CHAPTER 5

DATA COLLECTION
AND
1ST STAGE SCREENING OF POTENTIAL PUMPED STORAGE PROJECTS

(IDENTIFICATION AND PRIMARY SCREENING)

CHAPTER 5 DATA COLLECTION AND 1ST STAGE SCREENING OF POTENTIAL PUMPED STORAGE PROJECTS

5.1 STATE-WISE INFORMATION COLLECTION ON PUMPED STORAGE PROJECTS

5.1.1 Maharashtra State

(1) Development Needs of Pumped Storage Plant

Maharashtra has the largest probable capacity for development of PSP in India, so that CEA thinks that Maharashtra plays a key role to develop PSPs in the western regional grid. On the other hand, the state government has a plan to rapidly develop renewable energy such as 7,500 MW of solar power generation and 5,000 MW of wind power generation by 2020. GoMWRD who is in charge of development of PSP in Maharashtra thinks that PSP is one of the technically feasible options to supply balancing power to the grid as well as to secure peak power. However, Energy Department of the Government of Maharashtra as well as MAHAGENCO who is in charge of operation of PSPs after the commissioning regard PSP as costly in comparison of thermal power generation, so that they have an idea to mainly develop thermal power stations and seem to be reluctant to push forward development of PSPs. According to MAHAGENCO, cost for power generation by the existing Ghatghar PSP is 7 INR/U, but average cost in the case of thermal power generations by MAHAGENCO's is 2 ~ 3 INR/U.

From financial aspect, the government of Maharashtra is required to comply with the fiscal management target set by FRBM act, with the following three parameters for 2016-17:

Item	Estimate	Target
- Revenue deficit / GSDP rate:	-0.17 %	0.0 %
- Fiscal deficit / GSDP rate:	-1.59 %	-3.25 %
- Total debt stock / GSDP rate:	16.15 %	22.64 %

Except for revenue deficit, the state has achieved the target figures mentioned in the Report on 14th Finance Commission. As long as the state keeps such conditions, especially fiscal deficit, it is considered that there would be a possibility for the state to obtain finance including loans for development of pumped storage projects from a viewpoint of fiscal management of the state, if the state so desires. Generally speaking, there is no specific preference in PSP from a viewpoint of the Finance Department. Energy resource to satisfy the demand is first determined by the Energy Department / Water Resources Department.

According to the interview made to the Finance Department, they were reluctant to borrow loans, as long as it attracts state guarantee. For the state public utilities, like MAHAGENCO, the Finance Department was in an opinion that state utility, as an independent firm, should procure necessary funding within their capacity without counting on the state.

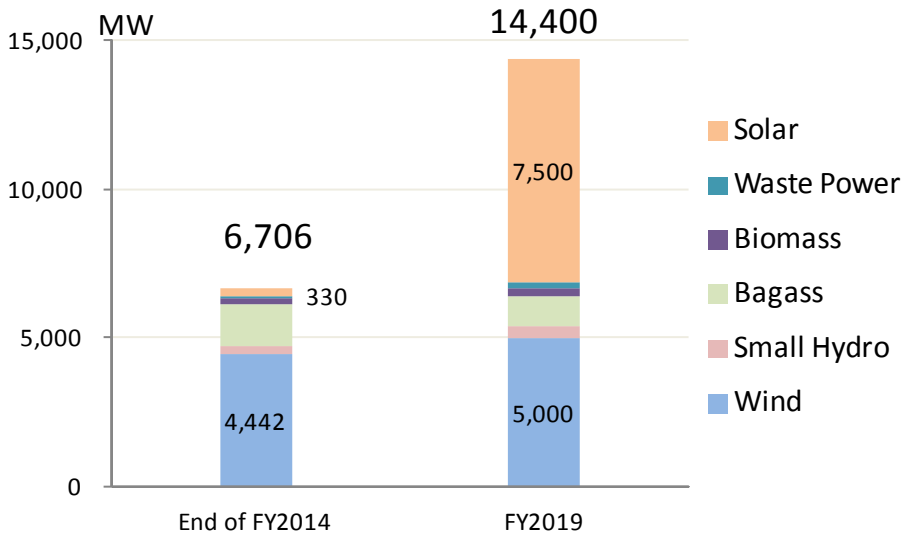
(2) Analysis of PSP possibility from the state power sector status

This analyzes the possibility of PSP development in terms of necessity for adjusting power and available options, power market structure, and capability of executing entities.

1) Necessity for adjusting power and available options

Steady increase is expected in both electric energy and peak demand in the Maharashtra state, at an annual average growth rate of 8.4% and 7.0% respectively from FY2014 to FY2019. Although the state is now enjoying net surplus position in term of both energy and peak, it seems to drop to tighter balance in FY2019, net surplus of only 2.4% for energy and 0.2% for peak, due to remarkable demand growth.

Regarding renewable energy, the state government proposes an extremely ambitious target to add 14,400MW of new capacity by 2020. The state decides to increase photovoltaic (PV) power generation to 7,500MW which is equivalent to more than 20 times of present capacity. When considering recent peak - off peak demand gap, 3,500MW as of October 2015, the state needs careful assessment of changing/increasing PV output and corresponding supply side measure. Stability of power grid may be challenged by this large increase of variable renewable power sources. It is uncertain, and even yet to be studied, whether existing one PSP and other hydropower plants is sufficient to cope with it.



source : Power for All Maharashtra, MOP, Feb., 2016

Figure 5.1.1-1 RE Capacity Addition from FY2015 to FY2019

Table 5.1.1-1 Major Pumped Storage Projects in Maharashtra

Location	Capacity	Stage
Warasgaon	1,200 MW	DPR is in progress
Panshet	1,600 MW	The work of investigation of the lower dam could not start.
Varandhghat	800 MW	The work of investigation of the lower dam could not start.

2) The different observation among stakeholders for PSP promotion

As for the construction of the pumped storage power stations (PSPs), the difference in observation for introducing pumped storage power generation becomes clear between the organizations in the state. The Water Resources Department, Government of Maharashtra (GOMWRD) has jurisdiction over a planning and the construction of PSP in the state, and, on the other hand, its operation belongs to the generation company of the state. GOMWRD and the State Dispatch Center are supporting to have new PSPs in view of expected growth of electricity demand and variable renewable energy. On the other hand, the Energy Department and Maharashtra State Power Generation Co., Ltd. (MSPGCL) insist on the use of the thermal power station rather than PSP because of its high cost nature.

When considering above issues, it is anticipated that the new development of the PSPs in the state may be difficult unless the consensus will be formed among the stakeholders.

(3) Pumped Storage Projects planned in Maharashtra state

In Maharashtra state, the following PSPs were found:

Table 5.1.1-2 Pumped Storage Projects planned in Maharashtra State

Name of PSPs	Capacity (MW)	Remarks
1. Warasgaon	1,200	Under preparation of the DPR.
2. Panshet	1,600	PFR has been completed, now S & I stage. But, S & I has been suspended due to agitations by local villagers.
3. Varandh Ghat	800	PFR has been completed, now S & I stage. But, S & I has been suspended due to agitations by local villagers.
4. Kodali	220	Under preparation of Preliminary Investigation Report
5. Humbarli	400	The project is planned to be done by THDC and NPCIL, but it has been stopped due to issue of forest land.
6. Malshej Ghat	700	DPR was completed. The PSP is executed by THDC, NPCIL and the state government, but it hasn't commenced yet.
7. Mukthel	110	PIR stage. The project has no issue on forest land, so it is regarded as attractive.
8. Ghatghar Stage-II	125	Under investigation

Name of PSPs	Capacity (MW)	Remarks
9. Chikhaldara	400	DPR Stage*
10. Atvan	1,200	Pre-Investigation Report stage The site is included in a wildlife sanctuary.
11. Konya Stage-IV	400	PIR stage. The site is included in a wildlife sanctuary. NHPC is interested in the development of this PSP.
12. Nive	1,200	PIR stage
13. Nandgaon	500	Rejected in JICA Survey in 2012 due to Reserved Forest
14. Konya Left Bank	80	The construction has been suspended due to significant increase of the construction cost.
15. Ulhas	1,000	Rejected in JICA Survey in 2012 due to Reserved Forest
16. Pinjal	700	Ditto
17. Kengadi	1,550	Ditto
18. Jalong	2,400	Ditto
19. Kolmondapada	800	Ditto
20. Kalu	1,150	Ditto
21. Sidgarh	1,500	Ditto
22. Amba	2,500	Ditto
23. Chornai	2,000	Ditto
24. Savitri	2,250	Ditto
25. Madliwadi (Madhaliwadi)	900	Rejected in JICA Survey in 2012 due to Reserved Forest, Wildlife Sanctuary & Important Bird Area
26. Baitarni (Vaitarni)	1,800	Ditto
27. Morawadi	2,320	Rejected in JICA Survey in 2012 due to Poor Accessibility, Wildlife Sanctuary & Important Bird Area
28. Gadgadi	600	Rejected in JICA Survey in 2012 due to Reserved Forest & Wildlife Sanctuary
29. Kundi	600	Rejected in JICA Survey in 2012 due to Wildlife Sanctuary
30. Aruna	1,950	Rejected in JICA Survey in 2012 due to Reserved Forest
31. Kharari	1,050	Ditto
32. Jalvara (Jalware)	2,000	Ditto
33. Paithan	12	Already Commissioned and Operational
34. Ujjani	12	Already Commissioned and Operational

The above PSPs are outlined below, and more detailed information is shown in Appendix 5-4. Currently, GoMWRD counts No.1 to 12 PSPs in the above table in the development of PSPs, and the total install capacity comes to 8,355 MW[1]. Among the twelve (12) PSPs, ten (10) PSPs are identified by GoMWRD, and remaining two (2) PSPs, namely Malshej Ghat and Humbarli PSPs are THDC's projects.

1) Warasgaon PSP

GoMWRD considers that this PSP is the most attractive among PSPs identified in Maharashtra

[1] GoMWRD, "Hydro Power - Pumped Storage" for CEA's meeting on PSPs, p17, 20th June, 2016

because the project has no issue on Forest Land, and NHPC also has the same opinion according to the minutes of the meeting on PSP held on 20th June, 2016[2]. According to GoMWRD, resettlement of almost 150 persons will be required for the development, but no person is opposed to develop this PSP at present. So, it is predicted that the resettlement doesn't hinder development of the PSP. Its PFR was already prepared through other JICA survey executed in 2012. In the survey, its installed capacity was estimated as 1,000 MW[3]. After that, the installed capacity was reestimated as 1,200 MW by GoMWRD. GoMWRD has planned to take up this PSP for further studies, and its DPR is presently under preparation.

2) Panshet &Varandh Ghat PSPs

Panshet and Varandh Ghat PSPs were also identified in other JICA Survey executed in 2012 together with the aforesaid Warasgaon PSP, and their installed capacities were estimated as 1,400 and 1,100 MW respectively[4]. After that, GoMWRD reestimated their installed capacities as 1,600 MW and 800 MW respectively. Their PFRs were already completed in the above survey. Currently, these PSPs are categorized in the S & I stage, but some surveys and investigations have been stopped due to strong oppositions by local villagers according to GoMWRD[5]. Therefore, these projects have been suspended.

3) Kodali PSP

Kodali PSP is found in CEA's presentation titled as "Indian Scenario of Pumped Storage Hydro Development" in the workshop on PSPs held on 27th October 2015[6]. According to the presentation, economical investigation report for this PSP was already submitted to the state government by GoMWRD. GoMWRD explained in the discussion with JICA Study Team that this PSP was categorized in PIR stage.

4) Malshej Ghat & Humbarli PSPs

Malshej Ghat PSP and Humbarli PSP are THDC's projects, not GoMWRD's[7]. As for Malshej Ghat PSP, its DPR has already been approved, but the construction works haven't been commenced because an agreement for the implementation among THDC, NPCIL and Government of Maharashtra hasn't been signed yet. On the other hand, Humbarli PSP has been suspended due to unavailability of Forest and Environmental Clearances because the project site is located at the fringe of Konya Wildlife Sanctuary[8].

5) PSPs found in the Interview with GoMWRD

According to GoMWRD's presentation for CEA's meeting on PSP held on 20th June 2016, the

[2] Minutes of CEA's Meeting on PSPs held on 20th June, 2016
[3] JICA, Data Collection Survey on Pumped Storage Hydropower Development in Maharashtra, October 2012
[4] JICA, Data Collection Survey on Pumped Storage Hydropower Development in Maharashtra, October 2012
[5] GoMWRD's Reply to Questionnaire from JICA Study Team
[6] CEA, Indian Scenario of Pumped Storage Hydro Development, 27th October 2015
[7] Salient features of Malshej Ghat and Humbarli PSPs
(http://thdc.gov.in/Projects/English/Scripts/Prj_Features.aspx?Vid=168)
[8] Current Status of Malshej Ghat and Humbarli PSPs

following PSPs are found to be identified in Maharashtra state in addition to Warasgaon, Panshet, Varandh Ghat, Kodali, Malshej Ghat and Humbarli PSPs[9].

Mutkhel PSP is categorized as PIR stage, and its installed capacity is estimated as 110 MW. According to the minutes of the abovementioned meeting on PSP held on 20th June 2016 (Refer to Appendix 5-3), it is recorded that this PSP is very attractive for the reason of no issue on forest land like Warasgaon PSP in spite of small installed capacity.

Ghatghar PSP (Stage II) is presently categorized into investigation stage, and its installed capacity is estimated as 125 MW. Needless to say, this PSP utilizes the existing reservoir for Ghatghar PSP (250 MW) which is in operation. After the Stage II has been commissioned, total installed capacity of Ghatghar PSP comes to 375 MW.

Chikhaldara PSP is categorized as DPR stage according to the minutes of the abovementioned meeting. However, judging from discussions with GoMWRD, this project is probably categorized as PIR stage. Its installed capacity is estimated as 400 MW.

Both Atvan PSP and Konya Stage-IV PSP are categorized into PIR stage. However, according to the minutes of the abovementioned meeting, it is recorded that NHPC thinks it difficult to develop these PSPs because both project sites exist in wildlife sanctuary.

Nive PSP is also categorized into PIR stage, but other information hasn't been obtained so far.

6) Nadgaon PSP

Nadgaon PSP was identified in other JICA Survey executed in 2012 together with Warasgaon, Panshet and Varandh Ghat PSPs, but PSP was eliminated in the survey because the project site exists in a Reserved Forest[10].

7) Koyna Left Bank PSP

Although Koyna Left Bank PSP has been categorized as "under construction" in the base paper for workshop titled as "Pumped Storage Development and Integration with Renewable Energy" held on 27th October 2015[11], it is found in the discussion with GoMWRD that the construction works has been suspended because of significant increase of the construction cost.

8) PSPs identified by CEA

Twenty (20) PSPs are found in the project list named as "PSH Sites identified by CEA" annexed to the aforesaid base paper[12]. But, it is found that all the PSPs except two operational PSPs, namely Paithan and Ujjani PSPs, have already been eliminated in other JICA Survey executed in

[9] GoMWRD, "Hydro Power - Pumped Storage" for CEA's meeting on PSPs, 20th June, 2016

[10] JICA, Data Collection Survey on Pumped Storage Hydropower Development in Maharashtra, p8-6, October 2012

[11] Central Board of Irrigation & Power, Base Paper for Workshop titled as "Pumped Storage Development and Integration with Renewable Energy", p4, 27th October, 2015

[12] Central Board of Irrigation & Power, Base Paper for Workshop titled as "Pumped Storage Development and Integration with Renewable Energy", p10, 27th October, 2015

2012 because of issues on Reserved Forest, Wildlife Sanctuary and/or Important Bird Area[13]. So, these eliminated PSPs are considered to be impracticable in a similar manner of the above JICA Survey.

(4) Social and Natural Environmental Aspects of Pumped Storage Projects planned in Maharashtra

Malshaej Ghat and Konya Stage-IV have got EC in 2008 and 1988 in 34 planned PSP in Maharashtra State. Humbarli, Mukthel, Ghatghar Stage-II, Konya Stage-IV, and Nive are in the Protected area. Malshej Ghat, Chikhaldara and Atvan might be in the Eco-sensitive area.

1) Warasgaon PSP

Warasgaon PSP locates Pune District and Raigarh District. Two new reservoirs are planned. Major land cover around the Upper Pond and Lower Pond is "Broadleaf Deciduous Forest" and "Crop Land" respectively. Scheduled Tribe rate of Pune District and Raigarh District is 3.7% and 1.26%. Resettlement more than 1,200 people are estimated.

EIA report of Warasgaon PSP has not been prepared yet. No domestic protected areas are confirmed around the project area so far. International Protected areas that Endemic Bird Area (EBA)[14] and Biodiversity Hotspots[15] covers the project area. The Talula – Mangaon – where the lower dam and reservoir are located is recommended as Eco-sensitive Zone by The Western Ghats Ecology Expert Panel (WGEEP). There is no known habitat of Elephant and Tiger. Forest clearance will be required. The affected forest area is not clear.

2) Panshet

Panshet PSP locates Pune District and Raigarh District. Two new reservoirs are planned. Major land cover around the Upper Pond and Lower Pond is "Broadleaf Deciduous Forest" and "Crop Land" respectively. Scheduled Tribe rate of Pune District and Raigarh District is 3.7% and 1.26%. No resettlement is expected.

EIA report of Panshet PSP has not been prepared yet. No domestic protected areas has been confirmed around the project area yet. International Protected areas that EBA and Biodiversity Hotspots covers the project area. The Talula – Mangaon – where the lower dam and reservoir are located is recommended as ESZ 3 by WGEEP. There is no known habitat of Elephant and Tiger around the project site. Forest clearance will be required. The affected forest area is not clear.

3) Varandh Ghat

Varandh PSP locates Pune District and Raigarh District. Two new reservoirs are planned. Major land cover around the project site is Cropland. Scheduled Tribe rate of Pune District and Raigarh

[13] JICA, Data Collection Survey on Pumped Storage Hydropower Development in Maharashtra, p8-6, October 2012

[14] Endemic Bird Areas (EBA) are regions of global conservation importance, identified by BirdLife International, where the distributions of two or more restricted-range bird species overlap.

[15] Biodiversity Hotspots are regions of global conservation importance defined by the presence of high levels of threat (at least 70% habitat loss) in areas with high levels of species endemism (at least 1,500 endemic plant species).

District is 3.7% and 1.26%. According to Data Collection Survey on Pumped Storage Hydropower Development in Maharashtra (JICA, 2012) the Involuntary resettlement is expected at the Upper Pond' site. The scale is expected to be small but the exact scale is not known. At the Lower Pond site, it seems that no residential house exists in the site.

EIA report of Varandh PSP has not been prepared yet. No domestic protected areas are confirmed around the project area. International Protected areas that EBA and Biodiversity Hotspots covers the project area. According to Data Collection Survey on Pumped Storage Hydropower Development in Maharashtra (JICA, 2012) Taluka – Mahad - where the lower dam and reservoir are located is recommended as ESZ 1 by WGEEP. There is no known habitat of Elephant and Tiger. Forest clearance will be required. The affected forest area is not clear.

4) Kodali

Kodali PSP locates Kolhapur District. No new reservoirs are planned because existing reservoir of Tilari HEP and Tilari Project are used. Major land cover around the project site is cultivated land and open forest. Scheduled Tribe rate of Kolhapur District is 0.78%. Huge amount of resettlement and land acquisition is not expected.

EIA report of Kodali PSP has not been prepared yet. No domestic protected areas are confirmed around the project area. International Protected area that EBA locates 1.5km from the project site and Biodiversity Hotspots covers the project area. The project locates in the known Tiger habitat. Forest clearance will be required. The affected forest area is not clear.

5) Humbarli

Humbarli PSP locates Satara District. One new Upper Pond is planned and existing Shivajisagar (Koyna) are used for Lower Pond. Major land cover around the project site is open forest and agricultural land. Scheduled Tribe rate of Satara District is 0.99%. Huge amount of resettlement and land acquisition is not expected.

EIA report of Humbarli PSP has not been prepared yet. Both upper and Lower Ponds are in the

Koyna Wildlife Sanctuary, Sahyadri Tiger Reserve, Western Ghats World Heritage Site, Biodiversity Hotspots, 2km from KBA, and 5km from EBA". The project locates in the known Tiger habitat. Forest clearance and wildlife clearance will be required. The affected forest area is not clear.

6) Malshej Ghat

Malshej Ghat PSP and its alternative locate in Thane District and Pune District. New dams (new Pond for lower dam) are planned. Major land cover around the project site is agricultural land. Scheduled Tribe rates of Thane District and Pune District are 13.95% and 3.70% respectively. The project is in the Scheduled tehsil (4. Murbad tehsil, 18. Junnar tehsil). Huge amount of resettlement and land acquisition is not expected.

EIA report of Malshej Ghat PSP was prepared and Environmental Clarence was issued in 2008.

Kalsubai H WLS are located 5km north from the project area. The project is outside of the known Tiger or Elephant habitat. Forest clearance will be required. The affected forest area is not clear but reportedly 49.4-174 ha of forest land is required from MOEF website.

7) Mukthel

Mukthel PSP locates Ahmadnagar District. New Upper Pond is planned because existing Lake Arther is used for Lower Pond. Major land cover around the project site is agricultural land. Scheduled Tribe rate of Ahmadnagar District is 8.33%. The project is in the Scheduled tehsil (16. Akole tehsil). Information of resettlement or land acquisition is not clear.

EIA report of Mukthel PSP has not been prepared yet. The Upper Pond locates in the Kalsubai H WLS. The project is outside of the known Tiger and Elephant habitat. Forest clearance will be required. The affected forest area is not clear.

8) Ghatghar Stage-II

Ghatghar Stage-II PSP locates Ahmadnagar District and Thane District. New Lower Pond is planned because existing Upper reservoir of Ghatghar HEP is used for Upper Pond. Major land cover around the project site is Agricultural land. Scheduled Tribe rates of Ahmadnagar District and Thane District are 8.33% and 13.95% respectively. Information of resettlement and land acquisition is not clear.

EIA report of Ghatghar Stage-II PSP has not been prepared yet. Upper Pond is planned in the Kalsubai H WLS and 5km from Biodiversity Hotspots. The project locates outside of the known Tiger and Elephant habitat. Forest clearance will be required. The affected forest area is not clear.

9) Chikhaldara

Chikhaldara PSP locates Amravati District. Major land cover around the project site is agricultural land. Scheduled Tribe rate of Amravati District is 13.99%. Huge amount of resettlement and land acquisition is not expected.

EIA report of Chikhaldara PSP has not been prepared yet. The Upper Pond is 0.5km from Melghat WLS, 1.5km from Gugamal NP, 2.9 km from Melghat Tiger Reserve, and 1km from KBA. The project locates in the known Tiger habitat. Forest clearance will be required. The affected forest area is not clear.

10) Atvan

Atvan PSP locates Pune District, Maharashtra State and Raigarh District, Chhattisgarh State. New Lower Pond might be planned and existing Pawna Lake might be used as Upper Pond. Major land cover around the project site is agricultural land and open forest. Scheduled Tribe rate of Pune District and Raigarh District is 3.70% and 27.13% respectively. Resettlement and land acquisition is not clear.

EIA report of Atvan PSP has not been prepared yet. The project site is in KBA, Endemic Bird Area, Biodiversity Hotspots, and 7km from Sudhagarh WLS, ". The project locates outside of the

known Tiger or Elephant habitat. Forest clearance will be required. The affected forest area is not clear.

11) Konya Stage-IV

Konya Stage-IV PSP locates Satara District. A new Upper reservoir is planned because existing Shivajisagar Reservoir is used. Major land cover around the project site is Agricultural land and open forest. Scheduled Tribe rate of Satara District is 0.99%. Resettlement and land acquisition is unclear.

EIA report of Konya Stage-IV PSP has been prepared and EC was granted in 1988. The project is in the Koyna WLS, Western Ghats World Heritage Site, Sahyadri Tiger Reserve, Biodiversity Hotspots, and 3km from KBA. The project locates in the known Tiger habitat. Forest clearance will be required. The affected forest area is not clear.

12) Nive

Nive PSP locates Satara District and Ratnagiri District. A new Pond will be planned and existing Shivajisagar Reservoir might be used. Major land cover around the project site is open forest. Scheduled Tribe rate of Satara District and Ratnagiri District are 0.99% and 1.26% respectively. Information of resettlement and land acquisition is not clear.
EIA report of Nive PSP has not been prepared yet. The project site is in Koyna WLS, Western Ghats World Heritage Site, Sahyadri Tiger Reserve, Endemic Bird Area, and Biodiversity Hotspots. The project locates in the known Tiger habitat. Forest clearance will be required. The affected forest area is not clear.

Table 5.1.1-3 EIA process and Protected area of the projects in Maharashtra State

Name of PSPs	Capacity (MW)	Project stage								EIA process	Domestic					International[16]								Tiger/ Elephant	Scheduled Tribe Rate	MOFA's "Overseas Travel Safety Information"	Remarks
		OP	UC	CEA	DPR	S & I	PFR	PIR	IDE		National Parks	Wildlife Sanctuaries	Conservation Reserves	Community Reserves	Tiger Reserve	Ramsar Site	UNESCO-MAB Biosphere Reserve	World Heritage Site	KBA	Endemic Bird Area	Biodiversity Hotspots	Alliance for Zero Extinction Sites					
1. Warasgaon	1,200				U/P					-										I	I			3.7% and 1.26%	Level 1	
2. Panshet	1,600					O/G				-										I	I			3.7% and 1.26%	Level 1	
3. Varandh Ghat	800					O/G				-										I	I			3.7% and 1.26%	Level 1	
4. Kodali	220							C		-										1.5km	I		Tiger	0.78%	Level 1	
5. Humbarli	400					O/G				-		I			I			I	2km	5km	I		Tiger	0.99%	Level 1	
6. Malshej Ghat	700				C					EC (2008)		4.3km												13.95% and 3.70%	Level 1	Scheduled tehsil
7. Mukthel	110							C		-		I												8.33%	Level 1	Scheduled tehsil
8. Ghatghar Stage-II	125							C		-		I									5km			8.33% and 13.95%	Level 1	
9. Chikhaldara	400							C		-	1.5km	0.5km			2.9km				1km				Tiger	13.99%	Level 1	
10. Atvan	1,200							C		-		7km							I	I	I			3.70%	Level 1	
10. Atvan	1,200							C											I	I				27.13%	Level 1	
11. Konya Stage-IV	400							C		EC (1988)		I			I			I	3km		I		Tiger	0.99%	Level 1	Monitoring reports were submitted.
12. Nive	1,200							C				I			I			I	I	I	I		Tiger	0.99% and 1.26%	Level 1	
13. Nandgaon	500	---	---	---	---	---	---	---	---																	R
15. Ulhas	1,000								○																	R
16. Pinjal	700								○																	R
17. Kengadi	1,550								○																	R
18. Jalong	2,400								○																	R
19. Kolmondapada	800								○																	R
20. Kalu	1,150								○																	R

[16] Locations of KBA, EBA, Biodiversity hotspots, and Alliance for Zero Extinction Sites are referred in IBAT (https://www.ibat-alliance.org)

21. Sidgarh	1,500								○																			R
22. Amba	2,500								○																			R
23. Chornai	2,000								○																			R
24. Savitri	2,250								○																			R
25. Madliwadi (Madhaliwadi)	900								○																			R
26. Baitarni (Vaitarni)	1,800								○																			R
27. Morawadi	2,320								○																			R
28. Gadgadi	600								○																			R
29. Kundi	600								○																			R
30. Aruna	1,950								○																			R
31. Kharari	1,050								○																			R
32. Jalvara (Jalware)	2,000								○																			R
33. Paithan	12	○																										C
34. Ujjani	12	○																										C

I: Inside of the area

5.1.2 Odisha State

(1) Development Needs of Pumped Storage Plant

Both the Energy Department of Government of Odisha and OHPC have the intention to advance PSPs due to the following reasons:

- Securement of peak power;
- Stabilization of the grid against large-volume introduction of renewable energy such as solar and wind powers;
- Following to the central government's policy to increase pumped storage plants.

From financial aspect, the government of Odisha is required to comply with the fiscal management target set by FRBM act, with the following three parameters for 2016-17:

Item	Estimate	Target
- Revenue deficit / GSDP rate:	+0.96 %	0.0 %
- Fiscal deficit / GSDP rate:	-3.79 % (-3.48 %)	-3.50 %
- Total debt stock / GSDP rate	16.96 %	19.58 %

As to the fiscal deficit, two figures are mentioned. Odisha has adopted to participate in UDAY scheme.Assuming that the eligibility of the scheme is confirmed by the Central government,the figure becomes -3.79 %. According to the rule of UDAY scheme, however, debt amount resulting from the scheme is not included in state debt, thus the figure for fiscal management becomes -3.48 %, which falls within the target stipulated in the Report of the 14th Finance Comission. As long as the state keeps an eye on fiscal management, it is considered that there would be a possibility for the state to obtain finance including loans for development of pumped storage projects from a viewpoint of fiscal management of the state, if the state so desires in the future. Generally speaking, there is no specific preference in PSP from a viewpoint of the Finance Department. Energy resource to satisfy the demand is first determined by the Energy Department.

According to the interview made to the Finance Department, they were interested in introducing a Japanese ODA loan under the following conditions:

- terms and conditions for the loan are preferable to the state in comparison with those for the locally available fund;
- technical assistance for the project is also provided.

Their main concern in introducing the finance in foreign currency is the fluctuation of foreign exchange, as well as the annual amount of repayment. They prefer finance in Indian Rupee because it does not accompany any foreign exchange risk.

On the other hand, OHPC has applied a grant from National Clean Energy Fund (NCEF) for development of pumped storage projects. Being a grant fund, OHPC expects much for it, however, NCEF has not extended its fund so far for a large scale hydropower projects including pumped storage scheme. Therefore, it is not clear if it would be realized as expected.

(2) Analysis of PSP possibility from the state power sector status

This chapter analyzes the possibility of PSP development in terms of necessity for adjusting power and available options, power market structure, and capability of executing entities.

1) Necessity for adjusting power and available options

Power supply-demand is largely balanced now. When considering the excess supply capacity of coal-fired power plant which was built up after 2000, there is sufficient capacity to meet with, at least, peak demand in a short term. However there is a possibility of tighter balance of peak supply-demand balance in a mid to long term if new capacity development will lag behind an increase of peak demand.

There is no critical problem in grid operation at the moment since the state holds large excess power generation capacity. However, state's plan to introduce large amount of variable renewable power generation source may increase necessity for peaking power in a future. The state's renewable power generation plan is targeted to introduce 3 GW by FY2022 which is equivalent to almost half of future peak demand (5.3GW in FY2019).

While, in terms of flexibility for balancing electricity supply-demand, the state has some existing and possible options. Of which, expand grid operation to wider area and segregation of feeder line for agriculture and irrigation demand has been in place, thus it cannot expect large addition of such measures. In addition, load shedding of VRE may be regarded as a last resort option, and demand response is uncertain in its effect. These considerations left gas-fired power plant (GPP) as a viable option. GPP has advantages of quick run up/down of operation, lower capital expenditure, and shorter lead time of construction, meanwhile its fuel cost and supply infrastructure, i.e. LNG receiving terminal and pipeline, are the challenges.

It is highly certain that necessity of Odisha state for flexibility mechanism increases in a future. PSP may be one of choices among combination of such mechanisms.

Table 5.1.2-1 Major Pumped Storage Projects in Odisha

Name/location	Progress
Upper Indravati	under preparation of DPR
Upper Kolab	before preparation of DPR
Balimela	before preparation of DPR

source: Interview to OHPC

2) Pro and Con of Single Buyer Model

Odisha state is employing so called "Single Buyer Model". GRIDCO, as a single buyer, is procuring whole generated electricity in the state and resales it to Discom. This model provides two implications for PSP development.

First, no PSP can be developed without concluding PPA (Power Purchase Agreement) with

GRIDCO as there is no other entity in the state who can procure generated electricity. In general, GRIDCO has negative perception to procure high cost electricity as they have a responsibility to supply electricity at cheaper price. And unfortunately, PSP has less cost competitiveness against others under an environment where there is no mechanism to count its power supply-demand adjusting flexibility into monetary value. On the other hand, this model enables PSP developer to clearly identify the negotiation target of power purchaser.

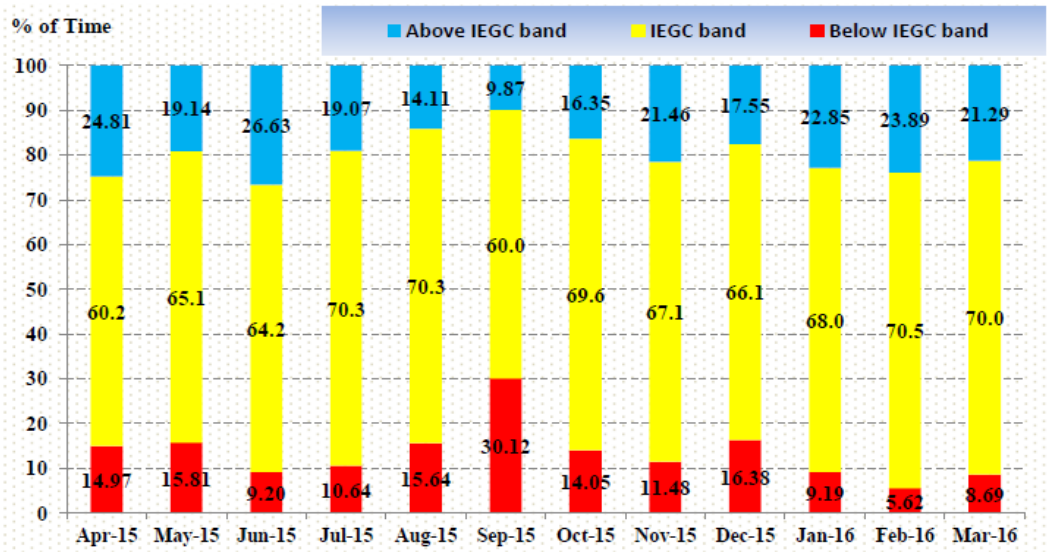
Second, single buyer model has an effect to hide high cost nature of PSP as it function as a cost pool to levelize various power sources. Although electricity cost of PSP is higher than others when compare one by one, its cost becomes marginal when look into total electricity procurement cost. In addition, no Discom and people may accuse cost of PSP because it hides itself behind total cost.

As such, compare to other states where generating company and distribution company are directly transacting electricity, the state can enjoy the benefit of single buyer model; easy and clear identification of negotiation target and obscure high cost nature of PSPS.

3) From Quantity to Quality of Electricity Supply

Frequency control range has set to become 49.9Hz – 50.05 Hz in February 2014 (The Indian Electricity Grid Code: IEGC). Frequency profile of Eastern Region, where Odisha state belongs in, shows that only about 70% of time is within the range. It exceeds 50.05 Hz mostly from winter to spring and it falls below 49.9 Hz mostly in September.

Until recently, majority of power demand came from household and agricultural load, while the most industries were prepared to supply themselves by captive power. Therefore, there were less requirements for a quality of electricity, i.e. stable voltage and frequency. However in a future, necessity for higher quality electricity may increase in accordance with increasing direct investment of foreign capital including Japan under the Make in India policy. Such environment will support developing PSPs which can work as a stabilizing measure of grid.



source: Eastern Regional Load Dispatch Center, Annual Grid Report 2015-16

Figure 5.1.2-1 Frequency Profile of Eastern Region in 2015-16

(3) Pumped Storage Projects planned in Odisha state

In Odisha state, the following four (4) PSPs were found:

Table 5.1.2-2 Pumped Storage Projects planned in Odisha State

Name of PSPs	Capacity (MW)	Remarks
1. Upper Indravati	600	PFR was completed in 2012. DPR is under preparation.
2. Upper Kolab	320	PFRs were been completed in 2012, but no action for preparation of DPR has been taken.
3. Balimela	400	
4. Jharlama	2,500	Possible to be located outside Odisha, so no action for development is taken by OHPC

The above PSPs are outlined below, and more detailed information is shown in Appendix 5-13.

