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

MIDDLE TAMOR HYDROPOWER PROJECT
(73 MW)

PROGRESS REPORT

(October 2023)

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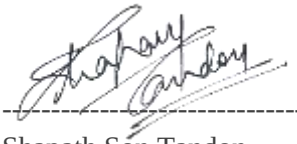
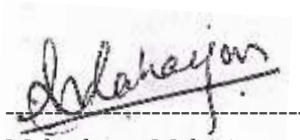
	Signature	**Date**
Prepared by:	 ---------- Shapath Son Tandon	07 November, 2023
Checked by:	 ---------- Sandesh Thapa	07 November, 2023
Recommended by:	 ---------- Maheshwor Maharjan	07 November, 2023
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ABBREVIATIONS AND ACRONYMS

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

The 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 are located in Phungling Municipality and Phaktanglung Rural Municipality, and the Powerhouse (PH) is situated in Mikwakhola Rural Municipality on the right bank of the Tamor River in the Taplejung district. The boundary coordinates of the project are 870 40' 01" E to 870 42' 40" E and 270 23' 29" N to 270 25' 19" N. The nearest black-topped approach road to the project site is at Bahanande, on the Mechi Highway (233 km from Charali in Jhapa), 7 km south of the district headquarters Phungling Bazar. From Phungling, the project Powerhouse (Thumba village) and Headworks (Mitlung village) sites are accessible via separate earthen roads, 15 km and 17 km long respectively.

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

SMTHL has overseen the construction work through four major individual contract packages with various international and national contractors. The Main Civil, Hydro-Mechanical, Electro-Mechanical, and Transmission Line Contractors have all been involved in the construction process. Apart from these major contracts, pre-construction and preparatory works have been executed by SMTHL. These include the construction of access roads, upgrading of existing roads, slope protection works, construction of bridges, land acquisition, and other necessary arrangements. The progress of these activities is detailed in this report.

Considering various technical factors affecting the overall progress of the Project and the construction of the transmission line being constructed by the Nepal Electricity Authority (NEA) from Dhunge Sanghu to Basantapur, the Employer and NEA agreed to extend the required commercial operation date (RCOD) until the completion of the construction of the above mentioned transmission line. Therefore, as per the second revision done on the Power Purchase Agreement (PPA) with NEA, the RCOD of the Project has been amended to a revised date of February 27, 2024 (Falgun 15, 2080).

The project's installed capacity is 73 MW, with a 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 weir, 50 m long, has its crest level at 887 m above mean sea level (amsl). The maximum height of the weir crest from its original ground level is 10.5 m. It diverts the required flow to the Intake. The Intake has 6 openings to withdraw the design discharge. The flow from the Intake is conveyed to the gravel trap and then to the underground settling basin via a concrete-cased approach pipe of 281.52 m length. The three-chambered 100 m long underground settling basin, designed with 90% trap efficiency, passes the clean water into the headrace tunnel.

The headrace tunnel, approximately 3,367 m long and lined with concrete and shotcrete, carries the design discharge to the penstock. The proposed penstock starts with a diameter of 4.5 m until a branching length of about 264.66 m. After that, four penstock pipes with internal diameters ranging from 2.25 m to 4.5 m supply water to the powerhouse. The Powerhouse, measuring 56.5 m in length and 26 m in width, has a tailwater level at 755 m amsl. Four units of vertical axis Francis turbines, each with a capacity of 18.25 MW, are set to generate the designed output of 73 MW. After power generation, the tailwater is discharged back to the Tamor River through a 75 m long tailrace culvert. The generated electricity is supplied through an approximately 9 km long 220 kV double circuit transmission line to the 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 depicted in Figure 1.

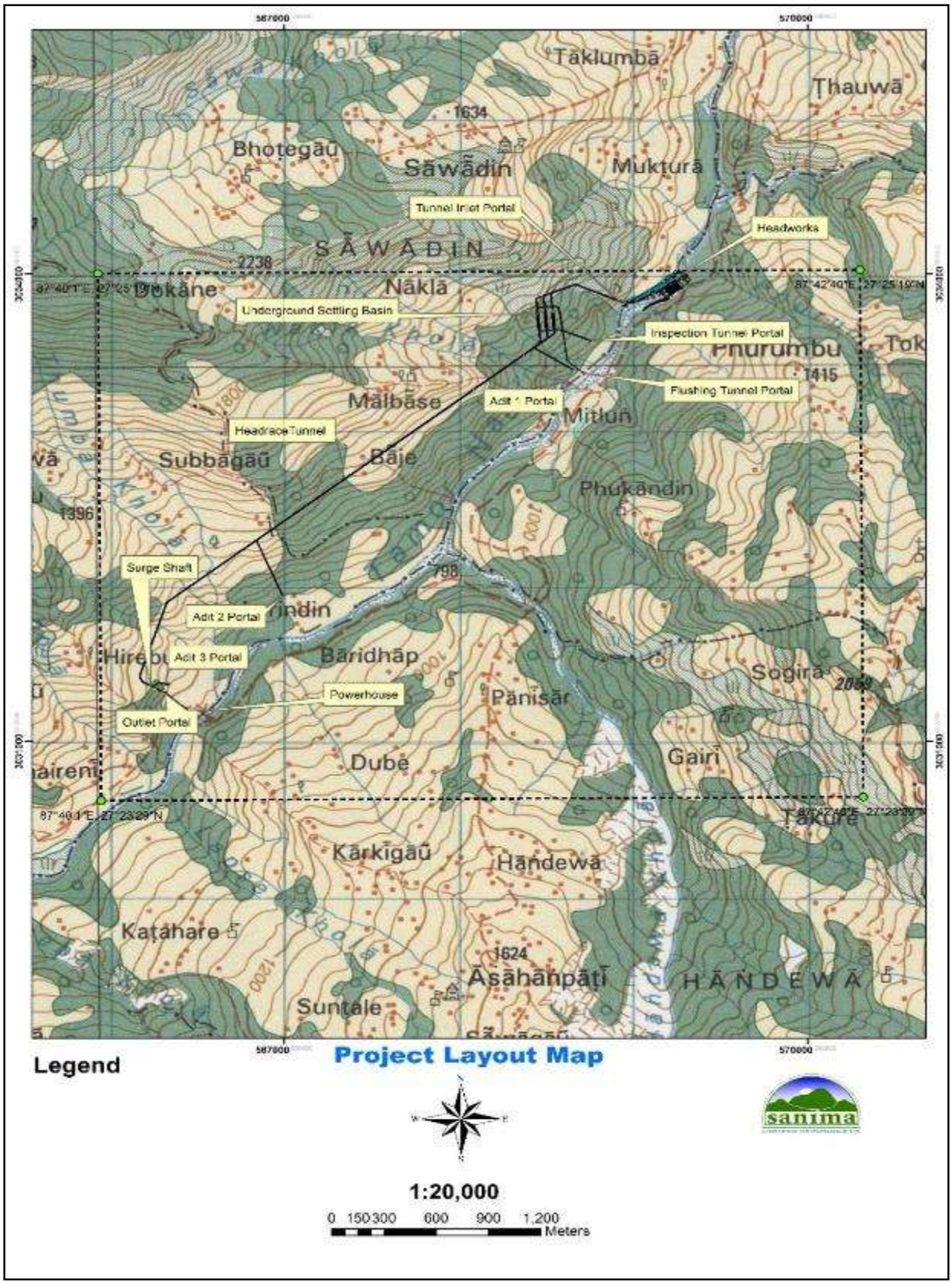


Figure 1-1: General layout of the Project Structures

1.2 PROJECT KEY INFORMATION

Table 1-1: 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	Total equity required (estimated)	NPR 3,332.5 Million
Total debt required (estimated)	NPR 9,997.5 Million	RCOD	Amended to 27 February 2024 (Falgun 15, 2023)
Lenders	NIBL – Lead, Nabil (Co-lead), Global IME (Co-lead), NMB, NCC, Laxmi, Nepal SBI, ADBL Banks	Consultant	Sanima Hydro and Engineering Pvt. Ltd. (SHE)
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
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

Table 1-2: Detailed Salient Features of the Project as per Generation License

Location:	Phungling Municipality, Phaktanglung Rural Municipalityand Mikwa Khola Rural Municipality, Taplejung District, Koshi Province of Nepal
Purpose of Project:	To supply renewable energy 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	50 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)
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 for 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)
Required Commercial Operation Date	: 26 Bhadra 2080 (11 September 2023)
Revised Required Commercial Operation Date	**:** 15 Falgun 2080 (27 February 2023)

1.5 MAJOR CONTRACT PACKAGES

Five different contract packages have been prepared for the Project's implementation. Among them, Package I was awarded to Zhejiang First Hydro & Power Construction Group Co., Pvt. Ltd. of Hangzhou, Zhejiang, China, for Main Civil Works Construction on April 12, 2018. Package II was awarded to Machhapuchhre Metal and Machinery Works Pvt. Ltd. for Hydro-mechanical and Penstock on July 11, 2019. Package III was awarded to Chongqing Water and Turbine Work Co. Pvt. Ltd., China, on December 23, 2019. Package IV was awarded to Cosmic Electrical Engineering Associates Pvt. Ltd., Nepal, on June 7, 2020. Lastly, Package V was awarded to Bavari Construction Pvt. Ltd. for preconstruction and preparatory works. Each of these packages represents a crucial aspect of the Project, contributing to its successful realization.

2 PROGRESS UPDATE

At the construction site the Engineer, Sanima Hydro and Engineering Private Limited (SHEPL) has been continuously monitoring the construction activities of the civil, hydro-mechanical, electro-mechanical, and transmission line contractors. The work progress achieved by the Project to date is described below.

2.1 PRE-CONSTRUCTION WORKS

2.1.1 ACCESS ROAD

A fully functional earthen access road, approximately 20 km in length, has been established leading to the construction site from the Mechi Highway junction (located at Bahanande). The majority of the access road sections have been built by the Project, which also involved upgrading existing village roads. These enhancements included necessary filling using riverbed material, the construction of side drains, as well as the addition of gabion and masonry wall structures. The access road features two river crossings: one at the Powerhouse location and another at the Headworks location. Additionally, the road passes over a significant dry stream (Hangdewa Khola), which sometimes results in road blockages during heavy monsoon rainfall. Furthermore, a few other dry streams require regular maintenance during the monsoon flood period.

An alternative road route from Mitlung to Thumba, along with the installation of an additional Bailey bridge at Budidaha, is fully operational, with occasional maintenance efforts. The management remains fully cautious and prepared for any potential disruptions that may occur on the access roads.

