



**Table: ES 1- Salient features of Heo H.E. Project in West Siang district of Arunachal Pradesh**

1.	<b>LOCATION</b>	
(i)	State	Arunachal Pradesh
(ii)	District	West Siang
(iii)	Village	Hiri/ Purying
(iv)	Access Road	Road from Tato to Mechuka village
(v)	Geographical Coordinates of Water Intake	
	Longitudes	94°16'31"E
	Latitudes	28°32'20"N
(vi)	Geographical Coordinates of Power house	
	Longitudes	94°18'43"E
	Latitudes	28°32'32"N
2.	<b>HYDROLOGY</b>	
(i)	Catchment area at the water intake (km <sup>2</sup> )	1065
(ii)	River	Yarjep River
(iii)	Average Annual Rainfall (mm)	2621 mm
(iv)	Min-Max temperature (°c)	1°c – 40°c
(v)	Min-Max humidity (%)	39% - 100%
(vi)	PMF (m <sup>3</sup> /s)	3900
(vii)	SPF (m <sup>3</sup> /s)	3200
3.	<b>BARRAGE</b>	
(i)	Length of Barrage	86.0 m
(ii)	HFL	1400.0 m
(iii)	FRL	1400.0 m
(iv)	Average River Bed Level	1386.0 m
(v)	Maximum Height of Barrage above riverbed level	16.0 m
(vi)	Bridge Deck level	1402.0 m
(vii)	Design flood (SPF)	3200 m <sup>3</sup> /s
4.	<b>SPILLWAY</b>	
(i)	Type	Gated
(ii)	No of Bays	5 No
(iii)	Sill Level	1188.0 m
(iv)	Size of Gate	11.5 m (W)x12.0 m(H)
(v)	Type of Gate	Radial gates
(vi)	Energy Dissipation arrangement	Stilling Basin Type
5.	<b>UNDERSLUICE</b>	
(i)	Type	Gated
(ii)	No of Bays	5 No
(iii)	Sill Level	1188.0 m

(iv)	Size of Gate	11.5 m (W)x12.0 m(H)
(v)	Type of Gate	Radial gates
(vi)	Energy Dissipation arrangement	Stilling Basin Type
6.	<b>POWER INTAKE</b>	
(i)	Length	31.0 m
(ii)	FRL	1400.0 m
(iii)	MDDL	1398.0 m
(iv)	Invert Level	EL 1387 m
(v)	Deck Level	EL 1402.00 m
(vi)	Size of Trash Rack	6 Nos each of 4 m width x 15 m height
(vii)	Size of Intake Gates	2 Nos each of 9.0 m width x 6.5 m height
(viii)	Type of Gates	Vertical lift gates
9.	<b>HEAD RACE TUNNEL</b>	
(i)	Length	3550 m
(ii)	Shape (Excavated)	Modified inclined legs horse shoe
(iii)	Shape (Finished)	Circular
(iv)	Diameter (m)	6.5 m
(v)	Design discharge (m <sup>3</sup> /s)	130.25 m <sup>3</sup> /s
(vi)	Head Pond Level	EL 1400.0 m
10.	<b>ADIT</b>	
(i).	Type	D-Shaped
(ii).	Adit-1 to HRT	6.0 m x 6.0 m, Length= 429 m
(iii).	Adit-2 to Bottom of Surge Shaft	7.5 m (W) x 8.0 m (H), Length=234 m and 6.0 m (W) x 6.0 m (H), Length=138 m
(iv).	Adit -3 to Top of surge shaft	6.0 m x 6.0 m, Length=67 m
(v).	Connecting Adilt tovalve house Bottom	7.5 m x 8.0 m, Length=97 m
(vi).	Connecting Adilt tovalve house Top	6.0 m x 6.0 m, Length=125 m
(vii).	Connecting Adilt to Bottom of Pressure shaft	7.5 m x 8.0 m, Length=132 m
11.	<b>SURGE SHAFT</b>	
(i)	Type	Restricted Orifice
(ii)	Diameter (m)	13.5
(iii)	Orifice Diameter (m)	3.2
(iv)	Vertical height (m)	78.5
12.	<b>VALVE HOUSE</b>	
(i)	Type	Underground
(ii)	Length	20.25 m
(iii)	Width	11.0 m
(iv)	Height	17.0 m up to top of Crown

