Harit Dynamics Pvt Ltd.

Date: 29.08.2017

To,

The Chief Secretary,
Government of Nagaland,
Kohima.

Sub: Expression of interest to setup Greenfield Small Hydro Power Project in Tuensang District.

Dear Sir,

We propose to set up **Small Hydro Project** across the **Yijung** River in the Hakchang Village of the Tuensang District. This is being proposed under a community private partnership initiative. The village and tribal council are being represented by REV CHINGMAK of the M/s Eleutheros Christian Society.

The proposed site has a potential to optimally generate 22.5 MWe of power. We have conducted extensive surveys and studies to ascertain the power potential and to arrive at details of project components.

This was made possible due to the encouragement extended by your good office vide meeting dated 15.03.2017.

We have also embarked on a dialogue with the concerned tribe and the village council through M/s. ECS, who are representing the interest of the respective tribes and village council belonging to that area, and we are happy to state that they are willing to be associated with us in setting up of the project, subject to mutually acceptable and beneficial terms and conditions.

We request you to kindly acknowledge our intent to establish this Power Project under the Community Private Initiative ambit and support us in this endeavour.

Thanking You,

With Regards
M/s Harit Dynamics Pvt Ltd

Narayana R. Bhide
Executive Director

Copy To: Power Secretary, Government of Nagaland, Kohima.

Address: 'DURGA', No: 553, 1st Main, R.M.V, II Stage 3rd Block, Dollars Colony, Bengaluru - 560094

HARIT DYNAMICS PVT. LTD.

&

ELEUTHEROS CHRISTIAN SOCIETY

HAK CHANG SMALL HYDRO PROJECT

ON THE

YIJUNG RIVER

TUENSANG DISTRICT, NAGALAND STATE

DETAILED PROJECT REPORT

(3 x 7500 Kw)

CONSULTANTS

M/s. RENEN RESOURCES

Bengaluru

HAK CHANG SMALL HYDRO PROJECT
ON THE YIJUNG RIVER NEAR TUENSANG DISTRICT, NAGALAND STATE

DETAILED PROJECT REPORT
(3 x 7500 kW = 22500 kW)

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HAK CHANG SMALL HYDRO PROJECT (3 x 7500 kW)

PROJECT ALLOTMENT AND PROFILE OF THE DEVELOPER

Proposed **HAK CHANG SMALL HYDRO PROJECT** (H.C.S.H.P.) is on Yijung river near Tuensang District, M/s **HARIT DYNAMICS PVT. LTD.** associated with M/s. **ELEUTHEROS CHRISTIAN SOCIETY,** Nagaland**.** for the develop ment of the scheme.

M/s HARIT DYNAMICS PVT. LTD. (H.D.P.L.) has investigated the potential of the site and it is contemplated to develop this Small Hydro Project. This report attempts to avail the maximum power out put available at this site. By the utilization of the head available in the Yijung river in the Tuensang District, a 22500 KW plant is found to be appropriate considering the head and discharge available at this project site.

M/s. ELEUTHEROS CHRISTIAN SOCIETY, Nagaland

Eleutheros Christian Society is a non-governmental organization established in 1993. The organization is operational in Nagaland. Eleutheros Christian Society works in the area of Advocacy and Research, Right to Information & Advocacy, etc. The NGO works towards the promotion of sustainable development.

M/s HARIT DYNAMICS PVT. LTD.

It is incorporated under Companies Act and is pursuing the business of Small hydro power development.

CHECK LIST

01.	NAME OF THE PROJECT	HAK CHANG SHP
02.	LOCATION	
	i. State	Nagaland
	ii. District	Tuensang
03.	CATEGORY OF THE PROJECT	Small Hydel Scheme
04.	PLANNING	
	Has the over all development of the stream / canal prepared and stages of development discussed briefly?	Yes
	Have the alternatives proposals been studied and their merits and demerits discussed?	Yes
	i. Stream/Surveys	Yes
	ii. Head works surveys	Yes
	iii. Plant site and camp site	Yes
	iv. Water Conductor System	Yes
	v. Power House, Switchyard, Tailrace	Yes
	vi. Communication etc.	Yes

05. GEOLOGY

Have the geological surveys for head works, power house and tail – race, etc., been carried out and report on general geology of the area and on geology of the site of principal structures appended?	Yes

06. FOUNDATION INVESTIGATIONS

Have the foundation investigations for the major civil structures and of the schemes, etc., been carried out?	Yes

07. MATERIAL SURVEYS

Have the surveys and laboratory tests for construction material, like previous and impervious soils, sand, aggregate etc., been carried out?	Yes

08. HYDROLOGICAL & METEOROLOGICAL INVESTIGATIONS

Have the hydrological and meteorological investigations been carried out and status of data discussed in report?

i.	Rainfall in the catchment	Yes
ii.	Gauge and discharge data of the stream	Yes

09. HYDROLOGY

Have the hydrology studies been carried out to establish the availability of water for the benefits envisaged, and what is the dependability of the potential?	Yes

10. LAND ACQUISITION & RESETTLEMENT

Have the provisions for land acquisition, and resettlement been considered?	Yes
Have the socio – economic problems involved in resettlement been investigated and discussed?	Does not arise

11. DESIGN

Has the layout of the project area, viz., location of diversion structure, workshop sheds, offices, camps, etc., been finalized?	Yes
Have the preliminary designs prepared for the following components?	
i. Diversion structure or weir etc.	Yes
ii. Power house & switchyard	Yes
iii. Power house eqpt., LT/HT switching eqpt. & control and protection eqpt.	Yes

12. POWER BENEFITS

Have the following points been discussed?		
i.	Total energy production and installed capacity of the grid system.	Yes
ii.	Energy generation from one project, firm power, seasonal power and total power.	Yes
iii.	Proposals for transmission and or connecting to the existing system, etc.,	Yes
iv.	Cost of generation power kW installed, power kWh generated as compared to the various hydel project and various services in the region to justify the economic viability of the scheme.	Yes

13. CONSTRUCTION PROGRAMME

Are the major components of work proposed to be done departmentally or through contractor?		Through Contractor
Have the year / month – wise quantities of the following items worked out of various components of the project?		
i.	Excavation-soft & hard strata	This will be worked out before
ii.	Earth work in filling	Commencement of work

iii. Stone for masonry
iv. Coarse aggr. For concrete
v. Steel for various sizes and type of reinforcement
vi. Cement
vii. Other materials – P.O.L Electricity

14. ESTIMATE

Is the estimate prepared	Yes
Have the analysis of rates for various major items of works for the major components of the project been furnished, with the basis of analysis and the price index at which the estimate is based?	Yes

15. ECOLOGICAL & ENVIRONMENT ASPECTS

Is the area likely to have any environmental and ecological problems due to the altered surface water pattern and preventive / corrective measures discussed?	No problems of ecology or environment being an existing scheme

16. CAMPS AND BUILDINGS

Has the planning of the camps / buildings been done?	Yes

17. SOIL CONSERVATION

Is the need for soil conservation measures in the project discussed?	Yes

SECTION – 1

EXECUTIVE SUMMARY

1.01 OBJECTIVE OF DPR

The objective of this Detailed Project Report (DPR) is to establish technical feasibility and economic viability for development of Small Hydro Electric Project on Yijung river near Tuensang District, Nagaland State , India.

1.02 PURPOSE

The basic purpose of the project development is to harness the replenishable source of energy due to head available in Yijung river. The energy generated will be evacuated to the available nearest grid. The energy generated from the project would be fed to the State Grid. This would help to strengthen the local grid and quality of power will improve with local area.

1.03 YIJUNG RIVER:

Yijung river originates from Nuroto hill area Zunheboto district. The river traverses towards north along the border of Mokokchung and Tuensang districts. The main tributaries of the river are Yangyu of Tuensang district and Nanung in Langpangkong range. The rivers flows further northward and leaves the hill near naginimora and finally merges with Brahmaputra river in the plains of Assam.

1.04 PROJECT

This **Hak Chang Small Hydro Project** is a run-of-the river development and is proposed using the natural fall of the Yijung river. The scheme utilizes seasonal monsoon discharges. This Small Hydel Scheme is proposed utilising the maximum Gross head of 118 m available at the proposed location in the Yijung river near Tuensang District. As about 118 m Gross Head and 23 cumecs discharge is available in the stream , it is proposed to install Small Hydel Project to meet the power shortage as well as to tap Renewable Energy Sources. So the proposed scheme is formulated for design discharge of 23 cumecs and 115m head. The total capacity of the scheme is 22500 KW with 3 units of 7500 KW.

1.05 HYDROLOGY

The stream was gauged by the developer at the downstream of the proposed project. For this purpose a gauge weir was constructed by the developer. This gauged data is used for our analysis and the flow data obtained from the above has been deduced based on catchment area proportion and the data is arrived for the proposed weir location. By using Rainfall run off correlation method and the catchment area the ten years flow data is obtained by using suitable correlation factor. This discharge data and the observed data is studied and since there is no much difference the observed data is considered for hydrological analysis.

1.06 DESIGN PHILOSOPHY

The gauged discharge data obtained has been deduced based on catchment area proportion and the data is arrived for a period of 1 years and used for analysis.

The project is designed proposing a Small diversion weir across Yijung River with an FRL of EL 742 m so that implementation of a simple ungated weir would be easier and safer. The weir is provided with a scouring sluice.

An Intake Structure with a course trash rack and two motorised gates are proposed on right side of the weir to draw controlled discharges into water conductor system.

The water conductor system consists of steel pipe of 2.4 m dia. 2800 m long taking off from the Left Blank of weir .

An Steel surge tank of 6.5m diameter projecting above the ground to a height of about 18 m is proposed. A controlling gate arrangement is proposed outside Surge tank.

From surge tank, a Penstock of 2.4 m diameter will run for 2800 m long which will trifurcate into three individual penstocks of 1.2 m diameter near power house, each about 25m long to feed three units of 7500 kW proposed to be installed for power generation.

Each turbine unit is provided with a inlet valve of 1.2 m diameter. The powerhouse, draft tube structure and tail race pool of about 18m long are proposed to be connected to a tail race channel of about 200m long to lead the water back into the river after power generation.

The powerhouse is located on the right side of the river in a gently sloping terrain to avoid huge excavations. This powerhouse utilizes economically exploitable gross head of 118 m. The powerhouse is designed to provide with three units each of 7500 kW rated capacity based on the gauged flows.

1.07 POWER STUDIES

Power studies are carried out to exploit economic power potential based on one years gauged data. The power studies are carried out to select the optimum power potential.

1.08 INSTALLED CAPACITY

The unit capacity of 2 x 10000 KW, 3 x 7500 KW were studied. The unit capacity 3 x 75000 KW has been selected keeping in view variations in flows based on discharge data for 1 years. It is observed that three units of 7500 KW is found to be more suitable than other alternative studied with lower capacity unit.

1.09 DEVELOPMENT OF THE SCHEME

The economic viability of the project has been examined for a capacity of 3 x 7500 KW. The Scheme is found to be technically feasible and economically viable.

1.10 EQUIPMENT

The Horizantal Francis turbine and Synchronous generator is proposed.

1.11 POWER TRANSMISSION

It is proposed to generate the power at 11kV and would be step up to 33 kV in the Out Door Switch Yard near the Power House. It is proposed to have 33 kV double circuit AB cables from the Switch Yard up to the neariest sub station.

1.12 ENERGY

The mean energy estimated based on the 1 years discharge data is worked out to 72.00 MU. Considering 0.03 MU of gross energy for the auxiliary loss and transmission loss the net saleable energy works out to 72 MU and the same is considered for financial evaluation of the project.

1.13 ESTIMATES

The cost estimates of civil works and Electro Mechanical works are prepared based on present price level by adopting schedule of rates for civil works and budgetary offers for E&M works. The cost of the project works out to Rs. 197.33 Crores without IDC and Rs. 225 Crores with IDC.

1.14 FINANCIAL RESOURCES

The financial resources would be tied up with a Debt Equity ratio of 75:25 by seeking loan assistance from financial institutions/ Banks like IREDA, IDBI, etc. The promoters will be arranging the equity.

1.15 COST OF GENERATION

The cost of generation during first year works out to and average cost of generation for first 10 years is also worked out.

1.16 FINANCIAL VIABILITY

The sale rate for first year is arrived based on the tariff adopted by Nagaland Govt., as per the guidelines of NLREC. The average sale rate for first 10 years period is worked out to be uniform.

1.17 SCHEDULE

The project will be completed in the quickest possible period of 24 months. It is proposed to make advance planning by commencing the civil works.

SECTION – 2

SALIENT FEATURES

2.01 LOCATION

Sl. No.	Description	Particulars
1	State	Nagaland
2	District	Tuensang

2.02 POWER SCHEME

Sl. No.	Description	Particulars
1.	Type of Project	Run of river scheme
2.	Name of the River	Yijung River
3.	**Geographical Co-ordinates**	
a.	**Diversion Weir**	
i	Latitude	94° 51’ 45.02”
ii	Longitude	26° 18’ 4.19”
b.	**Power House**	
i	Latitude	94° 52’ 12.80”
ii	Longitude	26° 18’ 38.36”

2.03 HYDROLOGY

Sl. No.	Description	Particulars
1	Source of water	Yijung River
2	Catchment area of (Sq.km)	175
3	Design inflow flood (Cumecs)	750
4	Flow availability for Power Generation	8– 10 months
5.	Design Discharge (Cumecs)	23.0

2.04 HEAD

Sl. No.	Description	Particulars
1	Maximum gross head (m)	118.0
2	Gross rated head (m)	118.0
3	Net rated head (m)	115.0

2.05 POWER & ENERGY POTENTIAL

Sl. No.	Description	Particulars
1	Installed capacity (KW)	22500
2	Number of Units (Nos.)	3
3	Rated capacity (KW)	7500
4	Gross annual Energy (MU)	72.00
5	Mean Saleable Energy (MU)	71.97

2.06 DIVERSION WEIR

Sl. No.	Description	Particulars
1	Type	Gravity
2	Shape of Crest	Ogee
3	Crest level (ELM)	+ 742.00
4	Capacity of spill way (Cumecs)	750.0
5	Head over the Crest (m)	2.75
6	Rear Slope	0.7:1
7	Length of Weir (m) including non over flow	87.00
8	Full Reservoir Level (ELM)	+742.00
9	Top of Non Overflow section (ELM)	+ 745.0
10	Height of the Weir (M)	6.0
11	Average Bed Level (ELM)	+745.0
12	Type of Construction	RCC
13	Type of energy dissipation	USBR - IV

2.07 INTAKE STRUCTURE / HEAD REGULATOR

Sl. No.	Description	Particulars
1	Number of vents (Nos)	1
2	Gate vent size (m x m)	3.75 x 3.75
3	Sill level (ELM)	+737.63
4	Top level (ELM)	+745.00
5	Length (m)	18.0
6	Width (m)	10.0
7	Normal water level (ELM)	+735.00
8	Type of construction	RCC

2.08 PENSTOCK OF 2.4 M DIA

Sl. No.	Description	Particulars
1	Penstock (Quantity)	One
2	Shell thickness (mm)	10 to 14
3	Diameter of penstock (m)	2.4
4	Length (m)	2800
5	Bends (Quantity)	8

