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

MIDDLE TAMOR HYDROPOWER PROJECT (73 MW)

PROGRESS REPORT

(May 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

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 Mikwakhola Rural Municipality at the right bank of the Tamor River in Taplejung district. The boundary co-ordinates of the project are 87^0 40' 01" E to 87^0 42' 40" E and 27^0 23' 29" N to 27^0 25' 19" N. The nearest black topped approach road from the project site is at Bahanande, on the Mechi Highway (233 km from Charali in Jhapa), 7 km south of district headquarters Phungling Bazar. From Phungling, the project Powerhouse (Thumba village) and Headworks (Mitlung village) sites are accessible via a 15 km and 17 km long separate earthen roads respectively.

Sanima Middle Tamor Hydropower Ltd. (SMTHL) was established as a Special Purpose Vehicle (SPV) Company for the implementation and operation of Middle Tamor Hydropower Project. The Generation License of the Project was obtained initially for 54 MW on 5 June 2017. Subsequently the design was revised and generation license for the revised capacity of 73MW was 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. The Main Civil, Hydro-Mechanical, Electro-Mechanical and Transmission Line Contractors have been working at the construction site. Beside above major contract packages, the pre-construction and preparatory works, which comprises various works like construction of access roads, upgrade of existing roads to be used by the Project, slope protection works, two bridges crossing Tamor river in the PH area in Thumba and Budidaha, 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 all necessary permissions from local authorities have already been executed by SMTHL. The progress of all these activities is described in this report. According to the revised and amended Power Purchase Agreement (PPA) with Nepal Electricity Authority (NEA), the required commercial operation date (RCOD) of the Project is 11 September 2023 (26 Bhadra 2080) for 73 MW. However, revision in the RCOD is being negotiated with the NEA.

The installed capacity of the project is 73 MW with the design discharge of 73.71 m^3/s, corresponding to 42.71% exceedance flow. The catchment area of the Project is 2,002 km^2 and the gross head is 132 m. The 50 m long weir has its crest level at 887 m above mean sea level (amsl). The maximum height of weir crest from its original ground level is 10.5 m which diverts the required flow to the Intake. Two undersluice gates maintain the design water level for intake and flush excessive debris 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 281.52 m length. Three-chambered 100 m long underground settling basins (with additional 50 m of inlet and outlet chamber) designed with 90% trap efficiency pass 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 supply the water to the powerhouse. The 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 an approximately 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.

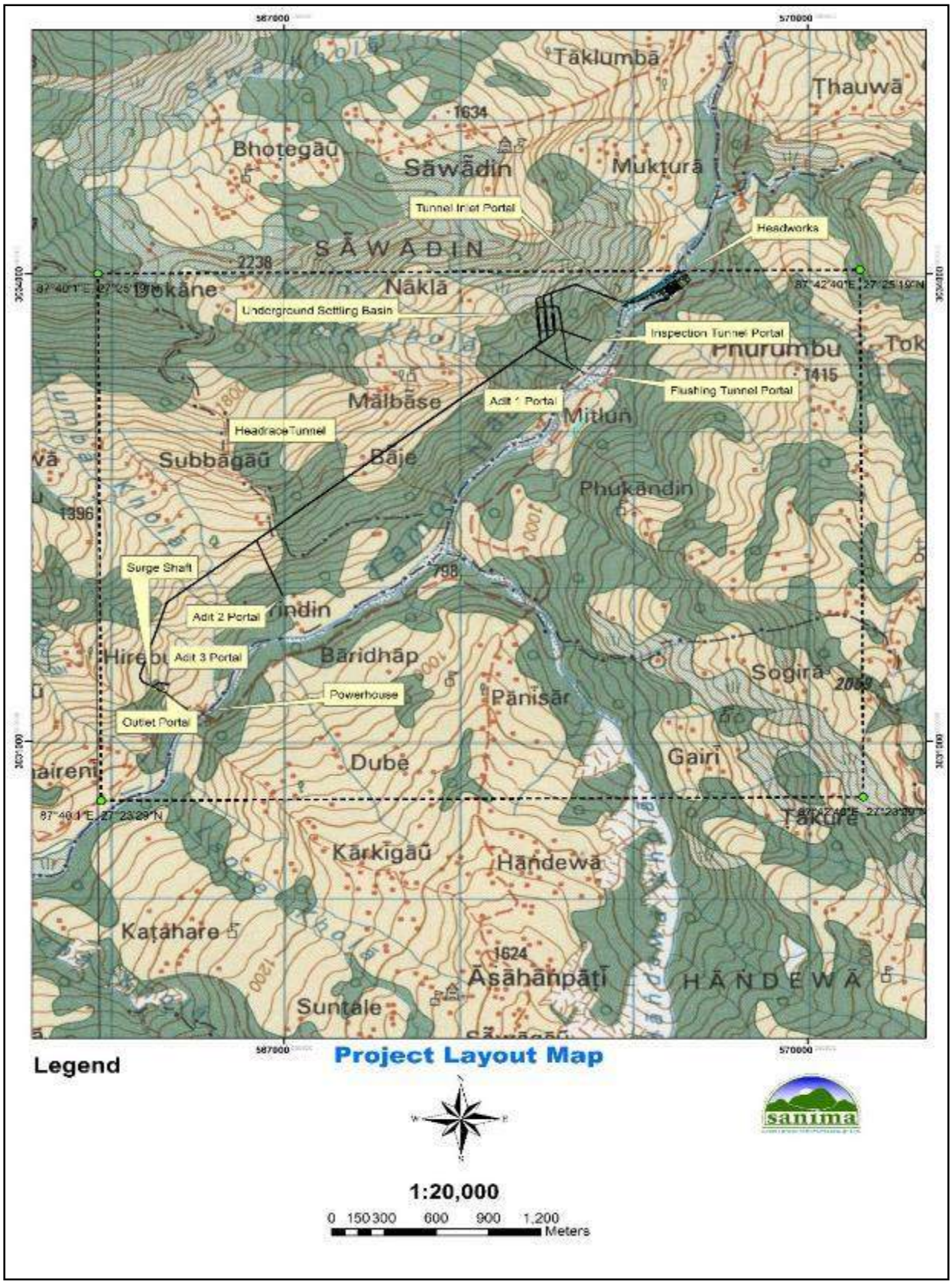


Figure 1-1: General layout of the Project Structures

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	11 September 2023 (26 Bhadra 2080) Revision in being negotiated with NEA
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

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

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) (Revision is being negotiated with the NEA)

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.

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 the transmission line contractors. The work progress achieved by the Project till date is described below.

