

Manang Marshyangdi Hydropower Company Pvt. Ltd.

Registered No: 78222/067/068

Ref. 20-291

July 01, 2020
(2077/03/17)

The Director,
Power Trade Department
Nepal Electricity Authority,
Darbarmarg, Kathmandu

Sub: **Submission of Revised Financial Analysis of Manang Marsyangdi Hydropower Project (135 MW)**

Dear Sir,

Further to our letter dated 2077/02/15 regarding the submission of documents for 135 MW Manang Marsyangdi HEP to ERC, the meeting and presentation of financial analysis was conducted on Ashadh 02, 2020 at your office. After the presentation of financial analysis we were asked to carry out simplified analysis as per the template provided to us from your side. Accordingly, the financial analysis was carried out and submitted through mail for your review & feedback. As per the meeting dated 2077/03/15 with your team and feedbacks provided to us on the financial analysis, it has been further updated and submitted herewith.

We therefore request you to conclude the final PPA in order to expedite the Financial Closure construction works at site at the earliest.

Thanking You,

Yours faithfully,

Uttar Kumar Shrestha

Uttar Kumar Shrestha
Director



श्री मल्हेराजी
आ.का.
२०७७/०३/२९

नेपाल विद्युत प्राधिकरण योजना, अनुमति तथा सूचना प्रविधि निर्देशनालय विद्युत व्यापार विभाग		
दस्तावेज नं: ५२६०	दस्तावेज मिति: ०६/०३/२०७७	
१. कारोबार विकास (BD)	२. निर्माण कार्यान्वयन (CV)	३. व्यापार तथा अर्थ (CF)
४. तलाश व्यवस्थापन (RM)	५. अन्य	
क) आ.का. गर्ने	ख) प्रत्यक्ष गर्ने	ग) पैसा गर्ने
घ) फाइल गर्ने	ड) पत्रि	च) अन्य

Current Contact Office
BPC Complex, Buddhanagar-313
P.O.Box: 11728

T 00977-1-4784026
F 00977-1-4780994

Registered Office
Dhumbarai - 4, Kathmandu
Email: mmhpp777@gmail.com

Manang Marshyangdi Hydropower Project (135 MW)
Detail of Project Cost with IDC

S.No.	Particulars	Total Cost (M NRs.)	Percentage
1	Project Development		
2	Environmental Mitigation & Management	190.80	0.49%
3	Land Acquisition	229.20	0.59%
4	Infrastructures	4,682.40	12.10%
5	Vehicles & Others	-	0.00%
6	Civil Construction Work	11,508.00	29.74%
7	Hydro-Mechanical Equipments	2,325.60	6.01%
8	Electro-Mechanical Equipments	4,173.60	10.78%
9	Transmission Line & Interconnection Facilities	276.00	0.71%
10	Engineering & Construction Supervision	3,973.20	10.27%
11	VAT Taxes and Duties	4,098.00	10.59%
12	Physical Contingencies	1,920.61	4.96%
13	Total price Contingencies		
13 a	Price Contingencies (Civil)		
13 b	Price Contingencies (Electrical)		
13 c	Price Contingencies (Hydro Mechanical)		
Total Cost Without Interest During Construction		33,377.41	86.24%
	Bank Charges (Loan Arrangement fee)	197.42	0.51%
	Interest During Construction	3,982.01	10.29%
	Hedging Cost During Construction	1,144.53	2.96%
Total Cost With Interest During Construction		38,701.38	

Net Asset Except Land (NRs.)	38,472.18	
------------------------------	-----------	--

	NPR	US\$
Cost per kw with out idc \$	247,240.04	2,060.33
Cost per kw with idc \$	286,676.86	2,388.97

idc

15x.

Manang Marshyangdi Hydropower Project (135 MW)