2.09 SURGE SHAFT

Sl. No.	Description	Particulars
1	Type	Simple
2	Diameter (m)	6.5
3	Sill level (ELM)	717.00
4	Top level (ELM)	735.00
5	FRL (ELM)	733.00
6	Maximum surge level (ELM)	732.00
7	Height of surge tank (m)	18
8	Type of construction	Steel

2.10 GATES, HOISTS AND PENSTOCK

Sl. No.	Description	Particulars
A	**Details of Separate penstocks**	
1.	No. of Unit penstock (Quantity)	3
2	Diameter of penstock (m)	1.2
3	Length (m)	32
4	Max. Design discharge per unit (cumecs)	8.0
5	Velocity of water (m/sec)	3.15

2.11 POWER HOUSE

Sl. No.	Description	Particulars
1	Type of Powerhouse	Surface
2	Length of powerhouse (m)	42.00
3	Width of powerhouse (m)	18.00
4	Generator floor level (ELM)	+ 623.50
5	Center line of Unit (ELM)	+ 624.50
6	Service bay level (ELM)	+ 630.50
7	Control room level (ELM)	+ 630.50
8	Normal tail water level (ELM)	+ 624.00
9	Crane hook level (ELM)	+ 636.88
10	Control room slab level (ELM)	+ 617.00
11	Power house Roof level (ELM)	+ 629.50
12	Draft tube bottom most level (ELM)	+ 620.50

2.12 TAIL RACE CHANNEL

Sl. No.	Description	Particulars
1	Shape	Trapezoidal
2	Bed width (m)	30.0
3	Normal tail water level (ELM)	+ 624.00
4	Bed level (ELM)	+ 622.6
5	Lining	CC
6	Value of n	0.018
7	Full supply design depth (m)	1.5
8	Max. Design Discharge (Cumecs)	24.5
9	Length of Tail Race Channel (m)	200.0

2. 13 TURBINE

Sl. No.	Description	Particulars
1	Type of turbine	Horizontal Francis
2	Number of Units	3
3	Runner diameter (mm)	1600
4	Rated capacity (kW)/ unit	7500
5	Speed (rpm)	750

2.14 GENERATOR

S. No.	Description	Particulars
1	Type	Synchronous
2	Rated capacity (kW)	7500
3	Power factor	0.85
4	Voltage (kV)	11
5	Frequency (Hz)	50
6	Speed (rpm)	750

2.15 POWER HOUSE CRANE

S. No.	Description	Particulars
1	Type	EOT
2	Capacity (Tonnes)	30 / 10
3	Class of duty	Class II
4	Type of girder	Double Girder

2.16 SWITCH YARD

Sl. No.	Description	Particulars
1	Generator Transformer capacity (KVA)	10000
2	Voltage (kV)	11 / 33
3	Number of Generator Transformers	3
4	Auxiliary Transformers capacity (KVA)	250
5	Number of Auxiliary Transformers	2

2.17 POWER EVACUATION

Sl No.	Description	Particulars
1	of Transmission Line (KV)	AB cables
2	Lenght (km)	25
3	Structure	RCC Poles
4	Conductor	AB cables

2.18 ESTIMATED COST

Sl. No.	Description	Particulars
1	Civil and H & M Works (Rs. lakhs)	10118.00
2	E & M Works (Rs. lakhs)	4400.00
3	Transmission Line (Rs. lakhs)	2500.00
4	Others (Rs. Lakhs)	2715.00
5	Total Project cost (Rs. lakhs)	19733.00
6	I D C (Rs. lakhs)	2764.00
7	Total Project Cost with IDC (Rs. lakhs)	22500.00
8	Gross Energy (MU)	72.00

SECTION - 3

SURVEY INVESTIGATIONS & GEOLOGY

3.01 TOPOGRAPHICAL SURVEY

Topographical Surveys for formulating the Small hydro electric project are carried out at the proposed site for weir and power house. The contour map and block level plans have been prepared for formulating the layout and fixing the main components of the scheme.

The surveys have also been carried out along the river course upstream to the weir to ascertain the presence of agricultural lands or any other permanent structures coming within the reservoir area. It is observed that no private cultivable land or permanent structures are available within the maximum flood level.

3.02 GEOLOGY & GEOTECHNICAL FEATURES

At the proposed weir site good foundable Granite rock is exposed. Good foundable rock is available at shallow depths at the surge tank and power house site, hence no foundation problems are anticipated**.**

3.02.1 General Geology

The country rock in the vicinity of the project area is massive migmatised granite gneiss traversed by quantity and pegmatite veins.

3.02.2 Sub-Surface Study

The rock is generally exposed in the river bed portion at the location of weir and also on the both river banks. Visual observation reveals that the bed rock is granite gneiss and granite gneiss associated with biotic schist. The depth of bed rock varies from 2 m to 6 m in the water conductor portion and 2 to 5 m in power house area.

3.02.3 Conclusion of Geological Study

i. At the location of weir exposed rock indicates that the rock is suitable for founding the weir at a depth of 1.0 m from river bed.

ii. Along the water conductor systems 1 to 2.0 m over burden is expected. Below 2.0 m good rock is expected.

iii. The area is generally rocky at the powerhouse site. In order to evaluate bed rock characters it is proposed to drill at least 5 drill holes in the power house area.

3.03 CONSTRUCTION MATERIAL INVESTIGATIONS

1. Cement & Steel	:	200 – 250 km from Sorrounding areas
2. Sand	:	250 km from Sorrounding areas
3. Course aggregate/rubble	:	90 km from Project site
4. P O L	:	90 km from Near by areas
5. All other materials	:	200 km from Near by areas

3.04 ROCK, COARSE AGGREGATE AND FINE AGGREGATE (SAND)

Coarse aggregate will be obtained from the local quarry and fine aggregate from Jorhat areas.

3.05 HYDROLOGICAL INVESTIGATIONS

The daily discharge data gauged on river near village downstream to the power house location for 1 years is obtained and the corresponding discharge data and Rain fall data based on catchment area is deduced.

SECTION - 4

HYDROLOGY & POWER STUDIES

4.01 GENERAL

Hydrology form a main part of any hydro electric project. The power production is a direct function of head and discharge. The Yijung river near Tuensang District is a Run off river Project. This Small Hydel Scheme proposes to utilize the discharge available in the Yijung stream . This chapter deals with analysis and fixing up of design flow for the proposed Small Hydel Scheme.

4.02 INTRODUCTION

Yijung river originates from Nuroto hill area Zunheboto district. The river traverses towards north along the border of Mokokchung and Tuensang districts. The main tributaries of the river are Yangyu of Tuensang district and Nanung in Langpangkong range. The rivers flows further northward and leaves the hill near naginimora and finally merges with Brahmaputra river in the plains of Assam.

4.03 CATCHMENT AREA

The catchment area of Yijung river near Tuensang District on the upstream side of the proposed weir site has been worked out as 175 Sq. km.

4.04 HYDROLOGY

The stream was gauged by the developer at the downstream of the proposed project for 1 years. For this purpose a gauge weir was constructed by the developer. This gauged data for 1 year is used for our analysis and the flow data obtained from the above has been deduced based on catchment area proportion and the data is arrived for the proposed weir location. The rainfall data is available for a period for 10 year from rain guage station. By using Rainfall run off correlation method and the catchment area the ten years flow data is obtained by using suitable correlation factor. This discharge data and the observed data is studied and since there is no much difference the observed data is considered for hydrological analysis. So the proposed scheme is formulated for design discharge of 23 cumecs and 115 m head. The total capacity of the scheme is 22500 KW with three units of 7500 KW.

4.05 RAINFALL DATA

The rainfall data is available for a period of 10 years rain gauge station,

4.06 GAUGED DATA

The stream was gauged by the developer at the downstream of the proposed project for 1 years. For this purpose a gauge weir was constructed by the developer. This gauged data of 1 years is used for our analysis and the flow data obtained from the above has been deduced based on catchment area proportion and the data is arrived for the proposed weir location.

Power and energy potential is calculated on deduced discharge data for the one years.

4.07 DISCHARGE STUDIES

The daily discharge data obtained based on catchmnt area proportion for the period of one year forms the basis for formulation of the project.

4.08 ANALYSIS OF FLOW DATA

The flow duration analysis of the Small Hydel scheme has been carried out considering the daily deduced discharge flow data in the river near the proposed weir site. The data of 1 year is been considered for the present analysis.

Average Rainfall	:	2.4m
Catchment Area	:	175 sq.km
Rainfall run-off correlation	:	0.55

$$Q = \frac{2.4 \times 175 \times 1000 \times 1000}{150 \times 24 \times 60 \times 60} \times 0.70$$

$$= 22.68 \text{ cumecs} - \text{say } 23 \text{ cumecs}$$

Further with the rainfall data the discharge data is arrived near the proposed weir location. This arrived discharges have been distributed proportionately with respect to daily rainfall data of nearby rain gauge station to compile the daily discharge. Based on the above daily discharges energy calculations are made .

4.9 FLOW DURATION CURVE

With the available data, a flow duration curve was prepared and the same is enclosed. The flow duration relationship is given in table.

Percentage of Time	Discharge in cumecs	No. of Days
5	43	18
10	39	36
15	37	55
20	32	73
25	27	92
30	24	115
35	22	128
40	20	146
45	18.32	165
50	14.5	183
55	12.7	200
60	11.2	219

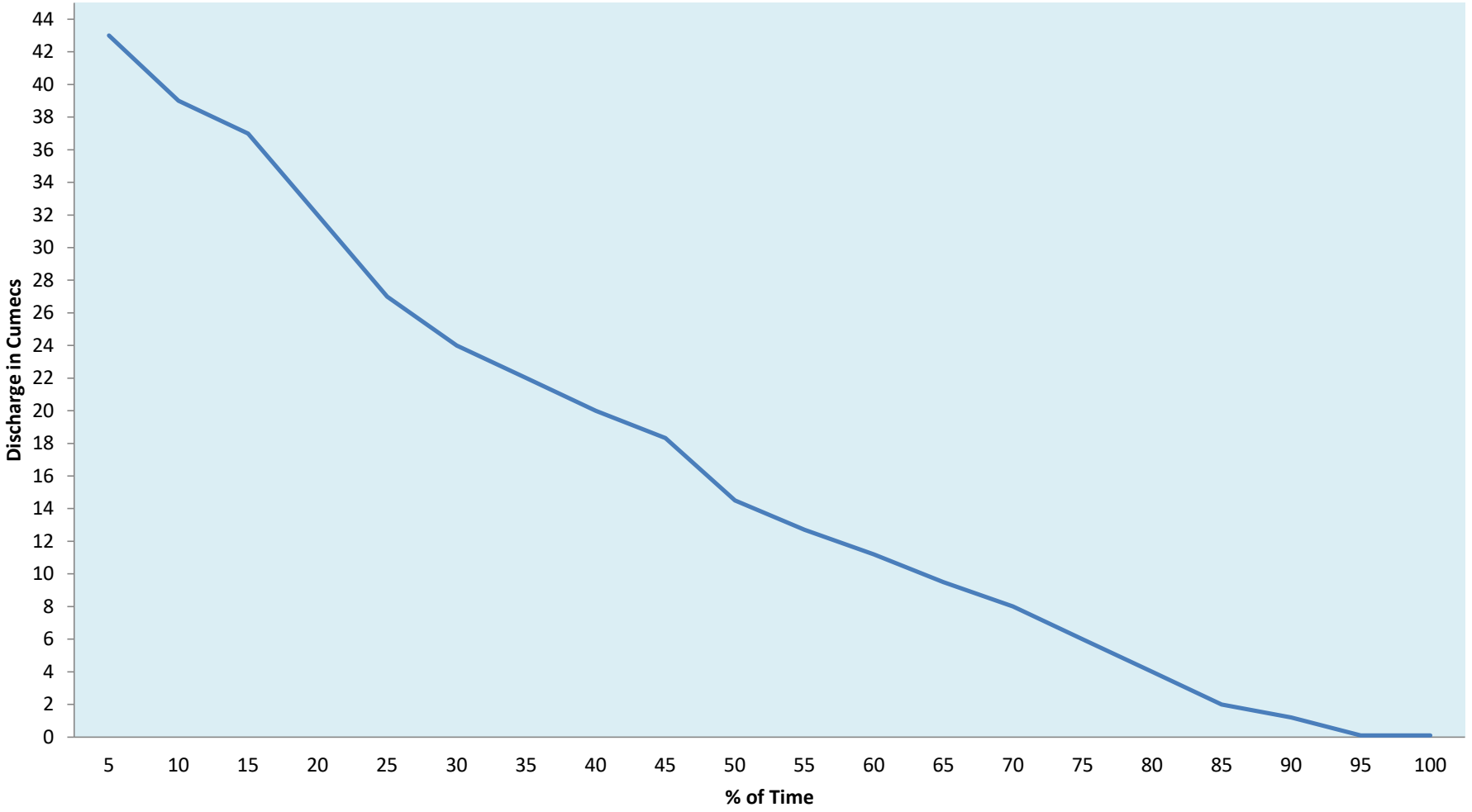
The procedure followed for analyzing the flow data for generating the flow duration curve is as follows.

1. The daily flow datas available for 10 years is arranged in descending order of magnitude of flows and no. of occurrences of each flow value is found out.

FIGURE - 4.1

HAK CHENG SMALL HYDRO PROJECT (3 X 7500 kw)

FLOW DURATION CURVE



2. From this the no. of times and percentage of time for each flow value has been equaled or exceeded in the period of record is obtained. The flow duration curve is obtained by Plotting each flow value (a lower value of the class interval) against the percent of time it has been equaled or exceeded.

3. The computations for the daily flow duration curve plotted is given in Fig. 4.1.

4.10 INSTALLED CAPACITY

The installed capacity is determined with the criterion of either maximum generation or optimum unit of generation, depending on the necessity and relative economy. This chapter deals with the aspects of water availability, power potential studies and generation , Choice of installed capacity etc.

4.11 HEAD STUDIES

The FRL proposed at Yijung river near Tuensang District is EL 742.0 . The river water level at a distance of about 3500 m (approx.) downstream of River is EL 622 m. Hence the Max. gross head of 118m is available. Allowing a loss of 3.0 m in the Head Regulator , gates etc. the net head available for power generation will be 115m

The losses in the various components are tabulated below:

Sl. No.	Nature of Loss	Loss (m)
1.	Head Loss at Intake Structure	0.03
2.	Loss due to gates @ Intake Structure	0.05
3.	Trash Rack Loss	0.03
5.	Hydraulic loss in Penstock of 2.4 m diameter	3.00
6.	Other Losses	3.11
	Total Losses	**3.00 m**

The total head loss works out to 3.0 m. The net head after losses works out to 115.0 m and the same is fixed as design head and the project envisages the utilization of this 115.0m rated head for power generation.

4.12 POWER POTENTIAL STUDIES

The power potential of the project is worked out by assuming an overall efficiency of 85% for turbine and generator at rated parameters. The power potential works out to 22500 KW at rated power draft of 23 cumecs and rated head of 115 m. The design gross head is of the order 118 m. Allowing losses of about 3.0m, the net head available is 115.0m. The average power benefit available with the net head of 115.0m considering part load operations will be 8.5 x 115 x 23 = 22483 KW say 22500 KW.

