

SANIMA MIDDLE TAMOR HYDROPOWER LIMITED

Shankha Park, Dhumbarahi, Kathmandu, Nepal

MIDDLE TAMOR HYDROPOWER PROJECT (73 MW)



PROGRESS REPORT

(April 2022)



Sanima Hydro and Engineering (P.) Ltd.

Shank Park, Dhumbarahi, G.P.O. Box. 19737 Kathmandu

Phone No.: +977 1 4372828 / 4373030, Fax: +977 1 4015799

Email: sanima@sanimahydro.com

Web: www.sanimaengineering.com

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	Signature	Date
Prepared by:	 Shapath Son Tandon, Mohini Bakhadhyo	07 May, 2022
Checked by:	Arbindra Shrestha	07 May, 2022
Recommended by:	 Dr. Sunil Kumar Lama	07 May, 2022
Approved by:	 Dr. Jugal Bhurtel	07 May, 2022



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Phone No.: +977 1 4372828 / 4373030, Fax: +977 1 4015799

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Web: www.sanimaengineering.com

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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 $87^{\circ} 40' 01''$ E to $87^{\circ} 42' 40''$ E and $27^{\circ} 23' 29''$ N to $27^{\circ} 25' 19''$ 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.

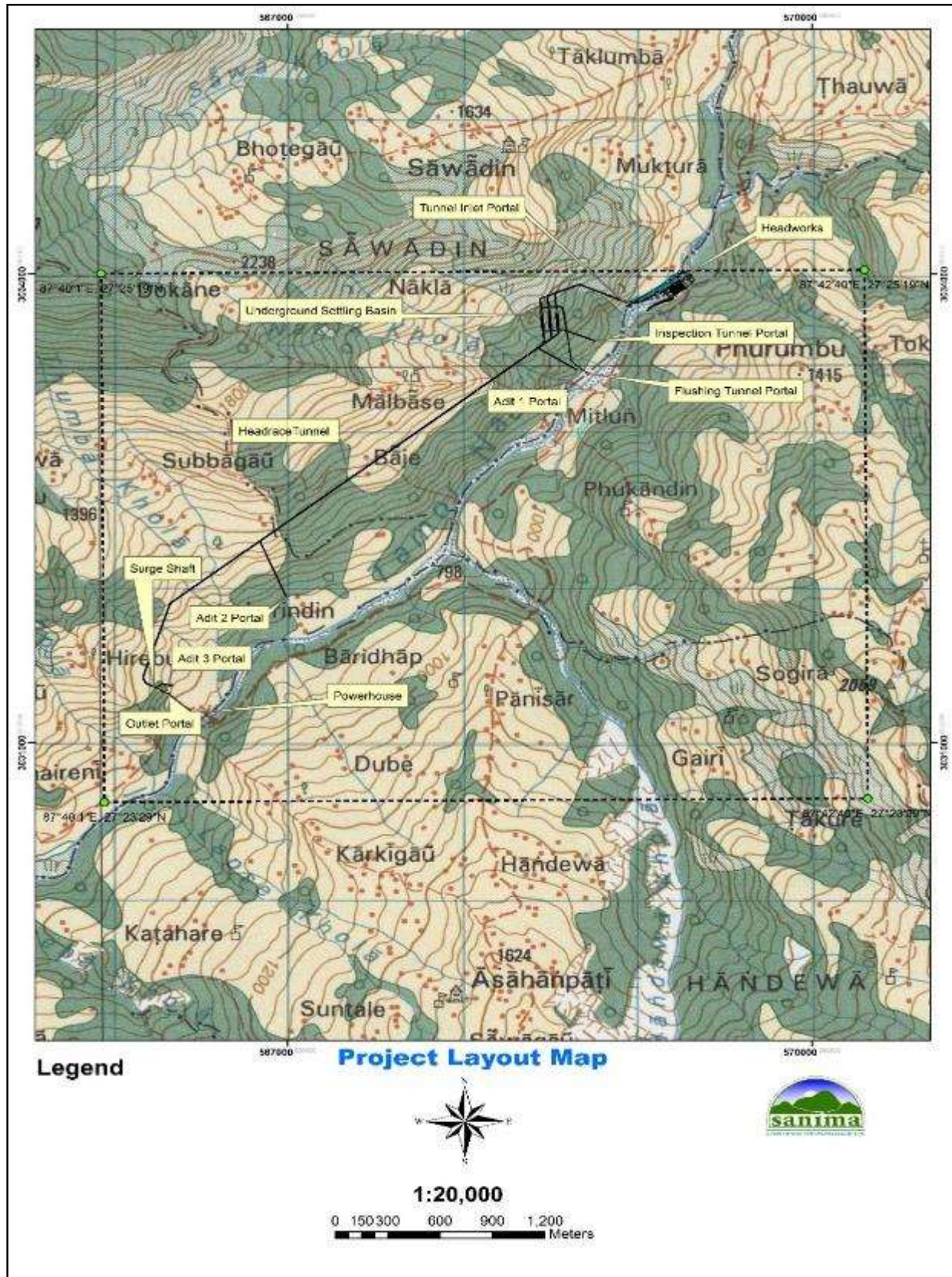
Sanima Middle Tamor Hydropower Ltd. (SMTHL) was established as a Special Purpose Vehicle (SPV) Company for the implementation and operation of Middle Tamor Hydropower Project (MTHP). The Generation License of the Project was obtained initially for 54 MW on 5 June 2017, and subsequently the design was 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 from 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. The extension of the RCOD has been already recommended by the NEA to Electricity Regulatory Commission (ERC).

Based on the current Revised Feasibility Study, the installed capacity of the project is 73 MW with the design discharge of $73.71 \text{ m}^3/\text{s}$, corresponding to 42.71% exceedance flow. The catchment area of the Project is $2,002 \text{ km}^2$ 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	: 2 nd Falgun 2064 (14 Feb 2008)
Transfer of survey license from SHEPL to TSE	: 23 rd Ashad 2068 (07 Jul 2011)
EIA approval	: 10 th Baisakh 2070 (23 Apr 2013)
SEIA approval for 73MW	: 6 th Kartik 2075 (23 Oct 2018)
Grid Connection Agreement	: 25 th Falgun 2071 (09 Mar 2015)
Generation license received	: 22 nd Jestha 2074 (05 Jun 2017)
Power Purchase Agreement ofr 54 MW (PPA)	: 26 th Poush 2073 (10 Jan 2017)
Power Purchase Agreement (PPA) for additional 20.9 MW	: 14 th Mangsir 2075 (30 Nov 2018)
Generation License received for 73 MW	: 24 th Mangsir 2075 (10 Dec 2018)
Financial Closure	: 27 th Magh 2075 (10 Feb 2019)
Main Civil Contract	: 29 th Chaitra 2074 (12 Apr 2018)
Hydro-mechanical Contract	: 26 th Ashad 2076 (11 July 2019)
ToR Approval for 220 kV TL Project	: 1 st Bhadra, 2076 (18 Aug 2019)
Electro-mechanical Contract	: 7 th Poush 2076 (23 Dec 2019)
Transmission Line Contract	: 25 th Jestha, 2076 (07 June 2020)
IEE Approval for 220 kV TL Project	: 29 th 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	: 27 th Bhadra 2079 (12 Sept 2022) for 54 MW and 30 Aashad 2080 (16 July 2023) for the additional capacity

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 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.

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 has already started.

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 2: 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 3: Gabion wall construction at new access road from Mitlung to Thumba



Figure 4: Bailey Bridge at Budidaha section



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



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



Figure 7: Construction Powerline

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 been carrying out concreting works of weir, stilling basin, powerhouse and tailrace culvert section along with excavation of underground works from the adit, outlet, surge shaft, 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.

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

S.N.	Name	Specification/Model	Quantity	Remarks
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	
		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 main civil contractor is carrying out excavation and concreting works at the headworks region through Nepali sub-contractors. Currently, the construction works of weir and stilling basin section is being carried out. Till date almost 77% concreting works have been completed at the weir section including upstream cutoff and almost 90% concreting works at stilling basin section have been completed. Other works fronts at the head works region have been suspended currently to complete more significant concreting works at weir and stilling basin before the upcoming monsoon. Moreover, almost 99% of concrete works at undersluice, 98% at intake (orifice structure), 92% at u/s floodwall, 79% at gravel trap and 82% at intake canal has been completed. Further, d/s right floodwall and u/s cutoff-wall at headworks have been already constructed.