Assumptions

Capacity	135,000	kW
Dry Season Rate (Peaking)	8.50	NRs/kw
Dry Season Rate (Non Peaking)	8.40	NRs/kw
Wet Season Rate	4.80	NRs/kw
Dry Energy Peaking (6 months)	38.673	Gwh
Dry Energy Non Peaking(6 months)	192.84	Gwh
Wet Energy (6 months)	535.08	Gwh
Project Cost w/o IDC (NRs.)	33,377.41	M NRs
Project Cost with IDC	38,701.38	M NRs
Net Asset except Land	38,472.18	M NRs
Exchange Rate	120	NRs/US\$
Project Construction Start Year	2021	AD
Fiscal Year (COD-)	2025	
Loan %	80%	of total project cost with financing
Debt Servicing Period	10	Years
Capital Drawdown % (0,1,2,3,4) Years	6.04%, 18.99%, 24.16%, 25.55%, 25.26%	
Fund Disbursement % in Preconstruction	100%	of Equity
Fund Disbursement % in 1st Year	84.19%	of Loan
	15.81%	of Equity
Fund Disbursement % in 2nd Year	84.46%	of Loan
	15.54%	of Equity
Fund Disbursement % in 3rd Year	85.31%	of Loan
	14.69%	of Equity
Fund Disbursement % in 4th Year	86.33%	of Loan
	13.67%	of Equity
Escalation on Revenue	3%	For 8 Years after COD
Income Tax	20.0%	
Waive-Off of Income Tax	50.0%	For 5 Years after 10th year of COD
Discount Rate	8%	
Interest Rate on Loan during construction	6.80%	
Interest Rate on Loan after construction	6.80%	
Inflation Rate on O & M, Expenses	3.00%	
Sensitivity Factor for Project Cost		
Sensitivity Factor for Revenue		
Sensitivity Factor for Interest Rate		
Loan Arrangement Fee (one time)	0.50%	
Annual O & M Costs	1.50%	of Base Cost
Insurance Premium	0.85%	of Base Cost
Annual Royalty for first 15 years (NRs M)		117.34
Annual Royalty after 15 years (NRs. M)		762.60

Results

Total Cost with IDC (M NRs.)	38,701
Total Cost without IDC and Hedging Fees (M NRs.)	33,377
Equity Net Present Value (NPV) NRs. M	4,257
BC Ratio (times)	1.06
Internal Rate of Return (IRR)	8.27%
IRR base Return on Equity (RoE)	10.36%
Debt Coverage Bearing Ratio (DCBR) Min	0.74
Simple Payback (Yrs)	9.35
Discounted Payback (Yrs.)	26.47
Cost per kw with idc \$	2,388.97

Manang Marshyangdi Hydropower Project (135 MW)

Installed Capacity : 135 MW

Location: Manang District

Financial Evaluation Summary of base case at 6.8% Interest rate

Assumptions			
1	Installed Capacity	135	MW
2	Construction Period (Loan drawdown Period)	4	Years
3	Loan Equity Ratio (With IDC)	80:20	Ratio
4	Loan Repayment Period Yearly Basis	10	Years
5	Bank Loan Interest	6.80%	PA
6	Bank Loan Arrangement Fees	0.50%	% On Total Loan
7	Dry Season Rate	8.40	Per Unit
8	Wet Season Rate	4.80	Per Unit
9	Peak Period Rate	8.50	Per Unit
10	Price Increment in energy rate for 8 years (after)	3%	on base rate
11	Operation & maintenance cost yearly increase by	3%	Yearly
12	Royalty on Capacity for 15 Years	200	Per KW
13	Royalty on Capacity after 15 Years	1500	Per Kw
14	Royalty on Revenue for 15 Years	2%	On Revenue
15	Royalty on Revenue after 15 Years	10%	On Revenue
16	Cost Escalation by	3%	
17	Generation loss effect by		
18	Staff Bonus Provision	2%	On Profit before Tax
19	Income Tax -(100% Holiday for 10 years- 50% thereafter)	20%	Holiday If COD with in
20	Discount factor (As per Current Scenerio)	8%	On Net Profit
21	Depreciation rate is as per Life of Project	3.33%	30 years
22	Machine replacement cost is part of Operation and	20%	of HM & EM Cost

Additional Assumptions		Amount	
1	Annual Forex Escalation	3%	
2	Additional Revenue from M2 to M1 after 2nd year of operation	360,000.00	Amount in ,000
Hedging Assumption			
3	Hedging Fees	2%	on Pricipal and Interest Balance
4	Developer Contributions	33.33%	

Basic Data		Amount	
1	Total Project Cost (With IDC)	38,701,376	Amount in ,000
2	Total Loan (80%)	30,961,001	Amount in ,000
3	Total Equity (20%)	7,740,375	Amount in ,000
4	Net Revenue (After Loss provision) for First year	4,516,957	Amount in ,000
5	* Net Revenue (After Loss provision) for Nineth	5,601,026	Amount in ,000
6	Yearly O & M cost	500,661	Amount in ,000
7	NEA Penalty (If Late COD)	225,848	5% of Revenue
8	Insurance Cost	283,708	Amount in ,000
9	First Year Royalty (At the starting)	117,339	Amount in ,000
10	Yearly Royalty After 15 years	762,603	Amount in ,000

