PRESENTATION ON KEEZHARKUTHU SMALL HYDRO ELECTRIC PROJECT (3X6.6MW) IN IDUKKI DISTRICT OF KERALA STATE.

1. POWER SCENARIO- ALL INDIA/ KERALA STATE.

- Energy plays a vital role in the socio-economic development and human welfare of a State. Apart from its contribution to economic development, it contributes significantly to revenue generation, employment, enhancement to the quality of life and reducing poverty.

- More recently, the need to reduce greenhouse gas emission, especially CO^2 has emerged as one of the important challenges in the power sector.

- To meet this challenge, emphasis on non-fossil fuel sources of energy exp., and the renewables viz, Hydro, Wind & Solar, has increased in the last few years.

- All India Installed Capacity as on 31.07.2017, as per Central Electricity Authority is as follows:

Sl No.	Description	Installed Capacity in MW
1	Thermal (coal, gas & diesel)	2,14,655
2	Hydro	44,187
3	Nuclear	5,780
4	Renewables (MNRE)	50,018
	Total	3,14,640

1.1 Power Scenario in Kerala State

- Kerala generates Power from four sources viz., Hydro, Thermal, Wind, & Solar.Of these, hydel & thermal power generation account for considerable majority.
- The main Challenges faced by the energy sector in the State are,
- Inadequate capacity addition over the years leading to massive in-house demand-supply gap.
- Negligible share of thermal energy in the energy mix.
- Limited presence for Independent Power Producers.
- Limited presence of Co-generating stations.

1.2 Installed capacity of Kerala State as on 31.03.2016 is as follows:

Sl No	Description	Installed Capacity	Capacity addition during 2015-16	% of increase during 2015-16.
1	Hydro	2104	22	1 %
2	Thermal	719	-	0%
3	Wind	43	8.4	20%
4	Solar	14	14	100%
	Total	2880 MW	44.4MW	

As may be seen from the above, the capacity addition of hydro during 2015-16, is only 1%.

Kerala is bestowed with huge hydro power potential by way of plentiful rain and many rivers. However, out of the estimated hydro potential of about 6000MW, only about 2104 MW (as on 31.03.2016) has been harnessed so far in the State due to Environmental/Forest issues.

- Also, in view of non-availability of suitable lands and problems connected with coal linkages, Capacity addition on Thermal Power plants has also become difficult.
- Under the circumstances, there is need to go in for more number of hydro stations by Kerala.

2. HYDRO POWER DEVELOPMENT IN KERALA STATE.

- Kerala is blessed with a unique network of rivers, (41 west flowing and 3 east flowing) and rich hydro power potential.
- Kerala once enjoyed a comfortable position w.r.t availability of power with the completion of major HEPs like Sabarigiri and Idukki in 1966.
- But, due to increase in demand and stalemates in capacity addition, power position in the State has become critical from 1985 onwards.
- Physiography of Kerala is not favourable for adding more number of base load thermal stations.
- The situation, therefore, warrants implementation of more number of hydro/other renewable generation schemes in lieu of thermal stations.
- Realising the above need, the Power Department of Kerala Govt. had issued necessary orders vide GO Ms 23/2014/PD dt. 21.09.2014 allotting 25 Small Hydro Projects with a total Installed Capacity of 110.45 MW to 25 developers on Build, Own, Operate & Transfer (BOOT) basis.
  As per the GO, these hydro power stations will be constructed, operated and handed over back to KSEB.

3. ADVANTAGES OF HYDRO POWER OVER OTHER SOURCES OF ENERGY.

- Hydro Power is a cheap, renewable, non-polluting and environmentally benign source of energy.

- Has the inherent ability for instantaneous starting, stopping, handling load variations and help in improving the reliabilities of power system.
- They have long useful life periods extending over 50 years and help in conserving the fossil fuel sources.
- They also help in opening avenues for development of remote & backward areas.
- In view of the forgoing, recently thrust has been given by Govt. of India as well as Kerala Govt. for prioritizing development of hydro sources of energy.

4. NEED FOR THE KEEZHARKUTHU SMALL HE PROJECT (3X6.6MW).

- To harness the hydro potential in the Keezhar river.
- To provide additional conventional energy to meet the power needs.
- To meet the peak hour demand also.
- To avoid low voltage problems in the vicinity.
- To speed up the rural electrification process.
- To improve the Socio- economic status of the area.
- To create additional employment to the local people.

- To provide capacity addition to the Grid to meet the escalating power demand.

- To create additional asset to the Kerala State Electricity Board / Kerala State, free of cost, as the project is to be developed on Build, Own, Operate & Transfer (BOOT Basis) and handed over back to KSEB after 30 years. Hydro stations can run for 70-100 years.

5. BACKGROUND OF KEEZHARKUTHU SMALL HYDRO ELECTRIC PROJECT (19.8MW).

- In order to enhance hydro capacity in the Grid (to enable flexible operation), Govt. of Kerala has allotted25 no's hydro power projects totaling to 110.45 MW capacity, for development under BOOT basis.

- Keezharkuthu Small Hydro Electric Project 3X6.6MW is one of those 25 projects and allotted to GMW Pvt. Ltd and GMW Engineers Pvt. Ltd., vide GO(Ms)NO. 23-2014- PD DTD. 21-07-14.

