Bid Addendum Report

THE PROCUREMENT OF

Topographical Survey by LiDAR

National Competitive Bidding (NCB)

NEA ENGINEERING COMPANY LIMITED

Addendum No:1

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Following changes are made in Bid Document

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S.no	Chapter	Relevant Topics	Existing	Modified
1	SECTION - V Works Requirements	Specifications Terms of Reference for Procurement of Consulting Services to preparation of topographic map, Generation of High Resolution DEM and Ortho photo Map with application of Airborne LiDAR	Specifications Terms of Reference for Procurement of Consulting Services to preparation of topographic map, Generation of High Resolution DEM and Ortho photo Map with application of Airborne LiDAR	Specifications Terms of Reference for Procurement of Consulting Services to preparation of topographic map, Generation of High Resolution DEM and Ortho photo Map with application of Airborne LiDAR, modified attached

Modified Specifications

Specifications

Terms of Reference for Procurement of Consulting Services to preparation of topographic map, Generation of High Resolution DEM and Ortho photo Map with application of Airborne LiDAR

a) Background

The proposed Mugu Karnali Storage Hydroelectric Project is located in Humla and Mugu District of province number 6 and Bajura District of province number 7 of Nepal.

The proposed Dam site is located at Swami Kartik Rural Municipality and Pandav Gupha Rural Municipality of Bajura District. The control survey should be conducted along the Karnali River which lies in the Swami Kartik Rural Municipality, Pandav Gupha Rural Municipality, Budhinanda Municipality and Himali Rural Municipaliy of Bajura District, Katyad Rural Municipality and Soru Rural Municipality of Mugu District and Tanjakot Rural Municipality, Adanchuli Rural Municipality and Sarkegad Rural Municipality of Humla District.

The license area of Mugu Karnali Storage Hydroelectric Project:-

Point	Latitude	Longitude
1	29^0 23' 43" N	81^0 39'14" E
2	29^0 41' 22" N	81^0 57'13" E
3	29^0 23' 43" N	81^0 57'13" E
4	29^0 41' 22" N	81^0 39'14" E

Table: Accessibility to Mugu Karnali Storage Hydroelectric Project via Plane

S.N.	Distance		Time (hrs./days)	Description Route
	From	To		
1	Kathmandu	Nepalgunj	1 hr	By Plane
2	Nepalgunj	Kolti,Bajura	30 minutes	By Plane
3	Kolti,Bajura	Juddi (Proposed Dam Axis)	5 hrs/8 km distance	On foot

Table: Accessibility to Mugu Karnali Storage Hydroelectric Project Project via Jeep

S.N.	Distance		Time (hrs/days)	Description Route
	From	To		
1	Kathmandu	Kalikot	2 days	By Bus/Jeep
2	Kalikot	Juddi (Proposed Dam Axis)	8 hrs	By Jeep

b) Objective and the Scope of the Consulting Service:

The objective of this assignment is to prepare contour with 1m contour interval, Digital Elevation Model with resolution 1m grid size without down-resampling and 15 cm GSD orthophoto map of project area.

The objective of this assignment includes the following components:

- **a.** Control Points Establishment with DGPS surveying.
- **b.** Lidar data acquisition from Aerial platform
- **c.** Aerial photography;
- **d.** Orthophoto processing
- **e.** Orthophoto map of given area with GSD 15 cm.
- **f.** Topographic map preparation with 1m minor contour interval and 5m major contour interval

c) Specification of LiDAR Surveying and Mapping:

S.N.	Description	Specification
	Coverage	Coverage of project area will be as mentioned in Appendix A and in digital shape file format will be provided later.
	LiDAR Point Density	At least 4 points/m2 but needs to increase due to terrain condition and other conditions to maintain desired accuracy.
	Ground sample distance (GSD) and focal length of lens	Medium frame camera should be used to capture digital image, and GSD at nadir should be 15 cm.
	Photographic Coverage	• The forward overlap (fore lap) between successive exposures in each run should be minimum 15 percentage but can increase to maintain desired accuracy. • The lateral overlap (side lap) between adjacent

