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Economic Considerations in Planning of SMMHP Plants

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Contents

- Cost Aspects
- Cost Reduction Measures
- Cost Assessment
- Financial Analysis and Tariff Determination

Cost Aspects of SHP Schemes

- Parameters affecting cost are
 - Physical sizes of Civil Works and E&M Equipments
 - Construction Aspects
 - Operating costs
- Unit cost of hydro schemes is inversely proportional to the head
- Per kW cost may be ranging from Rs 80,000/- to Rs.150,000/- depending upon the layout and capacity of the scheme (1 US\$ = INR 75)
- Costs may vary $\pm 30\%$ depending upon the location of the project and the topographical terrain.
- The cost of generation reduces with time.

Cost Reduction Measures

- The existing irrigation sluices can be used as intake
- The bypass/diversion channel can be eliminated by installing the equipment immediately downstream of the canal drop.
- Completely eliminating the powerhouse structure and design the generators, etc. for outdoor installation.
- Overhead crane can be eliminated by providing a removable latch in the roof.
- By clubbing of falls.
- Use of innovative technology such as rubber dams, siphon intake etc.

- Optimisation of conveyance pipe for run-of-river schemes.
- Optimal selection of electro-mechanical equipment.
- Use of bulb turbine for better efficiency and maintenance.
- Use of variable speed bulb turbines with compact generators.
- Development of high specific speed turbine runner.
- Identification of economic profitability using different type of turbines.
- Use of induction generators
- Use of digital governing control and protection
- Use of Supervisory Control and Data Acquisition System

Types of Cost Estimates

- Preliminary or rough cost estimate
 - Lump sump basis – based on experience on such projects
 - Per unit basis
 - Road / channel etc. on per metre / km basis
 - Building on floor area basis
 - Capacity basis
- Supplementary cost estimates – for additional works
- Revised cost estimate
- Annual repair and maintenance estimate
- Detailed itemized cost estimate

Detailed Itemized Cost Estimate

- Detailed itemized cost estimate based on actual quantities and item rates for civil works and budgetary quotes for equipment.
- Rates for various components of civil structures are generally adopted as per prevailing government schedule of rates.
- Cost of electromechanical units including generator and control panels etc. is based on budgetary price quoted by several manufacturers in the country and experience. Cost of other equipments such as switchyard equipment, crane, ventilation system equipment etc. are based on local enquiry with equipment manufacturers.
- Duties, taxes, freight and insurance charges have been included in the cost of electro-mechanical equipment. The estimates include inspection, erection and commissioning charges, losses on stock and maintenance during construction.

Project Cost

- Cost of different works
 - Civil Works
 - Electro- Mechanical Equipment
- Infrastructure facilities
 - Land
 - Roads
 - Building
 - Tools and Plants
- Other Costs
 - Preliminary
 - Audit and accounts
 - Establishment
 - Interest and taxes

Cost of Civil Works

Civil works costs are estimated based on quantities of different items and their prevailing prices. Major items of civil works are:

- Earthwork in excavation
 - In ordinary soil
 - In soft rock, where blasting is not required
 - In hard rock including blasting
- Concreting in plain cement concrete as well as in reinforced cement concrete including shuttering, mixing, placing in position, compacting and curing.
- Reinforcement steel bars cutting, bending, binding and placing in position.
- Structural steel including fabrication, transportation to site and erection.

Other Items of Civil Works

- Masonry work
- Damp proofing treatment
- Dewatering
- Doors, windows
- Floor finishing
- Plastering
- Sanitary and water supply works
- Drainage
- Fencing
- Paintings

Electro-Mechanical Equipment

- The costs of following items are obtained from different manufacturers/suppliers.
 - Turbines with governing system
 - Generator with excitation system
 - Electrical and mechanical auxiliary
 - Transformer and switchyard

Cost of Other Items

- Preliminaries
 - Cost of pre-construction and construction stage surveys and investigation pertaining to topography, geology, hydrology and construction materials etc.
 - Studies for preparation of project report
- Land
 - May belong to Government/ private having different land use
 - Land required to be acquired will be determined under different categories viz. Forest, cultivated, barren, etc. Cost of acquisition will then be worked out by considering land rates to be found by local enquiry or in consultation with Revenue authorities.
- Temporary buildings for manpower and stores
- Tools and Plants

- Audit and accounts
- Establishment including detailed engineering designs
- Miscellaneous
 - Provision under this will cover the cost of amenities and facilities for staff & workmen, running and maintenance of inspection vehicles, workman's compensation, construction power, security measures and other miscellaneous costs not considered elsewhere.
- Roads and communications
 - Costs to be considered to cover construction/ upgrading/ improvements of approach roads, footpaths, bridal paths.
- Ecology & Environment
 - A hydropower project generally does not disturb/ degrade the environment. Provision may however, be made for compensatory afforestation, re-claiming of construction sites, studies relating to ecology etc.