1) Upper Indravati PSP

Upper Indravati PSP is proposed to utilize the existing Upper Indravati reservoir as upper reservoir, and its lower reservoir is planned to be newly constructed at the west of the existing switchyard for Upper Indravati conventional hydropower plant. Its PFR was prepared in September 2012 by THDC together with those for Upper Kolab and Balimela PSPs[17]. Among three PSPs, OHPC regards this PSP as the most feasible. Consequently, OHPC ordered WAPCOS to prepare its DPR, and the DPR is under preparation now. OHPC expects WAPCOS to complete the DPR by December 2016 and hopes to commence the construction in 2017 for targeting commencement of operation by 2022. On the other hand, WAPCOS considers it quite difficult to

[17] Pre-Feasibility Study for Pumped Storage Scheme in Upper Indrāvati Hydro Electric Project, ODISHA (600 MW), September 2012

realize the above OHPC's program judging from the current progress of survey and investigation for the DPR.

2) Upper Kolab PSP

Upper Kolab PSP is planned to utilize the existing Upper Kolab reservoir and Satiguda pond as upper and lower reservoirs respectively. Its PFR was completed in September 2012 by THDC[18], but any action hasn't been taken for preparation of the DPR because OHPC regards that feasibility of this PSP is inferior to that of Upper Indravati PSP.

3) Balimela PSP

Balimela PSP is planned to utilize the existing Balimela reservoir as upper reservoir and to newly construct lower reservoir. Its PFR was completed in September 2012 by THDC[19], but any action hasn't been taken for preparation of the DPR because OHPC regards that feasibility of this PSP is inferior to that of Upper Indravati PSP.

4) Jharlama PSP

Jharlama PSP is found in the project list named as "PSH Sites identified by CEA" which is annexed to the base paper for workshop titled "Pumped Storage Development and Integration with Renewable Energy" held on 27th October 2015[20]. However, OHPC hasn't taken any action for the development. In addition, some officers said that the project site may be outside Odisha state.

(4) Social and Natural Environmental Aspects of Pumped Storage Projects planned in Odisha

There is no project which got EC in the four planned PSP in Odisha State. Jharlama PSP locates in the Sunabeda Wildlife Sanctuary.

1) Upper Indravati

Upper Indravati PSP locates Kalahandi District. New Lower Pond is planned and existing Indravati Dam is used for upper pond. Major land cover around the project site is Agricultural land and open forest. Scheduled Tribe rate of Kalahandi District is 28.50 %. According to Final Report on Pre-Feasibility Study for Pumped Storage Scheme in Upper Indrāvati Hydro Electric Project, ODISHA (600 MW) (2012, OHPCL) the proposed reservoir will lead to submergence of about 80 Ha. of land. Total land required for the construction of various components is about 85 Ha. In which the land acquisition shall be about 25 hectare. No resettlement except one temple is estimated by CONCEPTUAL LAYOUT DEVELOPMENT (WAPCOS, 2014).

[18] Pre-Feasibility Study for Pumped Storage Scheme in Upper Kolab Hydro Electric Project, ODISHA (320 MW), September 2012

[19] Pre-Feasibility Study for Pumped Storage Scheme in Balimela Hydro Electric Project, ODISHA (400 MW), September 2012

[20] Central Board of Irrigation & Power, Base Paper for Workshop titled as "Pumped Storage Development and Integration with Renewable Energy", p9, 27th October, 2015

EIA report of Upper Indravati PSP has not been prepared yet. There is no protected areas in and around the project site. The project locates outside of the known habitat of Elephant. Forest clearance will be required. The affected forest area is not clear.

The project is Level 2 (Avoid Non-essential travel) of the MOFA's "Overseas Travel Safety Information".

2) Upper Kolab

Upper Kolab PSP locates Koraput District. No new reservoir is planned and existing Kolab dam and irrigation reservoir are used. Major land cover around the project site is open forest and agricultural land. Scheduled Tribe rate of Koraput District is 56.56 %. Based on the "Final Report on Pre-Feasibility Study for Pumped Storage Scheme in Upper Kolab Hydro Electric Project ODISHA (320 MW)" (OHPCL, 2012) several houses might be resettled near the intake and outlet. Total land required for the construction of various components is about 65.00 Ha.

EIA report of Upper Kolab PSP has not been prepared yet. No protected forest will be affected. But some reserved forest might be affected around intake, outlet and surge tank. The project locates outside of the known Tiger or Elephant habitat. Forest clearance is required for Reserved Forest. The affected forest area is not clear.

The project is Level 2 (Avoid Non-essential travel) of the MOFA's "Overseas Travel Safety Information".

3) Balimela

Balimela PSP locates Malkangiri District. New lower pond is planned and existing Balimela dam is used for upper pond. Major land cover around the project site is Broadleaf Deciduous Forest and agricultural land. Scheduled Tribe rate of Malkangiri District is 57.83 %. Based on the Final Report on Pre-Feasibility Study for Pumped Storage Scheme in Balimela Hydro Electric Project, ODISHA (400 MW) (OHPC, 2012) the proposed reservoir will lead to submergence of about 50 Ha. of land. Total land required for the construction of various components is about 103 Ha.

EIA report of Balimela PSP has not been prepared yet. Any protected areas are confirmed in and around the project site. The project locates outside of the known Tiger or Elephant habitat. Forest clearance will be required. The affected forest area is not clear.

The project site is in the relatively high security risk area. The project is Level 2 (Avoid Non-essential travel) of the MOFA's "Overseas Travel Safety Information".

4) Jharlama

Jharlama PSP locates Nuapada District. The project layout is not clear. Major land cover around the project site is Broadleaf Deciduous Forest. Scheduled Tribe rate of Nuapada District is 33.80 %.

EIA report of Jharlama PSP has not been prepared yet. The project site is in Sunabeda WLS and

KBA. The project locates in the known Tiger habitat. Forest clearance will be required. The affected forest area is not clear.

The project site is in the relatively high security risk area. The project is Level 2 (Avoid Non-essential travel) of the MOFA's "Overseas Travel Safety Information".

Table 5.1.2-3 EIA process and Protected area of the projects in Odisha State

Name of PSPs	Capacity (MW)	Project stage								EIA process	Domestic					International[21]							Tiger/ Elephant	Scheduled Tribe Rate	MOFA's "Overseas Travel Safety Information"	Remarks
		OP	UC	CEA	DPR	S & I	PFR	PIR	IDE		National Parks	Wildlife Sanctuaries	Conservation Reserves	Community Reserves	Tiger Reserve	Ramsar Site	UNESCO-MAB Biosphere Reserve	World Heritage Site	KBA	Endemic Bird Area	Biodiversity Hotspots	Alliance for Zero Extinction Sites				
1. Upper Indravati	600				U/P					-													-	28.50%	Level 2	
2. Upper Kolab	320						C			-													-	56.56%	Level 2	
3. Balimela	400						C			-													-	57.83%	Level 2	Forest 103 ha
4. Jharlama	2,500								○	-		I							I				Tiger	33.80%	Level 2	Unknown

[21] Locations of KBA, EBA, Biodiversity hotspots, and Alliance for Zero Extinction Sites are referred in IBAT (https://www.ibat-alliance.org)

5.1.3 Telangana State

(1) Development Needs of Pumped Storage Plant

TSGENCO hopes to develop more PSPs in addition to Srisailam Left Bank PSP (900 MW) which is in operation and Nagrjuna Sagar PSP (705.6 MW) which will be operated as PSP in the near future after the completion of the lower reservoir because of stabilization of the grid when fluctuating electricity produced by solar and wind power generation is largely developed. However, TSGENCO has no PSP at present.

From the financial aspect, the government of Telangana is required to comply with the fiscal management target set by FRBM act, with the following three parameters for 2016-17:

Item	Estimate	Target
- Revenue deficit / GSDP rate:	+0.55 %	0.0 %
- Fiscal deficit / GSDP rate:	-3.50 %	-3.50 %
- Total debt stock / GSDP rate	18.46 %	22.23 %

The state has accomplished all the targets mentioned in the Report on 14th Finance Commission. It should be noted, however, that the amount of total debt stock has been increasing. The state was entitled for 0.5 % headroom over and above the fiscal deficit – GSDP target of 3 %, implying the fiscal deficit-GSDP limit of 3.5 % from 2016-17. This would bring additional Rs 2,500 crore in loans, but the state is heavily dependent on loans to fund its various flagship programs in social sector development.

As long as the state keeps an eye on fiscal management, it is considered that there would be a possibility for the state to obtain finance including loans for development of pumped storage projects from a viewpoint of fiscal management of the state, if the state so desires. Generally speaking, there is no specific preference in PSP from a viewpoint of the Finance Department. Energy resource to satisfy the demand is first determined by the Energy Department.

(2) Analysis of PSP possibility from the state power sector status

This chapter analyzes the possibility of PSP development in terms of necessity for adjusting power and available options, power market structure, and capability of executing entities.

1) Necessity for adjusting power and available options

Although the severe situation continues for the time being, the Telangana state is expected to improve the electricity supply and demand by FY2018 thanks to the increase of the power generation capacity. Notably, the state is planning to increase renewable power source, in particular solar PV.

As the demand for farming accounts for large part, the state has been coping by adjusting supply time to balance the supply and demand. In addition, the state introduces a TOD pricing to

promote off peak demand, and to equalize load. The state has already utilized pumped storage power generation (PSPs) effectively, the first plant has been in operation, and the second plant is expected to be commissioned as PSP soon. There is no further plans to develop the PSPs at the moment.

In addition, legal procedures for developing hydro power do not become clear because Telangana state is the new state which is divided from Andhra Pradesh very recently. Because the border of state is dotted a lot with candidate sites, the state is negative against the development of a new PSP project in the state.

It is thought that the development of the new PSP project in the state is difficult when considering these situations.

(3) Pumped Storage Projects planned in Telangana State

As mentioned above, except for Srisailam Left Bank and Nagrjuna Sagar PSPs, no PSP is planned in Telangana in the future because of non-availability of potential sites for developing PSPs. In the case of the Godavari Basin, sufficient head for PSP is not available in spite of abundant water. More information on Srisailam Left Bank and Nagrjuna Sagar PSPs is shown in Appendix 5-18.

By the way, concerning Inchampalli PSP, this project was planned much earlier than other projects such as Srisailam Left Bank and Nagarjuna Sagar PSP. However, the reservoir surface was anticipated to influence four states, namely Telangana, Andhra Pradesh, Maharashtra and Chhattisgarh. Consequently, this project was not taken up further due to unsolved inter-state issues.

By the way, during discussions with TSGENCO, TSGENCO asked JICA Study Team whether suitable technology for PSP with large amount of flow and low head for dams constructed in a staircase pattern is available or not. The reason of the inquiry is that lots of such sites exist in the state to transfer of water for drinking water and irrigation water supplies, which is called as “Lift Irrigation Schemes”. Total power requirement only for operation of all the schemes is estimated to be about 6,000 to 8,000 MW. In order to supply the required power, the state is requested to add another capacity of about 5,800 MW in next five years. Also, power from the solar power plants will be utilized for the schemes. Whenever power output is less from solar power plants, the schemes will be stopped operating subsequently. To prevent the schemes from stopping, TSGENCO has an idea to equip pumped storage plants at such dams to store off-peak power.

(4) Social and Natural Environmental Aspects of Pumped Storage Projects planned in Telangana State

None of the planned PSP projects in Telangana get Environmental Clearance. Srisailam Left Bank and Nagarjuna Sagar under operation and construction might be in the Nagarjunasagar National Park.

1) Inchampalli

Inchampalli PSP locates boundary of Karimnagar District, Telangana State and Bijapur District, Chhattisgarh state. Project information is not clear (maybe abandoned). Major land cover around the project site is Broadleaf Deciduous Forest and Agricultural land. Scheduled Tribe rate of Karimnagar District and Bijapur District are 2.83% and 47.7% respectively. Information of resettlement and land acquisition is not clear.

EIA report of Inchampalli PSP was not prepared. Project site is 7km from the Eturnagaram Sanctuary. The project locates in the known Tiger habitat. Forest clearance will be required. The affected forest area is not clear.

The project is Level 2 (Avoid Non-essential travel) of the MOFA's "Overseas Travel Safety Information".

2) Nagarjuna Sagar

Nagarjuna Sagar PSP locates Nalgonda District of Telangana State and Guntur District of Andhra Pradesh State and reportedly is under construction to commence operation. Major land cover around the project site is Agricultural area. Scheduled Tribe rate of Nalgonda District and Guntur District are 11.30% and 5.06% respectively. Information of resettlement and land acquisition is not clear.

The project site is in the Nagarjunasagar National Park and KBA. The project locates in the known Tiger habitat. The affected forest area is not clear.

Table 5.1.3-1 EIA process and Protected area of the projects in Telangana State

Name of PSPs	Capacity (MW)	Project stage								EIA process	Domestic					International[22]							Tiger/ Elephant	Scheduled Tribe Rate	MOFA's "Overseas Travel Safety Information"	Remarks
		OP	UC	CEA	DPR	S & I	PFR	PIR	IDE		National Parks	Wildlife Sanctuaries	Conservation Reserves	Community Reserves	Tiger Reserve	Ramsar Site	UNESCO-MAB Biosphere Reserve	World Heritage Site	KBA	Endemic Bird Area	Biodiversity Hotspots	Alliance for Zero Extinction Sites				
1. Inchampalli	975	---	---	---	---	---	---	---	---	-		7km											Tiger	2.83% and 47.70%	Level 2	
2. Nagarjuna Sagar	706		○							-	I								I				Tiger	11.30% and 5.06%	Level 1	

[22] Locations of KBA, EBA, Biodiversity hotspots, and Alliance for Zero Extinction Sites are referred in IBAT (https://www.ibat-alliance.org)

5.1.4 Karnataka State

(1) Development Needs of Pumped Storage Plant

Both Energy Department of Government of Karnataka and KPCL have a plan to develop 1,000 MW in total by 2022 in accordance with the report titled as "Wind and Solar Energy for meeting Karnataka's Future Electricity Demand" by National Institute of Advance Studies in March, 2015[23]. The reason to develop PSPs is;

- Stabilization of the grid against large-scale installation of renewable energy such as solar and wind power generations;
- Securement of peak power.

From the financial aspect, the government of Karnataka is required to comply with the fiscal management target set by FRBM act, with the following three parameters for 2016-17:

Item	Estimate	Target
- Revenue deficit / GSDP rate:	+0.1 %	0.0 %
- Fiscal deficit / GSDP rate:	-2.12 %	-3.00 %
- Total debt stock / GSDP rate	17.22 %	24.8 %

The state has achieved all the figures mentioned in the Report on 14th Finance Commission. Therefore, as long as the state keeps an eye on fiscal management, it is considered that there would be a possibility for the state to obtain finance including loans for development of pumped storage projects from a viewpoint of fiscal management of the state, if the state so desires. Generally speaking, there is no specific preference in PSP from a viewpoint of the Finance Department. Energy resource to satisfy the demand is first determined by the Energy Department.

According to the interview made to the Finance Department, priority is given to the agricultural sector by extending expenditure for irrigation and subsidies. Finance for a project with a huge amount inevitably leads to decrease in expenditure for agriculture, therefore, political decision shall be required. According to their opinion, basically the projects should be implemented with finance from local financing agencies by power companies. Actually the amount for foreign finance has reached to the ceiling, however, they are in an opinion that the ceiling is only for an operational rule.

(2) Analysis of PSP possibility from the state power sector status

This chapter analyzes the possibility of PSP development in terms of necessity for adjusting power and available options, power market structure, and capability of executing entities.

[23] National Institute Advanced Studies, Wind and Solar Energy for Meeting Karnataka's Future Electricity Demand, March 2015

1) Necessity for adjusting power and available options

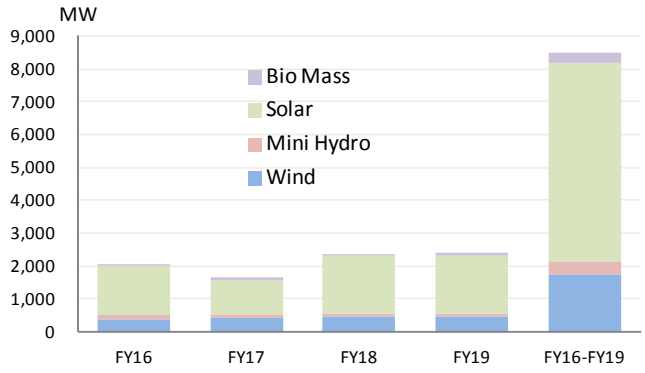
Large increase of electric energy and peak demand seems to continue from FY2014 to FY 2019 at an annual average growth rate of 8.8% and 10.1% respectively. Although the supply-demand balance turns in the net surplus position in FY2016 and later, power supply availability largely depends on the weather as hydro power capacity share one fifth to a quarter of the total capacity in the state. In addition, large increase in renewable energy, mainly solar PV, is anticipated.

The state has been separating the feeder line of the demand for agriculture and limit the supply time for it which aims at equalize the load in the state. The separation of the feeder line is completing approximately 85%, and remaining 15% will be completed in March, 2018. In addition, the state obligates industrial consumers to apply TOD pricing.

The state positively works on a pumped storage power generation (PSP) projects to strengthen the stability of the system in the state. Among three candidate projects, priority assessment is made by considering various factors such as existence of upper and lower reservoir and private land. Of which, the state is considering to tender the DPR preparation for two projects.

Besides, the threshold to receive support as a renewable energy ha excluded less than 25 MW in case of hydro power generation, which has been discouraging the development of large hydro power plant that has a capacity more than 25 MW. Therefore, the federal MNRE is going to re-categorize the definition of renewable energy to include the hydraulic power generation of more than 25MW to promote its development. [24] It is hoped that such an action greatly contributes to reduce GHG emission.

It is assumed that the needs of the PSP development is high with taking the situation mentioned above into consideration.



sources: Karnataka Power for all

Figure 5.1.4-1 RE Generation Capacity Addition Prospect

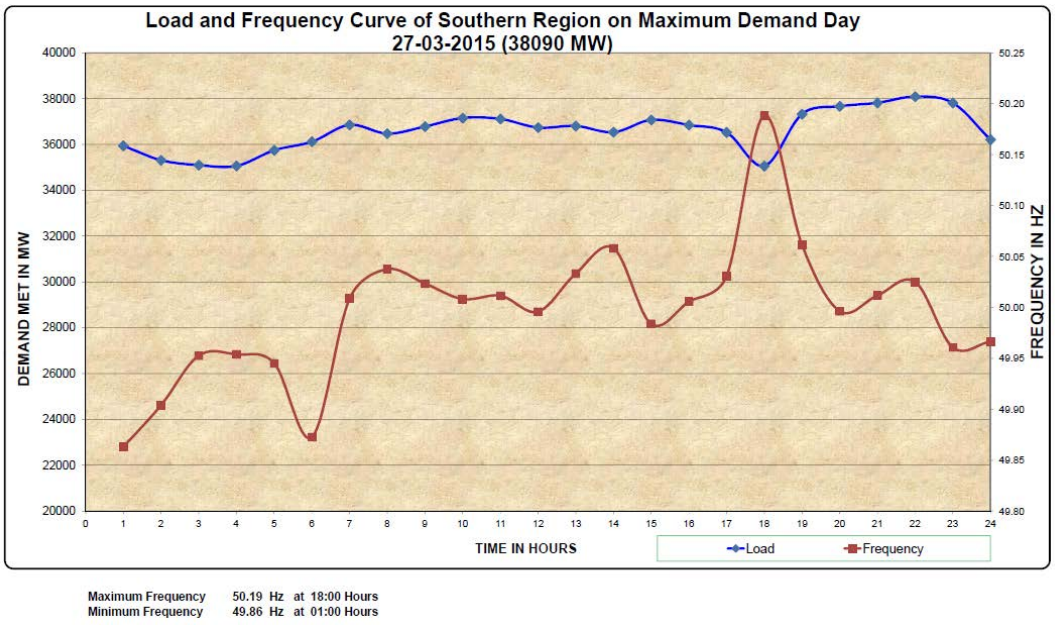
[24] The Economics Times; 2016.9.14

Table 5.1.4-1 Major Pumped Storgage Projects in Karnataka

Priority	Location	Capacity (tentative)	Stage
1st	Sharavathy	450, 800, 900, 1,000 MW	DPRs tender under preparation
2nd	Varahi	700 (250, 600, 1,000) MW	DPRs tender under preparation
3rd	Kali	600, 1,000 MW	PFR completed

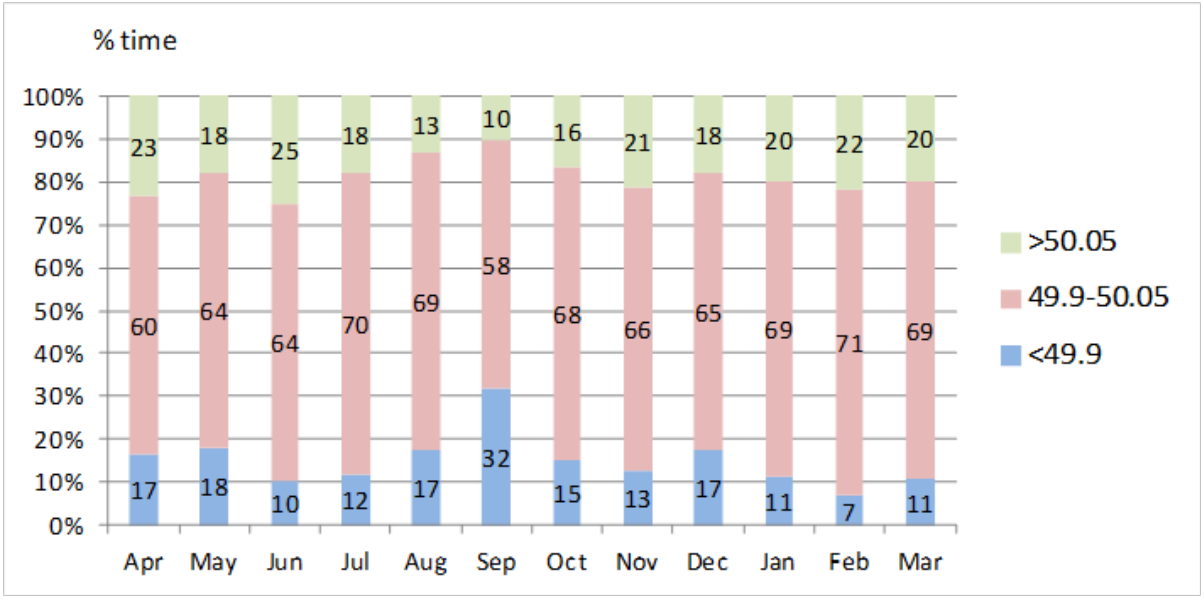
2) From Quantity to Quality of Electricity Supply

Frequency profile of Southern Region, where Karnataka state belongs, is frequently go out of control range (49.9 – 50.05 Hz). Until recently, majority of power demand came from household and agricultural load, while the most industries were prepared to supply themselves by captive power. Therefore, there were less requirement for a quality of electricity, i.e. stable voltage and frequency. However in a future, necessity for higher quality electricity may increase in accordance with increasing direct investment of foreign capital including Japan under the Make in India policy. Such environment will support developing PSP which can work as a stabilizing measure of grid.



source: Southern Regional Power Committee Annual Report in 2014-15

Figure 5.1.4-2 Load Curve and Frequency Curve of Southern Region on Maximum day in 2014-15



source: Southern Regional Load Dispatch Centre Quarterly Report

Figure 5.1.4-3 Frequency of Southern Region in 2015-16

(3) Pumped Storage Projects planned in Karnataka

In Karnataka state, the following seven (7) PSPs were found:

Table 5.1.4-2 Pumped Storage Projects planned in Karnataka State

Name of PSPs	Capacity (MW)	Remarks
1. Sharavathy	450 (800, 900)	1st priority in Karnataka
2. Varahi	700	2nd priority in Karnataka
3. Kali	1,000 (600)	3rd priority in Karnataka
4. Kollur	900	These four (4) PSPs are regarded as impracticable because all the sites are located in Western Ghat region.
5. Minhole	2,200	
6. Sitanadi	2,600	
7. Hulagi	2,200	

The above PSPs are outlined below, and more detailed information is shown in Appendix 5-19.

1) Sharavathy PSP

Sharavathy PSP is ranked as the first priority in the development of PSPs in Karnataka state. This PSP is planned to utilize the existing Talakalale and Gerusoppa reservoirs as upper and lower reservoirs respectively, so that it is unnecessary to newly construct any reservoir. Consequently, KPCL regards that this PSP has the least obstacles for development among three PSPs identified by KPCL. Its PFR was completed in 2008, and its installed capacity was estimated as 900 MW

for 6 hours in the PFR[25]. However, other development plans are also found in this survey. According to KPCL's presentation in January 2016, the installed capacity is estimated as 800 MW for 6 hours generation[26]. On the other hand, according to minutes of the meeting on PSP held by CEA on 20th June, 2016, the installed capacity is recorded as 450 MW even though duration of peak generation is unclear[27]. According to KPCL, it will be clarified in the DPR stage which development plan is the most suitable. KPCL intends to release the tender notice for preparation of the DPR for this PSP in the near future. For development of the PSP, land of 50 acre is newly required to be obtained. The project site seems to be outside any reserved forest and wildlife sanctuary judging from Appendix 5-24. So, it is foreseen that acquisition of the land doesn't becomes an issue.

2) Varahi PSP

Varahi PSP is ranked as the second priority in the development of PSPs in Karnataka state. This PSP is planned to utilize the existing Varahi pickup reservoir as upper reservoir, and its lower reservoir is planned to be newly constructed at the downstream of the tailrace outlet of the existing Varahi conventional hydropower station. Its installed capacity is currently set as 700 MW for 7 hours generation even though development plans in the cases of 250 MW, 600 MW, 1,000 MW are also studied[28].

Land of about 205 acre including 150 acre for the new lower reservoir is newly required to be obtained. According to KPCL, small villages exist in the project site, so that resettlement will be required. However, KPCL foresees that the resettlement may not be a major constraint for development of this PSP. On the other hand, according to information by National Remote Sensing Centre, the project site seems to exist in Someshwara Wildlife Sanctuary[29], so that acquisition of environmental clearance may be obstacle to the development even though this issue wasn't explained by KPCL in the interview.

Approach roads to both the upper reservoir and newly-constructed lower dam already exist. In addition, other infrastructures such as storage yard, site camp, etc., exist in KPCL's land because of the existence of the conventional hydropower plant. The existing transmission line can be utilized by means of upgrading the facility. PFR for this PSP seems to have been completed even though the PFR hasn't been provided for JICA Study Team. KPCL intends to release tender notice for preparation of DPR for this PSP in the near future together with Sharavathy PSP.

3) Kali PSP

According to KPCL, Kali PSP is ranked in the 3rd priority due to environmental issues. Two alternative layouts have been studied by KPCL[30]. 1st alternative layout is found in the

[25] KPCL, Pre-Feasibility Report on Sharavathy Pumped Storage Scheme
[26] KPCL, Potential for installing Pumped Storage Schemes in Karnataka
[27] Minutes of CEA's Meeting on PSPs held on 20th June, 2016
[28] KPCL, Outline of Varahi PSP
[29] JICA Study Team, Distribution of Wildlife Sanctuary around Varahi PSP
[30] Proposed Layouts for Kali PSPs

pre-feasibility study done in 2008, and its installed capacity is estimated as 600 MW[31]. In this layout, the existing Kadra reservoir is utilized as lower reservoir, and its upper reservoir is planned to be newly constructed. Newly necessary land is estimated to be approximately 600 acres including 551 acres for the new upper reservoir which totally exists in Kali Reserved Forest, so that KPCL seems to consider this layout as impracticable. On the other hand, 2nd alternative layout is planned to utilize the existing Bommanahalli and Kodasalli reservoirs as upper and lower reservoirs respectively. Its installed capacity is estimated as 1,000 MW, but length of the water conductor system is expected to get much longer than the 1st alternative layout. Considering the above aspects, Kali PSP is lowly prioritized over Sharavathy and Varahi PSPs.

4) Four (4) PSPs identified by CEA

Other four (4) PSPs, namely Kollur, Minhole, Sitanadi and Hulagi PSPs are found in the project list named as "PSH Sites identified by CEA" which is annexed to the base paper for workshop titled as "Pumped Storage Development and Integration with Renewable Energy" held on 27th October 2015[32]. According to KPCL, all the PSPs need new construction of both upper and lower reservoirs, and the reservoirs are planned in the ecologically sensitive zone of Western Ghats. Therefore, KPCL considers all the PSPs to be impracticable because of difficulty in obtaining forest and environmental clearances for construction of both lower and upper reservoirs.

(4) Social and Natural Environmental Aspects of Pumped Storage Projects planned in Karnataka

No project out of seven planned PSP in Karnataka State gets Environmental Clearance. Sharavathy, Kali and Kollur are in the Protected areas.

1) Sharavathy

Sharavathy PSP locates Shimoga District. No new Lower Pond is planned and existing Talakalale reservoir is used for upper pond and Gerusoppa reservoir is used for lower pond. Major land cover around the project site is Mixed Forest and Needleleaf Evergreen Forest. Scheduled Tribe rate of Shimoga District is 3.73 %. Information of resettlement and land acquisition is not clear.

EIA report of Sharavathy PSP has not been prepared yet. The project site is in Sharavathi Valley Sanctuary, Endemic Bird Area, Biodiversity Hotspots, and 5km from KBA. The project locates in the known Elephant and Tiger habitat. Forest clearance will be required. The affected forest area is not clear.

2) Varahi

Varahi PSP locates Udupi District and Shimoga District. New lower pond is planned and existing Varahi reservoir is used for upper pond. Major land cover around the project site is mixed forest.

[31] KPCL, Pre-Feasibility Report on Kali Pumped Storage Scheme

[32] Central Board of Irrigation & Power, Base Paper for Workshop titled as "Pumped Storage Development and Integration with Renewable Energy", p9, 27th October, 2015

Scheduled Tribe rate of Udupi District is 4.49 %. Information of resettlement and land acquisition is not clear.

EIA report of Varahi PSP has not been prepared yet. The project site is in Biodiversity Hotspots, and 10 km from the Mookambika Sanctuary and Western Ghats World Heritage Site. The project locates 2.3km from the known Tiger habitat. Forest clearance will be required. The affected forest area is not clear.

3) Kali

Kali PSP locates Uttara Kannada District. One option is, New upper pond is planned and existing Kadra reservoir is used for lower pond. The other option is to build both Upper and Lower new reservoirs. Major land cover around the project site is Broadleaf Deciduous Forest. Scheduled Tribe rate of Uttara Kannada District is 2.38%. Information of resettlement and land acquisition is not clear.

EIA report of Kali PSP has not been prepared yet. Upper Pond is in the Dandeli Sanctuary, Dandeli-Anshi Tiger Reserve, KBA, Biodiversity Hotspots, and 5km from Endemic Bird Area. The project locates in the known Tiger and Elephant habitat. Forest clearance will be required. The affected forest area is not clear.

4) Kollur

Kollur PSP locates Udupi District. The layout is unclear. Major land cover around the project site is Broadleaf Evergreen Forest. Scheduled Tribe rate of Udupi District is 4.49%. Information of resettlement and land acquisition is not clear.

EIA report of Kollur PSP has not been prepared yet. The project site might be in the Mookambika WLS, Biodiversity Hotspots, 5km from KBA, and 4km from Endemic Bird Area. The project locates outside of the known Tiger and Elephant habitat. Forest clearance will be required. The affected forest area is not clear.

5) Minhole

Location is not clear.

6) Sitanadi

Location is not clear.

7) Hulagi

Location is not clear.

Table 5.1.4-3 EIA process and Protected area of the projects in Karnataka State

Name of PSPs	Capacity (MW)	Project stage								EIA process	Domestic					International[33]							Tiger/ Elephant	Scheduled Tribe Rate	MOFA's "Overseas Travel Safety Information"	Remarks
		OP	UC	CEA	DPR	S & I	PFR	PIR	IDE		National Parks	Wildlife Sanctuaries	Conservation Reserves	Community Reserves	Tiger Reserve	Ramsar Site	UNESCO-MAB Biosphere Reserve	World Heritage Site	KBA	Endemic Bird Area	Biodiversity Hotspots	Alliance for Zero Extinction Sites				
1. Sharavathy	1,000						U/P-C			-		I							5km	I	I		Elephant and Tiger	3.73%	Level 1	
2. Varahi	700						U/P-C			-		10km						10km		I	I		2.3km from the known Tiger habitat	4.49%	Level 1	
3. Kali	1,000 (600)						U/P-C			-		I			I				I	5km	I		Tiger and Elephant	2.38%	Level 1	
4. Kollur	900								○	-		I							5km	4km	I			4.49%	Level 1	
5. Minhole	2,200								○																	Location Unknown
6. Sitanadi	2,600								○																	Location Unknown
7. Hulagi	2,200								○																	Location Unknown

[33] Locations of KBA, EBA, Biodiversity hotspots, and Alliance for Zero Extinction Sites are referred in IBAT (https://www.ibat-alliance.org)

5.1.5 Kerala State

(1) Development Needs of Pumped Storage Plant

Both Power Department of Government of Kerala and KSEB think PSPs necessary in Kerala for the following reasons:

- Securement of peak power;
- Storage of excess energy in off peak hours.

From the financial aspect, the government of Kerala is required to comply with the fiscal management target set by FRBM act, with the following three parameters for 2016-17:

Item	Estimate	Target
- Revenue deficit / GSDP rate:	+1.98 %	0.0 %
- Fiscal deficit / GSDP rate:	-3.51 %	-3.00 %
- Total debt stock / GSDP rate	26.82 %	30.84 %

The state has failed to achieve the target for fiscal deficit mentioned in the Report on 14th Finance Commission. Especially the most important parameter of Fiscal deficit / GSDP of 3.51 % is still higher than the target of 3.0 %. It is considered that there would be some difficulty for the state to obtain finance including loans for development of pumped storage projects from a viewpoint of fiscal management of the state. Generally speaking, there is no specific preference in PSP from a viewpoint of the Finance Department. Energy resource to satisfy the demand is first determined by the Power Department.

According to the interview made to the Finance Department, generally speaking, they were interested in introducing a Japanese ODA loan for power project. Their main concern in introducing the foreign finance is as follows:

- terms and conditions for the loan in comparison with those for the locally available fund;
- fluctuation of foreign exchange.

(2) Analysis of PSP possibility from the state power sector status

This chapter analyzes the possibility of PSP development in terms of necessity for adjusting power and available options, power market structure, and capability of executing entities.

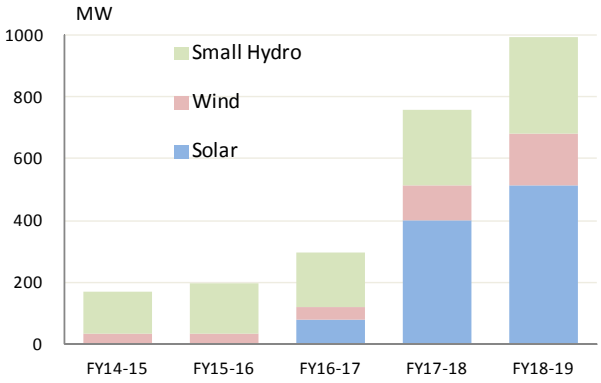
1) Necessity for adjusting power and available options

In Kerala state, large increase of electric energy and peak demand seems to continue from FY2014 to FY 2019 at an annual average growth rate of 7.2% and 6.1% respectively. Although the supply-demand balance turns in the net surplus position in FY2016 and later, the most of power supply availability depends on the weather as hydro power capacity share a half of the total capacity in the state. In addition, large increase in renewable energy, mainly solar, is anticipated.