		strips should be minimum 15 percentage, but can increase to maintain desired accuracy • In extreme terrain relief where the lateral overlap specified above is impossible to maintain in straight and parallel flight lines, the 'gaps' created by excessive relief shall be filled by short runs flown between the main runs and parallel to them.
	Fundamental Spatial Accuracy	• Fundamental vertical accuracy: Root Mean Square Error<= +/- .25 m. Or better on clear or vegetated ground. • Fundamental horizontal accuracy of ortho photo should be <= +/- .10 m.
	Coordinate Datum's	• Vertical: above mean sea level
	Vertical Datum	Consultant are required to adjust elevation data to local height datum.
	Ground Control System	Maximum distance between the Reference GPS station on the ground and airborne GPS units must not exceed 5 kilometers during the flight. All survey control data used or derived from this contract must be supplied to ensure independent Quality Assurance (QA) of the survey operations. It is therefore essential that all primary ground stations should be visible in photographs in accordance with the appropriate system. The primary ground control and check point surveys must be referenced to survey control marks with geodetic control points (in terms of coordinates and height) demarcated by survey department. Elevation data must be validated and corrected for systematic errors to ensure accuracy specifications are met. Documentation must describe how this has been achieved.
	LiDAR Data acquisition details	(1) A Draft Pre-Fight Agreement with provision whereby. LiDAR data over the Study Area must not be collected during any period where extent of LiDAR ground returns in any part of the Study Area is likely to be significantly compromised eg flood, adverse weather etc. (2) A Draft Pre-Flight Agreement will include provision whereby the Principal is notified of each proposed LIDAR collection flight with sufficient notice to enable consultation between Principal and the contractor to

		determine if data capture by the Contractor should proceed. (3) Flight line overlap must be 15% or greater, as required to ensure there are no data gaps between the usable portions of the swaths. Collections in high relief terrain are expected to require greater overlap. Any data with gaps between the geometrically usable portions of the swaths will be rejected. (4) The spatial distribution of geometrically usable points is expected to be uniform and free from clustering. In order to ensure consistent data densities throughout the project area: (5) Environmental conditions for data capture. a. Cloud and fog free between the aeroplane and the ground. b. Floodplain/wetland data must be captured during times of base flow and outside of significant surface inundation due to natural events and /or regulated environmental flows. c. Details of the aeroplane or helicopter, navigation and mission planning activities for LIDAR and digital photography acquisition. Include details of whether the photography and LIDAR will be acquired during the same mission (i.e. from the same aeroplane) or from separate missions. If separate missions are required to satisfy the respective resolution requirements for LIDAR and photography (eg. Due to flying height constraints) then specify alternative mission scenarios based on a sensor type and platform;
	Intensity Image	1. 1m grid intensity image or better to preserve required accuracy. 2. Mosaic generated using average laser intensity values from "first return" LiDAR points. 3. Tiled delivery, as per Data Supply Specifications below.
	Digital Surface Model (DSM)(orthometric)	1. 1m or better grid Digital Surface Model (DSM) to preserve required accuracy. 2. The DSM should be generated from the "first return" LiDAR mass point data. This will include ground and non-ground points such as vegetation and buildings.

		3. The DSM generation should employ a Point to TIN and TIN to Raster process with Natural Nearest Neighbour interpolation. 4. Void areas (i.e., areas outside the project boundary but within any tiling scheme) shall be coded using a unique "NODATA" value.
	Digital Terrain Model (DTM)(orthometric)	1. 1m or better grid bare earth Digital Elevation Model (DEM) to preserve required accuracy. 2. The DEM should be generated from the LiDAR mass point data classified as "Ground" only, so that it defines the "bare earth" ground surface. 3. The DEM generation should employ a Point to TIN and TIN to Raster process with Natural Nearest Neighbour interpolation. 4. Void areas (i.e., areas outside the project boundary but within any tiling scheme) shall be coded using a unique "NODATA" value
	DGPS Data collection	1. GPS data for all base station occupations in excess of 4 hours or more is to be provided in RINEX format (Receiver Independent Exchange Format). 2. GPS observation log sheets which include the following details: a. Survey mark id b. Occupation time & date c. Antenna height measurements d. Instrument /antenna types & serial numbers The GPS observation log sheets should be provided in pdf format or Excel spreadsheet if data is captured digitally. Where appropriate, some jurisdictions may find it useful to also request GPS data for any static primary control surveys.
	Metadata	1. For each supplied data product, a complete metadata statement consistent with the ISO Standard. 2. Metadata must be provided with every delivery including interim, partial and final deliveries. 3. The job will not be signed off by Contract Authority until the metadata is satisfactorily supplied.
	Spatial Accuracy Validation	1. The fundamental vertical accuracy of the point cloud dataset must be determined with check points located only in open, relatively flat terrain, where there is a very high probability that the sensor will have detected the ground surface. 2. The vertical accuracy of the point cloud dataset is to be tested using a TIN surface constructed from bare-earth LiDAR points compared against ground survey check points.