Schedule of Rate

S. No.	Item	Unit	Rate in Rs.
1.	Earth work in excavation in soft rock and dense hard soil excluding blasting	m ³	
2.	Earth work in excavation in hard rock including blasting	m ³	
3.	Under ground excavation in tunnel	m ³	
4.	Earth work in filling	m ³	
5.	Plain Cement concrete M-10 (1:3:6) in foundation	m ³	
6.	Plain Cement concrete M-15 (1:2:4) in foundation, flooring, slabs, walls, lining etc.	m ³	
7.	Reinforced cement concrete M-20 (1:1.5:3) excluding cost of reinforcement	m ³	
8.	Reinforced cement concrete M-25 (1:1:2) excluding cost of reinforcement	m ³	
9.	M-15 C.C. Block	m ³	
10.	PCC M-20 with nominal	m ³	
11.	Plum concrete M-15 with 40% cement concrete and 60% stone boulder/rock fragments	m ³	
12.	Random Rubble Stone masonry in 1:6 CC	m ³	
13.	12 mm thick cement plaster (1:4)	m ²	
14.	12 mm thick plaster in 1:6	Cum	
15.	M-20 CC in Anchor Block	Cum	
16.	Tor steel in RCC Work bending, binding, transportation etc.	M.T.	
17.	Structural steel like channels angles etc. including fabrication & erection	M.T.	

S. No.	Item	Unit	Rate in Rs.
18.	Gate, Trash rack, Penstock including fabrication and erection	M.T.	
19.	G.I. sheet	m ²	
20.	Heavy duty water proofing	m ²	
21.	Expansion joint (i) 1.75 m ϕ	No.	
22.	Wheel Valve (i) 250 mm ϕ	No.	
23.	M.S. pipe	MT	
24.	Inverted filter	Cum	

Estimate of Quantities and Cost of Civil Works

WEIR & INTAKE

S. No.	Item	Unit	Qty	Rate	Amount (Rs)
1	Excavation				
(i)	Earth work in excavation in ordinary soil and softrock and disposal of excavated earth as obtained to a distance upto 500 m including all leads and lifts, travelling, ramming the foundation trenches, removing roots of trees, shurbs all compete as per approved design, specification and direction of E/I.	Cum			
(ii)	Excavation in hard rock including blasting and disposal upto a distance of 500 m including all leads and lifts as per approved design, specification and direction of E/I.	Cum			
2	Earth work in filling in layers not exceeding 150 mm well watered, rammed, fully compacted and fine dressed with earth obtained after cutting within a lead of 1 km and all lift complete as per specification and direction of E/I.	Cum			
3	Providing PCC. M-10 with nominal mix of 1:3:6 with 4 cm down coarse aggregate, approved coarse sand and cement including vibrating finishing, curing, T&P etc. as per E/I.	Cum			
4	Providing RCC M-20 with approved quality of stone chips 20 down and well graded and clean coarse sand of FM- (2.5 to 3) including screening, shuttering, mixing cement concrete in mixer and placing in position, vibrating, striking, curing taxes and royalty all complete as per specification and direction of E/I.	Cum			

S. No.	Item	Unit	Qty	Rate	Amount (Rs)
5	Providing high tensile Tor steel reinforcement as per approved design and drawing including cartage to work site cutting, bending and binding with annealed wire with cost of wire, removal of rust, placing in position all complete as per specifications and directions of E/I.	MT			
6	Trash rack comprising (200 x 5)mm flats at 30 mm clear spacing 2 x 2.0 m x 2.0 m	MT			
7	Gate with hoists for intake (1.5 m x 2.0 m) and wier (5 m x 5.5 m) two nos.	No.			
8	Protection works at the downstream of wier				
9	River diversion				
	Sub Total Rs.				
	Add 3% Contingency				
	Total Rs.				

POWER HOUSE

S. No.	Item	Unit	Quantity	Rate	Amount (Rs)
1	Excavation				
(i)	Earth work in excavation in ordinary soil and softrock and disposal of excavated earth as obtained to a distance upto 500 m including all leads and lift, travelling, ramming the foundation trenches, removing roots of trees, shurbs all complete as per approved design, specification and direction of E/I.	Cum			
(ii)	Excavation in hard rock including blasting and disposal upto a distance of 500 m including all leads and lifts as per approved design, specification and direction of E/I.	Cum			
2	Earth work in filling in layers not exceeding 150 mm well watered, rammed, fully compacted and fine dressed with earth obtained after cutting within a lead of 1 km and all lift complete as per specification and direction of E/I.	Cum			
4	Providing RCC M-20 with approved quality of stone chips 20 down and well graded and clean coarse sand of FM- (2.5 to 3) including screening, shuttering, mixing cement concrete in mixer and placing in position, vibrating, striking, curing taxes and royalty all complete as per specification and direction of E/I.	Cum			

S. No.	Item	Unit	Quantity	Rate	Amount (Rs)
5	Providing high tensile Tor steel reinforcement as per approved design and drawing including cartage to work site cutting, bending and binding with annealed wire with cost of wire, removal of rust, placing in position all complete as per specifications and directions of E/I.	MT			
6	Providing and fixing roof truss purline and bracing including cost of structural steel fabrication, carrage, erection and 3 coats of painting as per approved drawing, specification and direction of E/I.	MT			
7	Providing and fixing G.I. sheeting of approved thickness and quality including cost of all fittings i.e. washers, rubber washers, 3 bolts etc., all complete as per drawings, specification and direction of E/I.	Sqm			
8	Heavy duty water proofing of power house roof, including cost of all material placement etc. as per drawing specification and direction of E/I.	Sqm			
9	White washing and distemper in three coats over new surface with approved quality of lime including cost of cleaning surface throughly and removing the scales of smoke and mesh mark with rubbing, scaffolding, washing of Jhoma floors all complete as per building specifications and directions of E/I.				