Results			
1	IRR (Internal rate of return)	8.27%	
2	EIRR / ROE (Return on Equity)	10.36%	
3	NPV (Net Present Value)	4,257,299	Amount in ,000
4	Cost per kW (1 US\$ = 120)	2388.97	Amount in \$
5	BC Ratio (benefit Cost Ratio)	1.06	Ratio
6	Pay back Period -Simple	9.35	Years
7	Pay back Period - Discounted	26.47	Years
8	Loan Repayment including interest	42,924,306	Amount in ,000
9	Revenue Per MW in NRs (Avg)	40,285	Amount in ,000
10	Cost Per MW in NRs	286,677	Amount in ,000

Manang Marshyangdi Hydro
FINANCIAL ANALYSIS

Season	Energy GWh	Rate (NRs.)
Dry peaking	38.67	8.50
Dry non peaking	192.84	8.40
Wet Energy	535.08	4.90

Project Status	Year	Total Project Cost Including IDC	IDC/Fin Costs	Hedging Fees during Const	Capital Excluding IDC and Hedging Cost	Debt @%	Equity @%	Weighted Avg Tariff	Net Energy	Revenue from energy sales	Revenue from M2 contributions	Total Revenue	Insurance Cost @ ...%	O & M Cost @%	Capacity Royalty	Revenue Royalty
		A				A(i)	A(ii)					B	C	D	E	F
	Year	NRs. M	NRs. M	NRs. M	NRs. M	NRs. M	NRs. M	NPR	GWh	NRs. M	NRs. M	NRs. M	NRs. M	NRs. M	NRs. M	NRs. M
Total		38,701.38	4,179.44	1,144.53	33,377.41	30,961.00	7,740.37			163,152.47	10,080.00	173,232.47	8,511.24	23,819.16	3,442.50	9,984.28
Pre Construction		2,336.42			2,336.42		2,336.42									
	1.00	7,148.70	387.09	286.13	6,675.48	6,186.56	1,152.14									
	2.00	9,350.83	720.34	286.13	8,344.35	7,898.15	1,452.58									
	3.00	9,889.94	1,259.45	286.13	8,344.35	8,437.26	1,452.58									
	4.00	9,775.49	1,812.55	286.13	7,676.80	8,439.03	1,336.46									
Construction Period																
	5.00							5.89	766.59	4,516.96		4,516.96	283.71	500.66	27.00	90.14
	6.00							6.07	766.59	4,552.47		4,552.47	283.71	515.68	27.00	93.05
	7.00							6.25	766.59	4,787.97	360.00	5,147.97	283.71	531.15	27.00	95.76
	8.00							6.42	766.59	4,923.48	360.00	5,283.48	283.71	547.09	27.00	98.47
	9.00							6.60	766.59	5,058.99	360.00	5,418.99	283.71	563.50	27.00	101.18
	10.00							6.78	766.59	5,194.50	360.00	5,554.50	283.71	580.40	27.00	103.89
	11.00							6.95	766.59	5,330.01	360.00	5,690.01	283.71	597.82	27.00	106.60
	12.00							7.13	766.59	5,465.52	360.00	5,825.52	283.71	615.75	27.00	109.31
	13.00							7.31	766.59	5,601.03	360.00	5,961.03	283.71	634.22	27.00	112.02
	14.00							7.31	766.59	5,601.03	360.00	5,961.03	283.71	653.25	27.00	112.02
	15.00							7.31	766.59	5,601.03	360.00	5,961.03	283.71	672.85	27.00	112.02
	16.00							7.31	766.59	5,601.03	360.00	5,961.03	283.71	693.03	27.00	112.02
	17.00							7.31	766.59	5,601.03	360.00	5,961.03	283.71	713.82	27.00	112.02
	18.00							7.31	766.59	5,601.03	360.00	5,961.03	283.71	735.24	27.00	112.02
	19.00							7.31	766.59	5,601.03	360.00	5,961.03	283.71	757.29	27.00	112.02
Operation																
	20.00							7.31	766.59	5,601.03	360.00	5,961.03	283.71	780.01	202.50	560.10
	21.00							7.31	766.59	5,601.03	360.00	5,961.03	283.71	803.41	202.50	560.10
	22.00							7.31	766.59	5,601.03	360.00	5,961.03	283.71	827.52	202.50	560.10
	23.00							7.31	766.59	5,601.03	360.00	5,961.03	283.71	852.34	202.50	560.10
	24.00							7.31	766.59	5,601.03	360.00	5,961.03	283.71	877.91	202.50	560.10
	25.00							7.31	766.59	5,601.03	360.00	5,961.03	283.71	904.25	202.50	560.10
	26.00							7.31	766.59	5,601.03	360.00	5,961.03	283.71	931.38	202.50	560.10
	27.00							7.31	766.59	5,601.03	360.00	5,961.03	283.71	959.32	202.50	560.10
	28.00							7.31	766.59	5,601.03	360.00	5,961.03	283.71	988.10	202.50	560.10
	29.00							7.31	766.59	5,601.03	360.00	5,961.03	283.71	1,017.74	202.50	560.10
	30.00							7.31	766.59	5,601.03	360.00	5,961.03	283.71	1,048.27	202.50	560.10
	31.00							7.31	766.59	5,601.03	360.00	5,961.03	283.71	1,079.72	202.50	560.10
	32.00							7.31	766.59	5,601.03	360.00	5,961.03	283.71	1,112.11	202.50	560.10
	33.00							7.31	766.59	5,601.03	360.00	5,961.03	283.71	1,145.48	202.50	560.10
	34.00							7.31	766.59	5,601.03	360.00	5,961.03	283.71	1,179.84	202.50	560.10