Further, the excavation works on the conveyance tank is in progress. The details of construction work area are described hereunder.

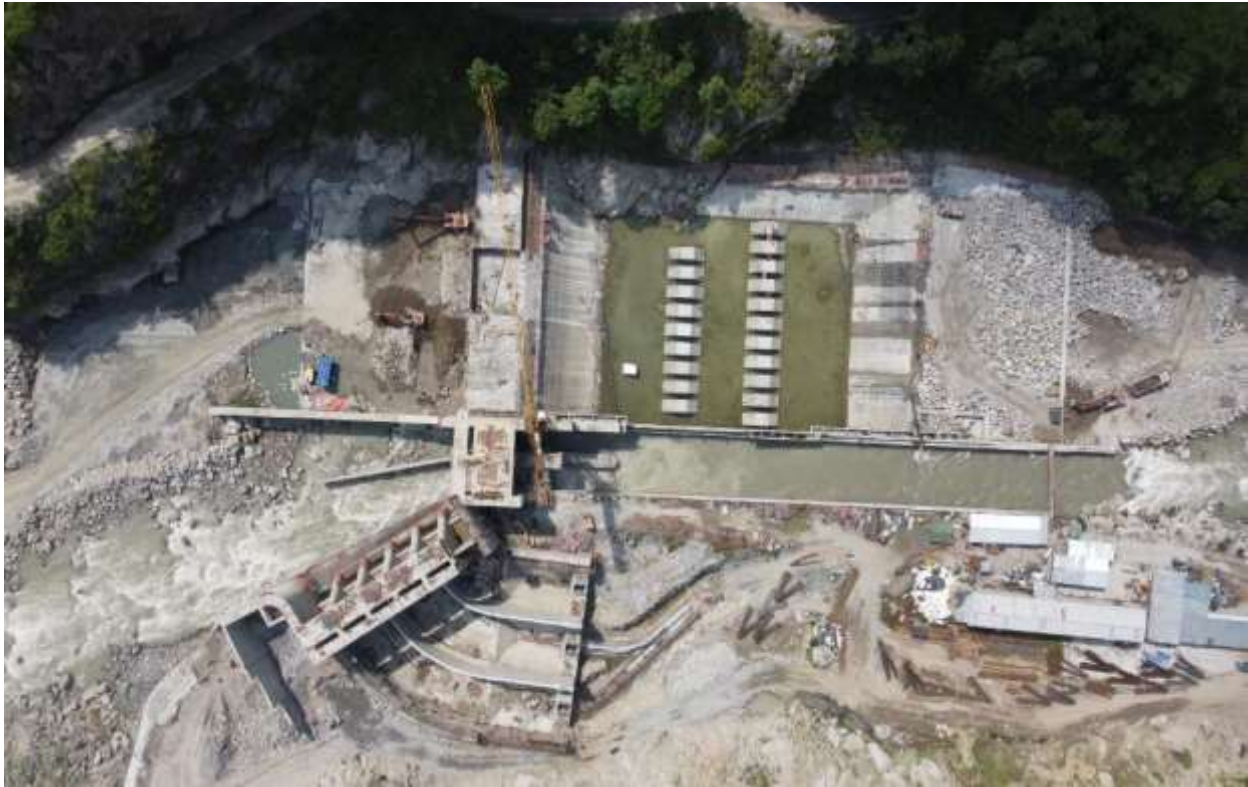


Figure 8: Aerial view of Headworks

2.2.1.1 INTAKE AND GRAVEL TRAP

More than 8,170 m³ of concrete has been poured at intake structure till date. Out of this about 35 m³ concrete was poured in the month of April 2022. The Contractor has shifted the tower crane from the intake to undersluice wall to allow concreting at the remaining orifice of intake.

About 3,780 m³ and 2,208 m³ of concrete (C25 & C35) has been poured at gravel trap and intake canal till date which is almost 79% and 82% of concreting works respectively. The Contractor is carrying out rebar installation and concreting works at the hill side intake canal wall and gravel trap wall. Also, the steel lining works and concreting is being carried out at the gravel flushing culvert. Furthermore, 5 numbers of trash racks and bed load sluice have already been constructed.

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

Structure	Total volume	Completed volume	Remaining volume	% Complete	% Remaining
Intake (Orifice)	8,397.68	8,168.17	229.51	98%	2%
Intake canal	2,704.64	2,208.60	496.04	82%	18%
Gravel trap	4,808.93	3,779.50	1,029.43	79%	21%



Figure 9: Intake and Undersluice section from upstream



Figure 10: Rebar and steel plate installation in gravel flushing culvert

2.2.1.2 WEIR AND STILLING BASIN

The concreting works at weir and stilling basin is in active progress taking into account the importance of this dry season for the completion of the entire Project. The contractor has already poured almost 13,278 m³ concrete in weir, 9,692.26 m³ in stilling basin and completed the concreting works at u/s slab and cutoff i.e. 2,135.24 m³ in upstream cutoff till date. Out of this, almost 1,988 m³ concreting was done in weir and 830 m³ concreting was done in stilling basin in the month of April 2022 only. In conclusion, 25,105 m³ volume of concreting works out of total has been carried out at weir and stilling basin section till date. The concreting works at the panel 01 of the weir main body has already reached the level of 883 amsl. The concrete works at the weir and stilling basin except the panel 1 is expected to be completed by June 2022. Further, the curtain grouting works at the upstream slab has already begun.

Table 5: Progress made at Weir Section

S.N	Structure	Estimated Quantity (m ³)	Progress (m ³)	%Completed
1	Weir Body	17,207.5	13,277.26	77%
2	Stilling Basin	10,742.5	9,692.26	90%
3	U/S Slab and Cutoff	2,135.24	2,135.24	100%
	Total	30,085.24	25,104.76	83%

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 UNDERSLUICE

Till date, more than 19,000 m³ of concreting has been poured in the Undersluice portion. The concreting at undersluice has been completed to a level of 898.95 amsl along with breast wall concreting between piers in panel-03. Further, the concreting works at fish ladder is from panel-04 to panel-08 is ongoing. About 99% of concreting works has already been completed in the undersluice portion till date.



Figure 11: Reinforcement works at weir main body



Figure 12: Aerial view of concreting works at stilling basin along with baffle blocks



Figure 13: Rebar Installation works at Panel 02 and 03 of main weir body



Figure 14: Concreting works at weir main body



Figure 15: Curtain grouting works at U/s slab of weir



Figure 16: Backfilling works at u/s floodwall region

2.2.1.5 U/S FLOODWALL

Till date, about 2,711 m³ of concrete has been poured at the upstream floodwall. The concreting works at the inclined slab of the u/s floodwall is going on. In addition, the backfilling works is being carried out simultaneously. About 92% of concreting works has been completed in U/S floodwall.

Table 6: Work Progress at U/s floodwall

Total volume	Completed volume	% Completed	% Remaining
2,944.12	2,711.01	92%	8%

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 has been carrying 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.

Currently, the Contractor is carrying out the excavation works in HRT from adit, settling basins, surge shaft and HRT from Outlet. Regarding the safety of the employees and smooth excavation works, the Employer has rented two Boomer machines which are currently being operated by the Main Civil Contractor for the excavation of settling basins. Till date, about 89% by length of the entire underground network has been excavated along with necessary supports works. The progress by volume is about 72% 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 5,750 m length 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 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 Contractor has already achieved breakthrough in SB-01 at the crown level. 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 excavation work of the settling basin in benching form from crown level along with the application of initial supports. 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 excavation work of the settling basin in benching form from crown level along with the application of initial supports. 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%. Further, additional excavation on the right face of the crown was carried out in this month. 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. Currently, there are two work fronts for HRT, one from Adit tunnel and another from outlet portal. About 3,132 m has been excavated till the end of April 2022, from two different faces.

HRT from Adit-01

About 1,422.23 m has been excavated till date from Adit-01 in the Headrace Tunnel section from this face along with support installation works.

HRT from the Outlet end

The Contractor has excavated 1,710.13 m of the HRT from the outlet end till date from this face along with support installation works.

Total length (m)	Excavated from Adit 01 (m)	Excavated from Outlet (m)	Total Excavation (m)	Completion %
3,369	1,422.23	1,710.13	3,132.36	93%

Only about 235 m of excavation is remaining for the breakthrough of the Headrace tunnel (HRT).

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 115.57 m till the end of April 2022 along with rock supports works.