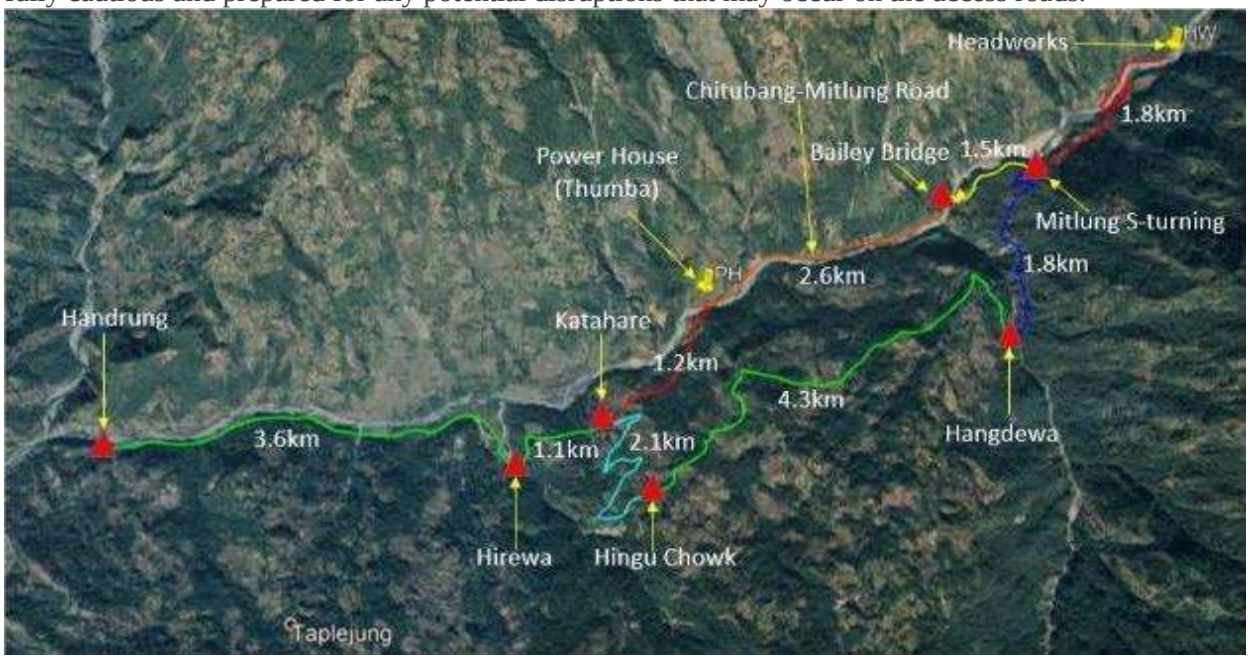


Figure 2-1: Access Road Network at site

2.1.2 CAMP FACILITIES

The construction of camp facilities in both the Headworks area (referred to as Simle Camp) and the Powerhouse area (known as Lorindin Camp) has been successfully completed, in accordance with the initial phase plan. In Simle Camp, eight buildings have been constructed, and in Lorindin Camp, three buildings have been completed. Additionally, an Army Camp and Bunker at Sisne, situated near the Headworks, are operational, with regular maintenance and cleaning being carried out, but no major maintenance work has been required thus far.

Figure 2-2: Construction of new camp building at the powerhouse

2.1.3 CONSTRUCTION POWERLINE

The Nepal Electricity Authority (NEA) Substation (S/S) located at Phungling (Hiti) in Taplejung, which is connected to the national grid, has been the primary power source supplying the necessary energy for the Project's construction. This power is delivered via a dedicated line originating from the nearby Hiti S/S, making it the most convenient source for the Project area.

The power requirements for the Project's construction, taking into account the load demands at the headworks, Adit-1, and the powerhouse, have been estimated at approximately 1.7 MVA. To transmit this power, a 17 km long 33 kV construction power line (currently operating at 11 kV) has been constructed, extending from the Hiti substation to both the powerhouse area and the headworks area. This construction power line has been operational since Mangsir 13, 2075 and has been maintained with minor interventions as needed.

2.2 MAIN CIVIL WORKS

The contract for the Main Civil Works was awarded to Zhejiang First Hydro and Power Construction Group Co. Ltd., China (referred to as 1st Hydro), on April 12, 2018. The construction of the main civil works commenced in March 2019, following the acquisition of the generation license and the successful financial closure achieved in February 2019.

At present, the Main Civil Contractor has completed the concreting activities at the significant civil structures within the headworks and powerhouse areas, including the weir, stilling basin, undersluice, intake, intake canal, gravel trap, conveyance tank, approach pipes, surge shaft, powerhouse main building, and tailrace section. Additionally, construction work is ongoing for various components, which include the anchor block and valve house, full lining of the headrace tunnel, and the concreting of the settling basin.

2.2.1 HEADWORKS

The Main Civil Contractor carried out concreting works at the headworks fronts through a number of Nepali sub-contractors and most of the structures have already been constructed. The construction of the weir, stilling basin, and the downstream floodwall has been successfully completed in June 2023. Additionally, the undersluice, intake (including the orifice structure) along with the gravel trap section have been completed in February 2023, along with the fish ladder.

Furthermore, the completion of construction of the Intake canal was achieved in March 2023 with the gravel trap being completed in July 2023. Further the construction of upstream (u/s) floodwall has also been completed. Most notably, the first water filling test at the headworks was carried successfully on August 01, 2023. The construction of the conveyance tank has been completed whereas the approach pipe encasing for underground portion is currently in the final stages of completion. A detailed breakdown of the construction work areas is provided below.

Figure 2-3: Aerial view of Headworks from the downstream

2.2.1.1 INTAKE AND GRAVEL TRAP

The construction of the intake structure as well as gravel trap has been completed as of July 2023, with approximately 8,178 m^3 of concrete poured in the intake region and approximately 4,808.93 m^3 of concrete poured in the gravel trap. Furthermore, the construction of the intake canal was successfully finalized in March 2023, with the pouring of approximately 2,704.64 m^3 of concrete within the intake canal region.

Table 2-1: Work Progress at Intake (orifice), gravel trap and intake canal

Structure	Total volume	Completed volume	% Complete
Intake (Orifice)	8,178.66	8,178.66	100%
Intake canal	2,704.64	2,704.64	100%
Gravel trap	4,808.93	4,808.93	100%

Figure 2-4: A view of intake from downstream and intake canal

Figure 2-5: A view of gravel trap and conveyance tank from upstream

2.2.1.2 WEIR AND STILLING BASIN

The construction of the stilling basin was successfully completed in May 2022, and the completion of the main body of the weir, in June 2022. Particularly, a considerable volume of concrete was poured in these structures: approximately 17,342.23 m^3 for the weir, 10,847.81 m^3 for the stilling basin, and 2,096.30 m^3 for the upstream slab and cutoff. In total, a significant 30,086.34 m^3 of concrete was used for the construction of the weir and stilling basin section.

Furthermore, the curtain grouting works at the upstream slab of the weir and undersluice bed have already been completed, adding to the progress of the project. Additionally, a small portion of the left bank floodwall, situated over the crest of the weir, has also been constructed. With the plugging of the weir openings being completed, the water filling test of the headworks region has been successfully conducted on August 01, 2023 by shutting down of all six intake gates and both the radial gates of undersluice. With this, a remarkable milestone of the Project has been achieved.

Table 2-2: 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%**

Figure 2-6: An aerial view of weir during monsoon water flow over the ogee crest

2.2.1.3 UNDERSLUICE

The construction of the undersluice has been successfully completed as of February 2023, along with the construction of the fish ladder. Throughout the construction process, approximately 19,327 m^3 of concrete has been poured into the undersluice portion.

Figure 2-7: A view of headworks during water filling test

2.2.1.4 CONVEYANCE TANK

The construction of conveyance tank has been completely accomplished as of June 2023. Up to the present date, approximately 7,700 m^3 of concrete has been poured at the conveyance tank region. The completion of conveyance tank marks a substantial progress that has been achieved by the Project at the headworks region.

Table 2-3: Work progress at conveyance tank

Total volume	Completed volume	% Completed	% Remaining
8,021.71	8,021.71	100%	0%

2.2.1.5 APPROACH PIPE

The concrete works at the approach pipe section, situated outside the Head-race Tunnel (HRT) inlet portal have already been completed as of June 2023, whilst the concrete encasing works of the approach pipe section inside the tunnel has already commenced. Out of the total length of the approach pipe, which is 282 meters, the hydro-mechanical contractor has already laid out around 220 meters of pipe up to the inlet portal. Additionally, more than 210 meters of the approach pipe section located outside inlet portal has already been encased in concrete. As of the current date, approximately 3,595 m^3 of concrete has been poured for the approach pipe section, which is about 65% of the total concreting work planned for this area.

Table 2-4: Work progress at approach pipe

Total volume	Completed volume	% Completed	% Remaining
5,531.90	3,595.00	65%	35%

Figure 2-8: A view of conveyance tank

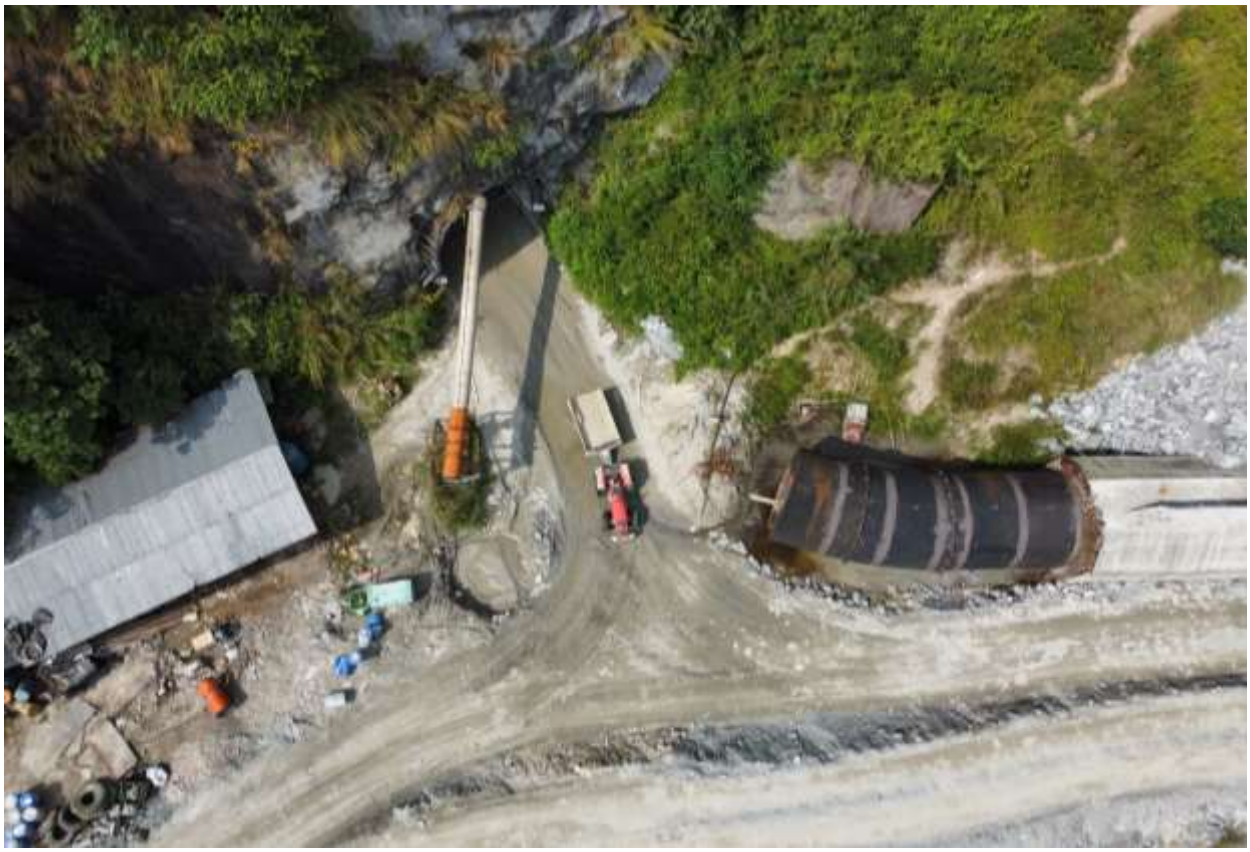


Figure 2-9: Approach pipes installation completed upto inlet portal

To sum up, the overall physical progress achieved at the headworks region is approximately 98%. The major construction works of the headworks region has been completed as of July 2023. The water filling at the headworks region has already been successfully completed on August 01, 2023 with the shutting down of all six number of intake gates and both the radial gates of the undersluice. The water filling test has marked a significant milestone achieved by the Project.