2.1 PRE-CONSTRUCTION WORKS

2.1.1 ACCESS ROAD

An approximately 20 km earthen access road towards the construction site from the junction of Mechi Highway (at Bahanande) is fully functional. Most 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 have 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 the additional Bailey bridge at Budidaha is fully operational with occasional maintenance. The management is fully cautious and staying alert of the potential disturbances in the access roads.

Figure 2-1: Access Road Network at site

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. Further, the construction of a new camp at the Powerhouse is in the final stage of construction. The main structural components have already been completed whereas, the furnishing works are being carried out.

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

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. 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 2-3: 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 after the receipt of generation license and successful financial closure in February 2019. Currently, the Main Civil Contractor has completed the concreting works at major civil structures of headworks and powerhouse like weir, stilling basin, undersluice, intake, intake canal, gravel trap, surge shaft, powerhouse main building and tailrace section. Furthermore, the remaining construction works at approach pipe, conveyance tank, anchor block, wall lining of headrace tunnel and excavation of settling basin are ongoing.

2.2.1 HEADWORKS

The Main Civil Contractor has been carrying out concreting works at the headworks region through Nepali sub-contractors. The construction works of weir and stilling basin have been completed as of June 2022 along with downstream floodwall. Further, the construction of undersluice and intake (orifice structure) has been completed as of February 2023 along with fish ladder. The construction of Intake canal has also been completed in March 2023. In addition to this, approximately 99% of construction works at u/s floodwall and 98% at gravel trap have been completed. The construction of conveyance tank and approach pipe is in the final stage of completion. About 98% concreting works at the conveyance tank and 50% at approach pipe casing has been completed. Details of construction work area are described hereunder.

Figure 2-4: Aerial view of Headworks

2.2.1.1 INTAKE AND GRAVEL TRAP

The construction of intake is almost in the final stage of completion. Almost 8,096 m^3 of concrete out of 8,178 m^3 has already been poured in intake (orifice region) which is about 99% of the total concrete volume. The construction of intake canal has been completed in the month of March 2023. About 2,704.64 m^3 concrete was poured in the intake canal region. In addition to this, about 4,741.46 m^3 of concrete has been poured at gravel trap till date which is almost 99% progress. The construction of intake and gravel trap is scheduled for completion by June 2023.

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

Structure	Total volume	Completed volume	% Complete
Intake (Orifice)	8,178.66	8,095.58	99%
Intake canal	2,704.64	2,704.64	100%
Gravel trap	4,808.93	4,741.46	99%

Figure 2-5: A front view of intake orifices

2.2.1.4 WEIR AND STILLING BASIN

The construction of stilling basin has been completed on the month of May 2022 whereas the construction of weir main body, a major milestone, has been completed on June 2022. Almost 17,342.23 m^3 concrete in weir, 10847.81 m^3 concrete at stilling basin and 2096.30 m^3 at u/s slab and cutoff was poured. In total, 30,086.34 m^3 volume of concreting works was carried out at the weir and stilling basin section. Further, the curtain grouting works at the upstream slab has already been completed. In addition to this, a small section of left bank floodwall over the weir crest is being carried out along with plugging of the weir openings.

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: A view of weir and undersluice from upstream

2.2.1.5 UNDERSLUICE

The construction of undersluice has been completed as of February 2023 along with the construction of the fish ladder. About 19,327 m^3 of concrete was poured in the Undersluice portion till the completion.

Figure 2-7: Gate installation works at undersluice

2.2.1.6 CONVEYANCE TANK

Till date, about 7,700 m^3 of concrete has been poured at the conveyance tank region. The concreting works at the top slab and side walls of the hill side panel is going on. Almost 98% of concreting works has been completed in the conveyance tank section. The concrete works at the conveyance tank is scheduled to be completed by June 2023.

Figure 2-8: Final stage concreting works at the conveyance tank right top slab

Table 2-3: Work progress at conveyance tank

Total volume	Completed volume	% Completed	% Remaining
8,021.71	7,682.80	96%	4%

2.2.1.7 APPROACH PIPE

Till date, about 2,760 m^3 or 50% of concreting work has been carried out at the approach pipe section. Out of the total length of approach pipe i.e. 282 meters, about 220 meters of pipe has already been laid out by the hydro-mechanical contractor whereas more than 210 meters has already been concrete cased. The concrete works at the approach pipe section, located out of HRT inlet, is scheduled to be completed by June 2023.

Table 2-4: Work progress at approach pipe

Total volume	Completed volume	% Completed	% Remaining
5,531.90	2,760.00	40%	50%

To sum up, the overall physical progress achieved at the headworks region is approximately 96%. The major construction works is scheduled to be completed in a month by the end of June 2023.

Figure 2-9: Erection of approach pipe

Figure 2-10: Bird's eye view of head works

2.2.2 UNDERGROUNDS WORKS

The progress in tunnel excavation was severely affected after the outbreak of COVID-19, which caused transportation hindrance, shortage of explosives and deployment of government security agencies. All Chinese workers left Nepal due to ever spreading COVID-19 and to avoid a complete shutdown, the Main Civil Contractor carried out the excavation of HRT and surge shaft through Nepali sub-contractors applying a strict health and safety measures. The excavation works and rock support works at settling basin sites were also carried out by a Nepali subcontractor. This way the Company somehow tried to minimize the delay caused by the evacuation of Chinese workers and impact of COVID-19, but it was still not enough.

Despite the difficulties caused by the global pandemic, the breakthrough of Headrace Tunnel (HRT) was achieved on July 15, 2022. In addition to this, the concrete lining works of the 80-meter-deep surge shaft, a challenging front, has already been completed. Moreover, the excavation works of the flushing tunnel network has also been completed. The concreting works at the HRT invert and walls has already been completed throughout the entirety of the length of HRT. Presently, the full lining concrete works are being carried out from adit and outlet section.

Further, the excavation works at settling basin 1 and 2 has already reached design elevation, whereas face and invert blasting at settling basin 3 is ongoing. At present, the concrete works at the walls of the settling basins bay 01 and 02 are being carried out. Regarding the safety of the employees and smooth excavation works, the Employer has rented a Boomer machine which is currently being operated by the Main Civil Contractor for the excavation of settling basins. Apart from the disturbance caused by the pandemic, occasional rock overbreaks in the caverns and their subsequent careful repair and maintenance have been the cause of delay in underground works. Nevertheless, till date about 99% by length of the entire underground network has been excavated along with necessary supports works. The progress by volume is about 95%. About 6,500 m out of the total 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 including 35 m long inlet transition zone and 15 m long outlet transition zone and is 13.5 m wide and 17.5 m high. The excavation of settling basin bay

01 has been completed as of February 2023. Till date almost 29,669.13 m^3 excavation has been carried out in SB-01. Further, the concrete lining works have already been commenced. Till date more than 80% of design concrete lining works at the walls of the settling basin 01 has been completed.