- As per KSEB proposal, the entire power generated from the Keezharkuthu project is to be supplied to KSEB and the power station is to be handed over back to KSEB after 30 years of operation.

- GMW Pvt. Limited has promoted an SPV in the name of **Keezharkuthu Power Private Limited** (KPPL) which has been registered in Kerala, for implementing the project.

6. LOCATION OF THE PROJECT.

State	:	Kerala
District	:	Idukki
Taluk	:	Thodupuzha
Nearest Town	:	Udambanoor
Nearest Railway Station	:	Aluva / Ernakulam

Weir Site

Village	:	Kaithapara

Power House

Village	:	Kanjikuzhi / Cheenikuzhi
River	:	Velurpuzha (Keezhar) / Kaliyarpuzha / Muvattupuzha

7. DESCRIPTION OF THE PROJECT

Under this project, it is proposed to utilize the flows of Kambar Stream of Keezhar River for hydro power generation by constructing a small 5 m high weir, a Power Tunnel 1600m long, a single Penstock of 1400m length and a Power House with 3 units of 19.8 MW capacity.

8.1 Salient features

Basin	:	Muvattupuzha
Catchment area	:	19.50 km^2
Head	:	460m
Power draft	:	195 C/s(5.5 cumecs)
Installed capacity	:	3X6.6MW

ROPEWAY

Based on the suggestion of Forest Department, the approach road has since been deleted. Instead of the road, a ropeway arrangement has been proposed.

Length	:	1000m
Width	:	4.5 m

Weir

BL	:	545 m
FRL	:	550 m
Height of Weir	:	5 m
Length of Weir	:	35 m
Dia. of Envl. Discharge Pipe	:	1 m

Discharge Capacity of Pipe	:	100 cusecs
Sill level of embedded Pipe	:	545 m

Tunnel

Diameter	:	2.5 m
Length	:	1600 m

Surge Shaft

Diameter	:	5 m
Sill level	:	530.5 m
Top Level	:	555 m

Penstock

Diameter	:	1.6m
Length	:	1400m

Powerhouse

Generator Floor level	:	88.85 m
Size of Power House	:	35X22.0 M
Installed capacity	:	3 units of 6.6 MW
Type of turbine	:	Pelton
Power draft	:	195 c/s
Tail water level	:	86.00 m

Tailrace channel

Shape	:	Trapezoidal
Length of Tail race channel	:	50 m

8. FINANCIAL ASPECTS

Capital Cost of the Project (Including IDC & Transmission line)	Rs. 148 Crores
Energy Benefits	65 million units / annum
Average cost of generation	Rs. 3.77/ Unit
Project Gestation period	2 Years

9. APPROVALS / STATUTORY & NON-STATUTORY CLEARANCE.

a) Clearance of Techno-Economic Feasibility Report (TEFR)
Techno-Economic clearance accorded by KSEB, for the installation of 3 x 6.6 MW.

b) Concurrence of PWD
Concurrence of PWD for the project is expected shortly from CE/Irrigation & Administration/Trivandrum.

c) Clearance from Tribal Welfare Department.
No Tribals are living in the Project area.

Clearance of Tribal Welfare Dept. of District Collectorate is in the final stage.

d) Local Body Approval.

Udambanoor Panchayat has accorded approval for implementing the project.

e) Forest Clearance.

•Proposal for diversion of 3.2425ha. of forest land in Thodupuzha Reserved Forest was submitted vide Lr. No. FP/KL/HYD/15907/2015 dated 08/10/2015. The proposal was rejected in view of the following:

(i). 3.2425 ha of forest land may not be establish the project.
(ii). The area is mounting with rich evergreen type of forest.
(iii). The position of Transmission line, alignment of road etc, could not be ascertained in the field properly.
(iv). Keezharkuthu water falls may have to be blocked totally.
(v). Submergence of 5m high Weir is not understood.
(vi). The area is used by elephant to drink water from the streams of Keezhar.
(vii).EIA study of the area need to be done.
(viii). Diverting an ecologically important landscape, for a small scale hydroelectric project cannot be considered worth implementing.
(ix). The proposal submitted by KPPL is vague and has given false information about the extent of forest land to be diverted.

- The Proposal was, therefore, re-visited and the project components were revised taking into account the various mitigatory measures and methodology for construction (explained in detail in Chapter 11 of this Presentation) and consequently the requirement of forest land is 4.9054 ha.
- Hence another proposal for initial diversion of 2.42ha of forest land and net diversion of 0.98 was submitted.
- Based on the direction of High Power Committee, a Joint inspection of the project was site was held on

17.11.2018 by the Official of Forest, Power Dept, EMC,KSEB & the project proponet.