Power Project (135 MW) YSIS OF PROJECT

Total Operation cost	Hedging Fees During Operation	EBITDA	Govt. Grant	Bank Interest @ ...% p.a	Depreciation SLM	Earning before Bonus and welfare	Bonus and Welfare	Earnings before Tax	Income Tax	Post Tax Earnings	DSRA	MMRA	Dis. Factor @ 10%	Principle amount	Free Cash Flow to Equity
$G = (C - D - E - F)$	X	H = (B - G - X)	I	J	K	L = (H + I - J - K)	M	N = L - M	O	P = (N - O)	Y	Z		Q	R = (N(H) + P + K - (Q - Y - Z))
NRs M	NRs M	NRs M	NRs M	NRs M	NRs M	NRs M	NRs M	NRs M	NRs M	NRs M			8%	NRs M	NRs M
45,757.18	1,618.60	125,856.70	-	11,963.30	38,701.38	75,192.02	1,504.29	73,687.73	9,544.64	64,143.09				30,961.00	62,187.71
													1.00		(2,116.42)
													0.93		(1,162.14)
													0.86		(1,152.68)
													0.79		(1,152.68)
													0.74		(1,116.46)
								(22.28)					0.68	2,243.49	(1,100.12)
901.71	298.54	3,316.71		2,048.94	1,290.05	(22.28)	-	271.66	-	(22.28)	124.40		0.63	2,399.98	(966.41)
919.44	273.33	3,459.70		1,892.45	1,290.05	277.20	5.54	271.66	-	271.66	128.13		0.58	2,567.39	(479.37)
937.62	246.34	3,964.02		1,725.04	1,290.05	948.93	18.98	929.95	-	929.95	131.98		0.54	2,746.47	(144.10)
956.26	217.48	4,109.74		1,545.96	1,290.05	1,273.74	25.47	1,248.26	-	1,248.26	135.94		0.50	2,938.05	(316.96)
975.39	186.67	4,256.94		1,354.38	1,290.05	1,612.51	32.25	1,580.26	-	1,580.26	140.02	109.20	0.46	3,142.99	(182.76)
995.00	153.82	4,405.68		1,149.44	1,290.05	1,966.19	39.32	1,926.87	-	1,926.87	144.22	112.47	0.43	3,362.22	(47.48)
1,015.12	118.82	4,556.06		930.21	1,290.05	2,335.81	46.72	2,289.09	-	2,289.09	148.54	115.85	0.40	3,596.75	88.95
1,035.77	81.59	4,708.16		695.68	1,290.05	2,722.43	54.45	2,667.98	-	2,667.98	153.00	119.32	0.37	3,847.64	226.59
1,056.95	42.02	4,862.06		444.79	1,290.05	3,127.22	62.54	3,064.67	-	3,064.67	157.59	122.90	0.34	4,116.03	235.34
1,075.98	-	4,885.05		176.41	1,290.05	3,418.60	68.37	3,350.23	-	3,350.23	162.32	126.59	0.32	4,395.01	5,985.01
1,095.58		4,865.45			1,290.05	3,575.41	71.51	3,503.90	350.39	3,153.51	(1,671.87)	130.39	0.29	4,291.45	
1,115.76		4,845.27			1,290.05	3,555.22	71.10	3,484.12	348.41	3,135.70		134.30	0.27	4,269.08	
1,136.55		4,824.47			1,290.05	3,534.43	70.89	3,463.24	346.37	3,117.37		138.33	0.25	4,246.04	
1,157.97		4,803.06			1,290.05	3,513.01	70.26	3,442.75	344.28	3,098.48		142.48	0.23	4,222.32	
1,180.02		4,781.00			1,290.05	3,490.96	69.82	3,421.14	342.11	3,079.02		146.75	0.21	4,200.10	
1,202.32		4,134.70			1,290.05	2,844.66	56.89	2,787.76	557.55	2,230.21		151.16	0.20	4,177.62	
1,224.72		4,111.30			1,290.05	2,821.26	56.43	2,764.83	552.97	2,211.86		155.69	0.18	4,155.10	
1,247.83		4,087.20			1,290.05	2,797.15	55.94	2,743.21	548.24	2,192.97		160.36	0.17	4,132.65	
1,271.65		4,062.37			1,290.05	2,772.33	55.45	2,716.88	543.38	2,173.50		165.17	0.16	4,110.18	
1,296.15		4,036.80			1,290.05	2,746.76	54.94	2,691.82	538.36	2,153.46		170.13	0.15	4,087.69	
1,321.32		4,010.47			1,290.05	2,720.42	54.41	2,666.01	533.20	2,132.81			0.14	4,065.24	
1,347.14		3,983.34			1,290.05	2,693.29	53.87	2,639.43	527.89	2,111.54			0.13	4,042.80	