Figure 2-11: A view of concrete lining works being carried out at Settling basin 01

5. **SETTLING BASIN BAY 02**

Figure 2-12: Concreting works at the settling basin bay 02 walls

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 is being applied near the spring line region of SB-02.

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 grouting works at the crown. About 110 m progress by length (average) has been achieved including inlet and outlet transition zone. Till date almost 15,000.00 m^3 excavation has been carried out in SB-03 along with the application of supports. This is about 51% volumetric excavation progress at SB-03. Further, the crown stabilization works have been completed at this front.

Figure 2-13: A view of SB 03 face

Table 2-5: Excavation progress of settling basins

S.N.	Particulars	Total Volume (m^3)	Excavated Volume (m^3)	Excavated Volume in Nov (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	15,000.00	14,669.13	51%	Excavation with supports
	Total	**89,007.39**	**74,338.26**	**14,669.13**	**84%**	

With this, the Contractor has already excavated almost 84% of earthwork volume in these three fronts of settling basin in benching form.

7. HEADRACE TUNNEL (HRT)

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

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%

7.2 Concreting works

The invert concreting works at the HRT has been completed throughout the section along with connecting tunnel to the Surge shaft and connecting tunnels to each settling basin bays. Till date, the invert concreting works has been completed along with wall lining. Currently, the full lining works are being carried out from both adit and outlet region.

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	670.00	35.00	5%

Figure 2-14: A section of HRT with concrete full lining

8. SURGE SHAFT

The excavation for the widening works of Surge shaft to its design diameter of 16.4 m was completed up to the entire depth of 79.93 m from the top level of the crown. The installation of supports of 6 m long, 32 mm dia. rock bolt and 75 mm thick steel fiber shotcrete has already been completed. The concreting works also has been completed as of January 31, 2023.

Further, the full concrete lining works at the connecting tunnel from HRT to Surge shaft has already begun and is being carried out at a great pace. Till date about 40 meters' full concrete lining works have already been completed at this section.

Figure 2-15: A view of full lining concrete at connecting tunnel to Surge Shaft

9. CONNECTING TUNNEL SETTLING BASIN TO HRT

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.

10. SETTLING BASIN INLET GATE SHAFT

The contractor is carrying out excavation of inlet gate shaft of settling basin-01 from the bottom and is in final stage of completion. The excavation of inlet gate shaft of settling basin-02 has already been completed as of February 2023.

11 VENTILATION TUNNEL

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

11. FLUSHING GATE SHAFT

The excavation along with support works of flushing gate shaft-01 is being carried out whereas the excavation for flushing gate shaft-02 has been started this month.

12. 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 rebar layout and simultaneous concrete pouring at the invert region.

Figure 2-16: A view of rebar layout at the flushing tunnel

2.2.3 POWERHOUSE

For excavation and concreting works at Powerhouse area, the Contractor (1st Hydro) employed Nepali workers through a Nepali sub-contractor company. Till date the concreting works at the powerhouse main building, manifold block and tailrace section has been completed along with all embedded concreting. Further, the concreting works for the ground floor of auxiliary powerhouse (control bay) has also been completed. In addition to this, the concreting works at the anchor block and saddle support region is going on.

2.2.3.1 PENSTOCK, ANCHOR BLOCKS AND SADDLE SUPPORT

The concreting works of the manifold region have all been completed along with the backfilling works. Further, the concreting works for the anchor block and the saddle support are being carried out at a rapid pace. Till date, more than 5,200.00 m^3 of concrete has already been poured in the anchor block and manifold region simultaneously with the laying of penstock.

2.2.3.2 POWERHOUSE AND CONTROL BAY

The construction of main powerhouse building and the ground floor of the auxiliary powerhouse building (control bay) has been completed. The first floor of the control bay shall begin soon. About 9,920.30 m^3 of concrete has been poured in the powerhouse and control bay building. The concrete works of generator casing of all 4 units have already been completed. The roofing works of the powerhouse has been completed along with the cladding works on the side walls and the installation of doors and windows.

2.2.3.3 TAILRACE CHAMBER, TAILRACE FLOODWALL AND TAILRACE CULVERT

The tailrace section of the project consists of tailrace chamber, tailrace culvert and tailrace floodwall. The construction of tailrace floodwall has been completed on February 2021 whereas the construction of tailrace chamber and tailrace culvert has been completed as of November 2022. About 3,374 m3 of concrete has been poured in the tailrace section.

2.2.3.3 SWITCHYARD

The excavation works for the switchyard region being carried out by the main civil works Contractor. The excavation is being done in benching form along with the construction of retaining wall.

Table 2-6: Progress of concreting at Powerhouse and tailrace culvert

Structure	Total volume	Completed volume	% 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	5,200.00	53%

Overall, the construction works of main powerhouse building is in the final stage of construction whereas the progress is about 53% along the penstock alignment.

Figure 2-17: A view of backfilling works at the manifold region

Figure 2-18: Construction of retaining wall at manifold region

Figure 2-19: Backfilling works along penstock alignment

Figure 2-20: A view of concreting works and pipe erection works along penstock alignment

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.

The erection of both the radial gates along with the hoisting for the gates and rubber seal have been completed at the undersluice. Also, the erection of all 6 vertical gates have been completed at the intake region. Out of the six, the rubber seal has been installed at 4 gates. The erection of hoisting is going on. In addition to these, the erection of 5 trashracks out of 6 have been completed at the Intake. Both the frames of trashracks have been erected at the conveyance tank. The erection of steel lining has been completed on all work fronts. The installation of embedded parts of Intake gate hoisting, TRCM and railing at top slab of intake has been completed. Similarly, the fabrication of steel pipes is in final stage of completion. Moreover, the HM Contractor has been carrying out the fabrication works of various gates and stop logs at his workshop.

The installation of approach pipes is ongoing at the headworks area in a rapid pace. Till date, almost 71 number of approach pipes have already been erected out of 96 pipes. With this, all the pipes from the expansion joint at conveyance tank up to the anchor block have been erected. The erection of penstock pipes along the penstock alignment slope is going on. Till date, the Contractor has already erected 21 number of penstock pipes having thickness 32mm (6 nos.), 30mm (7 nos.) and 28mm (8nos.). The installation of all three bifurcation units along with all associated reducers, bends and branch pipes have been completed. The concreting of manifold region was completed as soon as the front was handed over by the HM Contractor to the main Civil Contractor. All four-unit diffuser have been fabricated as well as installed.