2.2.2 UNDERGROUNDS WORKS

The progress in tunnel excavation faced significant challenges due to the outbreak of COVID-19, which led to transportation difficulties, a shortage of explosives, and the deployment of government security agencies. The departure of Chinese workers from Nepal due to the pandemic prompted the Main Civil Contractor to continue the excavation of the Headrace Tunnel (HRT) and surge shaft through Nepali sub-contractors while implementing stringent health and safety measures. The excavation and rock support work at the settling basin sites were also carried out by a Nepali subcontractor in an effort to mitigate the impact of the evacuation of Chinese workers and the COVID-19 pandemic, although the resulting delay persisted.

Despite these challenging circumstances, a significant achievement was reached as the breakthrough of the Headrace Tunnel (HRT) occurred on July 15, 2022. Additionally, the challenging task of completing the concrete lining works for the 80-meter-deep surge shaft has been accomplished. The excavation works for the flushing tunnel network have also been successfully completed. Concreting works for the HRT invert and walls have been completed along the entire length of the HRT. Currently, a majority of resources are deployed for the full lining concrete works at the HRT from the adit and outlet regions.

In the interest of employee safety and to facilitate smooth excavation, the Employer has rented a Boomer machine, operated by the Main Civil Contractor, for the excavation of the settling basins. The excavation works for settling basins 01, 02 and 03 have already reached the designated elevation. In addition, the concrete works at the hopper of SB 02 and SB 01 in going on in a rapid pace. Further, the wall concreting of SB 03 is being carried out.

Despite the disruptions caused by the pandemic and occasional rock overbreaks in the caverns, leading to extensive and time consuming repair and maintenance, significant progress has been made in the underground works. Approximately 99% by length of the entire underground network has been excavated, and the progress by volume is around 96%, with about 6,606 meters of the total tunnel network excavated to date out of 6,626 meters. The vertical sections of the underground works i.e. gate shafts are in the final stage of construction.

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

The total length of Approach Tunnel 01 is 186.33 meters, which includes a 35-meter inlet transition zone 01. The excavation of Approach Tunnel 01 was successfully completed on February 11, 2020, covering a distance of 151.26 meters. To ensure structural stability, initial support measures were implemented in all sections of the tunnel. This involved the installation of 50-75 mm thick shotcrete (sprayed concrete) and the placement of rock bolts. Additionally, the excavation of the inlet transition zone 01 has also been completed. To provide the necessary structural integrity, a final layer of steel-reinforced shotcrete, 150 mm thick, has been applied.

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

Figure 2-10: A view of SB 01 with completed wall lining and hopper concreting

Figure 2-11: A view of concreting at the left hopper of Settling Basin 01

The settling basin bay 01 is 100 meters long, which includes a 35-meter-long inlet transition zone and a 15-meter-long outlet transition zone. The dimensions of the settling basin are 13.5 meters in width and 17.5 meters in height. As of February 2023, the excavation of settling basin bay 01 has been successfully completed, with a total excavation volume of approximately 29,669.13 m3.

The construction progress is noteworthy; as concrete lining works are being carried out in a rapid pace in the basin. Currently, the concrete lining works at the walls of settling basin 01 has been completed along with left hopper wall, whilst the concreting of right hopper is going on.

5. SETTLING BASIN BAY 02

Figure 2-12: Concreting at hopper of SB 02

Figure 2-13: Concreting works at the right hopper of settling basin bay 02

Figure 2-14: Rebar layout of hopper of SB 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 excavation of settling basin bay 02 has been completed as of May 2023. Moreover, shotcrete works with wire mesh has been completed. Currently, the concrete lining works at the walls of settling basin 02 has been completed along with right hopper wall, whilst the concreting works at the left hopper is going on.

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 has already completed grouting works at the crown. Further, the excavation has already been completed and currently the wall concreting works are being carried out.

Figure 2-15: A view of SB 03 during installation of final lining wiremesh shotcrete

Figure 2-16: Final stage of outlet gate section invert concrete at SB 03

Table 2-5: Excavation progress of settling basins

S.N.	Particulars	Total Volume (m^3)	Excavated Volume (m^3)	Remaining Volume (m^3)	Percentage (%)	Remarks
1	Settling Basin-01	29,669.13	29,669.13	-	100%	Completed
2	Settling Basin-02	29,669.13	29,669.13	-	100%	Completed
3	Settling Basin-03	29,669.13	29,669.13	-	100%	Completed
	Total	**89,007.39**	**89,007.39**	**-**	**100%**	

With this, the Contractor has already completed the excavation works in all three settling basin bays. The concreting works are going on simultaneously in all three bays.

7. CONNECTING TUNNELS FROM SETTLING BASIN TO HRT

Three number of connecting tunnels connects each settling basin bays at the outlet transition region to the head race tunnel. All three tunnels meet at the 0+000 chainage of the HRT at the junction point of HRT with the Adit tunnel. The concreting works in this front has also completed as of October 2023. With this, completion in one of the most challenging work fronts at the head race tunnel region has been achieved.

Figure 2-17: Preparation for full lining at the connecting tunnel junction

Figure 2-18: Full lining concrete at connecting tunnel junction

Connecting tunnel-01
The full concrete lining works at connecting tunnel 01 from the end of outlet transition zone of SB-01 to connecting tunnel junction point has been completed.

Connecting tunnel-02
The full concrete lining works at connecting tunnel 02 from the end of outlet transition zone of SB-03 to connecting tunnel junction point has been completed.

Connecting tunnel-03
The full concrete lining works at connecting tunnel 03 from the end of outlet transition zone of SB-03 to connecting tunnel junction point has been completed.

8. HEADRACE TUNNEL (HRT)

The headrace tunnel, which spans a length of 3,369 meters, features an excavation size of 6.5 meters by 6.5 meters. It serves as a connecting passage that links the Connecting tunnels with the penstock pipe at the outlet region.

A significant milestone was achieved with the breakthrough of the headrace tunnel on July 15, 2022, occurring at a chainage of 1+545.37 meters from the tunnel's starting point. This breakthrough represents a significant accomplishment in the construction of the tunnel.

7.1 Excavation works

About 1,545.37 m was excavated from Adit-01 in the Headrace Tunnel section up to the breakthrough point whereas about 1,824.59 m was excavated from outlet site.

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%

8.2 Concreting works

The invert concreting works as well as wall concrete lining works up to spring line at the Headrace Tunnel (HRT) have been successfully completed, covering the entire section, including the connecting tunnel to the Surge shaft and the connecting tunnels leading to each settling basin bay.

Presently, the focus is on carrying out the full lining works for the HRT from both the adit (entrance) and the outlet region. This effort has resulted in the completion of the full concrete lining for approximately 574 meters out of the 625 meters of full concrete lining section, marking significant progress in the HRT work front.

Particulars	Total length (m)	Length of concreting works (m)	Completion %
Invert concrete	3,300.00	3,300.00	100%
Wall lining	2,700.00	2,700.00	100%
Full lining	625.00	574.00	92%

Figure 2-19: A section of HRT with concrete full lining from the adit region

Figure 2-20: Rebar installation at the HRT region

Figure 2-21: A section of HRT with concrete full lining from the outlet region

Figure 2-22: A completed section of concrete lining works at rock trap

9. SETTLING BASIN: INLET/OUTLET GATE SHAFT

The Settling Basin consists of 3 inlet gate shafts at the junction of each approach tunnel and with respective settling basin and 3 outlet gate shafts at the junction of each connecting tunnel. The gate shafts open on the top at the invert of inspection tunnel to the crown of the transition section of the settling basin. Each gate shafts consists one gate for control of water at the settling basin along with complete set of hoisting system and control mechanism.

The contractor has completed the excavation works of the inlet gate shaft for settling basin-01, 02, and 03. Further, the concreting works at the inlet gate shafts for 01 and 02 has already begun and is being carried out. The outlet gates, which are relatively shorter in length than inlet gates are scheduled for the excavation immediately after the completion of flushing gate shafts. The gate installation shall begin once the fronts are handed over by the Civil Contractor to the Hydro-mechanical Contractor.

Table 2-6: Details of excavation and concreting at inlet/outlet gate shafts of settling basin

S.N	Particulars	Excavation			Concrete works		
		Total depth (m)	Completed (m)	Completed (%)	Total depth (m)	Completed (m)	Completed (%)
1	SB Inlet gate 01	15.8	15.8	100%	26.8	25.3	94%
2	SB Inlet gate 02	15.8	15.8	100%	26.8	25.3	94%
3	SB Inlet gate 03	15.8	15.8	100%	26.8	0.0	0%
4	SB Outlet gate 01	3.5	0.0	0%	24.5	0.0	0%
5	SB Outlet gate 02	3.5	0.0	0%	24.5	0.0	0%
6	SB Outlet gate 03	3.5	0.0	0%	24.5	0.0	0%
	Total	**57.9**	**47.4**	**82%**	**153.9**	**50.6**	**33%**

Figure 2-18: Concreting at Inlet gate shaft 01 (left) and Inlet gate shaft 02 (right)

Figure 2-23: A view of settling basin inlet gate 03 (top view from inspection tunnel 01)

10. SEDIMENT FLUSHING TUNNEL

The excavation of 475 meters long sediment flushing tunnel has already been completed as of February 2023. The Contractor is carrying out full concrete lining at the flushing tunnel section. Till date the invert concreting works has already been completed in 316 meters and the full concrete lining works has been completed in 268 meters out of total 471 meters of flushing tunnel network.