- As per the suggestions made by the Forest Dept and the Consensus arrived at during the Joint inspection, a revised proposal seeking diversion of 4.4554 ha of forest land initially & **1.65 Ha** Finally has been uploaded on 9.3.2019.
- Due to the active spreading of the Corona virus during its 1st wave (March 2020) the Forest authorities couldn't process the Forest Clearance proposal on priority. The Divisional Forest Officer/Kothamangalam (DFO) vide his letter dated 4.8.2020, wanted us to demarcate all the project components and also to attend to the tree remuneration works.
- In view of the severe lockdown situations in Kerala State, the demarcation works couldn't be done faster. However, the demarcation works as well as tree remuneration works were completed during Oct'2020 and the DFO was requested to inspect the project site vide our letter dated 7.11.2020.
- In view of Corona situations and Kerala State Assembly Elections, the Divisional Forest Officer/Kothamangalam inspected the project site on 13.4.2021. The Divisional Forest Officer instructed his subordinates to collect some additional data from the field.
- The District Forest Officer / Kothamangalam again inspected the project sites on 24/4/2021. Further, District Forest Officer/Kothamangalam vide his letter dated 03.08.2021 stated that on field verification and scrutiny of Pattas and Land details of the **Non Forest Land** proposed for Keezharkuthu Small Hydro Electric Project (19.8 MW), it is found that an area of 1.48 Ha Land bears Pattas as per Kerala Land Assignment Special Rules 1993 and also that 0.5544 Ha in possession of Private parties haven't received pattas yet. Hence both these 1.481 Ha and 0.5544 Ha lands (Total 2.0354) should also be considered as forest land.
- As such, the DFO has directed to correct the land requirement for diversion as 4.4554 ha (2.42ha + 2.0354ha) and to resubmit the Forest Clearance proposal. Accordingly, the Forest Clearance proposal has been corrected & resubmitted for consideration for recommendation.
- The Chief Conservator of Forests / Kottayam now in his letter dated 29.11.2021 has informed that the portion of land i.e, 1000 x 4.5 = 4500m² required for the Ropeway may be added to the Forest land requirement for the project.

- As per the direction of the Chief Conservator of Forests / Kottayam, the land required for the Ropeway (4500 m²) has been added to the Forest land requirement & the total forest land requirement works out 4.9054ha. This modified proposal has been uploaded now.
- In sum, clearances from almost all concerned Departments have been obtained / are getting processed positively.

10. MAIN PROJECT COMPONENTS.

Ropeway to Weir site	:	1000m long and 5 mtr. Wide
Weir	:	5 m high
Tunnel	:	1600 m long
Surge Shaft	:	5 m diameter
Penstock	:	1400 m long
Power House	:	35X22 m size
Power Transmission Line	:	9 km long from Power House to the existing Udambanooor 110/33/11KV sub-station along the existing Panchayat / PWD roads.

11. METHODOLOGY FOR CONSTRUCTION

Construction of the civil Components of the Project Viz, Ropeway Road to weir site, Weir, Tunnel, a portion of Penstock, etc. alone may cause some impact on the existing environment, during the construction period.

- However, it is important to note that such activities are purely a temporary phenomina ie., only for a period of 30 months (2 ½ Years), which is the gestation period of the project.
- Ropeway to Weir (which lies in forest area) – 1000m long will be formed very carefully and used for construction activities. Thereafter, it will not be required and the same will be dismantled.

- The working area near weir site and a portion of tunnel intake will be handed over back to Forest Dept.
- On reaching weir site, Weir and Tunnel Intake will be done.
- **A temporary dumping yard** will be formed **outside the Forest boundary** at Kaithapara for disposal of the muck generated from the 1st half of the tunnel.
- Quantity of Tunnel Muck will be about 11000 m^3. A part of the muck amounting to 5500 m3 will be consumed for the Weir, road, tunnel lining and other allied works. All the balance muck, will be disposed of and no muck will be left behind either within RF area or outside RF land.
- After disposal of the entire muck, the temporary dump yard, which is outside the RF area, will be used for the construction of quarters, for 3 no's of operation staff.
- The 2nd half of the tunnel muck together with the Surge shaft muck will be transported through winch and an approach road to the **dumping yard** to be located near Power House, which will also be **outside the forest land**.
- The working area near surge shaft site and a portion of surge shaft land will also be handed over back.
- As far as Penstock is concerned, (of the 1400 m length) 700m lie in forest land and 700m outside the forest boundary.
- Laying of Penstock will be started from the Power House end and completed at the surge shaft end. The Single line Penstock will be buried under the ground thro'out the length in the forest area except for the steep rocky stretches. The buried portion will be refilled with earth. Extensive tree planting will be done and the entire land will be handed over back to Forest Department.
- Excavated earth, muck etc. arising from the Power House construction, will be disposed off thro' the **temporary dumping yard** to be formed near Power House which will be **outside the Forest boundary.**
- Erection of machinery (Power Generating Equipment) is involved only within the power house and not anywhere else.
- The temporary dumping yard formed near the Power House will be reclaimed and utilized for construction of quarters for the operation staff (15 nos or so, working under shift basis).

- As per the Deputy Chief Engineer, KSEB approval (accorded vide lr. dt. 16/11/2015), the power generated is to be evacuated by means of a 9 km long 33 KV Line from the Power House to the Udambanoor 110/33/11KV sub-station. This line passes passing through existing mud road, Panchayat road / PWD roads. **No diversion of forest land is involved** as per the "Power Evacuation System"proposal of KSEB.

12. FOREST ASPECTS

- Project Components are located in the Thodupuzha Reserve Forest from EL. 550m to 80m.
- Project Components have been devised in such a manner that R.F. land requirement is the barest minimum.