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 GRAVEL FLUSHING GATES AND STOPLOGS

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

Table 2-7: Detail of work progress of gates and stoplogs

S.N.	Description	Work status				Remarks
		1st Stage Embedded Parts	2nd stage embedded parts	Main Body		
				Fabrication	Erection	
Gates						
**1	Undersluice Gates	All Complete	All Complete	All Complete	All Complete	Gate frame completed but hoisting work has been ongoing.
**2	Intake Gates	All Complete	All Complete	All Complete	2 Nos complete	Preparation works for remaining gate ongoing
**3	Bedload sluice gates	All Complete	All Complete	All Complete	Ongoing	Erection 4 out of 5 gates have been completed
4	Fish Passage Gate	All Complete	All Complete			

S.N.	Description	Work status				Remarks
		1st Stage Embedded Parts	2nd stage embedded parts	Main Body		
				Fabrication	Erection	
5	Trash Passage Gate	All Complete	All Complete			
**6	Gravel Flushing Gates	All Complete	Ongoing	Complete		Work ongoing inaccordance with the main civil contractor work schedule
7	Setting Basin Inlet gates					
8	Settling Basin Flushing Gates					
9	Adit Bulk Head Gates					
10	Draft Tube Gates	All Complete	All Complete			
Stoplogs						
**1	Undersluice Stoplogs	All Complete	All Complete	All Complete		Preparation work has been ongoing.
**2	Bedload sluice Stologs	All Complete	All Complete	All Complete	Ongoing	Erection 4 out of 5 gates have been completed
3	Trash Passage Stopogs	All Complete	All Complete			
4	Gravel Flushing Stoplogs	All Complete	All Complete			
5	Settling Basin Flushing Stoplogs					
6	Tailrace Stoplogs	All Complete	All Complete			

2.3.3 TRASHRACKS

Table 2-8: 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	All Complete		Frame related work completed but panel erection remains
4	Settling Basin outlet Trashrack			

2.3.4 STEEL PIPES AND OTHERS

HEADRACE STRAIGHT PIPELINE

Internal Diameter: 4.5 m
Thickness: 16 mm

Table 2-9: 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
Erection	71	2

In overall, erection of 43 numbers of pipes have been completed from downstream section and 28 numbers of pipes has been completed from upstream section along with welding.

HEADRACE BENDS

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

Table 2-10: 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	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.
Erection of bend 03 have been completed and the welding works has been ongoing.

PENSTOCK PIPES

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

The erection of 6 number of pipes having thickness 32 mm, 7 nos. of pipes having thickness 30 mm and 4 additional pipes of thickness 28 mm has been completed. With this, the HM Contractor

has already completed the erection of 17 number of penstock pipes (other than bifurcation and branch pipes) at the penstock alignment.

Table 2-11: 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
Erection	21	4

Figure 2-21: Erection of penstock pipes

Figure 2-22: Simultaneous work progress with Civil works

REDUCERS

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

Table 2-12: Detail of work progress of Reducers

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

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

BRANCH PIPES

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

Table 2-13: Detail of work progress of Branch Pipes

Branch Pipes	Up to previous month
Cutting	29
Rolling	25

Branch Pipes	Up to previous month
Fitting	25
Welding	22
Inspection	18
Blasting	18
Painting	18
Transportation	18
Erection	18

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 2-14: 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 have been completed.

BIFURCATIONS

Table 2-15: 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 Unit 2 and 3 have been completed. Similarly, erection of bifurcation Unit 1 have been completed and the final welding works is nearing its completion.

Table 2-16: 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	√	√	√
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 2-17: 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. Both fabrication and erection of pipes has been completed.

Overall, about 73% physical progress has been achieved in the hydro-mechanical works of the Project.

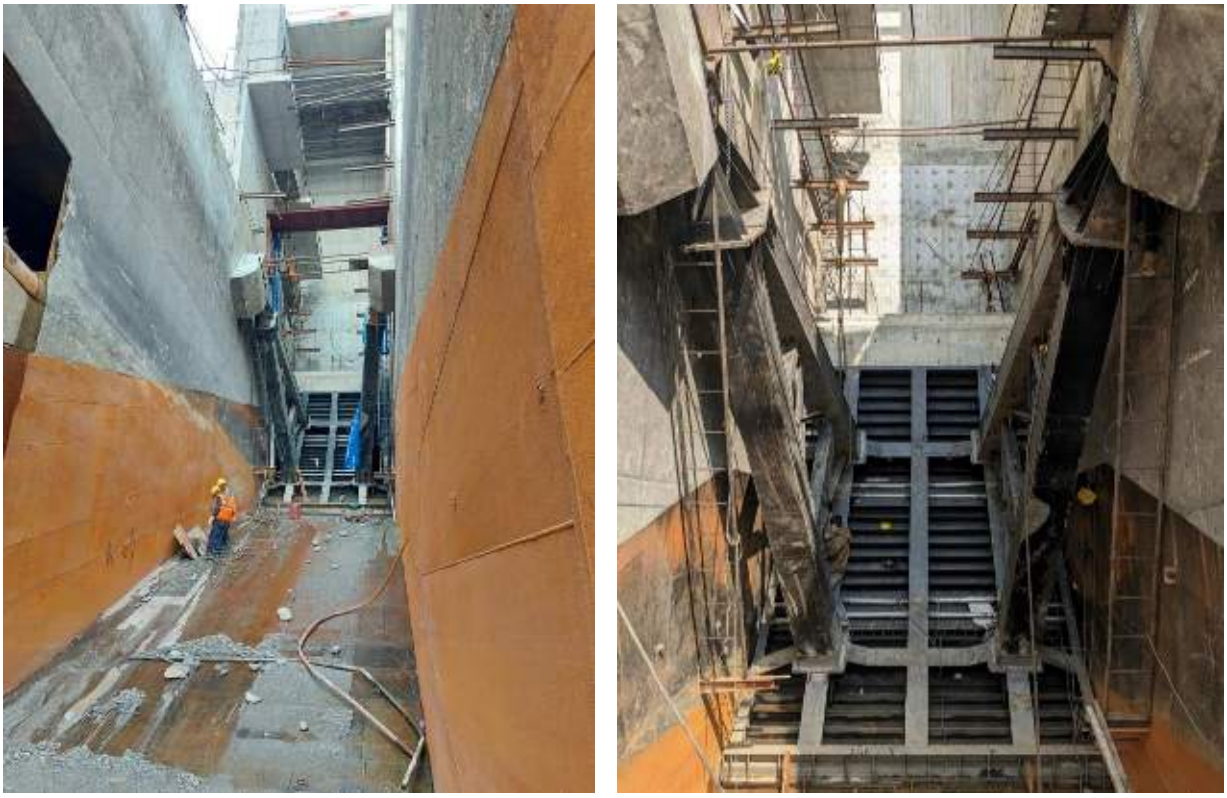


Figure 2-23: Erection of hydraulic hoisting cylinders of radial gate (left) and radial gates of intake side (right)