Figure 2-24: A view of full concrete lining at the flushing tunnel

Table 2-7: Details of concreting works at the flushing tunnel

S. N	Particulars	Total (m)	Invert Lining		Full Lining	
			Completed (m)	Remaining (m)	Completed (m)	Remaining (m)
1	Main flushing tunnel (2.4m x 2.9m)	316.0	316.0	0.0	316.0	0.0
2	Flushing branch 1 (2.4m x 2.4m)	30.8	30.8	0.0	30.8	0.0
3	Flushing branch 2 (2.4m x 2.4m)	28.7	0.0	28.7	0.0	28.7
4	Flushing branch 3 (2.4m x 2.4m)	30.8	30.8	0.0	30.8	0.0
5	Flushing branch 4 (2.4m x 2.4m)	28.7	28.7	0.0	0.0	28.7
6	Flushing branch 5 (2.4m x 2.4m)	35.6	15.5	20.1	0.0	35.6
	Total	**470.6**	**421.8**	**48.8**	**377.6**	**93**
			90%		**80%**	

11. FLUSHING GATE SHAFT

Figure 2-25: Breakthrough of flushing tunnel 04

A large network of flushing tunnel and shaft works as a structure to divert the sediments trapped in each settling basin back to the river. Fiver number of flushing gate shafts which are each about 25 meters high opens from inspection tunnel all the way to the flushing tunnel that lies below the settling basin level. Each gate shafts will consist of operating and hoisting platform at the inspection tunnel and gates at the settling

basin outlet region. During flushing, the gates will open and the sediments shall flush from the flushing tunnel network location below the settling basin level, all the way to flushing culver which opens back to the river near the HRT adit portal region.

The successful breakthrough of the flushing gate shafts 01 'A' and 02 'A' were achieved on August 03 and August 04 respectively. Presently, the excavation along with support works of flushing gate shafts 01 'B' and 02 'B' is being carried out and are expected to be completed by the first week of October 2023. The excavation of Flushing gate shaft 03 has also begun. Out of total 121 meters stretch of 5 vertical gate shafts, approximately 89.5 meters have already been excavated.

S.N.	Particulars	Total depth (m)	Excavated depth (m)	Remaining (m)	Completed (%)	Status
1	Flushing Shaft 01 'A'	24.5	24.5	0.0	100%	Breakthrough
2	Flushing Shaft 01 'B'	25.0	25.0	0.0	100%	Breakthrough
3	Flushing Shaft 02 'A'	24.0	24.0	0.0	100%	Breakthrough
4	Flushing Shaft 02 'B'	24.3	24.3	0.0	100%	Breakthrough
5	Flushing Shaft 03	23.5	17.5	6.0	74%	Ongoing
	Total	**121.3**	**115.3**	**6.0**	**95%**	

Figure 2-26: Excavation of flushing tunnel 03 in progress

12. SURGE SHAFT

The Project consists of almost 80 meters high vertical tunnel with design diameter of 16.4 meters. It is one of the most crucial hydraulic structure of the Project which required high skill and precision for the construction. The excavation of the shaft was successfully completed as of June 2022 along with the application of temporary rock supports. Further, the concreting works for the shaft was finalized as of January 31, 2023, along its depth of approximately 80 meters. In addition, the full concrete lining works for the connecting tunnel that links the Headrace Tunnel (HRT) to the Surge shaft has also been completed as of July 2023.

13. VENTILATION TUNNEL

The excavation of ventilation tunnel of 199.7 m has been completed in the month of March 2020. The ventilation tunnel opens at the crown level of the surge shaft and is located about 80 meters above the HRT invert at the point. About 50-75 mm thick shotcrete and rock bolt have been installed in all sections of ventilation tunnel as supports. The steel ribs have been installed as per site conditions. This tunnel is very crucial for the overall operation of the underground surge shaft and will act as an access tunnel to monitor the level of water at the Surge Shaft and future maintenance region.

Figure 2-27: A view of full lining concrete at connecting tunnel of Surge Shaft

Figure 2-28: Full concrete lining at the junction of connecting tunnel and HRT

2.2.3 POWERHOUSE AND PENSTOCK ALIGNMENT

To carry out excavation and concreting works at the Powerhouse area, the main civil contractor, 1st Hydro, employed Nepali workers through a Nepali sub-contractor company. The progress achieved up to the present date includes the completion of concreting works at various significant structures within the Powerhouse area, such as the powerhouse main building, manifold block, and the tailrace section, including all embedded concreting elements.

Furthermore, the concreting for the ground floor of the auxiliary powerhouse (control bay), has also been successfully completed. Additionally, ongoing concreting works are taking place at the anchor block 01 and valve house.

2.2.3.1 PENSTOCK, ANCHOR BLOCKS AND SADDLE SUPPORT

The concreting works in the manifold region, including the necessary backfilling, have been successfully completed, marking a significant milestone of the project. Further, all the associated penstock slope stabilization works using geo-synthetic composite has been completed on the inclined section of the penstock. The concrete works at the saddle supports and the penstock foundation at this inclined section has also been completed along with the penstock installation works inside the HRT. The project is now focusing on the concreting works for the anchor block 01 and the valve house located just outside of the HRT outlet, and this work is progressing rapidly.

As of the current date, a substantial amount of concrete, exceeding 6,500.00 m^3, has already been poured in the anchor block, saddle supports and manifold region. This concrete pouring is being conducted simultaneously with the laying of the penstock pipes by hydro-mechanical contractor.

2.2.3.2 POWERHOUSE AND CONTROL BAY

The construction of the main powerhouse building, as well as the ground floor of the auxiliary powerhouse building (control bay), has been successfully completed. Currently, the construction of the first floor of the control bay has already begun with the installation of metal posts and fabrication of truss structure.

A significant volume of concrete, approximately 9,920.30 m^3, has been poured in the powerhouse and control bay building. The concrete works for the generator casing of all four units have already been completed. Additionally, various finishing works have been accomplished, including the completion of the roofing on the powerhouse, cladding on the side walls, and the installation of doors and windows. Currently the painting work in the interior walls of the powerhouse is being carried out.

2.2.3.3 VALVEHOUSE

The valve house, where the penstock protection valve (PPV) rests, is located just outside the HRT outlet portal. The construction of the valve house building has already commenced. The construction of the base slab has been completed and currently, the construction of the beam and columns of the super structure is being carried out.

2.2.3.4 TAILRACE CHAMBER, TAILRACE FLOODWALL AND TAILRACE CULVERT

The tailrace section of the project comprises the tailrace chamber, tailrace culvert, and tailrace floodwall. The construction of the tailrace floodwall was successfully completed in February 2021, providing an important component for managing floodwater.

Additionally, the construction of the tailrace chamber and tailrace culvert has been completed as of November 2022, signifying another crucial step in the project's progress. Approximately 3,374 m^3 of concrete has been poured in the tailrace section.

2.2.3.5 SWITCHYARD

The main civil works contractor has successfully completed the civil works for the switchyard region along with the backfilling works, construction of retaining walls and transformer foundation. In addition, the electro-mechanical contractor has already carried out the erection works of various electro-mechanical works at the switchyard region. The installation of towers parts, and other accessories of the switchyard has also commenced from the last week of September and is expected to be completed by November.

Table 2-8: Progress of concreting at Powerhouse and tailrace culvert

Structure	Total concrete volume (m^3)	Completed Volume (m^3)	% Complete
Powerhouse and control bay	11,552.61	9,920.30	86%
Tailrace chamber, culvert & floodwall	3,374.37	3,374.37	100%
Penstock, anchor block and Manifold block	9,776.56	6,500.00	66%

Overall, the construction works of main powerhouse building is in the final stage of construction whereas the progress is about 66% along the penstock alignment.

Figure 2-29: Aerial view of powerhouse and swtichyard region

Figure 2-30: A view of the construction works of transformer foundation at switchyard region

Figure 2-31: A view of switchyard

Figure 2-32: A view of penstock alignment, switchyard and powerhouse

Figure 2-33: A view of powerhouse building

Figure 2-34: Construction of valve house

Figure 2-35: Interior view of powerhouse main building

Figure 2-36: Interior view of powerhouse auxiliary building (control bay)

2.3 HYDRO-MECHANICAL WORKS

The Hydro-mechanical (HM) works contract was awarded to Machhapuchhre Metal and Machinery Works (P) Ltd, and these works commenced in August 2019, starting from the headworks of the construction area. A summary of the progress made in various components of the HM works:

1. Fabrication works:
   - Fabrication of steel pipes at headworks (approach pipes) and powerhouse (penstock pipes, bifurcation and branch pipes) has been completed
   - HM Contractor carrying out fabrication of various gates and stop logs at their workshop
2. Undersluice:
   - Completion of all associated steel lining works
   - Embedded parts of Undersluice section (all complete)
   - Erection of both the radial gates and hoisting mechanisms completed
3. Intake:
   - Completion of all associated steel lining works
   - Embedded parts of Intake and trash racks section (all complete)
   - Erection of all 6 vertical gates along with the hoisting
   - Erection of all 6 trash racks completed at the Intake
   - Embedded parts of Intake gate hoisting, Trash rack Cleaning Machine (TRCM), and railing at the top slab of the intake completed
4. Headworks other fronts:
   - Trash rack frames erected at the conveyance tank
   - Steel lining completed on all work fronts
5. Approach Pipes:
   - Installation completed up to inlet portal bend at the headworks area
   - 71 out of 96 approach pipes already erected, covering the expansion joint at the conveyance tank up to the anchor block
6. Penstock Pipes:
   - Erection continuing along the penstock alignment slope
   - All penstock pipes installed with varying thicknesses (32mm, 30mm, 28mm, 25mm, 20mm, 18 mm and 16mm) throughout the penstock alignment
7. Bifurcation Units:
   - Installation completed for all three bifurcation units, including associated reducers, bends, and branch pipes
8. Manifold and Diffusers:
   - Concreting of the manifold region completed as the area was handed over from the HM Contractor to the main Civil Contractor
   - Installation of all pipes at the manifold is completed
   - Fabrication and installation completed for all four-unit diffusers

This update highlights substantial progress in the HM works and the achievement of key milestones across various sections of the project.

2.3.1 STEEL LINING

The steel lining works have been completed at Intake, undersluice, bed load sluice, and gravel flushing gate section. With this, the steel lining works have been completed at all associated work fronts.