13.1 Requirement of Forest land (break-up details).

Sl. No.	Project Components	Size (m)	Land requirement	Land requirement	Remarks
			(Area in m2)	(Area in ha.)	
1	2	3	4	5	6
1	Ropeway (for approaching) weir	1000x4.5	4500	0.45	The entire land of 4500m² will be handed over back to Forest Department after construction works are over.
2	Weir including submergence & Working area		8900	0.89	900 m2 (working area) will be handed over back to Forest Department.
3	Tunnel Intake	40X20	800	0.08	Of this, 600 m2 will be handed over back after construction
4	Power Tunnel (1600 m long)	1600X3	4800	0.48	Will be handed over fully back to Forest Department.

5	Surge Shaft & Working Area (near Surge Shaft)	60X45	2700	0.27	Of this 2500 m2 will be handed over back.
6	Penstock & Rail Track (out of 1400 m length, only 700 m lie in forest land)	700X7	4900	0.49	Will be handed over fully back to Forest Department.
7	Penstock & Rail track(remaining length of 700 m lie in Forest with Patta)	700X7	4900	0.49	Will be handed over fully back to Forest Department.
8	Powerhouse, Tailrace channel, Switchyard & Approach road	100 x 104.1	10410	1.041	Bears Pattas as per Kerala Land Assignment Special Rules 1993 900 m2 will be handed over back.
9	Temporary Dumping Yard I (near Power House)	40 x 40	1600	0.16	Bears Pattas as per Kerala Land Assignment Special Rules 1993. 1600 m2 will be handed over back.
10	Working area near Power House	79.2 x 70	5544	0.5544	Bears Pattas as per Kerala Land Assignment Special Rules 1993. 3000 m2 will be handed over back.
	Total		**49054**	**4.9054**	

13.2 Details of forest land to be handed over back after construction.

Sl. No.	Project Components	Forest land to be handed over back (m2)
(1)	(2)	(4)
1	Ropeway	4500
2	Weir including submergence & working area	900
3	Tunnel Intake	600
4	Power Tunnel (1600 m long)	4800
5	Surge Shaft & Working Area (near Surge Shaft)	2500
6	Penstock & Rail Track (out of 1400 m length, only 700 m lie in forest land)	4900
7	Penstock & Rail track(remaining length of 700 m lie in Forest with Patta)	4900
8	Powerhouse, Tailrace channel, Switchyard & Approach road	900
9	Temporary Dumping Yard I (near Power House)	1600
10	Working area near Power House	3000
	Total	**2.86 ha**

As may be seen from the above, the net diversion of forest land involved will be **4.9054 ha. – 2.86 ha = 2.0454 ha.** only.

13.3 Details of forest land to be acquired/to be handed over back after construction/Net requirement.

Sl. No.	Project Components	Forest land To be acquired (m^2)	Forest land to be handed over back (m2)	Net requirement (M^2)
(1)	(2)	(3)	(4)	(5)
1	Ropeway	4500	4500	-
2	Weir including submergence & working area	8900	900	8000
3	Tunnel Intake	800	600	200
4	Power Tunnel (1600 m long)	4800	4800	-
5	Surge Shaft & Working Area (near Surge Shaft)	2700	2500	200
6	Penstock & Rail Track (out of 1400 m length, only 700 m lie in forest land)	4900	4900	-
7	Penstock & Rail track(remaining length of 700 m lie in Forest with Patta)	4900	4900	-
8	Powerhouse,Tailrace channel, Switchyard & Approach road	10410	900	9510
9	Temporary Dumping Yard I (near Power House)	1600	1600	-
10	Working area near Power House	5544	3000	2544
	Total	**4.9054 ha**	**2.86 ha**	**2.0454 ha**

As may be seen from the above, the net requirement of forest land will be only 2.0454 hactares.

13.4 Details of Private land (non-forest land) to be acquired.

Sl. No.	Project Components	Private land requirement (m^2)	Area in (ha.)	Remarks
(1)	(2)	(3)	(4)	(5)
1	Temporary Dumping Yard (near Power House)	1600	0.16	
2	Private land for compensatory Afferrestation	49054	4.9054	
3	Power Transmission Line	0	0	
	Total	50654 m^2	5.0654 ha.	

13.5 Details of Tree cutting involved within the forest land proposed to be diverted (4.9054 ha) are as below:

Sl. No.	Description	Tree cutting (of various species & girths)
(1)	(2)	(3)
1	Ropeway	50 Nos
1	Weir Site (including submergence)	138 Nos
2	Surge Shaft Site	32 Nos
3	Penstock Route	115 Nos
	Total	335 Nos

Note : Details of the girth of the various trees involved are furnished in the EIA Report

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14.ENVIRONMENTAL ASPECTS

- **Existing Environment Scenario- Study Area.**
  - The study area is located between the geo-graphical co-ordinates of 9^{o} 00' 04" N & 9^{o} 49' 16" N Lattitudes 76^{o} 47' 38" E & 76^{o} 58' 37" Longitudes.
  - The area lies partly in raised ground as well as hills (Western Ghat). The area is constituted by natural forest, plantations and **agri-horticultural** fields and habitations.

- **Climate**
  - Tropical humid climate prevails in the project area and its environs thro'out the year. The temperature various from 21° C to 29° C with seasonal variations.
  - The range of hills falls in the Thodupuzha Forest Division. Although placed in a tropical mountain range, the area enjoys a subtropical to temperate climate. Humidity is high with the highest values ranging between 91-95%.