1,373.63		3,955.40			1,290.05	2,665.35	53.31	2,612.04	522.41	2,089.64			0.12	4,020.36	
1,400.81		3,926.62			1,290.05	2,636.57	52.73	2,583.84	516.77	2,067.07			0.11	4,000.00	
1,428.76		3,896.97			1,290.05	2,606.93	52.14	2,554.79	510.96	2,043.81			0.10	3,979.64	
1,457.48		3,866.44			1,290.05	2,576.40	51.53	2,524.87	504.97	2,019.89			0.09	3,959.29	
1,486.97		3,834.99			1,290.05	2,544.95	50.90	2,494.05	498.81	1,995.24			0.08	3,938.94	
1,517.24		3,802.60			1,290.05	2,512.56	50.25	2,462.31	492.46	1,969.84			0.07	3,918.59	
1,548.28		3,769.24			1,290.05	2,479.19	49.58	2,429.61	485.92	1,943.69			0.06	3,898.24	
1,579.99		3,734.87			1,290.05	2,444.83	48.90	2,395.93	479.19	1,916.75			0.05	3,877.89	
1,612.35													0.04	3,857.54	
1,645.36													0.03	3,837.19	
1,679.01													0.02	3,816.84	
1,713.30													0.01	3,796.49	
1,748.23													0.00	3,776.14	
1,783.80														3,755.79	
1,820.01														3,735.44	
1,856.76														3,715.09	
1,894.05														3,694.74	
1,931.88														3,674.39	
1,970.25														3,654.04	
2,009.16														3,633.69	
2,048.61														3,613.34	
2,088.60														3,592.99	
2,129.13														3,572.64	
2,170.20														3,552.29	
2,211.81														3,531.94	
2,254.06														3,511.59	
2,296.95														3,491.24	
2,340.48														3,470.89	
2,384.65														3,450.54	
2,429.46														3,430.19	
2,474.91														3,409.84	
2,521.00														3,389.49	
2,567.73														3,369.14	
2,615.10														3,348.79	
2,663.11														3,328.44	
2,711.76														3,308.09	
2,761.05														3,287.74	
2,810.98														3,267.39	
2,861.55														3,247.04	
2,912.76														3,226.69	
2,964.61														3,206.34	
3,017.10														3,185.99	
3,070.33														3,165.64	
3,124.30														3,145.29	
3,178.91														3,124.94	
3,234.16														3,104.59	
3,289.95														3,084.24	
3,346.28														3,063.89	
3,403.15														3,043.54	
3,460.56														3,023.19	
3,518.51														3,002.84	
3,577.00														2,982.49	
3,636.03														2,962.14	
3,695.60														2,941.79	
3,755.71														2,921.44	
3,816.36														2,901.09	
3,877.55														2,880.74	
3,939.28														2,860.39	
4,001.55														2,840.04	
4,064.36														2,819.69	
4,127.71														2,799.34	
4,191.60														2,778.99	
4,256.03														2,758.64	
4,321.00														2,738.29	
4,386.51														2,717.94	
4,452.56														2,697.59	
4,519.15														2,677.24	
4,586.28														2,656.89	
4,653.95														2,636.54	
4,722.16														2,616.19	
4,790.91														2,595.84	
4,860.20														2,575.49	
4,930.13														2,555.14	
5,000.70														2,534.79	
5,071.91														2,514.44	
5,143.66														2,494.09	
5,215.95														2,473.74	
5,288.78														2,453.39	
5,362.15														2,433.04	
5,436.06															