2.3.2 HM WORKS AT GATES AND STOP LOGS

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

Table 2-9: Detail of work progress of gates and stop logs

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	All Complete	All Complete	The gate frame is completed along with hoisting work.
**2	Intake Gates	All Complete	All Complete	All Complete	All Complete	Erection of 6 out of 6 gates have been
**3	Bedload sluice gates	All Complete	All Complete	All Complete	All Complete	Erection of 5 out of 5 gates have been completed
4	Fish Passage Gate	All Complete	All Complete	Ongoing		
5	Trash Passage Gate	All Complete	All Complete	Ongoing		
**6	Gravel Flushing Gates	All Complete	Ongoing	Complete		Work ongoing in accordance with the main civil contractor work schedule
7	Setting Basin Inlet gates	Ongoing	Ongoing	Ongoing		Concreting works is ongoing along with installation of embedded parts
8	Settling Basin Flushing Gates	Ongoing	Ongoing	Ongoing		
9	Adit Bulk Head Gates	Ongoing	Ongoing	Ongoing		
10	Draft Tube Gates	All Complete	All Complete	All Complete	All Complete	
Stoplogs						
**1	Undersluice Stop logs	All Complete	All Complete	All Complete		Preparation work has been ongoing.
**2	Bedload sluice Stop logs	All Complete	All Complete	All Complete	Completed	Erection of 5 out of 5 gates have been completed
3	Trash Passage Stop logs	All Complete	All Complete	Ongoing		
4	Gravel Flushing Stop logs	All Complete	All Complete	Ongoing		
5	Settling Basin Flushing Stop logs	Ongoing	Ongoing	Ongoing		
6	Tailrace Stop logs	All Complete	All Complete	All Complete		

2.3.3 TRASH RACKS

Table 2-10: Detail of work progress of trash rack

S.N.	Description	Work status		Remarks
		Embedded Parts	Main Body	
1	Intake Trash rack	Completed on all 6 units	Completed on all 6 units	
2	Bedload sluice Trash rack	All Complete	All Complete	
3	Conveyance Tank Trash rack	All Complete	All Complete	
4	Settling Basin outlet Trash rack	Pending		

Figure 2-37: Installation of trash rack at the conveyance tank region

2.3.4 STEEL PIPES AND OTHERS

HEADRACE STRAIGHT PIPELINE

Internal Diameter: 4.5 m
Thickness: 16 mm

Table 2-11: Detail of work progress of Headrace Pipe

Straight Pipes	Up to previous month	This Month
Cutting	96	X
Rolling	96	X

Straight Pipes	Up to previous month	This Month
Fitting	96	X
Welding	96	X
Inspection	96	X
Blasting	96	X
Painting	96	X
Erection	71	X

In overall, complete erection of 71 numbers of pipes have been completed from downstream section and from upstream section.

HEADRACE BENDS

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

Table 2-12: 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	√	√	√
Erection	√	√	√

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.
Erection of all three bends have been completed and the welding works has been ongoing.

Figure 2-38: Installation of head race bend at the approach pipe section

PENSTOCK PIPES

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

The Hydro-mechanical (HM) Contractor has made significant progress in the erection of penstock pipes with various thicknesses at the penstock alignment. Here's a breakdown of the completed pipe installations:

A. Manifold Section
- All associated pipes have been erected and encased with concrete (manifold block)

B. Penstock pipes in the inclined Section
- 32mm Thickness: 6 pipes (Completed)
- 30mm Thickness: 7 pipes (Completed)
- 28mm Thickness: 8 pipes (Completed)
- 25mm Thickness: 9 pipes (Completed)
- 22mm Thickness: 6 pipes (Completed)
- 20mm Thickness: 11 pipes (Completed)
- 18mm Thickness: 7 pipes (Completed)

C. Penstock pipes inside HRT
- 16mm Thickness: 40 pipes (Completed)
- 16mm Thickness bend: 2 pipes (Completed)

In total, the HM Contractor has successfully erected all penstock pipes covering a range of thicknesses from 32mm down to 18mm at the inclined section of the Penstock. The HM Contractor completed the installation of transition pipe (bell mouth) at the HRT outlet region on August 24, 2023. The bell mouth acts as a transition of waterway form Inverted-D to circular shape. The installation of penstock pipes located inside HRT has begun and is targeted to be completed within October last week. This achievement marks a significant milestone in the installation of the penstock pipes.

Table 2-13: Detail of work progress of Penstock Pipes and other pipes at the penstock alignment

S.N.	Particulars		Number of pipes	Length of each shell (m)	Total Length of section (m)	No. of pipes installed	Progress in meters	Progress %	Status
	Diameter (m)	Thickness (mm)							
A	**Penstock inside tunnel**								
1	4.5	16 mm pipe	40	2.5	100	**40**	**100**	100%	Completed
2	4.5	16 mm pipe (Bend)	2	2.5	5	**2**	**5**	100%	Completed
		Total	**42**		**105**	**42**	**105**	**100%**	
B	**Anchor block 01**								
1	4.5	18 mm pipe	7	2.5	17.5	**7**	**17.5**	100%	Completed
2	4.5	20 mm pipe	11	2.5	27.5	**11**	**27.5**	100%	Completed
3	4.5	22 mm pipe	6	2.5	15	**6**	**15**	100%	Completed
4	4.5	Cut piece	1	1.25	1.25	**1**	**1.25**	100%	Completed
		25 mm pipe	9	2.5	22.5	**9**	**22.5**	100%	Completed
5	4.5	28 mm pipe	8	2.5	20	**8**	**20**	100%	Completed
6	4.5	30 mm pipe	7	2.5	17.5	**7**	**17.5**	100%	Completed
7	4.5	32 mm pipe	6	2.5	15	**6**	**15**	100%	Completed
9	4.5	36 mm pipe (Bend)						100%	Completed
		Total	**55**		**136.25**	**55**	**136.25**	**100%**	
C	**Wyee (Bifurcation)**								
1	4.5 to 2.25 and 3.90	Wyee -1 (36 mm)	100% Completed						
2	3.90 to 2.25 and 3.18	Wyee -2 (30 mm)							
3	3.18 to 2.25 and 2.25	Wyee -3 (25 mm)							
D	**Manifold block**								
1	3.9	30 mm pipe	1	2.5	2.5	**1**	**2.5**	100%	Completed
		30 mm cut piece	1	2.47	2.47	**1**	**2.47**	100%	Completed
2	3.18	25 mm pipe	1	2.5	2.5	**1**	**2.5**	100%	Completed
		25 mm cut piece	1	1.76	1.76	**1**	**1.76**	100%	Completed
3	2.25	20 mm pipe	16	2.5	40	**16**	**40**	100%	Completed
4	2.00	20 mm pipe	22	2.5	53.18	**21**	**52.5**	99%	1 piece remaining
5	2.25 to 2.00	20 mm pipe (Reducer)	4					100%	Completed
		Total	**46**		**102.41**	**41**	**101.73**	**99%**	

Figure 2-39: Erection of penstock pipes

Figure 2-40: Top view of penstock alignment and the powerhouse region

Figure 2-41: Installation of pwnstock pipes inside HRT from outlet region

Figure 2-42: Installation of transition pipe at the plug block 01 region

REDUCERS

Internal Diameter: 2.25 m to 2.00 m
Thickness: 20 mm
Table 2-14: 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 unit's 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 2-15: Detail of work progress of Branch Pipes

Branch Pipes	Up to previous month
Cutting	29
Rolling	29
Fitting	29
Welding	29
Inspection	29
Blasting	29
Painting	29
Transportation	29
Erection	28

The erection of all associated branch pipes of penstock manifold have been completed on all 4 units. The final welding of final cut piece at unit 04 with diameter 2.25 m and thickness 20 mm is going on accordingly with the final welding of bifurcation unit 01.

BRANCH BENDS

Internal Diameter: 2.25 m
Thickness: 20 mm
The fabrication of reducer has been completed. The erection of branch bends on all has been completed.
Table 2-16: 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	√	√	√	√

Erection of all branch bends has been completed.

BIFURCATIONS

Table 2-17: 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

The erection of bifurcation Units 2 and 3 has been completed. Similarly, the erection of bifurcation Unit 1 has been completed and the final welding works are nearing completion.

Table 2-18: Detail of work progress of Bifurcation

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

2.3.5 DIFFUSER

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

Note: The erection of all four unit diffusers has been completed on all the units at powerhouse location.

Table 2-19: Detail of work progress of Diffuser

Description	Unit 1	Unit 2	Unit 3	Unit 4
Cutting	√	√	√	√
Fabrication	√	√	√	√
Welding	√	√	√	√

Description	Unit 1	Unit 2	Unit 3	Unit 4
Inspection	√	√	√	√
Painting	√	√	√	√
Transportation	√	√	√	√
Erection	√	√	√	√

2.3.6 ADDITIONAL WORKS

In addition to the previously mentioned progress, a significant advancement has been made by adding flushing pipes at the weir section. Each flushing pipe unit has a length of 15.76 meters, and there are a total of 2 units of these weir flushing pipes. Both the fabrication and erection of these flushing pipes have been successfully completed.

As a comprehensive summary, the overall physical progress achieved in the hydro-mechanical works of the project is approximately 86%. This signifies substantial progress in various aspects of the hydro-mechanical components, highlighting the effective coordination and efforts of the project team and contractors involved. The completion of key milestones, such as manifold, approach pipes, radial gates, intake gates, further demonstrates the project's steady progression towards its completion.

Figure 2-43: Erection of radial gate at unders luice

2.4 ELECTRO-MECHANICAL WORKS

The Electro-Mechanical (EM) works for the MTHP are being carried out by Chongqing Water Turbine Works Co. Ltd. (CWTW) from China. Their responsibilities span the entire electro-mechanical aspect, encompassing the design, fabrication, assembly, supply, and installation of all relevant components from the end of the penstock to the pickup gantry of the 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).

CWTW has completed all associated fabrication works. This incorporates the design, fabrication, and testing of vital equipment like generator sets, runners, and shafts. To date, around 90% of the equipment has already been delivered, featuring turbine parts, generator components, control panels, cables, Electric Overhead Travel (EOT) crane and accessories, switchyard equipment and PPV accessories, and more.

Regarding the delivery of the EM equipment, the 13th shipment consisting crucial components like the Positive Pressure Ventilation (PPV) valve and communication system have been dispatched from the factory.

S.N.	Particulars	Overall Progress till date	Status	Remarks
A	**Overall Electro-mechanical Works**	**90%**	In Progress	
1	Contract signing	100%	Completed	a. Contract awarded on 23rd December 2019 b. Design works completed
2	Fabrication of equipment	100%	Completed	a. Major equipment Generator/Turbine/Transformer/MIV completed b. Overall completed
3	Import/Delivery	90%	In Progress	a. All Generator/Turbine including its accessories delivered to site b. The 13th shipment containing PPV and communication system is being delivered to the Project site c. 90% completed
4	Installation	85%	In Progress	a. 3 units of machine installation has been completed b. Unit 04 machine installation is in final stage c. Panel shifting has been completed inside control room d. Cable laying has been commenced

Figure 2-44: Electro-mechanical work progress summary

The mobilization of manpower and resources for installation works of Electro-mechanical equipment commenced officially on February 09, 2021. The setup work for the camp and warehouse has been successfully completed, and the installation process is well underway. Due to COVID-19's impact, the EM Contractor, being a Chinese company, encountered challenges in mobilizing their national workers at the site. To address this, they engaged a Nepali subcontractor, JADE, who smoothly carried out installation works for various parts. The project team has now overcome these hurdles by mobilizing its project manager and technical experts, mostly mechanical and electrical engineers. This initiative has significantly facilitated the smooth progression of installation works, with approximately 85% of the erection and installation process already accomplished at the site.

These achievements highlight the remarkable progress made in the EM works, showcasing the resilience, adaptability, and collaborative efforts of the project team and contractors, despite the pandemic's disruptions. To date, the overall progress achieved by the Project in EM works is approximately 90%.

2.4.1 MANUFACTURING WORKS

The majority of the manufacturing works for the Electro-Mechanical equipment have been successfully completed at various factories in China. Of particular significance, all turbine sets, including spare runners, have been manufactured, delivered to the site and are currently in the active process of installation.