For the available head and discharge, power potential studies have been made for the alternatives given below.

1) 2 X 11250 kW

2) 3X 75000 kW

Considering the cost of Power House Civil Works would be less with the alternative -1. But on the flip side cost of the Electro Mechanical equipment escalate because of the Machine size increases.

The generation of the units will be less compare to second alternative.

Even though cost of the Power House Civil and Electro Mechanical works would increases the net generation of units will increases while in long run.

4.13 DEPENDABLE ENERGY ANALYSIS

The dependable energy is worked out based on flow data for 1 years.

The annual energy has been calculated for all the available 1 years Period. The abstract of monthly energy and annual energy has been tabulated. The annual energy is arranged in descending order and the following results are obtained based on Probability theory.

4.14 CONCLUSION & RECOMMENDATION

Careful analysis of the Energy studies of the two alternatives i.e (1) 2 X 11250 kW (2) 3 x 7500kW indicates that 3 x 7500 kW is a ideal one. For the present DPR we have considered 3x 7500 kW alternative.

SECTION – 5

DESIGN FEATURES AND CRITERIA FOR STRUCTURES

5.01 GENERAL

The project comprises of mainly the following civil works which are described in detail in following paras.

1. A diversion weir.
2. An Intake Structure / Head Regulator.
3. A penstock of 2.4m diameter from Weir and trifurcating to 1.2 m diameter to feed 3 machines of 7500 kW
4. A Surge tank of 6.5m diameter
5. A surface powerhouse to house three units of 7500 kW
7. A tail race channel to suit the equipment layout.
8. Switchyard civil works.

The overall general layout plan is furnished in Exhibit No. YMFR-KR-999-001&002

5.02 DIVERSION WEIR

The river flows in rapids and then has a concentrated fall. In order to utilize the head available in the rapids, a diversion weir is proposed just upstream of the rapids. Considering the river width, bed level and economics the location of the weir has been fixed.

An ungated weir is proposed with its crest level as EL 742.0 m to maintain FRL for power generation. The weir is designed as a free over fall ogee spillway for passing a maximum flood discharge of 200 cumecs with a designed lift of 1.8 m. The length of weir is 87 m and its maximum height is 6 m from the deepest foundation level. The ungated weir is given a rear slope of 0.7H:1V. At the toe of weir, a stilling basin type of energy dissipation arrangement with a concrete apron with its floor level at EL 737.0 m is provided for a length of 10.0 m for energy dissipation for the flood passing over the weir. As the entire river bed is covered with rock formation the cistern floor will be anchored to the rock with suitable anchor bars. On either side of the stilling basin, wing walls are proposed with their top levels at EL 745 m on downstream side of weir. The design of weir is based on IS: 6512 and the stilling basin design is based on USBR. Details of weir are given in Drg. No. YMFR-KR-999-002

5.03 INTAKE STRUCTURE

An intake structure is proposed on Left side of the weir to facilitate regulation of flow to the power house from the river. This is a cement concrete structure consisting of single vent of 3.75m x 3.75 m size. The floor level of intake is

kept at EL 647.625 m and top level of platform is kept at EL 655.00 m. The vent of intake shall be fitted with an intake service gate and electrical drum hoist to facilitate control of flow into the penstock. On the upstream side of intake, gate grooves are proposed for provision of one stoplog gate which will facilitate as a stand by during repair and maintenance of intake gate. A breast wall with a bell mouth is provided in front of intake barrel. Design of intake structure is based on IS 9761.

5.04 TRASH RACK

Steel trash racks are proposed just at the entry of the intake to prevent debris entering into the penstock. These trash racks are provided upto the level of intake platform at EL745 m. The design of trash rack shall conform to IS 11388.

5.05 INTAKE GATES

The intake vent is proposed to be provided with service gate to the vent size of 3.75 m x 3.75 m to provide control of flow into the water conductor system. Motor operated rope drum hoist is provided on top of intake platform at EL 745 m for operation of the gate. In front of intake gate, grooves are provided to install stop log gates to facilitate repairs for intake gates. Design of intake gates shall conform to IS 4622.

5.06 BELL MOUTH ENTRY

While bell mouth is provided in front of intake barrel, transition from a square section at the upstream face of intake groove to a circular section at penstock is provided to obtain a stream lined flow into the penstock. Bell mouth shape is designed as per USBR Monogram no: 6.

5.07 PENSTOCK OF 2.4 m DIA

From the Diversion Weir one individual penstock of 2.4 m dia is proposed. This penstock will continue for a length of 2800 m from surge tank and at a distance from power house the main penstock trifurcates into 3 individual penstock of 1.2 m diameter each. Penstock 2.4m diameter is designed to carry a maximum flow of 23 cumecs. Velocity allowed is 3.4 m/sec and shell thickness shall be 12 mm to 14 mm. Hydraulic design of penstock has been done based on IS 11625. Penstock shall be covered by concrete of thickness 300 mm all round and necessary anchor blocks have been proposed to take care of bends and change of direction etc.

5.08 SURGE TANK

As the length of water conductor system is more, it is necessary to provide a surge tank. Based on Thoma's formula a simple surge tank of inner diameter of 6.5m with a factor of safety of 2.0 is arrived. The sidewalls of surge tank shall be of Steel. Minimum surge works out to be EL 717 m and maximum surge +EL 735.00. However by providing a overflow pipe at EL

735 the top of surge tank has been limited to EL 735. The total height of surge tank shall be 18.00 m. An RCC raft is proposed. One intake gate at surge tank exit has been proposed. Surge tank hydraulic design has been carried out as per IS 7396. Details of Surge Tank are given in Drg. No. YMFR-KR-999-003.

5.09 POWER HOUSE

The powerhouse to accommodate the generating units is a reinforced concrete frame structure of 18 m wide and m 42 m long. The entire power house building is founded on a reinforced concrete raft. The generators are kept at floor EL 623.5 m. On the right side of machine hall an service bay of 7.0 m wide is proposed at EL 630.5m to receive all the machinery parts before erecting them in position. A control room of 6.5m wide is provided on upstream side of powerhouse. The floor level is kept at EL 630.5m. All the control panels required for operation of units and connected auxiliaries will be installed in the control room. Details are furnished in drawing No. YMFR-KR-999-004 & 005

5.10 TAIL RACE POOL AND TAIL RACE CHANNEL

A 200m long Tail Race Pool / channel will led the water from power house back to the stream. The level in the stream where the Tail race joins should be EL 622.6 m. The normal tail water level is 624 m. The river is regraded for a length of 200 m to achieve the bed level in the Tail race channel. The tail race

channel is lined with cement concrete. The bed width is 30m and the side slope of 1:1 is proposed.

5.11 GATES AND HOISTS

The following gates may be required for the scheme.

i. Intake gate near Head regulator with hydraulic hoist – 1 no.

ii. Intake gate near surge tank with hydraulic hoist – 1 no.

iii. Draft tube gate for turbines - 3 nos.

5.12 SWITCH YARD

The switchyard is proposed to be located near the power house. An area of 23m x 40m size is proposed for accommodating outdoor equipment.

SECTION - 6

ELECTRICAL & MECHANICAL EQUIPMENT

6.01 GENERAL

The scope of Electrical and Mechanical equipment required for the project covers the following:

i. Spherical valve.

ii. Turbine and its auxiliaries like governor oil pressure unit and cooling water system

iii. Generator, its auxiliaries, control and protective gear and breakers etc.

iv. Generator transformers with on load tap changer along with control and protective gear and breakers etc.

v. Auxiliary power supply system consists of auxiliary transformer, D.G set for alternative emergency supply.

vi. Controls supply system consisting of station battery, charger and its distribution system.

vii. The power house auxiliary like EOT crane, de-watering and drainage system, fire fighting, air conditioning and ventilation system.

viii. Power evacuation system consists of 33kV switchyard transmission line terminal bay equipment at Sub Station is Power Transformer, Breakers, CTs, PTs, LAS etc.

6.02 SPHERICAL VALVE

Each turbine is provided with a Spherical valve to act as a main inlet valve in order to achieve quick closing to cut off the water supply for the turbine in the event of any machine tripping eventuality. The Spherical valve will be of by plain door type with rubber seals designed to open under unbalanced conditions and close against full flow in emergency. The Spherical valve shall be normally opened and closed by hydraulic system and also have backup closing system with dead weight for closer during emergency.

Size: The size of the Spherical valve proposed is 1200 mm.

Body: It shall be fabricated from steel plates and provided with PTFE/Grease lubricated bronze bushes for bearings and cup seals for trunions and stainless steel sealing ring for the main seal.

Door: It shall have by plain door fabricated from steel plates. The valve door shall have peripheral sealing ring of solid rubber.

Sealing device: The valve will be provided with adequately reinforced rubber sealing held in position by means of removable sealing ring fixed by rust less screws against stainless steel ring secured to the valve body.

Dismantling Joint: The joint shall be of telescopic type and located on down stream of valve facilitating dismantling of valve during maintenance.

Lever: A lever will be provided to the trunion and a dead weight will be mounted on other end.

Servo motor: Servo motor of double acting type comprising of fabricated steel cylinder with covers, piston, pressure oil system will be provided in a complete shape.

By pass valve: Each Spherical Valve is provided with a bypass valve for pressure equalization

Gate Valve: Each Spherical Valve will be provided with gate valve of 1800mm size for maintenance of main valve.

6.03 TURBINE

Type of Turbine: The project is medium head Small hydro scheme with design head range of 115 m and the unit discharge of 7 cumecs. The maximum and minimum head can vary between 115 m to 118 m and power draft variation can be from 2.0 cumecs to 7.5 cumecs. In view of this Francis type turbine is selected for the project. The turbine can achieve a speed of 750 rpm and hence directly coupled generator is proposed.

The design parameters of the turbine are as follows:

Description	Particulars
Rated capacity (kW)	7500
Rated discharge (Cumecs)	7
Design head (m)	115
Runner diameter (mm)	1200
Speed (rpm)	750
Quantity	3

The specifications of main components of turbine are as follows:

Runner: The runner will be of 13/4 chromium nickel stainless steel.

Shaft Assembly: It will be of forged construction with forged end flanges. The shaft will be provided with a renewable sleeve in the shaft seal area and a stuffing box type shaft seal gland will be provided to prevent water leakage from the turbine along the shaft. A guide bearing lubricated with water will be provided for the turbine and a thrust bearing is also provided.

Coupling: A rigid coupling will be provided for transmission of turbine power to Generator.

Runner Casing: Cast steel runner casing will be provided to house the runner assembly.

Stay ring: Stay ring assembly will be provided at the outlet of the BF Valve. It will be fabricated from the mild steel to with stand hydraulic forces.

Operating Gear: Adequate number of guide vanes of stainless steel or cast steel will be provided to guide the incoming water flow on to the runner blade at an optimum angle.

Servo Motor: Each turbine will be provided with a oil operated double acting type servo motor to open and close the guide vane besides shut down in emergencies. A dead weight will be provided to close the guide vane and cut off the water to the turbine in emergency.

Oil Pressure Unit: Each turbine will be provided with a oil pressure unit to supply control oil to the servo motors of guide vane mechanism. Oil pumping unit will be provided with nitrogen filled pressure accumulator to supply pressure oil for closing turbine guide vane during emergency like failure of oil pressure unit motor pump set.

Cooling Water System: Each turbine will be provided with one cooling water system to provide water for lubrication of turbine guide bearing and generator bearings.

6.04 GENERATOR

Design Parameters: The following are design parameters

Description	Particulars
Rated Capacity (kW)	7500
Power factor	0.85
Voltage (kV)	11 +/- 10%
Frequency (Hz)	50 +/- 5%
Speed (rpm)	750
Frequency range	+/-5%
Insulation	Class-F
Quantity	3

General description: The generators are horizontal synchronous type designed for coupling with water turbine.

Construction:

Stator:

The stator frame shall be of cast iron/fabricated steel construction. The stator core shall be built up of segmental punching of low loss, non-oriented steel sheets and end plates.

The stator winding shall be of multi-turn or single turn type and shall be insulated with class 'F' insulation. The stator winding shall be star connected with both ends of conductors of each plate brought out of the stator. The stator terminal boxes shall be provided with non – magnetic type, removable un drilled cable gland plates.

Embedded temperature detectors of resistance type shall be provided for stator winding located symmetrically.

Rotor:

The design and construction of rotor shall be in accordance with the best modern practice.

Field Winding:

Field winding shall consist of fabricated field coils or any other type with adequate provision for cooling purpose.

Damper winding:

The field poles shall be provided with adequate damper windings to ensure stability under fault-conditions.

Shaft:

The generator shaft shall be made of the best quality carbon steel properly heat – oriented. The generator shaft shall have suitable provision for compiling to turbine / gear box.

Bearings:

The generator bearings shall be of pad type or sleeve type, oil lubricated either self-lubrication or forced lubrication type.

The generator employs radial ventilation with a fan mounted on the shaft.

Excitation system:

The excitation system will be static or brushless type and will be suitable for parallel operation of the generators with the grid. The system will include AVR, field suppression equipment, field circuit breaker, convertors for static excitation system or PMG for brushless excitation system, fiels flashing unit etc. The excitation system shall have the following feature.

a) Maximum and minimum excitation limiter.
b) Resistive / reactive drop compensators.
c) V/Hz limiter.
d) Over Current limiter.

Excitation system will have both auto mode and manual mode and the above mentioned features will be available both in auto and manual mode.

6.05 STEP UP TRANSFORMER:

The Scheme will be provided with three generator transformers to transform the generated power to 33 kV for evacuation to the grid. The design particulars of power transformer are as follows:

1. Capacity : 10000 KVA
2. Voltage ratio : 11 kV / 33 kV
3. Vector group : Ynd 11
4. OLTC : +/- 15% Variation
5. Winding : Class F

6. Flux density : 1.7 Tesla
7. Type of cooling : ONAN
8. No. of phase : 3
9. Quantity : 3 Nos.

6.06 AUXILIARY POWER SUPPLY

The scheme will be provided with 250 KVA, 11 kV / 415 Volts Delta/Star auxiliary transformer to cater to all the auxiliary loads. The transformer will be connected to station auxiliary board. The station auxiliary board will be provided with a stand by emergency supply by means of one D.G set of 250 KVA capacity to meet the emergency auxiliary loads.

6.07 CONSTRUCTION OF SWITCHYARD

A 33 kV switchyard is proposed on the left side of the powerhouse. The generator transformer with breakers, CTs, PTs, LAs are proposed to be erected in the out door yard. The power transformer is connected to the generator by means of AB cables for transfer of power. The 33 kV side of transformer is connected to a common 33 kV bus. Double circuit transmission line with Zeebra conductor and will be provided with metering arrangement as per the guidelines of State Electricity Board for measurement of the energy exported to the grid.

6.08 POWER EVACUATION

It is proposed to generate the power at 11 kV and will be stepped up to 33kV line and will be evacuated by 33/66 kV line (transmission line) From O.D.Y of power house. The 66/33 kV line is connected to the nearby Tuensong Power substation (66/33/11) located 25 km from site. Suitable metering arrangement will be proposed at the switchyard as per the stipulation for metering the energy evacuated to grid.

