite helpful in keeping the progress healthy while keeping the workers and staff safe from any future infections.