Manang Marshyangdi Hydropower Project (135 MW)
FINANCIAL ANALYSIS OF PROJECT

B/C Ratio: 1.05

Discounted Cashflow to Equity	Project Cashflow	Cumulative Project Cashflow	Simple Payback Period	Project Discount Cashflow	Cumulative Discounted Project Cashflow	Discounted Payback Period	Cashflow Before Debt Service	Debt Service	DSCR	Cost	Benefit
NPV			Years						Avg	NPV	NPV
NRS. M	NRS. M			NRS. M			NRS. M	NRS. M	0.93	NRS. M	NRS. M
4,257.30	75,769.61		9.35	927.74		26.47	109,645.6	42,924.3	Min	43,601.5	46,049.0
(2,336.42)	(2,336.42)	(2,336.42)		(2,336.42)	(2,336.42)				0.74	2,336.42	-
(1,076.06)	(7,348.70)	(9,685.12)		(6,804.35)	(9,140.77)					2,346.75	-
(1,245.44)	(9,350.83)	(19,035.95)		(8,016.83)	(17,157.60)					9,350.83	-
(1,153.18)	(9,889.94)	(28,925.89)		(7,850.95)	(25,008.55)					9,889.94	-
(982.34)	(9,775.49)	(38,701.38)		(7,185.28)	(32,193.83)					9,775.49	-
(748.72)	3,490.85	(35,210.53)	1.00	2,375.81	(29,818.02)	1.00	3,192.31	4,292.43	0.74	1,025.11	4,516.96
(609.00)	3,599.35	(31,611.18)	1.00	2,268.20	(27,549.82)	1.00	3,326.02	4,292.43	0.77	1,053.12	4,652.47
(279.71)	4,059.40	(27,551.78)	1.00	2,368.62	(25,181.20)	1.00	3,813.06	4,292.43	0.89	1,088.58	5,147.97
(185.91)	4,165.81	(23,385.98)	1.00	2,250.66	(22,930.54)	1.00	3,948.33	4,292.43	0.92	1,117.68	5,283.48
(158.56)	4,162.14	(19,223.84)	1.00	2,082.11	(20,848.44)	1.00	3,975.47	4,292.43	0.93	1,256.85	5,418.99
(84.65)	4,263.48	(14,960.35)	1.00	1,974.82	(18,873.62)	1.00	4,109.67	4,292.43	0.96	1,291.02	5,554.50
(20.36)	4,363.78	(10,596.58)	1.00	1,871.55	(17,002.07)	1.00	4,244.95	4,292.43	1.00	1,326.23	5,690.01
35.33	4,462.98	(6,133.60)	1.00	1,772.31	(15,229.76)	1.00	4,381.39	4,292.43	1.02	1,362.54	5,825.52
83.32	4,561.04	(1,572.56)	1.00	1,577.08	(13,552.68)	1.00	4,519.07	4,292.43	1.05	1,399.99	5,961.03
80.12	4,527.77	2,955.20	0.35	1,541.53	(12,011.15)	1.00	4,527.77	4,292.43	1.05	1,433.26	5,961.03
1,886.73	5,985.03	8,940.24		1,886.73	(10,124.42)	1.00	5,985.03			(374.39)	5,961.03
1,252.63	4,291.45	13,231.68		1,252.63	(8,871.78)	1.00	4,291.45			1,321.17	5,961.03
1,153.60	4,269.08	17,500.77		1,153.60	(7,717.98)	1.00	4,269.08			1,345.57	5,961.03
1,062.57	4,246.04	21,746.81		1,062.57	(6,655.41)	1.00	4,246.04			1,370.71	5,961.03
978.36	4,222.32	25,969.13		978.36	(5,677.05)	1.00	4,222.32			1,396.60	5,961.03
722.83	3,369.10	29,338.23		722.83	(4,954.22)	1.00	3,369.10			2,034.37	5,961.03
664.75	3,346.22	32,684.45		664.75	(4,289.47)	1.00	3,346.22			2,061.84	5,961.03
611.17	3,322.65	36,007.10		611.17	(3,678.30)	1.00	3,322.65			2,090.13	5,961.03
561.76	3,298.38	39,305.48		561.76	(3,116.54)	1.00	3,298.38			2,119.27	5,961.03
516.21	3,273.38	42,578.85		516.21	(2,600.33)	1.00	3,273.38			2,149.29	5,961.03
499.80	3,422.86	46,001.71		499.80	(2,100.53)	1.00	3,422.86			2,004.97	5,961.03
459.90	3,401.59	49,403.29		459.90	(1,640.63)	1.00	3,401.59			2,031.55	5,961.03
423.09	3,379.68	52,782.98		423.09	(1,217.54)	1.00	3,379.68			2,058.94	5,961.03
389.14	3,357.12	56,140.09		389.14	(828.40)	1.00	3,357.12			2,087.14	5,961.03
357.82	3,333.88	59,473.97		357.82	(470.59)	1.00	3,333.88			2,116.19	5,961.03
328.93	3,309.94	62,783.91		328.93	(141.65)	1.00	3,309.94			2,146.11	5,961.03
302.30	3,285.29	66,069.20		302.30	160.65	0.47	3,285.29			2,176.93	5,961.03
277.74	3,259.89	69,329.09		277.74	438.39	0.00	3,259.89			2,208.67	5,961.03
255.11	3,233.73	72,562.82		255.11	693.50	0.00	3,233.73			2,241.37	5,961.03
234.24	3,206.79	75,769.61		234.24	927.74	0.00				2,275.05	5,961.03
Project IRR	8.27%										

