



Government of Nepal
Ministry of Energy, Water Resource and Irrigation
Budhi Gandaki Hydropower Project
Environment Compensation distribution, Resettlement &
Rehabilitation Unit (ECRRU)
Gandaki Rural Municipality -08 , Siurenita Gorkha

TERMS OF REFERENCE

FOR

**The detailed Engineering Survey of Ring Road
around Proposed Budhigandaki Hydro Power
Project and Demarcation of its Reservoir in
Gorkha District**

1
Rivara



2018

1. Introduction

Hydropower is one of the major potential water resources which can boost economy of the country. Nepal has 83,000 MW theoretical potential, among which 43,000 MW seems economically viable potential. About 2% of the techno-economically viable potential has been harnessed, so far. Up to date, 760MW of power from hydropower development and 53 Mw of Thermal Power has been generated resulting 813 MW in total. The harnessing of un-tapped water resources on large scale could provide significant contribution to boost the economy of the country, poverty reduction and employment generation. It could be considered as the major economic backbones of the country.

It has been realized that hydropower can play dominant role in Nepalese economy, both by providing cost effective environment friendly power supply to improve energy services and as well as by contributing to GDP growth by exporting power to India. The government of Nepal intends to develop these hydropower potential in economical, efficient and sustainable manner to meet the growing power demand of the country as well as to export the power to India. In line with the Hydropower Development Policy, 2001 and Water Resources Strategy, 2002, the government of Nepal emphasis to increase the private sector involvement in the hydropower development for large, medium and small hydropower projects. The Government of Nepal has developing hydropower projects through Nepal Electricity Authority utilizing either its own fund or fund from the donors.

It is a great irony that a country Nepal, having high hydropower potential has power shortage upto 16 hours daily throughout the country in summer season and one of the highest electricity tariffs in the world, which is surpassing the beyond affordability limit of Nepalese people. In recent years in order to get rid of power shortage, GON has given the priority for development of storage hydropower projects. Recently, in order to supply easy and reliable electricity service through development and extension of hydropower, the Government of Nepal initiated development of two storage project through Hydropower Project Development Committee. Budhi Gandaki Hydroelectric Project Development Committee (BGHP) is one of them.

BGHP was established by Government of Nepal on 15th Ashoj, 2069 (1st October, 2012) for development of Budhi Gandaki Hydropower Project located in Gorkha/Dhading in Budhi Gandaki River a tributary of the Trishuli River, Gandaki Basin.

Budhi Gandaki Storage Project was identified as one of the potential storage hydropower projects and prefeasibility study was carried out in 1983-1984 by the Government of Nepal. It Recommended designing a 225m high rock fill dam with clay core, in a narrow and steep valley, retaining a reservoir of 3,320 hm³ with its FSL at El. 520. The underground powerhouse connected to the reservoir by a 276m long headrace tunnel was designed with four Francis turbines rated for a net head of 185m and a discharge of 4 x 107.5 m³/s thus providing a total installed capacity of 600MW and generating an average annual energy of 2,495GWh . The study concluded that the project has a high energy potential, large storage volume, and favorable location and access in Central Nepal near the main load center. Based on this pre-feasibility report, the project is technically viable and economically attractive.



In addition Government of Nepal declared this project as of National Pride for which Feasibility Study of Detail Engineering design is being carried out. Till date Final Feasibility Study Report has been prepared and based on this study report Installed Capacity of the project has been fixed as 1200 MW generating mean annual energy of 3383 GWh. The final output shall be obtained after completion of Final Report by October- 2015.

At present, Budhi Gandaki Hydropower Project Environment Compensation distribution, Resettlement & Rehabilitation Unit (BGHPECRRU) is preparing Detailed Engineering Design of the Project for implementation. As part of the project planning and basic requirement for implementation, BGHPECRRU intends to conduct Detail Engineering Survey of Ring road Around the proposed Budhi Gandaki Hydropower Reservoir area in Gorkha District.

2. Objective

The main objective of the consulting services is to conduct a detail engineering survey of the proposed road, prepare detailed design report of ring road and demarcation of reservoir for implementation of BGHP. The consultant is required to perform the following jobs:

- ✓ Detail Engineering survey and demarcation of reservoir and its corridor;
- ✓ Conduct hydrological studies for cross drainage works and propose appropriate cross drainage (CD) structures;
- ✓ Prepare detail survey design reports;

The proposed road is to be designed for Feeder Roads standard to facilitate stage construction. In general Nepal Road Standard, 2070 should be followed for the geometric design parameters.