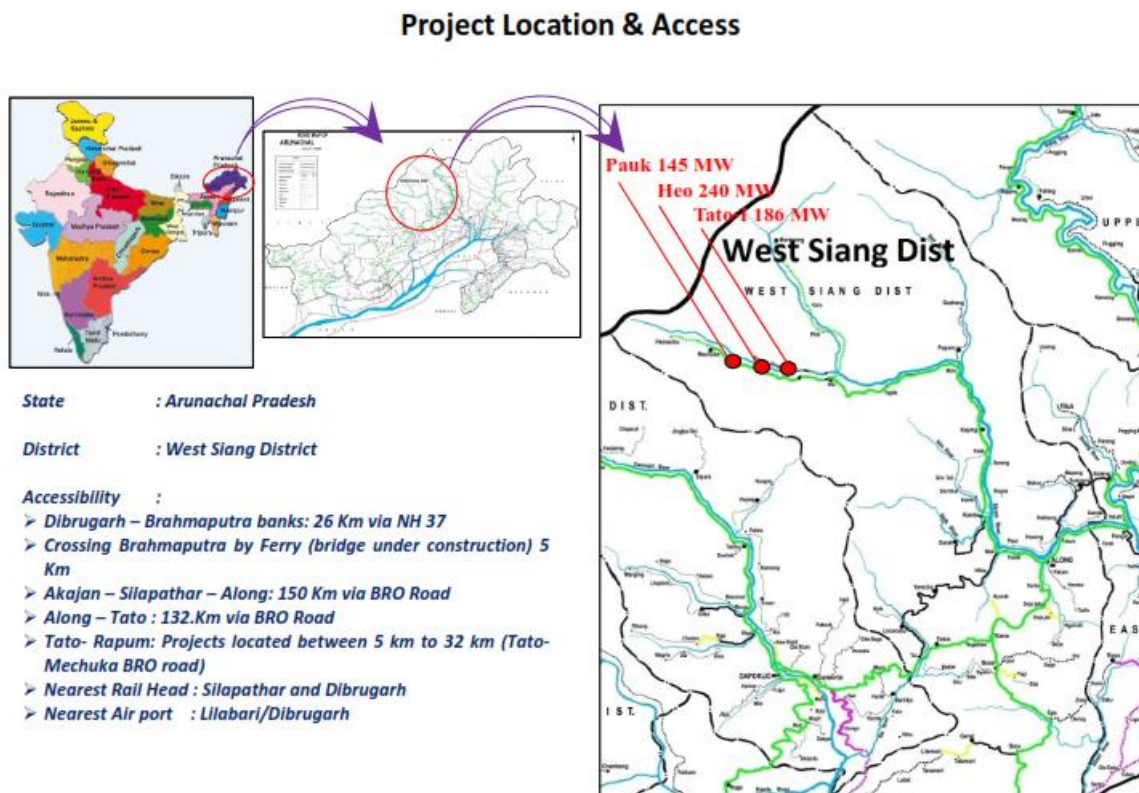
(v)	Number of Valves	1
(vi)	Diameter	5.75 m
13.	<b>PRESSURE SHAFT</b>	
(i)	Number	1
(ii)	Type	Underground Steel lined
(iii)	Internal Diameter	5.75 m
(iv)	Horizontal Length at EL 1345.0 m	112.92 m
(v)	Length of lower bed	30.08 m
(vi)	Inclined Length from EL 1190.80 m to EL 1182.07 m	83.83
(vii)	Thickness (mm)	Varies from 16 mm to 46 mm
(viii)	Grade of Steel	Sumiten 610 Grade F
14.	<b>UNIT PRESSURE SHAFT</b>	
(i)	Number	3
(ii)	Diameter (m)	2.75
(iii)	Length (m)	Average 25 m each
(iv)	Thickness (mm)	Varies from 16 mm to 50 mm, bifurcator 58 mm 20 mm
(v)	Grade of Steel	Sumiten 610 Grade F
15.	<b>POWER HOUSE</b>	
(i)	Type	Surface
(ii)	Head (m)	
	a. Gross Head (m)	210.0 m
	b. Net Head (m)	201.83 m
(iii)	<b>Size of power house:</b>	
	a. Length (m)	86 m
	b. Width (m)	19.60 m
	c. Height (m)	28 m
(iv)	Installed capacity (MW)	240 (3 x 80 MW)
(v)	Turbine (s):	
	a. Type	Francis vertical
	b. Number	3
	c. Turbine C/L Elevation	EL 1184.80 m
	d. Min Tail Water Level	EL 1189.00 m
	e. Normal Tail Water Level	EL 1189.00 m
(vi)	Generators	
	Capacity	3x80MW
	Voltage	11 kV
16.	<b>GENERATOR STEP-UP TRANSFORMERS</b>	
(i)	Number	10 (including one spare)
(ii)	Type	Single Phase
(iii)	Capacity/Rating	25.5 MVA