6.09 CONTROL AND PROTECTIVE GEAR

Turbine Protections: Each turbine will be provided with necessary control and protective gear against over speed, cooling water failure for guide bearing, failure of oil pressure unit etc.

Generator Protections: Each generator will be provided with following protections:

1. Stator earth fault
2. Rotor Earth Fault
3. Generator differential
4. Reverse active power
5. Reverse reactive power
6. Negative sequence
7. Logs of excitation
8. Over current
9. Over and Under voltage
10. Over and under frequency
11. Stator winding temperature
12. Bearing temperature

Generator Transformers Protections: The generator transformer is provided with following protections:

1. Over current
2. Earth fault
3. Differential
4. Restricted earth fault
5. Over voltage
6. Over flux protection
7. Over and under frequency
8. Buchholz relay
9. Oil & winding temperature protection.

Line Protections: The 33 kV line is provided with following protections:

1. Over current
2. Earth fault
3. Distance protection
4. Over voltage / under voltage

Metering: The metering required for measurement of various parameters like voltage, current, active and reactive power, power factor, energy etc.

Breakers: The following HT breakers will be provided.

Generator Transformer Breaker: 145 kV, 1600 amps, 31.5 K.A, S.F6 breaker will be Provided - 3 Nos.

A single line diagram for the electrical layout of the scheme is prepared and appended.

6.10 POWER HOUSE CRANE

The power house will be provided with one EOT crane for carrying out unloading, erection, operation and maintenance of all the units. The capacity is estimated as 30 tonne and however will be provided as per the requirements of heaviest assembly need to be hauled.

6.11 DE-WATERING & DRAINAGE

The powerhouse will be provided with one common de-watering and drainage pit out side the powerhouse. Three vertical type turbine pumps of 5kW capacity each will be installed. All the draft tube drains will be connected to the de-watering sump. The drainage of powerhouse turbine floor will be also diverted to the dewatering and drainage pit.

6.12 FIRE PROTECTION

Suitable type of fire protection equipment for thermal and electrical fires will be provided in the control room, power house and switchyard to safeguard the various electrical equipment in and around the power house from the hazards of electrical and thermal fire. The fire protection equipment comprises of CO2 cylinders, foam type and dry type portable or mobile fire extinguishers as detailed below.

i. Generator Hall: Chemical powder type of 10 Kg capacity - 6Nos. and Co2 filled extinguishers 6Nos.

ii. Control room: Foam type 3 Nos. and Co2 type 6 Nos. each of 10 Kg capacity

iii. Switchyard: Foam type- 6 Nos. and CO2 type -3Nos.

6.13 VENTILATION & ILLUMINATION:

6.13.1 Ventilation: The powerhouse will be provided with 3 Nos. exhaust fans to provide ventilation for exhaust air from power house, control room and battery room.

6.13.2 Illumination: The power house, control room and switchyard areas will be illuminated with adequate sodium vapour lamps adopting following light intensity.

1. Powerhouse - 200 lux
2. Control room - 500 lux
3. Switchyard - 50 lux
4. Battery room - 150 lux

6.14 EARTHING:

The power house and switchyard areas will be provided with earthing by construction of an earth mat laid beneath, the powerhouse raft in the power house area and in the switchyard area by utilizing 75 mm x 10 mm thick GI flat. The total earth resistance of the powerhouse will be maintained below one ohm. All the electrical equipment will be earthed connecting to this earth grid by means of two independent earths. The power station would be provided with protection against lightning also.

6.15 CABLING:

The cabling can be classified as power cables and control cables.

6.15.1 Power Cables: The power cables for 11 kV & 33 kV applications will be of XLPE insulation, aluminum, armoured cables and LT power cables will be of PVC insulated aluminum-armored cables.

6.15.2 Control cables: All control cables will be of copper multi-strand armoured multi-core PVC insulated cables. Signal cables will be of screened type.

6.16 OPERATION & MAINTENANCE OF UNITS

i. A maintenance schedule for carrying out preventive maintenance as well as major over hauls will be prepared immediately after commissioning the units in consultation with the equipment supplier.

ii. The staff experienced with Operation and Maintenance of similar units will be deployed. One Plant Manager/E&M assisted by two Engineers, one electrical and one Mechanical will look after the operation and maintenance activities of the project.

iii. Shift operators will be deployed in the shift duties for operation and maintenance of units. Under each shift one operator with diploma qualification assisted by two assistant operators of ITI qualification will be deployed to look after operations in the generator floor, control room and switchyard.

iv. The maintenance gang manned by diploma mechanical engineer will be deployed in general shift to look after the maintenance works.

v. The general maintenance gang manned by diploma electrical engineer will be deployed to look after all electrical maintenance works.

vi. The major over hauls and maintenance works during off season will be awarded to the respective equipment manufacturers and the units will be maintained under their supervision and guidance.

SECTION - 7

CONSTRUCTION PLANNING

7.01 MONTH WISE PLANNING AND PROGRAM

The construction planning is programmed such that the project can be completed within 24 months period after commencement of works in dry season. Month wise implementation schedule is prepared for construction of water conductor system , Surge tank , penstock ,power house, downstream transition, Tail race channel and trash racks, gate and hoists in the form of a bar chart. Geotechnical tests will be completed before commencement of civil works for powerhouse.

The planning of E & M works is also carried out and a bar chart is prepared. The procurement action for E & M equipment will be commenced parallel with the civil works. The switchyard works will be completed along with unit works. The construction of 33 kV line for evacuation of power from the powerhouse to the near by 33 kV substation will be completed by the time powerhouse switchyard is ready for charging.

7.02 CONSTRUCTION PLANNING OF CIVIL WORKS

The planning of various components to achieve the target are discussed.

7.02.1 Materials Planning

Advance action will be initiated for the procurement of main construction materials like cement, steel, coarse aggregate and fine aggregate from the sources mentioned as per section-3. The required quantities of materials will be procured progressively as per the construction program.

7.02.2 The Plant and Equipment Planning

The civil works of the project will be executed through contract system. Hence no procurement of major equipment and plant is contemplated. The other auxiliary equipment like D.G sets, de-watering pumps, gantry crane, welding sets and other tools and plants required will be procured.

7.03 INVENTORY OF PLANT AND EQUIPMENT

There is no separate major inventory of plant and equipment proposed to be procured for implementation of the scheme except Diesel Generating sets, dewatering pumps, welding sets, gantry crane and other general tools and plants as all the works will be carried out by following contract system.

7.04 ORGANIZATION AND MAN POWER PLANNING

7.04.1 Organization

The services of Consultants with expertise in the field of Small hydropower development will be taken up for carrying out detailed engineering for both

civil and electrical mechanical works besides planning activity of the project and procurement of various material and equipment. Services of Specialists, consultants / organizations will be taken for special jobs like carrying out model studies and geo-technical investigations.

7.04.2 Manpower Planning

A separate organization would be planned for implementation of the project with three managers. One Manager (Civil) will look after the civil works assisted by two site engineers one for Penstock and Surge tank and another for power house, tail race channel and other works like gates and hoists etc. One Manager (E&M) will look after the E&M works assisted by two Senior Engineers one for Mechanical Works and one for Electrical Works including 33 kV line and allied works. One Manager (Commercial & financial) will be designated to co-ordinate all the commercial as well as financial aspects of the project works. Adequate staff would be appointed in each wing to assist the concerned. The Managing Director will over see the successful implementation of the scheme.

7.05 PLANNING OF ELECTRO-MECHANICAL WORKS

The procurement of the equipment will be done by following Limited International Competitive Bidding process by placing one order for supply of all the equipment of the project and a separate order for erection of the equipment.

7.06 POWER EVACUATION WORKS

It is proposed to generate the power at 11 kV and will be stepped up to 33kV line and will be evacuated by 33/66 kV line (transmission line) From O.D.Y of power house. The 66/33 kV line is connected to the nearby Tuensang Power substation (33/66) located 25 km from site. Suitable metering arrangement will be proposed at the switchyard as per the stipulation for metering the energy evacuated to grid.

7.06.01 Considering the advantage and disadvantage of the above 2 alternatives , it is proposed to have 33 kV DC line with AB Cables on RCC poles for evacuation of power from the Power House .

7.07 LAND ACQUISITION

The various structures forming part of the scheme are coming under Private land. The load is already acquired.

7.08 APPROVALS AND DOCUMENTATION

i. The Detailed Project Report (DPR) may be submitted to Nagaland Power Department for approval soliciting single window clearance, being the nodal agency of the state, before submission of the same to financial institutions for sanction of loan assistance.

ii. The approval from Nagaland Power Transmission Corporation may be obtained for laying the 33 kV line connecting the powerhouse to the Substation at Tuensang.

iii. A power purchase agreement may be entered with State power Transmission Corporation for sale of energy at the tariff approved by government of Nagaland in case the developer wishes to sell the energy to State Power Transmission Corporation.

iv. The land required for the scheme has been identified and no forest land or Government land is involved. For land alienation the company will have long registered lease from the concerned village council/ Tribal council. Hence it will be suitable for mortgage for the financial institutes.

SECTION – 8
ESTIMATES

8.01 INTRODUCTION

The estimates have been prepared to arrive at the capital cost of the project based on the guidelines of Financial Institutions for Small Hydel Scheme near Tuensang District .

The estimates for civil works are based on the schedule of rates of Nagaland applicable for year 2016-17 and prevailing market rates.

The cost estimates for Electrical and Mechanical works have been prepared on the basis of budgetary offers received from equipment manufacturers as per prevailing market rates.

The estimated costs under main heads are as follows:

Description	**Estimated cost (Rs. in Lakhs)**
Civil Works	10118.00
E&M Works	4400.00
Transmission line	2500.00
others	2715.00
Sub-Total	**19733.00**
I D C	2764.00
Total	**22497.00**

The abstract of costs of major items is appended (Table 8.1.0).

8.02 CIVIL WORKS

The costs of civil works are prepared based on preliminary designs and drawings prepared for various components of the project. The main components are Penstock, Surge tank , Penstock ,Power house, tail race pool and gates and hoists. The estimates are appended vide table 8.1.5.1 to 8.1.5.11

The rate analysis of the civil works adopted based on the schedule of rates of Nagaland Power Transmission Corporation for various items of Works are appended vide table 8.2.

The details of the civil works are as follows:

Rs. in Lakhs

Sl. No.	DESCRIPTION	AMOUNT
1	Weir overflow & Non overflow section	875.30
2	Head Regulator	172.00
3	Penstock (2.4 m dia)	3500.00
4	Penstock Civil works (2.4 m dia)	2780.00
5	Surge Tank Civil works	427.00
6	Surge Tank(steel)	420.00
7	Power House	1076.30
8	Downstream Transition	318.00

9	Tail Race Channel	249.00
10	Gates & Hoists	300.00
	TOTAL	**10118.00**

8.03 E & M WORKS

The ex-works prices of E&M equipment have been worked out based on the competitive rates of budgetary offers. The sales tax at 12% and freight at 3% and insurance at 1% each are included. The spares for 2 years operation is estimated and provided. The tools and plants required for general O&M of the units are estimated and included. The charges for erection and supervision are estimated separately and provided.

The estimated cost for Double circuit 33 kV transmission line with AB conductor on 9.1 m RCC poles and connecting arrangement at the 33 kV substation near the project site is prepared for power evacuation.

The abstract estimate for E&M works (Table No. 8.1.5), and 33kV transmission system (Table 8.1.6) are appended. The details of the E&M estimates are as follows:

Sl. No.	Description	Estimated Cost (Rs. in Lakhs)
1.	Main Generating Equipment	
2.	Control Equipment	
3.	Switch yard & Switch gear	
4.	Auxiliaries	
5.	Spares, Tools & Plants	
6.	Freight & Insurance	
	Total	**4400.00**

8.04 OTHER COSTS

The following are the items estimated towards other costs.

i. **Preliminary & Pre – operative Expenses:** A provision of Rs.300 lakhs of project cost has been made towards Preliminary & Pre – operative Expenses . The details are appended vide Table No.8.1.1.

ii. **Land & Preliminaries:** The cost of land and preliminaries is estimated as Rs.300.00 lakhs which includes Rs.60.00 lakhs towards land and balance Rs.240.00 lakhs towards site clearance, preliminary expenses and development charges payable to State Government for approval of layout etc,. The details are appended vide Table No.8.1.2.

iii. **Surveys and Investigations:** The cost of this item is estimated as Rs.200.00 lakhs, which includes detailed surveys, Hydrological investigations and Geo-Physical investigations and Model studies. The details are appended vide Table No. 8.1.3.

iv. **Infrastructure Works:** This item is estimated as Rs.575.00 lakhs which includes, providing electricity and communication to the project site, improvement of existing road and approach road for power house site, provision of vehicles for transport and construction of temporary and permanent buildings. The details are appended vide Table No. 8.1.4.

v. **Engineering and Consultancy:** A provision of Rs.300.00 lakhs is made towards Engineering and Consultancy which includes preparation of detailed project report, design and carrying out detailed engineering of civil and electrical & mechanical works besides consultancy for planning of civil works. The details are appended vide Table 8.1.8.

vi. **Project Management:** A provision of Rs.500.00 Lakhs is made towards project management which includes establishment charges, loan commitment charges payable to Financial Institutions, Audit and Accounts fees and fees for project approval. The details are appended vide Table 8.1.9.

vii. **Contingencies:** A provision of 2.81% of Hard cost without IDC has been made towards unforeseen items and contingencies.

viii. The details of other costs are as follows:

Description	**Estimated cost (Rs. in Lakhs)**
Preliminary,Pre–operative Expenses	300.00
Land and Preliminaries	300.00
Surveys and Investigations	200.00
Infrastructure works	575.00
Engineering and Consultancy	300.00
Transmission	2500.00
Project Management	500.00
Contingencies (2.81%)	540.00
Sub-Total	**5215.00**

8.05 INTEREST DURING CONSTRUCTION

The interest during construction has been estimated by adopting a rate of 14 % for term loan from financial institutions as per the anticipated expenditure spread over the 12 months from the date of 1st disbursement completion period and is worked out as Rs.2762.00 lakhs.

SECTION - 9

FINANCIAL & ECONOMIC ANALYSIS

9.01 INTRODUCTION

The financial and economic analysis of the project is carried out assuming that the energy will be sold to Nagaland State Government.

The cost of energy is worked out for next 10 years period.

9.02 FINANCIAL RESOURCES

It is proposed to approach financial institutions like IREDA, IDBI, and other banks for term loan for the project .

9.03 MEANS OF FINANCE

i. **Equity**: The developer will provide equity to the extent of 25% of the project cost based on the estimates.

ii. **Debt**: The term loan to the extent of 75%.

9.04 INTEREST DURING CONSTRUCTION

IDC has been considered for scheduled completion period of 24 months. Interest rate of 12 % is considered for loans with a re-payment period of 12 years including moratorium of 2 year. The principal amount of loan is proposed to be re-paid in 40 equal quarterly installments over a period of 10 years.