3. Scope of Work

The consultant shall carry out the necessary field works along the alignment. The consultant shall be responsible for accuracy, interpretation, analysis of all data received including conclusion and recommendations. The scope of work to be carried out by the consultant shall include but may not be limited to the following:

- Review available reports, other past studies, Nepal Road Standard, Standard specifications for Road and Bridge, other DOR and DOLIDAR publications and guidelines;
- Conduct desk study;
- Conduct walkover survey;
- Detail engineering survey of the alignment selected during pre-feasibility study. The selected alignment during pre-feasibility study can be altered based on consultant's best engineering judgment with justification.
- Prepare the topographical map of the selected alignment corridor;
- Make inventory of the trees, houses and other structures to be relocated/affected due to the construction of road ;
- Carry out L-Section Survey along the center line as per standard norms.
- Carry out X-section survey at 20m center to center.



- Install Permanent Demarcation with permanent Benchmark (22.5cmx22.5cmx75cm) of RCC pillars with 10cm above ground level) at 1-1.5km interval of road alignment on the ground and provide (X,Y,Z) co-ordinate of each BM with references.
- Install RCC, 22.5cmx22.5cmx75cm RCC pillars with 10cm above ground level, at 545 masl (FRL of BGHEP) around the reservoir area along the road alignment. The RCC pillars should be installed at an interval of 200m where one pillar is clearly visible from another. In any case the interval shall not be less than 500m. Similarly, provide co-ordinates of each pillar in tabular form with reference in detail.
- Explore and recommend availability of sources of basic road construction materials (quarry site) required for construction in vicinity of the project area.
- Prepare detail survey design report, estimate and tender document for detail survey, demarcation of reservoir;

4. Project location and Access Road

The Budhi Gandaki Hydropower Project Dam Site is located on the Budhi Gandaki River, approximately 2km from its confluence with Trishuli River at Benighat. Benighat can be accessed by the Prithivi Highway linking Kathmandu and Pokhara about 80km from Kathmandu and thereafter about 2 km vehicle approachable road up to Surenitar of Gorkha district. The dam site lies at about 2 km from Surenitar. The Project area lies in the districts of Gorkha and Dhading of Western and Central Development Region of Nepal.

5. Study Approach

The consultant shall conduct study in one phases:

- Detail Engineering Survey, demarcation of reservoir and Estimate & Tender document preparation Phase

5.1 Detail Survey and Design

The consultant shall conduct detail engineering survey, demarcation of reservoir and survey design report. The detail engineering survey of road corridor shall include establishment of Bench Marks (BM), fixing of road alignment by setting out intersection point (IP) and intermediates points & other reference points, taking longitudinal section (LS) and cross section (CS) using appropriate methods. The Intersection points (IP) shall be set out with proper establishment of Bench-Marks with at least two triangular permanent references. Bench mark shall be established properly every two consecutive points at a distance of every 200 meters interval along the road alignment. Level should be transferred from bench mark established by BGHP by means of leveling survey.

The detail engineering survey shall include topographical survey of road corridor. The detailed survey of road consists of the following activities:

- Establishment of Bench Mark at distance of at least 200m interval away from the cutting and filling area
- Topographic survey of road corridor including road inventory survey of existing



- structures
- L-Section and X-Section Survey of road as per the standard
- Final survey design Report

8.1.1 Topographical survey and mapping

The topographical survey of road corridor shall be conducted showing the details/monuments that lies within the survey strip. The work for the Topographical survey will be conducted but not limited to:

- Establishment of Survey monuments / Bench mark
- Topographical survey of road in 30 m wide strip (15 m on either side of centre line) and prepare detailed topographical map of the proposed road corridor in 1: 1000 scale.

(a) Establishment of Survey monuments / Bench mark

In order to carry out the survey works permanent survey monuments shall be established along the road. These monuments shall serve as bench marks and control points for traverse survey. The permanent benchmarks shall be established at 1-1.5km intervals along the road alignment at secured and easily visible area. The size of bench mark shall be 22.5 cm x 22.5 cm x 75 cm long nails embedded flushed with top surface and made of 1: 2: 4 reinforced cement concrete if other permanent structure is not available. The upper surface of the monuments shall be 10 cm above natural ground surface.