The state has been adjusting supply–demand balance by hydraulic power generation that account for most of the generation in the state. The state is planning to utilize gas power generations and pumped storage power generations (PSPs) in the future for this sake. The state has already introduced TOD pricing for the industrial consumers and planning to extend its application to high-tension voltage consumers.

The state has worked on PSP projects to strengthen the stability of the system in the state. There are some two candidate projects and both are in the investigation stage (KSEBL nominated many sites, 2 projects are selected as leading ones).

Above mentioned the conditions indicate that the state can manage the grid stability by existing hydraulic power generation for the time being. Development of PSP may take time as it is still in the investigation stage.



source : Kelara Power for All

Figure 5.1.5-1 RE Capacity Prospect

Table 5.1.5-1 Major Pumped Storgage Projects in Kerala

Priority	Location	Capacity	Stage
1st	Idukki	300 MW	Under Investigation
2nd	Pallivasal	600 MW	Under Investigation

(3) Pumped Storage Projects planned in Kerala

In Kerala state, the following PSPs were found:

Table 5.1.5-2 Pumped Storage Projects planned in Kerala State

Name of PSPs	Capacity (MW)	Remarks
1. Sholayar-I	810	The PSP was cancelled due to unavailability of forest clearance.
2. Sholayar-II	390	
3. Pringalkuthu	80	
4. Kuttiyadi	2,400	KSEB has no intention to advance the PSP because the site exists in reserved forest.
5. Idamalyar	2,200	
6. Idduki	300	PFR is under preparation. There are some options to utilize the existing Idukki reservoirs for PSP.
7. Pallivasal	600	Just identified. Investigation is under way. Although both reservoirs are required to be newly constructed, the both sites seem to be at the outside of reserved forest and wildlife sanctuary.
8. Kakki/ Upper Moozhiyar as upper reservoir and Moozhiyar Reservoir as lower	375	KSEB is currently surveying and studying this PSP, and no action for preparation of the PFR has been taken.
9. Idukki as upper reservoir and Malankara as lower	1,100	Ditto, There are some options to utilize the existing Idukki reservoirs for PSP.
10. Idukki as upper reservoir and Marmala	450	Ditto, There are some options to utilize the existing Idukki reservoirs for PSP.
11. Ponmudi as upper reservoir and Kallarkutty as lower	250	Ditto
12. Sengulam and Kallarkutty reservoirs	200	Ditto
13. Kallarkutty and Lower Periyar reservoirs	200	Ditto
14. Peringalkuth and Idamalayar reservoirs	350	Ditto
15. Sholayar and Idamalayar reservoirs	900	Ditto
16. Kakkayam and Peruvannamoozhi reservoirs	900	Ditto
17. Pazhassi sagar	200	Ditto

The above PSPs are outlined below, and more detailed information is shown in Appendix 5-30.

1) Sholayar-I, Sholayar-II and Peringalkuthu PSPs

These PSPs were identified by the state government. However, according to CEA's presentation titled as "Indian Scenario of Pumped Storage Hydro Development" in the workshop on PSPs held on 27th October 2015, it was explained that these PSPs couldn't be taken up due to impossibility to obtain Forest Clearance[34].

[34] CEA, Indian Scenario of Pumped Storage Hydro Development, 27th October 2015

2) Kuttiyadi and Idamalyar PSPs

Kuttiyadi and Idamalyar PSPs are found in the project list named as "PSH Sites identified by CEA" which is annexed to the base paper for workshop titled as "Pumped Storage Development and Integration with Renewable Energy" held on 27th October 2015[35]. However, KSEB has no intention to develop these PSPs because of difficulty to newly acquire lands in Reserved Forests are newly required, so that KSEB regards these PSP as impracticable.

3) Idukki and Pallivasal PSPs

KSEB currently focuses on two PSPs, namely Idukki at Kulamavu (300 MW) and Pallivasal at Munnar (600 MW). KSEB plans to prepare their DPRs for 2 to 3 years and to be commissioned by 2027. KSEB commenced the survey and investigation for both PSPs from May 2016, and preparation of PFR for Idukki PSP has been commenced.

By the way, some development plans to utilize the existing Idukki reservoir for pumped storage project are found as stated later. In the above case of the installed capacity with 300 MW, the intake is planned to be placed near Kulamavu dam which is one of the dams enclosing Idukki reservoir, and the lower reservoir is newly constructed at the downstream of the dam. According to reconnaissance survey executed by KSEB, it is predicted that resettlement due to the development of the PSP is very limited. However, the installed capacity is somewhat small, so KSEB tries to increase the installed capacity more. KSEB has already identified another development plan to utilize the existing Malankara reservoir as lower reservoir. In this case, its installed capacity increases up to 1,100 MW. Moreover, KSEB has identified one more development plan to newly construct lower reservoir near Marmala falls existing at the southwest of Idukki reservoir, whose installed capacity is estimated as 450 MW.

On the other hand, in the case of Pallivasal PSP, both upper and lower reservoirs are required to be newly constructed. But, lands for both reservoirs are outside of any Reserved Forest and Wildlife Sanctuary according to KSEB's reconnaissance survey. In addition, it is predicted that resettlement due to the development of the PSP is very limited. In light of the above, KSEB considers these PSPs to be hopeful among PSPs identified in Kerala, so that KSEB currently urges these PFRs.

4) Ten (10) PSPs newly identified by KSEB

In addition to Idukki and Pallivasal PSPs, KSEB has newly identified ten (10) PSPs through desk studies[36]. All the PSPs are very preliminary stage. So, any PFR hasn't been prepared yet.

(4) Social and Natural Environmental Aspects of Pumped Storage Projects planned in Kerala

No project out of 17 planned PSPs in Kerala State has Environmental Certificate. No 16. Kakkayam

[35] Central Board of Irrigation & Power, Base Paper for Workshop titled as "Pumped Storage Development and Integration with Renewable Energy", p9, 27th October, 2015

[36] KSEB, Details of various Pumped Storage Schemes considered by KSEBL, July 2016

and Peruvannamoozhi is in the Protected area. 10 projects are in the 10km distance from the protected area. These 10 projects might be in the Eco-Sensitive zones.

1) Sholayar-I

Sholayar-I PSP locates Thrissur District and Idukki District. No new pond is planned and existing Sholayar reservoir is used for upper pond and Edamalayar reservoir is used for lower pond. Major land cover around the project site is Broadleaf Evergreen Forest. Scheduled Tribe rate of Thrissur District and Idukki District are 0.30% and 5.03% respectively. Information of resettlement and land acquisition is not clear.

EIA report of Sholayar-I PSP has not been prepared yet. The project site is in the KBA, Endemic Bird Area, Biodiversity Hotspots, 4km from the Parambikulam Sanctuary and 4.7 km from Paramblkulam Tiger Reserve. The project locates in the known Elephant and Tiger habitat. Forest clearance will be required. The affected forest area is not clear.

2) Sholayar-II

Sholayar-II PSP locates Thrissur District and Ernakulam District. No new pond is planned and existing Poringalkuthu reservoir is used for upper pond and Edamalayar reservoir is used for lower pond. Major land cover around the project site is Broadleaf Evergreen Forest. Scheduled Tribe rate of Thrissur District and Ernakulam District are 0.30% and 0.50% respectively. Information of resettlement and land acquisition is not clear.

EIA report of Sholayar-II PSP has not been prepared yet. The project site is in the KBA, Endemic Bird Area, Biodiversity Hotspots, 9km from the Parambikulam Sanctuary, and 8.8 km from Paramblkulam Tiger Reserve. The project locates in the known Elephant and Tiger habitat. Forest clearance will be required. The affected forest area is not clear.

3) Pringalkuthu

Pringalkuthu PSP locates Thrissur District. The layout is unclear. Major land cover around the project site is Broadleaf Evergreen Forest. Scheduled Tribe rate of Thrissur District is 0.30%. Information of resettlement and land acquisition is not clear.

EIA report of Pringalkuthu PSP has not been prepared yet. The project site is in the KBA, Endemic Bird Area, Biodiversity Hotspots, and 4.9 km from Paramblkulam Tiger Reserve. The project locates in the known Elephant and Tiger habitat. Forest clearance will be required. The affected forest area is not clear.

4) Kuttiyadi

Kuttiyadi PSP locates Kozhikode District. The layout is unclear. Major land cover around the project site is Broadleaf Evergreen Forest. Scheduled Tribe rate of Kozhikode District is 0.49%. Information of resettlement and land acquisition is not clear.

EIA report of Kuttiyadi PSP has not been prepared yet. The project site is in the KBA, Biodiversity Hotspots, and Endemic Bird Area. The project locates in the known Tiger habitat.

Forest clearance will be required. The affected forest area is not clear.

5) Edamalayar

Edamalayar PSP locates Idduki District. The layout is unclear. Major land cover around the project site is Broadleaf Evergreen Forest. Scheduled Tribe rate of Idduki District is 5.03%. Information of resettlement and land acquisition is not clear.

EIA report of Edamalayar PSP has not been prepared yet. The project site is in KBA, Endemic Bird Area, and Biodiversity Hotspots. The project locates in the known Elephant and Tiger habitat. Forest clearance will be required. The affected forest area is not clear.

6) Idduki

Idduki PSP locates Idduki District. New lower pond is planned and existing Idukki Reservoir is used for the Upper pond. Major land cover around the project site is Mixed forest. Scheduled Tribe rate of Idduki District is 5.03%. According to KSEB number of the resettlement is 12. Land acquisition is not clear.

EIA report of Idduki PSP has not been prepared yet. Upper Pond is in the Iddukki Sanctuary, KBA, Endemic Bird Area, and Biodiversity Hotspots. The project locates in the known Tiger habitat and 10km from the Elephant habitat. Forest clearance will be required. The affected forest area is not clear.

7) Pallivasal

Pallivasal PSP locates Idduki District. New upper and lower ponds are planned. Major land cover around the project site is Broadleaf Evergreen Forest. Scheduled Tribe rate of Idduki District is 5.03%. According to KSEB number of the resettlement is 5. Information of land acquisition is not clear.

EIA report of Pallivasal PSP has not been prepared yet. The project site is in KBA, Endemic Bird Area, Biodiversity Hotspots, 7km from the Western Ghats World Heritage Site, and 1km from Alliance for Zero Extinction Sites. The project locates 1km from the known Elephant and Tiger habitat. Forest clearance will be required. The affected forest area is not clear.

8) Kakki / Upper Moozhiyar as Upper Pond and Moozhiyar Reservoir as lower (Kakki-Moozhiyar)

Kakki-Moozhiyar PSP locates Pathanamthitta District. No new pond is planned and existing Kakki Reservoir is used for the Upper pond and Moozhiyar Reservoir is used for the Lower pond. Major land cover around the project site is Broadleaf Evergreen Forest. Scheduled Tribe rate of Pathanamthitta District is 0.68%. Information of resettlement and land acquisition is not clear.

EIA report of Kakki-Moozhiyar PSP has not been prepared yet. The project site is in the Western Ghats World Heritage Site, KBA, Endemic Bird Area, Biodiversity Hotspots, and 9.3km from Periyar Tiger Reserve. The project locates in the known Elephant and Tiger habitat. Forest clearance will be required. The affected forest area is not clear.

9) Idukki as Upper Pond and Malankara as lower (Idukki – Malankara)

Idukki - Malankara PSP locates Idukki District. No new pond is planned and existing Idukki Reservoir is used for the Upper pond and Malankara Reservoir is used for the Lower Pond. Major land cover around the project site is Broadleaf Evergreen Forest. Scheduled Tribe rate of Idukki District is 5.03%. Information of resettlement and land acquisition is not clear.

EIA report of Idukki - Malankara PSP has not been prepared yet. Project site is in KBA, Endemic Bird Area, Biodiversity Hotspots, and 1km from the Idukki Sanctuary. The project locates in the known Tiger habitat and 10km from the Elephant habitat. Forest clearance will be required. The affected forest area is not clear.

10) Idukki as Upper Pond and Marmala (Idukki - Marmala)

Idukki - Marmala PSP locates Idukki District and Kottayam District. New Lower Pond is planned and existing Idukki Reservoir is used for the Upper pond. Major land cover around the project site is Broadleaf Evergreen Forest and Open forest. Scheduled Tribe rate of Idukki District and Kottayam District are 5.03% and 1.11% respectively. Information of resettlement and land acquisition is not clear.

EIA report of Idukki - Marmala PSP has not been prepared yet. The project site is in KBA, Endemic Bird Area, Biodiversity Hotspots, and 1km from the Idukki Sanctuary. The project locates in the known Tiger habitat. Forest clearance will be required. The affected forest area is not clear.

11) Ponmudi as Upper Pond and Kallarkutty as lower (Ponmudi – Kallarkutty)

Ponmudi – Kallarkutty PSP locates Idukki District. No new Ponds are planned and existing Ponmudi Reservoir is used as Upper Pond and Kallarkutty Reservoir is used as Lower Pond. Major land cover around the project site is Broadleaf Evergreen Forest. Scheduled Tribe rate of Idukki District is 5.03%. Information of resettlement and land acquisition is not clear.

EIA report of Ponmudi – Kallarkutty PSP has not been prepared yet. Project site is in KBA, Endemic Bird Area, Biodiversity Hotspots, 6km from Alliance for Zero Extinction Sites, and 2.4km from the Idukki Sanctuary. The project locates in the known Tiger habitat and 1km from the Elephant habitat. Forest clearance will be required. The affected forest area is not clear.

12) Sengulam and Kallarkutty reservoirs (Sengulam – Kallarkutty)

Sengulam – Kallarkutty PSP locates in Idukki District. No new Ponds is planned and existing Sengulam Reservoir is used for Upper Pond and Kallarkutty Reservoir is used for the Lower Pond. Major land cover around the project site is Broadleaf Evergreen Forest. Scheduled Tribe rate of Idukki District is 5.03%. Information of resettlement and land acquisition is not clear.

EIA report of Sengulam – Kallarkutty PSP has not been prepared yet. The project site is in KBA, Endemic Bird Area, Biodiversity Hotspots, 3km from Alliance for Zero Extinction Sites, 4km from the Idukki Sanctuary, and 8km from the Western Ghats World Heritage Site. The project

locates 1km from the known Tiger habitat and 2km from the Elephant habitat. Forest clearance will be required. The affected forest area is not clear.

13) Kallarkutty and Lower Periyar reservoirs (Kallarkutty - Lower Periyar)

Kallarkutty - Lower Periyar PSP locates Idukki District. No new Pond is planned and existing Kallarkutty Reservoir is used for Upper Pond and Lower Periyar Reservoir is used for Lower Pond. Major land cover around the project site is Broadleaf Evergreen Forest. Scheduled Tribe rate of Idukki District is 5.03%. Information of resettlement and land acquisition is not clear.

EIA report of Kallarkutty - Lower Periyar PSP has not been prepared yet. The project site is in KBA, Endemic Bird Area, Biodiversity Hotspots, Alliance for Zero Extinction Sites, 1.7km from the Idukki Sanctuary, and 9km from the Western Ghats World Heritage Site. The project locates in the known Tiger habitat and 0.8km from the Elephant habitat. Forest clearance will be required. The affected forest area is not clear.

14) Peringalkuth and Idamalayar reservoirs (Peringalkuth - Idamalayar)

Peringalkuth - Idamalayar PSP locates Thrissur District, Ernakulam District and Idukki District. No new pond is planned and existing Peringalkuth reservoir is used for upper pond and Edamalayar reservoir (Idamalayar Reservoir) is used for lower pond. Major land cover around the project site is Broadleaf Evergreen Forest. Scheduled Tribe rate of Thrissur District, Ernakulam District and Idukki District are 0.30%, 0.50% and 5.03% respectively. Information of resettlement and land acquisition is not clear.

EIA report of Peringalkuth - Idamalayar PSP has not been prepared yet. The project site is in KBA, Endemic Bird Area, Biodiversity Hotspots, 7.2 km from Paramblkulam Tiger Reserve, and 8km from the Parambikulam Sanctuary. The project locates in the known Elephant and Tiger habitat. Forest clearance will be required. The affected forest area is not clear.

15) Sholayar and Idamalayar reservoirs (Sholayar - Idamalayar)

Sholayar- Idamalayar PSP locates Thrissur District and Idukki District. No new pond is planned and existing Sholayar reservoir is used for upper pond and Edamalayar reservoir is used for lower pond. Major land cover around the project site is Broadleaf Evergreen Forest. Scheduled Tribe rate of Thrissur District and Idukki District are 0.30% and 5.03% respectively. Information of resettlement and land acquisition is not clear.

EIA report of Sholayar- Idamalayar PSP has not been prepared yet. The project site is in KBA, Endemic Bird Area, Biodiversity Hotspots, 4.3 km from Paramblkulam Tiger Reserve, 9km from Alliance for Zero Extinction Sites, and 5km from the Parambikulam Sanctuary. The project locates in the known Elephant and Tiger habitat. Forest clearance will be required. The affected forest area is not clear.

16) Kakkayam and Peruvannamoozhi reservoirs (Kakkayam - Peruvannamoozhi)

Kakkayam - Peruvannamoozhi PSP locates Kozhikode District. No new pond is planned is planned and existing Kakkayam Reservoir is used for the Upper Pond and Peruvannamoozhi Reservoir is used for the Lower Pond. Major land cover around the project site is Broadleaf Evergreen Forest. Scheduled Tribe rate of Kozhikode District is 0.49%. Information of resettlement and land acquisition is not clear.

EIA report of Kakkayam - Peruvannamoozhi PSP has not been prepared yet. The project site is in the Malabar Sanctuary, KBA, Endemic Bird Area, and Biodiversity Hotspots. The project locates in the known Tiger habitat and 1km from the Elephant habitat. Forest clearance will be required. The affected forest area is not clear.

17) Pazhassi sagar

Pazhassi sagar PSP locates Kannur District. Laterite Quarry is used for the Upper Pond and existing Pazhassi Reservoir is used for Lower Pond. Major land cover around the project site is Open Forest. Scheduled Tribe rate of Kannur District is 1.64%. Information of resettlement and land acquisition is not clear.

EIA report of Pazhassi sagar PSP has not been prepared yet. Project site is in KBA, Biodiversity Hotspots, and 8.0 km from The Nilgiri Biosphere Reserve. The project locates in the known Elephant habitat and 2km from the Tiger habitat. Forest clearance will be required. The affected forest area is not clear.

Table 5.1.5-3 EIA process and Protected area of the projects in Kerala State

Name of PSPs	Capacity (MW)	Project stage								EIA process	Domestic					International[37]							Tiger/ Elephant	Scheduled Tribe Rate	MOEA's "Overseas Travel Safety Information"	Remarks
		OP	UC	CEA	DPR	S & I	PFR	PIR	IDE		National Parks	Wildlife Sanctuaries	Conservation Reserves	Community Reserves	Tiger Reserve	Ramsar Site	UNESCO-MAB Biosphere Reserve	World Heritage Site	KBA	Endemic Bird Area	Biodiversity Hotspots	Alliance for Zero Extinction Sites				
1. Sholayar-I	810	---	---	---	---	---	---	---	---	-		4km			4.7 km				I	I	I		Elephant and Tiger	0.30% and 5.03%	Level 1	Location unclear (No. 15?)
2. Sholayar-II	390	---	---	---	---	---	---	---	---	-		9km			8.8 km				I	I	I		Elephant and Tiger	0.30% and 0.50%	Level 1	Location unclear (No. 14?)
3. Pringalkuthu	80	---	---	---	---	---	---	---	---	-					4.9km				I	I	I		Elephant and Tiger	0.30%	Level 1	
4. Kuttiyadi	2,400	---	---	---	---	---	---	---	---	-									I	I	I		Tiger	0.49%	Level 1	
5. Edamalayar	2,000	---	---	---	---	---	---	---	---	-									I	I	I		Elephant and Tiger	5.03%	Level 1	
6. Idduki	300						U/P			-		I							I	I	I		Tiger and 10km from Elephant	5.03%	Level 1	Location unknown, 12 resettlements
7. Pallivasal	600							U/P		-								7km	I	I	I	1km	1km from the Tiger and Elephant	5.03%	Level 1	5 resettlements
8. Kakki-Moozhiyar	375								○	-					9.3km			I	I	I	I		Tiger and Elephant	0.68%	Level 1	Forest
9. Idukki - Malankara	1,100								○	-		1km							I	I	I		Tiger and 10km from Elephant	5.03%	Level 1	
10. Idukki - Marmala	450								○	-		1km							I	I	I		Tiger	5.03% and 1.11%	Level 1	
11. Ponmudi – Kallarkutty	250								○	-		2.4km							I	I	I	6km	Tiger and 1km from Elephant	5.03%	Level 1	
12. Sengulam – Kallarkutty	200								○	-		4km						8km	I	I	I	3km	1km from	5.03%	Level 1	No forest

[37] Locations of KBA, EBA, Biodiversity hotspots, and Alliance for Zero Extinction Sites are referred in IBAT (https://www.ibat-alliance.org)

																							Tiger and 2km from Elephant			
13. Kallarkutty - Lower Periyar	200								○	-		1.7km						9km	I	I	I	4km	Tiger and 0.8km from Elephant	5.03%	Level 1	Forest
14. Peringalkuth - Idamalayar	350								○	-		8km			7.2km				I	I	I		Elephant and Tiger	0.30%, 0.50% and 5.03%	Level 1	Tribal colony, Forest, (Same as No.2 Sholayar-II?)
15. Sholayar - Idamalayar	900								○	-		5km			4.3km				I	I	I	9km	Elephant and Tiger	0.30% and 5.03%	Level 1	Tribal colony, (same as No.1 Sholayar-I?)
16. Kakkayam - Peruvannamoozhi	900								○	-		I							I	I	I		Tiger and 1km from Elephant	0.49%	Level 1	Forest, (Same as No.4 Kuttiyadi?)
17. Pazhassi sagar	200								○	-							8.0km		I		I		Elephant and 2km from the Tiger	1.64%	Level 1	No forest

5.1.6 Tamil Nadu State

(1) Development Needs of Pumped Storage Plant

Both the Energy Department of Government of Tamil Nadu and TANGEDCO have the intention to develop pumped storage projects due to the following reasons:

- Storage power mainly produced by solar & wind power generations;
- Securement of peak power;
- Stabilization of the grid against large-volume introduction of renewable energy such as solar and wind powers whose outputs largely fluctuate.

From the financial aspect, the government of Tamil Nadu is required to comply with the fiscal management target set by FRBM act, with the following three parameters for 2016-17:

Item	Estimate	Target
- Revenue deficit / GSDP rate:	-0.7 %	0.0 %
- Fiscal deficit / GSDP rate:	-2.92 %	-3.50 %
- Total debt stock / GSDP rate	19.60 %	21.72 %

The state has failed to achieve the target for revenue deficit mentioned in the Report on 14th Finance Commission. As long as the state keeps an eye on fiscal management, it is considered that there would be a possibility for the state to obtain finance including loans for development of pumped storage projects from a viewpoint of fiscal management of the state, if the state so desires. Generally speaking, there is no specific preference in PSP from a viewpoint of the Finance Department. Energy resource to satisfy the demand is first determined by the Energy Department.

According to the interview made to the Finance Department, they were much interested in introducing a Japanese ODA loan, due mainly to the following reasons:

- loan conditions, i.e. attractive interest rate and a long repayment period
- a large amount of finance is available
- relatively small fluctuation of foreign exchange in Japanese Yen as compared to US dollar

(2) Analysis of PSP possibility from the state power sector status

This chapter analyzes the possibility of PSP development in terms of necessity for adjusting power and available options, power market structure, and capability of executing entities.

1) Necessity for adjusting power and available options

According to the CEA report, the electricity supply in Tamil Nadu is going to exceed its demand for FY2016. Although the detail data has not been obtained, the state is assumed to secure sufficient supply capacity thanks to startups of large-capacity powers such as Kudankulam nuclear power plant.

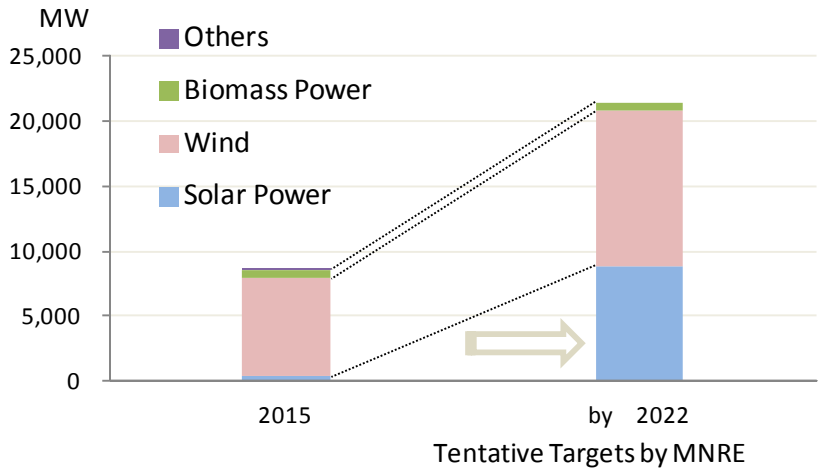
In terms of renewable energy, it is anticipated that large-scale introduction advances. The federal Ministry for New and Renewable Energy (MNRE) indicates 8,800 MW, which is more than 20 times of existing capacity, as tentative target until 2022, as the state is regarded to have large potential of solar PV.

On the other hand, in July 2016, it was reported that the solar PV was experienced curtailment of output, for the first ever in India. Although the cause is being unknown, strong concern is expressed for this issue from developers of solar PV and even from MNRE. The state is urged to take action to address increasing solar PV in the state.

The state is going to push forward development of available hydraulic power generation including PSP to balance electricity supply-demand in a future. The state is selecting two candidate projects, and of which one has completed DPR.

Besides, the threshold to receive support as a renewable energy has excluded less than 25 MW in case of hydro power generation, which has been discouraging the development of large hydro power plant that has a capacity more than 25 MW. Therefore, the federal MNRE is going to re-categorize the definition of renewable energy to include the hydraulic power generation of more than 25MW to promote its development. [38] It is hoped that such an action greatly contributes to reduce GHG emission.

Taking the situation mentioned above into consideration, it is thought that the needs for introducing the PSP are high in the state.



source: MNRE

Figure 5.1.6-1 Generation Capacity Targets of Renewables

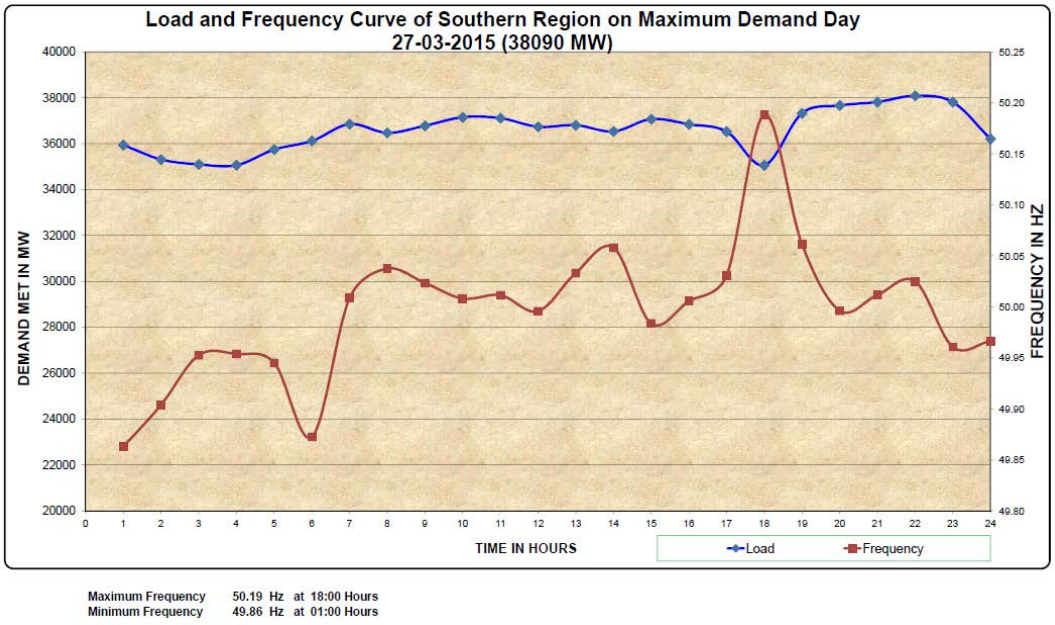
[38] The Econ0mics Times; 2016.9.14

Table 5.1.6-1 Major Pumped Storgage Projects in Tamil Nadu

Priority	Location	Capacity	Stage
1st	Kundah	500 MW	DPR Completed ICB Preparation for phase 1
2nd	Shillahalla	2,000 MW	DPR (phase 1) ongoing (almost completed)

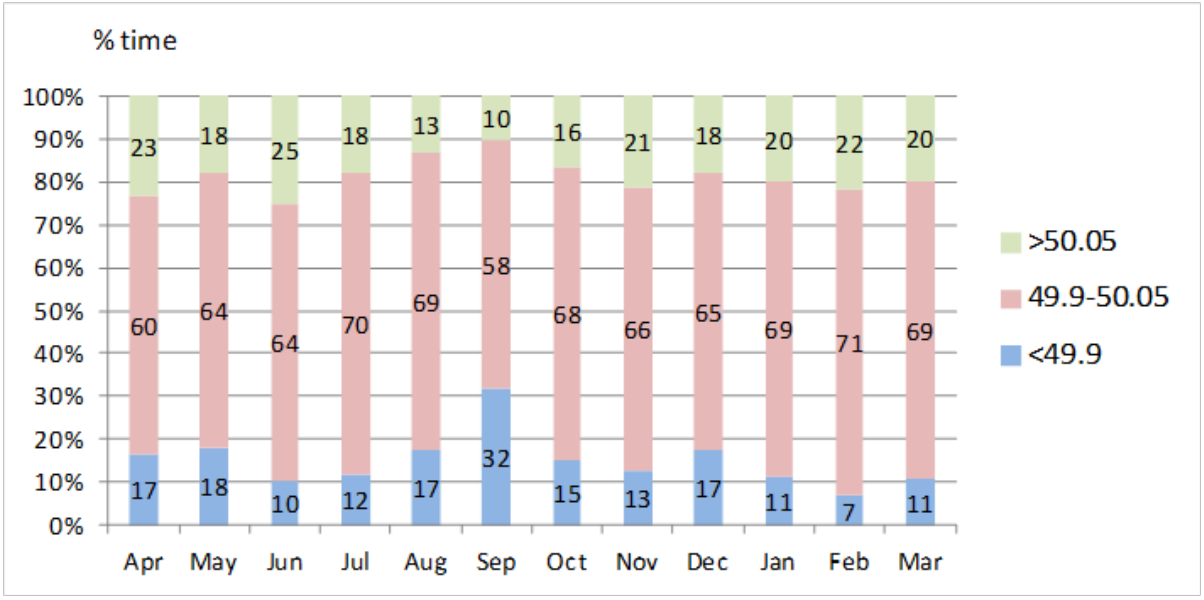
2) From Quantity to Quality of Electricity Supply

Frequency profile of Southern Region, where Tamil Nadu state belong, is frequently go out of control range (49.9 – 50.05 Hz). Until recently, majority of power demand came from household and agricultural load, while the most industries were prepared to supply themselves by captive power. Therefore, there were less requirement for a quality of electricity, i.e. stable voltage and frequency. However in a future, necessity for higher quality electricity may increase in accordance with increasing direct investment of foreign capital including Japan under the Make in India policy. Such environment will support developing PSP which can work as a stabilizing measure of grid.



source: Southern Regional Power Committee Annual Report in 2014-15

Figure 5.1.6-2 Load Curve and Frequency Curve of Southern Region on Maximum day in 2014-15



source: Southern Regional Load Dispatch Centre Quarterly Report

Figure 5.1.6-3 Frequency of Southern Region in 2015-16

(3) Pumped Storage Projects planned in Tamil Nadu

In Tamil Nadu state, the following seven (7) PSPs were found:

Table 5.1.6-2 Pumped Storage Projects planned in Tamil Nadu State

Name of PSPs	Capacity (MW)	Remarks
1. Kundah	500	1st priority in Tamil Nadu. Tender notice for the Phase-1 is planned to be announced by October, 2016.
2. Sillahalla	2,000	2nd priority in Tamil Nadu. DPR for the Phase-1 will be finalized in September 2016.
3. Mettur	500	PFR is under preparation. The upper reservoir is planned in Palamalai Reserved Forest.
4. Kodayar	500	High head over 1,000 m.
5. Manalar	500	High head over 1,000 m.
6. Vellimalai	200	TANGEDCO doesn't take any action to advance this PSP at present.
7. Nallar	2,700	TANGEDCO has no intention to develop this PSP.

The above PSPs are outlined below, and more detailed information is shown in Appendix 5-33.

1) Kundah PSP

Kundah PSP is planned to utilize the existing Porthimund and Emerald reservoir as upper and lower reservoirs respectively which exist in Nilgiris district. So, it is unnecessary to newly construct any reservoir, and TANGEDCO ranks this PSP in the first priority over the other PSPs

planned in Tamil Nadu. Its DPR has already been completed[39], and both Forest and Environmental Clearances have been obtained according to TANGEDCO. Therefore, TANGEDCO considers that any social and environmental issues aren't arisen.

The project is divided into three phases. The Phase-1 covers main civil works and installation one unit (125 MW), the Phase-2 covers installation of two units (125 MW x 2) and the Phase-3 covers installation of one unit (125 MW). TANGEDCO plans to release tender notice for the Phase-1 by October 2016 and to finalize the contract by January 2017. After that, it is planned to commence the construction works by April 2017 considering that the commissioning is programmed in FY 2021. Presently, construction of the main access tunnel (MAT) has been completed by 1,000 m and the cable cum ventilation tunnel (CCVT) has already been excavated by 500 m out of 700 m, which are executed as a part of the preparatory work.

Type of turbine for this PSP has already been finalized as fixed speed type. Considering that approval for the development has been awarded under the condition to install fixed speed type unit, there is less possibility to change type of unit from fixed speed type to adjustable speed type.

Finance for the Phase-1 has been decided to done by Rural Electrification Corporation (REC), so that TANGEDCO thinks it unlikely to change the finance source from REC to JICA.

2) Sillahalla PSP

Sillahalla PSP is ranked in the second priority among the PSPs planned in Tamil Nadu. The project site ranges in Nilgiris and Coimbatore districts. It is planned to utilize the existing Pillur reservoir as lower reservoir and to newly construct upper reservoir. The upper reservoir will be connected with the existing Emerald and Avalanche reservoirs through newly-constructed link tunnel. Noteworthy features are very high head which is around 1,500 m and a long water conductor system having a length over 17 km. The main access tunnel is also very long, which is nearly 5.75 km[40].

The project is divided into two phases. The Pahse-1 comprises the construction of the upper reservoir and connecting link tunnel, and the Phase-2 is to construct the water conductor system and underground powerhouse.

According to TANGEDCO, DPR for the Phase-1 has been finalized (but under approval process). After the finalization of the DPR, tender notice for preparation of DPR for the Phase-2 had been planned to be announced by December 2016 after conditions for the preparation of the DPR for the Phase-2 are consolidated on the basis of the DPR for the Phase-1. But as of January, 2017, this tender has not been noticed yet.

According to TANGEDCO, any work on the Phase-1 doesn't have any social and environmental issue because land required for newly proposed upper dam exists in private lands which are mainly composed of cultivated fields and doesn't exist in forest land, so TANGEDCO predicts to

[39] TANGEDCO, Detailed Project Report for Kundah Pumped Storage Hydro Electric Project, October 2015

[40] TANGEDCO, Pre-Feasibility Report on Sillahalla Pumped Storage Hydro Electric Project (4x500MW), January 2012

be able to obtain the necessary private lands. In addition, resettlement is also not required for the Phase-1. However, it is unclear whether social and environmental issues will arise in the Phase-2 or not.

In the discussions with TANGEDCO, it is found that TANGEDCO doesn't stick to the present challenging development plan with extreme high head and long water conductor system. So, TANGEDCO welcomes suggestions downsizing, segmentation into two or three PSPs, etc.