9.05 COST OF GENERATION

The following assumptions are made to arrive at the annual charges for calculation of Cost of Energy. The operating expenditure has been arrived based on the estimated cost.

i. **Interest on loan** is considered at 12% for the loan funds from financial institutions.

ii. **Operation and Maintenance Charges** are considered at 4% of project cost and escalated at a rate of 5% per annum.

iii. **Insurance** is considered at 0.06% of project-estimated cost with an escalation rate of 5% per annum.

iv. **Income Tax :** A tax holiday has been assumed for initial 10 years period after commissioning as per the present policy of Governement of India.

v. **Royalty:** The water royalty is considered at 3% of the gross revenue, during the tenure of the loan and at 10% thereafter.

vi. **Taxes duties and levies**: They have been considered as nil on production and sale of energy while arriving at the sale rate since they could not be assessed. All the taxes, duties and levies payable on generation and sale of energy in the future date could not be estimated and have not been included while calculating the cost of generation and sale rate.

vii. **Cost of generation** is arrived by considering the expenditure enumerated above.

viii. **Sale rate:** Sale rate is arrived based on the cost of generation and the rate fixed by Electricity Regulatory Commision with no annual escalation as being adopted by Government of Nagaland for Small Hydel Scheme.

The sale rate of energy is taken as to Rs.4.73/KWh uniformly for the first 10 years.

9.06 SALES REVENUE

The annual sales revenue is considered based on project sale rate on the net saleable energy of 72 MU.

9.07 PROFITABILITY

The profitability statement is prepared for first 12 years period considering loan repayment schedule. The net cash surplus is arrived and is shown in the profitability statement.

9.08 D S C R

It is computed by calculating gross cash flows and debt servicing expenses. For the funds borrowed from Financial Institutions a 2-year moratorium on the repayment of principal and 40 equal quarterly installments for repayment of principal and interest has been assumed. The average DSCR for 10 years works out to 1.18.

9.09 I R R

For calculating IRR, the annual net revenue is worked out after deducting operating expenses excluding interest on loan. The post tax IRR for 20 years works out to 13.17%.

9.10 MNES SUBSIDY

MNES subsidy has been considered as per prevailing norms.

9.11 FINANCIAL STATEMENTS

The following financial statements are appended.

Cost of project and means of finance

i. Loan repayment schedule

ii. Projected Profitability statement

iii. Projected balance sheet

iv. DSCR statement

v. I R R

SECTION - 10

CONCLUSIONS

i. This power Scheme is designed to install three units with 7500 KW.

ii. The daily discharge data gauged on river Yijung, near Tuensang District downstream of the proposed weir location for 10 years period is obtained and the corresponding discharge data based on catchment area is deduced for 10 years period and used for power studies.

iii. The project is proposed with three units of 7500 KW capacity at an estimated cost of Rs.22500.00 lakhs including IDC.

iv. The average sale rate for the 10 years is taken as Rs. 4.73 per KWh uniformly for the first 10 years.

vi. The power evacuation system is contemplated as 33 kV by proposing a separate 33 kV transmission line from powerhouse switchyard to the 115/33 - 66 kV sub-station. Any alternative arrangement available nearer to the powerhouse before the commissioning of the project will be utilized.

vii. The clearance for the land and approval of possession on owner ship basis or on lease shall be completed first. The approaches for power house shall be completed before commencement of the major works.

viii. The land acquisition shall be completed immediately for implementation of the scheme.

ix. The Geological investigations for construction of the weir shall be immediately taken-up.

x. The approvals required should be initiated immediately and financial closer may be completed.

xi. The procurement of E&M equipment may be done under the financial institutions to avail deemed export benefits.

xii. The Ministry of Non-conventional Energy sources may be approached for availing benefits of subsidy on capital and charges for investigations and detailed project report preparation.

SECTION - 11

ENVIRONMENT & ECOLOGY

11.01 GENERAL

The Small Hydel Scheme near Hak Chang village is proposed to be set up on the left side of Yijung River near Tuensang District in Nagaland state. Project work areas do not fall into any habitated areas. The villages in the surrounding vicinity on the plain area are sparsely populated.

11.02 SITE SELECTION AND CONSTRUCTION

Site selection of the scheme has been done keeping in view the ecological setting of the area. Being a run-of-river project, no land submergence is involved and unlike dam based projects, it is free from the associated problems of water logging, salinity and rehabilitation of population.

Project components are planned to be constructed with foundation firmly embedded in the rocks or in underground locations. Hence, there is no danger of any erosion or disturbance. Project construction would neither affect nor bring any significant changes to the physical aspects of the project area. Soil stabilization measures will be a part of the design criteria. Excavated material from the power house will be suitably carried to the designated dumping areas and adequately settled / secured.

The infrastructural facilities to be created for the construction activities will be mostly temporary in nature. Land acquired for temporary site office and labour colony shall be returned in its original shape after completion of project by taking adequate preventive / corrective measures.

11.03 NATURAL RESOURCE BASE

Project activities will not affect the natural resource base in the project area in short term or in the long term. Project does not envisage any consumptive use of water.

Also, there will be no adverse effect on aquatic wildlife or fish wealth. It is generally only due to large dams that the fish migration patterns change. In case of Small hydro schemes such as the one being proposed, there is no significant change in the velocities of water current and hence no csges in the ambient conditions for the aquatic faunas.

11.04 PUBLIC HEALTH ASPECT

Being a Small hydel scheme, public health aspect will not be affected. The project promoters would ensure that the contractor shall adopt and take suitable sanitation measures. Site drinking water arrangements shall be made and septic tanks shall be constructed to take care of public health requirements.

11.05 ESTIMATION OF MEASURES

Following measures with adequate budgetary provisions have been considered.

- Provision of safe drinking water and sanitation
- Provision of kerosene oil to labourers
- Restoration of temporary land acquired for site office and labour colony to its original shape.
- Plantation of trees and in power house area.

TABLE 8.1.0
HAK CHENG SMALL HYDRO PROJECT (3 x 7500 kW)
ABSTRACT OF COSTS
MAJOR ITEMS

Rs. in Lakhs

Sl. No.	DESCRIPTION	AMOUNT
1	Preliminary and Pre-Operative Expences	300.00
2	Land and Preliminaries	300.00
3	Surveys & Investigations	200.00
4	Building & Infrastructure works	575.00
5	Power Plant Civil & HM Works	10118.00
6	Power Plant Electro-Mechanical Works	4400.00
7	Transmission line works	2500.00
8	Engineering & Consultancy	300.00
9	Project Management	500.00
	SUB TOTAL	**19193.00**
10	Project Contingencies	540.00
11	**Project cost without IDC**	**19733.00**
12	Interest During Construction (14 %)	2762.00
13	**Total Project Cost with IDC**	**22495.00**
	Say	**22500.00**

TABLE 8.1.1
HAK CHENG SMALL HYDRO PROJECT (3 x 7500 kW)
PRELIMINARY AND PRE-OPERATIVE EXPENCES
ABSTRACT ESTIMATE

Rs. in Lakhs

Sl. No.	DESCRIPTION	AMOUNT
1	Preliminary and Pre - Operative Expences	300
	TOTAL	**300**

TABLE 8.1.2
HAK CHENG SMALL HYDRO PROJECT (3 x 7500 kW)
LAND AND PRELIMINARIES
ABSTRACT ESTIMATE

Rs. in Lakhs

Sl. No.	DESCRIPTION	AMOUNT
1	Land	60
2	Preliminaries	100
3	Site Clearance	50
4	Development Charges	50
5	Approval of Layout	40
	TOTAL	**300**

TABLE 8.1.3
HAK CHENG SMALL HYDRO PROJECT (3 x 7500 kW)
SURVEYS AND INVESTIGATIONS
ABSTRACT ESTIMATE

Rs. in Lakhs

Sl. No.	DESCRIPTION	AMOUNT
1	Detailed Surveys	60
2	Geo-Physical Investigations	70
3	Hydrological Investigations	40
4	Model Studies	30
	TOTAL	**200**

TABLE 8.1.4
HAK CHENG SMALL HYDRO PROJECT (3 x 7500 kW)
BUILDINGS AND INFRASTRUCTURE WORKS
ABSTRACT ESTIMATE

Rs. in Lakhs

Sl. No.	DESCRIPTION	AMOUNT
1	Approach Roads	300
2	Buildings	200
3	Transport vehicle	75
	TOTAL	**575**

TABLE 8.1.5
HAK CHENG SMALL HYDRO PROJECT (3 x 7500 kW)
CIVIL WORKS AND HYDRO MECHANICAL WORKS OF THE PROJECT
ABSTRACT ESTIMATE

Rs. in Lakhs

Sl. No.	DESCRIPTION	AMOUNT
1	Weir overflow & Non overflow section	875.30
2	Head Regulator	172.00
3	Penstock (2.4 m dia)	3500.00
4	Penstock Civil works (2.4 m dia)	2780.00
5	Surge Tank Civil works	427.00
6	Surge Tank(steel)	420.00
7	Power House	1076.30
8	Downstream Transition	318.00
9	Tail Race Channel	249.00
10	Gates & Hoists	300.00
	TOTAL	**10117.60**

TABLE 8.1.6
HAK CHENG SMALL HYDRO PROJECT (3 x 7500 kW)
ELECTRICAL & MECHANICAL WORKS OF THE PROJECT
ABSTRACT ESTIMATE

Rs. in Lakhs

Sl. No.	DESCRIPTION	AMOUNT
1	Main Generating Equipment	
2	Control Equipment	
3	Switchyard & Switch gear	LS
4	Auxiliaries	
5	Spares, Tools & Plants	
6	Freight, Insurance	
	TOTAL	**4400.00**

TABLE 8.1.7
HAK CHENG SMALL HYDRO PROJECT (3 x 7500 kW)
TRANSMISSION
ABSTRACT ESTIMATE

Rs. in lakhs

Sl. No.	DESCRIPTION	AMOUNT
1	33 kV Transmission line and connection	1550
2	All works for Sub Station	900
3	Supervision	50
	Total	**2500**

TABLE 8.1.8
HAK CHENG SMALL HYDRO PROJECT (3 x 7500 kW)
ENGINEERING AND CONSULTANCY
ABSTRACT ESTIMATE

Rs. in lakhs

Sl. No.	DESCRIPTION	AMOUNT
1	Project Reports	45
2	Design & Detailed Engineering	80
3	Consultancy for planning of works	175
	Total	**300**

TABLE 8.1.9
HAK CHENG SMALL HYDRO PROJECT (3 x 7500 kW)
PROJECT MANAGEMENT

Rs. in lakhs

Sl. No.	DESCRIPTION	AMOUNT
1	Establishment	120.00
2	Loan Commitment Charges	150.00
3	Audit & Accounts Fees	120.00
4	Fees for Project approval	110.00
	TOTAL	**500.00**

TABLE 8.1.5.1
HAK CHENG SMALL HYDRO PROJECT (3 x 7500 kW)
OVERFLOW / NON OVERFLOW SECTION AND STILLING BASIN

SL. No	Description	Qty.	Unit	Rate Rs.	Amount Rs. in lakhs
1	Excavation in all soils	1500	Cum	300	4.50
2	Excavation in hard rock	1500	Cum	950	14.25
3	PCC M10 grade concrete with 40 mm maximum size aggregate for levelling course.	150	Cum	9000	13.50
4	M15 Concrete for Weir	2000	Cum	13000	260.00
5	RCC M-20 grade for wing walls & stilling basin	2500	Cum	15000	375.00
6	Reinforcement steel work for concrete	250	MT	60000	150.00
7	Formation and removal of Coffer dam		LS		30.00
8	Dewatering during construction		LS		5.00
9	Back filling		LS		3.00
10	Formation of Bridge , Culvert ,Nalla etc.,		LS		15.00
11	Miscellaneous and contingencies		LS		5.00
	TOTAL				**875.25**
				Say	**875.30**

TABLE 8.1.5.2
HAK CHENG SMALL HYDRO PROJECT (3 x 7500 kW)
SCHEDULE OF ITEMS FOR HEAD REGULATOR

SL.NO	PARTICULARS	Qty.	Unit	Rate Rs. in Fig.	Amount Rs. in lakhs
1	Excavation in all soils including all leads and lifts, forming channel,carrying the excess soil upto 2 kms depositing and levelling uniformly after stacking the useful materials.				
	i) Ordinary soil	1200	Cum	300	3.60
	ii) Hard Rock	1000	Cum	950	9.50
2	PCC M10 grade concrete with 40 mm maximum size aggregate for levelling course.	50	Cum	9000	4.50
3	RCC M-15 grade concrete with maximum size of 20mm aggregate for floor	225	Cum	13000	29.25
4	RCC M-20 grade concrete with max. size of 20 mm aggregate for piers & retaining walls.	500	Cum	15000	75.00
5	Reinforcement steel work for concrete	75	MT	60000	45.00
6	Provision for dewatering.		LS		5.00
	TOTAL				**171.85**
				Say	**172.00**

TABLE 8.1.5.3
HAK CHENG SMALL HYDRO PROJECT (3 x 7500 kW)
SCHEDULE OF ITEMS FOR PENSTOCK (2.4 m DIA)

SL.NO	PARTICULARS	Qty.	Unit	Rate Rs. in Fig.	Amount Rs. in lakhs
1	Fabrication & Erection of steel penstocks of 2.4m dia	2300	MT	145000	3335.00
2	Miscellaneous and contingencies	LS			165.00
	TOTAL				**3500.00**
				Say	**3500.00**

TABLE 8.1.5.4
HAK CHENG SMALL HYDRO PROJECT (3 x 7500 kW)
SCHEDULE OF ITEMS FOR CIVIL WORKS FOR PENSTOCK 2.4 M DIA

SL.NO	PARTICULARS	Qty.	Unit	Rate Rs. in Fig.	Amount Rs. in lakhs
1	Excavation in all soils including all leads and lifts carrying the excess soil upto 2 kms depositing and levelling uniformly after stacking the useful materials				
	i. Ordinary Soil	17000	Cum	300	51.00
	ii. Hard Rock	12000	Cum	950	114.00
2	PCC M10 Grade concrete with 40mm maximum size aggregate for levelling course	1800	Cum	90000	1620.00
3	RCCM-20 grade concrete with 20mm maximum size aggregate.	6000	Cum	15000	900.00
4	Reinforcement steel work for RCC	150	MT	60000	90.00
5	Miscellaneous and contingencies		LS		5.00
	TOTAL				**2780.00**
				Say	**2780.00**

TABLE 8.1.5.5
HAK CHENG SMALL HYDRO PROJECT (3 x 7500 kW)
SCHEDULE OF ITEMS FOR SURGE TANK

SL.NO	PARTICULARS	Qty.	Unit	Rate Rs. in Fig.	Amount Rs. in lakhs
1	Excavation in all soils including all leads and lifts, carrying the excess soil upto 2 kms depositing and levelling uniformly after stacking the useful materials.				
	i) Ordinary Soil	1200	Cum	300	3.60
	ii) Hard Rock	1000	Cum	950	9.50
2	PCC M10 grade concrete with 40 mm maximum size aggregate for levelling course.	100	Cum	9000	9.00
3	RCC M-20 for raft and walls	1800	Cum	15000	270.00
4	Reinforcement Steel	125	MT	60000	75.00
5	Drilling, grouting and fixing anchor bars	250	M	1900	4.75
6	Provision for form work		LS		25.00
7	Miscellaneous and contingencies		LS		30.00
	TOTAL				**426.85**
				Say	**427.00**