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. Steel ribs have been installed as per site conditions.

11. SURGE SHAFT

The excavation of 8 m diameter surge shaft has been already been completed by the Main Civil Contractor throughout a depth of almost 80 m. Further, the Contractor is carrying out the widening works to its design diameter of 16m up to a depth of about 63.60 m from the top level of crown. The Contractor is carrying out sequential excavation with support of 6m long, 32 mm dia. rock bolt and 75 mm thick steel fiber Shotcrete. Till date almost 14,161.85 cubic meters of earthwork has been excavated in surge shaft which is almost 84% of the total estimated earthwork volume. The excavation of surge shaft up to its design diameter of 16m is expected to be complete by May 2022.

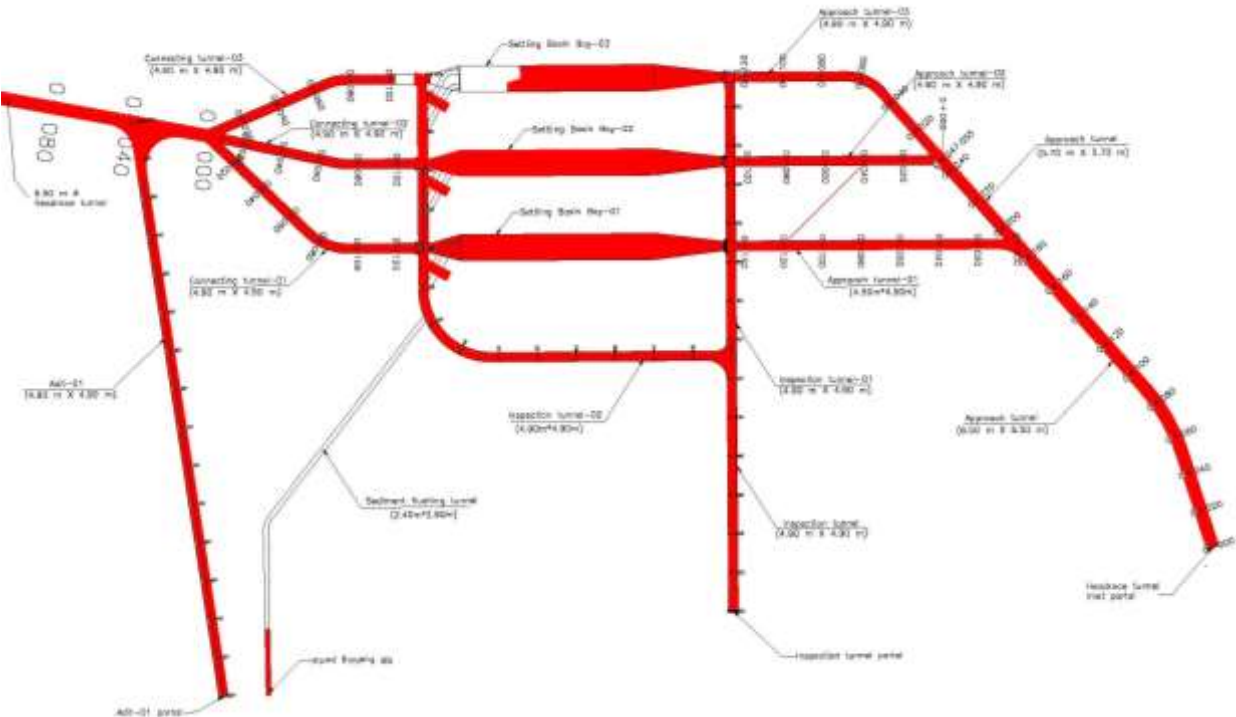


Figure 17: Schematic diagram of underground works near headworks

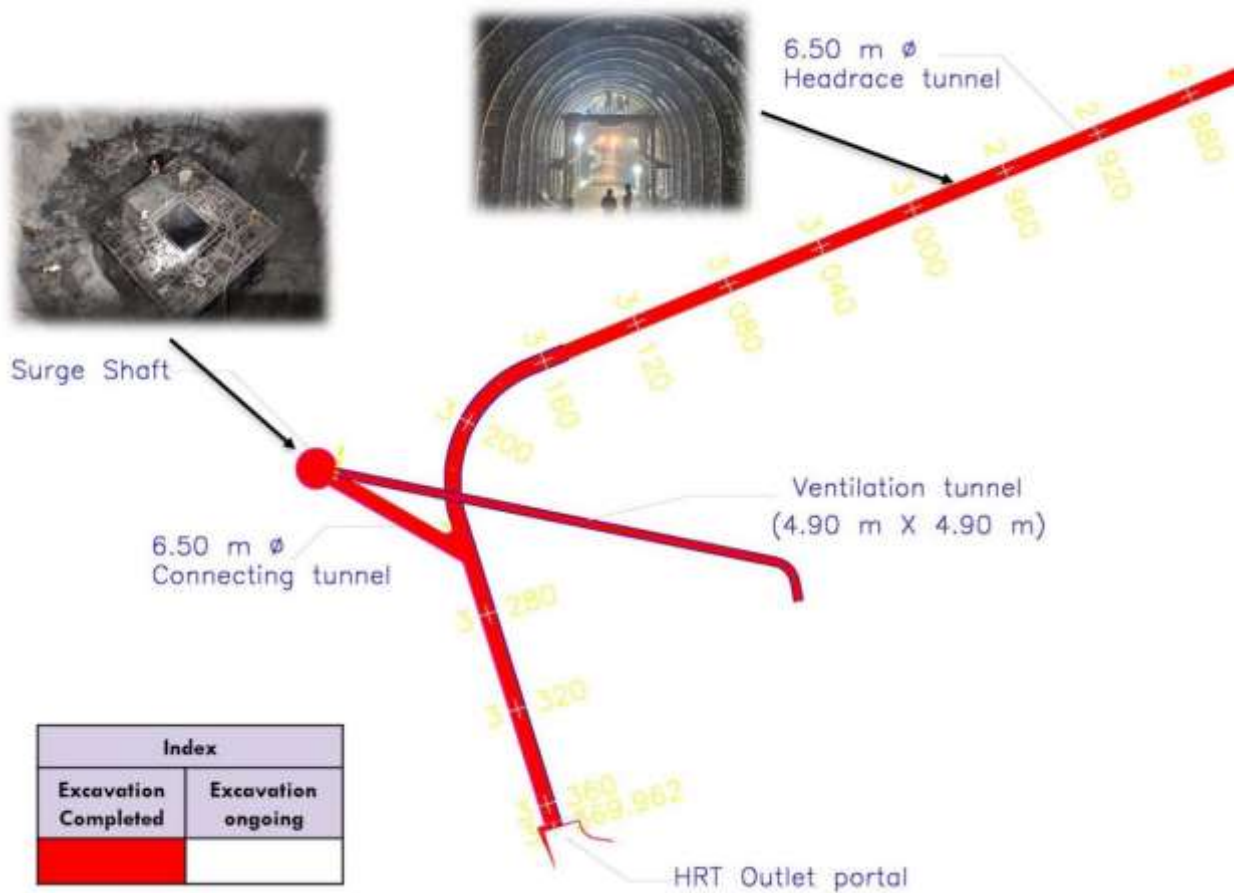


Figure 18: Schematic diagram of underground works near powerhouse



Figure 19: A view of HRT from adit



Figure 20: Rock support works at HRT from adit



Figure 21: A view of application of shotcrete with robotic shotcrete machine at SB-02



Figure 22: Breakthrough at Connecting Tunnel junction (SB-02)



Figure 23: Excavation works at flushing tunnel



Figure 24: A view of HRT from Outlet



Figure 25: A view of Settling Basin



Figure 26: Excavation 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	247.055		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	131.5		3,025.22	3,025.22	-	Completed
5	Settling Basin Bay-01		150.00	150	150	29,669.13	9,244.79	20,424.34	Crown Support
6	Settling Basin Bay-02		150.00	150	150	29,669.13	9,244.79	20,424.34	Crown Support
7	Settling Basin Bay-03		150.00	110.5	108.4	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	112.5		2,749.25	2,638.66	110.59	Pending
10	Connecting Tunnel-03		121.32	104.6		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	289.524		7,420.23	7,420.23	-	Completed
13	Adit-01		299.47	299.472		6,782.49	6,782.49	-	Completed
14	Sediment Flushing Tunnel		506.36	115.57		3600.00	818.24	2781.76	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	70.2		2,765.88	2,765.88	-	Completed
17	Surge Shaft		79.93	63.6 m from crown		16880.38	14161.85	2718.53	Active
18	Ventilation Tunnel		199.75	199.746		2,560.64	2,560.64	-	Completed
19.1	HRT	From Adit	3,369.96	1422.23		133248.58	56508.02	9361.44	Active
19.2		From Outlet		1710.13			67379.12		Active
Total			6,625.92	5847.08		299455.349	216873.56	82581.79	
				89%					72%
				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. The excavation works at Powerhouse has already been completed. The concrete works at tailrace floodwall has also been completed. Further, the concreting works at Powerhouse is being carried out. Till date almost 81% concreting works at Powerhouse and 47% at Tailrace culvert has been completed.