S. No.	Item	Unit	Quantity	Rate	Amount (Rs)
10	Supplying and fixing in position mild steel railings, chequered plates and other mild steel embedments including fabrication, painting etc. as per drawings and specifications and direction of E/I.	MT			
11	Supply and fixing of drainage pipes in Power House				
12	Supplying and fixing P.V.C. seal 150 mm wide				
13	Supplying and fixing rail for E.O.T. crane	MT			
14	Dewatering of Power House Pit				
15	Supplying and fixing floor tiles				
16	Supplying and fixing aluminium door and fitting including glazing				
17	Supplying and fixing steel doors and windows with glazing				
18	Supplying and fixing for sanitary fittings including septic tank				
19	Security fencing around Power House area				
20	Landscaping of power House Area				
21	10 to 25 mm gravel in Switchyard				
22	Protection works on hill and river side				
	Sub Total Rs.				
	Add 3% Contingency				
	Total Rs.				

Abstract of Project Cost

Sl. No.	Particular	Cost Rs. (lacs)
I	Works	
1.	A-Preliminary	
2.	B-Land	
3.	C-Works	
4.	K-Building	
5.	M-Plantation	
6.	O-Miscellaneous	
7.	P-Maintenance	
8.	O-Special T&P	
9.	R-Communication – Approach road (new and remodelling)	
10.	S-Power Plant	
	Total (I – works)	
II	Establishment 8- 10 % of I-Works excluding the cost of ‘B’ land	
III	Ordinary T&P 1% of I-Works	
IV	Losses on Stock 0.25% of C-Works	
V	Suspense	
VI	Receipt and Recoveries	
VII	Indirect Charges	
VIII	1% of I-Works for audits and accounts	
	Sub Total (I to VIII)	
IX	Taxes	
X	IDC	
XI	F.C.	
XII	LADA @ 1-2% of cost	
	Grand Total Rs. Lacs	

Miscellaneous

S. No.	Description of Item	Amount (in Lacs)
1.	Transport vehicle maintenance 2 vehicles @ Rs. 10000/- per year for three years	
2.	Power supply to work sites	
3.	Water supply, sewage & drainage works	
4.	Photography, Vediography	
5.	Telephone connections to work sites	
a).	Installation charges	
b).	Running and maintenance charges @ Rs. 20000/- per year for three years	
6.	Medical aid and health sanitation	
7.	Printing technical literature and publicity	
8.	Workmen compensation	
9.	Security arrangements	
10.	Foundation stone laying ceremonies and project inauguration	
11.	Award to workers	
12.	Entertaining guests & invitees	
13.	Rehabilitation	
14.	Miscellaneous and rounding off	
	Total Rs. Lacs	

Special Tools and Plants

S. No.	Description of Item	Quantity	Amount (in Lacs)
1.	Air Compressor	1	
2.	Concrete Mixture	2	
3.	Concrete Vibrator	2	
4.	Rock Drills and Tripod	-	
5.	Light Vehicle	2	
6.	Workshop Machines and Tools	L.S.	
	Total Rs. Lacs		

Financing Arrangements and Means of Financing

- Financial institutions have different procedures and norms for extending loan facility.
- The means of finance is arrived at from the followings:-
 - Contribution of promoters
 - Equity of developers
 - Loans from different financial institutions.
 - Grant in aid /subsidy from the Government

Phasing of Expenditure

- The project cost shall be spread over the construction period depending upon the payment terms with the executing agencies / suppliers. The following distribution of cost may be taken.

S. No.	Construction Period (Years)	Phasing of Expenditure (%) in different years			
		Year 1	Year 2	Year 3	Year 4
1.	1	100			
2.	2	40	60		
3.	3	25	35	40	
4.	4	20	25	25	30

Interest during Construction

- Interest during construction (IDC) need to be computed based on withdrawal schedule of loan as per phasing of expenditure on prevailing interest rate.

Economic Analysis

- Quantitative evaluation of the economic feasibility of the project.
- A comparison between the benefits and costs of the projects over the life time of the project.

Financial analysis

- Quantitative assessment of the ability of the project to repay the investment on a self-liquidating basis.
- Project to be financially feasible, the revenue receipts over the life time of the project should be more than the project disbursements.