EXECUTIVE SUMMARY

Manang Marsyangdi Hydro-electric Project (MMHEP) is located on the Marsyangdi River in Manang district of Province-4 of the Federal Democratic Republic of Nepal. It is a PRoR project with an installed capacity of 135MW being studied in the upper reaches of Marsyangdi River and adopts diversion type development. The water from the tailrace of MMHEP will be utilized by Lower Manang Marsyangdi Hydro-electric Project (LMMHPP).

In July 2016 Manang Marsyangdi Hydro Power Company P. Ltd. submitted a feasibility study report. According to this report, the Project development scheme was to dam the river 500m downstream of the confluence with Nar khola near Koto village and divert water through a 7.27 km long headrace tunnel to the surface powerhouse on the Left Bank terrace of Marsyangdi River, which would be 500m upstream of the confluence of China Khola with the Marsyangdi River. The powerhouse had an installed capacity of 144 MW (3 units) with 38 m³/s discharge utilizing 454m water head. However, the feasibility study carried out by QYEC at the current stage has several changes in the project features with respect to the previous study of MMHEP which have been summarized further.

The project area of MMHEP is about 65 km from the nearest city Besisahar and about 235 km from capital city Kathmandu. The project lies between the project boundary of 28° 32' 05" N to 28°33'37" N and 84°15'38" E to 84°20'00" E. The project components of MMHEP are located in Chame and Nashong Rural Municipalities of Manang district, encompassing the villages Koto, Chitipu, Thanchok, Timang, Syarku and Danakyu. The headworks components of the project are proposed near Koto Village approximately 500 m downstream of the confluence of Nar Khola and Marsyangdi River, Chame Rural Municipality-4. The surface powerhouse is located at the left-bank terrace of the Marsyangdi River, approximately 1.4 km upstream of the confluence of China Khola and Marsyangdi River at Bagarchhap Village, Nashong Rural Municipality wards- 1 and 3. The access road from Powerhouse to headworks site is nearly 13 km.

MMHEP is PRoR type project with daily peaking of 1.66 hours during the dry season. The design discharge (Q40.8 percentage exceedance) of the project is 36.78 m³/s, and the gross head is 430.2m. The diversion structure is a non-overflow concrete gravity dam with gated spillway. The proposed dam is 24m high. The water diverted from Marsyangdi River will be conveyed through a 6075m long HRT to the surface powerhouse on the left bank terrace of Marsyangdi River which is approximately 1.4 km upstream of the confluence of China Khola and Marsyangdi River at Bagarchhap village. The tailrace of MMHEP will be connected with LMMHPP headworks at the downstream end.

The Marsyangdi River is one of the main tributaries of the Gandaki River which meets with the Ganges River in India. The catchment originates at the Himalays in western Nepal and sources from Tilicho Tal which lies at about 5000 masl. The catchment area at the dam axis is 1635 km², of which the area of 901 km² is above 5000 masl. The catchment area at Powerhouse is 1693 km² of which 909 km² is above 5000 masl, a small part of this catchment area also belonging within the Annapurna Peak Natural Reserve. The Marsyangdi Basin has a humid-temperate climate with temperature as well as rainfall intensity varying with altitude. The average annual precipitation in the Marsyangdi river basin is 426 mm at the intake site and 444 mm at the powerhouse site. The long-term mean monthly flow calculated at the intake site has the minimum discharge of 10.62 m³/s in February and the maximum flow of 157.94 m³/s in August. The design flood is taken for 50-year return period and its value is 69 m³/s, while the check flood is taken as 500-year return period and its value is 1053 m³/s.