Figure 2-24: Erection of approach pipes (left) and penstock pipes (right)

2.4 ELECTRO-MECHANICAL WORKS

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

The EM contractor has already completed almost 99% fabrication works at various factories in China, which includes the design, fabrication and testing of generator sets, runner, shaft, etc. Till date, the EM contractor has delivered almost 90% of the equipment which includes most of the turbine parts, generator parts, EOT crane accessories, etc.

Moreover, the 11th shipment of EM equipment containing Transformer, has arrived Biratnagar, while the 12th shipment containing power and control cables has been dispatched from the factory. They are expected to be delivered well before the rainy season. As of this date, PPV valve and commination system are at the final stage of procurement and fabrication and expected to be dispatched from the factory very soon. The photographs depicted below shows a brief work progress of EM works.

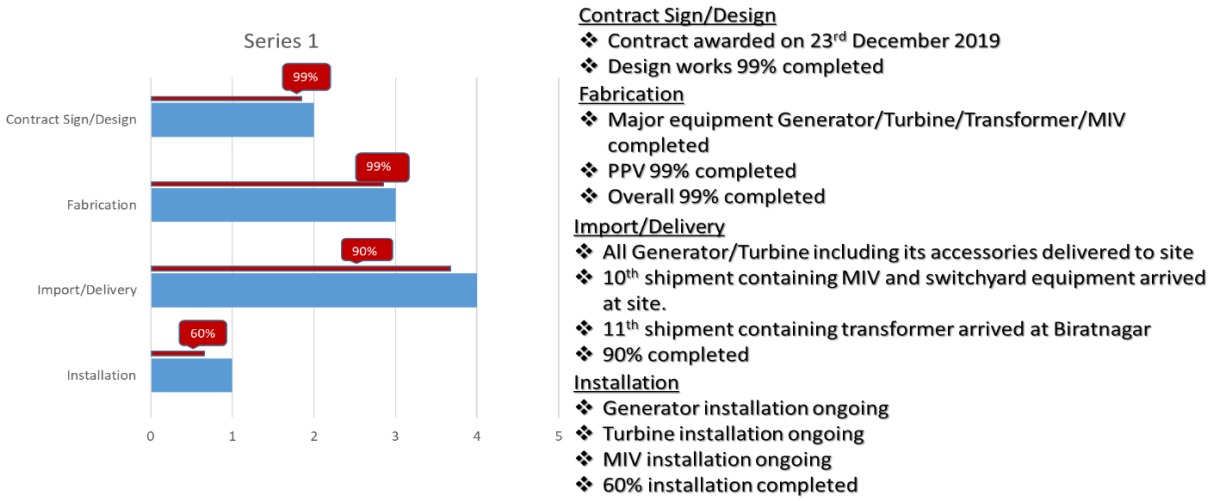


Figure 2-25: Electro-mechanical work progress summary

The EM Contractor officially mobilized its manpower and resources to the site for installation works on February 09, 2021. The camp and warehouse setup work has been completed. The installation of draft tube elbow in all 4 units has been completed along with the first stage embedded parts and pipes. Due to the spread of COVID-19 pandemic, the EM Contractor, also a Chinese company, could not mobilize its national workers at site and thus has been working also with a Nepali subcontractor with minimum impact on the instalaltion works. The Nepalese sub-contractor, JADE, swiftly mobilized its manpower and carried out spiral case instalaltion works of all the units along with other imbedded parts and pipes. However, the Contractor now has mobilized its project manager including its technical manpower mostly engineers of both mechanical and electrical background in the site and as of this date, the installation works is smoothly being carried out, where almost 60% erection and installation works have already been completed at the site.

2.4.1 MANUFACTURING WORKS

Most of the manufacturing works of Electro-Mechanical equipment have been completed at various factories in China. Most importantly all the turbine sets including spare runner has been manufactured and delivered to site for installation. Similarly, all the generator sets have been manufactured and tested which are mostly delivered to the site for installation works. Brief manufacturing progress are listed below:

- **Turbine**- 100% completed
- **Generator**-100% completed
- **Governor**- 100% completed
- **Excitation system**-100% completed
- **Switchyard equipment including transformer and steel structures**- 100% completed
- **PPV valve**-70% completed
- **MIV valve**-100% completed
- **Control panels**: 100% completed
- **Control and protection system**-100% completed
- **Cables**- 100% completed

To conclude, most of the EM equipment are manufactured and except for the transformers and PPV are delivered to Project site.
A few photographs showing the manufacturing progress are listed below:

Figure 2-26: Communication system ready for delivery

Figure 2-27: DC panels are ready to be dispatched at CWTW factory, China

Figure 2-28: PPV disc being assembled with PPV body

Figure 2-29: PPV preassembled in a factory in China

Figure 2-30: Flange being manufactured at the Contractor's Factory in China

2.4.2 INSTALLATION WORKS

Electro-Mechanical installation works is ongoing at fast pace after completion of powerhouse by the Civil Contractor. Most of the imbedded parts and pipes of turbine and generator were installed along with the civil work progress which becomes the foundation of further EM works. Similarly, installation, commissioning and load testing of the EOT crane have been carried out which is one of the major milestone for Electro-Mechanical installation works. The photographs mentioned below shows the detail cross work with the Civil Contractor.