Similarly, the generator sets have undergone manufacturing and testing processes and are delivered to the site for installation activities. Here's a brief overview of the manufacturing progress for key components:

- **Turbine** - 100% completed, delivered and installation (ongoing)
- **Generator** - 100% completed, delivered and installation (ongoing)
- **Governor** - 100% completed, delivered and installation (ongoing)
- **Excitation system** - 100% completed, delivered and installation (ongoing)
- **Switchyard equipment including transformer and steel structures** - 100% completed, delivered and installation (ongoing)
- **PPV valve** - 100% completed, delivery (ongoing)
- **MIV valve** - 100% completed, delivered and installed (completed)
- **Control panels** - 100% completed, delivered and installation (ongoing)
- **Control and protection system** - 100% completed, delivered and installation (ongoing)
- **Cables** - 100% completed, delivered and installation (ongoing)

In conclusion, all required Electro-Mechanical equipment have been manufactured. Whist the majority of the EM equipment have been successfully delivered, the transformers and the PPV valve are on the process of being delivered to the project site.

A few photographs showing the manufacturing progress are listed below:

Figure 2-45: Fire fighting valve getting ready for testing

Figure 2-46: DC panels are ready to be dispatched at CWTW factory, China

Figure 2-47: PPV hydraulic system ready for dispatch

Figure 2-48: PPV disc being welded

Figure 2-49: PPV swing body being machined

2.4.2 INSTALLATION WORKS

The Electro-Mechanical installation works are ongoing at a rapid pace after the completion of the powerhouse by the Civil Contractor. The installation of embedded parts and pipes for the turbine and generator has been aligned with the civil work, serving as the foundation for further EM activities. Additionally, the EOT crane installation, commissioning, and load testing, a crucial Electro-Mechanical milestone, have been successfully carried out. The final assembly of turbines and generators is ongoing, showcasing the coordinated efforts with the Civil Contractor. The photograph mentioned below shows a brief summary of installation works progress of electro-mechanical works at each units.

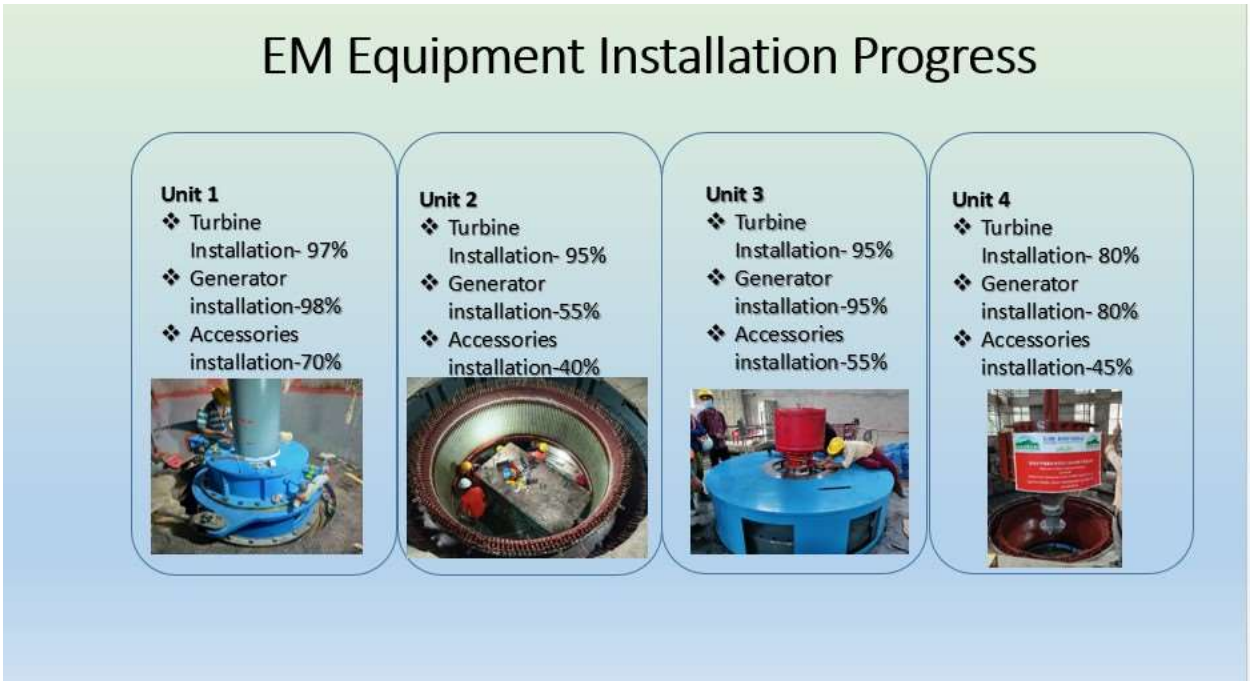


Figure 2-50: Summary of Machine installation

As of now around 85% of installation work has been completed. Few important work front of EM works has been detailed below:

2.4.2.1 EOT CRANE INSTALLATION

Upon the completion of roofing work in Bay 1, the electrical commissioning of the crane was conducted. The crane's functionality was thoroughly tested as it was driven from Bay 1 to Bay 5 at different speed levels, with a careful check of safety measures and connections. An essential step in validating the EOT (Electric Overhead Travel) crane's capabilities involved a successful load test, where a 66-ton dummy load was lifted to verify the crane's load capacity. The progress and details of this significant load test are visually documented in the provided photographs below.

2.4.2.2 UNIT 1

The installation of vital turbine and generator components is progressing rapidly with the final assembly of the bottom ring, guide vane, head cover, lower guide bearing and the upper bracket. Additionally, the assembly of the split stator and rotor for the generator has been fully accomplished, representing a significant achievement. Ensuring the integrity of the electrical components, the high voltage testing of the installed stator coils and rotor has been successfully carried out. The summary of works carried out is mentioned below,

- Installation of thrust and upper guide bearing of upper bracket
- Installation of lower guide bearing bush
- Coupling of runner and rotor shaft
- Run-out and alignment check of shaft
- Pressure test of upper bracket bearing oil cooler
- Installation of water distribution system is on going

Figure 54: Final installation of excitation system

Figure 2-51: Installation of temperature and resistance measuring sensors at thurst bearing

Figure 2-52: Rotor and stator coupling in unit 01

Figure 2-53: Final installation of water guide mechanism along with monitoring sensors

2.4.2.3 UNIT 2

The final assembly of critical components, including the bottom ring, guide vane, main shaft with the runner, head cover, and air cooler, has been successfully completed. Concurrently, the lower bracket, split stator parts, and upper bracket have been carefully lowered and preassembled. The stator coil shipment containing coils and other winding materials is dispatched from the country of origin and the stator winding works will start soon once the shipment is received at site. This month pressure test of upper bracket bearing oil cooler is carried out. Attached below are a few photographs that aptly showcase the ongoing progress achieved in the project.

Figure 2-54: High voltage AC test of stator coils

Figure 2-55: Final assembly and lowering of runner with main shaft in unit 2

2.4.2.4 UNIT 3

The final installation of the turbine and generator has been successfully completed by mounting excitation system, the last component starting from bottom to vertically upwards. This complex process was carried out precisely, ensuring the GBT standards of machine safety and efficiency. The installation was conducted in several sequential phases, with each step tested and validated before proceeding to the next.

The installation process includes the following critical steps:

1. **High Voltage Tests:** Both the stator and rotor of the generator underwent high voltage tests as per GBT standard to verify their electrical insulation and safety. These tests ensure the generator's capability to withstand the high electrical loads efficiently.

2. **Kerosene Leakage Tests:** The turbine guide bearing (TGB) oil tank, Lower guide bearing (LGB) oil tank, combination of upper guide bearing (UGB) and thrust bearing oil tank underwent thorough kerosene leakage tests to ensure that these crucial components are free from any potential leaks.

3. **Pressure Tests:** The rotor braking mechanism and the cooling system of the LGB and UGB went through comprehensive pressure test to guarantee their reliability during operation. Ensuring that these systems can withstand the required pressures is vital for overall system safety.The installation has now reached its final stage, where we are adding the finishing touches:

4. **Accessories Mounting:** Various sensors and instruments are being mounted to the turbine and generator to monitor and control their performance. These accessories play a crucial role in ensuring the efficient and safe operation of the system.

5. **Power and Control Cables:** The power and control cables are being carefully laid and connected to the generator and associated control systems. This step is pivotal for the proper functioning of the entire setup. Few photographs of the work progress are shown below:

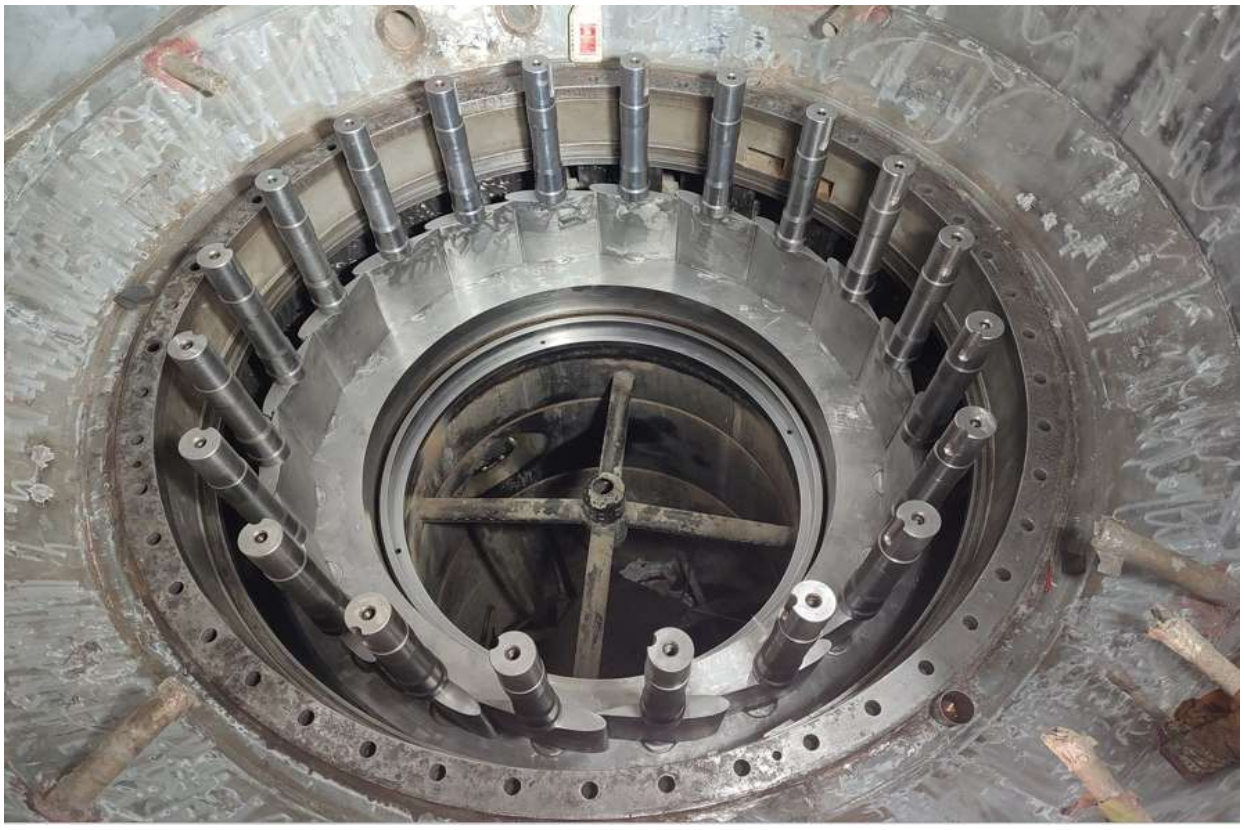


Figure 2-56: Final assembly of bottom ring and guide vane

Figure 2-57: Pressure test of upper bracket bearings oil cooler

Figure 2-58: Different stages of thrust bearing installation

Figure 2-59: Final installation of turbine guide bearing and water regulating mechanism