Geologically, gneiss and sandstone are the main rock types found throughout the project area. Besides these rock types, project area consists of colluvial and alluvial deposits. The left side of the dam axis is on bedrock while the right side has deposits of alluvium; hence bank protection works might be required at the right bank. The settling basin is proposed in the old alluvial deposit at dry cultivated land at the right bank of the River. There is steep rock dipping towards the hill side of the settling basin therefore slope stability problems are not expected. The headrace is a river-crossing just downstream of the settling basin which discharges into the HRT that runs from the left bank of the

river. The major rock type along the HRT is gneiss. The dominant rock type in surge chamber is also gneiss creating favorable chamber-forming conditions. The penstock lies in fractured gneiss with poor rock quality, requiring supports. The surface powerhouse is located on left bank of Marsyangdi River on the rocky hill slopes of mainly gray-grayish-white gneiss.

The diversion structure is a non-overflow type concrete gravity dam with gated spillway having a total crest length of 89.5m. It has two gated-spillway bays and one undersluice bay provided to safely regulate the flow during floods. The dam deck level is at 2584 masl. The Full Supply Level (FSL) is 2582 masl and the Minimum Operation Level is 2579 masl. The invert level of the spillway and undersluice bottom slab and crest is 2563 masl while the original bed level of the river is 2560 masl. The size of spillway gates and openings is 8 x 8.5 (wxh) m and that of the undersluice gate and opening is 3 x 8.5 m (wxh). The dam has been designed to safely pass the flood of 500 years return period i.e. 1053 m³/s of which the two spillway bays and undersluice pass 887 m³/s and 166 m³/s respectively. At times other than floods, the sediments, debris and boulders accumulated in front of the intake is flushed out from time to time through the undersluice.

The side intake structure is provided at the right bank adjacent to the undersluice bay with two openings of size 6 x 5 m (w x h). Coarse trashrack is provided to prevent trash and large size floating debris from entering the orifices. Discharge is conveyed to the settling basin from the intake through a single approach channel of width 10m and height of side walls 6-6.4 m with a top level fixed at 2583 masl. Double-chambered surface settling basin further divided into two flat-bed hoppers in each chamber has been designed to settle suspended sediments of size 0.1 mm with a trapping efficiency of 86.6%. The hydraulic dimensions of the settling basin are 160 x 14 x 13.6 (LxBxH) m. The flushing arrangement is provided at the end of each bay to flush the settled sediments back into the river through a flushing culvert. Intermittent gravity flushing system has been adopted.

The water from settling basin will be conveyed to the headrace tunnel through a power culvert, 3.5x3.5 m and 51.327m in length, from the head pond provided at the outlet of the settling basin. This power culvert also comprises of a river crossing structure to convey the discharge from the settling basin at right bank to the HRT at the left. The length of headrace tunnel is 6075.5 m from tunnel inlet to surge chamber. The surge chamber consists of vertical shaft and upper chamber. The vertical shaft is 6m in diameter and 83.30 m height, the invert of the upper chamber is at 2586 masl which is 74 m from the invert of vertical shaft and HRT intersection which is at 2512 masl. The upper chamber is 180 m in length and divided into two sections each having a length of 90 m with the longitudinal gradient of 1% inclining towards the shaft and a D shape cross section 4.5m width and 5.2-6.1 m in height.

Water is conveyed to the powerhouse through a penstock conduit consisting of three horizontal sections and two vertical-shaft sections. The length of penstock pipe up to the first bifurcation point is 965.42m including bell-mouth and surge shaft offset length, which through two numbers of bifurcated pipes feeds water to two sets of Pelton turbine units housed in the surface powerhouse located at left bank of Marsyangdi River. The bifurcated length of penstocks is 47.08m and the diameter before and after bifurcation is 3.3m and 2.2m respectively. The size of powerhouse is 66 x 25 x 35 (LxBxH) m. The water released from the tailrace of the powerhouse feeds into the HRT of the LMMHPP. The size of the tailrace canal (covered) is 6 x 6 m and 80 m in length. The tailwater level is 2147 masl.

The Manang Marsyangdi Hydro-electric Project will generate a total average energy of 751 GWh annually. Energy generated during the dry and wet seasons is 229 GWh and 522 GWh respectively with 30.5% dry energy in 6 months (December-May). The project is able to sustain a minimum of 1.66 hours of daily peak energy production throughout the dry season months.

The project cost was estimated after detailed rate analysis and quantity estimation for each of the components. The project life has been taken as 30 years, the debt-equity ratio is 80:20, interest rate is 6.8% and an inflation rate of 4% has been considered. The tariff rates of NRs. 8.5 and 8.4 /kWh for dry energy during peaking and non-peaking time, and NRs. 4.8 /kWh for wet energy has been taken. The IRR on total investment is 8.6% and that on equity is 10.4%.

To summarize, MMHEP is found environmentally friendly, technically feasible and financially viable.