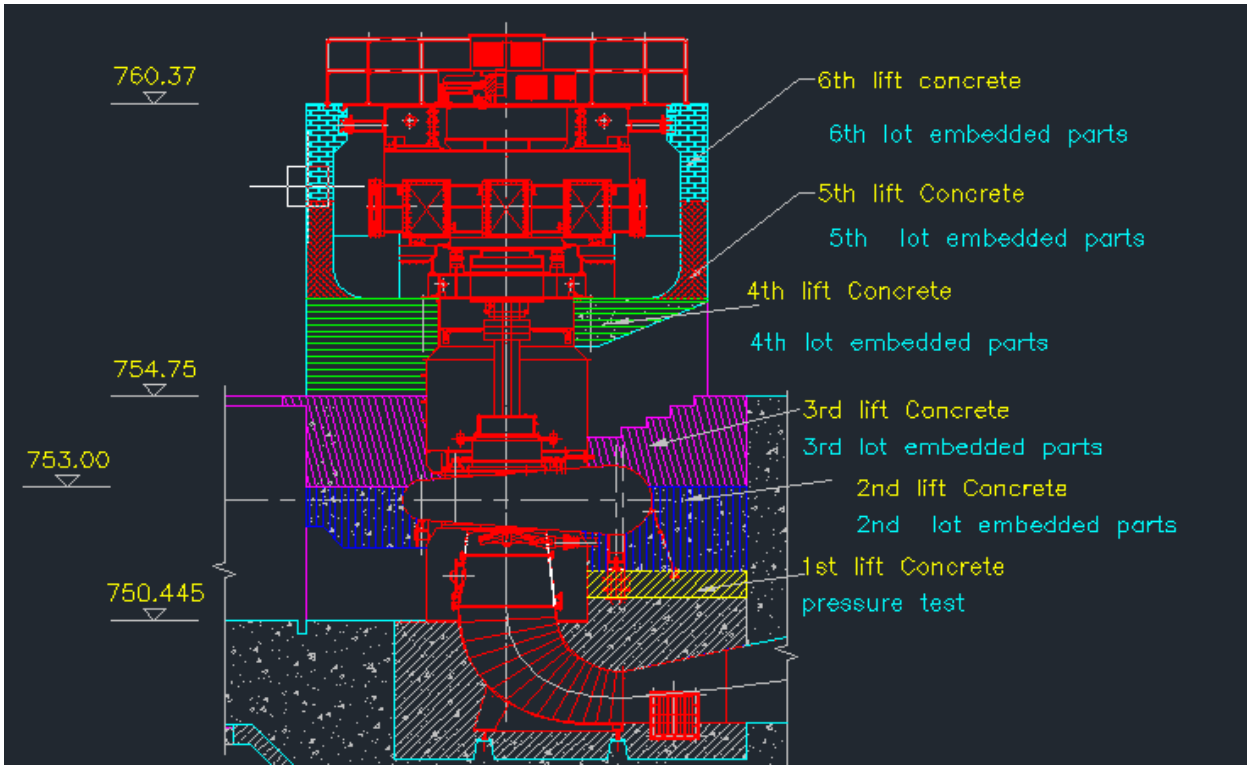


Figure 2-31: Picture showing installation interface between Civil and EM Works

The photograph mentioned below shows a brief summary of installation works progress of electro-mechanical works at each units.

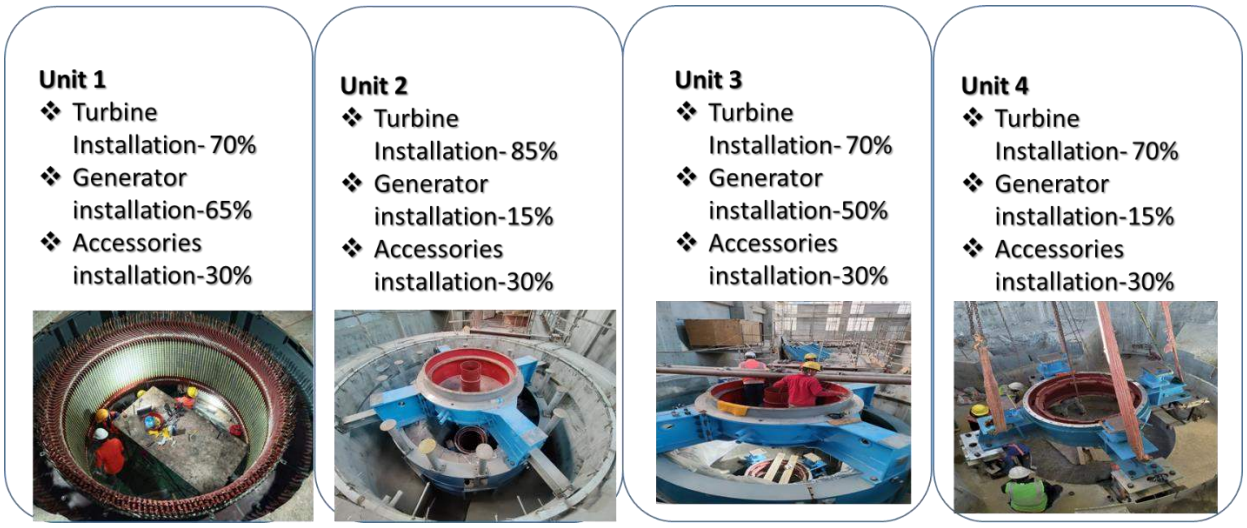


Figure 2-32: Summary of Machine installation

As of now around 60% of installation work has been completed. Few important work front of EM works has been detailed below:

2.4.2.1 EOT CRANE INSTALLATION

After the completion of roofing in Bay 1 – electrical commissioning of the crane had been carried out. The crane was driven from bay 1 to bay 5 at various speed levels, safety & connections were checked accordingly. In order to verify the load capacity of EOT, load test of EOT crane was carried out by lifting 66 TON of dummy load successfully. A few photographs showing the proceedings of load test are shown below:

2.4.2.2 UNIT 1

The installation of critical turbine and generator components is progressing rapidly with the preassembly of bottom ring, guide vane, head cover and lower bracket along with the assembly of split stator and rotor for the generator completed. The high voltage testing of installed stator coils and rotor has been successfully completed.

Figure 2-33: A view of stator

Figure 54: High voltage test of stator coil

Figure 55: Installation of lower bracket in unit 1

2.4.2.3 UNIT 2

The final assembly of bottom ring, guide vane, main shaft with runner, head cover and air cooler has been completed, while the lower bracket, split stator parts and upper bracket have been lowered and preassembled. Additionally, the rotor of unit one has been parked in unit two to facilitate the rotor assembly work of the next unit. A few photographs are attached below depicting the work progress.

Figure 2-34: Lowering of runner with main shaft in unit 2 (left0 and final assembly of bottom ring, guide vane, head cover and main shaft with runner (right)

Figure 2-35: Final assembly of stator air cooler

Figure 2-36: Temporary parking of roter of unit 01 at unit 02

2.4.2.4 UNIT 3

The bottom ring, guide vane, head cover, and lower bracket have been preassembled and are currently awaiting final assembly. The high voltage A.C. test of stator coils has been successfully completed. Currently, the rotor assembly and stator coil brazing works are nearing completion. A few progress photos are shown below:

Figure 61: Roundness checking of rotor after yoke punching sheet assembly

Figure 2-37: Preassembly of bottom ring and guide vane

Figure 2-38: Completion of stator winding works

2.4.2.5 UNIT 4

The final assembly of turbine components, which involved lowering the bottom ring, guide vane, and head cover, has been successfully completed, along with the preassembly of generator parts, including the lower bracket, split stator, stator air cooling system and upper bracket, and currently arrangements are being made for coil winding. A few photographs of the work progress are shown below.