Financial Analysis-terms

- Basic Parameters
- Cost of Project & Means of Finance
- Capital cost
- Debt equity ratio
- Computation of IDC
- Annual expenditure
- O &m Expenditure
- Depreciation – WDV and SLM methods
- Insurance
- Interest on term loan and working capital
- Return on equity
- Generation cost

Financial Analysis - Terms

- Computation of Tariff
- Levellised tariff
- Working Capital Requirement
- Term Loan Repayment
- Income Tax
- Internal Rate of Return
- Debt Service Coverage Ratio
- Benefit cost ratio
- Net present value

Financial Principles

Useful Life	- 40 years
Tariff Period	- 40 years or may vary
Debt Equity Ratio	- 70 : 30
Loan and Finance Charges	
Repayment period	-13 years
Moratorium Period	- construction period + 1 year

Interest Rate

Based on long term prime lending rate (LTPLR) of State Bank of India (SBI) prevalent during the previous year plus 150 basis points

Return on Equity

Discount Rate

- Time value of money

Present Value

$$PV = \sum_{i=1}^n \left[\frac{CF_i}{(1+d)^i} \right] + \left[\frac{S_n}{(1+d)^n} \right]$$

Where,

NPV= Net present value

CF_I = Net cash flow in year I starting with initial investment

S_n = Salvage value

d = discount rate

n = last year of cash flow

Internal Rate of Return (IRR)

- IRR is the discount rate which net present value of project is zero.
- If IRR is less than the interest rate or cost of funding, the project is economically not viable.

Benefit-Cost Ratio (B/C)

- The B/C ratio is the ratio of the present value of benefits to the present value of the costs
- Project with a B/C ratio of less than one is economically infeasible

Economic / Financial Evaluation

- Net present value method- should be positive
- Internal rate return method- more than the cost of capital
- Benefit-cost ratio- more than 1

Benefit Cost Ratio

Discount Rate	11%				
Expenditure	Discount Factor	Present value of expenditure	Receipt	Present value of benefits	Year
	0.11				
65000	0.901	58559			1
75000	0.812	60872			2
12000	0.731	8774	50000	36559.57	3
12000	0.659	7905	50000	32936.55	4
12000	0.593	7121	50000	29672.57	5
12000	0.535	6416	50000	26732.04	6
12000	0.482	5780	50000	24082.92	7
	Total	155426		149983.65	
	BC Ratio	0.965			

Parameters

	Project Financing				
	Project Cost (Rs. Lakhs)	5548.00	Pattern of Debt Withdrawls		
	IDC (Rs. Lakhs)	695.20	Year1	25%	2.50
	Entry tax	110.96	Year2	35%	1.50
	Financial charges (Rs. Lakhs)	40.00	Year3	40%	0.50
	LADA	95.91			
	Total cost (Rs. Lakhs)	6490.08			
7.00	Debt (Rs. Lakhs)	4543.05	Interest	13.00%	
3.00	Equity(Rs. Lakhs)	1947.02	Moratorium	3+1	
	% of Debt	0.70	Payback	10.00	
	Working Capital				
	1/12th of O&M (Rs. Lakhs)	6.94			
60.00	60 days rec. (Rs. Lakhs)	237.43	Interest on Working Capital		
	(Rs. Lacs)	244.37		12.5%	
	Capacity(kW)	3500 * 2			
	PLF	73.00%			
	Units Generated (lacs)	448.60			
5.00%	less:Plant availability losses@5%	22.43			
0.50%	less:Aux Consmp@0.5%	2.24			
2.50%	less:Transmission & Transformation@2.5%	11.22			
	less:water royalty@15/21/33%	67.29	94.21	148.04	
	Units for sale(lacs)	356.64	329.72	275.89	

	Cost of Generation(Rs/unit)	3.25			
	Revenue per unit(Rs.)	4.05			
	Tax Rate	34%			
	Dividend Rate	16%			
	O & M -- % of Project Cost	1.5%			
	Project Cost(Rs. Lacs)	5548.00			
	Internal Rate of Return				
	40 Years	14.16%			
	Cost of Generation(Rs/unit)	3.06			

Parameters

Profitability Statement (Rs. Lacs)											
Year after end of construction	1	2	3	4	5	6	7	8	9	10	11
Gross Revenue	1444.38	1444.38	1444.38	1444.38	1444.38	1444.38	1444.38	1444.38	1444.38	1444.38	1444.38
Less: Expenses											
O & M expenses	83.22	87.38	91.75	96.34	101.15	106.21	111.52	117.10	122.95	129.10	135.56
Gross Margin	1361.16	1357.00	1352.63	1348.04	1343.23	1338.17	1332.86	1327.28	1321.43	1315.28	1308.82
Less Depreciation	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05
Less: Interest											
Term loan interest	590.60	553.68	455.25	356.82	258.39	159.95	61.52	0.00	0.00	0.00	0.00
Working Capital interest	30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55
Preliminary expn. wr. off	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Profit before Tax	597.96	630.71	724.78	818.62	912.24	1005.61	1098.74	1154.68	1148.83	1142.68	1136.22
Tax	0.00	0.00	80.05	115.79	147.88	177.15	204.24	222.24	226.59	229.88	394.94
Profit after Tax	597.96	630.71	644.73	702.83	764.36	828.46	894.50	932.44	922.23	912.80	741.28
Dividend	311.52	311.52	311.52	311.52	311.52	311.52	311.52	311.52	311.52	311.52	311.52
Retained Earnings	286.44	319.19	333.21	391.31	452.83	516.94	582.97	620.92	610.71	601.27	429.76
Unabsorbed Loss	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Accumulated Retained En.	286.44	605.63	938.84	1330.15	1782.98	2299.92	2882.89	3503.81	4114.52	4715.79	5145.56
Profit after tax	597.96	630.71	644.73	702.83	764.36	828.46	894.50	932.44	922.23	912.80	741.28
Add: Interest(Term loan)	590.60	553.68	455.25	356.82	258.39	159.95	61.52	0.00	0.00	0.00	0.00
Add: Depreciation	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05
CFlow from end of year 3	1330.61	1326.45	1242.04	1201.71	1164.80	1130.47	1098.07	1074.50	1064.29	1054.85	883.34
Cost of generation											
O & M expenses	83.22	87.38	91.75	96.34	101.15	106.21	111.52	117.10	122.95	129.10	135.56
Depreciation	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05
Interest on term loan	590.60	553.68	455.25	356.82	258.39	159.95	61.52	0.00	0.00	0.00	0.00
Working Capital interest	30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55
Return of Equity	311.52	311.52	311.52	311.52	311.52	311.52	311.52	311.52	311.52	311.52	311.52
Total annual cost	1157.94	1125.19	1031.13	937.28	843.66	750.29	657.17	601.22	607.08	613.23	619.68
Generation cost per unit	3.25	3.15	2.89	2.63	2.37	2.10	1.84	1.69	1.70	1.72	1.74
Cash flows	-3082.79	-1590.07	-1817.22	1330.61	1326.45	1242.04	1201.71	1164.80	1130.47	1098.07	1074.50
IRR 40 years	14.155%										