TABLE 8.1.5.6
HAK CHENG SMALL HYDRO PROJECT (3 x 7500 kW)
SCHEDULE OF ITEMS FOR STEEL SURGE TANK

SL.NO	PARTICULARS	Qty.	Unit	Rate Rs. in Fig.	Amount Rs. in lakhs
1	Fabrication & Erection of steel SURGE TANK	150	MT	170000	255.00
2	Miscellaneous and contingencies	LS			165.00
	TOTAL				**420.00**
				Say	**420.00**

TABLE 8.1.5.7
HAK CHENG SMALL HYDRO PROJECT (3 x 7500 kW)
SCHEDULE OF ITEMS FOR POWER HOUSE

SL.NO	PARTICULARS	Qty.	Unit	Rate Rs. in Fig.	Amount Rs. in lakhs
1	Clearing Site		LS		3.00
2	Excavation including all leads & lifts, conveying the excavated material (inexcess backfilling qty) up to a lead of 2 kms. Stacking the useful materials and dumping the soil in low lying areas, diversion road areas etc.				
	a. Ordinary soil	18000	Cum	300	54.00
	b. Hard Rock	15000	Cum	950	142.50
3	PCC M-10 (1:4:8) for levelling course with max size of 40 mm aggregate	50	Cum	9000	4.50
4	R.C.C mass work in M-15 / max size of 40 mm aggregate for sub-structure main blocks including form work	2500	Cum	13000	325.00
5	RCC work in M-20/max 20mm size aggregate for all works for super-structure including form work.	150	Cum	15000	22.50
6	Reinforcement steel work for RCC	445	MT	60000	267.00
7	Structural steel work for ladders cable tray supports stairs and rails chequred plates etc. including painting	50	MT	170000	85.00
8	Brick work in CM 1:4 for walls	650	Cum	2500	16.25
9	Providing and fixing steel doors / windows ventilators including glaring painting	350	Sq.m	3300	11.55
10	Structural steel fabrication and erection for roof trusses, purilins etc., including all fittings and painting	40	MT	170000	68.00
	C/O				**999.30**

TABLE 8.1.5.8
HAK CHENG SMALL HYDRO PROJECT (3 x 7500 kW)
SCHEDULE OF ITEMS FOR POWER HOUSE (CONTD .)

SL.NO	PARTICULARS	Qty.	Unit	Rate Rs. in Fig.	Amount Rs. in lakhs
11	Roofing with CGI sheets	3000	Sq.m	1500	45.00
12	Drilling 40mm holes for grouting if required in foundation	500	M	750	3.75
13	Cement grouting work	1800	Bags	300	5.40
14	Plastering brick / cement hollow block walls with CM 1:4 12mm thick				
	(a) Cement paint on exterior walls 3 coats	1200	Sq.m	180	2.16
	(b) Distempering for interior wall 3 coats	1200	Sq.m	150	1.80
15	Mosaic flooring in office area and control room	350	Sq.m	450	1.58
16	Hard Surfacing for floors with ironite in CM 1:3:2 mm thick	400	Sq.m	450	1.80
17	Acid resistant tile flooring in battery room and charge room	250	Sq.m	1700	4.25
18	Ceramic tiles in toilet floor / walls	200	Sq.m	595	1.19
19	Providing and fixing water supply and sanitary fittings		LS		5.00
20	Provision for Dewatering		LS		5.00
	TOTAL				**1076.23**
				Say	**1076.30**

TABLE 8.1.5.9
HAK CHENG SMALL HYDRO PROJECT (3 x 7500 kW)
SCHEDULE OF ITEMS FOR DOWNSTREAM TRANSITION

SL.NO	PARTICULARS	Qty.	Unit	Rate Rs. in Fig.	Amount Rs. in lakhs
1	Excavation including all leads conveying the excess excavated materials (in excess of filling qty.) up to a lead of 2 Km , stacking the useful material and dumping the soils in low lying areas, diversion road etc. as directyed at site.				
	i) Ordinary Soil	9000	Cum	300	27.00
	ii) Hard rock	8000	Cum	950	76.00
2	PCC M10 grade concrete with 40 mm maximum size aggregate for levelling course.	50	Cum	9000	4.50
3	Backfilling with available excavated soil behind retaining walls ,forming embankment etc., Consolidated and finished to required level.	7500	Cum	125	9.38
4	RCC M-20 grade concrete with max. size of 20 mm aggregate for retaining walls..	600	Cum	15000	90.00
5	Reinforcement steel work for concrete	90	MT	60000	54.00
6	RCC M-15 grade concrete with maximum size of 20mm aggregate for inclined floor	400	Cum	13000	52.00
7	Provision for dewatering		LS		5.00
	TOTAL				**317.88**
				Say	**318.00**

TABLE 8.1.5.10
HAK CHENG SMALL HYDRO PROJECT (3 x 7500 kW)
SCHEDULE OF ITEMS FOR TAIL RACE CHANNEL & RIVER REGRADING

SL.NO	PARTICULARS	Qty.	Unit	Rate Rs. in Fig.	Amount Rs. in lakhs
1	Excavation in all soils including all leads and lifts, forming channel,carrying the excess soil upto 2 kms depositing and levelling uniformly after stacking the useful materials.				
	i) Ordinary soil	8000	Cum	300	24.00
	ii) Hard Rock	11000	Cum	950	104.50
2	PCC M10 grade concrete with 40 mm maximum size aggregate for levelling course.	200	Cum	9000	18.00
3	PCC M-15 grade concrete with 20mm maximum size aggregate for channel sides and base	250	Cum	13000	32.50
4	River Regrading		LS		50.00
5	Provision for dewatering.		LS		20.00
	TOTAL				**249.00**
				Say	**249.00**

TABLE 8.1.5.11

HAK CHENG SMALL HYDRO PROJECT (3 x 7500 kW)
TRASH RACKS, GATES AND HOISTS
ABSTRACT ESTIMATE

SL.NO	PARTICULARS	Qty.	RATE	Amount Rs. In Lakhs
1	a) Intake Gate at Head Regulator (3m x 3m) b) Electrical Hoist for Intake Gate	1		
2	a) Stoplog Gate at Head Regulator (3m x 3m) b) Electrical Hoist for stoplog gate at Intake structure	1		LS
3	Trash Rack (5.5m x 3m)	1		
4	a. Intake gate at Surge Tank (2.25m x 2.25m) b. Electrical Hoist for Intake Gate	1		
5	a. Draft Tube Gates (4.75m x 2.25m) b. Draft Tube Gates Hoists	2		
	Total	200	150000	300.00

TABLE 8.1.6.1
HAK CHENG SMALL HYDRO PROJECT (3 x 7500 kW)
ELECTRICAL & MECHANICAL WORKS
DETAILED ESTIMATE

PAGE 1/2

SL. NO.	DESCRIPTION	QTY	RATE	AMOUNT Rs. in Lakhs
1	**Main Generating Equipment**			
I)	Francis Turbine to develop 7500 KW at generator	3		
ii)	Butterfly valve	3		
iii)	Oil Pressure Units	3		
iv)	Cooling Water Systems	3		
v)	Dewatering & Drainage system	3		
vi)	Synchronous Generator 11kV, 7500 KW, 0.85 PF 1500 rpm, 50 Hz	3		
	Sub total			
2	**Control Equipment**			
i)	a) Generator control & Relay panel	3		
	b)11kV switchgear panel with necessary control & metering	3 sets		
	c) LAVT cubicle	3 Nos.		
	d) Neutral grounding resistor with 11kV isolator	3 Nos.		
ii)	Transformer control, protection, Metering & Annunciation panel	3 sets		LS
iii)	OLTC Control Panel	3 Nos.		
iv)	Turbine Control Panels	3 Nos.		
v)	Capacitor Control Panel	3 Nos.		
vi)	11kV Station Auxillary Board	2 sets		
vii)	415 V, 150 AH Battery with charger and D.C. Distribution Board	2 Nos.		
	Sub total			
3	**Switch yard and Switch Gear**			
i)	Power Transformer 10000 KVA 11KV with OLTC	3 Nos.		
ii)	11 KV, 13.12 KV 1250 A SF-6VCB	2 Nos.		
iii)	11 kV Isolators, CT's PT's, LA's, Bus Bars, Switch yard structures & Trivector metering arrangement	2 set		
iv)	11 kV feeder protection pannels	2 set		
v)	250 kVA, 11 kV / 415 V Auxillary Transformer system	1 No.		

TABLE 8.1.6.2
HAK CHENG SMALL HYDRO PROJECT (3 x 7500 kW)
ELECTRICAL & MECHANICAL WORKS
DETAILED ESTIMATE

SL. NO.	DESCRIPTION	QUANTITY	RATE	AMOUNT Rs. in Lakhs
4	**Auxilliary Equipments**			
i)	Power & Control Cables	1		
ii)	Station Lighting	1		
iii)	Station Ventilation	1		
iv)	Station Fire Fighting	1		
v)	Control Room air Conditioning	1		
vi)	125 KVA, 415 V DG Set with control panel	1		
vii)	Station Earthing	1		
viii)	Station Communication	1		
ix)	30 Tonnes EOT Crane	1		LS
	Sub total			
5	**Spares, Tools & Plants**			
i)	Spares	1		
ii)	Tools & Plants	1		
	Sub Total			
6	**Total Ex-works price of E&M equipment**			
7	**Freight, Insurance etc.,**	1		
	Total for Supply			**4400.00**

TABLE 8.1.7.1
HAK CHENG SMALL HYDRO PROJECT (3 x 7500 kW)
TRANSMISSION
DETAILED ESTIMATE

SL. NO.	DESCRIPTION	QUANTITY	RATE	AMOUNT Rs. in lakhs
1	33 kV Single circuit Line on 9.10 m pscc poles with Coyote conductor			
2	33 kV Breaker		LS	
3	CTS, PTS, LAS & Metering Arrangement			
4	Supervision Charges			
	Total			**2500**

PROJECT FINANCIALS

HARIT DYNAMICS PVT LTD
Yijung River SHP (3 x7500 KW)
HAK CHANG VILLAGE

PROJECTED BALANCE SHEETS	**1st Yr.**	**2nd Yr.**	**3rd Yr.**	**4th Yr.**	**5th Yr.**	**6th Yr.**	**7th Yr.**	**8th Yr.**	**9th Yr.**	**10th Yr.**	**11th Yr.**	**12th Yr.**
LIABILITIES												
Promoters Fund	5,625.00	5,625.00	5,625.00	5,625.00	5,625.00	5,625.00	5,625.00	5,625.00	5,625.00	5,625.00	5,625.00	5,625.00
Subsidy	2,000.00	2,000.00	2,000.00	2,000.00	2,000.00	2,000.00	2,000.00	2,000.00	2,000.00	2,000.00	2,000.00	2,000.00
Reserves abd Surplus	675.07	1,545.44	2,610.72	3,870.56	5,324.55	6,972.27	8,307.03	9,834.63	11,316.19	12,989.59	13,303.14	13,605.53
Loan	15,187.50	13,500.00	11,812.50	10,125.00	8,437.50	6,750.00	5,062.50	3,375.00				
	23,487.57	**22,670.44**	**22,048.22**	**21,620.56**	**21,387.05**	**21,347.27**	**20,994.53**	**20,834.63**	**18,941.19**	**20,614.59**	**20,928.14**	**21,230.53**
ASSETS												
Fixed Assets												
Gross Block	22,500.00	22,500.00	22,500.00	22,500.00	22,500.00	22,500.00	22,500.00	22,500.00	22,500.00	22,500.00	22,500.00	22,500.00
Less : Depreciation	535.04	1,070.09	1,605.13	2,140.18	2,675.22	3,210.26	3,745.31	4,280.35	4,815.40	5,350.44	5,885.48	6,420.53
	21,964.96	21,429.91	20,894.87	20,359.82	19,824.78	19,289.74	18,754.69	18,219.65	17,684.60	17,149.56	16,614.52	16,079.47
Bank FD - Subsidy	1,300.00	80.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00
Cash & Bank Balance	222.62	1,160.52	1,093.36	1,200.74	1,502.27	1,997.53	2,179.84	2,554.98	1,196.59	3,405.03	4,253.62	5,091.06
	23,487.57	**22,670.44**	**22,048.22**	**21,620.56**	**21,387.05**	**21,347.27**	**20,994.53**	**20,834.63**	**18,941.19**	**20,614.59**	**20,928.14**	**21,230.53**

HARIT DYNAMICS PVT LTD
Yijung River SHP (3 x7500 KW)
HAK CHANG VILLAGE

CASH FLOW STATEMAENT	**1st Yr.**	**2nd Yr.**	**3rd Yr.**	**4th Yr.**	**5th Yr.**	**6th Yr.**	**7th Yr.**	**8th Yr.**	**9th Yr.**	**10th Yr.**	**11th Yr.**	**12th Yr.**
Sources of Funds												
Net Profit after tax	675.07	870.36	1,065.29	1,259.84	1,453.99	1,647.72	1,841.01	2,033.85	1,987.81	2,179.65	819.80	808.64
Add: Depreciation	535.04	535.04	535.04	535.04	535.04	535.04	535.04	535.04	535.04	535.04	535.04	535.04
	1,210.12	1,405.41	1,600.33	1,794.88	1,989.03	2,182.76	2,376.06	2,568.89	2,522.85	2,714.70	1,354.84	1,343.68
Promoters fund	5,625.00											
Loan borrowed	16,875.00											
Subsidy	2,000.00											
Bank FD matured		1,220.00	20.00	-	-	-	-	-	-	-	-	-
	25,710.12	**2,625.41**	**1,620.33**	**1,794.88**	**1,989.03**	**2,182.76**	**2,376.06**	**2,568.89**	**2,522.85**	**2,714.70**	**1,354.84**	**1,343.68**
Application Funds												
Purchase of Assets	22,500.00											
Loan Repayment	1,687.50	1,687.50	1,687.50	1,687.50	1,687.50	1,687.50	1,687.50	1,687.50	3,375.00	-	-	-
Return On Equity	-	-	-	-	-	-	506.25	506.25	506.25	506.25	506.25	506.25
Bank FD	1,300.00											
	25,487.50	1,687.50	1,687.50	1,687.50	1,687.50	1,687.50	2,193.75	2,193.75	3,881.25	506.25	506.25	506.25
Surplus	222.62	937.91	-67.17	107.38	301.53	495.26	182.31	375.14	-1,358.40	2,208.45	848.59	837.43
Opening Balance	-	222.62	1,160.52	1,093.36	1,200.74	1,502.27	1,997.53	2,179.84	2,554.98	1,196.59	3,405.03	4,253.62
Cl Balance	**222.62**	**1,160.52**	**1,093.36**	**1,200.74**	**1,502.27**	**1,997.53**	**2,179.84**	**2,554.98**	**1,196.59**	**3,405.03**	**4,253.62**	**5,091.06**

TABLE 1.3

HARITH DYNAMICS PVT LTD

YANG MUN SHP (3 x7500 KW)