(iv)	Voltage	11 kV/ 220/ $\sqrt{3}$ kV
(v)	Location (Elevation)	EL 1193.30 m
17.	<b>POTHEAD YARD</b>	
(i)	No of outgoing lines	Two
(ii)	Size	80 m x15 m (Approx)
(iii)	No. of Bays	4 (including space for two future Bays)
18.	<b>GIS HALL</b>	
(i)	Size	45 m x15 m (Approx)
(ii)	Voltage	220 kV
(iii)	Type	GIS
(iv)	No. of 220 kV bays	8 (3 Generating bays, 2 outgoings bays, 1, bus coupler bay, 1 Bus Reactor Bay, 1 Station Transformer Bay)
(v)	Space for spare bays	2 nos. in GIS area
19.	<b>TAILRACE</b>	
(i)	Type and Shape	Open air tail race basin
(ii)	Normal Tail Water level	EL 1189.0 m
(iii)	Number of draft-tube gates	3
(iv)	Size of draft Tube gates	7 m (W) x 3.95 m (H)
(v)	Sill Level of Draft Tube Gates	EL 1177.50 m
20.	<b>CONSTRUCTION PERIOD</b>	
(i)	Total construction period	39 months
(ii)	Commissioning of units	
	Unit-1	38 months
	Unit-2	38.5 months
	Unit-3	39 months
21.	<b>POWER &amp; ENERGY BENEFITS</b>	
(i)	Installed capacity (MW)	240 MW
(ii)	Load factor (%)	48.49 %
(iii)	Design energy (Million Units)	1000.2
22.	<b>COST</b>	
(i)	Hard Cost (Sept 2014 P.L)Rs. Crores	1066.7
(ii)	Hard Cost/MW Rs. Crores	4.44
(iii)	Completed Cost including Escalation, IDC, Financial Charges (Rs Crores)	1604.18
(iv)	Completed Cost per MW (Rs Crores)	6.68
(v)	Levelized Tariff at completion cost (Rs/kWh)	3.80

The construction of Heo Hydro Electric Project is classified in **Section 2 (I)(b)(i)** i.e. all activities or items listed in the notification of the Government of India in the Department of Economic Affairs (Infrastructure Section) number 13/6/2009-INF dated 7<sup>th</sup> October, 2013 listed under Annexure 1 “Updated Harmonized Master List of Infrastructure Sub-Sectors” under category Energy and Infrastructure sub-sector Electricity Generation, for public purpose according to the RTFCTLARR ACT 2013.

## 1.2 Location

The project is located in the Tato and Mechuka circles of West Siang district in Arunachal Pradesh. Lipusi is a central village of the area, which is about 140 km from Aalo, the district headquarters. The intake site is downstream of Purying village (opposite to Hiri village) located between 28° 32' 20''N latitude and 94°16'31''E longitude. Its power house site is upstream of Meying village located between 28° 32'32''N latitude and 94°18' 43''E longitude. The access and location of project is shown in **Figure ES 2**. The Heo hydroelectric project site is accessible through a motor able road from Aalo up to Hiri village, at a distance of about 155 km. The project site connected to National Highway-52 at Aalo via state road (Tato – Aalo), and is about 305 km from Akajan in Assam or about 259 km from Pasighat (Akajan to Pasighat NH-52 distance 103Km). For Heo HEP the nearest broad gauge rail head is at Silapathar (Approx. 303 km) and extending railroad up to Pasighat is under construction. From the project site, the nearest operational airport is 448 km, located at Likhali in North Lakhimpur district of Assam and the nearest international airport is 837 km located at Guwahati, the capital city of Assam.



**Figure: ES 2–Location Map & Access to Heo HEP**

### 1.3 Size and Attributes of Land Acquisition

Total land required for the various components of Heo H.E. project is 52.8 ha, in which 47.7 Ha is surface land, 2.3 Ha is riverbed and 2.8 Ha is underground. The entire land is categorized as Unclassified State Forest/Community Forest land as shown in Table: ES 2. The total submergence area is 3.0 ha including 1.8 ha of riverbed and 1.2 ha of surface land. The impacted surface & including river bed is 50.0 ha