12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1444.38	1335.37	1335.37	1335.37	1335.37	1335.37	1335.37	1335.37	1335.37	1335.37	1335.37	1335.37	1335.37	1335.37	1335.37
142.33	149.45	156.92	164.77	173.01	181.66	190.74	200.28	210.29	220.81	231.85	243.44	255.61	268.39	281.81
1302.05	1185.92	1178.45	1170.60	1162.36	1153.71	1144.63	1135.09	1125.08	1114.56	1103.52	1091.93	1079.76	1066.98	1053.56
142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55
1129.45	1013.32	1005.85	998.00	989.76	981.11	972.03	962.49	952.48	941.96	930.92	919.33	907.16	894.38	880.96
397.90	362.84	364.03	364.53	364.45	363.86	362.80	361.33	359.48	357.27	354.72	351.84	348.65	345.14	341.32
731.54	650.48	641.82	633.47	625.31	617.26	609.23	601.16	593.00	584.70	576.21	567.49	558.51	549.24	539.63
311.52	311.52	311.52	311.52	311.52	311.52	311.52	311.52	311.52	311.52	311.52	311.52	311.52	311.52	311.52
420.02	338.96	330.30	321.94	313.79	305.73	297.70	289.64	281.48	273.17	264.68	255.97	246.99	237.71	228.11
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5565.58	5904.53	6234.83	6556.77	6870.56	7176.29	7474.00	7763.63	8045.11	8318.28	8582.96	8838.93	9085.92	9323.63	9551.74
731.54	650.48	641.82	633.47	625.31	617.26	609.23	601.16	593.00	584.70	576.21	567.49	558.51	549.24	539.63
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05
873.60	792.54	783.87	775.52	767.36	759.31	751.28	743.21	735.05	726.75	718.26	709.54	700.57	691.29	681.69
142.33	149.45	156.92	164.77	173.01	181.66	190.74	200.28	210.29	220.81	231.85	243.44	255.61	268.39	281.81
142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55
311.52	311.52	311.52	311.52	311.52	311.52	311.52	311.52	311.52	311.52	311.52	311.52	311.52	311.52	311.52
626.46	633.57	641.05	648.89	657.13	665.78	674.87	684.40	694.42	704.93	715.97	727.56	739.74	752.52	765.94
1.76	1.78	1.80	1.82	1.84	1.87	1.89	1.92	1.95	1.98	2.01	2.04	2.07	2.11	2.15
1064.29	1054.85	883.34	873.60	792.54	783.87	775.52	767.36	759.31	751.28	743.21	735.05	726.75	718.26	709.54

27	28	29	30	31	32	33	34	35	36	37	38	39	40
1335.37	1335.37	1335.37	1335.37	1117.35	1117.35	1117.35	1117.35	1117.35	1117.35	1117.35	1117.35	1117.35	1117.35
295.90	310.70	326.23	342.54	359.67	377.66	396.54	416.37	437.18	459.04	481.99	506.09	531.40	557.97
1039.47	1024.67	1009.14	992.83	757.68	739.69	720.81	700.99	680.17	658.31	635.36	611.26	585.95	559.38
142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55
866.87	852.07	836.54	820.23	585.08	567.09	548.21	528.39	507.57	485.71	462.76	438.66	413.35	386.78
337.20	332.77	328.02	322.95	243.43	237.70	231.62	225.19	218.39	211.21	203.63	195.63	187.21	178.34
529.67	519.30	508.52	497.28	341.65	329.40	316.59	303.20	289.18	274.50	259.13	243.02	226.14	208.44
311.52	311.52	311.52	311.52	311.52	311.52	311.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00
218.14	207.78	196.99	185.75	30.13	17.87	5.07	303.20	289.18	274.50	259.13	243.02	226.14	208.44
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9769.88	9977.66	10174.66	10360.41	10390.54	10408.41	10413.48	10716.67	11005.85	11280.35	11539.48	11782.50	12008.64	12217.08
529.67	519.30	508.52	497.28	341.65	329.40	316.59	303.20	289.18	274.50	259.13	243.02	226.14	208.44
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05
671.72	661.36	650.57	639.33	483.70	471.45	458.64	445.25	431.23	416.56	401.18	385.08	368.19	350.49
295.90	310.70	326.23	342.54	359.67	377.66	396.54	416.37	437.18	459.04	481.99	506.09	531.40	557.97
142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55	30.55
311.52	311.52	311.52	311.52	311.52	311.52	311.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00
780.03	794.82	810.36	826.67	843.80	861.78	880.66	588.97	609.78	631.64	654.59	678.69	704.00	730.57
2.19	2.23	2.27	2.32	2.37	2.42	2.47	1.65	1.71	1.77	1.84	1.90	1.97	2.05
700.57	691.29	681.69	671.72	661.36	650.57	639.33	483.70	471.45	458.64	445.25	431.23	416.56	401.18