HAK CHANG VILLAGE

LOAN REPAYMENT SCHEDULE

	FINANCIAL INSTITUITION				Rs.in Lakhs		
Inst. No.	Op.Bal.	Inst.	Cl.Bal.	Int. @ 12%	Interest	Principle	Total
1.00	16875.00	421.88	16453.13	506.25			
2.00	16453.13	421.88	16031.25	493.59			
3.00	16031.25	421.88	15609.38	480.94			
4.00	15609.38	421.88	15187.50	468.28	1949.06	1687.50	3636.56
5.00	15187.50	421.88	14765.63	455.63			
6.00	14765.63	421.88	14343.75	442.97			
7.00	14343.75	421.88	13921.88	430.31			
8.00	13921.88	421.88	13500.00	417.66	1746.56	1687.50	3434.06
9.00	13500.00	421.88	13078.13	405.00			
10.00	13078.13	421.88	12656.25	392.34			
11.00	12656.25	421.88	12234.38	379.69			
12.00	12234.38	421.88	11812.50	367.03	1544.06	1687.50	3231.56
13.00	11812.50	421.88	11390.63	354.38			
14.00	11390.63	421.88	10968.75	341.72			
15.00	10968.75	421.88	10546.88	329.06			
16.00	10546.88	421.88	10125.00	316.41	1341.56	1687.50	3029.06
17.00	10125.00	421.88	9703.13	303.75			
18.00	9703.13	421.88	9281.25	291.09			
19.00	9281.25	421.88	8859.38	278.44			
20.00	8859.38	421.88	8437.50	265.78	1139.06	1687.50	2826.56
21.00	8437.50	421.88	8015.63	253.13			
22.00	8015.63	421.88	7593.75	240.47			
23.00	7593.75	421.88	7171.88	227.81			
24.00	7171.88	421.88	6750.00	215.16	936.56	1687.50	2624.06
25.00	6750.00	421.88	6328.13	202.50			
26.00	6328.13	421.88	5906.25	189.84			
27.00	5906.25	421.88	5484.38	177.19			
28.00	5484.38	421.88	5062.50	164.53	734.06	1687.50	2421.56
29.00	5062.50	421.88	4640.63	151.88			
30.00	4640.63	421.88	4218.75	139.22			
31.00	4218.75	421.88	3796.88	126.56			
32.00	3796.88	421.88	3375.00	113.91	531.56	1687.50	2219.06
33.00	3375.00	421.88	2953.13	101.25			
34.00	2953.13	421.88	2531.25	88.59			
35.00	2531.25	421.88	2109.38	75.94			
36.00	2109.38	421.88	1687.50	63.28	329.06	1687.50	2016.56
37.00	1687.50	421.88	1265.63	50.63			
38.00	1265.63	421.88	843.75	37.97			
39.00	843.75	421.88	421.88	25.31			
40.00	421.88	421.88	0.00	12.66	126.56	1687.50	1814.06
41.00		421.88					
42.00							
43.00							
44.00							
45.00							
Total		17296.88		10378.13	10378.13	16875.00	27253.13

Admissible Depreciation

	1st Yr.	2nd Yr.	3rd Yr.	4th Yr.	5th Yr.	6th Yr.	7th Yr.	8th Yr.	9th Yr.	10th Yr.	11th Yr.	12th Yr.
Plant and Machinery												
Power plant Transimissi	13379	13060.58	12742.16	12423.74	12105.32	11786.9	11468.48	11150.06	10831.64	10513.22	10194.8	9876.378
Depreciation	318.4202	318.4202	318.4202	318.4202	318.4202	318.4202	318.4202	318.4202	318.4202	318.4202	318.4202	318.4202
	13060.58	**12742.16**	**12423.74**	**12105.32**	**11786.9**	**11468.48**	**11150.06**	**10831.64**	**10513.22**	**10194.8**	**9876.378**	**9557.958**
Dam, and Civil structure	9121	8904.376	8687.753	8471.129	8254.505	8037.881	7821.258	7604.634	7388.01	7171.386	6954.763	6738.139
	216.6238	216.6238	216.6238	216.6238	216.6238	216.6238	216.6238	216.6238	216.6238	216.6238	216.6238	216.6238
	8904.376	**8687.753**	**8471.129**	**8254.505**	**8037.881**	**7821.258**	**7604.634**	**7388.01**	**7171.386**	**6954.763**	**6738.139**	**6521.515**
Total Dep	**535.044**	**535.044**	**535.044**	**535.044**	**535.044**	**535.044**	**535.044**	**535.044**	**535.044**	**535.044**	**535.044**	**535.044**
WDV	**21964.96**	**21429.91**	**20894.87**	**20359.82**	**19824.78**	**19289.74**	**18754.69**	**18219.65**	**17684.6**	**17149.56**	**16614.52**	**16079.47**

HARIT DYNAMICS PVT LTD

Yijung River SHP (3 x7500 KW)

HAK CHANG VILLAGE

IRR calculations

	1st Yr.	2nd Yr.	3rd Yr.	4th Yr.	5th Yr.	6th Yr.	7th Yr.	8th Yr.	9th Yr.	10th Yr.	11th Yr.	12th Yr.
-PAT	1,210.12	1,405.41	1,600.33	1,794.88	1,989.03	2,182.76	2,376.06	2,568.89	2,522.85	2,714.70	1,354.84	1,343.68
-Depreciation	535.04	535.04	535.04	535.04	535.04	535.04	535.04	535.04	535.04	535.04	535.04	535.04
- Interest	1,949.06	1,746.56	1,544.06	1,341.56	1,139.06	936.56	734.06	531.56	329.06	126.56	-	-
Total Cash Flows	3,694.22	3,687.01	3,679.44	3,671.49	3,663.14	3,654.37	3,645.17	3,635.50	3,386.96	3,376.30	1,889.89	1,878.73

IRR	for 10 Yr.s	9.81%
	for 15 Yr.s	12.20%
	for 20 Yr.s	13.17%
	for 25 Yr.s	13.59%
	for 30 Yr.s	13.80%
	for 35 Yr.s	13.90%

HARIT DYNAMICS PVT LTD
Yijung River SHP (3 x7500 KW)
HAK CHANG VILLAGE

PROFITABILITY STATEMENT

1. Total Cost of the Project (incl IDC)	Rs. Lakhs	**22,500**
2. Equity	Rs. Lakhs	**5,625**
3. Term Loans	Rs. Lakhs	**16,875**
Average Sale Rate (Rs. / KWH)		**4.73**

Particulars	1st Yr.	2nd Yr.	3rd Yr.	4th Yr.	5th Yr.	6th Yr.	7th Yr.	8th Yr.	9th Yr.	10th Yr.	11th Yr.	12th Yr.
Sale Energy lakh kwh	720	720	720	720	720	720	720	720	720	720	720	720
Sale Price	4.73	4.73	4.73	4.73	4.73	4.73	4.73	4.73	4.73	4.73	2.52	2.52
Sale Revenue (A)	3,405.60	3,405.60	3,405.60	3,405.60	3,405.60	3,405.60	3,405.60	3,405.60	3,405.60	3,405.60	1,814.40	1,814.40
Total Revenue	3,405.60	3,405.60	3,405.60	3,405.60	3,405.60	3,405.60	3,405.60	3,405.60	3,405.60	3,405.60	1,814.40	1,814.40
Operating Exp.												
a.Interest on loans @12%	1,949.06	1,746.56	1,544.06	1,341.56	1,139.06	936.56	734.06	531.56	329.06	126.56	-	-
b.Depreciation @	535.04	535.04	535.04	535.04	535.04	535.04	535.04	535.04	535.04	535.04	535.04	535.04
c.Management Expenses												
d.O&M Charges @ 4% (5%annual escalation after every 1 Yr.)	136.22	143.04	150.19	157.70	165.58	173.86	182.55	191.68	201.26	211.33	221.89	232.99
e.Insurance @0.06%	8.03	8.43	8.85	9.29	9.76	10.25	10.76	11.30	11.86	12.45	13.08	13.73
h.Royalty	102.17	102.17	102.17	102.17	102.17	102.17	102.17	102.17	340.56	340.56	181.44	181.44
Total Op.Exp.(B)	2,730.53	2,535.24	2,340.31	2,145.76	1,951.61	1,757.88	1,564.59	1,371.75	1,417.79	1,225.95	951.45	963.20
Profit Before Tax	675.07	870.36	1,065.29	1,259.84	1,453.99	1,647.72	1,841.01	2,033.85	1,987.81	2,179.65	862.95	851.20
Provision for Tax	-	-	-	-	-	-	-	-	-	-	43.15	42.56
Profit After Tax	675.07	870.36	1,065.29	1,259.84	1,453.99	1,647.72	1,841.01	2,033.85	1,987.81	2,179.65	819.80	808.64
Return on Equity@ 9%	-	-	-	-	-	-	506.25	506.25	506.25	506.25	506.25	506.25
Profit after Return on Equity	675.07	870.36	1,065.29	1,259.84	1,453.99	1,647.72	1,334.76	1,527.60	1,481.56	1,673.40	313.55	302.39
Cash surplus (PAT+Dep.-Return on equity)	1,210.12	1,405.41	1,600.33	1,794.88	1,989.03	2,182.76	2,376.06	2,568.89	2,522.85	2,714.70	1,354.84	1,343.68

MNES Subsidy												
Loan Repayment	1,687.50	1,687.50	1,687.50	1,687.50	1,687.50	1,687.50	1,687.50	1,687.50	1,687.50	1,687.50		
Net cash surplus	-477.38	-282.09	-87.17	107.38	301.53	495.26	688.56	881.39	835.35	1,027.20		
Net Cum Surplus												
PAT + Dep.+Int	3,159.18	3,151.97	3,144.39	3,136.44	3,128.09	3,119.33	3,110.12	3,100.46	2,851.91	2,841.26		
Loan Rep + Int	3,636.56	3,434.06	3,231.56	3,029.06	2,826.56	2,624.06	2,421.56	2,219.06	2,016.56	1,814.06		
DSCR	0.87	0.92	0.97	1.04	1.11	1.19	1.28	1.40	1.41	1.57		
	1.18											

HARIT DYNAMICS PVT. LTD.

HAK CHANG SMALL HYDRO PROJECT

(3 x 7.5 MW = 22.5 MW)

TARIFF FILING FORMS (HYDRO)

FOR DETERMINATION OF TARIFF

(Annexure-I)

CHECKLIST OF FORMS AND OTHER INFORMATION/ DOCUMENTS FOR TARIFF FILING FOR HAK CHANG SMALL HYDRO POWER GENERATION STATION

Form No.	Title of Tariff Filing Forms (Hydro)	Tick
FORM- 1	Summary Sheet	
FORM-2	Details of Type of hydro station, Capacity Index, Primary energy rate etc..	
FORM-3	Salient Features of Hydroelectric Project	
FORM- 4	Details of Foreign loans	
FORM-5	Abstract of Admitted Capital Cost for the existing Projects	
FORM-5A	Abstract of Capital Cost Estimates and Schedule of Commissioning for the New projects	
FORM-5B	Break-up of Capital Cost for Hydro Power Generating Station	
FORM-5C	Break-up of Capital Cost for Plant & Equipment	
FORM-5D	Break-up of Construction/Supply/Service packages	
FORM- 6	Financial Package upto COD	
FORM- 7	Details of Project Specific Loans	
FORM- 8	Details of Allocation of corporate loans to various projects	
FORM-9	Statement of Additional Capitalisation after COD	
FORM- 10	Financing of Additional Capitalisation	
FORM- 11	Calculation of Depreciation	
FORM- 12	Statement of Depreciation	
FORM- 13	Calculation of Weighted Average Rate of Interest on Actual Loans	
FORM- 14	Draw Down Schedule for Calculation of IDC & Financing Charges	
FORM- 15	Details of operation and Maintenance Expenses	

Other Information/ Documents		
Sl. No.	**Information/Document**	**Tick**
1	Certificate of incorporation, Certificate for Commencement of Business, Memorandum of Association, & Articles of Association (For New Station setup by a company making tariff application for the first time to NERC)	
2	A. Station wise and Corporate audited Balance Sheet and Profit & Loss Accounts with all the Schedules & annexures on COD of the Station for the new station & for the relevant years. B. Station wise and Corporate audited Balance Sheet and Profit & Loss Accounts with all the Schedules & annexures for the existing station for the relevant years.	
3	Copies of relevant loan Agreements	
4	Copies of the approval of Competent Authority for the Capital Cost and Financial package.	
5	Copies of the Equity participation agreements and necessary approval for the foreign equity.	
6	Copies of the BPSA/PPA with the beneficiaries, if any	
7	Detailed note giving reasons of cost and time over run, if applicable.	
8	Generating Company shall submit copy of Cost Audit Report along with cost accounting records, cost details, statements, schedules etc. for the Generating Unit wise /stage wise/Station wise/ and subsequently consolidated at Company level as submitted to the Govt. of India for first two years at the time of mid-term true-up in 2016-17 and for balance period of tariff period 2014-19 at the time of final true-up in 2019- In case of initial tariff filing the latest available Cost Audit Report should be furnished.	
9	Any other relevant information, (Please specify)	

Note : Electronic copy of the petition (in words format) and detailed calculation as per these formats (in excel format) and any other information submitted shall also be furnished in the form of CD/Floppy disc.

FORM- 1

SUMMARY SHEET

Name of the Company: HARIT DYNAMICS PVT. LTD.
Name of the Generating Station: HAK CHANG SMALL HYDRO PROJECT
District: Tuesang District **State: Nagaland State**

(Rs. In lakh)

S.No.	Particulars	1st Year	2nd Year	3rd Year	4th Year	5th Year
1	2	3	4	5	6	7
1.1	Depreciation	535.04	535.04	535.04	535.04	535.04
1.2	Interest on Loan	1,949.06	1,746.56	1,544.06	1,341.56	1,139.06
1.3	Return on Equity[1]	_	_	_	_	_
1.4	Interest on Working Capital					
1.5	O & M Expenses	136.22	143.04	150.19	157.70	165.58
	Total					

Note
1: Details of calculations, considering equity as per regulation, to be furnished.

M/s HARIT DYNAMICS PVT. LTD.

Director

FORM- 2

DETAILS OF COD, TYPE OF HYDRO STATION, NORMATIVE ANNUAL PLANT AVAILABILITY FACTOR(NAPAF) & OTHER NORMATIVE PARAMETERS CONSIDERED FOR TARIFF CALCULATION

Name of the Applicant: HARIT DYNAMICS PVT. LTD.
Name of the Generating Station: HAK CHANG SMALL HYDRO PROJECT

Year Ending March

	Particulars	**Unit**	**Existing Year**	2nd Year	**3rd Year**	4th **Year**	5th **Year**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
1	Installed Capacity	MW	22.5				
2	Free power to home state	%	Nill				
3	Date of commercial operation (actual/anticipated)						
	Unit-1		7.5				
	Unit-2		7.5				
	Unit-3		7.5				
4	Type of Station						
	a) Surface/underground		SURFACE				
	b) Purely ROR/ Pondage/Storage		Run of River				
	c) Peaking/non-peaking						
	d) No. of hours of peaking						
	e) Overload capacity(MW) & period		10 % for 3 months				
5	Type of excitation						
	a) Rotating exciters on generator		Brush Less				
	b) Static excitation						
6	Design Energy (Annual)	GWh	68				
7	Auxiliary Consumption	%	0.015				
8	Transmission Losses	%	0.015				
9	Saleable Primary Energy	GWh	71.97				
10	Primary Energy Rate	Rupees/ Kwh	4.73				

1. Month wise 10-day Design energy figures to be given separately with the petition.

M/s HARIT DYNAMICS PVT. LTD.