Figure 64: Final assembly of runner with main shaft

Figure 65: Stator air cooler assembly

2.4.2.6 Main inlet valve

All 4 units of Main inlet valve have been successfully delivered to the site, and as of today, they have been lowered into their respective positions, with the downstream side welding of the unit 1 and unit 2 now completed. Few photographs of different stages of assembly of Main inlet valve are shown below:

Figure 66: All 4 units M.I.V. lowered to its position

Figure 2-39: Unit 4 MIV lowered to its position

Figure 2-40: Unit 2 MIV assembled at Service bay

Figure 2-41: Unit 03 MIV lowered in to its position

2.4.2.7 Control Room

All the embedded parts and pipes for control room have been completed. Installation of panel boards are planned immediately after the Civil Contractor handover the work front to EM Contractor.

Figure 70: Installation of channels for panel board foundation

2.4.2.8 Switchyard

Installation of switchyard equipment's are planned immediately after the site is handed over to EM Contractor.

2.5 TRANSMISSION LINE WORKS

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

Till date, the Contractor has completed check survey, soil investigation works, design, procurement of the tower parts, and construction of tower foundations and erection of towers. All the materials such as tower parts, insulators, accessories and conductors have been imported and are safely stored at site. The construction license of the transmission line has been acquired. The land acquisition works for 23 tower angle points (AP) were after the acquiring of construction license for the construction of 220 kV transmission line. The land acquisition work is left only at AP17 which is the government land. Necessary forest clearance permission is being obtained from the government for AP17 and is being followed up rigorously.

The erection of stub and foundation concreting works have been completed in 22 locations which is almost 92% of total foundation works. Similarly, the tower erection works have already completed at 22 locations which is also around 92% of the total erection works. The Contractor is currently carrying out stringing works of the transmission line conductor after the initial RoW clearance. The Contractor has already completed the stringing works from AP24 to AP19 and AP13 to AP10.

The transmission line route map is shown in figure below.

Figure 2-42: Transmission line route map

2.5.1 CONSTRUCTION WORKS

The Contractor has completed the foundation works as well the erection of towers at 22 tower locations. The locations remained for the foundation works are AP17 and AP01. The following table shows the progress in transmission line achieved so far. In addition to this, the Contractor has already completed the stringing works from AP24 to AP18 and AP13 to AP06. The total length of conductor stringed is about 6 kilometres which is about 42% of the total stringing works.

Table 2-18: Summary of Transmission Line works progress

S.N.	Description	Total	Unit	Completed	% Completed
1	Land Procurement works	24	Nos	23	96%
2	Foundation Works	24	Nos	22	92%
3	Tower Erection Works	24	Nos	22	92%
4	Stringing Works	9	Km	6	67%

Overall, the construction progress of Transmission line works is about 90% and is in line with our expected commercial operation date.

Table 2-19: Details of Transmission Line works

S. N.	Tower No.	Land Procured	Excavation Completed	Foundation Completed	Protection Work	Tower Erection	Stringing	Remarks
1	**AP1**	**Yes**	**No**	**No**	**No**	**No**	**No**	**Starting point**
2	AP2	Yes	Yes	Yes	No	Yes	No	Erection completed
3	AP3	Yes	Yes	Yes	Yes	Yes	No	Erection completed
4	AP4	Yes	Yes	Yes	Yes	Yes	No	Erection completed
5	AP5	Yes	Yes	Yes	Yes	Yes	No	Erection completed
6	**AP6**	Yes	Yes	Yes	No	Yes	No	**Stringing completed**
7	**AP7**	Yes	No	No	Yes	Yes	No	**Stringing completed**
8	**AP8**	Yes	Yes	Yes	No	Yes	No	**Stringing completed**
9	**AP9**	Yes	Yes	Yes	Yes	Yes	No	**Stringing completed**
10	**AP10**	Yes	Yes	Yes	Yes	Yes	Yes	**Stringing completed**
11	**AP11**	Yes	Yes	Yes	Yes	Yes	Yes	**Stringing completed**
12	**AP12**	Yes	Yes	Yes	Yes	Yes	Yes	**Stringing completed**

S. N.	Tower No.	Land Procured	Excavation Completed	Foundation Completed	Protection Work	Tower Erection	Stringing	Remarks
13	**AP13**	Yes	Yes	Yes	Yes	Yes	Yes	**Stringing completed**
14	AP14	Yes	Yes	Yes	Yes	Yes	No	Erection completed
15	AP15	Yes	Yes	Yes	Yes	Yes	No	Erection completed
16	AP16	Yes	Yes	Yes	Yes	Yes	No	Erection completed
17	**AP17**	**No**	**No**	**No**	**No**	**No**	**No**	**Government Land**
18	AP18	Yes	Yes	Yes	No	Yes	No	Erection completed
19	**AP19**	Yes	Yes	Yes	Yes	Yes	No	**Stringing completed**
20	**AP20**	Yes	Yes	Yes	Yes	Yes	No	**Stringing completed**
21	**AP21**	Yes	Yes	Yes	No	Yes	Yes	**Stringing completed**
22	**AP22**	Yes	Yes	Yes	No	Yes	Yes	**Stringing completed**
23	**AP23**	Yes	Yes	Yes	No	Yes	Yes	**Stringing completed**
24	**AP24**	Yes	Yes	Yes	No	Yes	Yes	**Stringing completed**

Figure 2-43: View of erected towers from right bank of Tamor

Figure 2-44: A view of stringing works

Figure 58: A view of Stringing works completed between two angle points

Figure 2-45: Conductor stringing works at various angle points

2.6 FINANCIAL PROGRESS TILL DATE

The total revised Project cost of Middle Tamor Hydropower Project is NPR. 13,330,000,000 (In words- NPR Thirteen Billion Three Hundred Thirty Million only). Out of the total Project cost, the equity portion is NPR. 3,332,500,000, whereas the debt required is NPR. 9,997,500,000. The promoter's equity portion, which is 70% of the total equity i.e. NPR 2,332,750,000, has been fully paid up. The Public equity portion, which is 30% of the total equity or NPR 999,750,000 has also been fully paid up and the Company has already been listed at Nepal Stock Exchange. Necessary arrangements for the debt portion has been made through a consortium of 8 commercial banks led by Nepal Investment Mega Bank Ltd.