Repayment of Debt (Rs. Lakhs)

Amount	4543.05										
Interest	13.00%										
Year		1	2	3	4	5	6	7	8	9	10
Beg. Bal.		1135.76	2725.83	4543.05	4543.05	4543.05	3785.88	3028.70	2271.53	1514.35	757.18
Interest					590.60	553.68	455.25	356.82	258.39	159.95	61.52
Principal						757.18	757.18	757.18	757.18	757.18	757.18
End Bal.		1135.76	2725.83	4543.05	4543.05	3785.88	3028.70	2271.53	1514.35	757.18	0.00
Total Payment		0.00	0.00	0.00	590.60	1310.86	1212.43	1113.99	1015.56	917.13	818.70
	(Rs. Lakhs)										
Year	Loan	Repay.	Quar. Intr.	Annual Intr.							
I	4543.05	0.00	147.65								
	4543.05	0.00	147.65								
	4543.05	0.00	147.65								
	4543.05	0.00	147.65	590.60							
II	4543.05	189.29	147.65								
	4353.76	189.29	141.50								
	4164.47	189.29	135.35								
	3975.17	189.29	129.19	553.68							
III	3785.88	189.29	123.04								
	3596.58	189.29	116.89								
	3407.29	189.29	110.74								
	3218.00	189.29	104.58	455.25							

IV	3028.70	189.29	98.43								
	2839.41	189.29	92.28								
	2650.11	189.29	86.13								
	2460.82	189.29	79.98	356.82							
V	2271.53	189.29	73.82								
	2082.23	189.29	67.67								
	1892.94	189.29	61.52								
	1703.64	189.29	55.37	258.39							
VI	1514.35	189.29	49.22								
	1325.06	189.29	43.06								
	1135.76	189.29	36.91								
	946.47	189.29	30.76	159.95							
VII	757.18	189.29	24.61								
	567.88	189.29	18.46								
	378.59	189.29	12.30								
	189.29	189.29	6.15	61.52							

Depreciation

Asset	Amount (Rs. Lakhs)	SLM -- MNES		WDV -- Income Tax
<u>Building & Civil Works</u>				10%
Diversion weir and intake	286.25	3.40%	9.73	
Head and Tail race Channel/tunnel	437.99	1.95%	8.54	
Desilting, surge tank	71.11	3.40%	2.42	
Penstock	321.71	3.40%	10.94	
Power Hs. Building	943.18	3.40%	32.07	
Building	130.00	3.02%	3.93	
Roads	425.00	3.02%	12.84	
Total Rs.	2615.24	lacs	80.46	lakhs
<u>Plant & Mach.</u>				15%
Electro mech equipment	1811.64	3.40%	61.60	
Total Rs.	1811.64	lacs	61.60	lakhs

Depreciation

Year	1	2	3	4	5	6	7	8	9	10	11
SLM	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05
Accumulated Dep.	142.05	284.11	426.16	568.22	710.27	852.32	994.38	1136.43	1278.49	1420.54	1562.59
WDV											
Cost -- Building	2615.24	2353.72	2118.34	1906.51	1715.86	1544.27	1389.85	1250.86	1125.78	1013.20	911.88
Plant & Mach.	1811.64	1358.73	1019.05	764.29	573.21	429.91	322.43	241.82	181.37	136.03	102.02
Depreciation -- Building	261.52	235.37	211.83	190.65	171.59	154.43	138.98	125.09	112.58	101.32	91.19
-- Mach.	452.91	339.68	254.76	191.07	143.30	107.48	80.61	60.46	45.34	34.01	25.50
Total Dep.	714.43	575.05	466.60	381.72	314.89	261.90	219.59	185.54	157.92	135.33	116.69
Accumulated Dep.	714.43	1289.49	1756.08	2137.81	2452.70	2714.60	2934.19	3119.74	3277.66	3412.98	3529.68
Profit before Tax	597.96	630.71	724.78	818.62	912.24	1005.61	1098.74	1154.68	1148.83	1142.68	1136.22
Add: SLM dep	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05
Less: WDV dep	714.43	575.05	466.60	381.72	314.89	261.90	219.59	185.54	157.92	135.33	116.69
Taxable Profit	25.58	197.71	400.24	578.96	739.40	885.76	1021.20	1111.19	1132.96	1149.41	1161.58
Tax			80.05	115.79	147.88	177.15	204.24	222.24	226.59	229.88	394.94