Director

FORM – 3

SALIENT FEATURES OF HYDROELECTRIC PROJECT

Name of the Applicant : HARIT DYNAMICS PVT. LTD.
Name of the Generating Station: HAK CHANG SMALL HYDRO PROJECT

1. Location	
State/Distt.	Tuesang District in Nagaland State
River	Yang Mun River
2. Diversion Tunnel	
Shape	Ogee
Length (M)	87
Width (M)	6
3. Dam	
Type	It's is a Run of River project
Maximum dam height (M)	
4. Spillway	
Type	Ogee
Capacity of spillway (Cumecs)	750.00
5. Reservoir	
Full Reservoir Level (FRL) (ELM)	+742
Minimum Draw Down Level (MDDL) (ELM)	+745
Live storage (MCM)	It is Run of River Project
6. Head Race Tunnel	
Size and type	RCC , 3.75 x 3.75 m
Length (M)	18 m
7. Surge Shaft	
Type	Steel
Diameter (M)	6.5
Height (M)	18
8. Penstock/Pressure shafts	
Type	Steel
Diameter & Length (M)	2.4 m & 2800 m
9. Power House	
Installed capacity (No of units x MW)	3 x 7.5 MW
Type of turbine	Francis
Rated Head(M)	115 m
Rated Discharge(Cumecs)	7 per unit
Head at Full Reservoir Level (M)	118 m
MW Capability at FRL	22.5 MW

10. Tail Race Tunnel/Channel	
Diameter (M) , shape	30
Length (M)	200
Minimum tail water level (ELM)	+623 m
11. Switchyard	
Type of Switch gear	Out Door
No. of generator bays	3
No. of line bays	2

Note: Specify limitation on generation during specific time period(s) on account of restrictions on water use due to irrigation, drinking water, industrial, environmental considerations etc. **(NOT APPLICABLE)**

M/s HARIT DYNAMICS PVT. LTD.

Director

FORM- 4

DETAILS OF FOREIGN LOANS (Not applicable)

(Details only in respect of loans applicable to the project under petition)

Name of the Applicant : HARIT DYNAMICS PVT. LTD.

Name of the Generating Station : HAK CHANG SMALL HYDRO PROJECT

Exchange Rate as on 31.3.2017 : 1 $ = 64.8 Rs.

Sl.	Financial Year (Starting from COD)	Year 1				Year 2				Year 3 and so on			
	1	2	3	4	5	6	7	8	9	10	11	12	13
		Date	Amount (Foreign Currency)	Relevant Exchange Rate	Amount (Rs. Lakh)	Date	Amount (Foreign Currency)	Relevant Exchange Rate	Amount (Rs.Lakh)	Date	Amount (Foreign Currency)	Relevant Exchange Rate	Amount (Rs. Lakh)
	Currency1[1]												
A.1	At the date of Drawl[2]												
2	Scheduled repayment date of principal												
3	Scheduled payment date of interest												
4	At the end of Financial year												
B	In case of Hedging[3]												
1	At the date of hedging												
2	Period of hedging												
3	Cost of hedging												
	Currency2[1]												
A.1	At the date of Drawl[2]												
2	Scheduled repayment date of principal												
3	Scheduled payment date of interest												
4	At the end of Financial year												
B	In case of Hedging[3]												
1	At the date of hedging												

Sl.	Financial Year (Starting from COD)	Year 1				Year 2				Year 3 and so on			
	1	2	3	4	5	6	7	8	9	10	11	12	13
2	Period of hedging												
3	Cost of hedging												
	Currency3[1] & so on												
A.1	At the date of Drawl[2]												
2	Scheduled repayment date of principal												
3	Scheduled payment date of interest												
4	At the end of Financial year												
B	In case of Hedging[3]												
1	At the date of hedging												
2	Period of hedging												
3	Cost of hedging												

1. Name of the currency to be mentioned e.g. US$, DM, etc.
2. In case of more than one drawl during the year, Exchange rate at the date of each drawl to be given
3. Furnish details of hedging, in case of more than one hedging during the year or part hedging, details of each hedging are to be given
4. Tax (such as withholding tax) details as applicable including change in rates, date from which change effective etc. must be clearly indicated.

M/s HARIT DYNAMICS PVT. LTD.

Director

FORM-5

ABSTRACT OF ADMITTED CAPITAL COST FOR THE EXISTING PROJECTS (Not Applicable)

Name of the Applicant: **HARIT DYNAMICS PVT. LTD.**
Name of the Generating Station: **HAK CHANG SMALL HYDRO PROJECT**

	Capital Cost as admitted by NERC	
a)	**Capital cost admitted as on_____**	
	(Give reference of the relevant NERC Order with Petition No. & Date)	
b)	Foreign Component, if any (In Million US $ or the relevant Currency)	
c)	Foreign Exchange rate considered for the admitted Capital cost (Rs Lakh)	
d)	Total Foreign Component (Rs. Lakh)	
e)	Domestic Component (Rs. Lakh.)	
f)	Hedging cost, if any, considered for the admitted Capital cost (Rs Lakh)	
	Total Capital cost admitted (Rs. Lakh) (d+e+f)	

M/s HARIT DYNAMICS PVT. LTD.

Director

FORM- 5A

ABSTRACT OF CAPITAL COST ESTIMATES AND SCHEDULE OF COMMISSIONING FOR THE NEW PROJECTS

Name of the Applicant : HARIT DYNAMICS PVT. LTD.
Name of the Generating Station : HAK CHANG SMALL HYDRO PROJECT

New Projects
Capital Cost Estimates

Board of Director/ Agency approving the Capital cost estimates:	**22500.00 lakhs**	
Date of approval of the Capital cost estimates:		
	Present Day Cost	**Completed Cost**
Price level of approved estimates	As on End of 3rd Qtr. of the year	As on scheduled COD of the Station
Foreign Exchange rate considered for the Capital cost estimates	Nill	
Capital Cost excluding IDC, IEDC & FC		
Foreign Component, if any (In Million US $ or the relevant Currency)	Nill	
Domestic Component (Rs. Lakh)	19733.00	
Capital cost excluding IDC, IEDC, FC, FERV & Hedging Cost (Rs. Lakh)	**19733.00**	
IDC, IEDC, FC, FERV & Hedging Cost		
Foreign Component, if any (In Million US $ or the relevant Currency)		
Domestic Component (Rs. Lakh)		
Total IDC, IEDC, FC, FERV & Hedging Cost (Rs. Lakh		
Rate of taxes & duties considered		
Capital cost Including IDC, IEDC, FC, FERV & Hedging Cost		
Foreign Component, if any (In Million US $ or the relevant Currency)	Nill	
Domestic Component (Rs. Lakh)	_	
Capital cost Including IDC, IEDC & FC (Rs. Lakh)	**22500.00**	
Schedule of Commissioning as per investment approval		
Scheduled COD of Unit-I		

Scheduled COD of Unit-II	
Scheduled COD of Unit -III	

Note:

1. Copy of approval letter should be enclosed
2. Details of Capital Cost are to be furnished as per FORM-5B or 5C as applicable
3. Details of IDC & Financing Charges are to be furnished as per FORM-14.

M/s HARIT DYNAMICS PVT. LTD.

Director

BREAK-UP OF CAPITAL COST FOR NEW HYDRO POWER GENERATING STATION FORM -5B

Name of the Applicant : HARIT DYNAMICS PVT. LTD.
Name of the Generating Station : HAK CHANG SMALL HYDRO PROJEC

(Amount in Rs Lakh)

Sl. No. (1)	Break Down (2)	Original Cost as approved by Authority/Investment Approval (3)	Actual Capital Expenditure as on actual/anticipated COD (4)	Liabilities/ Provisions (5)	Variation (6=3-4-5)	Reasons for Variation (7)
1.0	**Infrastructure Works**					
1.1	Preliminary including Development	300.00				
1.2	Land*	160.00				
1.3	R&R expenditure	100.00				
1.4	Buildings	200.00				
1.5	Township	300.00				
1.6	Maintenance	100.00				
1.7	Tools & Plants	100.00				
1.8	Communication	75.00				
1.9	Environment & Ecology	40.00				
1.10	Losses on stock	_				
1.11	Receipt & Recoveries	_				
1.12	**Total (Infrastructure works)**	1375.00				
2.0	**Major Civil Works**					
2.1	Dam, Intake & De-	875.30				

Sl. No	Break Down (2)	Original Cost as approved by Authority/Investment Approval (3)	Actual Capital Expenditure as on actual/anticipated COD (4)	Liabilities/ Provisions (5)	Variation (6=3-4-5)	Reasons for Variation
	silting Chambers					
2.2	HRT, TRT, Surge Shaft & Pressure shafts	3628.00				
2.3	Power Plant civil works	1076.30				
2.4	Other civil works (to be specified)	318.00				
2.5	**Total (Major Civil Works)**	**5897.00**				
3.0	**Hydro Mechanical equipments**	**4220.00**				
4.0	**Plant & Equipment**	4200.00				
4.1	Initial spares of Plant & Equipment	200.00				
4.2	**Total (Plant & Equipment)**	**4400.00**				
5.0	**Taxes and Duties**					
5.1	Custom Duty					
5.2	Other taxes & Duties					
5.3	**Total Taxes & Duties**					

Sl. No. (1)	Break Down (2)	Original Cost as approved by Authority/Investment Approval (3)	Actual Capital Expenditure as on actual/anticipated COD (4)	Liabilities/ Provisions (5)	Variation (6=3-4-5)	Reasons for Variation (7)
6.0	**Capital Cost without IDC, FC, FERV & Hedging Cost**	19733.00				
7.0	**IDC, FC, FERV & Hedging Cost**					
7.1	Interest During Construction (IDC)	2762.00				
7.2	Financing Charges (FC)	NILL				
7.3	Foreign Exchange Rate Variation (FERV)	NILL				
8	**Total of IDC, FC, FERV**	2762.00				
9	**Capital cost including IDC, FC, FERV**	22500.00				

M/s HARIT DYNAMICS PVT. LTD.

Director

FORM- 5C

BREAK-UP OF CAPITAL COST FOR PLANT & EQUIPMENT (NEW PROJECTS)

Name of the Applicant : HARIT DYNAMICS PVT. LTD.

Name of the Generating Station : HAK CHANG SMALL HYDRO PROJECT

(Amount in Rs Lakh)

Sl. No. (1)	Break Down (2)	Approximate Cost as approved by Authority/Investment Approval (1)	Cost on Actual/anticipated COD (1)	Variation	Reasons for Variation*
		Total Cost	Total Cost	(3)	(4)
1.0	**Generator, turbine & Accessories**				
1.1	Generator package	1120.00			
1.2	Turbine package	949.00			
1.3	Unit control Board	51.00			
1.4	C&I package	80.00			
1.5	Bus Duct of GT connection	30.00			
1.6	**Total (Generator, turbine & Accessories)**	**2230**			
2.0	**Auxiliary Electrical Equipment**				
2.1	Step up transformer	180.00			
2.2	Unit Auxiliary Transformer	20.00			
2.3	Local supply transformer	437.00			
2.4	Station transformer				
2.5	SCADA				
2.6	Switchgear, Batteries, DC dist. Board				

Sl. No. (1)	Break Down (2)	Original Cost as approved by Authority/Investment Approval (1)	Cost on Actual/anticipated COD (1)	Variation	Reasons for Variation*
		Total Cost	Total Cost	(3)	(4)
2.7	Telecommunication equipment	3.00			
2.8	Illumination of Dam, PH and Switchyard	2.00			
2.9	Cables & cable facilities, grounding	150.00			
2.10	Diesel generating sets	20.00			
2.11	**Total (Auxiliary Elect. Equipment)**				
3.0	**Auxiliary equipment & services for power station**				
3.1	EOT crane	90.00			
3.2	Other cranes	20.00			
3.3	Electric lifts & elevators	2.00			
3.4	Cooling water system	50.00			
3.5	Drainage & dewatering system	20.00			
3.6	Fire fighting equipment	12.00			
3.7	Air conditioning, ventilation and heating	2.00			
3.8	Water supply system	35.00			
3.9	Oil handling equipment	17.00			
3.10	Workshop machines & equipment	30.00			
3.11	**Total (Auxiliary equipt. & services for PS)**	**3320**			

Sl. No. (1)	Break Down (2)	Original Cost as approved by Authority/Investment Approval (1)	Cost on Actual/anticipated COD (1)	Variation	Reasons for Variation*
		Total Cost	Total Cost	(3)	(4)
4.0	**Switchyard package**	1000.00			
5.0	**Initial spares for all above equipment's**	80.00			
6.0	**Total Cost (Plant & Equipment) excluding IDC, FC, FERV & Hedging Cost**	**4400.00**			
7.0	**IDC, FC, FERV & Hedging Cost**				
7.1	Interest During Construction (IDC)	616.00			
7.2	Financing Charges (FC)				
7.3	Foreign Exchange Rate Variation (FERV)				
7.4	Hedging Cost				
7.5	**Total of IDC, FC, FERV & Hedging Cost**				
8.0	**Total Cost (Plant & Equipment) including IDC, FC, FERV & Hedging Cost**	**5016.00**			

Note:

1. In case of cost variation, a detailed note giving reasons of such variation should be submitted clearly indicating whether such cost overrun was beyond the control of the generating company.

M/s HARIT DYNAMICS PVT. LTD.

Director

FORM- 5D

BREAK-UP OF CONSTRUCTION/SUPPLY/SERVICE PACKAGES

Name of the Applicant : HARIT DYNAMICS PVT. LTD.
Name of the Generating Station : HAK CHANG SMALL HYDRO PROJECT

1	Name/No. of Construction / Supply / Service Package	Package A	Package B	Package C	...	Total Cost of all packages
2	Scope of works[1] (in line with head of cost break-ups as applicable)					
3	Whether awarded through ICB/DCB/ Departmentally/ Deposit Work					
4	No. of bids received					
5	Date of Award					
6	Date of Start of work					
7	Date of Completion of Work/Expected date of completion of work					
8	Value of Award[2] in (Rs. Lakh)					
9	Firm or With Escalation in prices					
10	Actual capital expenditure till the completion or up to COD whichever is earlier(Rs.Lakh)					
11	Taxes & Duties and IEDC (Rs. Lakh)					
12	IDC, FC, FERV & Hedging cost (Rs. Lakh)					
13	Sub -total (10+11+12) (Rs. Lakh)					

Note:

1. If there is any package, which need to be shown in Indian Rupee and foreign currency (ies), the same should be shown separately along with the currency, the exchange rate and the date

M/s HARIT DYNAMICS PVT. LTD.

Director