		3. Check points are to be surveyed independently of any LiDAR GPS operations. 4. The number of check points (locations) is dependent on the extent of the survey. The following strategy should be used as a guide: a. Check points must be established to adequately cover the full extent of the survey area and be representative of the project area landscape. b. A minimum of 10 check points (locations), then 1 point per 1 km² in 1 km * 1 km grid in different vegetation types. When 10 points are tested, the 90 percent confidence interval would generally allow 1 point to fail the threshold given in product specifications 5. The proposed check point survey design must be submitted with the quotation and approved by the Contract Authority prior to implementation. Acceptance of the post-survey spatial accuracy report discussed above is dependent on the quality, number and distribution of these check points. 6. In the above circumstances a "compiled to meet" statement of horizontal accuracy at 95 percent confidence should be reported.
	Data Processing	Consultants should process all the acquired data (LiDAR and Ortho photo) in Data Processing LAB(Software and Hardware) inside or outside Nepal.
	Facilitation	NEA Engineering Company Ltd. will only facilitate in administrative procedure (inter and intra governmental organisations)

d) Intermediate Deliverables

Deliverable Required	**Quality Assurance Deliverable**	**Format**
Deliverable 1	LiDAR survey and photography mission flight plans	Georeferenced shape file
Deliverable 2	Report on planned ground control, check points	Word and Shape files

	– including details of connections to State survey control marks.	
Deliverable 3	Report on planned check points to be collected by the Consultant At least 1 check points must lie within 1 km * 1 km	Word and Shape files

e) Final Deliverables of LiDAR Surveying and Mapping:

i)LiDAR Deliverables

Deliverable	***LiDAR Deliverables***	***Format***
Deliverable 1	Raw LiDAR (point cloud) survey data comprising all returns (1st, 2nd, etc.., and last return), representing all ground and non-ground returns and including overlapping swathes	ASPRS LAS (Version 1.1),file format X,Y,Z coordinates, return intensity value, time and date for each point. Supply in data tiles. All points retained, and classified as per LAS v1.1 See: http://www.lasformat.org/
Deliverable 2	Digital Surface Model and Digital Terrain Model of 1m grid resolution	DEM should be supplied in img /geoTiff/Tiff format
Deliverable 3	Contour of 0.5m interval and topographic map with 1 m minor contour and 5 m major contour showing the distinct manmade and natural features.	Contour, spot elevation and topographic features should be supplied in shape file and drawing file in Autocad format in UTM coordinate system and Nepal

ii) Orthophoto

Deliverable	***Digital Photography Deliverables***	***Format***
Deliverable 4	Near-natural colour-balanced digital photography for photogrammetry application. Georeferenced, but not ortho-rectified. 15 cm ground sample distance (GSD).	Photographs with GPS INV data, Campfile and .IMG/.TIFF/.GEOTIFF format Red, Green, Blue.

Deliverable 5	Ortho rectified multispectral digital photograph with 15 cm GSD.	.IMG .IMG/.TIFF/. GEOTIFF Red, Green, Blue Orthorectification aerial digital photography should be applied to a horizontal accuracy of 0.1 m (RMSE) or better, so that it is compatible with the accuracy required for the LiDAR DEM with Scene Size.
Deliverable 6	Colour balanced mosaic with 15 cm GSD	Red, Green , Blue.

f) Documents

i) Flight Data Storage (FDS) report

A report shall be delivered with the raw data (on FDS) giving the following information:

a. Project names.
b. Number of images.
c. FDS metadata report
d. Year(s), month(s) and day(s) of raw data.
e. Camera type.
f. Run number and flight direction.
g. Aeroplane type and identification.
h. Names of pilot(s), navigator and photographer.
i. Start and end time for each run in local time.
j. Computed altitude above mean sea level (true altitude).
k. GSD of output images.
l. Weather conditions – cloud type, degree of haze, turbulence etc.
m. General comment on quality.