It needs to be noticed that the State government in Oct. 2016 reportedly requested the central to fund PSPs under the renewable energy scheme.[41]

3) Mettur PSP

According to TANGEDCO, this PSP is also one of the candidate PSPs to be developed next to Kundah and Sillahalla PSPs. The project site exists in Salem district, and it is planned to utilize Mettur (Stanley) reservoir as lower reservoir, and its upper reservoir is proposed to be newly constructed in the ridge located at the southwest of the existing Mettur dam. However, the upper reservoir seems to be located in Palamalai Reserved Forest according to TANGEDCO's information[42]. This issue may be obstacle for the development. PFR for the PSP is under preparation.

4) Kodayar PSP

According to TANGEDCO, this PSP is also one of the candidate PSPs to be developed next to Kundah and Sillahalla PSPs. The project site exists in Kanyakumari district as with Vellimalai PSP as stated later, and it is planned to utilize the existing Upper Kodayar and Pechiparai reservoirs as upper and lower reservoirs respectively, so that it is unnecessary to newly construct any reservoir[43]. Its head is estimated to be 1,234 m, which is considerably high head for PSP. The high head may cause difficulty in selection of reversible pump turbine. The initial survey has been completed, and PFR for the PSP is under preparation.

5) Manalar PSP

According to TANGEDCO, this PSP is also one of the candidate PSPs to be developed next to Kundah and Sillahalla PSPs. The project site exists in Theni district, and it is planned to utilize the existing Manalar reservoir as upper reservoir and its lower reservoir is planned to be newly constructed near Surulipatti village existing at the northwest of Manalar reservoir[44]. Its head is estimated to be 1,050 m. As with Kodayar PSP, the high head may cause difficulty in selection of reversible pump turbine. The initial survey has been completed, and PFR for the PSP is under preparation.

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41 2016/10/08 Deccan Chronicle, http://www.deccanchronicle.com/nation/in-other-news/081016/address-quality-of-coal-centre-urged.html

42 Outline of 5 PSPs planned in Tamil Nadu, July 2016

43 Outline of 5 PSPs planned in Tamil Nadu, July 2016

44 Outline of 5 PSPs planned in Tamil Nadu, July 2016

6) Vellimalai PSP

Vellimalai PSP is found in the report titled as "System Operation Report" released by Southern Regional Load Dispatch Center in 2011[45]. However, TANGEDCO presently regards this PSP as inferior to the above five PSPs in light of the installed capacity. And, another reason is that Kodayar PSP planed in the same district as Vellimalai PSP has priority over Vellimalai PSP. So, TANGEDCO doesn't take any action for the development of this PSP at present.

7) Nallar PSP

Nallar PSP is found in the project list titled as "PSH Sites identified by CEA" which is annexed to the base paper for workshop on pumped storage development and integration with renewable energy held on 27th October 2015[46]. TANGEDCO considers that development of the PSP is difficult judging from the project site and doesn't take any action for the development.

(4) Social and Natural Environmental Aspects of Pumped Storage Projects planned in Tamil Nadu

Only Kundah PSP has Environmental Clearance out of seven planned PSP in Tamil Nadu State. Kondayar PSP and Manalar PSP are in the Wildlife Sanctuaries. Kundah PSP and Silahalla PSP might be in the Eco-Sensitive Zones.

1) Kundah

Kundah PSP locates The Nilgiris District. No reservoirs is planned because existing Porthimund Reservoir is used for Upper Pond and Emerald Reservoir is used for Lower Pond. Major land cover around the project site is Evergreen forest. Scheduled Tribe rate of The Nilgiris District is 4.46 %. Information of resettlement and land acquisition is not clear.

EIA report of Kundah PSP was prepared in 2007 and original EC was granted in May 2007 and extention EC was granted in September 2013. Project site is in The Nilgiri Biosphere Reserve, KBA, Endemic Bird Area, Biodiversity Hotspots, 2km from Mukurthi National Park, 3 km from Western Ghats World Heritage Site, and 4km from Alliance for Zero Extinction (AZE) Sites[47]. The project locates in the known Tiger and Elephant habitat. Forest clearance will be required. The affected forest area is not clear.

2) Sillahalla

Silahalla PSP (Option 1 and Option 2) locates The Nilgiris District and Coimbatore District. New Upper Pond is planned and existing Pillur reservoir is used for Lower Pond. Major land cover around the project site is evergreen dense forest and agricultural land. Scheduled Tribe rate of

[45] Southern Regional Load Dispatch Centre, System Operation Report, p21, August 2011

[46] Central Board of Irrigation & Power, Base Paper for Workshop titled as "Pumped Storage Development and Integration with Renewable Energy", p9, 27th October, 2015

[47] Alliance for Zero Extinction (AZE): AZE sites are the last refuges for some of the highest threatened species on the planet. AZE sites are discrete areas that contain 95% of the known global population of an Endangered (EN) or Critically Endangered (CR) species or 95% of one life history segment (e.g. breeding or wintering) of an EN or CR species.

The Nilgiris District and Coimbatore District are 4.46% and 0.82% respectively. Information of resettlement and land acquisition is not clear.

EIA report of Silahalla PSP has not been prepared yet. Project site is in KBA, Endemic Bird Area, Biodiversity Hotspots, 1.9km from The Nilgiri Biosphere Reserve, 7.3km from Mukurthi National Park, and 7.6 km from Western Ghats World Heritage Site. The project locates in the known Tiger and Elephant habitat. Forest clearance will be required. The affected forest area is not clear.

3) Mettur

Mettur PSP locates Salem District. New Upper Pond is planned and existing Stanley reservoir is used for Lower Pond. Major land cover around the project site is Evergreen forest, Agricultural land and Urban area. Scheduled Tribe rate of Salem District is 3.43 %. Information of resettlement and land acquisition is not clear.

EIA report of Mettur PSP has not been prepared yet. The project site is 7.9 km from the Nilgiri Biosphere Reserve. The project locates 5km from the known Tiger habitat and 10 km from the Elephant habitat. Forest clearance will be required. The affected forest area is not clear.

4) Kodayar

Kodayar PSP locates Kanniyakumari District. No reservoir is planned and existing Upper Kodayar Reservoir is used for Upper pond and Pechiparai Reservoir is used for lower pond. Major land cover around the project site is dense evergreen forest. Scheduled Tribe rate of Kanniyakumari District is 0.39%. Information of resettlement and land acquisition is not clear.

EIA report of Kodayar PSP has not been prepared yet. The project site is in Kalakad Sanctuary and Mundanthurai Sanctuary, KBA, Endemic Bird Area, Biodiversity Hotspots, 0.5km from Kalakad - Mundanthurai Tiger Reserve, 0.5km from Western Ghats World Heritage Site, and

1.5km from Alliance for Zero Extinction Sites. The project locates in the known Tiger and Elephant habitat. Forest clearance will be required. The affected forest area is not clear.

5) Manalar

Manalar PSP locates Theni District. New lower pond is planned and existing Manalar reservoir is used for Upper pond. Major land cover around the project site is dense and open forest. Scheduled Tribe rate of Theni District 0.15%. Information of resettlement and land acquisition is not clear.

EIA report of Manalar PSP has not been prepared yet. Upper Pond is in Megamalai WLS, Endemic Bird Area, Biodiversity Hotspots, KB Forcal area, 0.5km from Western Ghats World Heritage Site, 9.7km from Srivilliputhur (Giant Squirrel) WLS, and 0.5km from Periyar Tiger Reserve. The project locates in the known Tiger and Elephant habitat. Forest clearance will be required. The affected forest area is not clear.

6) Vellimalai

Location of Vellimalai project is not clear.

7) Nallar

Location of Nallar project is not clear.

Table 5.1.6-3 EIA process and Protected area of the projects in Tamil Nadu State

Name of PSPs	Capacity (MW)	Project stage								EIA process	Domestic					International[48]							Tiger/ Elephant	Scheduled Tribe Rate	MOFA's "Overseas Travel Safety Information"	Remarks
		OP	UC	CEA	DPR	S & I	PFR	PIR	IDE		National Parks	Wildlife Sanctuaries	Conservation Reserves	Community Reserves	Tiger Reserve	Ramsar Site	UNESCO-MAB Biosphere Reserve	World Heritage Site	KBA	Endemic Bird Area	Biodiversity Hotspots	Alliance for Zero Extinction Sites				
1. Kundah	500		○							F (May 2007)	2km						I	3km	I	I	I	4km	Tiger and Elephant	4.66%	Level 1	Reserved forest 19.98 ha
2. Sillahalla	2,000				U/P					-	7.3km						1.9km	7.6 km	I	I	I		Tiger and Elephant	4.46% and 0.82%	Level 1	
3. Mettur	500							U/P		-							7.9km							3.43%	Level 1	
4. Kodayar	500							U/P		-		I			0.5km			1.9km	I	I	I	1.5km	Tiger and Elephant	0.39%	Level 1	
5. Manalar	500							U/P		-		I 9.7km			0.5km			0.5km	I	I	I		Tiger and Elephant	0.15%	Level 1	
6. Vellimalai	200								○	-									I							Location unclear
7. Nallar	2,700								○	-									I							Location unclear

[48] Locations of KBA, EBA, Biodiversity hotspots, and Alliance for Zero Extinction Sites are referred in IBAT (https://www.ibat-alliance.org)

5.1.7 West Bengal State

(1) Development Needs of Pumped Storage Plant

Both Department of Power and Non-conventional Energy Source of Government of West Bengal and WBSEDCL have the intention to advance pumped storage projects due to the following reasons:

- Stabilization of the grid against large-volume introduction of renewable energy such as solar and wind powers;
- Securement of peak power;
- Improvement of demand-supply gap.

From the financial aspect, the government of West Bengal is required to comply with the fiscal management target set by FRBM act, with the following three parameters for 2016-17:

Item	Estimate	Target
- Revenue deficit / GSDP rate:	0.0 %	0.0 %
- Fiscal deficit / GSDP rate:	-1.96 %	-3.00 %
- Total debt stock / GSDP rate	33.72 %	36.24 %

The state has achieved the figures mentioned in Report on 14th Finance Commission, however, it should be noted that the amount for debt stock occupies a large share in GSDP. As long as the state keeps an eye on fiscal management, it is considered that there would be a possibility for the state to obtain finance including loans for development of pumped storage projects from a viewpoint of fiscal management of the state, if the state so desires. Generally speaking, there is no specific preference in PSP from a viewpoint of the Finance Department. Energy resource to satisfy the demand is first determined by the Department of Power.

According to the interview made to the Finance Department, they were interested in introducing a Japanese ODA loan due mainly to the following points:

- terms and conditions for the loan are preferable to the state in comparison with those for the locally available fund;
- technical assistance for the project is also provided.

The Finance Department is committed to the repayment of the loan, therefore, they will make sure if the repayment schedule is made in line with their fiscal management policy.

(2) Analysis of PSP possibility from the state power sector status

This chapter analyzes the possibility of PSP development in terms of necessity for adjusting power and available options, power market structure, and capability of executing entities.

1) Necessity for adjusting power and available options

It is said the electricity supply is going to exceed its demand in FY2016, and keep the stable position until FY2019. Sufficient capacity addition, such as thermal power stations, along with increasing demand is planned in the state's and private companies.

As for renewable energy, the state's target does not reach to that of central government', the state is going to revise up the target and to introduce the large-scale renewable energy.

West Bengal state currently utilizes one existing pumped storage power generation (900 MW) as a tool to stabilize the grid. Furthermore, the state works on the development of new PSP projects, and DPR is completed for one of these projects, namely Turga. Notably, the state is considering to install 1,200 MW solar PV in Turga. CEA strongly supports this new idea to combine a power generation of adjusting power supply-demand with a variable power source. It is expected to become the model case in India.

Besides, the threshold to receive support as a renewable energy has excluded less than 25 MW in case of hydro power generation, which has been discouraging the development of large hydro power plant that has a capacity more than 25 MW. Therefore, the federal MNRE is going to re-categorize the definition of renewable energy to include the hydraulic power generation of more than 25MW to promote its development. [49] It is hoped that such an action greatly contributes to reduce GHG emission.

Taking the situation mentioned above into consideration, it is thought that the needs for introducing the PSP are very high in the state, combined with an aim of the expansion of the renewable energy.

Table 5.1.7-1 Major Pumped Storgage Projects in West Bengal

Priority	Location	Capacity	Stage
1st	Turga	1,000 MW	DPR Completed
2nd	Bandhu	900 MW	DPR tender under preparation
3rd	Kulbera	1,100 MW	Identified stage

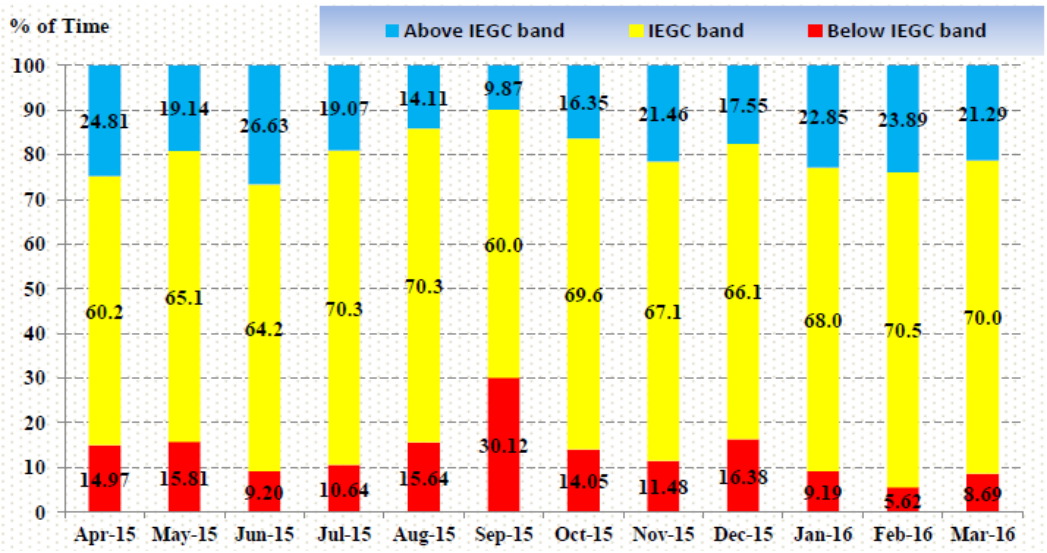
2) From Quantity to Quality of Electricity Supply

Frequency control range has set to become 49.9Hz – 50.05 Hz in February 2014 (The Indian Electricity Grid Code: IEGC). Frequency profile of Eastern Region, where West Bengal state belongs, shows that only about 70% of time is within the range. It exceeds 50.05 Hz mostly from winter to spring and it falls below 49.9 Hz mostly in September.

Until recently, majority of power demand came from household and agricultural load, while the most industries were prepared to supply themselves by captive power. Therefore, there were less requirements for a quality of electricity, i.e. stable voltage and frequency. However in a future,

[49] The Economics Times; 2016.9.14

necessity for higher quality electricity may increase in accordance with increasing direct investment of foreign capital including Japan under the Make in India policy. Such environment will support developing PSP which can work as a stabilizing measure of grid.



source: Eastern Regional Load Dispatch Center, Annual Grid Report 2015-16

Figure 5.1.7-1 Frequency Profile of Eastern Region in 2015-16

(3) Pumped Storage Projects planned in West Bengal

In West Bengal state, the following seven (7) PSPs were found:

Table 5.1.7-2 Pumped Storage Projects planned in West Bengal State

Name of PSPs	Capacity (MW)	Remarks
1. Turga	1,000	DPR will be approved soon.
2. Bandhu	900	S & I stage. Planned to commission is 2028 at the earliest
3. Kurbera	1,100	Identified. Next project to Bandhu PSP
4. Kathlajal	900	Identified. But the site is located in reserved forest, so the development seems to be quite difficult
5. Boro	500	No information
6. Panchet Hill	600	Very initial stage, any study hasn't been conducted.
7. Panchet	40	Operated as conventional hydropower plant due to lack of the lower reservoir

The above PSPs are outlined below, and more detailed information is shown in Appendix 5-38.

1) Turga PSP

The project site is located in Ayodhya Hill where the existing Purulia PSP also exists. This PSP is planned to utilize the existing irrigation reservoir which is located at almost 2 km west from the lower reservoir for Purulia PSP, and its upper reservoir is planned to be newly constructed. Its

DPR has already been prepared and submitted to CEA, and it is expected not to be long before the DPR is approved by CEA. Its installed capacity is designed as 1,000 MW, and two (2) fixed speed type units and two (2) adjustable speed type units are installed. In the West Bengal state especially which has 30% of frequency outside of IEGC band, adjustable type PSP has more advantages in its grid stabilizing/balancing capability.

Tender for detailed design and/or construction supervision will be called after obtaining clearances required for the development. The state government has already approached JICA for request funding.

2) Bandhu PSP

According to WBSEDCL's presentation in the workshop titled as " Pumped Storage Development and Integration with Renewable Energy" held on 27th October 2015, this PSP is categorized in S & I stage[50]. Its installed capacity is estimated as 900 MW. According to WBSEDCL, this PSP is planned to be commissioned in 2028 at the earliest. Its PFR has been completed, but it is required to be amended. After topographical survey and preliminary geotechnical investigation have been carried out by Survey of India (SOI) and Geological Survey of India (GSI), other survey & investigations for preparation of the DPR are will be executed. According to the minutes of CEA's meeting on PSP held on 20th June 2016, its DPR is planned to be prepared by 2019[51].

3) Kulbera PSP

According to the abovementioned presentation, this PSP is categorized in Identified stage, and its installed capacity is estimated as 1,100 MW. According to WBSEDCL, the project site is located in Ajodhya Hill as with Purulia & Turga PSPs. This PSP is planned to utilize the existing irrigation dam as lower reservoir, and its upper reservoir is planned to be newly constructed. According to the minute of the abovementioned meeting, this PSP will be commenced after the completion of the DPR for Bandhu PSP.

4) Kathlajal PSP

According to the abovementioned presentation, this PSP is also categorized in Identified stage, and its installed capacity is estimated as 900 MW. However, it is found in the discussion with WBSEDCL that the project site is located in Mata Reserved Forest, so that WBSEDCL regards this PSP as impracticable.

5) Boro PSP

Boro PSP is found in the project list titled as "PSH Sites identified by CEA" which is annexed to the base paper for workshop on pumped storage development and integration with renewable energy held on 27th October 2015[52]. According to WBSEDCL, this PSP isn't WBSEDCL's

[50] WBSEDCL, PSPs planned in West Bengal, 27th October 2015

[51] Minutes of CEA's Meeting on PSPs held on 20th June, 2016

[52] Central Board of Irrigation & Power, Base Paper for Workshop titled as "Pumped Storage Development and Integration

project, so that the status is unclear.

6) Panchet Hill PSP

This PSP is planned by Damodar Valley Corporation (DVC) who is a government organization which operates several power stations in the Damodar River area ranging from West Bengal state to Jharkhand state. According to DVC, this PSP is very initial stage, so no action has been conducted for the development.

7) Panchet PSP

This project is also DVC's. According to DVC, this plant is currently operated as conventional hydropower plant because the lower dam hasn't been constructed.

(4) Social and Natural Environmental Aspects of Pumped Storage Projects planned in West Bengal

Turga has already prepared EIA and now waiting for the Environmental Certificate. The locations of the other projects are not clear.

1) Turga

Turga PSP locates Puruliya District. New Upper Pond is planned and existing irrigation reservoir is expanded for the lower pond. Major land cover around the project site is Broadleaf Deciduous Forest, Crop land and Open forest. Scheduled Tribe rate of Puruliya District is 18.45%. Information of resettlement and land acquisition is not clear.

EIA report of Turga PSP was prepared and submitted to MoEFCC on 9th May 2016 and issued on 10th August, 2016 (Although it is conditional to the approval of Stage-1 Forest Clearance, this is considered practically formal issuance). The Environmental Certificate (EC) has not been granted yet. The project site is outside of the protected areas. The project locates 30 km from the known Elephant habitat. 1st Stage Request for the Forest clearance (FC) was submitted in 2013 but the FC has not been granted yet. Based on the EIA Report for Turga Pumped Storage Project, West Bengal (WBSEDCL, 2016) the affected forest area is 234 ha.

2) Bandhu

Bandhu PSP locates Puruliya District. New Ponds are planned. Major land cover around the project site is Broadleaf Deciduous Forest. Scheduled Tribe rate of Puruliya District are 18.45%. Information of resettlement and land acquisition is not clear.

EIA report of Bandhu PSP has not been prepared yet. The project site is outside of the protected areas. The project locates outside the known Elephant habitat. Forest clearance will be required. The affected forest area is not clear.

with Renewable Energy", p9, 27th October, 2015

3) Kurbera

Location is not clear.

4) Kathlajal

Location is not clear.

5) Boro

Location is not clear.

6) Panchet Hill

Location is not clear.

7) Panchet

Location is not clear.

Table 5.1.7-3 EIA process and Protected area of the projects in West Bengal State

Name of PSPs	Capacity (MW)	Project stage								EIA process	Domestic					International[53]							Tiger/ Elephant	Scheduled Tribe Rate	MOFA's "Overseas Travel Safety Information"	Remarks
		OP	UC	CEA	DPR	S & I	PFR	PIR	IDE		National Parks	Wildlife Sanctuaries	Conservation Reserves	Community Reserves	Tiger Reserve	Ramsar Site	UNESCO-MAB Biosphere Reserve	World Heritage Site	KBA	Endemic Bird Area	Biodiversity Hotspots	Alliance for Zero Extinction Sites				
1. Turga	1,000			○						EC issued														18.45%	Level 1	Forest Clearance is requested
2. Bandhu	900					O/G																		18.45%	Level 1	Location unclear
3. Kurbera	1,100								○																	Location unclear
4. Kathlajal	900								○																	Mata Reserved Forest, Location unclear
5. Boro	500								○																	Location unclear
6. Panchet Hill	600								○										I							Location unclear
7. Panchet	40	○																	I							Location unclear

[53] Locations of KBA, EBA, Biodiversity hotspots, and Alliance for Zero Extinction Sites are referred in IBAT (https://www.ibat-alliance.org)

5.1.8 Other States except the Above Seven States

Current situations of pumped storage projects found in other states except the above seven state are described as below. Incidentally, most of the PSPs are found in the project list titled as "PSH Sites identified by CEA" which is annexed to the base paper for workshop on pumped storage development and integration with renewable energy held on 27th October 2015[54]:

(1) Northern Region

Table 5.1.8-1 Pumped Storage Projects found in Northern Region

No.	State	Name of PSP	Head (m)	Installed Capacity (MW)	Current Situation
1	Jammu & Kashmir	Matlimarg	520	1,520	According to JKSPDC, this PSP isn't proposed by the state government, so the status is unclear.
2	Himachal Pradesh	Majra	221	1,800	According to HPPCL, the site isn't located in this state and isn't developed by HPPCL.
3	Himachal Pradesh	Renuka	315	1,800	According to HPPCL, DPR for 40 MW conventional hydel planned around Renuka has been prepared and submitted to CWC and CEA. TEC is awaited.
4	Uttar Pradesh	Jaspalgarh	190	1,935	According to UPRVUNL, this PSP isn't proposed by the state government. Currently, no PSP is planned in the state.
5	Rajasthan	Badrinagar	164	1,935	According to RRVUNL, these projects have been identified, but both sites exist in Sariska wildlife sanctuary, so survey & investigation are stopped.
6	Rajasthan	Barah	214	1,980	
7	Uttarakhand	Tehri	347	1,000	This is THDC's project, and the installed capacity is changed from 2,100 MW to 1,000 MW. The commissioning is planned in September 2019[55].
8	Uttarakhand	Ichari	493.6	50	PFR is probably completed. S & I for DPR is recommended[56].

(2) Southern Region

Table 5.1.8-2 Pumped Storage Projects found in Southern Region

No.	State	Name of PSP	Head (m)	Installed Capacity (MW)	Current Situation
1	Andhra Pradesh	Tigaleru	246	1,950	According to APGENCO, this PSP isn't planned by the state government. So, the status is unclear.
2	Andhra Pradesh	Sileru	N/A	N/A	PSP to use the existing Upper and Lower Sileru reservoirs is newly proposed. But, the project is very initial stage.

[54] Central Board of Irrigation & Power, Base Paper for Workshop titled as "Pumped Storage Development and Integration with Renewable Energy", p9-10, 27th October, 2015

[55] Outline of Tehri Pumped Storage Plant (1,000 MW)

[56] Rajendra Chalisgaonkar and Mukesh Mohan, Prospects of Developing Pumped Storage Projects utilizing the Reservoir of Existing Hydropower Project in the state of Uttarakhand, 2015

(3) Eastern Region

Table 5.1.8-3 Pumped Storage Projects found in Eastern Region

No.	State	Name of PSP	Head (m)	Installed Capacity (MW)	Current Situation
1	Bihar	Langupahar	363	2,800	According to BSPGCL, this PSP isn't proposed by the state government. So, the status is unclear.
2	Bihar	Sinafdar	135	345	These PSPs were stopped at PFR stage due to very high tariff[57].
3	Bihar	Telharkund	112.5	400	
4	Bihar	Hathiadah-	188	1,600	
5	Bihar	Durgawati	116	225	

(4) Western Region

Table 5.1.8-4 Pumped Storage Projects found in Western Region

No.	State	Name of PSP	Head (m)	Installed Capacity (MW)	Current Situation
1	Madhya Pradesh	Mara	205	1,100	All the PSPs cannot be developed due to issues on forest land, wildlife sanctuary or coal mines[58].
2	Madhya Pradesh	Binauda	290	2,250	
3	Madhya Pradesh	Kabra	182	1,200	
4	Madhya Pradesh	Tanbia	223	1,600	
5	Chattisgarh	Dangari	341	1,500	All the sites are located in Reserved Forest, so clearance for S & I hasn't been granted[59].
6	Chattisgarh	Rauni	260	2,500	
7	Chattisgarh	Suini	322	1,000	
8	Gujarat	Kadana	44	240	According to SSNNL, this plant is presently operated as conventional hydro due to vibration problem.
9	Gujarat	Sardar Sarovar	100	1,200	According to SSNNL, this plant is presently operated as conventional hydro because lower dam named Garudeshwar Weir is under construction. The construction of the weir is expected to be completed by 2018.

[57] Pumped Storage Projects identified in Bihar

[58] CEA, Presentation on "Hydro Power Development in India"

[59] CEA, Presentation on "Hydro Power Development in India"

(5) North Eastern Region

Table 5.1.8-5 Pumped Storage Projects found in North Eastern Region

No.	State	Name of PSP	Head (m)	Installed Capacity (MW)	Current Situation
1	Manipur	Tuivai	138	1,500	According to NEEPCO, the capacities of Tuivai and Hengtam are estimated as almost 1,500 and 500 MW respectively by initial desk study. However, further study has been stopped because of; - Distance to the international border; - High cost due to mainly new construction of upper & lower reservoirs.
2	Manipur	Hengtam	168	500	
3	Assam	Khuai Lui	187	2,100	This PSP is planned by NEEPCO. So, the status is unclear.
4	Mizoram	Lieva Lui	515	570	According to NEEPCO, all the PSP are at "idenfitied" stage. Tuitho Lui PSP has an issue on Reserved Forest. Tariff of PSP is expected to be high because tariff of pumping energy (conventional hydel) is high (12 to 15 INR/ kwh) as well as both upper & lower reservoirs are newly constructed. Consequently, NEEPCO has no intention to develop these PSPs at present.
5	Mizoram	Pakwa	500	1,000	
6	Mizoram	Tuitho Lui	530	1,500	
7	Mizoram	Mat	308	1,400	
8	Mizoram	Tuiphai Lui	643	1,650	
9	Mizoram	Nghasih	318	400	
10	Mizoram	Daizo Lui	1,070	1,200	

5.2 ANALYSIS OF CANDIDATE PROJECTS/STATES

5.2.1 Candidate Sites

The Study team had started the work to collect the candidate sites for PSPs initially from the disclosed data at the start of the study. Those included the list of Potential Pumped Storage Projects in India by Central Board of Irrigation & Power in October 2015, originally organized by CEA in 1987. It is shown in Table 1.2.3-2, chapter 1. This one was very aged data, the team had acknowledged the credibility deteriorated. Thus, the team independently had surveyed PSP sites in India in numerous media and institutions then compiling and reflecting those into the initial list "Potential Pumped Storage Projects in India gathered by JICA Study Team". It is shown in Table 1.2.3-1, chapter 1.

In the course of the study, the Study team has progressively revised the data through interviews made from time to time with the relevant agencies in the targeted states during April through August, 2016, as shown in the interviews schedule below.

Table 5.2.1-1 Stage 1 Survey Schedule

Stage 1; Basic Data Collection & 1st Stage Screening of Potential PSPs

Survey	Period	Visits	Purpose
1st Work Period in India	April 18th - April 28th, 2016	CEA, MOP, CERC, NTPC, NHPC, PFC, PTC, IEX, etc.	- Collect and analyze wide range of update data/information on Indian (central) power sector - Collect and analyze wide range of update data/information on targeted States power sectors - Review and screen (1st stage screening) the potential PSP candidate projects
2nd Work Period-1 in India	June 13th - June 30th, 2016	Maharashtra, Odisha, Telangana	
2nd Work Period-2 in India	July 18th - July 30th, 2016	Karnataka, Kerala, Tamil Nadu	
2nd Work Period-3 in India	August 15th - August 24th, 2016	West Bengal	

(The subsequent surveys for Stage 2& 3 attached for reference, colored in dark)

Stage 2; 2nd Stage Screening – Further Screening for Promising Sites

Survey	Period	Visits	Purpose
3rd Work Period in India	September 20th - October 1st, 2016	Odisha, West Bengal, Tamil Nadu	- Eliminate candidates which are judged un-exploitable (ie. behind other projects). - Extract promising sites from technical, economical, and social environmental aspects. - Conduct further state visits on candidate state agencies/governments for detailed necessary information and make evaluations on feasibility of each state/site for PSP development.

Stage 3; 3rd Stage Screening – Selection of the most Promising Site(s) and Examination on the Candidate Development Site

4th Work Period in India	October 24th - October 27th, 2016		- Select some (1-2) most promising states and project sites for PSP development. - Evaluate the possibility of Project Formation using ODA Loan by detail consultations, discussions and interviews with corresponding state agencies/governments. - Evaluate and compile requisite conditions for project development.
5th Work Period in India	November 14th - November 22nd, 2016	Karnataka, West Bengal, Meghalaya	

In the Stage 1 Survey, the Team excluded some of the candidate sites and added some other newly discovered sites. The team then finalized the PSP candidate sites list as of present (Sep., 2016) for further perusal. The project sites are listed in the following table.

The collected state wise information on state needs for PSPs and its financial status, briefs of each project, and s social and natural environmental aspects are detailed in chap. 5.1.

The exact communications of updated information for states were attached as the Stage 1 Survey interview minutes as in the Appendix.

Table 5.2.1-2 PSP Candidate Sites

State	Project Name	Output(MW)
Maharashtra	Warasgaon	4*300
Maharashtra	Panshet	4*400
Maharashtra	Varandh Ghat	2*400
Maharashtra	Nandgaon	500
Maharashtra	Kodali	2*110
Maharashtra	Malshej Ghat	2*350
Maharashtra	Humbarli (Koyna Stage V)	2*200
Maharashtra	Mutkhel	1*110
Maharashtra	Ghatghar Stage-II	1*125
Maharashtra	Chikhaldara	2*200
Maharashtra	Atvan	4*300
Maharashtra	Konya Stage-VI	2*200
Maharashtra	Nive	4*300
Maharashtra	Ulhas	1,000
Maharashtra	Pinjal	700
Maharashtra	Kengadi	1,550
Maharashtra	Jalong	2,400
Maharashtra	Kolmondapada	800
Maharashtra	Kalu	1,150
Maharashtra	Sidgarh	1,500
Maharashtra	Amba	2,500
Maharashtra	Chornai	2,000
Maharashtra	Savitri	2,250
Maharashtra	Madliwadi (Madhaliwadi)	900
Maharashtra	Baitarni (Vaitarni)	1,800
Maharashtra	Morawadi	2,320
Maharashtra	Gadgadi	600
Maharashtra	Kundi	600
Maharashtra	Aruna	1,950
Maharashtra	Kharari	1,050
Maharashtra	Jalvara (Jalware)	2,000

State	Project Name	Output(MW)
Odisha	Upper Indravati	4*150
Odisha	Upper Kolab	4*80
Odisha	Balimera	4*100
Odisha	Jharlama	2,500
Telangana	Nagarjuna Sagar	7*100.8
	Srisailam Left Bank	900
	Icchampally	975
Karnataka	Sharavathy PSP	450, 800, 900, 1,000
Karnataka	Varahi PSP	700 (250, 600, 1,000)
Karnataka	Kali PSP	600, 1,000
Karnataka	Kollur	900
Karnataka	Minhole	2,200
Karnataka	Sitanadi	2,600
Karnataka	Hulagi	2,200
Kerala	Pallivasal	600
Kerala	Idukki (Idukki- Malankara)	1,100
Kerala	Idukki (Idukki- Marmala)	450
Kerala	Idukki	300
Kerala	Kerala-1 (Kakki/Upper Moozhiar-Moozhiar)	375
Kerala	Kerala-4 (Ponmudi-Kallarkutty)	250
Kerala	Kerala-5 (Sengulam-Kallarkutty)	200
Kerala	Kerala-6 (Kallarkutty-Lower Periyar)	200
Kerala	Kerala-7 (Peringalkuth-Idamalayar)	350
Kerala	Sholayar II	390
Kerala	Kerala-8/Sholayar and Idamalayar reservoirs	900
Kerala	Sholayar I	810
Kerala	Kerala-9 (Kakkayam-Peruvannamoozhi)	900
Kerala	Kuttiyadi	2,400
Kerala	Kerala-10 (Pazhassi sagar)	200
Kerala	Pringalkuthu	80
Kerala	Edamalyar	2,000
West Bengal	Panchet Hill	600

State	Project Name	Output(MW)
Tamil Nadu	Kundah	500
Tamil Nadu	Sillahalla	2,000
Tamil Nadu	Vellimalai	200
Tamil Nadu	Kodayar	500
Tamil Nadu	Manalar	500
Tamil Nadu	Mettur	500
Tamil Nadu	Nallar	2,700
West Bengal	Turga	1,000
West Bengal	Bandhu (Bandu)	900
West Bengal	Kathlajal	900
West Bengal	Kulbera	1,100
West Bengal	Boro	500
West Bengal	Panchet	40
West Bengal	Panchet Hill	600

source: JICA Team

5.2.2 Site Selection Criteria

In the Stage 1 site selection, the generally accepted terms have been considered as the criteria of extraction. However, as this Study is in principle “desk top” study which does not include site surveys, some of the items are hard to collect. Furthermore, the Study team found majority of the candidate projects remain at the “immature” stage that made detailed economic analysis impractical.

In order to select candidate projects, the criteria for screening was established, which was focused on the following items; (a) technical aspects, (b) economical aspects, (c) social and environmental aspects, (d) state power sector status, (e) state governmental supports, plus (f) Intention for Japanese Yen Loan, (g) Opportunity for Japanese companies participation, etc.

Each item includes ;

(a) ; technical aspects are including ; (i) output, (ii) design head, (iii) new reservoir (presence or absence), (iv) stage of development, (v) others,

(b) ; economical aspects are including ; (i) project costs, (ii) project cost/MW (INR/kW), (iii) Levelized Tariff (INR/U), generation costs, EIRR, or other indicative economics index. It is acknowledged most of immature projects are unable to present such figures.

(c) ; social and environmental aspects are including ; (i) security, (ii) protected area such as “national parks”, “wildlife sanctuaries”, “World Heritage Sites”, “reserved forests”, etc., (iii) animals habitats of Elephant and Tiger, (iv) Scheduled Tribes, (v) land acquisition, (vi)

settlements, (vii) obstacles against development like NGOs, agitations, (viii) other environment issues, etc.