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 along the penstock alignment. Till date, more than 82,000 m³ of earthwork has already been excavated. Further, the main civil contractor is carrying out rebar installation works for the concreting of the manifold blocks simultaneously with the hydro-mechanical contractor as the installation of the bifurcation and branch pipes is completed. Till date almost 883 m³ of concrete has already been poured in the manifold region.

2.2.3.2 POWERHOUSE

Till date, about 7,166.92 m³ of concrete has been poured in the powerhouse super structure which is almost 81% concrete progress. The rebar installation works at the crane beam at Bay 03 is ongoing. The Contractor has already completed the concrete works at the crane beam level up to Bay 02 and carrying out rebar installation works on the roof column along with grouting works for rail track of EOT crane in crane beam. The roof truss shall be erected from June 2022.

2.2.3.3 TAILRACE FLOODWALL AND TAILRACE CULVERT

The construction of tailrace floodwall has been completed on February 2021. About 1,326.52 m³ of concrete has been poured in the tailrace floodwall region. Currently, the contractor has been carrying out the rebar installation and concreting works at tailrace culvert section. The contractor has already completed about 47% of concreting works at tailrace culvert. About 924.43 m³ of concrete has been poured in tailrace culvert region.

Table 7: Progress of concreting at Powerhouse and tailrace culvert

Structure	Panel	Total BoQ Quantity (m ³)	Total progress (m ³)	Percentage Progress%
Powerhouse	Bay-01	1100.42	1,012.8444	92.04%
	Bay-02	1829.53	1571.00	85.87%
	Bay-03	1769.92	1352.48	76.41%
	Bay-04	1769.92	1302.51	73.59%
	Bay-05	2373.99	1928.11	81.22%
Sub-Total		8,843.78	7,166.92	81.04%
Tailrace	Panel-01	981.97	429.69	43.76%
	Panel-02	981.97	494.74	50.38%
Sub-Total		1,963.93	924.43	47.07%
Penstock	Anchor block	9,776.56	882.53	9%
Sub Total		9,776.56	882.53	9%



Figure 27: Concreting works at the manifold

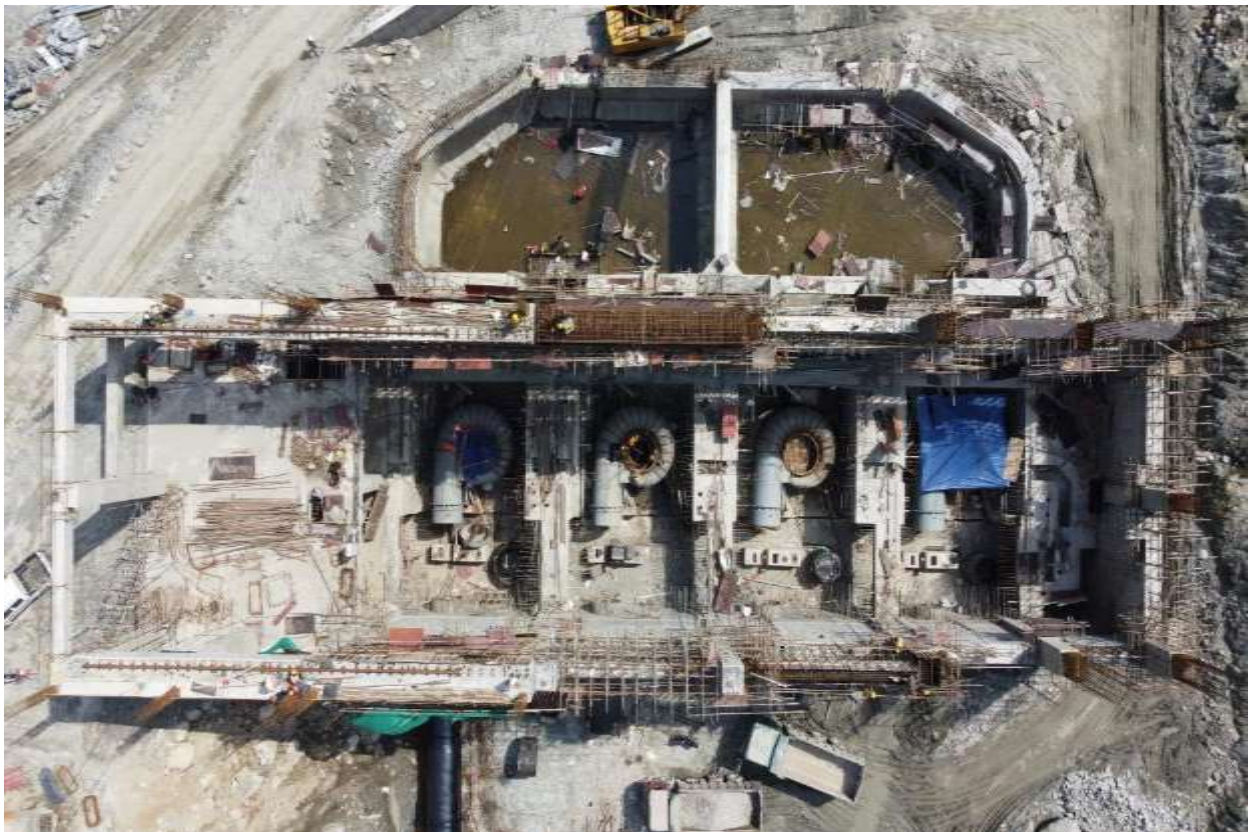


Figure 28: Top view of powerhouse in March end



Figure 29: Inside view of Powerhouse at Bay 02, 03, 04 & 05



Figure 30: Concreting works at Crane beam at Bay 04



Figure 31: Reinforcement works at Tailrace culvert Panel 01 & 02



Figure 32: Backfilling works at Penstock manifold



Figure 33: Interface works at manifold

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 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 almost 63 number of penstock pipes out of required 103.

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

2.3.1 HUMAN RESOURCES, EQUIPMENT AND MATERIALS DETAIL

Table 8: Human Resources (HM Contractor)

S.N	Description	Nos
1	Mechanical Engineer	1
2	Admin / Accountant	1
3	Supervisor	3
4	Rolling Machine Operator	1
5	Crane Operator	1
6	Driver	1
7	Kitchen Staff	2
8	Storekeeper	1
9	Welder	3
10	Fitter	2
11	Helper	11
12	Electrician	1
13	Sand Blaster	2
14	Painter	2
15	QC Officer	1
16	Non-Skilled	2
TOTAL		35

Table 9: Equipment and Materials Status (HM Contractor) at the end of August.

S.N	Description	Quantity
1	DG 40 KVA	1

S.N	Description	Quantity
2	Endo power Crane 14T	1
4	Mobile Crane 25T	1
3	Mahindra Bolero	1
4	Welding Machine	12
5	PUG cutting machine	3
6	Grinding machine	10
7	Hand drill machine	1
8	Jack Hammer	1
9	Oxygen gas	10
10	LP gas	2
11	Welding electrode 3.15 mm 7018	515 kg
12	Welding electrode 4 mm 7018	240 kg

2.3.2 STEEL LINING

Steel Lining work has been completed at Intake, undersluice and bed load sluice. Steel lining work on the gravel flushing area is ongoing in accordance with the work front made available by the Civil Contractor.

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.