In addition, the consultant shall also install RCC pillars, 22.5 cm x 22.5 cm x 75 cm RCC pillars with 10cm above ground level, at 545 masl (FRL of BGHEP) for demarcation of buffer zone around the reservoir area along the road alignment. The RCC pillars should be installed at an interval of 200M in such a way that one pillar is clearly visible from another.

The details of all the RCC pillar installed for Permanent Bench mark and demarcation of Buffer zone needs to be provided with detailed information such as Demarcation pillar No. (DP No.), Permanent Bench Mark no., (PBM NO.) their co-ordinate (X,Y,Z), chainage, and location in Tabular format including separate reference sheet in drawing.

Apart from this supplementary control points shall be established at intermediate inter visible locations. Additional offset survey points shall be established as required to get the detail topographic features of the proposed area. Description cards (D- cards) of all the bench mark will be prepared with a set of reference for easy retrieval in future. All permanent benchmarks and survey control points shall be surveyed and tolerable error shall not exceed 10 x Square root of distance in Km.

(b) Topographical survey

The detailed topographic survey of the road corridor covering a width of 30 m shall be carried out. The density of survey points shall be at least 1 point per 25 square meters. Topographic map in scale 1: 1000 or appropriate scale shall contain details of Survey control points, Settlement with starting and end points, Landslide/ Slope instabilities, natural stream and structures.



8.1.2 Engineering Study and Inventory Survey

The engineering survey and inventory shall include following to facilitate design of road

a. ROAD INVENTORY SURVEY

- Sub base condition survey
- Road geometry survey
- Existing structure survey, if any
- Side drains requirements survey
- Cross drainage requirements survey
- Retaining and protection work requirements survey
- Terrain survey
- Land use survey
- The locations of settlements, off the road structures, electric poles, streams, and water taps within the area of the plan.

8.1.2.1 Engineering Drawings Details

The consultant shall prepare the following plans and working drawings for reports using format and title sheets as required by the BGHP.

- Map of the zone/district demarcation showing the location of the road.
- Index plan of topo-sheet/ Index map;
- Map showing complete alignment covering the right of way of road corridor with post, controlling/obligatory points, names of area, land use, markets, villages, VDC, municipality, district demarcation, names of natural drainage etc;
- Location Map showing linkage of the proposed road with surrounding road network;
- Map showing survey and design status of the complete road, intersection points, Benchmarks and other references points;
- Plan, Profile (Longitudinal Section) and Cross- Section in the following Scale.
 - Plan - 1:1000
 - Horizontal Profile - 1:1000
 - Vertical Profile - 1:200
 - Cross Section - 1: 200
 - Points (IP). Bench Mark (BM) and other reference points
- Plans and profile of the road should contain details of geometry viz. horizontal alignment with coordinates of IP, deflection angle, IP to IP distances, Chainage of IP, curve data etc., index of (IP, PBM, Km post, DP), names of adjoining structures, names of VDC or municipalities, forest, temples, school, land use pattern, cross drainage structure, retaining and protection structure required or as directed by Engineer/site in charge;
- Standard charts of mentioned cross drainage structures, retaining/Brest wall and protection works, side drain, typical cross section of the road according to types of soil, passing zone(if provided), hairpin bend (if provided);
- Reference charts of all intersection points (IP), bench marks (BM) & other reference points;



9.0 Work Schedule

The consultant shall complete the study within 10th months of signing of contract.

10.0 Key Professionals required for the Study

Consultancy firm may nominate the composition of the survey team as it may deem necessary to accomplish the scope of work. However, it is a must for the team to have these personnel for full tenure to accomplish both the fieldwork and deskwork with the required minimum qualification and experience:

S.No.	Description	Minimum Qualification	Minimum Experience In Relevant Field (Years)	No. of Person
1	Team Leader/Engineer	Master's Degree in Engineering faculty or relevant	Above 10 years	1
2	Structural Engineer	Bachelor level passed in Civil Engineering faculty and works	4 years	1
3	Geologist/Geotechnical	Bachelor level passed in related faculty and works	4 years	1
4	Hydrologist	Bachelor level passed in related faculty and works	4 years	1
5	Environmentalist	Bachelor level passed in related faculty and works	4 years	1
6	Geometric Engineer/Surveyor	Bachelor Level passed in Survey/Geometric Engineering	4 years	1
7	Sub-Engineer/Survey Assistant	Diploma in relevant field	-	1