- **Rainfall**
  - The area receives rainfall from both South West and North East monsoons. Annual average rainfall is about 3265mm.

- **Physiography**
  - The physiography of the area is structurally controlled. The Muvattupuzha river drains through highly varied geological formations of Pre – Combrian Crystallines, tertiary sedimentary rocks and laterites. The sedimentary formation are composed of vaikom, Quilon and warkole beds. Vaikom beds are composed of gravels, coarse to very coarse sands, clay and carbonaceous beds.

- **Water Resources**

  - The Muvattupuzha river (west flowing) originate in Idukki District, flows thro Ernakulam district to merge with Vembanattu lake and then to the Arabian Sea. The Muvattupuzha River is formed by the confluence of three rivers viz., Kothamangalam River or Kothayaar, Kaliyar and Thodupuzha aaru .

  - The major source of water is the Todhupuzha River, which originates in the Idukki district and provides water thro out the year.

- **Land use**

  - Consists of the cropped area, other un-cultivated land, lands non-available for cultivation, fallow lands and forest lands. Agriculture & Horticulture are very commonly witnessed.

  - **Biological Environment Study** covering Flora & Fauna study, Vegetation plantations, specific diversity, aquatic flora, fishes, amphibians & reptiles, Birds & Mammals, aquatic fauna, endangered species etc.

    and

  - **Impact Identification Study** covering Impacts during construction phase, physical environment, Biological environment, impact on flora fauna, loss of bio- diversity , habitat loss, wild animal movement, impact during operation phase etc. have been carried out during the Environmental Impact Assessment (EIA) study. EIA report has been prepared by Agriculture and Ecosystem Management Group (AGES)- Thiruvananthapuram and the same has been submitted separately.

15 MITIGATORY MEASURES.

Project with large activities are likely to have notable impacts on various components of the ecosystem. Such projects also require long gestation periods. In the present case, the gestation period as per schedule of implementation is only 2 ½ years, relatively very short compared to average gestation period of Indian HEPs.

To lessen these impacts necessary measures have been identified at the early stage itself-in the form of mitigatory measures and also as Environmental Management Plan. High sincerity on the part of the project proponent in implementing the mitigatory measures is of prime importance. These measures need to be taken up in two phases viz., the construction phase and the operation phase.

15.1 Construction Phase

The project, during the construction phase, may cause increase in suspended particle matter in the air and water, temporary disturbance to local wild life, because of the movement of man and materials, increased pressure on neighbouring natural vegetation etc. However, almost all of these changes are reversible and confined to the project area temporarily and would not lead to permanent repercussions in the Environment.

Mitigatory measures

- Only the barest minimum Forest land ie, 4.9054 ha is proposed to be diverted. Of this, 2.86 ha forest land which are not required after the construction phase will be handed over back to Forest Department. (Already discussed under chapter 12)
- 100% of the muck generated out of tunnel mining will be consumed for Weir Construction, road, tunnel lining and allied works.

- No dumping yard is proposed within the R.F. for disposal of the remaining muck. Temporary dumping yards are proposed outside the RF area for disposal of the muck.
- The forest land proposed to be diverted for the working area near Weir as well as surge shaft will be handed over back, after the construction phase.
- Provision has been made for Environmental flow pipe of 1m diameter in the Weir which is capable of discharging up to 100 c/s. The sill level of the pipe will be at the Bed level of the river and below that of the power tunnel , which will ensure smooth flow of water.
- As per the Revised Proposal for forest clearance, all the components have been made underground viz. tunnel, Penstock etc. and the power house is already in the forest land with Pattas (400 m away from the Forest boundary). The Penstock being embedded below ground, the hill slope can be maintained as before and there will not be any obstruction to crossing of animals, if any.
- Regular maintenance is not required at the surge shaft location. Only annual maintenance will be required.
- Approach road to Power House have been proposed well outside the RF boundary.
- No Forest land / Private land is required for the Power Transmission Line.

Vehicles movement

Minimum number of vehicles will be plied. Vehicles & machinery that are new and in good operational fitness alone will be used in the project activities. Vehicles movement will strictly be controlled with proper schedules. No movement in connection with project activities will be allowed during evening, night and early morning hours. Driver of vehicles and machinery attendant will be properly educated about the possible disturbance to the forest environment.

Work force

- About 50 workers at the Weir site and 50 workers at the PH site (which includes Engineers, Technician, machine operators, vehicles drivers both skilled and unskilled labour) will be engaged in the project

construction activities.

- Labourers will be engaged locally.
- The Labourers will be accommodated in the nearby private lands. Required fuel and other necessary amenities will be provided to them.
  They will be educated on the need for protection of the local environmental and will be strictly instructed to constrict themselves to the work site and not to get involve in collecting fire wood or the like from the forest area.
- The Co. will make sure that the work force do not settle down in the vicinity of the workplace or bring in their live stocks and put stress on the local ecology.

Noise Control

Blasting is unavoidable only for the tunneling work. Therefore controlled blasting with sand bags, old tyres etc. to minimize the impact of blasting will be resorted to. Strict adherence to noise control and to limit vibration will be adopted. In open cut areas blasting will be avoided and better technique for breaking the tunnel muck shall be adopted, so that noise and vibration are scaled down.