12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05
1704.65	1846.70	1988.76	2130.81	2272.87	2414.92	2556.97	2699.03	2841.08	2983.14	3125.19	3267.24	3409.30	3551.35	3693.41
820.69	738.62	664.76	598.28	538.45	484.61	436.15	392.53	353.28	317.95	286.16	257.54	231.79	208.61	187.75
76.51	57.39	43.04	32.28	24.21	18.16	13.62	10.21	7.66	5.75	4.31	3.23	2.42	1.82	1.36
82.07	73.86	66.48	59.83	53.85	48.46	43.61	39.25	35.33	31.80	28.62	25.75	23.18	20.86	18.77
19.13	14.35	10.76	8.07	6.05	4.54	3.40	2.55	1.92	1.44	1.08	0.81	0.61	0.45	0.34
101.20	88.21	77.24	67.90	59.90	53.00	47.02	41.81	37.24	33.23	29.69	26.56	23.78	21.32	19.12
3630.87	3719.08	3796.32	3864.22	3924.11	3977.11	4024.13	4065.94	4103.18	4136.41	4166.11	4192.67	4216.45	4237.77	4256.88
1129.45	1013.32	1005.85	998.00	989.76	981.11	972.03	962.49	952.48	941.96	930.92	919.33	907.16	894.38	880.96
142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05
101.20	88.21	77.24	67.90	59.90	53.00	47.02	41.81	37.24	33.23	29.69	26.56	23.78	21.32	19.12
1170.30	1067.16	1070.66	1072.16	1071.92	1070.17	1067.06	1062.74	1057.29	1050.79	1043.28	1034.82	1025.43	1015.12	1003.90
397.90	362.84	364.03	364.53	364.45	363.86	362.80	361.33	359.48	357.27	354.72	351.84	348.65	345.14	341.32

27	28	29	30	31	32	33	34	35	36	37	38	39	40
142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05
3835.46	3977.51	4119.57	4261.62	4403.68	4545.73	4687.78	4829.84	4971.89	5113.95	5256.00	5398.05	5540.11	5682.16
168.97	152.08	136.87	123.18	110.86	99.78	89.80	80.82	72.74	65.46	58.92	53.03	47.72	42.95
1.02	0.77	0.58	0.43	0.32	0.24	0.18	0.14	0.10	0.08	0.06	0.04	0.03	0.02
16.90	15.21	13.69	12.32	11.09	9.98	8.98	8.08	7.27	6.55	5.89	5.30	4.77	4.30
0.26	0.19	0.14	0.11	0.08	0.06	0.05	0.03	0.03	0.02	0.01	0.01	0.01	0.01
17.15	15.40	13.83	12.43	11.17	10.04	9.03	8.12	7.30	6.57	5.91	5.31	4.78	4.30
4274.04	4289.44	4303.27	4315.69	4326.86	4336.90	4345.92	4354.04	4361.34	4367.91	4373.81	4379.12	4383.91	4388.21
866.87	852.07	836.54	820.23	585.08	567.09	548.21	528.39	507.57	485.71	462.76	438.66	413.35	386.78
142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05
17.15	15.40	13.83	12.43	11.17	10.04	9.03	8.12	7.30	6.57	5.91	5.31	4.78	4.30
991.77	978.73	964.76	949.85	715.97	699.11	681.24	662.32	642.32	621.20	598.90	575.40	550.62	524.53
337.20	332.77	328.02	322.95	243.43	237.70	231.62	225.19	218.39	211.21	203.63	195.63	187.21	178.34

Debt Service Coverage Ratio (Rs. Lakhs)

Year after end of construction	1	2	3	4	5	6	7	8	9	10	TOTAL
Profit after Tax	597.96	630.71	724.78	818.62	912.24	1005.61	1098.74	1154.68	1148.83	1142.68	9234.85
Add: Depreciation	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	1420.54
Add: Prelim. Expn.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Add: Interest - Term Loan	590.60	553.68	455.25	356.82	258.39	159.95	61.52	0.00	0.00	0.00	2436.21
Total (1)	1330.61	1326.45	1322.08	1317.50	1312.68	1307.62	1302.31	1296.74	1290.88	1284.73	13091.61
Interest	590.60	553.68	455.25	356.82	258.39	159.95	61.52	0.00	0.00	0.00	2436.21
Repayment	0.00	757.18	757.18	757.18	757.18	757.18	757.18	0.00	0.00	0.00	4543.05
Total (2)	590.60	1310.86	1212.43	1113.99	1015.56	917.13	818.70	0.00	0.00	0.00	6979.27
DSCR(1)/(2)	2.25	1.01	1.09	1.18	1.29	1.43	1.59				1.88
Return on Equity											
Profit after Tax	597.96	630.71	724.78	818.62	912.24	1005.61	1098.74	1154.68	1148.83	1142.68	
Equity share Capital	1947.02	1947.02	1947.02	1947.02	1947.02	1947.02	1947.02	1947.02	1947.02	1947.02	
ROE	31%	32%	37%	42%	47%	52%	56%	59%	59%	59%	
Return on Capital Employed											
Gross Profit	1361.16	1357.00	1352.63	1348.04	1343.23	1338.17	1332.86	1327.28	1321.43	1315.28	
Less: Depreciation	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	142.05	
Total(1)	1219.11	1214.94	1210.58	1205.99	1201.17	1196.11	1190.80	1185.23	1179.37	1173.22	
Capital Employed	6490.08	5732.90	4975.72	4218.55	3461.37	2704.20	1947.02	1947.02	1947.02	1947.02	
Total(2)	6490.08	5732.90	4975.72	4218.55	3461.37	2704.20	1947.02	1947.02	1947.02	1947.02	
ROCE(1)/(2)	19%	21%	24%	29%	35%	44%	61%	61%	61%	60%	