(d) ; state power sector status are including ; (i) necessity/justification of PSP (from power supply demand, power purchase/retail market, conventional/renewable generations, etc.), (ii) Discom's financial debt status, etc.

(e) ; state government supports are including ; (i) state power/energy department support, (ii) adequate budget provisions in the state plan, (iii) state finance department support, (iv) debt-sustainability clearance, (v) consistency with the priorities of the state governments (such as the current Five Year Plan, power development plan), etc.

(f) ; Intention for Japanese Yen Loan, and

(g) ; Opportunity for Japanese companies participation

are preliminary items for screening projects and these shall be revisited in Stage 2.

In this stage, terms such as "site accesses", "transmission lines" are not included as those are driven after the actual site reconnaissance surveys are done. In the same way, due to unavailability of information, we considered not to include "status of upper stream, downstream project", "water right issues", etc. in systematic ways.

For the Stage 2 onwards, the viable pumped storage projects are selected in more light of the following issues in the successive interviews with relevant agencies. The stage 2 analysis is detailed in chap 6.

- A project is hopeful to set up as yen-denominated government credits;
- A project is considered in which Japanese company has advantage in comparison to foreign company;
- State is positive for foreign debt.

etc.

On the basis of the above criteria, 4 states were selected for the later stage (Stage 2).

- ✓ Odisha,
- ✓ Karnataka
- ✓ Tamil Nadu,
- ✓ West Bengal,

Analysis items details are as follows.

(1) Technical aspects

Desirably, technical matters covering areas of hydrology, geology, design, electro-mechanical system, power system, etc. shall be examined. But in this Study, most of the projects are very immature stage such as some are having PFR reports, only a few having DPR reports. Most were lacking the detailed information. So, it is considered suitable not to investigate details of the designs unless necessary, but rather appropriate to put emphasis on development stage.

1) Output

Though the capacity of PSP is designed rather large, it is generally accepted the economy of PSP improves as the installed capacity increases. While it enlarges envionmental considerations and the capacity has its upper limit from regional/state grid size (to maintain stability when tripps). Hopefully 500-1,000MW capacity is expected as a rule of thumb.

The scale merit of installed capacity is adopted as a criterion.

2) Design head

Some projects (in Tamil Nadu and Karnataka) have an excessive height in rated head. It is profitable but technically increases difficulties. In additions, Japanese manufacturing companies haven't experienced larger head than some 700m (728m pumping head for Kannagawa PSP). It is considered a serious disadvantage for Japanese companies' participation to the Japanese Yen Loan project. Hopefully the head no larger than 800m is expected.

3) New reservoir (presence or absence)

It does not affect the project design quality essentially. However the feasibility of project is largely influenced as new reservoir results in emergence of new submergence zones plus potential forest compensation, resettlement, impacts on flora-fauna, etc. During Pre-feasibility stage, Prior Environmental Clearance and Village consent are required now for hydroelectric power generation Category A: no less than 50 MW. The approval for prior environmental clearance is more time consuming in new reservoir project thus even preliminary survey and investigation may require further period of time to initiate. That is why many states have been prioritizing such PSP projects utilizing existing reservoir(s). In general utilizing both (upper and lower) existing reservoirs can be evaluated to lead less hurdled, ie., more feasible project.

4) Stage of development

The team categorizes stages: Identified stage, Preliminary investigation stage (PIR), Pre-Feasibility stage (PFR), Survey & investigation stage (S&I), Detailed Project Report stage (DPR), and it is continuing to Detailed Design stage (DD), Construction stage, and Operational stage. If the scale exceeds 1,000 Crores CEA concurrence (TEC) is required after DPR. Sometimes executing agencies use the terms in confuses unintentionally or intentionally, so the team classified each project based on collected information.

As scheme of Japanese ODA such as the technical assistance can be applied from early stage, e.g. preparation of PFR or DPR, so the stage of development is not decisive element. But in Central government norms, the project implementing agencies (PIAs) should send preliminary project report (PPR) and all the requisite details in the prescribed format to the central line ministry for ODA application. It is considered PFR as the implication of PPR, but not exactly obvious (there are often utilized as DPR with exceptions by MOP). In thinking of timely commitment of Japanese Yen Loan, certain developed stage projects are advantageous for approaching central government.

Required NOC and Clearances are different from the project stages. During Pre-feasibility stage, Prior Environmental Clearance and Village consent are required. During DPR stage, 1st Stage Forest Clearance, Environmental Clearance and other Clearances are needed.

The study team confirmed stage level of each project from the agencies. Those reports were

attempted to collect. However, some projects were rejected for reasons that it is difficult to submit

the report to third party before decision of financing. In some cases it implies the incredibility of project study level that for particular project in the identified stage agencies may have claimed it PFR stage to attract attention from JICA.

5) Others

(2) Economical aspects

According to the documents or reports submitted by the agencies and replies of questionnaires project cost and tariff etc. of each project are confirmed/estimated. It includes

1) Project costs,
2) Project cost/MW (INR/U),
3) Levelized Tariff (INR/U), generation costs, EIRR, or other indicative economics index as available.

It is acknowledged most of immature projects are unable to present such figures.

(3) Social and environmental aspects

India has an environment rich in biodiversity. There are a lot of conservation areas such as national

parks and wildlife sanctuaries in India. Here, the relationship between project area and conservation area, existence precious species, etc. is selected as items used in the evaluation of natural environment impact.

Until the early 2010s, MoEFCC (then MOEF) had been strict ever for development such as abolishing "In-principle approvals" used to be given with a set of conditions that have to be fulfilled before the final clearance. Now MoEFCC has reportedly[60] taken a number of policy and procedure related decisions which have reduced the weighted average time taken in granting Environment Clearances. However at the same time, it has been keeping strict stance for relaxing regulations although central power ministries had been trying to do the same, like that MoEFCC tightens position to give Environmental Clearance only after approval of Forest Clearance.

Each item below is essential for feasibility of any project.

[60] Economic Times, April 2, 2016.

1) Security,

Security aspect should be checked in order to execute hydro power project. But not much information is available so MOFA's "Overseas Travel Safety Information" is used. Level 2 (Avoid Non-essential travel) covers Maharashtra state, Odisha state, Telangana state and others.

2) Protected area such as “national parks”, “wildlife sanctuaries”, “World Heritage Sites”, “reserved forests”, etc.,

3) Animals habitats of Elephant and Tiger,

A large amount of area around the Protected Areas of the country had been in the prohibited or regulated zone on account of the default condition of 10 km radius applied to all Protected Areas in the absence of specific notifications for such areas as was required to be done under the National Wildlife Management Plan.

In case of Western Ghat, the "non-tolerance" policy towards prohibiting "highly interventionist and environmentally damaging activities" may possibly be applied even for hydro power projects.

If located in 5 km ESZ, or within 10-15 km from boundary of NP or Sanctuary, Wildlife NOC is required.

If Forest area or wild life area is affected, Forest Clearance/ Wildlife clearance is required.

4) Scheduled Tribes,

If Scheduled Tribe population is affected, Clearance of REHABILITATION AND RESETTLEMENT (R&R) PLAN is required. In case located in Scheduled area more than 50% tribal population (such as parts of Odisha), village consent or consent from Gran Sabha is required.

5) Land acquisition,

6) Resettlement,

As of now, Land Acquisition, Rehabilitation and Resettlement Act, 2013 applies to the compensation of the land acquisition. However compensations to farmers have become serious issues. 70-80 % consensus is required plus compensation cost becomes too high. A new amendment bill 2015 has been introduced on the table in the congress to improve (from government point of view) situation but failed to pass the congress. Now big states, most of those ruled by the Bharatiya Janata Party (BJP) and its alliance partners are said to seek themselves from the logjam over amendments to the contentious land acquisition Bill 2013 by proposing to bring their states own laws for boosting infrastructure development. It is underway[61].

7) Obstacles against development like NGOs, agitations,

Large hydro power developments sometimes have become stalled and abandoned from peoples

[61] Times of India, etc. July 16, 2016

opposition. Gundia (Karnataka), some projects in Northeast region have given up.

8) Other environment issues, etc.

(4) State power sector status

1) Necessity/Justification of PSP (from power supply demand, power purchase/retail market, conventional/renewable generations, etc.),

Increase of power (energy and demand) and foreseen power balance determines the future power development, including the necessity for adjusting power balance by PSPs.

The increase of renewables (which is the mandatory in each state) may challenge the stability of power grid for which PSPs can contribute as the grid stabilization system. It helps the introduction of Renewables in each state.

Benefit of PSPs is valued on reducing power purchase in peak hours, reducing penalties against lowering base thermal output in off-peak hours, and balances of power market (purchase cost and tariff price) as well. There is an option to have PSPs attaining the "economic operation" (ie., purchase or obtaining cheap power for pumping and sell it in higher priced market, PPA, bilateral trade). Generally speaking it is unclear for Gencos or Discoms to do the same at present low power market but they may pursue it (or may have been doing time to time) when opportunities arise.

2) Power sector status

The state budget, allocation to the power sector should be considered. Discom's finance status indicates the reluctance of Discoms to purchase power and/or inability which affects the payment security of power trade of Discom's PPA, bilateral trading, etc.

(5) State government supports

Not all related departments are unanimously supporting PSPs. The followings are considered.

1) State power/energy department support,

PSPs executing agencies (Genco, Discom, Water resource department, etc.) sometimes have not got consensus from other power proponents (like Discom as PPA proponent) or state government power/energy department, especially in early stages.

2) Adequate budget provisions in the state plan,

State budgetary allocation to power sector in general, or nomination of specific PSP project in state budget is an index of state policy for power sector and PSPs.

3) State finance department support,

State finance department's recognition of the projects, expression of support of the projects, and desirably expression of interest for Japanese Yen Loan is the index of proceeding project.

4) Debt-sustainability clearance,

The States are required to remain within the borrowing ceiling fixed by the Ministry of Finance each year and also the fiscal deficit limits & debt to GSDP norms. In case requirement of loans tend to breach the overall borrowing ceiling of the State during the loan disbursal period the State will be required to substitute an otherwise agreed source of borrowing so as to remain within the net borrowing ceilings. The debt status is an index for position of state finance department and state government for external loan.

This should be careful however, that if the debt condition is acceptably good, then central government (DEA) may urge such state to utilize domestic finance, REC, PFC, or other financial markets by its own risk, and not approve pursuing low interest external loans.

5) Consistency with the priorities of the state governments (such as the current Five Year Plan, power development plan), etc,

Overall consistency can be valued if PSP projects are in the current Five Year Plan, power development plan of the state government.

(6) * Intention for Japanese Yen Loan *

(7) * Opportunity for Japanese companies participation *

*(6) *and *(7) * are the "preliminary" intentions of executing agencies and state finance department is to be confirmed in the Stage 1. These are revisited in Stage 2-3.

5.2.3 Site Selection

All the above was considered and evaluated by the JICA team. Project data in screening after Stage 1 survey is shown in the following Tables (Table 5.2.3-1, 2).

The following states and projects were selected as candidate projects for Stage 2 as a conclusion. (Note that the below information was at the end of Stage 1 survey as of August, 2016. These were revised in the Stage 2).

Table 5.2.3-1 Selected PSP States and Sites in Stage 1

(1) Odisha

- Upper Indravati (600MW) (1st priority in the state) : DPR underway. Odisha (OHPC) is Showing interest in JICA loan.
- Upper Kolab (320 MW), Balimera (400MW) : PFR completed.

(2) Karnataka

- Sharavathy (450, 800-1,000MW) (1st priority in the state) : DPR tender awaited. State Finance dept. is not affirmative on external loans.
- Varahi (700MW) : ditto.

(3) Tamil Nadu

- Kundha (500MW) : Construction stage. REC funded under Fixed type PS machine.
- Sillahalla (2,000MW) : DPR (phase 1) to be completed. Head 1,500m is too large.
- Mettur (500MW) : PIR stage.

(4) West Bengal

- Turga (1,000MW) : TEC letter awaited. MOP be contacted for listing "Rolling Plan".
- Bandhu (900MW) : S&I stage but DPR planned tendered.

At this Stage, Odisha (OD), and West Bengal (WB) are the candidates.

Karnataka (KN) is not prospective from the state finance division's negative stance. Tamil Nadu (TN) is not prospective either, as its prioritized project is hard for Japanese manufactures to participate. But either or both Karnataka (KN) and Tamil Nadu (TN) are decided to be traced and revisited expecting change in situations in future, though they seem less prospective at the moment.

It is outside of the scope of the Study, but the Study team may need to conduct "site visits" in some stages.

The details of each state are as follows.

(1) Maharashtra

The executing agency GOMWRD has proposed many PSPs as candidates. GOMWRD commented itself has studied some PSPs to PFR, S&I stages, one at DPR stage.

JICA team considers the biggest hurdle seems that state energy department does not support PSPs development at the moment. Unless the situation is improved, it is hard to put projects forward for Japanese Yen Loans.

(Plus, though GOMWRD told the team that PFRs were completed for some sites, those PFRs were not provided. Those maybe remain as PIR level reports.)

- GOMWRD commented Warasgaon (1,200MW) is at DPR stage, and Panshet (1,600MW) and Varandah Ghat (800MW) are at S&I stages. However it commented S&I were stopped because of the local people's oppositions.

  (JPOWER had conducted those study at PFR level. But the team recognized they are all now at S&I levels. The environmental issues are known to certain level)

- GOMWRD commented Kodali, Muthel, GhatgharII, Chikhaldara, Atvan, and Nive were at PFR completed. However the reports were not provided against several requests. (The Team now considers there were not much hope to obtain those.

- GOMWRD considers the state will face serious power deficit in rapid demand growth so PSPs as peak power supply is required. But it considers that the state government (including Energy dept. and MAHAGENCO) does not take PSPs as necessary and thermal powers would suffice the needs of supply. GOMWRD said it keeps "preparing projects on the shelf" for the future when opportunity arises.

- JICA team had tried to contact Energy department through GOMWRD since previous 2012 Study of Maharashtra M/P. But till present it was unsuccessful. The state obviously has many potentially promising sites even outside protected areas. JICA team considers it necessary to keep contacts with GOMWRD and should keep trying to reach Energy department, but also does not believe the team can change the state situation within this Study timeline.

(2) Odisha

The executing agency OHPC has proposed Upper Indravati, Upper Kolab and Balimela as candidates.

- OHPC completed PFR of Upper Indravati (600MW). DPR is underway. OHPC commented it would be completed in 6 months at the beginning. (It changed it time to time later.)

  (JICA team considers it takes much longer time from the information from WAPCOS, DPR consultant. Furthermore, environmental issues are unaware by OHPC. It seems up to WAPCOS.)

- Balimela (400MW), Upper Kolab (320MW) ; OHPC commented PFRs were completed. But it so far has not proceeded those to the next stages. Environmental issues were unaware by OHPC.

  (JICA team considers those are behind Upper Indravati but decided to be left for further reviews.)

- Jharlama ; It was not acknowledged by Odisha state. Out of concerns of the state.

(3) Telangana

The executing agency TSGENCO has proposed no PSPs as candidates. (JICA team considers it is rather negative in promoting new PSPs at the moment. It may be because lack of potential sites under the circumstances irrigation requirement is regarded important.)

(4) Karnataka

The executing agency KPCL has adopted PSPs as Sharavathy, Kali, Verahi the candidates but regarded Kali less feasible and has dropped it. Those 3 sites are the existing reservoir hydropower plants and KPCL considers new PSP project without utilizing existing reservoirs are extremely difficult to achieve in scheduled time.

- Karnataka has PSP development target of 1,000 MW. This was set as the required realistic capacity to control and stabilize grid considering the rapidly increasing renewable capacity. (The JICA Study team confirmed it in Energy department as well.)
- KPCL considers 1,000 MW suffices for the time being to meet renewables. KPCL put 1st priority on Sharavathy PSP as it has least environmental issues, etc. In case Sharavathy does not reach 1,000 MW alone it moves to develop Varahi PSP.
- KPCL commented DPR tenders for these 3 PSPs would be released soon in the interviews in July, 2016. (However, the Study team considers it doubtful, and it would be optimistic prospect and be delayed.)
- The scope of DPR includes the output capacity, layout, etc. of PSPs. It plans to prepare DPR in 18 months.
- KPCL believes no TEC approval process is required as it plans to complete the project within 1,000 Crores. Such projects in its view is outside of TEC. (The Study team confirmed it in official central government documents but is still unsure if CEA/MOP admits it).
- KPCL admits EC and FC are barriers difficult to surmount in Karnataka hydro development. Thus it commented it has chosen candidates so as to avoid environmental obstacles as much as possible. Sharavathy is the site having the least problems, such as both reservoirs are existing and has avoided environmentally problematic areas. (The Study team tried to confirm protected areas but no data was obtained.)
- KPCL left it unforeseeable if PSP development may cause NGO oppositions etc. (the team pointed that Karnataka is a state which experienced severe oppositions from agitations, NGO, local residents in Gundia HPS).
- KPCL believes power surplus in 2018. KPCL said tariff revision was being done regularly.

<u>CONS</u>

- State finance department was against further utilizing external loans rather is in the view KPCL should seek domestic funds (REC, PFC) or ways not increase state fiscal deficit. KPCL has not obtained consensus from the state finance department.
- Karnataka finance department had rejected to utilize Japanese Yen Loan in the Bangalore Outer Ring Road Project on the same reason. At the same circumstances of the state finance division, the team considers it remains the big hurdle for KPCL to overcome.

- KPCL has not contacted environmental division of the state yet. The Study team tried to confirm protected areas but data provision was refused from state Wildlife Division. As for Sharavathi, KPCL commented it outside. It seems that way from what the team collected in public sources. But it should be confirmed directly from the concerned division in later stage.

(5) Kerala

The executing agency KSEBL has expressed willingness to utilize Japanese Yen Loan for its PSP projects. They presented many PSP plans. However the JICA team found most of them are very preliminary, even at identified stages. No candidates are selected at this stage. Also, it is considered difficult for the state to obtain finance from a viewpoint of fiscal management of the state as it suffers from fiscal deficit.

- KSEBL stated Idduki (300 MW) as PFR stage and S&I is underway. But the team considers it as still early to evaluate as it began 2 months back. Pallivasari was proposed by the state to CEA but the team considers it remains very early stage (though KSEBL sometimes had commented they are PFR completed). Others are all very early stages of development.
- Kerala lacks its own power capacity. Its own power is the large reservoir hydro plants of 2,000 MW. But the large hydropower was fully developed. Now all new power developments are dependent on the allocations from central utilities. The actual peak supply and energy supply are impossible without CGU supplying more than 50%, and this is considered unchanged.
- The team considers the necessity for its own state power exists. It might be economically feasible as cost of off-peak hydro power is less 1 INR/U if it supplies peak power at high tariff or high in market.
- Introduction of renewables are small and the team found it restrictive in the future against its target.
- The KSEBL expressed wishes to have PSPs. It seems easier state government to be persuaded and unanimous to apply Japanese Yen Loan application to the central government. But the PSPs necessity has not been justified and it is not persuasive to central MOP. Cheap base load power source development maybe put more priority in the state.
- Besides the state remains in the large debt stock and fiscal deficit, which makes the state to be able to seek external finance.
- From JICA information, the government administration is weak and projects had largely delayed in the past, and corruptions had occurred in the past too. It is not favorable.

(6) Tamil Nadu

The executing agency TANGEDCO has expressed interest to utilize Japanese Yen Loan for its PSP projects. They presented Kundah, Sillahalla, and some other PSP plans. However the JICA team

found Kundah has been funded by REC, and Sillahalla and some other PSPs have its head far beyond Japanese manufactures experiences. The team confirmed TANGEDCO puts priority on developing ongoing Kundah and Sillahalla, but also keeps developing PSPs more. Other 3 sites are in investigation stages. Among 3 sites, Mettur only applies the limit of applicable PSP head of Japanese manufacturers. But Mettur comes after Prioritized 2 PSPs so it would be in float some time.

- TANGEDCO has expressed state government has approved and set the PSP introduction clearly in its state cabinet. The state defines its purpose of PSPs as Power storage, Peaking power supply, and Grid stabilization. (JICA team confirmed this in budget speech of the state congress, etc.)
- TANGEDCO commented the power supply condition has been improving and almost reached surplus status. The state has plenty potential of renewables and continues to develop renewables and TANGEDCO expressed the state circumstances are ready to accept such high cost PSP power supply plants of its own. (The JICA team approves it. However it has kept supplying huge subsidies and left Discoms in huge debt as well.)
- KPCL commented it would welcome JICA loans in the phases after phase 2 of Kundah, but it would continue development no matter what without support of JICA. As for Sillahalla, TANGEDCO commented it is still open for JICA fund acceptance.
- The finance department commented the state has been keeping and will maintain 3% of fiscal deficit ceiling limit, and it would be little risk to violate it with further external funds as Tamil Nadu has a large GSDP growth. The finance division encouraged the team to hurry as ADB and WB show their interests. It considers JICA loan favorable with its low interests and long replayment period.

1) Kundah (500MW)

- ✓ Targetted at 2021 completion. TANGEDCO plans to prepare EM & CIVIL tender by 2017.
- ✓ EC obtained. There is no resettlement.
- ✓ Phase 1 (upper damsite, etc.) as well as phase 2 (powerhouse, conductor system) do not require TEC approval.
- ✓ Phase 1 already funded by REC so if JICA takes it needs to be revoked.
- ✓ Already “Fixed Machines” were selected in DPR. (JICA team considers it is less likely to replace it to “Variable Type”)

2) Sillahalla (2,000MW)

- ✓ Finance is open from phase 2 project. It exceeds 1,000 Crores that requires TEC approvals from central government.
- ✓ Output or layout is not fixed. The TOR of DPR (phase 2) is decided after DPR (phase 1). DPR (phase 1) would be completed soon and submitted state government for approval. DPR (Phase 2) tender may be prepared in around 2017/April.

- ✓ The experiences in the world had TANGEDCO decide the design head as 1,500m. But if required it may change output and/or head. (TANGEDCO implied it is possible to lower the head within the feasible range reachable by Japanese manufacturers)

  (JICA team consulted with Toshiba about its availability to adopt high head PSP machine. The reply was not hopeful. JICA team considers thus it would be difficult to let the state reconsider its1,500 m head.[62])

3) Kadayar, Manalar, Mettur

- ✓ All 500 MW, and TANGEDCO commented all in investigation ongoing. (JICA team considers they are all PIR stages. Kadyar and Manalar exceeds their head over 1,000m, so they are outside of the scope for Japanese Yen Loan).
- ✓ Mettur has design head of 208m. (But JICA team presumes it probably is coming up c for DPR stage some years later at earliest as TANGEDCO clearly comments it prioritizes Kundah and Sillahalla.)

(7) West Bengal

The executing agency WBSEDCL has 3 PSPs sites Turga, Bandhu, and Kulbera as candidates. It expressed willingness to utilize Japanese Yen Loan for its Turga PSP project.

- ➢ The finance vision commented the state is well within 3% of Fiscal Deficit limit thus there is no hurdle to pursue external loans. The priority of loans lies in Drinking water, Roads, Power, Inland waterway, Ports. It also stated that the state has not determined any funding source for Bandhu yet as it is still investigation stage. Japanese Yen Loan attracts state but WB and ADB keeps the state as well.
- ➢ The renewables target of the state is 4,322MW by 2022. (JICA team considers the state does not have any concrete feasible plan in addition to unavailability of grid stabilization plan except PSPs.)

1) Turga (1,000MW)

- ✓ DPR completed. Approved by CEA on August, 2016. TEC letter from CEA awaited at the time of visti on September, 2016. (Later, TEC was issued on 5th October, 2016.)
- ✓ WBSEDCL commented contacting action to MOP by state government is ready to initiate. (As on January, 2017, WBSEDCL has been conducting the explanations in the state government).
- ✓ WBSEDCL expressed wishes to introduce JICA loan for Detailed Design and Construction.

[62] On December, 2016, the state chief minister J. Jayalalithaa passed away. As she stayed in the position for long, the situation of the state government needs to be carefully monitored. (January, 2017)

2) Bandhu (900 MW)

- ✓ WBSEDCL commented Bandhu comes next to Turga, but it expects COD in 2025 – 2030 at earliest.
- ✓ WBSEDCL also commented it is in S&I stage. It plans to tender DPR preparation work in appropriate timing.

3) Kulbera (1,100MW)

- ✓ WBSEDCL said it still at an "identified" stage. It plans to utilize an existing irrigation dam/pond as lower reservoir and to construct a new upper reservoir.

4) Kathlaj (900MW)

- ✓ WBSEDCL took up this project but expressively considered it is within boundary of Reserved Forest. WBSEDCL kept this "Identified" and commented no intention to proceed at the moment.

5) Boro (500MW)

- ✓ Outside of concern of WBSEDCL. It was selected by CEA.

6) Panchet (40MW), Panchet Hill (600MW)

- ✓ They are DVC projects. Panchet is operation already and Panchet Hill is in an early stage.

It is not meaningful at this stage to pursue "ranking study" on allocating points to each evaluation as many sites are lacking information. However, as a trial, the JICA team just conducted rough point allocations to each project.

The point allocations are assumed and conducted as below. In each evaluation, multiplier is applied to A; 1.0, B; 0.6, C or N/A, ND ; 0.2.

- Technical Evaluation ; 20
- Economical Evaluation ; 20
- Social & Environmental Evaluation ; 30
- State Power Sector status ; 10,
- State Government Support Evaluation ; 20

(The team allocates Social & Environmental Evaluation highest. Intention for Japanese Yen Loan, and Opportunity for Japanese companies are omitted on purpose, because it is not clear if they disclosed the true intentions to the JICA team.)

As a trial result, the projects which records above 60 are,

- Warasgaon ; total 64
- Upper Indravati ; total 88
- Sharavathy ; total 64

- Varahi ; total 64
- Kundah ; total 88
- Sillahalla ; total 68
- Turga ; total 88
- Bandhu ; total 72

The result shows almost the same result described in above. Warasgaon in Maharashtra shows high score indicating potential advantage of the site. This was decided to be dropped in Stage 1, but the state has the largest PSP potential among all states so it is awaited that it changes the direction of the wind.

Table 5.2.3-2 Stage 1 Survey Project data for screening (9-1)

State	Project Name	Technical Evaluation							Economical Evaluation				
		Output(MW)	Design head (m)	Reservoir (existing, new)	Remarks	Stage	Commissioning Year	Evaluation	Project cost (Cr)	Project cost/MW (INR/kWh)	Levelized Tariff (INR/U), etc.	Evaluation	Upper Dam
Maharashtra	Warasgaon	4*300	501	UD : New LD : New	PFR completed (JICA, 2012) PFR approved. DPR preparation on progress	DPR stage	N/A	A	5543Cr (for1,000MW)	55,430	EIRR13.6%	B	Pune district
Maharashtra	Panshet	4*400	555	UD : New LD : New	PFR completed (JICA, 2012) PFR approved. PIR underway but suspended.	S&I stage	N/A	A	7015Cr for 1400MW	50,107	EIRR16.4%	B	Pune district
Maharashtra	Varandh Ghat	2*400	508	UD : New LD : New	PFR completed (JICA, 2012) PFR approved. PIR underway but suspended.	S&I stage	N/A	A	5036Cr for 1100MW	45,782	EIRR19.2%	B	Pune district
Maharashtra	Nandgaon	500	N/A	N/A	rejected in JICA survey due to Reserved Forest	Cancelled	-	C				C	N/A
Maharashtra	Kodali	2*110	525	UD : Ext LD : Ext	PFR completed. Detailed survey yet to be taken. PFR not provided to team.	PIR (PFR completed)	N/A	C	1760Cr	80,000	9.0489 INR/U (cost of generaion)	C	Kolhapur District
Maharashtra	Malshej Ghat	2*350	396	UD : New LD : New	DPR completed & submitted in 2010	DPR completed	FY2017-18	A	2695.26Cr	38,504	2.89, as per Draft DPR	A	Pune district
Maharashtra	Humbarli (Koyna Stage V)	2*200	320	UD : New LD : Ext	PFR Completed in 1996. S&I/DPR only after a firm commitment on GoM.	PIR (PFR completed)	N/A	B	838.92 Cr	20,950	2.3628 INR/U (cost of generaion)	A	Satara district
Maharashtra	Mutkhel	1*110	N/A	N/A	PFR completed. Or Very early stage (GOMWRD). PFR not provided to team.	PIR (PFR completed)	N/A	C				ND	Ahmednagar District
Maharashtra	Ghatghar Stage-II	1*125	N/A	UD : Ext LD : New	PFR completed. Or Very early stage (GOMWRD). PFR not provided to team.	PIR	N/A	C				ND	Ahmednagar District
Maharashtra	Chikhaldara	2*200	N/A	N/A	PFR completed. Or Very early stage (GOMWRD). PFR not provided to team.	(presumed) PIR	N/A	C				ND	Amrawati district
Maharashtra	Atvan	4*300	N/A	N/A	PFR completed. Preparation of DPR approved but not started.PFR not provided to team.	PIR	N/A	C				ND	Pune district
Maharashtra	Konya Stage-VI	2*200	409	UD : New LD : Ext	PFR completed. Preparation of DPR approved but not started. Or Very early stage (GOMWRD). NHPC shows interest.	PIR	N/A	B	1,700	42,500	B/C=1.89	B	Satara district
Maharashtra	Nive	4*300	N/A	UD : Ext LD : New	PFR completed. Or Very early stage (GOMWRD). PFR not provided to team.	PIR	N/A	C				ND	Pune district
Maharashtra	Ulhas	N/A	N/A	-	Rejected by JICA Study (2012) due to Reserved Forest	Cancelled	-	C				ND	
Maharashtra	Pinjal	N/A	N/A	-	Rejected by JICA Study (2012) due to Reserved Forest	Cancelled	-	C				ND	
Maharashtra	Kengadi	N/A	N/A	-	Rejected by JICA Study (2012) due to Reserved Forest	Cancelled	-	C				ND	
Maharashtra	Jalong	N/A	N/A	-	Rejected by JICA Study (2012) due to Reserved Forest	Cancelled	-	C				ND	
Maharashtra	Kolmondapada	N/A	N/A	-	Rejected by JICA Study (2012) due to Reserved Forest	Cancelled	-	C				ND	
Maharashtra	Kalu	N/A	N/A	-	Rejected by JICA Study (2012) due to Reserved Forest	Cancelled	-	C				ND	
Maharashtra	Sidgarh	N/A	N/A	-	Rejected by JICA Study (2012) due to Reserved Forest	Cancelled	-	C				ND	
Maharashtra	Amba	N/A	N/A	-	Rejected by JICA Study (2012) due to Reserved Forest	Cancelled	-	C				ND	
Maharashtra	Chornai	N/A	N/A	-	Rejected by JICA Study (2012) due to Reserved Forest	Cancelled	-	C				ND	
Maharashtra	Savitri	N/A	N/A	-	Rejected by JICA Study (2012) due to Reserved Forest	Cancelled	-	C				ND	
Maharashtra	Madliwadi (Madhaliwadi)	N/A	N/A	-	Rejected by JICA Study (2012) due to Reserved Forest, WLS, IBA	Cancelled	-	C				ND	
Maharashtra	Baitarni (Vaitarni)	N/A	N/A	-	Rejected by JICA Study (2012) due to Reserved Forest, WLS, IBA	Cancelled	-	C				ND	
Maharashtra	Morawadi	N/A	N/A	-	Rejected by JICA Study (2012) due to accessability,WLS, IBA	Cancelled	-	C				ND	
Maharashtra	Gadgadi	N/A	N/A	-	Rejected by JICA Study (2012) due to Reserved Forest, WLS	Cancelled	-	C				ND	
Maharashtra	Kundi	N/A	N/A	-	Rejected by JICA Study (2012) due to WLS	Cancelled	-	C				ND	
Maharashtra	Aruna	N/A	N/A	-	Rejected by JICA Study (2012) due to Reserved Forest	Cancelled	-	C				ND	
Maharashtra	Kharari	N/A	N/A	-	Rejected by JICA Study (2012) due to Reserved Forest	Cancelled	-	C				ND	
Maharashtra	Jalvara (Jalware)	N/A	N/A	-	Rejected by JICA Study (2012) due to Reserved Forest	Cancelled	-	C				ND	

Table 5.2.3-2 Stage 1 Survey Project data for screening (9-2)

State	Project Name	Social & environmental Evaluation											
		Lower Dam	Safety	National Park, Reserved Forest	Wild Life Sanctuary	Tiger/ Elephant habitat	KBA	Endemic Bird Area	Biodiversity Hotspots	Scheduled Tribe Rate	EIA report, EC, FC	Remarks	Evaluation
Maharashtra	Warasgaon	Raigad District	level 1		nil but Eco-sensiitive zone proposed			in	in	3.7% and 1.26%		>1,000 resettlement required.	B
Maharashtra	Panshet	Raigad District	level 1		nil but Eco-sensiitive zone proposed			in	in	3.7% and 1.26%		opposition stopped S&I	C
Maharashtra	Varandh Ghat	Raigad District	level 1		nil but Eco-sensiitive zone proposed			in	in	3.7% and 1.26%		some resettlement required. opposition stopped S&I	C
Maharashtra	Nandgaon	N/A	level 1	Reserved Forest	N/A	N/A	N/A	N/A	N/A	N/A			C
Maharashtra	Kodali	Kolhapur District	level 1		nil	tiger		1.5km	in	0.78%			C
Maharashtra	Malshej Ghat	Thane district	level 1		5km from Kalsubai H WLS					13.95% and 3.70%	EC (2008)	Scheduled tehsil. forest land required	A
Maharashtra	Humbarli (Koyna Stage V)	Satara district	level 1	Western Ghat WHS	Koyna WLS,	tiger	2km	5km		0.99%	approval pending by National wildlife board against submittal by state.	affeects 6 villages	C
Maharashtra	Mutkhel	Ahmednagar District	level 1		Kalsubai H WLS					8.33%		Scheduled tehsil	C
Maharashtra	Ghatghar Stage-II	Thane District	level 1		Kalsubai H WLS				5km	8.33% and 13.95%			-
Maharashtra	Chikhaldara	Amrawati district	level 1	1.5km from Gugamal NP	0.5km from Melghat WLS	2.9km from tiger reserve	1km			13.99%			C
Maharashtra	Atvan	Raigad District	level 1		7km from Sudhagarh WLS		in	in	in	3.70%, 27.13%			C
Maharashtra	Konya Stage-VI	Satara district	level 1	Western Ghat WHS	Koyna WLS	tiger	3km		in	0.99%	EC (1988)		C
Maharashtra	Nive	Raigad District	level 1	Western Ghat WHS	Koyna WLS	tiger reserve		in	in	0.99% and 1.26%			C
Maharashtra	Ulhas		level 1										C
Maharashtra	Pinjal		level 1										C
Maharashtra	Kengadi		level 1										C
Maharashtra	Jalong		level 1										C
Maharashtra	Kolmondapada		level 1										C
Maharashtra	Kalu		level 1										C
Maharashtra	Sidgarh		level 1										C
Maharashtra	Amba		level 1										C
Maharashtra	Chornai		level 1										C
Maharashtra	Savitri		level 1										C
Maharashtra	Madliwadi (Madhaliwadi)		level 1										C
Maharashtra	Baitarni (Vaitarni)		level 1										C
Maharashtra	Morawadi		level 1										C
Maharashtra	Gadgadi		level 1										C
Maharashtra	Kundi		level 1										C
Maharashtra	Aruna		level 1										C
Maharashtra	Kharari		level 1										C
Maharashtra	Jalvara (Jalware)		level 1										C

Table 5.2.3-2 Stage 1 Survey Project data for screening (9-3)