Table 10: Detail of work progress of gates and stoplogs

S.N.	Description	1 st Stage Embedded parts	2 nd Stage Embedded parts	Remarks
Fabrication of Gates				
1	Undersluice Gates	All Complete	All Complete	
2	Intake Gates	All Complete	All Complete	
3	Bedload sluice gates	All Complete	All Complete	3 units of gate panel have arrived at site.
4	Fish Passage Gate	All Complete	Pending	
5	Trash Passage Gate	Pending	Pending	1 st stage and 2 nd stage embedded parts available at site
6	Gravel Flushing Gates	Ongoing	Ongoing	Erection of 1 st stage and 2 nd stage embedded parts all complete up to elevation 880.295 masl
7	Setting Basin Inlet gates	Pending	Pending	
8	Settling Basin Flushing Gates	Pending	Pending	

9	Adit Bulk Head Gates	Pending	Pending	
10	Draft Tube Gates	All Complete	All Complete	Erection of embedded parts of gates have been completed along with the embedded parts of hoisting
Fabrication of stoplogs				
1	Undersluice Stoplogs	All Complete	All Complete	
2	Bedload sluice Stop logs	All Complete	All Complete	
3	Trash Passage Stop logs	Pending	Pending	Sill beam on one unit has been erected
4	Gravel Flushing Stoplogs	Ongoing	Ongoing	Erection of 1 st stage and 2 nd stage embedded parts all complete up to elevation 880.295 masl
5	Settling Basin Flushing Stoplogs	Pending	Pending	
6	Tailrace Stoplogs	Pending	Pending	

2.3.3 TRASHRACKS

Table 11: 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			
4	Settling Basin outlet Trashrack			

2.3.4 STEEL PIPES AND OTHERS HEADRACE STRAIGHT PIPELINE

Internal Diameter: 4.5 m

Thickness: 16 mm

Table 12: 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	27	X

HEADRACE BENDS

Internal Diameter: 4.5 m

Thickness: 16 mm

*Note: Fabrication of headrace bend has been completed.**Table 13: 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.***PENSTOCK PIPES**

Internal Diameter: 4.5 m

Thickness: 16 mm to 36 mm

Table 14: 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. The HM Contactor has already transported 20 nos. pipes to powerhouse storage yard till date.

REDUCERS

Internal Diameter: 2.25 m to 2.00 m

Thickness: 20 mm

Fabrication of reducer has been completed whereas reducer at unit 04 has been installed.

Table 15: Detail of work progress of Reducers

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

BRANCH PIPES

Internal Diameter: 3.90 m to 2.25 m

Thickness: 20 mm to 32 mm

Table 16: Detail of work progress of Branch Pipes

Branch Pipes	Up to previous month	This Month
Cutting	29	X
Rolling	25	X
Fitting	25	X
Welding	22	X
Inspection	18	X
Blasting	18	X
Painting	18	X
Transportation	18	X

Fabricated Pipes of diameter 2.00 m and thickness 20 mm has been transported to powerhouse location and erection has been started on Unit 1. Erection of 4 Nos of branch pipe has been completed this month along with final layer of painting.

BRANCH BENDS

Internal Diameter: 2.25 m

Thickness: 20 mm

Fabrication of reducer has been completed. Erection of Branch bend No 04 has been completed and No 03 has been ongoing at site along with the welding works.

Table 17: 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	X	X	√	√

BIFURCATIONS*Table 18: 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 completed at Pokhara workshop and is already delivered to the site. Fabrication of sickle plate for Unit 1 and Unit 2 is ongoing at site along with welding and testing works. Further, erection of Unit 3 has been ongoing at site.

Table 19: Detail of work progress of Bifurcation

Bifurcation	Unit 1	Unit 2	Unit 3
Cutting	√	√	√

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

2.3.5 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.

Table 20: Detail of work progress of Diffuser

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

2.3.6 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. Fabrication of pipes is completed and erection works has been ongoing.



Figure 34: Aerial view of HM Camp, storage yard, workshop and Army camp



Figure 35: Erection of weir flushing pipe (ID: 2.25 m , thk: 12 mm)p



Figure 36: Bifurcation Unit 3 (Inlet Dia: 3.18 m, Outlet Dia: 2.25 m , thk: 25 mm)



Figure 37: View of excavation works and installation works of penstock



Figure 38: Rolling of penstock pipe



Figure 39: Steel lining works at gravel flushing culvert

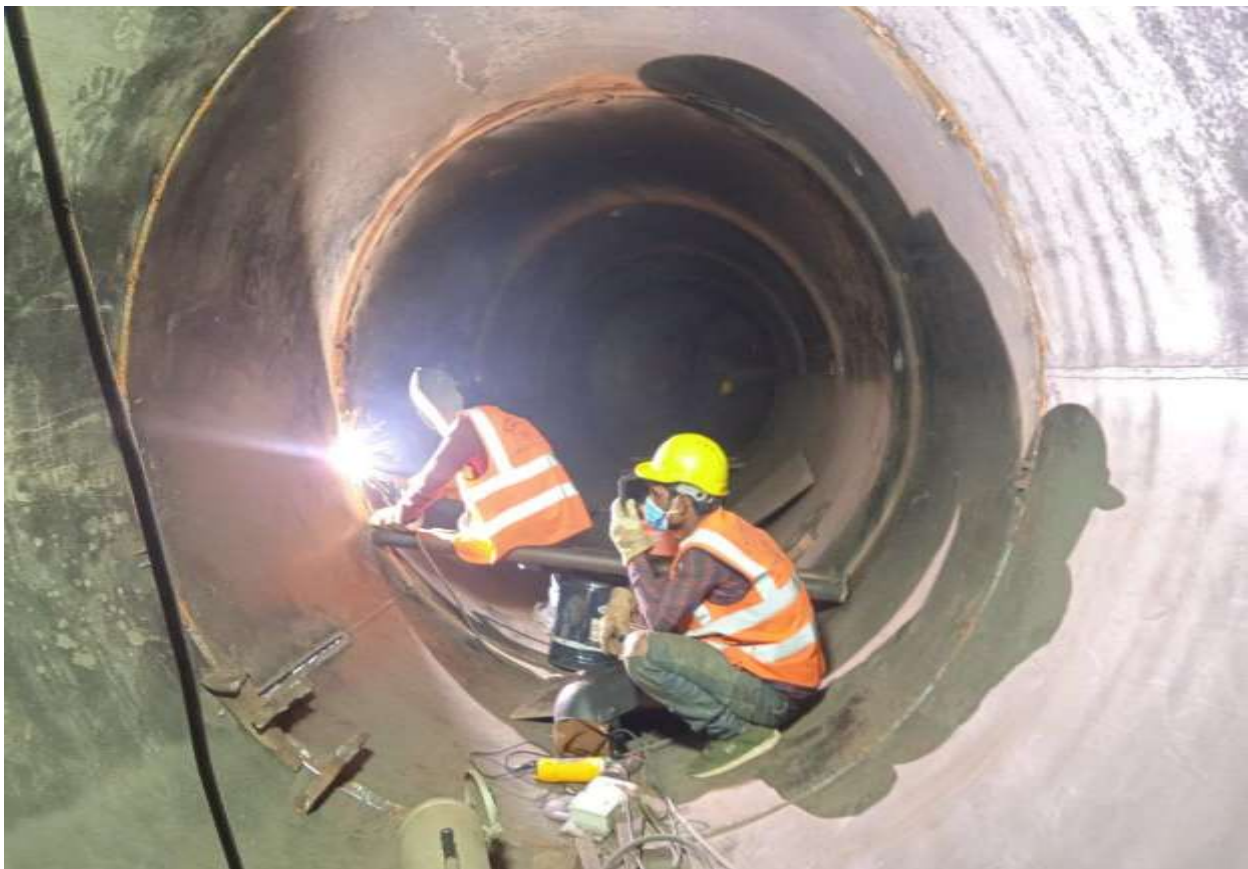


Figure 40: Welding works at powerhouse

2.4 ELECTRO-MECHANICAL WORKS

The design, fabrication, assembly, supply and installation of electro-mechanical work 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 electromechanical works starting from the end of penstock until the high voltage power line (220 kV) 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 officially mobilized its manpower and resources to the site on February 09, 2021. The earthing works under the foundation of powerhouse has been completed. The design, fabrications and assembly works are being carried out at various factories in China. The installation of draft tube elbow in all 4 units has been completed along with the first stage embedded parts and pipes. The fourth and fifth shipment of the 1st lot of EM equipment has already reached site which includes all four units spiral casing, turbine and EOT crane accessories. With this, the contractor has completed the delivery of all equipment defined in the 1st lot of delivery as per the supply arrangement of Electro-mechanical works Contract.