General Cost and Tariff

YEAR			1	2	3	4	5	6	7	8
Units Generated		units in Lacs.	1021.16	1021.16	1021.16	1021.16	1021.16	1021.16	1021.16	1021.16
FIXED COST										
O & M Expenses		Rs. In lacs	494.68	522.98	552.89	584.51	617.95	653.30	690.66	730.17
Depreciation		Rs. In lacs	1117.31	1117.31	1117.31	1117.31	1117.31	1117.31	1117.31	1117.31
Interest on term Loan		Rs. In lacs	1708.99	1475.35	1322.64	1183.42	1044.19	904.96	765.74	626.51
Interest on Working Capital Loan		Rs. In lacs	78.27	78.27	78.27	78.27	78.27	78.27	78.27	78.27
Return on Equity		Rs. In lacs	1172.71	1172.71	1172.71	1172.71	1172.71	1172.71	1172.71	1172.71
TOTAL COST		Rs. In lacs	4571.96	4366.62	4243.82	4136.22	4030.43	3926.55	3824.69	3724.97
Tariff p.u			4.48	4.28	4.16	4.05	3.95	3.85	3.75	3.65
Discount Factor(B)	13.10%	1.1310	0.88	0.78	0.69	0.61	0.54	0.48	0.42	0.37
(I)										
C= (A*B)			3.96	3.34	2.87	2.48	2.13	1.84	1.58	1.36
(II)										
Levelised Teriff for 13 Yrs			3.94							
Levelised Teriff for 35 Yrs			3.78							

9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1021.16	1021.16	1021.16	1021.16	1021.16	1021.16	1021.16	1021.16	1021.16	1021.16	1021.16	1021.16	1021.16	1021.16	1021.16
771.94	816.09	862.77	912.12	964.29	1019.45	1077.76	1139.41	1204.59	1273.49	1346.33	1423.34	1504.76	1590.83	1681.83
1117.31	1117.31	1117.31	1117.31	166.98	166.98	166.98	166.98	166.98	166.98	166.98	166.98	166.98	166.98	166.98
487.29	348.06	208.84	69.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
78.27	78.27	78.27	78.27	78.27	78.27	78.27	78.27	78.27	78.27	78.27	78.27	78.27	78.27	78.27
1172.71	1172.71	1407.25	1407.25	1407.25	1407.25	1407.25	1407.25	1407.25	1407.25	1407.25	1407.25	1407.25	1407.25	1407.25
3627.51	3532.44	3674.44	3584.56	2616.80	2671.96	2730.27	2791.92	2857.09	2925.99	2998.84	3075.85	3157.26	3243.34	3334.33
3.55	3.46	3.60	3.51	2.56	2.62	2.67	2.73	2.80	2.87	2.94	3.01	3.09	3.18	3.27
0.33	0.29	0.26	0.23	0.20	0.18	0.16	0.14	0.12	0.11	0.10	0.09	0.08	0.07	0.06
				6.09										
1.17	1.01	0.93	0.80	0.52	0.47	0.42	0.38	0.35	0.31	0.28	0.26	0.23	0.21	0.19
				23.99										

24	25	26	27	28	29	30	31	32	33	34	35
1021.16	1021.16	1021.16	1021.16	1021.16	1021.16	1021.16	1021.16	1021.16	1021.16	1021.16	1021.16
1778.03	1879.73	1987.25	2100.92	2221.09	2348.14	2482.45	2624.45	2774.57	2933.27	3101.06	3278.44
166.98	166.98	166.98	166.98	166.98	166.98	166.98	166.98	166.98	166.98	166.98	166.98
78.27	78.27	78.27	78.27	78.27	78.27	78.27	78.27	78.27	78.27	78.27	78.27
1407.25	1407.25	1407.25	1407.25	1407.25	1407.25	1407.25	1407.25	1407.25	1407.25	1407.25	1407.25
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3430.53	3532.23	3639.76	3753.43	3873.60	4000.65	4134.96	4276.96	4427.07	4585.78	4753.56	4930.94
3.36	3.46	3.56	3.68	3.79	3.92	4.05	4.19	4.34	4.49	4.66	4.83
0.05	0.05	0.04	0.04	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.01
											7.53
0.18	0.16	0.15	0.13	0.12	0.11	0.10	0.09	0.08	0.08	0.07	0.06
											28.43

Online training of SAARC Professionals on Small, Mini and Micro Hydro Power Generation (Sept 13 - 17, 2021)

Thank you