State	Project Name	State Power Sector status		State Government Support					Preliminary Evalutaion		Stage 1
		Necessity/Justification of PSP from power sector status	Power Sector Evaluation	Power/Energy Dept. Support	Finance Dept. Support	Debt-sustainability clearance	Consistency with the priorities of the State Governments	Evaluation	Intention for Japanese Yen Loan	Opportunity for Japanese companies	Total Evaluation
Maharashtra	Warasgaon	Securement of peak power and stabilization of the grid.	A	C	N/A	A	C	C	N/A	N/A	64
Maharashtra	Panshet	Securement of peak power and stabilization of the grid.	A	C	N/A	A	C	C	N/A	N/A	52
Maharashtra	Varandh Ghat	Securement of peak power and stabilization of the grid.	A	C	N/A	A	C	C	N/A	N/A	52
Maharashtra	Nandgaon	-	A	C	N/A	A	C	C	N/A	ND	28
Maharashtra	Kodali	Securement of peak power and stabilization of the grid.	A	C	N/A	A	C	C	N/A	N/A	28
Maharashtra	Malshej Ghat	Securement of peak power and stabilization of the grid.	A	C	N/A	A	A	C	N/A	N/A	84
Maharashtra	Humbarli (Koyna Stage V)	Securement of peak power and stabilization of the grid.	A	C	N/A	A	C	C	N/A	N/A	52
Maharashtra	Mutkhel	Securement of peak power and stabilization of the grid.	A	C	N/A	A	C	C	N/A	N/A	28
Maharashtra	Ghatghar Stage-II	Securement of peak power and stabilization of the grid.	A	C	N/A	A	C	C	N/A	N/A	28
Maharashtra	Chikhaldara	Securement of peak power and stabilization of the grid.	A	C	N/A	A	C	C	N/A	N/A	28
Maharashtra	Atvan	Securement of peak power and stabilization of the grid.	A	C	N/A	A	C	C	N/A	N/A	28
Maharashtra	Konya Stage-VI	Securement of peak power and stabilization of the grid.	A	C	N/A	A	C	C	N/A	N/A	44
Maharashtra	Nive	Securement of peak power and stabilization of the grid.	A	C	N/A	A	C	C	N/A	N/A	28
Maharashtra	Ulhas	Securement of peak power and stabilization of the grid.	-	-	-	-	-	-	-	-	20
Maharashtra	Pinjal	Securement of peak power and stabilization of the grid.	-	-	-	-	-	-	-	-	20
Maharashtra	Kengadi	Securement of peak power and stabilization of the grid.	-	-	-	-	-	-	-	-	20
Maharashtra	Jalong	Securement of peak power and stabilization of the grid.	-	-	-	-	-	-	-	-	20
Maharashtra	Kolmondapada	Securement of peak power and stabilization of the grid.	-	-	-	-	-	-	-	-	20
Maharashtra	Kalu	Securement of peak power and stabilization of the grid.	-	-	-	-	-	-	-	-	20
Maharashtra	Sidgarh	Securement of peak power and stabilization of the grid.	-	-	-	-	-	-	-	-	20
Maharashtra	Amba	Securement of peak power and stabilization of the grid.	-	-	-	-	-	-	-	-	20
Maharashtra	Chornai	Securement of peak power and stabilization of the grid.	-	-	-	-	-	-	-	-	20
Maharashtra	Savitri	Securement of peak power and stabilization of the grid.	-	-	-	-	-	-	-	-	20
Maharashtra	Madliwadi (Madhaliwadi)	Securement of peak power and stabilization of the grid.	-	-	-	-	-	-	-	-	20
Maharashtra	Baitarni (Vaitarni)	Securement of peak power and stabilization of the grid.	-	-	-	-	-	-	-	-	20
Maharashtra	Morawadi	Securement of peak power and stabilization of the grid.	-	-	-	-	-	-	-	-	20
Maharashtra	Gadgadi	Securement of peak power and stabilization of the grid.	-	-	-	-	-	-	-	-	20
Maharashtra	Kundi	Securement of peak power and stabilization of the grid.	-	-	-	-	-	-	-	-	20
Maharashtra	Aruna	Securement of peak power and stabilization of the grid.	-	-	-	-	-	-	-	-	20
Maharashtra	Kharari	Securement of peak power and stabilization of the grid.	-	-	-	-	-	-	-	-	20
Maharashtra	Jalvara (Jalware)	Securement of peak power and stabilization of the grid.	-	-	-	-	-	-	-	-	20
											20

Table 5.2.3-2 Stage 1 Survey Project data for screening (9-4)

State	Project Name	Technical Evaluation							Economical Evaluation				
		Output(MW)	Design head (m)	Reservoir (existing, new)	Remarks	Stage	Commissioning Year	Evaluation	Project cost (Cr)	Project cost/MW (INR/kWh)	Levelized Tariff (INR/U), etc.	Evaluation	Upper Dam
Odisha	Upper Indravati	4*150	344	UD : Ext LD : New	PFR (THDC) completed, DPR (WAPCOS) under preparation	DPR	2022 at earliest	B	1,601	26,675	2.5, or 3.25 (2016/June)	A	Kalahandi district
Odisha	Upper Kolab	4*80	251	UD : Ext LD : Ext	PFR has been completed (2012/Sep), but no further action for preparation of DPR.	PFR completed	N/A	B	813	25,419	3.0 (PFR)	A	Kolaput district
Odisha	Balimela	4*100	246	UD : Ext LD : New	PFR has been completed(2012/Sep), but no further action for preparation of DPR.	PFR completed	N/A	B	1,404	35,090	3.13	A	Malkangiri district
Odisha	Jharlama	2,500	N/A	N/A	not acknowledged.	identified?	N/A	C				ND	N/A
Telangana	Nagarjuna Sagar	7*100.8	94	LD; New	presently operated as conventional HP. Will be operated as PSP after completion of LD.	construction	1980-85	N/A				ND	Guntur district
Telangana	Srisailam Left Bank	900	107	Existing		operated	2001-	N/A				ND	-
Telangana	Icchampally	975	N/A	Existing	not taken up due to the inter-state issue in view of submergence of 4 states,	cancelled		C				ND	-
Karnataka	Sharavathy	450, 800, 900, 1,000	436	UD : Ext LD : Ext	Public announcement for preparation of the DPR released soon. The S&I yet to be taken.	PFR, DPR to be tendered	2023	B	1449Cr (900MW) (PFR,2009)	16,100		A	Shimoga district
Karnataka	Varahi	700 (250, 600, 1,000)	476	UD : Ext LD : New	Public announcement for preparation of the DPR released soon. The S&I yet to be taken.	PFR, DPR to be tendered	2023	B	3900(1000MW), 2346(600), 1025(250)	39,000(1000MW), 39,100(600), 41,000(250)		A	Shimoga district
Karnataka	Kali	600, 1,000	374	alt 1: UD:New, LD:Ext alt 2: UD:Ext, LD: Ext	presently no DPR tender planned by KPCL.	PFR completed		B	1243.4Cr (600MW) (PFR,2009) alt.1	20,723		alt1 :A,	Uttara Kannada district
Karnataka	Kollur	900	N/A	UD : New LD : New	The site is planned in Western Ghat region hence all activities stopped	cancelled		C				ND	
Karnataka	Minhole	2,200	N/A	UD : New LD : New	The site is planned in Western Ghat region hence all activities stopped	cancelled		C				ND	
Karnataka	Sitanadi	2,600	N/A	UD : New LD : New	The site is planned in Western Ghat region hence all activities stopped	cancelled		C				ND	
Karnataka	Hulagi	2,200	N/A	UD : New LD : New	The site is planned in Western Ghat region hence all activities stopped	cancelled		C				ND	
Kerala	Pallivasal	600	550	UD : New LD : New	Investigation is ongoing. S&I commenced May/2016 (KSEBL)	Identified or Very Early	2026-27 expected	C				ND	Idukki district
Kerala	Idukki (Idukki- Malankara)	1,100	635	UD : Ext LD : Ext	Investigation is ongoing. S&I commenced May/2016 (KSEBL)	Very Early		C				ND	Idukki district
Kerala	Idukki (Idukki- Marmala)	450	260	UD : Ext LD : New	Investigation is ongoing. S&I commenced May/2016 (KSEBL)	Very Early		C				ND	Idukki district
Kerala	Idukki	300	550	UD : Ext LD : New		PFR	2026-27 expected	C				ND	Idukki district
Kerala	Kakki/Upper Moozhiar-Moozhiar (Kerala-1)	375	700	UD : Ext LD : Ext		Identified		C				ND	Pathanamthitta district
Kerala	Ponmudi-Kallarkutty (Kerala-4)	250	216	UD : Ext LD : Ext		Identified		C				ND	Idukki district
Kerala	Sengulam-Kallarkutty (Kerala-5)	200	345	UD : Ext LD : Ext		Identified		C				ND	Idukki district
Kerala	Kallarkutty-Lower Periyar (Kerala-6)	200	172	UD : Ext LD : Ext		Identified		C				ND	Idukki district

Table 5.2.3-2 Stage 1 Survey Project data for screening (9-5)

State	Project Name	Social & environmental Evaluation											
		Lower Dam	Safety	National Park, Reserved Forest	Wild Life Sanctuary	Tiger/ Elephant habitat	KBA	Endemic Bird Area	Biodiversity Hotspots	Scheduled Tribe Rate	EIA report, EC, FC	Remarks	Evaluation
Odisha	Upper Indravati	Kalahandi district	level 2	(possibly close to Reserved Forest)						28.50%		one temple resettelment Land required for private/forest lands.	A
Odisha	Upper Kolab	Kolaput district	level 2	(possibly Reserved Forest)						56.56%		a few resettlement. Land required for private/forest lands.	C
Odisha	Balimela	Malkangiri district	level 2							57.83%		103ha forest submerged. Settlement to be studied in DPR	C
Odisha	Jharlama	N/A	N/A		Sunabeda WLS	tiger	in						C
Telangana	Nagarjuna Sagar	Guntur district	level 1	Nagarjunasagar NP		tiger	in			11.30%, 5.06%			C
Telangana	Srisailam Left Bank	-	level 1		Nagarjunasagar NP	tiger				2.04%			C
Telangana	Icchampally	-	level 2		7km from Eturnagaram S	tiger				2.83%, 47.70%			C
Karnataka	Sharavathy	Uttara Kannad district	level 1		Sharavathi Valley WLS (or outside of WLS)	Elephant and Tiger	5km	in	in	3.73%		50 acre is required to be obtained	B
Karnataka	Varahi	Udupi district	level 1	10km from Western Ghats WHS	10 km from the Mookambika S (or possibly inside of WLS)	2.3km from known tiger habitat			in	4.49%		lower reservoir (150) , 55 acre is additionally required. Small villages resettlement	B
Karnataka	Kali	Uttara Kannada district	level 1	Reserved Forest	Dandeli WLS	tigere reserve, Tiger and Elephant	in	5km	in	2.38%			alt 1: C, alt.2: B
Karnataka	Kollur		N/A	In Western Ghat	Mookambika WLS		5km	4km	in	4.49%			C
Karnataka	Minhole		N/A	In Western Ghat									C
Karnataka	Sitanadi		N/A	In Western Ghat									C
Karnataka	Hulagi		N/A	In Western Ghat									C
Kerala	Pallivasal	Idukki district	level 1	outside of RF, WLS (KSEBL)	1km from Aliance Zero Extinction Site	1km from the Tiger and Elephant	in	in	in	5.03%		4 families resettlement	B/C
Kerala	Idukki (Idukki- Malankara)	Idukki district	level 1		1km from Idukki S	Tiger and 10km from Elephant	in	in	in	5.03%			C
Kerala	Idukki (Idukki- Marmala)	Kottayam district	level 1		1km from Idukki S	Tiger	in	in	in	5.03% and 1.11%		private lands required	C
Kerala	Idukki	Idukki district	level 1		Iddukki Sanctuary	Tiger, 10km from Elephant	in	in	in	5.03%		12 families resettlement	C
Kerala	Kakki/Upper Moozhiar-Moozhiar (Kerala-1)	Pathanamthitta district	level 1		Western Ghats WHS	9.3km from tiger reserve, Tiger and Elephant	in	in	in	0.68%			C
Kerala	Ponmudi-Kallarkutty (Kerala-4)	Idukki district	level 1		2.4km from the Idukki S, 6km from Aliance Zero Site	Tiger and 1km from Elephant	in	in	in	5.03%		maybe private land required	C
Kerala	Sengulam-Kallarkutty (Kerala-5)	Idukki district	level 1	8km from Western Ghat WHS	4km from the Idukki S, 3km from Alliance Zero Site	1km from Tiger and 2km from Elephant	in	in	in	5.03%		(possibly no forest land?)	C
Kerala	Kallarkutty-Lower Periyar (Kerala-6)	Idukki district	level 1	9km from Western Ghat WHS	1.7km from Idukki S, IN Alliance Zero Site	Tiger and 0.8km from Elephant	in	in	in	5.03%		forest land maybe required	C

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Table 5.2.3-2 Stage 1 Survey Project data for screening (9-6)

State	Project Name	State Power Sector status		State Government Support					Preliminary Evalutaion		Stage 1
		Necessity/Justification of PSP from power sector status	Power Sector Evaluation	Power/Energy Dept. Support	Finance Dept. Support	Debt-sustainability clearance	Consistency with the priorities of the State Governments	Evaluation	Intention for Japanese Yen Loan	Opportunity for Japanese companies	Total Evaluation
Odisha	Upper Indravati	Securement of peak power and stabilization of the grid.	B	A	A	C	A	A	A	N/A	88
Odisha	Upper Kolab	Securement of peak power and stabilization of the grid.	B	A	A	C	B	B	A	N/A	56
Odisha	Balimela	Securement of peak power and stabilization of the grid.	B	A	A	C	B	B	A	N/A	56
Odisha	Jharlama		-	-	-	C	C	C	-	-	20
Telangana	Nagarjuna Sagar		C	C	already funded	C	C	C	C	Hitachi, Mitsubishi	20
Telangana	Srisailam Left Bank		C	C	already funded	C	C	C	C	C	20
Telangana	Icchampally		C	C	N/A	C	C	C	-	-	20
Karnataka	Sharavathy	1st is to stabilize the grid, 2nd is to secure peak power.	A	A	C/B	A	B	C	B	N/A	64
Karnataka	Varahi	1st is to stabilize the grid, 2nd is to secure peak power.	A	A	C/B	A	B	C	B	N/A	64
Karnataka	Kali	1st is to stabilize the grid, 2nd is to secure peak power.	A	A	C/B	A	B	C	B	N/A	36
Karnataka	Kollur		-	-	-	-	-	-	-	-	20
Karnataka	Minhole		-	-	-	-	-	-	-	-	20
Karnataka	Sitanadi		-	-	-	-	-	-	-	-	20
Karnataka	Hulagi		-	-	-	-	-	-	-	-	20
Kerala	Pallivasal	Supply of peak power, supply of balancing power,etc. However, not so much justifiable.	B	A	A	C	C	C	A	N/A	24
Kerala	Idukki (Idukki- Malankara)	Supply of peak power, supply of balancing power,etc. However, not so much justifiable.	B	A	A	C	C	C	A	N/A	24
Kerala	Idukki (Idukki- Marmala)	Supply of peak power, supply of balancing power,etc. However, not so much justifiable.	B	A	A	C	C	C	A	N/A	24
Kerala	Idukki	Supply of peak power, supply of balancing power,etc. However, not so much justifiable.	B	A	A	C	C	C	A	N/A	24
Kerala	Kakki/Upper Moozhiar-Moozhiar (Kerala-1)	Supply of peak power, supply of balancing power,etc. However, not so much justifiable.	B	A	A	C	C	C	A	N/A	24
Kerala	Ponmudi-Kallarkutty (Kerala-4)	Supply of peak power, supply of balancing power,etc. However, not so much justifiable.	B	A	A	C	C	C	A	N/A	24
Kerala	Sengulam-Kallarkutty (Kerala-5)	Supply of peak power, supply of balancing power,etc. However, not so much justifiable.	B	A	A	C	C	C	A	N/A	24
Kerala	Kallarkutty-Lower Periyar (Kerala-6)	Supply of peak power, supply of balancing power,etc. However, not so much justifiable.	B	A	A	C	C	C	A	N/A	24

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Table 5.2.3-2 Stage 1 Survey Project data for screening (9-7)

State	Project Name	Technical Evaluation							Economical Evaluation				Upper Dam
		Output(MW)	Design head (m)	Reservoir (existing, new)	Remarks	Stage	Commissioning Year	Evaluation	Project cost (Cr)	Project cost/MW (INR/kWh)	Levelized Tariff (INR/U), etc.	Evaluation	
Kerala	Peringalkuth-Idamalayar (Kerala-7)	350	202	UD : Ext LD : Ext		Identified		C				ND	Thrissur district
Kerala	Sholayar II	390	N/A	N/A		Yet taken up (cancelled)		C				ND	Thrissur district
Kerala	Sholayar and Idamalayar reservoirs (Kerala-8)	900	520	UD : Ext LD : Ext		Identified		C				ND	Thrissur district
Kerala	Sholayar I	810	N/A	N/A		Yet taken up (cancelled)		C				ND	Thrissur district
Kerala	Kakkayam-Peruvannamoozhi (Kerala-9)	900	520	UD : Ext LD : Ext		Identified		C				ND	Kozhikode district
Kerala	Kuttiyadi	2,400	645	N/A		cancelled		C				ND	
Kerala	Pazhassi sagar (Kerala-10)	200	115	UD : Ext (laterite quarries), LD : Ext		Identified		C				ND	Kannur district
Kerala	Pringalkuthu	80	N/A	N/A		Yet taken up (cancelled)	non availability of FC	C				ND	N/A
Kerala	Edamalyar	2,000	N/A	N/A		cancelled		C				ND	
Tamil Nadu	Kundah	500	236	UD : Ext LD : Ext	partial construction commences. Phase 1 & phae 2 tenders to come 2017.	DPR completed	2021-	A	1,831Cr (DPR)	36,633	5.64 (DPR)	B	Nilgiris district
Tamil Nadu	Sillahalla	2,000	1,599	UD : New LD : Ext	DPR under preparation DPR phase1 finalized Sep/2016, DPR phase2 tender by Dec/2016 (TANGEDCO,2016/July)	DPR	2021-22	C	6,914Cr (PFR)	34,570	3.31 (PFR, conclusion)	A	Nilgiris district
Tamil Nadu	Vellimalai	200	N/A	UD : New LD : New	maybe renamed as Kadayar with increasing output. (Energy dept, 2016/July) Low priority and no action taken by TANGEDCO.	very early, Identified		C				ND	Kanyakumari district
Tamil Nadu	Kodayar	500	1,234	UD : Ext LD : Ext	Investigation is ongoing.	PIR		C	2,550Cr	51,000		C	Kanyakumari district
Tamil Nadu	Manalar	500	1,050	UD : Ext LD : New	Investigation is ongoing.	PIR		C	3,350Cr	67,000		C	Theni district
Tamil Nadu	Mettur	500	208	UD : New LD : Ext	Investigation is ongoing.	PIR		C	2,200Cr (500MW)	44,000		B	Salem district
Tamil Nadu	Nallar	2,700	N/A	N/A	no action.	unknown		N/A				ND	N/A
West Bengal	Turga	1,000	146	UD : New LD : New	Approved by CEA (2016/Aug.)	DPR competed	2022	A	4,519	45,188	6.07	B	Purulia district
West Bengal	Bandhu (Bandu)	900	N/A	UD : New LD : New	PFR is available but layout changed.	S&I	2028 or 2025-30 earliest	B				ND	Purulia district
West Bengal	Kathlajal	900	N/A	N/A	PFR not done. In RF.(WBSEDCL, 2016/Sep.)	Identified	N/A	C				ND	
West Bengal	Kulbera	1,100	152	UD : New LD : Ext	PFR not done. S&I yet taken up (WBSEDCL, 2016/Sep.)	Identified	N/A	C				ND	Purulia district
West Bengal	Boro	500	N/A	N/A	no action by WBSEDCL	unknown	N/A	C				ND	
West Bengal	Panchet	40	N/A	N/A	DVC	operated	N/A	N/A				ND	
West Bengal	Panchet Hill	600	N/A	N/A	DVC	Identified	N/A	N/A				ND	

Table 5.2.3-2 Stage 1 Survey Project data for screening (9-8)

State	Project Name	Social & environmental Evaluation											
		Lower Dam	Safety	National Park, Reserved Forest	Wild Life Sanctuary	Tiger/ Elephant habitat	KBA	Endemic Bird Area	Biodiversity Hotspots	Scheduled Tribe Rate	EIA report, EC, FC	Remarks	Evaluation
Kerala	Peringalkuth-Idamalayar (Kerala-7)	Ernakulam district	level 1		8km from Parambikulam S	Elephant and Tiger	in	in	in	0.30%, 0.50% and 5.03%		forest land maybe required	C
Kerala	Sholayar II	Idukki district	level 1		9km from Parambikulam S	8.8km from tiger reserve. Elephant and Tiger	in	in	in	0.30% and 5.03%	non availability of FC	FC unavailable	C
Kerala	Sholayar and Idamalayar reservoirs (Kerala-8)	Idukki district	level 1		5km from Parambikulam S, 9km from Alliance Zero Site	4.3km from tiger reserve, Elephant and Tiger	in	in	in	0.30% and 5.03%		tribal and forest land required	C
Kerala	Sholayar I	Ernakulam district	level 1		4km from Parambikulam S	4.7km from tiger reserve. Elephant and Tiger	in	in	in	0.30% and 0.50%	non availability of FC	FC unavailable	C
Kerala	Kakkayam-Peruvannamoozhi (Kerala-9)	Kozhikode district	level 1		Malabar WLS	Tiger and 1km from Elephant	in	in	in	0.49%		forest and private lands required	C
Kerala	Kuttiyadi		level 1	(possibly in Reserved Forest)		tiger	in	in	in	0.49%			C
Kerala	Pazhassi sagar (Kerala-10)	Kannur district	level 1		8km from Nilgiri Reserve	Elephant and 2km from the Tiger	in		in	1.64%			C
Kerala	Pringalkuthu	N/A	level 1			4.9km from tiger reserve.	in	in	in	0.30%	FC unavailable	FC unavailable	C
Kerala	Edamalyar		level 1	(possibly in Reserved Forest)		tiger and elephant	in	in	in	5.03%			C
Tamil Nadu	Kundah	Nilgiris district	level 1	2km from National Parks, 3km from Western Ghat WHS	4km from AZE	Tiger and Elephant	in	in	in	4.46%	EC obtained (2007)		A
Tamil Nadu	Sillahalla	Coimbatore district	level 1	8km from Western Ghats WHS	1.9km from Nilgiris Reserve	Tiger and Elephant	in	in	in	4.46% and 0.82%			B
Tamil Nadu	Vellimalai	Kanyakumari district	level 1		location unclear	location unclear				location unclear			C
Tamil Nadu	Kodayar	Kanyakumari district	level 1	0.5km from Western Ghat WHS	Kalakad S, Mundanthurai S	0.5km from tiger reserve, Tiger and Elephant	in	in	in	0.39%			C
Tamil Nadu	Manalar	Theni district	level 1	KB Forcal Area, 0.5km from Western Ghat WHS	Megamalai WLS, 9.7km from Srivilliputhur S	0.5km from tiger resrve,Tiger and Elephant	in	in	in	0.15%			B
Tamil Nadu	Mettur	Salem district	level 1	(possibly UD in RF)	7.9km from Nilgiris Reserve	5km from Tiger, 10km from Elephant				3.43%			C
Tamil Nadu	Nallar	N/A	N/A		location unclear	location unclear				location unclear			N/A
West Bengal	Turga	Purulia district	level 1			30km from elephant				18.45%	EC obtained (2016/5)	234ha forest	A
West Bengal	Bandhu (Bandu)	Purulia district	level 1							18.45%			A
West Bengal	Kathlajal		N/A	Reserved Forest	location unclear	location unclear				N/A			C
West Bengal	Kulbera	Purulia district	level 1		location unclear	location unclear				N/A			C
West Bengal	Boro		N/A		location unclear	location unclear				N/A			C
West Bengal	Panchet		N/A		N/A	N/A				N/A			C
West Bengal	Panchet Hill		N/A		N/A	N/A				N/A			C

Table 5.2.3-2 Stage 1 Survey Project data for screening (9-9)

State	Project Name	State Power Sector status		State Government Support					Preliminary Evalutaion		Stage 1
		Necessity/Justification of PSP from power sector status	Power Sector Evaluation	Power/Energy Dept. Support	Finance Dept. Support	Debt-sustainability clearance	Consistency with the priorities of the State Governments	Evaluation	Intention for Japanese Yen Loan	Opportunity for Japanese companies	Total Evaluation
Kerala	Peringalkuth-Idamalayar (Kerala-7)	Supply of peak power, supply of balancing power,etc. However, not so much justifiable.	B	A	A	C	C	C	A	N/A	24
Kerala	Sholayar II	Supply of peak power, supply of balancing power,etc. However, not so much justifiable.	B	C	N/A	N/A	N/A	C			24
Kerala	Sholayar and Idamalayar reservoirs (Kerala-8)	Supply of peak power, supply of balancing power,etc. However, not so much justifiable.	B	A	A	C	C	C	A	N/A	24
Kerala	Sholayar I	Supply of peak power, supply of balancing power,etc. However, not so much justifiable.	B	C	N/A	N/A	N/A	C	-	-	24
Kerala	Kakkayam-Peruvannamoozhi (Kerala-9)	Supply of peak power, supply of balancing power,etc. However, not so much justifiable.	B	A	A	C	C	C	A	N/A	24
Kerala	Kuttiyadi	Supply of peak power, supply of balancing power,etc. However, not so much justifiable.	B	C	N/A	N/A	N/A	C	-	-	24
Kerala	Pazhassi sagar (Kerala-10)	Supply of peak power, supply of balancing power,etc. However, not so much justifiable.	B	A	A	C	C	C	A	N/A	24
Kerala	Pringalkuthu	Supply of peak power, supply of balancing power,etc. However, not so much justifiable.	B	C	N/A	N/A	N/A	C	-	-	24
Kerala	Edamalyar	Supply of peak power, supply of balancing power,etc. However, not so much justifiable.	B	C	N/A	N/A	N/A	C	-	-	24
			B								
Tamil Nadu	Kundah	Storage, securement of peak power, stabilization of the grid against many introduction of REN.	B	A	A	A	A	A	Negative	Negative as REC funded	88
Tamil Nadu	Sillahalla	Storage, securement of peak power, stabilization of the grid against many introduction of REN.	B	A	A	A	A	A	Affirmative	C	68
Tamil Nadu	Vellimalai	Storage, securement of peak power, stabilization of the grid against many introduction of REN.	B	A	A	A	A	A	ND	ND	40
Tamil Nadu	Kodayar	Storage, securement of peak power, stabilization of the grid against many introduction of REN.	B	A	A	A	A	A	ND	ND	40
Tamil Nadu	Manalar	Storage, securement of peak power, stabilization of the grid against many introduction of REN.	B	A	A	A	A	A	ND	ND	52
Tamil Nadu	Mettur	Storage, securement of peak power, stabilization of the grid against many introduction of REN.	B	A	A	A	A	A	ND	ND	48
Tamil Nadu	Nallar		-	-	-	-	-	-	-	-	20
West Bengal	Turga	securement of peak power, stabilization of the grid for thermal power generation.	B	A	A	A	A	A	A	A	88
West Bengal	Bandhu (Bandu)	securement of peak power, stabilization of the grid for thermal power generation.	B	A	A	A	A	A	B	N/A	72
West Bengal	Kathlajal	securement of peak power, stabilization of the grid for thermal power generation.	B	C	A	A	C	C	N/A	N/A	24
West Bengal	Kulbera	securement of peak power, stabilization of the grid for thermal power generation.	B	B	A	A	B	B	N/A	N/A	32
West Bengal	Boro	securement of peak power, stabilization of the grid for thermal power generation.	-	-	-	-	-	-	-	-	20
West Bengal	Panchet	securement of peak power, stabilization of the grid for thermal power generation.	-	-	-	-	-	-	-	-	20
West Bengal	Panchet Hill	securement of peak power, stabilization of the grid for thermal power generation.	-	-	-	-	-	-	-	-	20

Legend of Eavaluation	
Technical Evaluation	A; promising B; acceptable、 C: technical issues unsolved
Economical Evaluation	A: low cost, high economy B; middle, C; cost high, ND: No data
Social & Environmental Evaluation	A: few, B; some C: many, no data, too immature
State Power Sector status	See attached.(separate sheet)
State Government Support Evaluation	A; positive B; neutral C; negative
Intention for Japanese Yen Loan	A: Yes B ; some C : no, negative, N/A ; no information
Opportunity for Japanese companies	A: Yes B ; some C : no, negative, N/A ; no information

Table 5.2.3-3 Stage 1 Survey Project data for screening (Power Sector criteria)

State Power Sector Situation				
state	Energy budget	対GSDP比	Discom	Evaluation
MS	9,840	1.04%	See below	A
OD	2,801	1.89%		B
TS	5,116	2.35%		C
KN	12,632	3.67%		A
KR	1,623	0.72%		B
TN	2,000	0.39%		B
WB	1,498	0.38%		B

	A	B	C	D				
State	**Trend in state-wise discom debt, AT&C losses and ACS-ARR gap (without subsidy)**	**State Support**	**Risk profile of Discoms**	**Grades of state Discoms**	**accumurated debt (Crores)**		**subsidy (Crores)**	**UDAY**
Maharashtra	1 (Lowest Risk)	II	Low Risk	B+	5,947	2014-15	4,462	Yes
Odisha	2	III	Moderate Risk		6,121	2014-15	N/A	Yes
Telangana	3	II	High Risk	A,B+,	13,867	2014-15	N/A	Under Prep
Karnataka	1 (Lowest Risk)	I (Highest Support)	Low Risk	A,A,A,B+,B	2,561	2014-15	7,197	Yes
Kerala	1 (Lowest Risk)	III	Low Risk	B+	5,976	2015-16	N/A	Yes
Tamil Nadu	3	II	High Risk	C+	80,000	2015-16	9,007	No
West Bengal	2	IV (Lowest Support)	Moderate Risk	B+	131	2015-16	small	No

(source)	
A	CRISIL Insight, July/2016, data from 2013
B	CRISIL Insight, July/2016, data from 2013
C	CRISIL Insight, July/2016, data from 2015(presumed)
D	State Distribution Utilities Fourth Annual Integrated Rating, Ministry of Power, June 2016

Table 5.2.3-4 Stage 1 Survey Project data for screening (State Finance criteria)

State Finance Situation								
GSDP (Crores)	対GDP比	rank	Revenue deficit/GDP (%)	Fiscal deficit/GDP (%)	Total debt stock/GDP (%)	Revenue deficit (Crores)	Fiscal deficit (Crores)	Total debt stock (Crores)
947,550	15.90%	1st	-0.47	-1.93	16.26	-644,334	-1,686,639	15,748,277
148,576	2.40%	16th	2.05	-2.99	15.75	280,809	-262,980	2,075,608
217,432	3.70%	12th	0.01	-2.90	17.27	15,220	-387,029	3,491,958
344,106	5.70%	6th	0.10	-2.70	24.10	0	-929,085	7,742,378
226,209	4.00%	10th	-2.65	-3.59	26.05	-551,949	-827,923	6,042,029
515,458	8.50%	2nd	-0.40	-2.90	21.20	-192,247	-1,345,731	10,092,979
398,387	6.60%	5th	-1.03	-2.68	32.46	-795,641	-1,267,821	12,886,416

CHAPTER 6

FORMATION OF CONCRETE CANDIDATE

(Stage 2 & 3 Screening)

CHAPTER 6 FORMATION OF CONCRETE CANDIDATE (Stage 2 & 3 Screening)

6.1 ANALYSIS OF CANDIDATE PROJECTS/STATES

6.1.1 Candidate States

Upon the completion of the Stage 1 survey, with the consultation with JICA India Office, the Study team selected 4 states to conduct further study. Those are;

- Odisha (OD),
- West Bengal (WB),
- Karnataka (KN),
- Tamil Nadu (TN)

The team conducted the successive meetings with those state agencies. Initially, the Scope of the Study intends to further eliminate candidates to extract 1 or 2 promising projects. However, it was found difficult to screen the sites further, as each site has issues to overcome.

Therefore, the team had discussions with JICA India Office at each time before and after the survey, and it has been determined not to eliminate further candidate states, through Stage 2 and Stage 3. The surveys are conducted according to the schedule below.

Table 6.1.1-1 Stage 2 & 3 Survey Schedule

Stage 2; 2nd Stage Screening – Further Screening for Promising Sites			
Survey	**Period**	**Visits**	**Purpose**
3rd Work Period in India	September 20th - October 1st, 2016	Odisha, West Bengal, Tamil Nadu	- Eliminate candidates which are judged un-exploitable (ie. behind other projects). - Extract promising sites from technical, economical, and social environmental aspects. - Conduct further state visits on candidate state agencies/governments for detailed necessary information and make evaluations on feasibility of each state/site for PSP development.
Stage 3; 3rd Stage Screening – Selection of the most Promising Site(s) and Examination on the Candidate Development Site			
4th Work Period in India	October 24th - October 27th, 2016	West Bengal	- Select some (1-2) most promising states and project sites for PSP development. - Evaluate the possibility of Project Formation using ODA Loan by detail consultations, discussions and interviews with corresponding state agencies/governments. - Evaluate and compile requisite conditions for project development.
5th Work Period in India	November 14th - November 22nd, 2016	Karnataka, West Bengal, Meghalaya	

In the Stage 2 and Stage 3 Survey, the Team did not exclude any of candidate sites selected in Stage 1 Survey. Instead, the team tried to collect much more information from relevant agencies.

In the 5th Work Period in India, the team visited Meghalaya state. This was based on the JICA request. The Meghalaya Energy Corporation Ltd. (MECL) several times had been contacting JICA for Japanese Yen Loan and explained they had PSP project to apply for JICA ODA. The meetings with MECL revealed there is no such PSP project.

6.1.2 Stage 2; 2nd Stage Screening – Further Screening for Promising Sites

In this Stage, the team conducted the Survey in Odisha, West Bengal, and Tamil Nadu. The findings were summarized below.

(1) Odisha :

1) Dates of visit : September 21-23, 2016

2) Interviewed agencies : GEDCOL. GRIDCO, OHPC, OERC,SLDC, Energy Department,

3) Findings and JICA teams evaluation

- GRIDCO had been against PSPs in Stage 1 survey. But this time they expressed they accepts PSPs to the extent its price remains within certain range (if Renewable costs 7 INR/U, 9 INR/U be purchased for PSPs). Energy Department continuously expressed its willingness to develop PSPs.

  (JICA team considers Odisha government has a certain unanimous stance to develop PSPs.)

- The Odisha applied all 3 PSP projects (Upper Indravati, Upper Kolab, Balimela) for National Clean Energy Fund (NCEF) grant. OHPC expects the outcome would be in March 2017. He commented the JICA loan would be considered after the state receives the outcome. In case failed, they would expect Japanese Yen Loan.

- OHPC stated it expects PSPs as balancing power against renewables.

  (The JICA team considers it seems unpersuasive that PSPs are required for renewables in the state. The renewables target 3,000MW was assigned by central government. There are no practical ongoing or planned projects such as Solar, etc. in Odisha. The team considers the Odisha thinks it in doubt too. It may be obstacle to get NCEF grant which they considers.)

- Odisha prioritizes Upper Indravati first, it puts Balimela second, and Upper Kolab third. But OHPC has not done any study on the latter 2 projects after PFRs.

  (JICA team considers OHPC only will initiate DPRs for the 2 projects after completion of Upper Indravati DPR. But they may release DPR works much earlier if NCEF grant is obtained.)

- As for Upper Indravati,

  - ✓ OHPC expects to have DPR completed in May 2017. But it does not stick to COD in 2022.

    (JICA views it impossible. OHPC does not understand guidelines, procedures of CEA approvals, EC approvals, etc. The team got information from WAPCOS that it woud take much longer. The COD of 2022 considered impossible.)

  - ✓ It seems true that the area does not interfere with Reserved Forest from the interviews.

- ✓ They leave study of applying adjustable speed machines to WAPCOS.