**Table: ES 2- Project component wise break up of land in Heo H.E. Project**

S. No	Project Component	Surface Land	River Bed	UG Area	Total Area (Ha)
1	Submergence Area	2.8	5.6	-	8.4
2	Barrage area	1.5	0.3	-	1.8
3	Barrage Muck Disposal area	2.6	-	-	2.6
4	Barrage Storage and Colony area	1.2	-	-	1.2
5	Barrage Quarry site	0.3	-	-	0.3
6	Barrage Access Road	6.7	-	-	6.7
7	Power House Area(including penstock and tail Race)	9.2	-	-	9.2
8	PH Muck Disposal area	3.5	-	-	3.5
9	PH Storage Area, office and Colony	1.3	-	-	1.3
10	PH Quarry Site	0.3	-	-	0.3
11	Barrage & PH Quarry site	0.5	-	-	0.5
12	PH Access Road	15.5	-	-	15.5
13	Adit Area	1.1	-	-	1.1
14	Adit Muck Disposal 1	0.8	-	-	0.8
15	Adit Muck Disposal 2	1.4	-	-	1.4
16	Adit Access Road	2.6	-	-	2.6
17	Head Race Tunnel(including Adit tunnels)	-	-	2.7	2.7
	<b>Total</b>	<b>51.3</b>	<b>5.9</b>	<b>2.7</b>	<b>59.9</b>
	<b>G Total</b>	<b>57.20</b>			

The project is located in Tato and Mechuka administrative circles of West Siang with total surface land requirement including riverbed is 57.20 Ha. The total surface land including riverbed in affected villages for which the land acquisition has been initiated under RFCTLARR Act 2013 are as under:

**Table: ES 3- Affected Village wise Land Requirement**

<b>S.No</b>	<b>Name of Village</b>	<b>Surface Land (Ha)</b>	<b>River Bed (Ha)</b>	<b>Total (Ha)</b>
1	Gapo	10.80	0.0	10.80
2	Meying	19.00	0.0	19.00
3	Lipusi	6.76	0.15	6.91
4	Hiri	9.00	2.80	11.80
5	Purying	5.24	2.95	8.19
6	Chingrong	0.50	0.0	.50
	<b>Total</b>	<b>51.30</b>	<b>2.30</b>	<b>57.20</b>

#### **1.4 Alternatives Considered**

There is no known other alternative to generate electricity with such capacities in area, where the potential resides in hydropower. Hydropower being site specific no alternative has been identified to generate 240 MW power in the area. However, the Developer has been requested to describe the design / technical alternatives envisaged for the project.

##### **1.4.1 BARRAGE/INTAKE**

Two potential intake locations with rock outcrops exposed on both banks were studied. One location having river bed level of 1386m with Barrage to maintain FRL at Ele: 1400m requires HRT of 3.55km and other downstream with river bed level at 1355m requires 65m high and 200m wide dam at FRL requires HRT length 2.5km. Based on techno-economic consideration upstream location was finalized and DPR has been approved accordingly.

##### **1.4.2 POWER HOUSE**

Regarding the power house site, the Developer has informed that there is only one option for location of a surface power house due to topographical reason. The power house is located nearby Meying village area, on the left bank, with no impact on houses and habitation. The head race tunnel 3.55km is located on the left bank negotiating about 5km river length to gain the natural available head between the Purying and Meying villages. The Head Race Tunnel is crossing various layers of suitable rocks, mainly Quartzite biotite, Augen gneiss and interbedded quartzite and schist

#### **1.5 Social Impacts**

The social impact for the acquisition of land for the construction of proposed (240 MW) Heo Hydro Electric Project has been classified as:

- ✓ Impact during Pre- construction stage.
- ✓ Impact during Construction Stage.



✓ Impact during Operation stage

The main aim of the Social Impact Assessment is to identify the project specific impacts and some of impacts have already been identified in Heo EIA report, which are the basis to frame a Social Impact Management Plan which will ensure that the various adverse impacts are mitigated and the positive impacts are enhanced. The social impact management measures shall be implemented during the various stages of the project viz. Construction Stage and Operational Stage. A description of the various impacts is identified during different stages of construction, which is presented in Table 7.1.