Disposal of debris

As already explained, it is proposed to source all the requirement of blue metal and rubble from the muck generated during mining. This will be strictly followed so that problems of disposal of mucks and debris can be reduced significantly. About 50% of the muck will be utilized for the construction works and the balance disposed of through the temporary dumping yards, to be formed outside R.F.

15.2 Operation Phase

During the operation phase of the project, the following points will be taken into account.

- Cross bar shall be fixed to prevent entry of unauthorized vehicles into the project area and the roads will be strictly controlled.
- Also, stringent control of entry of people will be ensured.
- A layer of surface soil may be laid and grass grown to enhance soil binding, stabilization and also would have natural look. Bare areas will be a source of soil erosion. Therefore the bare areas will be covered with suitable grass species.
- The number of staff / Labourers will be limited to the minimum required.
- The staff Quarters area will be kept away from the project site. Neat and proper sanitation facilities shall be provided. Good drinking water supply shall be provided. Sewage and sullage water shall not be let into the stream / river course as it is. They shall be treated properly.
- Required fuel (LPG gas) will be arranged to Officials and project staff for minimum cooking. Minimum number of vehicles shall be deployed.
- The project proponent will have adequate arrangements to deal with any accidents such as fire. All state of the art facilities for fire fighting both in the project area and in the immediate surrounding will be kept operationally ready. The staff and labour also will be trained in the fire fighting protocols, both to face indoor and outdoor eventualities and also to handle various types of fires.
- Medical and other basic facilities will be made available both during construction and operation phase of the project.
- Local plant species planted during construction phase will be maintained properly.

16. ENVIRONMENTAL MANAGEMENT PLAN (EMP).

Looking at the nature of the project, the gestation period of which as per the schedules is 2 ½ years, an Environmental Management Plan has been evolved taking into consideration the impacts and identified mitigatory measures. Some of the important aspects that need attention while developing the EMP are the following:

- Compensatory Afforestation
- Catchment Area Treatment Plan
- Muck Disposal and Management
- Waste disposal & sanitation, and
- Disaster Management.

An Environmental Monitoring cell is also proposed to be formed to look into this aspect and provide advice as and when required.

- **Compensatory Afforestation Programme**

Compensatory Afforestation is mandatory for this project, as diversion of 4.9054 ha of Forest land initially is required. The Company has identified 4.9054 ha. of non – forest land in Kaithapara village, which is adjoining the forest land. The afforestation program may be done in collaboration/Consultation with the Kerala Forest Department. The afforestation program will include a variety of activities such as raising the nursery of recommended plant species, preparation of planting ground, planting, watering and protection. Native plant species will be considered for planting.

- **Catchment Area Treatment Plan**

The main purpose of Catchment Area Treatment Plan (CATP) is to reduce erosion/siltation caused due to construction activities. In the present case, approach road, weir, Intake, Surge shaft and Penstock are required to be constructed. This would cause slight disturbance temporarily. Mitigation of this disturbance is very essential for the long term sustainability of the environment as well as the proposed project is unavoidable. Afforestation will be done and the forest lands handed over back.

Biotic treatment measures are suggested at the portion of land with extreme slopes, the lands that are

subject to notable erosion. The land situated below 0.6m and above 0.6m of the FRL contours of the WEIR is recommended for planting a green belt.

- **Muck Disposal And Management**

  Tunnel excavation is the major work of this project. The Tunnel will be done by the conventional method of drilling and blasting, as this method is suitable of all type of rocks seen in the project locations. In the initial reaches controlled blasting will be adopted in order to reduce the surface vibrations and noise. The materials used for tunnel excavation are gelatine, Fuse coils and Detonators. Specific blasting design will be evolved in consultation with Central Mining Research Institute, Nagpur. The main purpose of tunnel blasting design is to achieve the maximum pull of rock with lowest quantity of explosives. The quantum of tunnel muck that will be generated will be about 11000 cubic meters. Considering the demand for random rubble, blue metal to be generated from the excavated muck about 100% of the total quantum will be lifted and utilized for the project works. After all the utilizable muck is lifted the remainder will be disposed off thro' the temporary dumping yards (created for the purpose in private lands)

- **Water Requirement**

  During the construction phase, the total number of person involved will be about 100. As far as this project is concerned, the water source is very potable and hygienic. No source of pollution is present upstream of the source. However, minimum treatment required will be ensured to further ensure the safety of water.

- **Waste Disposal and Sanitation**

  Waste disposal during Construction Phase

  During the construction phase, the contract workers will be housed in temporary quarters. In total, about 50 people will be involved in the project construction at the weir site and another 50 people near PH site.

Garbage generated by the employees (permanent and temporary) will be collected and disposed off by the company appointed agency during the construction phase. Proper segregation of the wastes will be done and according to the type of waste, disposal strategy will be adopted. The project area will be treated as plastic free zone and appropriate mechanism to dispose them will be made available. It will be insured that no waste gets into the local environment of the project site and does not get into the adjacent water bodies, stream etc.

Waste disposal during Operation

During the operation phase, total number of work force will come down to one fifth (from 100 to 20) of that during construction phase. Temporary quarters made for the construction laborers will be dismantled and hence the garbage disposal load will come down drastically. The waste, generated from the operation of the project, will be negligible. During the operation phase, sullage water as well as sewage sludge load will also come down drastically.