  (JICA team considers doubtful whether OHPC holds clear visions as to application of adjustable machines in Odisha against cost increases. This should be traced and supported by JICA.)

(2) West Bengal :

1) Dates of visit : September 24-27, 2016

JICA team conducted the site survey on Turga and Bandhu during September 24-26.

2) Interviewed agencies : WBSEDCL, WBSLDC, ERLDC, WBERC

3) Findings and JICA teams evaluation

- ➢ According to the information JICA team obtained, CMD of WBSEDCL had refused to see

  (On the issues of Bandhu PSP project they already had decided it to be allocated for ADB loans. The team decided to eliminate Bandhu PSP for further pursuing it as candidate for Japanese Yen Loan in the Study.)

- ➢ Renewables are very poor in the state. At present 5MW and less than 3% of total capacity.

  (JICA team considers Renewables are not primary reason to introduce/enhance PSPs in this state at the moment. Distribution agency operates PSP as to secure peak power and keep optimum power procurement of off-peak and peak-time powers. It may be utilizing it for economic operations when it procures cheap pumping power and sells in beneficial market.)

- ➢ As for Turga,
  - ✓ TEC letter are not yet received. But WBSEDCL is aware DPR was approved by CEA.
  - ✓ EC letter was issued. Forest land acquisitions are ongoing and this is requisite for Stage 1 FC.
  - ✓ WBSEDCL is requested to complete explanatory adit in the site and complete geotechnical testings by February 2017 which WBSEDCL had accepted.
  - ✓ WBSEDCL expressed it will initiate approaching MOP for listing it up for Rolling Plan. It showed willingness to keep pursuing and applying Japanese Yen Loan.

    (JICA team confirmed the site status. It is impractical to finish adit excavation by February 2017. The team considers WBSEDCL still keeps intention to utilize Japanese Yen Loan.)

- ➢ As for Bandhu,
  - ✓ It is informed to JICA team that ; 1) High ranked state government officials already allocated Bandhu PSP for ADB. They contacted ADB to take up Turga too but ADB

declined it. 2) CMD of WBSEDCL wouldn't meet JICA on Bandhu issues. 3) Preparation for DPR will be started soon. 4) Development schedule was uncertain. 3 years are necessary for DPR.

(JICA team had obtained another information ADB is only interested in 300MW solar project. The team knew the decision may change new officials replace. However at the moment, there seems no choice but retain pursuing Bandhu.)

(3) Tamil Nadu :

1) Dates of visit : September 29, 2016

2) Interviewed agencies : TANGEDCO

3) Findings and JICA teams evaluation

- JICA team inquired the funding source, but TANGEDCO declined to reply.[1]
- As for Kundah,
  - ✓ JICA team accepted it impossible to participate at this stage into Kundah PSP, as it was already being funded by REC and by fixed type PSP machines, though unmentioned during the meetings.
  - ✓ TANGEDCO stated the project does not affect any protected areas that no clearance needed, also commented FCs for all phases had been obtained.
- As for Shillahalla,
  - ✓ TANGEDCO stated Tamil Nadu plans a large scale solar and wind power projects in addition to nuclear and thermal projects, thus would secure power surplus. This necessitates PSPs development in the state.

    (JICA team confirmed the large renewables development status in the state. The team also confirmed the consecutive plans of PSPs in the state are acknowledged in the power development schedule. So, although the distributor in the state remains deficit, the team considers PSPs are securely supported by the state and prospective.)
  - ✓ TANGEDCO explained that Voith had presented 1,500m head PSP achievable. Other Japanese manufactures hadn't. TANGEDCO accepted and applied it to the project. It considered the design proposed would be cost optimum.
  - ✓ TANGEDCO stated it would not consider changing the current schedule. It expects to obtain necessary clearances in 2017-18, commences constructions in 2019, completes in 2023 at earliest.

[1] It needs to be noticed that the State government in Oct. 2016 reportedly requested the central to fund PSPs under the renewable energy scheme.

(Though the schedule is impractical, JICA team considers it unlikely to revise the design and persuade TANGEDCO as it would be moving on fast track forward. The team also admits it the proposed design would be cost minimum if realized though it contains numerous construction risks, so it would be difficult to have them reconsider it.)

- ✓ TANGEDCO explained that such information as protected areas, resettlement issues, etc., were not collected yet. No EIA was initiated and they plan to conduct it after DPR.

  (JICA team considers some part of the project possibly interferes with Reserved Forest. The prospect of EIA may be not so smooth.)

- TANGEDCO listed other Mettur, Kodayar, Manalar as successive PSPs. It also expressed the intentions to adopt other new fresh PSP potentials which will be taken up and it would initiate study on those.

  (JICA team considers those can be ODA candidate, as Tamil Nadu continues to develop PSPs after Kundah and Sillahalla. Those PSPs with practically feasible heads can be targets of Japanese manufacturers. It would take some time, and TANGEDCO suggested JICA team to revisit on March 2017 for further discussion.)

6.1.3 Stage 3; 3rd Stage Screening – Selection of the most Promising Site(s) and Examination on the Candidate Development Site

In this Stage, the team conducted the Survey in West Bengal (twice), Karnataka, and Meghalaya. The findings were summarized below.

On October, the JICA team initiated the Stage 3 survey.

(1) West Bengal

1) Dates of visit : October 25, 2016

2) Interviewed agencies : WBSEDCL

3) Findings and JICA teams evaluation

JICA team conducted the most advanced PSP which WBSEDCL expressed intention utilizing Japanese Yen Loan.

- WBSEDCL stated it was working on the cost revision of the approved cost of Turga in DPR. In parallel, it considered applying 85% of project cost to Japanese Yen Loan.
- WBSEDCL expressed intention to tender Detailed Design work on November 2016. It wishes to allocate Japanese Yen Loan to DD work, even if it is before L/A.
- However, WBSEDCL mentioned that it was not secured to apply Japanese Yen Loan as it is

an issue of WBSEDCL Board.

(JICA team examined the possibility of West Bengal's funding sources. They are:

a) NCEF grant. This was applied by Odisha. There is probability West Bengal took up the same way.

The purpose for which money is spent is reportedly undetermined. The Coal Cess (now renamed Clean Environment Cess) becomes 400 INR/t in 2016/17. 2016/17 allocation to NCEF from Clean Environment Cess was 8,500 Crores, and the accumulated allocated mount to NCEF from 2010-2015 was 35,000 Crores. West Bengal in the past had applied NCEF on PSP+Solar. But now that PSPs entered the Renewables category, PSP alone may be certified to apply NCEF.

b) Domestic loans as REC, PFC. They can be possible option. West Bengal has rather large debt stock that the state finance division has a propensity to do refinance. Domestic finance condition was still eased due to low tone of capital investment.

c) Other external funds as WB, ADB. The JICA team knew the state was being contacted by ADB. But the team considers JIC loan would be advantageous in its interest and repayment period.

JICA team's view is the above and it needs to carefully monitor the West Bengal state through WBSEDCL closely.

In the sideline of this visit on October, the JICA team got the information that:

a) KPCL, Karnataka state has decided to allocate preparation of DPR on Sharavathy alone to Indian consultant by negotiation basis not by biddings. That would become a complete package "umbrella contract" including Survey and Investigation, preparation of DPR, EIA, TEC application work, It intends to complete DPR in 2018.

b) Maharashtra state intends to shift the design circle section of power generation projects in GOMWRD to MAHAGENCO. (JICA team had been considering it was partly because PSP project in WRD was separated from main state power planning division why PSPs were not promoted in the state. Thus, if succeeded some change would be expected.)

On November, the JICA team continued the Stage 3 survey on the following states.

(2) Karnataka

1) Dates of visit : November 15, 2016

2) Interviewed agencies : KPCL

3) Findings and JICA teams evaluation

JICA team conducted the visit to KPCL to confirm and update the current situation of 3 PSPs

announced to be tendered soon in Stage 2 survey.

- KPCL reiterated the Karataka state intends to develop PSPs to meet the grid stability when a large scale renewables as solar, etc. come into the grid. Currently up to 1,000 MW would be justified.
- KPCL showed interests to utilize Japanese Yen Loan. But it also admitted it had been considering other sources as REC, PFC, or other domestic lenders. It sates KPCL would manage to secure those funds on its own guarantees. KPCL commented the state government decides after cost becomes clear.
- KPCL stated the development priority comes to Sharavathy 1st, Varahi 2nd.
- KPCL ordered WAPCOS to execute revising 3 PSPs PFR for 3 months first, and conduct DPR preparation of Sharavati in 18 (or 15) months.
- KPCL stated all works of Survey and Investigation, obtaining necessary approval were dispatched to WAPCOS.
- KPCL commented it was not so much aware of environmental situations but that it expected no hurdles as Sharavathy uses only existing reservoirs. KPCL admitted Varahi interferes with Wild Life Sanctuary but was not aware to what extent it would affect..

(JICA team acknowledged the situation as above. There was a need to obtain S&I, DPR data from WAPCOS and the team got approval from KPCL. JICA team considers it would be to some degree a matter of consultant WAPCOS whether adjustable PSP machines would be promoted. Thus the team contacted WAPCOS and discussed the issues on November 21, 2016. (At the moment (as of Dec. 2016, JPOWER was in the process to make a MOU with WAPCOS.))

(3) West Bengal

1) Dates of visit : November 16, 2016

2) Interviewed agencies : WBSEDCL

3) Findings and JICA teams evaluation

This was the continuation of the update of WBSEDCL's action for Japanese Yen Loan on Turga PSP.

- The cost update of Turga was complete. WBSEDCL or the state finance division would submit application to MOP in 2 weeks (Bilateral Financial Cooperation Application form).
- WBSEDCL mentioned it would be January 2017 when it releases tender notice of DD.
- WBSEDCL expressed keen interests as to have JICA upper ranking officials contact the same of West Bengal state. It intends to have them discuss Japanese Yen Loan utilization to DD before Loan Agreement. The team replied it had delivered the request to JICA already.

(JICA team has got information that Chief Engineer of PSP division was promoted as Executive Director in charge of Turga after the visit. The team expects it would trigger the situation for the better. It needs to be monitored closely)

(4) Meghalaya

1) Dates of visit : November 17-18, 2016

2) Interviewed agencies : MECL, MePGCL,Power Department of Meghalaya State Government,

3) Findings and JICA teams evaluation

It was conducted on the request of JICA, as the Meghalaya state had been approaching JICA several times requesting JICA funds, and had told JICA that it had 3 PSP projects on its own with upcoming PFRs. The visit showed however, it once had put emphasis on PSP but now did not promote PSP. The discoveries are:

- MECL stated it had no PSPs projects. It commented it was aware the state has suitable potential candidates geographically but the state has no intention to develop those as PSPs. It had no PFRs.
- MECL stated the priority areas for development would be Run of River conventional hydro projects.
- It stated the priorities are:
  - ✓ Umngot 210MW (TEC stage)
  - ✓ MHEP (Myntdu Leshka) 210MW (DPR stage)
  - ✓ Mawblei 75MW

It expressed expectations to allocate JICA loans on those projects.

- MECL also stated and expressed keen interests on exporting hydro power to Bangladesh via inter-national transmission line through Bangladesh, using such as Umngot (210MW). It showed interest utilizing JICA loans to the transmission line.
- Power Department of Meghalaya State Government did not know about PSPs. It expressed interests and told it is grateful if JICA conducts feasibility study on PSPs in Meghalaya.

JICA team had another meeting with Retired Director Generation (Ex- Director Generation), MECL. He stated keen intention to develop PSPs in Meghalaya for export to Bangladesh and had been managing MECL on that direction. He admitted the incumbent Director changed the development policy but expressed hopes that JICA could persuade MECL.

On the sideline of the meeting with Ex-Director, JICA team reviewed the state power condition.

- The current state owned installed capacity only was 282MW. It gets allocated supply from CGU 178 MW.

- Although the MECL stressed the state is power surplus, it was clear 60 % of energy demand was from allocation of CGU and NEEPCO outside via PPAs.
- Thus it was not justifiable to develop PSPs for its own use in the state.
- It would be one option to solely utilize PSPs for economic utilization by procuring cheap energy from CGUs and sell power to high tariff market in Bangladesh. Ex-Director showed expectation on this as power purchase cost from CGU at 3 INR/U and Bangladesh power tariff at 6 INR/U. But JICA team suggested the balance 3 INR/U was insufficient for economic PSS. Further, power supply cost from MECL was higher by 1-2 INR/U from power purchase cost. Revision of the current PPAs with CGU is required.
- Among all, transmission capacity to import additional off peak power to PSPs must be guaranteed.

JICA team expressed these concerns to Ex-Director and advised him to consider them.

At this stage, there has been found changes in the comments of execution agencies, especially application of Japanese Yen Loan from Stage 1. The team inevitably decided to exclude Bandhu at the moment to further contact to West Bengal state. Likewise, the following issues should be kept in mind.

- **As for Odisha, there would be little changes in state stance until NCEF decision to apply grants to Upper Indravati. We should wait till then.**
- **As for Tamil Nadu, the funding source for Kundha was REC and TANGEDCO views JICA participation is impractical. The change of design on Sillahalla downgraded from 1,500m head is also hard to achieve. There are more upcoming PSP projects in the state, and should be monitored.**
- **As for Karnataka, they already assigned DPR preparation exclusively to domestic consultant. KPCL has expressed not only expecting JICA loan but considering domestic loans as well. There was not a chance for Japanese consultant to participate in DPR tender. It is only possible to contact the design through WAPCOS so as to move it to Adjustable machines.**
- **As for West Bengal, it was "confirmed" Bandhu was allocated to ADB already in the state. It is so at the moment unless until some changes occur in either state government or WBSEDCL. Even for Turga, their stance for external funds may not be firm[2].**

The following section details the outcome and the evaluation of each project by the Team. Not all candidate projects selected in chapter 5 were able to be provided. Thus, the collected information was limited to some - main projects of each state.

It should be emphasized the stance of each agency moves and changes from time to time referring the

[2] All these information are unofficially collected through interviews in WBSEDCL. (it is advised to treat it confidential)

relations to the central government. So, periodic contacts are indispensable. (the below was the summary at the end of December).

6.2 PROJECT INFORMATION (PUMPED STORAGE PLANNING)

6.2.1 Odisha State

(1) Upper Indravati Pumped Storage Project

According to information from WAPCOS who is preparing its DPR now, it is currently planned to be finish preparing the DPR by June 2017 even though Chairman cum Managing Director of OHPC foresees that the DPR will be completed by May 2017 at the latest. OHPC plans to tender for its civil and electro-mechanical works in 2018 and 2019 respectively after obtaining indispensable clearances such as Techno-Economic Clearance, Forest Clearance and Environmental Clearance in the short term and to finish the construction within 4.5 years. However, WAPCOS opines that the OHPC's prospect is so optimistic that it takes more time to obtain the necessary clearances on the basis of his experience in Turga PSP by WBSEDCL, etc.

As for an adjustable speed type unit, OHPC orders WAPCOS to study in the DPR study whether an adjustable speed type unit is adoptable for this PSP or not. In addition to the necessity, WAPCOS will study which both capacity per unit and number of units are the best in the DPR study.

After the completion of the PFR in 2012, conceptual layout for the lower dam and water conductor system was finalized in April, 2014 even though other facilities such as the transformer room, switchyard, cable tunnel, ventilation tunnel, main access tunnel, control building, etc., haven't been arranged yet. According to the conceptual layout[3], the underground powerhouse is currently arranged below the valley. Considering possibility that amount of spring water inflows into the powerhouse, it may be preferable that the powerhouse is shifted beneath a ridge. Needless to say, temple which will be submerged in the lower reservoir shall be replaced in light of lowering social impact on the development.

6.2.2 Karnataka State

(1) Sharavathy Pumped Storage Project

In the second interview with KPCL held in November 2016, it is unveiled that KPCL made an order for updating PFR for Sharavathy, Varahi and Kali PSPs with WAPCOS through negotiated contract. According to KPCL, the contract covers preparation of the DPRs and EIA reports, survey & investigation for the DPRs and EIA reports, support to obtain clearances such as Forest Clearance, Environmental Clearance, Techno-Economic Clearance, etc., in addition to the update of the PFRs. The update is planned to be finished by February 2017. After the completion of the update, its DPR will be prepared in fifteen to eighteen months.

[3] OHPC, Conceptual Layout Development of Upper Indravati Pumped Storage Project (600 MW), April 2014

This PSP is still the first priority PSP in Karnataka because this PSP utilizes two existing reservoirs as the upper and lower reservoirs respectively. Considering that any reservoir isn't required to be newly constructed, KPCL foresees that construction of the PSP can be completed for less than five years.

Its installed capacity and duration of peak generation are probably revised to 1,000 MW (4 x 250 MW) and 10 hours respectively in this update.

(2) Varahi Pumped Storage Project

As abovementioned, PFR of Varahi PSP is updating now, and the update is scheduled to be finished by February 2017. This PSP is ranked as second to develop PSP in Karnataka next to Sharavathy PSP.

A part of the project site probably exist in Someshwara Wildlife Sanctuary, but it hasn't been confirmed how much impact arise against the wildlife sanctuary.

6.2.3 Tamil Nadu State

(1) Sillahalla Pumped Storage Project

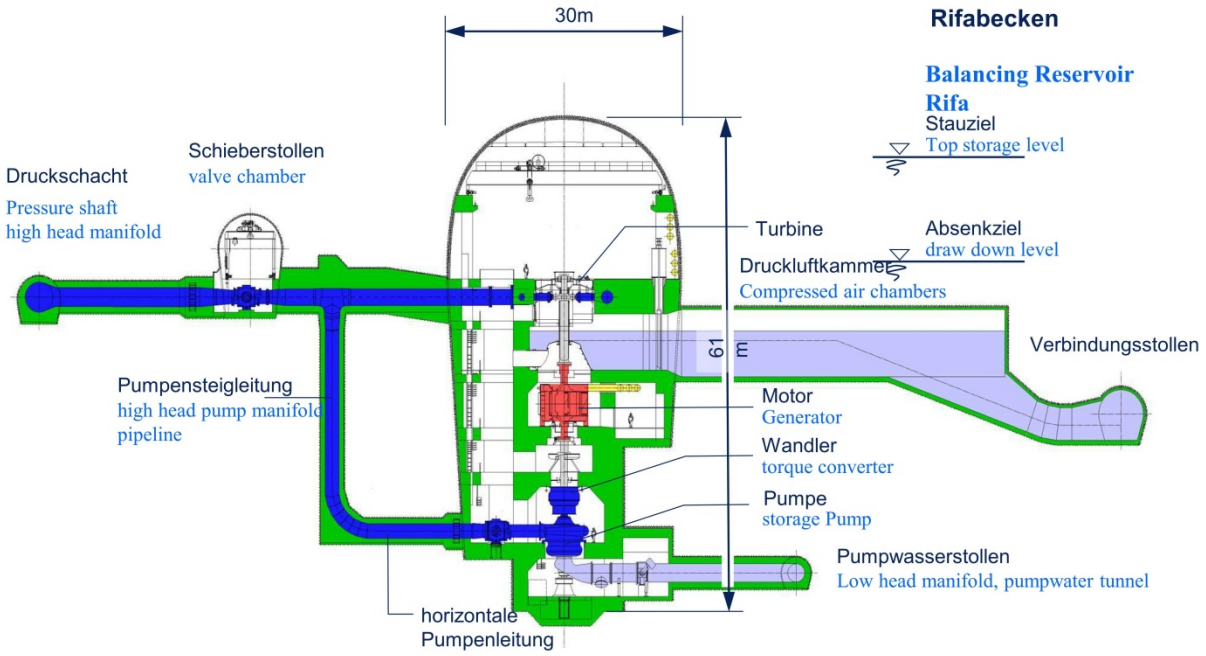
According to 2nd interview with TANGEDCO held in September 2016, DPR for the Phase-1 to construct the upper dam and aqueduct tunnel connecting between the upper reservoir and the existing Emerald reservoir will be completed in October 2016, and Survey & Investigation for the Phase-2 to construct the water conductor system, powerhouse, switchyard, etc., is expected to be finished in October 2016. So, it is found that the project lags behind the schedule somewhat.

In the interview, the JICA Study Team also grasped how to overcome extreme high head which is unapplicable to a pump-turbine. TANGEDCO plans to adopt ternary sets which consist of a motor-generator, a separate Pelton turbine and a multi-stage pump set, which European manufacturer has advantage. When TANGDCO requested several manufacturers including Toshiba to propose how to overcome the extreme high head, only VOITH submitted proposal to apply the ternary set to this PSP with head of approximately 1,500 m. According to VOITH's proposal[4], VOITH has proposed TANGEDCO to change capacity per unit and number of units from 500 MW x 4 units to 250 MW x 8 units in consideration of the present technical limitation. Judging from the applicable range of multi-stage pump, combination of head of 1,500 m and capacity per unit of 250 MW is presently out of the applicable range, so that this PSP is regarded as challenging in the case of adoption of the ternary set.

The unit proposed by VOITH isn't adjustable speed unit, but the plant system can adjust an input by means of power generation to supply a part of amount of water pumping up from a lower reservoir to an upper reservoir to a turbine for power generation. Consequently, the plant can be operated continuously from pumping mode to power generation mode[5].

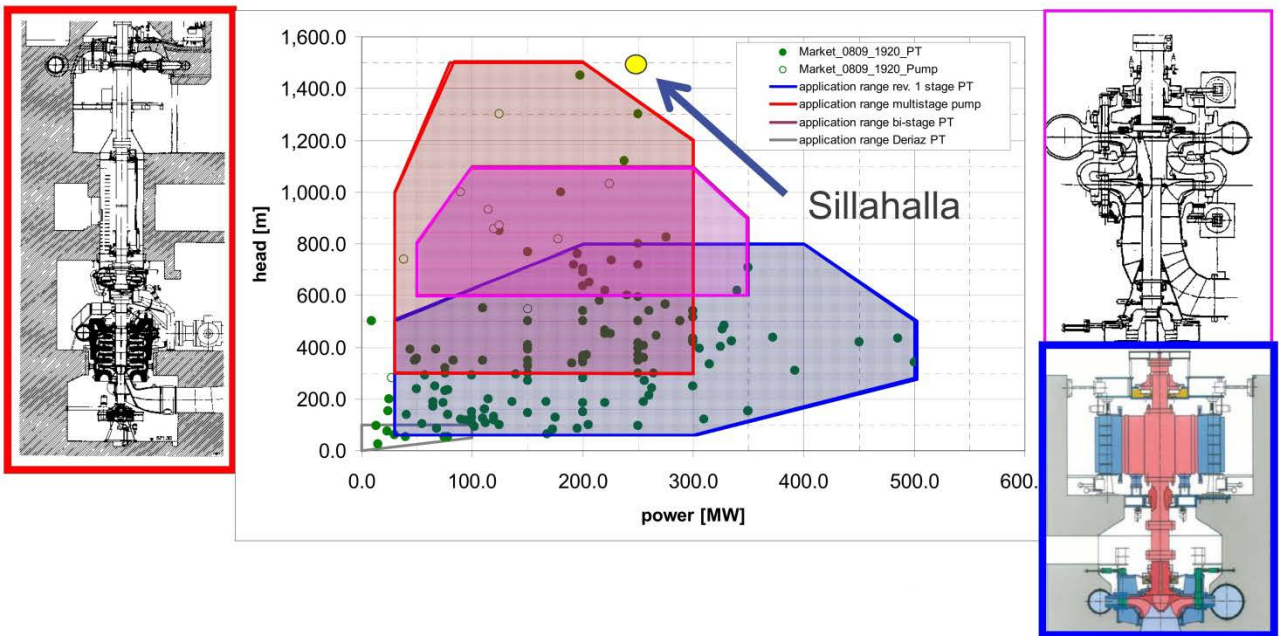
[4] VOITH, Preliminary Hydraulic Layout – Sillahalla, November 2013

[5] JICA, Final Report on Survey for Applicable Possibility of Adjustable Speed Pump Turbine, January 2012



source: Presentation by illwerke vkw titled as Sustainable Hydropower Strategies for the Alpine Region 4th International Conference "Water in the Alps"

Figure 6.2.3-1 Longitudinal Section of KOPS II Powerhouse installed Ternary Set



source: Voith's Proposal titled as "Preliminary Hydraulic Layout Sillahalla"

Figure 6.2.3-2 Applicable Range of Pump and Pump-Turbine

By the way, according to article released on 21st October 2016, TANGEDCO has firstly floated tender to procure 500 MW of solar power in order to meet requirement of Renewable Purchase Obligation. And, it is also reported that approximately 1,200 MW of solar power is required for 2016-17 and approximately 2,400 MW of solar power is required for 2017-18 to meet target of Renewable Purchase Obligation[6]. Considering the circumstance, more pumped storage hydropower plant will be required for stabilization of the grid.

6.2.4 West Bengal State

(1) Turga Pumped Storage Project

WBSEDCL received an official letter[7] from CEA to award Techno-Economic Clearance to this PSP on 5th October 2016 under the condition of installation of two (2) fixed speed type units and two (2) adjustable speed type units, not three (3) fixed speed type units and one (1) adjustable speed type unit. Accordingly, it is supposed that WBSEDCL takes action to list up this PSP into the Rolling Plan. In order to push forward this PSP, WBSEDCL hopes to release tender notice for selection of a foreign consultant for detailed design and construction supervision for this PSP in November 2016. The reason is that WBSEDCL desires to push forward the detailed design and supervision as quickly as possible in consideration of pressure by CEA who hopes to strongly push forward PSPs, but it hasn't been consolidated how to fundraise so far.

As of September 2016 when the 2nd interview was held, some issues are outstanding. Stage-1 Forest Clearance hasn't been obtained yet. Consequently, transfer procedures for 369 acres and 35 acres lands haven't been completed yet because the abovementioned Forest Clearance is indispensable to complete the lands' transfer. Additionally, Environmental Clearance also hasn't been obtained because the abovementioned forest clearance hasn't been obtained, too even though Expert Appraisal Committee issued a letter on 10th August 2016 to recommend issuing Environmental Clearance under the condition of obtaining the abovementioned Forest Clearance.

Although some issues are pending, this PSP is the most advanced among the PSPs in India whose construction works haven't been started. And, WBSEDCL desires to develop this PSP by means of Japanese yen-denominated government credits. Furthermore, it has already been decided that two (2) adjustable speed units of which Japanese manufacturers have advantage are installed. Considering these matters, this PSP is hopeful one to be developed by utilizing Japanese yen-denominated government credits.

[6] The Hindu, http://www.thehindu.com/news/cities/chennai/tangedco-floats-tender-for-500-mw-solar-power/article9247902.ece, 21st October 2016

[7] CEA's Letter titled as "Turga Pumped Storage Project (4 x 250 MW=1,000 MW) in West Bengal by WBSEDCL at an Estimated Completion Cost of Rs.4,234.90 Crores at December 2014 PL including IDC of Rs.439.42 Crores – Issue of Concurrence" issued on 5th October 2016 (Letter No. 2/WB/22/CEA/2013-PAC/713-745)

(2) Bandhu Pumped Storage Project

WBSEDCL regards this PSP as the second priority next to Turga PSP. So, the JICA Study Team made an appointment with Chairman cum Managing Director of WBSEDCL in September 2016 to hear about both Turga and Bandhu PSPs, but he suddenly cancelled the interview. Although the reason of the cancellation hasn't been professed, it is conjectured that he has no intention to discuss Bandhu PSP with JICA including his study team because ADB has already approached WBSEDCL for finance to this PSP, and consequently it is supposed that high-level of WBSEDCL has an intention to seek the finance from ADB. Judging from the situation, the JICA Study Team thinks it inappropriate to select this PSP as hopeful one for development by utilizing Japanese yen-denominated government credits.

6.3 PROJECT INFORMATION (ENVIRONMENTAL ASPECTS)

6.3.1 Upper Indravati PSP

Upper Indravati PSP locates Kalahandi District. New Lower Pond is planned and existing Indravati Dam is used for upper pond.

(1) Environmental Conditions

1) Land use

Major land cover around the project site is Agricultural land and open forest. According to Final Report on Pre-Feasibility Study for Pumped Storage Scheme in Upper Indrāvati Hydro Electric Project, ODISHA (600 MW) (2012, OHPCL) the proposed reservoir will lead to submergence of about 80 ha of land. Total land required for the construction of various components is about 85 ha. In which the land acquisition shall be about 25 ha. No resettlement except one temple is estimated by CONCEPTUAL LAYOUT DEVELOPMENT (WAPCOS, 2014).

2) Protected areas

There is no protected areas in and around the project site.

3) IUCN Red List Species

The project locates outside of the known habitat of Elephant. According to the Integrated Biodiversity Assessment Tool (IBAT) [8] the number of IUCN red list species in the grid cell[9] 73197 are 33 including Critically endangered (CR) 2, Endangered (EN) 5, Vulnerable (VU) 13, Near threatened (NT) 10, and Data deficient (DD) 3 (See Table 6.3.1-1).

[8] "Protected Area and Key Biodiversity Area data downloaded from the Integrated Biodiversity Assessment Tool (IBAT) (https://www.ibat-alliance.org/ibat-conservation). Provided by BirdLife International, Conservation International, IUCN and UNEP-WCMC. Please contact ibat@birdlife.org for further information."

[9] One cell is sexanglular with 30km side.

Table 6.3.1-1 Protected Species recorded near Upper Indravati PS

Taxonomic group	Species	Common name	IUCN Red List Category[10]
Birds	*Anhinga melanogaster*	Oriental Darter	NT
Birds	*Anthracoceros coronatus*	Malabar Pied Hornbill	NT
Birds	*Chaetornis striata*	Bristled Grassbird	VU
Birds	*Circus macrourus*	Pallid Harrier	NT
Birds	*Clanga clanga*	Greater Spotted Eagle	VU
Birds	*Clanga hastata*	Indian Spotted Eagle	VU
Birds	*Columba punicea*	Pale-capped Pigeon	VU
Birds	*Falco chicquera*	Red-headed Falcon	NT
Birds	*Gyps bengalensis*	White-rumped Vulture	CR
Birds	*Leptoptilos javanicus*	Lesser Adjutant	VU
Birds	*Limosa limosa*	Black-tailed Godwit	NT
Birds	*Mycteria leucocephala*	Painted Stork	NT
Birds	*Neophron percnopterus*	Egyptian Vulture	EN
Birds	*Pelecanus philippensis*	Spot-billed Pelican	NT
Birds	*Psittacula eupatria*	Alexandrine Parakeet	NT
Birds	*Sarcogyps calvus*	Red-headed Vulture	CR
Birds	*Sterna acuticauda*	Black-bellied Tern	EN
Birds	*Sterna aurantia*	River Tern	NT
Birds	*Sypheotides indicus*	Lesser Florican	EN
Mammals	*Bos gaurus*	Gaur	VU
Mammals	*Cuon alpinus*	Dhole	EN
Mammals	*Hyaena hyaena*	Striped Hyaena	NT
Mammals	*Lutrogale perspicillata*	Smooth-coated Otter	VU
Mammals	*Manis crassicaudata*	Indian Pangolin	EN
Mammals	*Melursus ursinus*	Sloth Bear	VU
Mammals	*Prionailurus rubiginosus*	Rusty-spotted Cat	VU
Mammals	*Rusa unicolor*	Sambar	VU
Mammals	*Tetracerus quadricornis*	Four-horned Antelope	VU
Reptiles	*Crocodylus palustris*	Mugger	VU
Reptiles	*Eutropis innotata*	Blanford's Mabuya	DD
Reptiles	*Hemidactylus subtriedrus*	Madras Blotched Gecko	DD
Reptiles	*Ophiophagus hannah*	King Cobra	VU
Snails and Slugs	*Tricula gravelyi*		DD

source: IBAT (https://www.ibat-alliance.org)

4) Forest land

Most of the project site is in the reserved forest (See Figure 6.3.1-2). Forest Clearance will be required.

(2) Anxious points

Most of the project site is under the forest area. Then the process of Forest Clearance might take time. Scheduled Tribe rate of Kalahandi District is 28.50 %. It is a bit higher than the other projects. Even if any resettlements are not expected, the project might affect agricultural activities of scheduled tribes. The security aspect is anxious because the security level of the project site is Level 2 (Avoid

[10] CR: Extremely high risk of extinction in the wild./ EN: High risk of extinction in the wild./ VU: High risk of endangerment in the wild. /NT: Likely to become endangered in the near future. / DD: Not enough data to make an assessment of its risk of extinction.

Non-essential travel) of the MOFA's "Overseas Travel Safety Information".

(3) Required Actions

In order to reduce the risk of delay by the Forest Clearance, it is recommended that Prior Environmental Clearance is obtained before starting preparation of DPR (ie., it should have been obtained). During social survey, scheduled tribe should be paid attention. For biological survey detail biological survey for the specie should be planned after identifying the most vulnerable species from the reported IUCN red list.

Figure 6.3.1-1 Satellite Image of Upper Indravati PSP

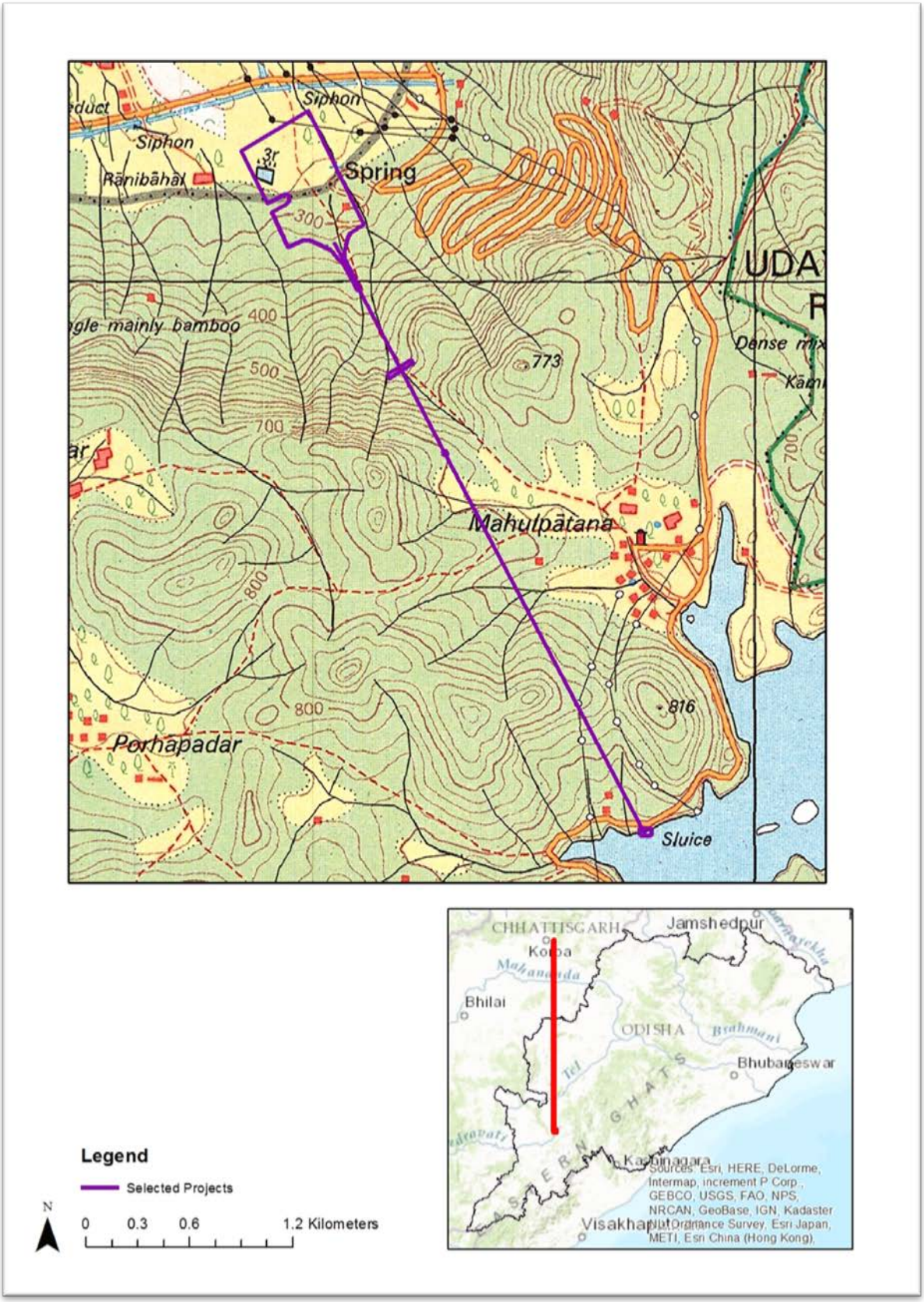


Figure 6.3.1-2 Forest land of Upper Indravati PSP

6.3.2 Upper Kolab PSP

Upper Kolab PSP locates Koraput District. No new reservoir is planned and existing Kolab dam and irrigation reservoir are used.