Further, the EM contractor has already completed almost 90% fabrication works at his factory in China, which includes the design, fabrication and testing of generator sets, runner, shaft, etc. Till date, the EM contractor has delivered almost 55% of the equipment which includes spiral casing, seamless pipes, earthing flats, EOT crane accessories, draft tube elbow, cone, pit liner, etc. Also, almost 25% erection and installation works have already been completed at the site whereas testing and debugging is scheduled for next year.

Moreover, the 7th lot shipment of EM equipment has been delivered to the Project site, which includes generator and runner set for unit 1 and unit 2 along with its accessories. 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 limited management input.

2.4.1 MANUFACTURING WORKS

All the Turbine parts has been completed and dispatched to site for installation including spare runner. 2 sets of stator have been dispatched to site along with the copper bar for one unit. With this, majority of generator and Turbine parts has been manufactured along with its imbedded parts and ready for delivery. All 4 sets of Governor are assembled and ready for delivery. Similarly, 4 sets of excitation panel and Neutral grounding cabinet are assembled and ready for delivery. All 4 sets of Main inlet valve are in manufacturing process and due to be completed in May 2022. Additionally, raw materials for Penstock Protection valve are being purchased and soon to be manufactured. Few photographs of the manufactured equipment's are given below:

2.4.1.1 EOT CRANE INSTALLATION

After the Installation of all various pipes system such as cooling system, ventilation system, air and oil system pipes and embedded parts up to 760.37 amsl – installation of EOT crane has been carried out. Rail track's level has been maintained and second level of concreting has been completed. Further installation works has been carried out in Bay 1 and Bay 2. Few photographs of the progress made are attached below,



Figure 42:Excitation panel (at EM factory at China)



Figure 41: Ongoing Installation of rail track in Bay 1 downstream's crane beam



Figure 43: Rotor spider hub (at EM factory at China)



Figure 44: Fabrication of rotor and generator parts in China



Figure 45: Governor (at EM factory at China)



Figure 46: Stator and copper bar ready for delivery



Figure 47: Main inlet valve production



Figure 48: Fabrication of neutral grounding panel (at EM factory at China)

2.4.1.1 INSTALLATION OF SPIRAL CASE

All the Stay ring has been placed inside the pit including its segments and taper pipes. As of this date all the respective segments have been assembled –welded –tested expect for unit 3 & unit 4. Fitting allowance of Unit 1 has been fitted and welding works for unit 1 and 2 has been completed whereas welding is ongoing for unit 3 and unit 4. Following table shows the latest status of work progress of Spiral case installation works:

Table 21: Table showing work progress of Spiral case installation

Unit	Stay ring placement	Taper pipe placement	Segment Assembly	Welding	UT	Pressure Test
1	Yes	Yes	Yes	Completed	Completed	Ready
2	Yes	Yes	Yes	Completed	Completed	Ready
3	Yes	Yes	Yes	Started	Not Ready	Not Ready
3	Yes	Yes	Yes	Started	Not Ready	Not Ready

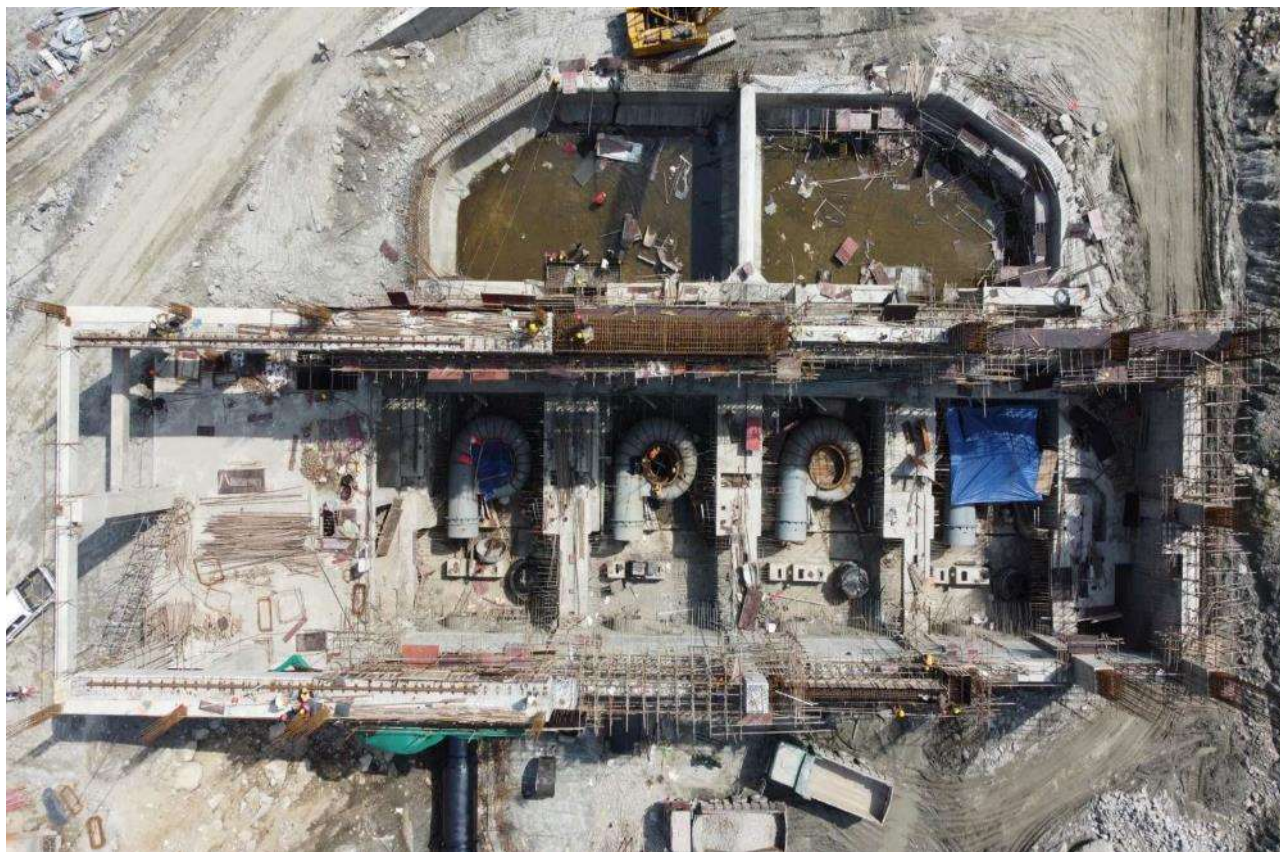


Figure 49: Aerial View showing all four spiral cases and tail race

2.4.2 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	1
3	Mechanical Engineer	1
4	Installation Engineer	2
5	Mechanical Supervisor	2
6	Translator	1
7	Semi-skilled manpower	5
8	Helper	10
Total		23