Out of the total Contract amount, 71% has already been paid to the Main Civil Contractor till date against the Interim Payment Certificate (IPC) raised by the Contractor. Till date, payment against 24 IPCs have been disbursed to the Main Civil Contractor. Similarly, 67% of the Contract amount has been paid to the Hydro-Mechanical Contractor till IPC 6 out of design and procurement portion. All required Steel plates have been purchased by the Employer. 89% of the Contract amount has already been paid to the Electro-Mechanical Contractor against the bills of supply portion for the dispatch up to the 11th lot of EM equipment after the receipt at site and advance paid against Advance Payment Guarantee (APG). Furthermore, about 98% of the total Contract amount has been provided to the TL Contractor against the bills up to IPC#08 including all additional variations and advance payments.

Table 2-20: Financial Progress of Major Contract Packages Till Date

Major Contract Packages	Expense till date (%)	Remaining Budget (%)
Main Civil Works	**71%**	29%
Hydro-Mechanical Works	**67%**	33%
Electro-Mechanical Works	**89%**	19%
Transmission Line Works	**98%**	2%

The total financial expenditure of the overall Project till date is about **77%** out of the total project cost of NPR. 13,330,000,000.

Particulars	% Expense till date	% Remaining Budget
Financial Progress of MTHP	**77%**	23%

3 OCCUPATIONAL HEALTH SAFETY AND ENVIRONMENT (OHSE)

3.1 SAFETY PROTOCALS AT THE PROJECT

Safety protocol against various types of risks and hazards has been prepared and 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. A dedicated health care worker has been permanently employed by the Employer to maintain health and safety of the employees along with the establishment of a heath care facility with sufficient medicines and first aid kit. 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.

To avoid any potential risk at the underground works, the Contractor safety personnel have been instructed to continually make the employees aware of potential hazards relating to drilling and blasting activities inside the tunnel and the control measures that they are to adhere. Further, periodically safety induction training is being conducted at site to the workers of contractors and sub-contractors. The foreman in charge have been instructed to continuously monitor the worker's 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.

The OSHE team of the Employer has been carrying out regular safety drill at the Contractor's camp at the headworks and powerhouse to train the workers and the staff regarding the proper procedures during natural calamity or hazard. Tool box talk is provided to every new batch of workers at the construction site along with required safety training.

Moreover, all members of the technical team have been advised to be cautious when entering hazardous areas. Extra efforts to ensure the safety of visitors have been well implemented. Instructions are given to the technical team to continue to follow safe working practices to keep possible incidents to a bare minimum.

4 IMPACT OF COVID-19 ON THE PROJECT

4.1 FIRST WAVE OF COVID-19 FROM MARCH 2020

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

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

However, dangerous spread of the pandemic across Nepal and unavailability of vaccines made the Chinese workers increasingly restless and concerned about their health and safety. The Main Civil Contractor requested the Employer for a complete shutdown of project so that they could return to China for preventive measures and return after vaccination. However, in the Monthly Coordination meeting held on September 25, 2020 the Employer and Engineer rejected the request of the Contractor for a complete shutdown and suggested to proceed with the construction works employing Nepali Sub-Contractors for excavation of tunnel and excavation and concreting of Powerhouse and Tailrace floodwall. Almost all Chinese workers were evacuated to China 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 had already been delayed and was resumed only after 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 the first wave.

The Employer jointly with the Engineer and the Contractors, with the benefit of 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, 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 were resumed only 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. However, the initial encouraging momentum of the construction work was permanently lost.

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 for each wave of the pandemic on demand from projects that needed such time compensation. We have also been granted such extension. Thus, the revised RCOD of the Project is Bhadra 26, 2080 (11 September 2023). In view of the current pace of the progress on various work fronts in the Project, we are optimistic that a significant progress will be achieved by the deadline.

5 CONCLUSION

To sum up, the progress in Main Civil works is about 87% whereas in Hydro-mechanicals works is almost 73%. Further, the progress in Electro-mechanical works and Transmission Line works is 82% and 92%, respectively.

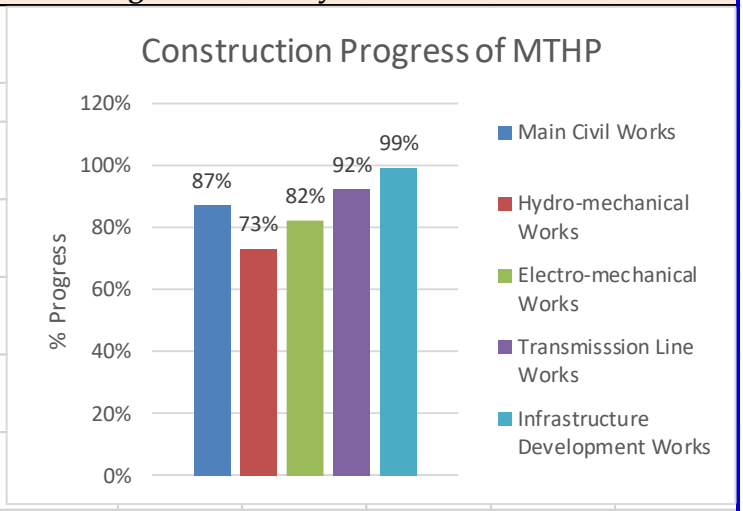
Table 5-1: Work progress summary chart

Sanima Middle Tamor Hydropower Ltd.

Middle Tamor Hydropower Project (MTHP-73 MW)

Construction Progress Summary

S.N.	Particulars	Construction Progress
1	Main Civil Works	87%
2	Hydro-mechanical Works	73%
3	Electro-mechanical Works	82%
4	Transmisssion Line Works	92%
5	Infrastructure Development Works	99%
	Overall Physical Progress	88%



As outlined above, despite all difficulties faced by the Project due to the pandemic related long obstructions, about **88%** of construction progress has been achieved till date. Although the desired level could not be reached due to the pandemic, the progress is still satisfactory in these times of great challenges. The unforeseen geological surprises, physical constraints of excavation in large caverns, overbreaks that required repair and maintenance 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 boomers, batching plant, grouting machines, robotic shotcrete machine, generators, dump trucks, excavators, loaders, transit mixtures, concrete pump, pneumatic jack hammers, water pumps, drum rollers, 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 future pandemic outbreaks or similar other difficulties, 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.