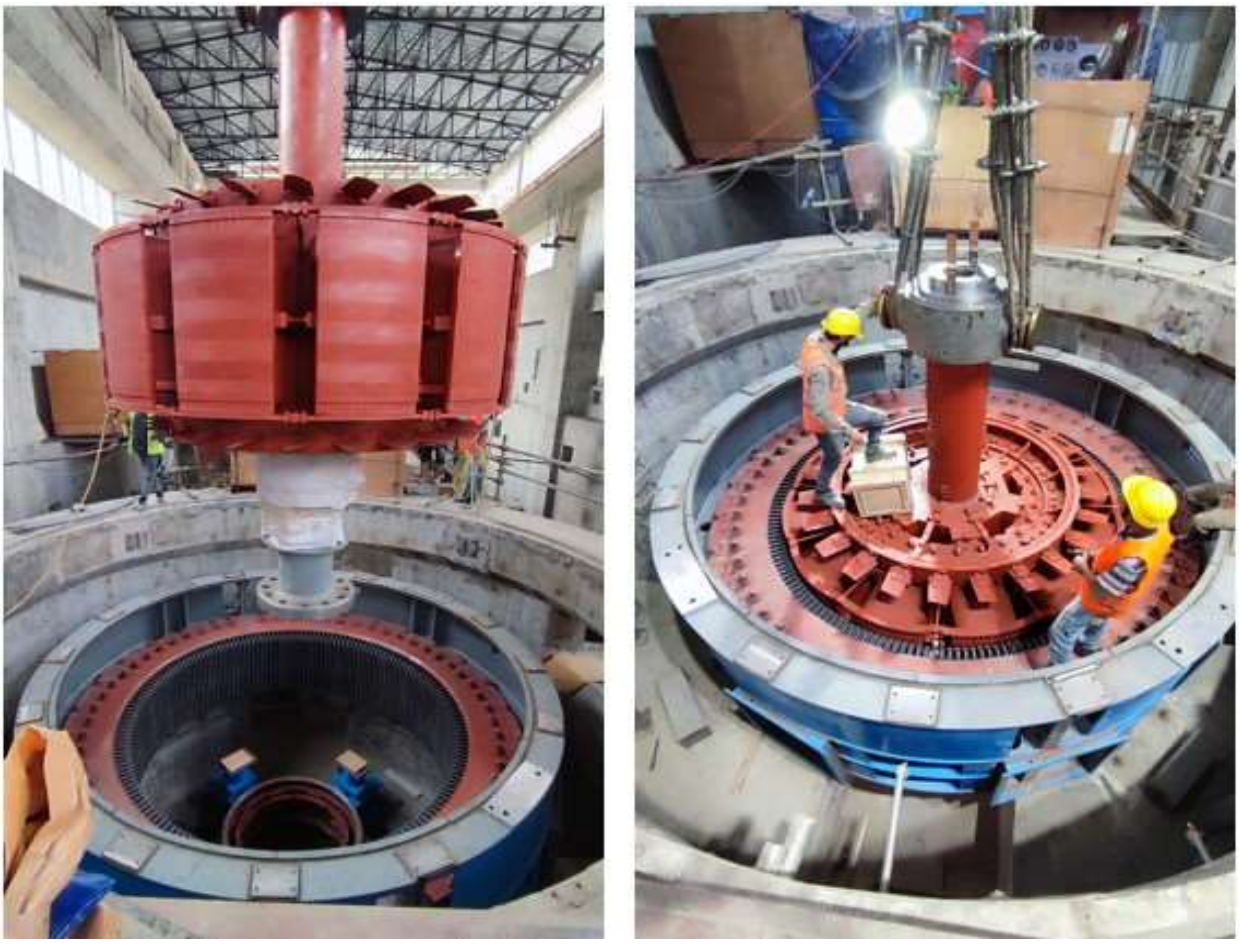


Figure 2-60: Rotor lowering in unit 3

Figure 2-61: Assembly of runner with main shaft

2.4.2.5 UNIT 4

The final assembly of turbine and generator components, which involved lowering the bottom ring, guide vane, head cover, and split stator has been successfully completed, along with the winding and high voltage test of stator and rotor. The current works are axis alignment of rotating part and accessories mounting. Included herewith are a few photographs below that visually depict the noteworthy progress made in the project.

Figure 2-62: Rotor lowering of unit 04

Figure 2-63: Run-out check of shaft

Figure 2-64: Final assembly of bottom ring, guide vane, head cover and main shaft with runner

2.4.2.6 MAIN INLET VALVE

The delivery of all four units of the Main Inlet Valve (MIV) has been accomplished, and these units have been successfully positioned at the site. As of the present date, the downstream side welding for units 1 and 2 has been successfully completed. Meanwhile, welding works in Unit 3 and Unit 4 are ongoing at the downstream side, along with the erection and welding of the cut piece joining the Main Inlet Valve and

Penstock of Unit 1, Unit 2, and Unit 3 at the upstream side. Attached herewith are a selection of photographs, illustrating various stages of the Main Inlet Valve assembly process.

Figure 2-65: Unit 01 bypass valve work

Figure 2-66: Unit 02 bypass valve assembly and erection

Figure 2-67: Unit 03 preparation for bypass valve erection

Figure 2-68: MIV assembled at service bay

2.4.2.7 Equipment installation and cable laying in powerhouse and control room

The installation of all the embedded parts, pipes, ventilation fans, control panels, cable support bracket and auxiliary transformer of the control room have been completed and now the laying of power and control cables are ongoing.

Figure 2-69: Installation of control panels

Figure 2-70: Laying of power cables in 11KV switch gear room

Figure 2-71: Laying of power and control cables in main powerhouse

Figure 2-72: Cable tray work under the floor slab of turbine floor

2.4.2.8 SWITCHYARD

Laying of earthing flats, embedded parts and pipes simultaneously completed with the Main Civil works. The installation of Electro-mechanical components at the switchyard region was commenced from September 26, 2023. Erection of gantry tower and other equipment posts are ongoing. Few photographs of the work progress are shown below.

Figure 2-73: Erection of gantry tower and other supporting posts

Figure 2-74: Erection of gantry towers at switchyard

2.5 TRANSMISSION LINE WORKS

A contract was signed with Cosmic Electrical Engineering Associates Private Limited on June 07, 2020, for the comprehensive completion of a 9 km long, 220 kV D/C transmission line. This transmission line consists of 24 towers and originates from the switchyard of the Middle Tamor Hydropower Project, aiming to establish a connection with the interconnecting bay of the Dhunge-Sanghu sub-station in Taplejung, a project being constructed by NEA.

The progress thus far has been substantial, encompassing check surveys, soil investigations, design, procurement of tower components, construction of tower foundations, and the erection of towers. All essential materials, including tower parts, insulators, accessories, and conductors, have been imported and are securely stored on-site. Additionally, the required construction license has been duly obtained, and the process of land acquisition for all 24 tower angle points (APs) have been completed.

Regarding the overall progress of the transmission line, significant milestones have been achieved, with foundation concreting and stub erection completed at 22 locations and ongoing at remaining 2 locations, accounting for approximately 94% of the total foundation works. Likewise, tower erection has been accomplished at 22 sites and ongoing at remaining 2 locations, approximately equivalent to 94% of the total erection works. The current focus of the Contractor centers on the stringing works for the transmission line conductor, following initial right-of-way clearance. Substantial progress has already been made with the stringing process completed from AP24 to AP18 and from AP13 to AP06. As of this date, the Contractor has completed more than 6 km of conductor stringing out of 9 km.

As per the Connection agreement, power generated from Middle Tamor Hydropower Project has to be evacuated at Dhungesanghu substation. Currently 132 kV system at Dhungesanghu sub-station is near completion, however it has to be upgraded to a 220 kV system, whose construction is yet to be started. Hence, the power generated from Middle Tamor Hydropower Project seems impossible to be connected at Dhungesanghu sub-station. This concern was raised during various meetings of the coordination committee with NEA, where it has been proposed to establish a contingency arrangement until 220 kV system is built at Dhungesanghu sub-station. This alternative evacuation arrangement involves the stringing of the second circuit from the Dhungesanghu substation to the Basantapur substation and an interconnection bay at Basantapur sub-station. This circuit will operate at 220 kV and will be exclusively dedicated to the Middle Tamor Hydropower Project for power evacuation to 220 kV bay at Basantapur sub-station. The Contract for stringing of the second circuit and the construction of the bay has already been awarded by NEA to Nepal Hydro and Electric Limited (NHE). The required manpower and equipment have already been deployed to the site by the Contractor and the construction of the bay has already begun.

The power evacuation of the Middle Tamor Hydropower Project (MTHP) entirely depends on the completion of the above mentioned contingency arrangement and NEA has informed Sanima Middle Tamor Hydropower Ltd. that the alternative arrangement is anticipated to be completed by February 27, 2023. In that case, it is evident that the contingency arrangement will not be in place before the current Required Commercial Operation Date (RCOD) of MTHP. Therefore, the RCOD of the Project will be aligned with the completion of the aforementioned contingency evacuation arrangement of 220 kV transmission line from the Basantapur to Dhungesanghu Substation.

The transmission line route map is shown in figure below.

Figure 2-75: Transmission line route map

2.5.1 CONSTRUCTION WORKS

The Contractor has successfully finalized the foundation works and tower erection for 22 tower locations. The foundation construction works are going on at the AP17 and AP01. The current status of the transmission line project progress is detailed in the provided table. Additionally, the Contractor has accomplished the stringing works from AP24 to AP18 and from AP13 to AP06, resulting in approximately 6 kilometers of the conductor being strung, constituting about 42% completion of the total stringing work. This progress signifies a substantial step forward in the execution of the transmission line project.

Table 2-20: Summary of Transmission Line works progress

S.N.	Description	Total	Unit	Completed	% Completed
1	Land Procurement works	24	Nos	24	100%
2	Foundation Works	24	Nos	22	94%
3	Tower Erection Works	24	Nos	22	94%
4	Stringing Works	9	Km	6	67%

Overall, the construction progress of the Transmission line works is about 93% and is in line with our revised commercial operation date.