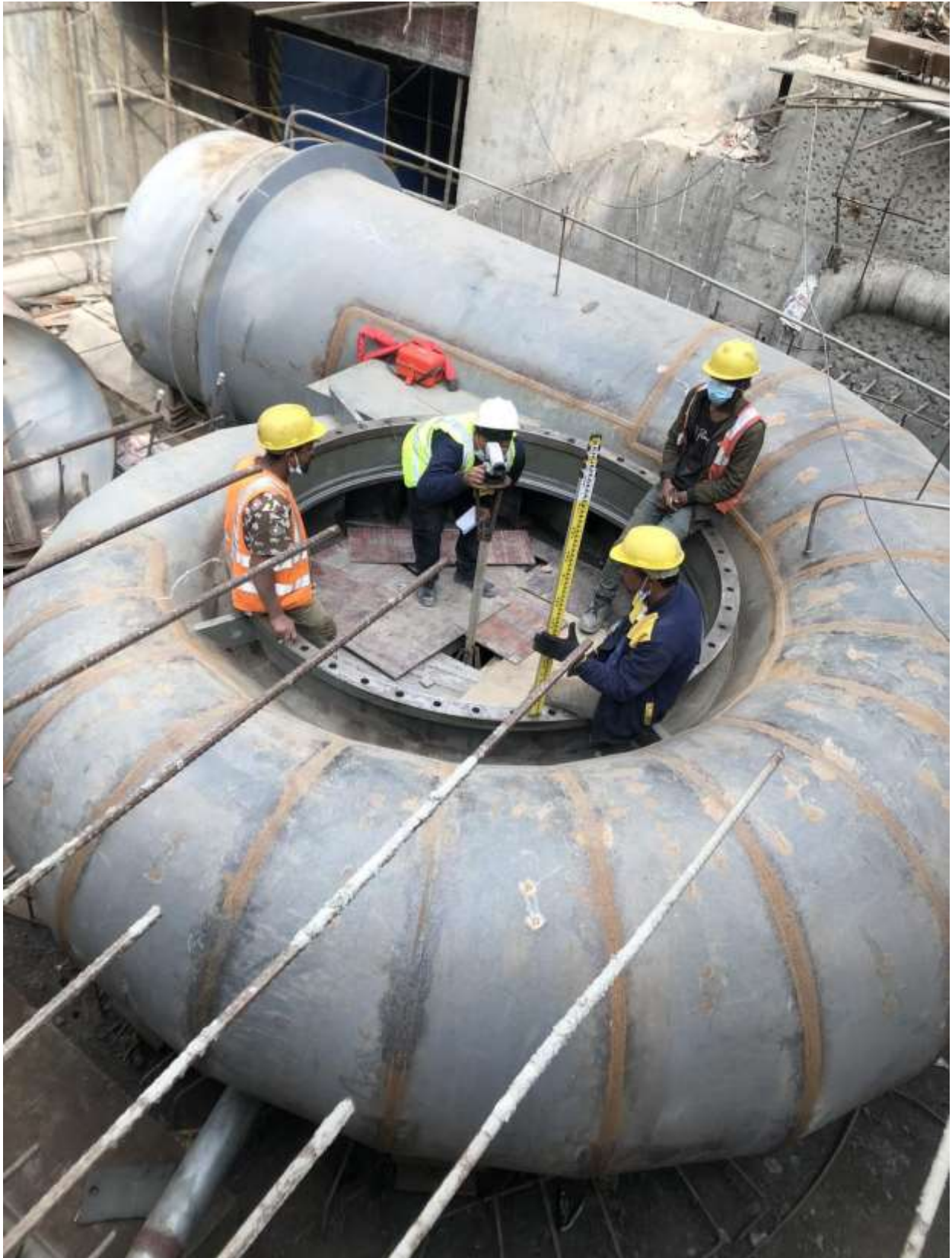


Figure 50: Labeling work of Stay ring



Figure 51: DPT test of welded segments of Spiral case

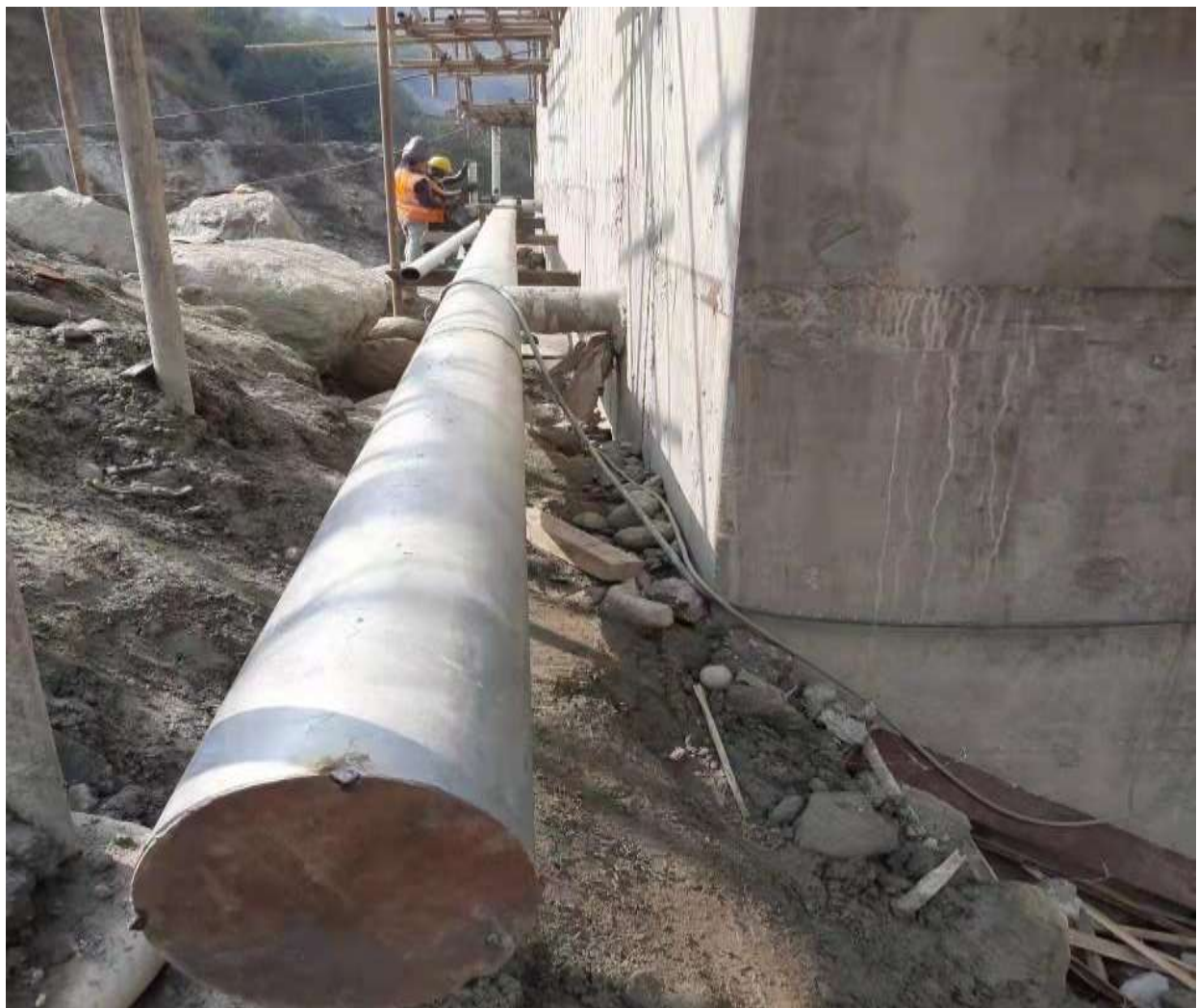


Figure 52: Imbedded pipes of firefighting system



Figure 53: Surface being readied for Ultrasonic test



Figure 54: Nose drain of Spiral case

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 and design of the tower and is currently working on the construction of foundation of the towers. Manufacturing of most of the tower parts has been completed in India and China and being imported to the Project site gradually. Furthermore, tower accessories including insulator, OPGW, conductor, etc. have already been manufactured, tested and is in process of delivery to the Project site.

The construction license of the transmission line has been acquired. The land acquisition works for 20 tower angle points (AP) has been completed and the land acquisition works for the remaining locations along with the RoW clearance is in progress. The erection of stub and foundation concreting works have been completed in 19 locations which is almost 80% of total foundation works whereas the foundation works is ongoing in 1 location. The tower erection works have already started at AP16 and AP10 as the tower parts are being delivered to the Project site. The transmission line route map is shown in figure below.

The transmission line route map is shown in figure below.