**Table: ES 4- Identification of Social Impacts at different stages**

<b>Pre-construction</b>	<b>Construction</b>	<b>Operation</b>
Acquisition of land	Change in land environment	Depletion of migration workers during construction.
Acquisition of trees	Migrant population estimated as 1300	Demolition of temporary camps
Construction activities of access roads, colonies, offices and stores, movement of vehicular movement may enhance noise and dust/air pollution.	population at peak construction stage	Green belt development restoration of quarries.
Change in scenic beauty of landscape	Increase in vehicular movement, machinery and deployment of DG sets	Beautification of project area
Influx of migrant population related to construction activities begins.	Dust and noise pollution	Work force required for maintenance and operation of Project stays in permanent colonies, offices and stores.
Generation of water and solid wastes	Change in water quality	Social Development
Enhancement of Commercial establishments to meet need of additional people and construction activities	Increase in water waste and solid waste	Economic Development
Job opportunities to locals	Human health and visual impacts	Infrastructure development
	Fuel	Improvement of quality of life
	Social evil activities and new diseases.	Livelihood opportunities and self-employment.
	Better employment and business opportunities for locals.	Benefits extended under LADF are permanent.
	Technical enhancement of	Uninterrupted power supply, infrastructure and communication facilities to surrounding villages will lay

	such as communication system, modern facilities of life styles.  Better social qualities due to cultural fusion.	new opportunities.
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Total number of landowners in the project area referred to as Project Affected Families is 68 nos. Most of the people of the area are dependent on Community Forest Land for their livelihood and Forest produce collection. The impact on livelihood could be mitigated with the intervention of Rehabilitation measures as per the RFCTLARR Act 2013 and Mitigation measures under the Environment Act as already committed by the developer. Further explorative technique has been used to assess social impacts on families, understand social and demographic profile the project affected families.

In view of social impacts, rehabilitation of the PAFs has been proposed. During site social survey, choice and desire of affected people have also been collected through survey questionnaires. Mitigation measure of the adverse impacts shall be following:

- Payment of compensation for lost asset as per LARR Act, 2013
- Preference to the landowners in getting jobs during project construction period as per MoA entered between GoAP and project developer.

### 1.6 Mitigation Measures

It appears from the analysis and overview of the provisions of compensation for land acquisition under RTFCTLARR, 2013 will be sufficient to manage the social issues.

In addition to compensation for land, Rehabilitation package for the affected families and Compensation against Diversion of Unclassified State Forest (USF) as per applicable Govt. of Arunachal Pradesh Rehabilitation & Resettlement Policy, 2008

**Table : ES 5- Analysis of the Various Possible Social Impacts**

S.No	Type of Impact	Status	Mitigation Measures
1	Loss of land	Yes there will be loss of land and is direct impact.	Compensation as per RFCTLARR Act, 2013 and Rules 2015
2	Livelihood and Income	This is an indirect impact. At present no livelihood activity	Compensated in R&R procedures as

		exists on proposed land under acquisition except some forest produce if any	per RFCTLARR and Rule 2015.
3	Physical Resources	Change in land environment Change in scenic beauty Noise and dust pollution Deterioration of water quality Generation of water and solid waste Influx of migrant workers during construction Pressures on Fuel wood	Mitigation measures as per Approved Heo EMP recommendation
4	Private Assets	There are houses in affected villages, but not falling in land required for acquisition. However, there are trees, which can be considered as assets	Project affected and nearby villages private assets of locals will be increased to meet demand during construction and maintenance stage
5	Public Services and Utilities	There is no loss on any public services and utilities. Instead infrastructure facilities including communication system will be increased with better amenities.	Good road connectivity by BRO and developer (project internal roads) and communication system will be established.
6	Health	There will be no possible negative impacts on health to land owners and surrounding villages due to construction activities	Mitigating measures were discussed in Public Health Management chapter of Approved Heo EMP

### 1.7 Assessment of Social Cost and Benefits

Though, it is very difficult to quantify actual cost of social impact based on severity of land acquisition. However efforts were made to minimize negative impacts through intervention of R&R measures. However, the project will entail a multitude of benefits to the entire area. The project will have following benefits for the people:

Social costs are calculated by comparing project benefits and negative impacts, from construction of Heo HEP in Mechuka sub-division of West Siang District of Arunachal Pradesh. The compensation of land as per RFCTLARR Act & Rules towards land acquisition for the development of proposed project, LADP as per Hydro Policy and GoAP RR policy will be the benefits to the affected families/persons.

Positive and negative aspects of the project have been discussed in detail in the following Table no: 8.1

**Table: ES 6- Comparative Analysis of Positive and Negative Impacts**

S.No	Positive Impact	Negative Impact	Remarks
1	Enhanced payment towards land acquisition	Loss of Community Forest land	After careful examination of various parameters of cost and benefit of positive and negative impacts, it is found that the project would come as a net benefit the locals community to a large extent
2	Social Development		
3	Infrastructure Development		
4	Economic Development		
5	Improvement of quality of life		
6	Employment generation		

This project will help the local people in infrastructure development, social development and will increase livelihood opportunities & self-employment sources.