Figure 2-76: Photographs showing stringing works

Figure 2-77: A view of stringing works

Figure 2-78: Conductor stringing works at various angle points

Figure 2-79: Erected last tower at AP24 and tower of NEA (left)

2.6 FINANCIAL PROGRESS TO DATE

The total revised cost of the Middle Tamor Hydropower Project is estimated to be NPR 13,330,000,000 (In words - NPR Thirteen Billion Three Hundred Thirty Million only). Within this project cost, the equity portion amounts to NPR 3,332,500,000, while the necessary debt is NPR 9,997,500,000. The promoter's equity share, representing 70% of the total equity (NPR 2,332,750,000), has been fully paid. Additionally, the public equity share, constituting 30% of the total equity or NPR 999,750,000, has also been completely paid, leading to the Company's listing on the Nepal Stock Exchange. The debt portion has been arranged through a consortium of 8 commercial banks, with Nepal Investment Mega Bank Ltd. leading the effort.

Regarding the Contract amount, 77% has been disbursed to the Main Civil Contractor up to the present date against the raised Interim Payment Certificates (IPCs), with a total of 26 IPCs being settled. Likewise, 73% of the Contract amount has been paid to the Hydro-Mechanical Contractor up to IPC 7, covering the design and procurement segment. The Employer has acquired all the necessary steel plates. Furthermore, 91% of the Contract amount has been provided to the Electro-Mechanical Contractor, covering the supply portion's bills for dispatch up to the 12th lot of EM equipment following their receipt on-site, along with an advance paid against the Advance Payment Guarantee (APG). Additionally, about 98% of the total Contract amount has been issued to the Transmission Line (TL) Contractor, encompassing bills up to IPC#08, which also incorporates all additional variations and advance payments.

Table 2-21: Financial Progress of Major Contract Packages Till Date

Major Contract Packages	Expense till date (%)	Remaining Budget (%)
Main Civil Works	**77%**	23%
Hydro-Mechanical Works	**73%**	27%
Electro-Mechanical Works	**91%**	9%
Transmission Line Works	**98%**	2%

The total financial expenditure of the overall Project till date is about **82%** out of the total project cost of NPR. 13,330,000,000.

Particulars	% Expense till date	% Remaining Budget
Financial Progress of MTHP	**82%**	18%

In summary, the financial progress is compatible with the physical progress achieved by the project to date. However, the project budget may exceed, if the project is not completed within the planned construction period and the extended RCOD.

3 OCCUPATIONAL HEALTH SAFETY AND ENVIRONMENT (OHSE)

3.1 SAFETY PROTOCOLS AT THE PROJECT

A comprehensive safety protocol has been developed and put into action at the Project site to mitigate various risks and hazards. The Employer takes the health and safety of all employees seriously, providing suitable and necessary Personal Protective Equipment (PPE) on a daily basis. A dedicated healthcare worker is permanently employed to ensure the well-being of employees, along with the establishment of a healthcare facility equipped with sufficient medicines and a first aid kit. Regular health screening is conducted by the Occupational Health, Safety, and Environment (OHSE) team, including temperature checks and general health assessments.

To prevent risks during underground work, Contractor safety personnel continually educate employees about potential hazards associated with drilling and blasting activities in the tunnel, emphasizing adherence to control measures. Periodic safety induction training is conducted for contractors and sub-contractors, and foremen oversee the team's entry and exit from the tunnel. Fire extinguishers are strategically placed in high-temperature work areas, and oxygen levels and lighting are closely monitored in underground work zones. The Employer has facilitated telecom facilities for communication within tunnel structures.

The OSHE team regularly conducts safety drills at the Contractor's camp in the headworks and powerhouse, providing training on proper procedures during natural calamities or hazards. Tool box talks are given to new batches of workers at the construction site, alongside essential safety training. Furthermore, the technical team members are advised to exercise caution when entering hazardous areas, and extra precautions are taken to ensure the safety of visitors. Following safe working practices remains a priority, aiming to minimize possible incidents effectively.

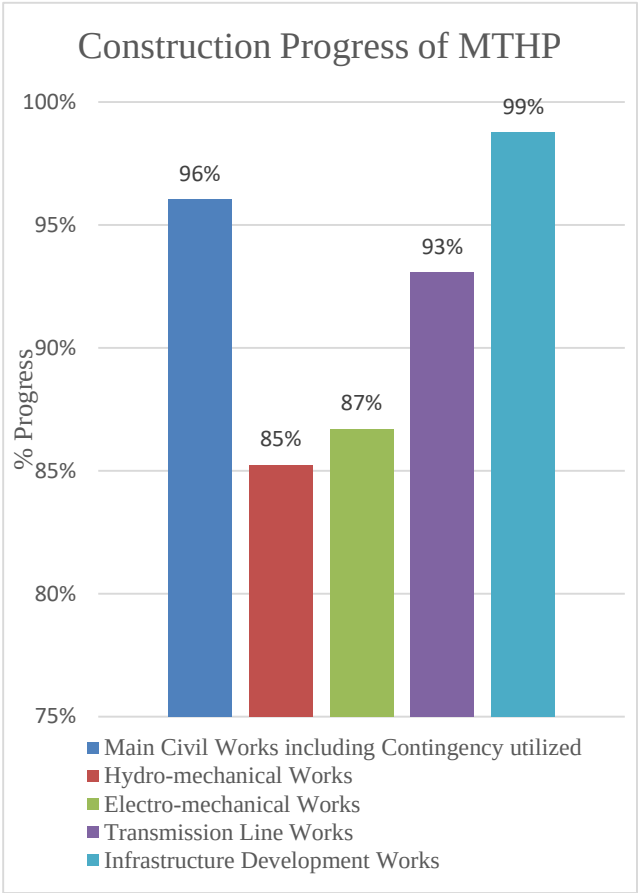
4 CONCLUSION

4.1 PROGRESS SUMMARY

In summary, the Middle Tamor Hydropower Project has made significant progress in various aspects of the construction. The Main Civil works are nearly 96% complete, while the Hydro-mechanical works are around 86% complete. Additionally, the progress in Electro-mechanical works is at 90%, and the Transmission Line works are also at 93%. This demonstrates substantial advancements in multiple key areas of the project, despite the challenges faced, and reflects the dedication and efforts of all involved parties.

Table 4-1: Work progress summary chart

S.N.	Particulars	Construction Progress
1	**Main Civil Works including Contingency utilized**	**96%**
1.1	Headworks	98%
1.2	Underground Works (HRT)	95%
1.3	Underground Works (SB and others)	87%
1.4	Underground Works (Surge Shaft and ventilation)	100%
1.5	Powerhouse, Control bay and Tailrace	98%
1.6	Penstock and anchor block	77%
1.7	General items	100%
2	**Hydro-mechanical Works**	**86%**
3	**Electro-mechanical Works**	**90%**
4	**Transmission Line Works**	**93%**
5	**Infrastructure Development Works**	**99%**
	Overall Physical Progress	**95%**



This progress collectively demonstrates the significant strides made by the Middle Tamor Hydropower Project across multiple essential areas. Despite the challenges posed by various factors, the collaboration among multiple stakeholders, including project management, contractors, and on-site workers, is evident in the substantial progress achieved. Yet the Engineer recognizes that there are specific areas that may require additional attention in critical work fronts to catch up with the required progress such as in settling basin, penstock slope stabilization, excavation of vertical shafts, issues related to clearance of RoW, etc. Special attention has been given to settling basin 03, gate shafts, penstock installation, and smooth supply of construction materials during the monsoon season.

4.2 FUTURE CHALLENGES

Despite the considerable challenges brought about by the pandemic, the Middle Tamor Hydropower Project has achieved approximately **95%** of the construction progress to date. Although the original goals were impacted due to the pandemic, the progress made in these challenging times is satisfactory. The construction faced unexpected geological issues, limitations in cavern excavation due to frequent

overbreaks requiring continuous repairs in challenging sections, and an extended tunnel excavation cycle, all of which affected the pace of work.

In response to various challenges faced by the Project, the Employer has provided additional support to the Contractors, including mobilizing extra equipment such as boomers, batching plants, grouting machines, robotic shotcrete machines, generators, trucks, excavators, loaders, concrete pumps, jackhammers, water pumps and rollers as well as addressing their cash flow issues. The management is well aware of these challenges and has been collaborating with various stakeholders, including the Engineer, Contractors, Subcontractors, Suppliers, Transporters, and government authorities at various levels.

Considering potential future pandemic outbreaks or similar difficulties, the project has implemented efficient mechanisms. These include maintaining sufficient stocks of essential construction materials, engaging new subcontractors, implementing strict health and safety protocols, and establishing isolation centers at the Project site. These collective efforts have been playing a crucial role in maintaining progress while prioritizing the safety and well-being of workers and staff, setting a positive example for managing construction projects in the face of unexpected challenges.

Obviously, the challenges posed by the global COVID-19 pandemic have had a significant impact on the construction timeline of the Middle Tamor Hydropower Project. Furthermore, the collapse of Hewa Khola bridge linking Phidim and Hilihang along the Mechi Highway on June 18, 2023 led to a complete disruption of all vehicular movement for almost a month. This, in turn, halted the transportation of construction materials like rebars, cements, admixtures and explosives as well as the movement of manpower for several weeks. During this period, the construction works at the site was being carried out using the construction materials that were stocked at the Project site, and only a limited quantity of materials transported via. alternative route. Unfortunately, the construction pace of the project was severely hindered during a critical phase of the Project.

Additionally, the supply of explosives to the project was disrupted due to India halting the supply. This caused a disruption in the excavation works in critical areas such as settling basin benching, settling basin gate shafts, and flushing gates shafts for over two months. While the project managed to gradually arrange the required explosives through various alternative means in small quantities, the overall schedule for the excavation works was significantly delayed.

Recognizing the unforeseen disruptions caused by the COVID pandemic, the collapse of the Hewa bridge, the scarcity of explosives, extended treatment of geological overbreaks on the Settling Basins, and the transmission line from Dhunge Sanghu to Basantapur (being developed by the NEA) not being completed within the earlier RCOD which resulted in the contingency evacuation plan for power transmission of the Project, the Employer has extended the RCOD to mitigate the effects of the ongoing crisis. With this extension, the RCOD of the Project has been renewed until February 27, 2024 to align with the completion of the contingency evacuation arrangement of 220 kV transmission line from Dhungesanghu to Basantapur S/s. The Employer is continuously monitoring the progress in the evacuation arrangement being developed by the NEA and working proactively in achieving the successful completion of this Project by the above stated deadline. This decision reflects a proactive approach by all stakeholders involved, including the company, the Engineer, and other project partners, to ensure a realistic and achievable timeline for the completion of the project amidst the unique challenges posed mainly by the pandemic. The collaborative efforts aimed at navigating the Project through these challenging circumstances highlight the commitment to both the successful completion of the Middle Tamor Hydropower Project and the safety and well-being of all workers and stakeholders involved.