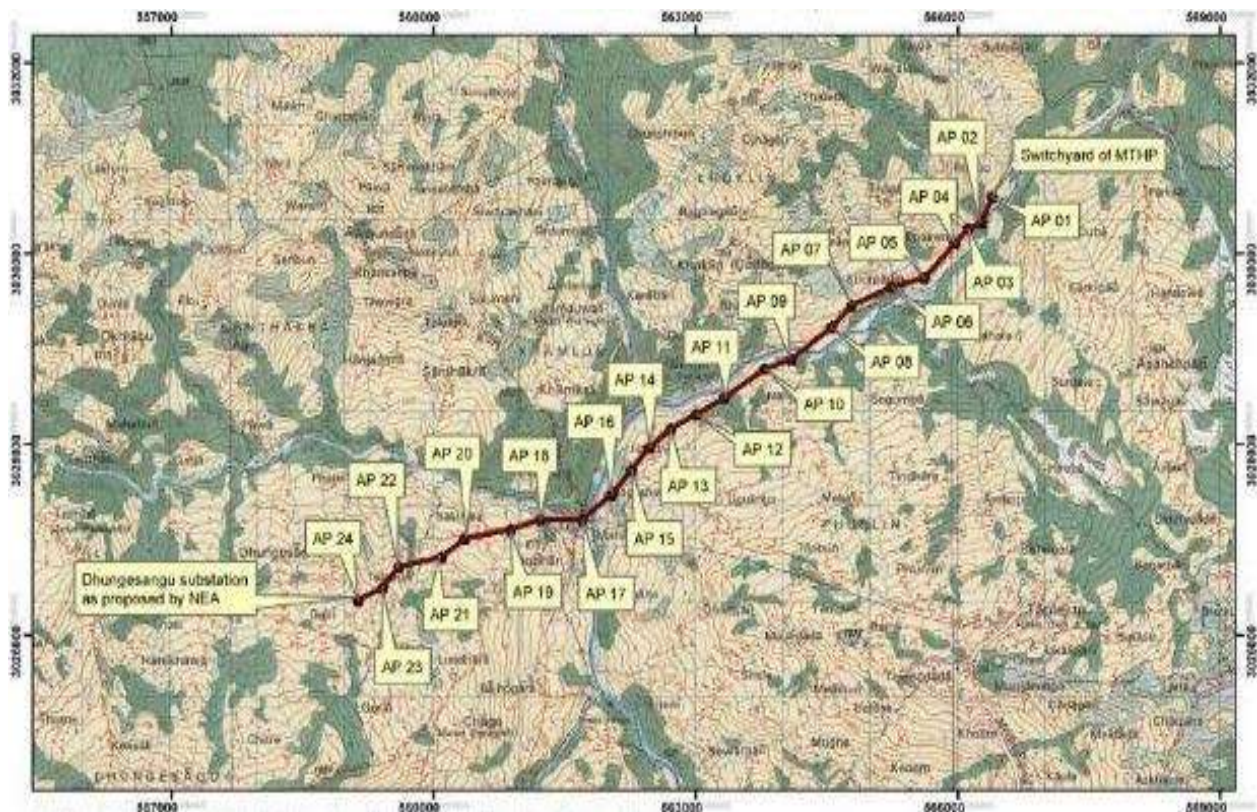


Figure 55: Transmission line route map

2.5.1 HUMAN RESOURCES OF TL CONTRACTOR*Table 23: 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 24: 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. The erection tower at AP16 has been completed where is in final stage of completion at AP10.

S.N.	Description	Total	Unit	Completed	% Completed
1	Land Procurement works	24	Nos	22	92
2	Foundation Works	24	Nos	19	80
3	Tower Erection Works	24	Nos	1	4
4	Stringing Works	10	Km	0	0



Figure 56: Tower erection works ongoing at AP16



Figure 57: Rebar installation work of leg at AP24



Figure 58: Foundation work at AP-18



Figure 50: Stubs erection in AP-18



Figure 59: Foundation Work of AP-22

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, 56% 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 18 IPCs have been already disbursed to the Main Civil Contractor whereas the Contractor is in process of raising IPC 19. Similarly, 52% 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. 53% 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 70% of the total Contract amount have been provided to the TL Contractor against the bills up to IPC#04 and advances.

Table 25: Financial Progress of Major Contract Packages Till Date

Major Contract Packages	% Expense till date	% Remaining Budget
Main Civil Works	56%	44%
Hydro-Mechanical Works	52%	48%
Electro-Mechanical Works	53%	47%
Transmission Line Works	70%	30%

The total financial progress of the Project including major Contract Works along with Infrastructure Works, EMP including Land, General Items, Pre-operating and management is about **60%** till date. However, in overall the total expended amount in the Project is about **50%** financial expenditure out of the total project cost.

Particulars	% Expense till date	% Remaining Budget
Financial Progress of MTHP	50%	50%

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 tunnel excavation 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.



Figure 60: Sample collection for PCR testing at Contractor's camp

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.

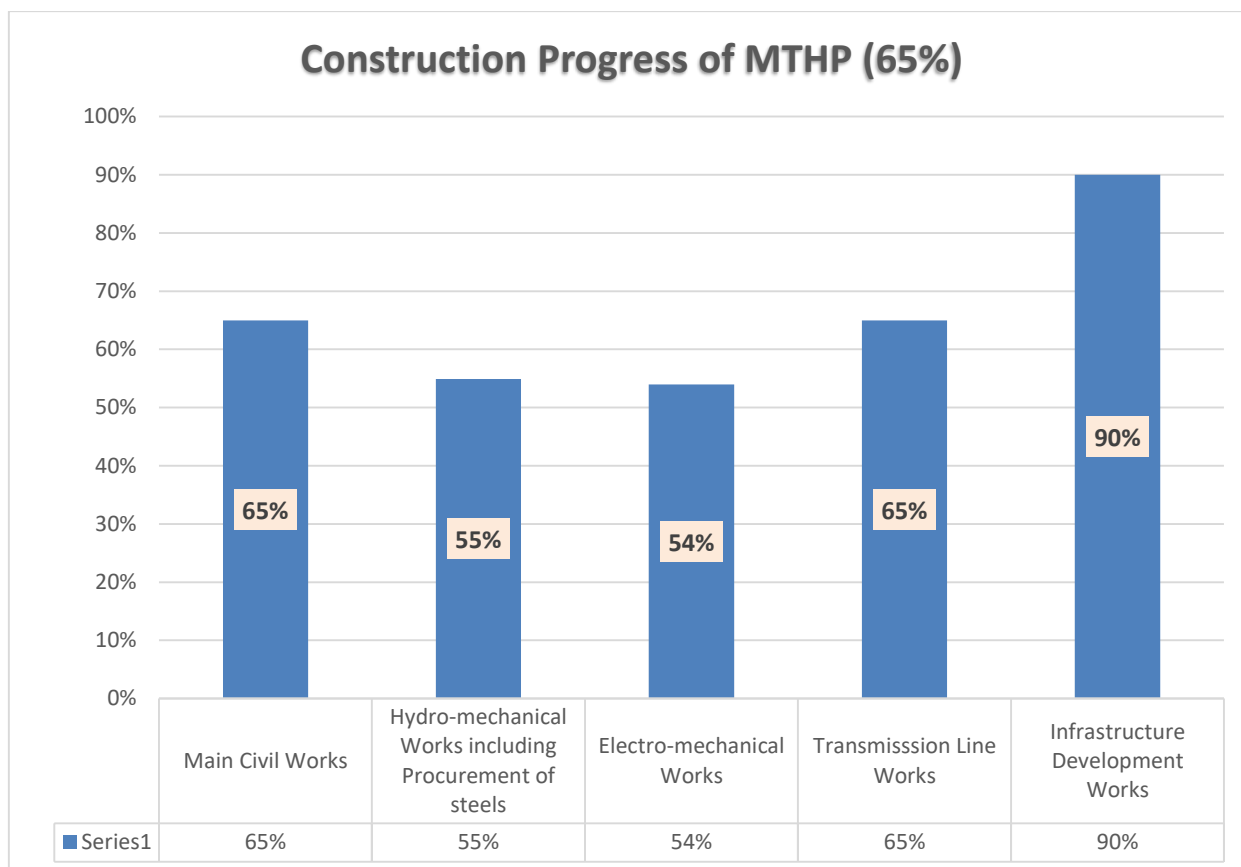
Repeated temporary pauses in the construction activities caused by the pandemic certainly affected the overall organization, planning and execution of the project work. Considering the effect of COVID-19 pandemic on many hydro projects under construction in the country, the Government through Nepal Electricity 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 65% whereas in Hydro-mechanicals works is almost 52%. Further, the progress in Electro-mechanical works and Transmission Line works is 54% and 65% respectively.

S.N.	Major Contract Packages	Project estimated cost	Financial Project Weightage	Physical Progress
1	Main Civil Works	7,023,626,172.07	66%	65%
1.1	<i>Headworks and Temporary River Diversion</i>	2,644,894,449.45	25%	70%
1.2	<i>Powerhouse and Penstock</i>	756,567,243.65	7%	60%
1.3	<i>Underground Works (HRT and Settling Basin)</i>	3,188,172,001.85	30%	57%
1.4	<i>General Items</i>	433,992,477.13	4%	70%
2	Hydro-mechanical Works including Procurement of steels	679,042,357.44	6%	55%
2.1	<i>Contract amount</i>	567,134,202.24	5%	47%
2.2	<i>Procurement of steel plates</i>	111,908,155.20	1%	95%
3	Electro-mechanical Works	1,437,913,611.68	13%	54%
4	Transmission Line Works	181,911,166.19	2%	65%
5	Infrastructure Development Works	1,334,023,000.00	13%	90%
	Overall Construction Progress	10,656,516,307.39		65%

Figure 61: Work progress summary chart



As outlined above, despite all difficulties faced by the Project due to COVID-19, about **65%** 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.