- **Risk analysis and Disaster Management Plan.**

It is important to improve the environment, since safe and healthy working conditions are the best protection for the worker and the best guarantee for sustained increased production. The Policy relating to safety and working conditions will be followed. The maintenance of conducive working conditions involves - managing issues such as wage structures, fixing of minimum wage and protection of income, fixing of working hours, periods of rest, paid holydays, provision of canteen facilities etc. Safety includes not only protection of workers against accidents at work but also against occupational diseases.

Risk assessment is the proactive identification of hazards and an action plan to control the hazard in the order of priority as assessed and proper documentation of the same. The action plan will be monitored on a regular basis. Hazards that have the potential to cause harm will be addressed first. Elimination of the hazard is the preferred control, which involves change of either equipment or materials or work methods.

17. BENEFIT COST ANALYSIS

The overall cost of the project is estimated at Rs.148 crores. The cost per MW of installed capacity works out to Rs.7.48 Cr/ MW. Average cost of generation works out to Rs.3.77 / unit. This is very low when compared to thermal schemes.

The Benefit – cost Analysis has been made as required under the Forest Conservation Act 1980. Details are furnished in the E.I.A Report.

The parameters considered are Loss of Forests, Loss of animal husbandry, productivity including loss of fodder, environmental losses etc. The total loss works out to Rs.76.7 lakhs

While evaluating the benefits, the factors considered are Revenue from sale of energy of 65 MU, Employment potential etc. The total Benefits work out to Rs.3267 lakhs

$$\text{Ratio} = \frac{\text{Benefits B.C.}}{\text{Cost}}$$

$$= \frac{\text{Rs.3267 lakhs}}{\text{Rs.76.70 lakhs}}$$

= 42.59

18. CLEAN DEVELOPMENT MECHANISM (CDM)

- In order to reduce the Climate Change and consequently Global warming, Ministry of power, Govt. of India is increasingly emphasizing on reduction in green house gas (CO_2) emission from power sector, which inter – alia gives emphasis for hydro capacity addition.
- United States Environmental Protection Agency (USEPA) uses the AVoided Emissions and geneRation Tool (AVERT) to assess equivalencies for emission reductions from Renewable Energy (RE) programs.

Emission factor:

The average CO^2 emission rate (2016 data) adopting AVERT is 7.44×10^{-4} metric tons CO^2 / KWHr.

The annual average energy generation expected from the Keezharkuthu Hydro power project is 65MU. Or 65,000,000 Kwhr. The quantity of CO2 emission avoided due to the above hydro energy generation will be : $7.44 \times 10^{-4} \times 65{,}000{,}000 = 48{,}360$ metric tons of CO^2 perannum

With a view to avoid such green house emissions and encourage implementation of more number of hydro projects, Ministry of New and Renewable Energy (MNRE), Govt. of India is extending benefits for such renewable energy projects under Clean Development Mechanism (CDM).

19. HYDRO POWER OBLIGATION POLICY OF GOVT OF INDIA

Ministry of Power, Govt. of India vide their Circular dt. 9.10.2014, had fixed the requirement of hydro power addition by the State Governments. As per this Circular, the hydro power addition required for Kerala is 5%, at the end of the 13^{th} Plan period.

Having exploited almost all the major hydro potential, Kerala is left only with small hydro potential. For

achieving 5% addition to the hydro power capacity, the requirement is 2104 MW x 0.05 = 105 MW. Development of the 25 Nos small hydro schemes allotted by Kerala Govt will realize 111 MW of hydro capacity addition. As such, implementation of this project becomes necessary.

20. ADDITIONAL BENEFITS OF THE PROJECT.

- This project will meet the peak hour demand of Kerala grid during morning and evening and thereby ensuring quality power supply.
- This project will help to ensure optimal thermal-hydro mix for the flexible operation of the grid.
- Helpful for the all-round socio-economic development of the area and the State at large.
- Creates employment potential to the local people.
- Helpful to rectify the low voltage problems in the area.
- Will be useful for rural electrification in the nearby areas.

21. SWOT ANALYSIS

Strength

- Adds valuable 19.8MW of clean energy to the Grid which has a total Installed Capacity of 2104 MW only.
- Helpful in meeting the peak hours demand.
- Adds 65 million units of energy - a major infra-structure requirement for the

development of Kerala.

- Only a run - of - the - river project requiring 4.9054 ha of forest land for the present and only 2.0454ha in the long run.
- Helps in conserving the natural fossil fuels like coal, natural gas, naptha etc.
- Helps in reducing the greenhouse gases like CO_2 to an extent of 49104 MT everyyear.
- Will be an asset to KSEB in the long nun.
- Helpful for rural electrification.
- Local employment
- Socio- economic boost.

Weakness

- Located In Thodupuzha Reserved Forest Area.
- Need for (1600m long) tunneling work inside R.F.
- Formation of Ropeway to weir site in R.F.
- Requirement of 4.454 ha. of forest land.