ii) Output Images Report

A report shall be delivered with the output images giving the following information:

n. Project names
o. Number of images
p. Year(s), month(s) and day(s) of raw data.
q. Camera type.
r. Strip number and flight direction.
s. Aeroplane type and identification.
t. Names of pilot(s), navigator and photographer.
u. Start and end time for each run in local time.
v. Computed altitude above mean sea level (true altitude).
w. Type and GSD of output images.
x. Date of processing.

y. Operator of Post Processing
z. Weather conditions – cloud type, degree of haze, turbulence etc.
aa. General comment on quality

iii) Other material to be delivered

a. Plot of planned flight missions
b. Plot of finished flight missions with thumbnails
c. AERIAL SURVEY REPORT

g) Project Period:

Total duration of project is 15 months from the date of signing of contract.

h) Training:

Consultant must provide training and technology transfer on following terms:

a. Flight Plan
b. LiDAR Data Collection Procedure and Methodology
c. Data Acquisition
d. Preliminary data processing
e. Final data processing
f. DEM(DTM and DSM) generation and ortho photo generation
g. Preparation of orthophoto map

i) Team Composition:

a) Team Composition of Inter-national Key Experts

S.N.	Position	Qualification	Experience	Additional Qualification
1.	Team Leader	At Least, Master's Degree in Geomatics engineering / Geo-informatics or GIS and Remote sensing or Civil Engineering or Environmental Science/ Environmental Engineering or forestry or Natural Resource Management or Applied Earth Science urban/rural/regional Planning or Geography with GIS and Remote Sensing, Photogrammetric, Geologist. Preferable Ph.D.in one of the above mentioned subjects.	At least 5 projects of relevant work experience in LiDAR Mapping and Surveying field. After completion of Basic Degree .	With GIS and Remote Sensing included in course or at least six months mandatory training in GIS and Remote sensing or having post-graduate diploma in GIS or Remote sensing as an extra academic achievement in addition to the specified master degree if GIS and RS are not included in course.
2.	LiDAR Data Processing Expert	At least Masters Degree in Geoinformatics/IT/Computer Science/Engineering	At least 4 projects of relevant work experience in LiDar data processing after completion of	

a) Team Composition of Inter-national Key Experts				
S.N.	**Position**	**Qualification**	**Experience**	**Additional Qualification**
			relevant course. After completion of Basic Degree	
3.	Pilot	Relevant Degree and Pilot training	At least 4 projects of relevant work experience in LiDAR Surveying After completion of Basic Degree	

b) Team Composition of National Key Experts				
S.N.	**Position**	**Qualification**	**Experience**	**Additional Qualification**
4.	Deputy Team Leader	At Least, Master's Degree in Geomatics engineering / Geo-informatics or GIS and Remote sensing or Environmental Science/ Environmental Engineering or forestry or Natural Resource Management or Applied Earth Science urban/rural/regional Planning or Geography with GIS and Remote Sensing, Photogrammetric, Geologist. Preferable Ph.D.in one of the above mentioned subjects.	At least 4 projects of relevant work experience in related field. After completion of Basic Degree	With GIS and Remote Sensing included in course or at least six months mandatory training in GIS and Remote sensing or having post-graduate diploma in GIS or Remote sensing as an extra academic achievement in addition to the specified master degree if GIS and RS are not included in course.
5.	Senior Surveyor/ Geomatic Engineer	Having Completed at least Senior Surveying Course (or equivalent to senior surveying Course)/or B.E. in Geomatics Engineering/Survey engineering.	At least 2 projects of relevant work experience in related field after Completion of the relevant course After completion of Basic Degree	
6.	GIS /RS Expert	At least having BE in geomatic engineering preferable master's Degree with GIS/RS included and studied in course or having PG diploma in GIS/RS after the completion of Bachelor's Degree.	At least 2 projects of relevant work experience in related field after completion of relevant course. After completion of Basic Degree	
7.	GPS Operator	One year Junior Surveyor Course or Diploma in Geomatics.	At least 1 projects of relevant work experience in related field. After completion of Basic Degree	