11.0 Reporting

The consultant shall prepare and submit following reports to BGHP as under:

S.No.	Report	No. of Copies	Time to submit	Remarks
1	Inception report	3 hard copies and 1	1.5 months	Duration is



		digital copy in DVD		counted from the issuing date of work order.
2	Field report	3 hard copies and 1 digital copy in DVD	6 months	
3	Draft final report including document	3 hard copies and 1 digital copy in DVD	8 months	
4	Final Report including full documents	10 hard copies including 3 digital copies in DVDs	10 months	

11.1 Inception/Feasibility Report:

The Consultants shall submit Three copies Inception report of Detailed Survey within **1.5 months** from date of contract agreement. The inception report shall be based on the finding of desk study and feasibility study. The report shall include the proposed three alternatives, evaluation of the alignment and recommendations selected alternative for further detail survey and design with proper justification of selection. The report shall address socio-economics, environmental, geological, geo-morphological aspect. Necessary photographs & sketch should be attached.

11.2 Field Report

The Consultants shall submit three copies of Field Report within **6th months** from date of contract agreement Field Report shall be submitted including all the outcomes from field survey. The field report will include following;

- Detail road survey and demarcation survey data.
- Geological information and geographical data.
- Data related to plants.
- Social, economic and environmental data.
- Land ownership information along road alignment (Private land, guthi land, gov.land and forest)

11.3 Draft Final Report

The Consultants shall submit three copies of Draft Final Report within **8th months** from date of contract agreement. The Draft Final Report shall fully cover all the requirements as stated in the TOR. The draft final report will include the following:

- Detail drawings, detail design, rate analysis, cost estimate, tender document and BOQ.
- Social and environmental report.
- D-card report of bench mark and demarcation pillar.

The consultant team shall make a presentation in the office of BGHP discuss on draft report with concerned Engineers/site in charge of BGHP. The comments and suggestions given in draft final report should be incorporated in final report

11.4 Final Report



After incorporating the comments and suggestions on the Draft Report, the consultant shall prepare and submit 7 hard copies and soft copies (3 DVDs with one Hard disk-1TB) of Final Report within **10th months** of signing of contract. The final report will include the following:

- Detail drawings, detail design, rate analysis, cost estimate, tender document and BOQ.
- Social and environmental report.
- D-card report of bench mark and demarcation pillar.

12.0 Financial Proposal

The consultant shall submit financial proposal on per km basis based on the activities mention in scope of work of ToR. The financial proposal should include all liable taxes.

13.0 Mode of Payment

Payment will be made to consultant in following basis:

S. N.	Mobilization/ Submission of Reports	% of Payment
1	Preparation and submission of Three hard copies and one digital copy of Inception Report and its approval from BGHP	20%
2	Preparation and submission of Three hard copies and one Hard disk-1TB of Field Report and its approval from BGHP	30%
3	Preparation and submission of Three hard copies of draft final report along with one Hard disk-1TB and its approval from BGHP	30%
4	Preparation and submission of Seven hard copies of Final Report in original along with digital copy (3 DVDs with one Hard disk-1TB) and its approval from BGHP	20%

14.0 Liaison with engineer in-charge

The Consultants are required to maintain close liaison with the concerned site in charge /Engineer in charge. Draft survey report, design consideration, structures and other technical aspects of the design shall be discussed with the concerned site in-charge /Engineer.

15.0 Consultants Facilities

It should be noted that the Consultant should provide all the logistics, office space, lab facilities, essential design software and technical/support staff required to carry out their services. The Consultant shall also be responsible for providing all other necessary facilities and logistic support for its staff, including accommodation, transportation, office equipment, communication, utilities, office supplies and other miscellaneous requirements for which BGHP(ECRRU) shall not pay separately.

16.0 Data and Assistance to be provided by the Client



On request, the Consultants will be given access to any relevant information, including project information. Further, required support if needed, shall be provided from the BGHP(ECRRU) as requested by the consultant during the course of field survey, data collection and other related works.

17.0 Hiring of Survey Helper

The consultant should hire local survey helper/staff required for survey work and priority should be given to the concerned from submerged area as far as possible.

❖ ***Note :If the survey length is extended in this situation the firm should be work as per initial contract Amount.***