Opportunities

- Utilisation of perennial flow of water - a renewable source of energy.
- Hydro projects will, invariably, be located on the hills only. Availing of difference in ground levels viz., head.
- No trans-basin diversion of water is involved.
- Impact on the existing environment will be a temporary phenomena i.e. arises only during the construction period of 2 ½ years.
- Proper Environmental Management Plan comprising Compensatory Afforestation, Restoration of

disturbed area by Catchment Area Treatment Plan , Tree Plantation Programme with native species etc.

- Non-disturbance during operation period, restoration of forest etc.
- Distinct advantage over other sources of energy like coal, oil fired, Gas based stations from engineering socio-economic point of view.

Threat

- Real threat is NIL, as only the potential energy of water is utilized for power generation.
- Temporary disturbance to flora & fauna in the area, during the project construction period of 2 ½ years.

22. PRESENT STATUS OF THE PROJECT DEVELOPMENT.

After allotment of the project, the following clearances have been obtained:

- Techno – Economic clearance (TEC) from KSEB obtained
- Approval for Power Transmission line route obtained.
- Since there is no trans - basin diversion or irrigation concurrence of PWD is in the final stage
- As there is no tribals living in the project area, clearance from Tribal welfare Dept. is also in the final stage.
- Approval of Local body ie., panchayat - already obtained.

- Power Purchase agreement is in position

- Discussion held with the national funding agency viz. Indian Renewable Energy Development Agency (IREDA) a Government of India Enterprise and they have expressed their willingness to fund the project.

- Forest clearance is the only clearance pending.

23. SUMMARY

- The Kerala State Electricity Board proposes to construct the run of the river Keezharkuthu Hydro Electric Project (19.8 MW) in Idukki Dt. The Project involves construction of water conducting system, Power House, switch yard and power evacuation system.

- The project does not propose construction of any major storage structure and intends to utilize water flows of Keezhar at an upper level, for power production to meet the energy needs of Kerala.

- As discussed under the Chapters 17 & 21, (from the technical and economic point of view), the project is highly beneficial. The estimated Benefit - Cost ratio is 42.59.

- The Agriculture & Eco System Management Group (AGES) Trivandram has carried out the EIA study, on the request of KPPL. The scope of the study is for examination of the ecological impact of the Keezharkuthu project, on the existing environment. The study examined the project sites and its environs focussing on the impact of the project on biological components and ecological environment. Field survey of the project sites and its environs were undertaken recently. Standard methods were adopted for collection of the primary data on flora and fauna.

- Since the project area and its environs fall within the Thodupuzha Reserve Forest, KPPL would take utmost care in minimizing disturbances during the construction phase of the project.
- As most of the installations of Keezharkuthu are to be placed underground and only a few over ground components like weir, surge shaft etc. will be left behind, the project is expected to cause minimum impact to the local environment. Proper scheduling of the project execution, barest minimum utilization of the approach road after the construction period, stringent control on vehicle movement and access to roads, proper management of debris and wastes, reduction in blasting to the minimum requirement and effective control of workers in terms of reducing their pressure on the local environment, can help considerably in reducing the impacts.

- Out of the 4.9054 ha of forest land requirement during the construction phase, 2.86 ha of forest lands are proposed to he handed over back to the forest Department and net diversion of forest land involved will only be 2.0454 ha.

- An equivalent area 4.9054 ha of private land is to be given towards compensatory afforestation. In addition, 2.86 ha of forest land will also be handed over back after construction works. As such there will be a net increase in forest cover to the extent of 2.86 ha.

24. REQUEST

The Forest Department is requested to reconsider and recommend the Forest Clearance proposal (for initial diversion of 4.9054 ha of forest land) and final diversion of 2.0454ha of forest land for the Keezharkuthu hydro power project (3 x 6.6 MW), on conditional basis, in the light of the following:

i. Need for hydro capacity addition to Kerala State in the absence of adequate thermal capacity.
ii. Merits of hydro power.

iii. The entire power generated from this project is to be supplied only to KSEB and not to any other third parties, as per the agreement with KSEB. Also, the Keezharkuthu power station is to be handed over back to KSEB after 30 years.

iv. Reduced forest land requirement of 4.9054 ha and handing over back of 2.86 ha of forest land, after the construction phase. Net requirement of forest land will only be 2.0454 ha.

v. Methodology of construction, which mitigates the impact on the existing environment.

vi. Mitigatory measures contemplated.

vii. Proposed Environmental Management Plan.

viii. Provision made for environmental discharges downstream of the weir to maintain the Keezharkuthu waterfall.

ix. Avoiding emission of green house gases to the tune of 48,360 MT of CO_2 everyyear.

x. Conservation of natural fossil fuels like coal, natural gas etc.

xi. Generation of 65 MU of energy and the additional benefits thereof.

xii. Benefit - cost ratio of 42.59

xiii. All the people residing nearby are favoring the project and they are looking for employment opportunities as well as social economical development

xiv. Rejection of such minimum forest land requirement proposal would mislead the other developers of the 25 projects allotted in 2014 and 20 more projects allotted recently in Dec 2017.

xv. In the Summary and Conclusion of the EIA Report, it is concluded that this project can be showcased as a model for sustainable development and also that the project deserves favorable consideration by the Regulatory Authorities of Kerala for implementation.

xvi. The process of development and conservation of environment would have to go hand in hand to achieve better standard of life to the common people.

“ THANK YOU”