(1) Environmental Conditions

1) Land use

Major land cover around the project site is open forest and agricultural land. Based on the "Final Report on Pre-Feasibility Study for Pumped Storage Scheme in Upper Kolab Hydro Electric Project ODISHA (320 MW)" (OHPCL, 2012) several houses might be resettled near the intake and outlet. Total land required for the construction of various components is about 65.00 ha.

2) Protected areas

No protected areas are found around the project area.

3) IUCN Red List Species

The project locates outside of the known Tiger or Elephant habitat. According to IBAT the number of protected species in the grid cell 73196, which the project locates, are Globally Threatened (CR, EN, VU), Near Threatened (NT) and Data Deficient (DD) species 35 (See Table 6.3.2-1).

Table 6.3.2-1 Protected Species recorded near Upper Kolab PSP

Taxonomic group	Species	Common name	IUCN Red List Category
Birds	*Anhinga melanogaster*	Oriental Darter	NT
Birds	*Anthracoceros coronatus*	Malabar Pied Hornbill	NT
Birds	*Aythya nyroca*	Ferruginous Duck	NT
Birds	*Chaetornis striata*	Bristled Grassbird	VU
Birds	*Circus macrourus*	Pallid Harrier	NT
Birds	*Clanga clanga*	Greater Spotted Eagle	VU
Birds	*Clanga hastata*	Indian Spotted Eagle	VU
Birds	*Columba punicea*	Pale-capped Pigeon	VU
Birds	*Ephippiorhynchus asiaticus*	Black-necked Stork	NT
Birds	*Falco chicquera*	Red-headed Falcon	NT
Birds	*Gyps bengalensis*	White-rumped Vulture	CR
Birds	*Limosa limosa*	Black-tailed Godwit	NT
Birds	*Mycteria leucocephala*	Painted Stork	NT
Birds	*Neophron percnopterus*	Egyptian Vulture	EN
Birds	*Pelecanus philippensis*	Spot-billed Pelican	NT
Birds	*Psittacula eupatria*	Alexandrine Parakeet	NT
Birds	*Sarcogyps calvus*	Red-headed Vulture	CR
Birds	*Sterna acuticauda*	Black-bellied Tern	EN

Birds	*Sterna aurantia*	River Tern	NT
Birds	*Sypheotides indicus*	Lesser Florican	EN
Fishes	*Anguilla bengalensis*	Indian Mottled Eel	NT
Fishes	*Anguilla bicolor*	Shortfin Eel	NT
Mammals	*Bos gaurus*	Gaur	VU
Mammals	*Cuon alpinus*	Dhole	EN
Mammals	*Lutrogale perspicillata*	Smooth-coated Otter	VU
Mammals	*Manis crassicaudata*	Indian Pangolin	EN
Mammals	*Melursus ursinus*	Sloth Bear	VU
Mammals	*Prionailurus rubiginosus*	Rusty-spotted Cat	VU
Mammals	*Rusa unicolor*	Sambar	VU
Mammals	*Tetracerus quadricornis*	Four-horned Antelope	VU
Reptiles	*Crocodylus palustris*	Mugger	VU
Reptiles	*Eutropis innotata*	Blanford's Mabuya	DD
Reptiles	*Geckoella jeyporensis*	Jeypore Ground Gecko	CR
Reptiles	*Hemidactylus subtriedrus*	Madras Blotched Gecko	DD
Reptiles	*Ophiophagus hannah*	King Cobra	VU

source: IBAT (https://www.ibat-alliance.org)

4) Forest land

Some reserved forest will be affected around intake, outlet and surge tank (See Figure 6.3.2-2).

Exact area of affected forest is not clear.

(2) Anxious points

Scheduled Tribe rate of Koraput District is 56.56 % which is very higher than the other projects. Then some kind of tribal issues are concerned. The project is Level 2 (Avoid Non-essential travel) of the MOFA's "Overseas Travel Safety Information". Then security issues are one of the risk for conducting the project.

(3) Required Actions

To avoid any environmental risk which might affect the project seriously, Prior Environmental Clearance (Site Clearance) should be obtained before DPR (at present after PFR). During the survey for EIA, detail biological survey targeting for some IUCN red list species are recommended. While discussion with the local people, careful attention to the tribal people are required.

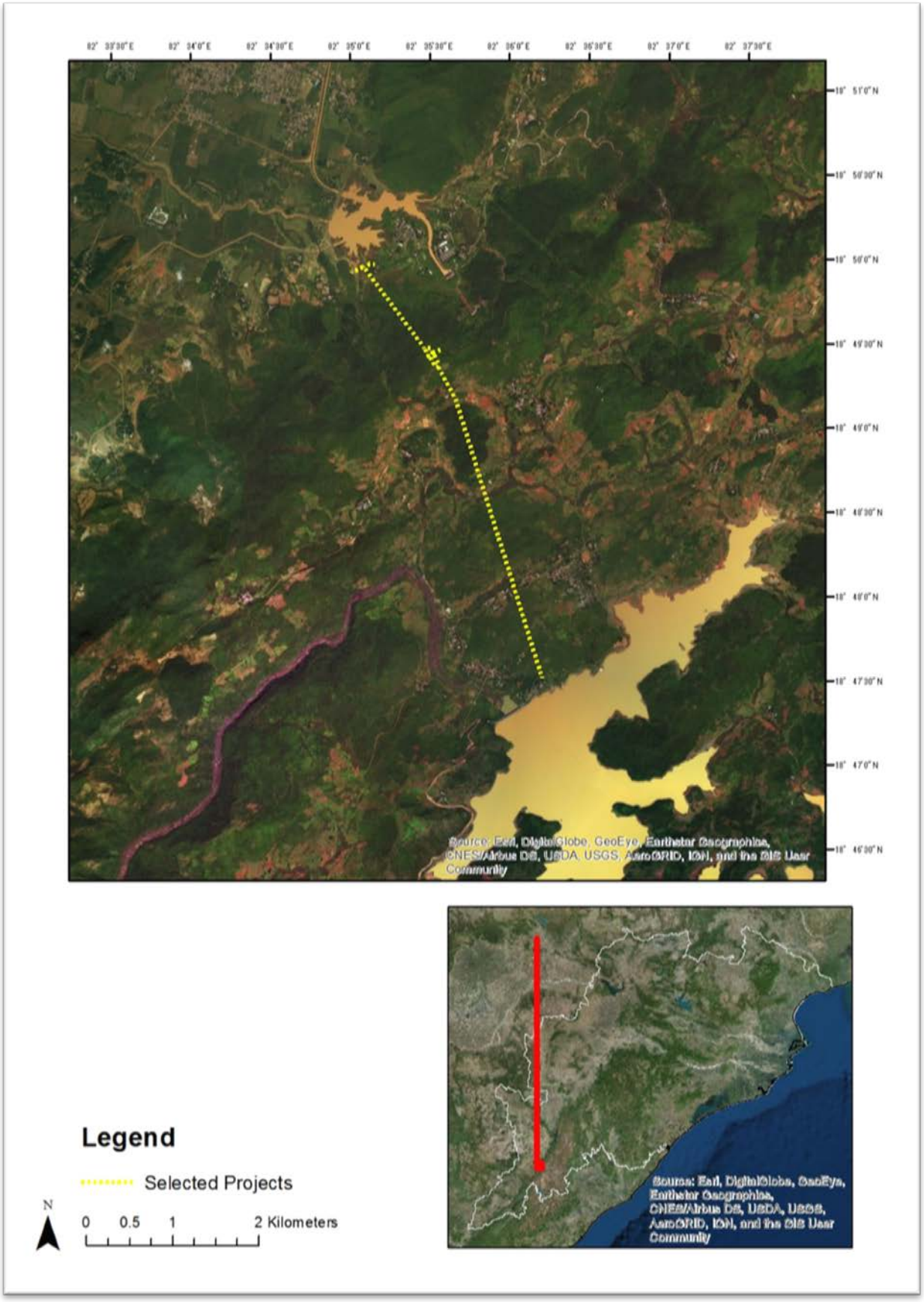


Figure 6.3.2-1 Satellite Image of Upper Kolab PSP

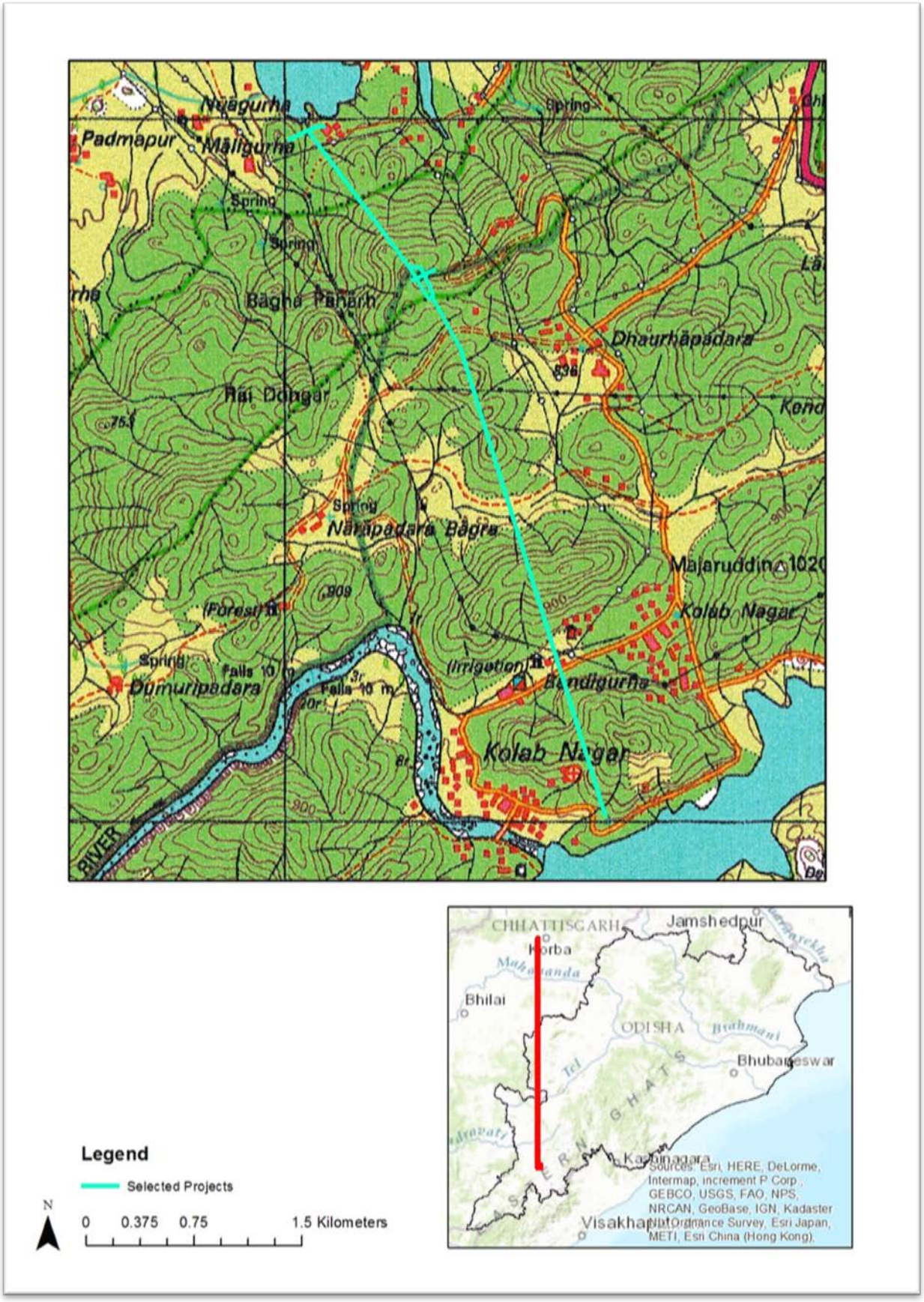


Figure 6.3.2-2 Forest land near Upper Kolab PSP

6.3.3 Sharavathy PSP

Sharavathy PSP locates Shimoga District. No new Lower Pond is planned and existing Talakalale reservoir is used for upper pond and Gerusoppa reservoir is used for lower pond.

(1) Environmental Conditions

1) Land use

Major land cover around the project site is Mixed Forest and Needleleaf Evergreen Forest. Information of resettlement and land acquisition is not clear.

2) Protected areas

The project site is in Sharavathi Valley Sanctuary, Endemic Bird Area, Biodiversity Hotspots, and 5km from KBA.

3) IUCN Red List Species

The project locates in the known Elephant and Tiger habitat. According to IBAT the number of protected species in the grid cell 70592 which the project locates are Globally Threatened (CR, EN, VU), Near Threatened (NT) and Data Deficient (DD) species 59 (See Table 6.3.3-1).

Table 6.3.3-1 Protected Species recorded near Sharavathy PSP

Taxonomic group	Species	Common name	IUCN Red List Category
Amphibians	*Micrixalus saxicola*	Malabar Tropical Frog	VU
Amphibians	*Philautus neelanethrus*		EN
Birds	*Amandava formosa*	Green Avadavat	VU
Birds	*Anhinga melanogaster*	Oriental Darter	NT
Birds	*Anthracoceros coronatus*	Malabar Pied Hornbill	NT
Birds	*Aythya nyroca*	Ferruginous Duck	NT
Birds	*Buceros bicornis*	Great Hornbill	NT
Birds	*Chaetornis striata*	Bristled Grassbird	VU
Birds	*Ciconia episcopus*	Asian Woollyneck	VU
Birds	*Circus macrourus*	Pallid Harrier	NT
Birds	*Clanga hastata*	Indian Spotted Eagle	VU
Birds	*Columba elphinstonii*	Nilgiri Woodpigeon	VU
Birds	*Ephippiorhynchus asiaticus*	Black-necked Stork	NT
Birds	*Esacus recurvirostris*	Great Thick-knee	NT
Birds	*Eumyias albicaudatus*	Nilgiri Flycatcher	NT
Birds	*Falco chicquera*	Red-headed Falcon	NT
Birds	*Gallinago nemoricola*	Wood Snipe	VU
Birds	*Gyps bengalensis*	White-rumped Vulture	CR
Birds	*Gyps indicus*	Indian Vulture	CR
Birds	*Icthyophaga ichthyaetus*	Grey-headed Fish-eagle	NT
Birds	*Leptoptilos javanicus*	Lesser Adjutant	VU
Birds	*Limosa limosa*	Black-tailed Godwit	NT
Birds	*Mycteria leucocephala*	Painted Stork	NT
Birds	*Neophron percnopterus*	Egyptian Vulture	EN
Birds	*Numenius arquata*	Eurasian Curlew	NT
Birds	*Phylloscopus tytleri*	Tytler's Leaf-warbler	NT

Taxonomic group	Species	Common name	IUCN Red List Category
Birds	*Psittacula eupatria*	Alexandrine Parakeet	NT
Birds	*Pycnonotus priocephalus*	Grey-headed Bulbul	NT
Birds	*Pycnonotus xantholaemus*	Yellow-throated Bulbul	VU
Birds	*Sarcogyps calvus*	Red-headed Vulture	CR
Birds	*Sterna acuticauda*	Black-bellied Tern	EN
Birds	*Sterna aurantia*	River Tern	NT
Birds	*Sypheotides indicus*	Lesser Florican	EN
Birds	*Threskiornis melanocephalus*	Black-headed Ibis	NT
Fishes	*Anguilla bicolor*	Shortfin Eel	NT
Fishes	*Labeo potail*	Deccan Labeo	EN
Fishes	*Tor khudree*	Black Mahseer	EN
Mammals	*Bos gaurus*	Gaur	VU
Mammals	*Cuon alpinus*	Dhole	EN
Mammals	*Elephas maximus*	Asian Elephant	EN
Mammals	*Hyaena hyaena*	Striped Hyaena	NT
Mammals	*Lutrogale perspicillata*	Smooth-coated Otter	VU
Mammals	*Macaca silenus*	Lion-tailed Macaque	EN
Mammals	*Manis crassicaudata*	Indian Pangolin	EN
Mammals	*Melursus ursinus*	Sloth Bear	VU
Mammals	*Panthera pardus*	Leopard	NT
Mammals	*Panthera tigris*	Tiger	EN
Mammals	*Prionailurus rubiginosus*	Rusty-spotted Cat	VU
Mammals	*Rusa unicolor*	Sambar	VU
Mammals	*Semnopithecus hypoleucos*	Black-footed Gray Langur	VU
Mammals	*Tetracerus quadricornis*	Four-horned Antelope	VU
Other invertebrates	*Thrigmopoeus insignis*	Notable Large Burrowing Spider	VU
Other invertebrates	*Thrigmopoeus truculentus*	Karwar Large Burrowing Spider	NT
Reptiles	*Boiga beddomei*	Beddome's Cat Snake	DD
Reptiles	*Cnemaspis heteropholis*	Gund Day Gecko	NT
Reptiles	*Cnemaspis indraneildasii*	Das's Day Gecko	VU
Reptiles	*Crocodylus palustris*	Mugger	VU
Reptiles	*Dendrelaphis chairecacos*		DD
Reptiles	*Ophiophagus hannah*	King Cobra	VU

source: IBAT (https://www.ibat-alliance.org)

4) Forest land

The exact locations of Resaved Forest are not clear. Based on the topographical map (See Figure 6.3.3-4) and satellite image (See Figure 6.3.3-1), the possibility of impact on Reserved Forest would be high.

(2) Anxious points

The project site is covered by one domestic protected area and two international protected areas. Then the biodiversity impact is the most anxious points. Impact on protected species including Tiger and Elephants seems to be serious. Social issues including Scheduled Tribe and resettlement might not be so serious.

(3) Required Actions

Even if it is still in the Prior Environmental Clearance (Site Clearance) stage, detail biological survey is recommended. The habitat survey for Tiger and Elephants are prerequisite. Then proactive action for impact avoidance can be taken in DPR stage. Not only the Environmental Clearance and Forest Clearance but also Wildlife Clearance is required for the Wildlife Sanctuary.

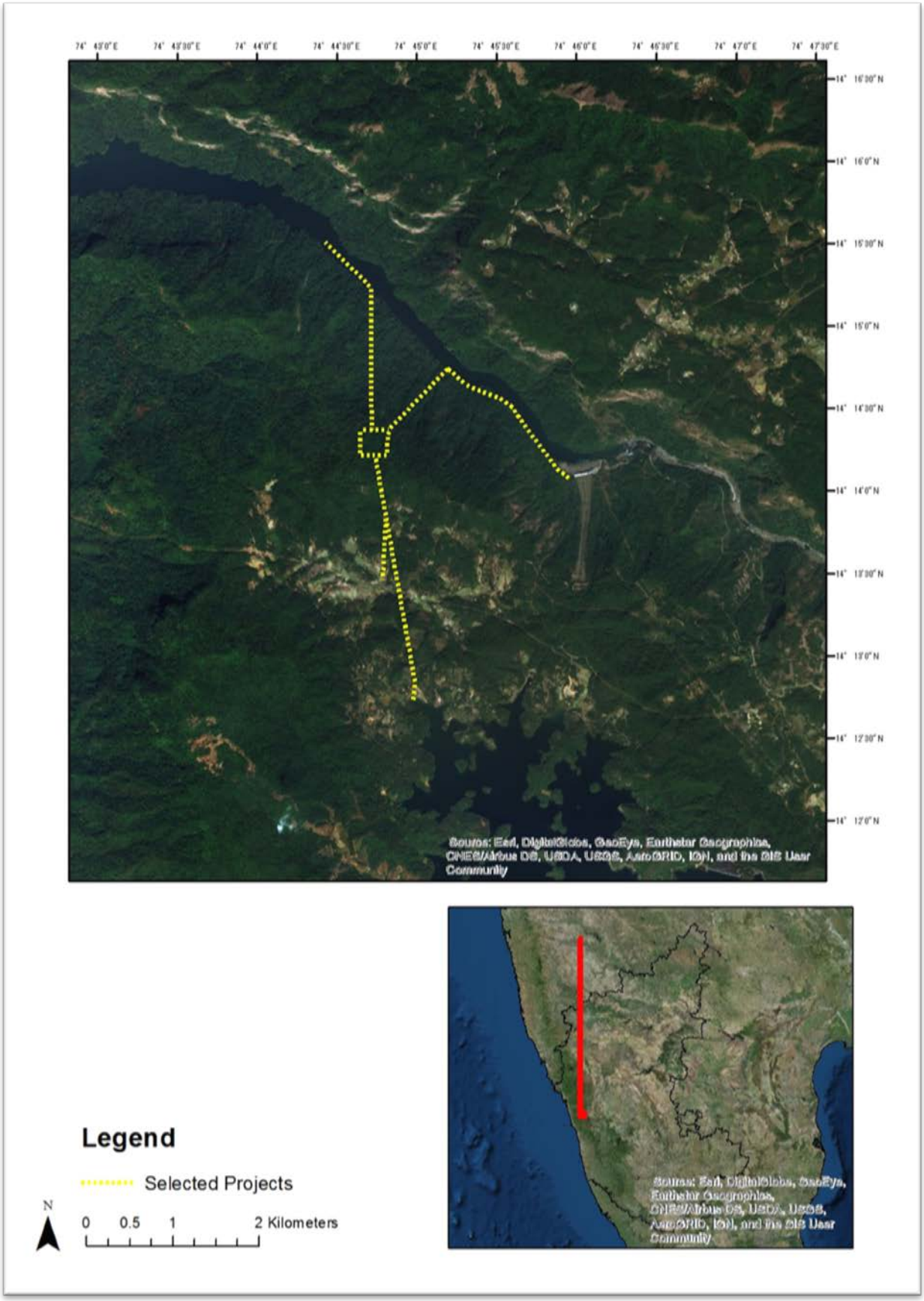
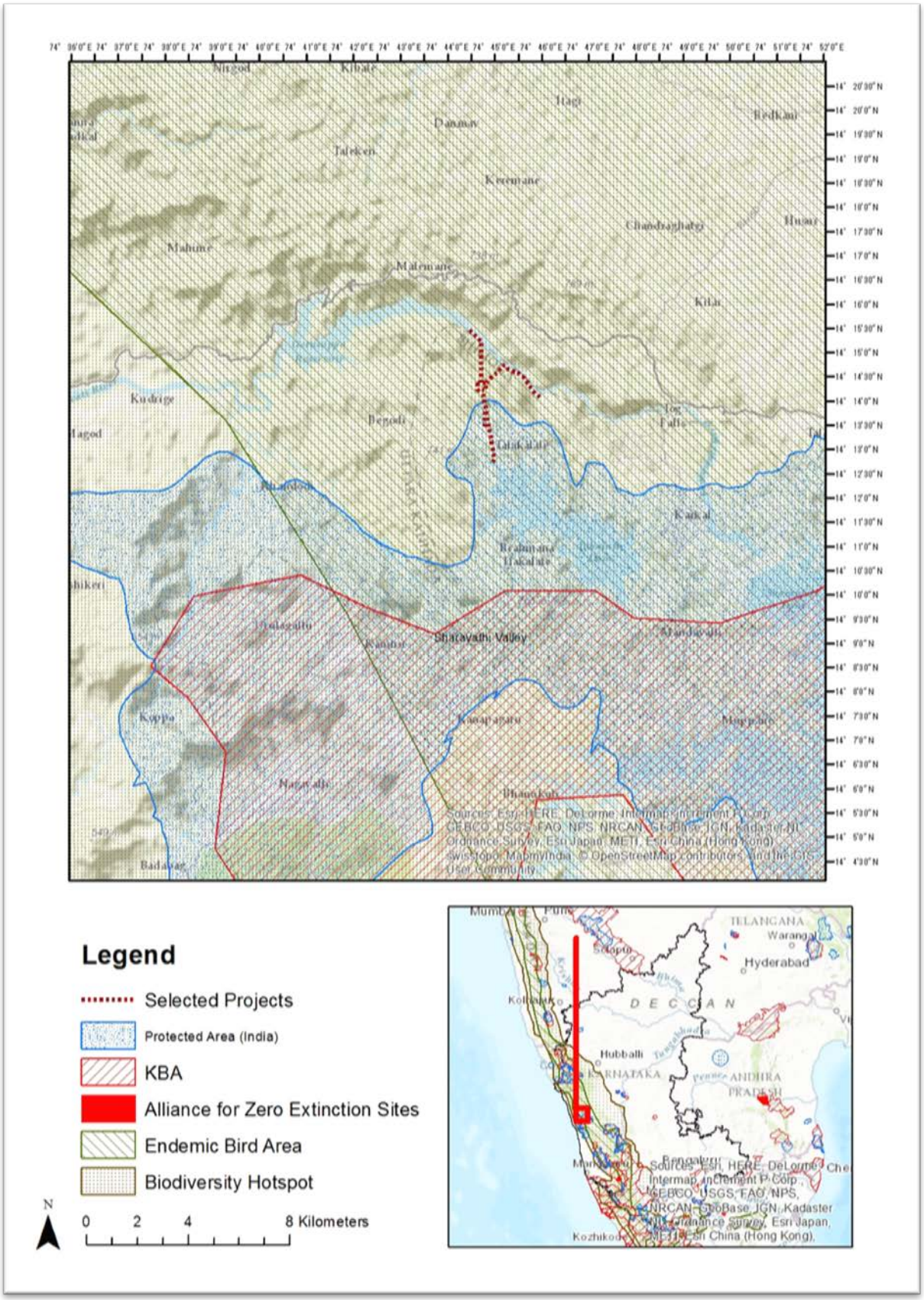
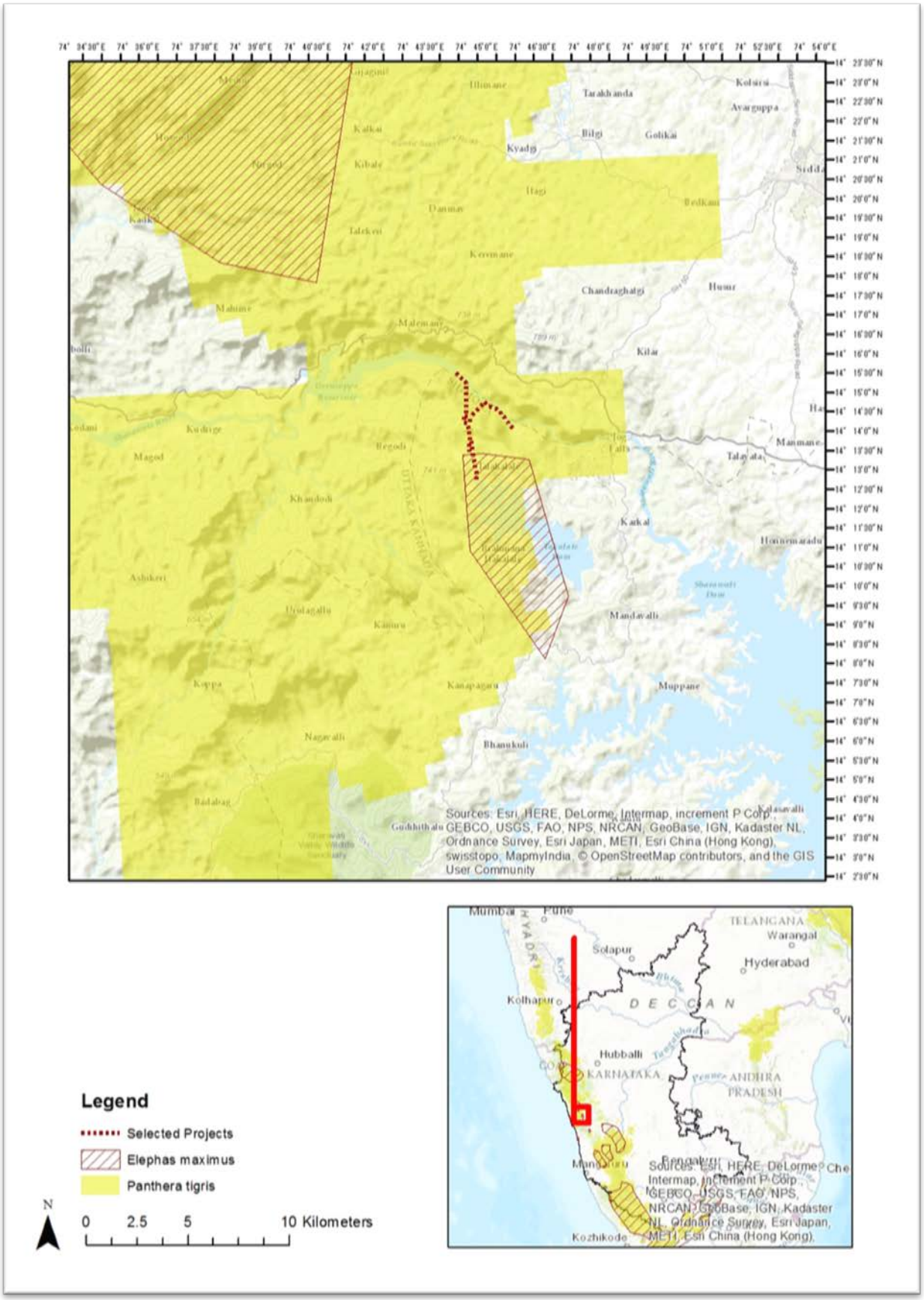


Figure 6.3.3-1 Satellite Image of Sharavathy PSP



source: IBAT (https://www.ibat-alliance.org)

Figure 6.3.3-2 Protected Areas of Sharavathy PSP



source: IUCN (http://www.iucnredlist.org/)

Figure 6.3.3-3 Tiger and Elephant habitats around Sharavathy PSP

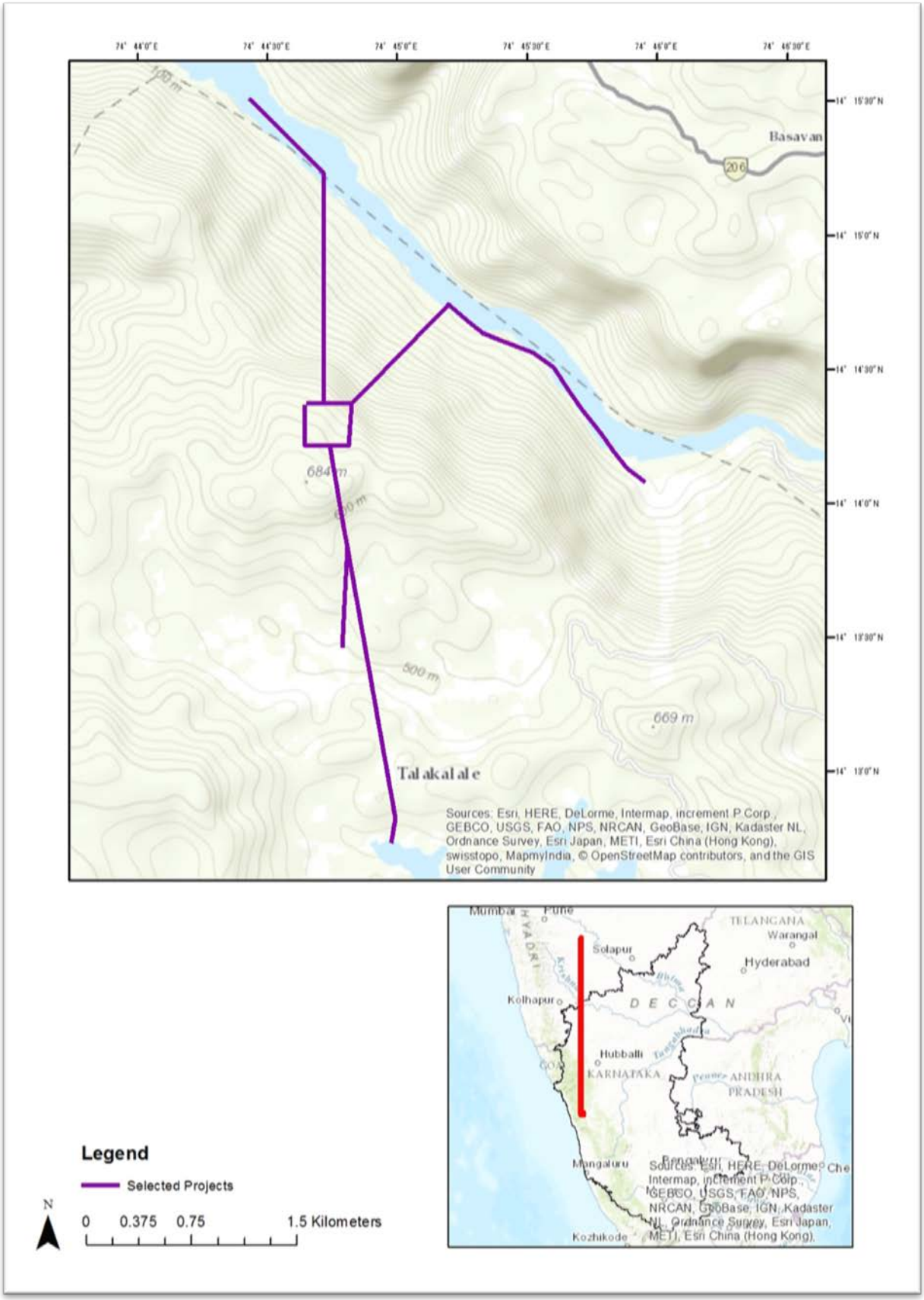


Figure 6.3.3-4 Topographical map of Sharavathy PSP

6.3.4 Varahi PSP

(1) Environmental Conditions

Varahi PSP locates Udupi District and Shimoga District. New lower pond is planned and existing Varahi reservoir is used for upper pond.

1) Land use

Major land cover around the project site is mixed forest. Information of resettlement and land acquisition is not clear.

2) Protected areas

The project site is in Biodiversity Hotspots, and 10 km from the Mookambika Sanctuary and Western Ghats World Heritage Site.

3) IUCN Red List Species

The project locates 2.3km from the known Tiger habitat. According to IBAT the number of protected species in the grid cell 70673 are Globally Threatened (CR, EN, VU), Near Threatened (NT) and Data Deficient (DD) species 69 (See Table 6.3.4-1).

Table 6.3.4-1 Protected Species recorded near Varahi PSP

Taxonomic group	Species	Common name	IUCN Red List Category
Amphibians	*Clinotarsus curtipes*		NT
Amphibians	*Hylarana aurantiaca*		VU
Amphibians	*Hylarana temporalis*		NT
Amphibians	*Indirana brachytarsus*		EN
Amphibians	*Nyctibatrachus aliciae*		EN
Amphibians	*Nyctibatrachus major*		VU
Amphibians	*Nyctibatrachus sanctipalustris*		EN
Amphibians	*Philautus neelanethrus*		EN
Amphibians	*Ramanella montana*		NT
Birds	*Amandava formosa*	Green Avadavat	VU
Birds	*Anhinga melanogaster*	Oriental Darter	NT
Birds	*Anthracoceros coronatus*	Malabar Pied Hornbill	NT
Birds	*Aythya nyroca*	Ferruginous Duck	NT
Birds	*Buceros bicornis*	Great Hornbill	NT
Birds	*Chaetornis striata*	Bristled Grassbird	VU
Birds	*Ciconia episcopus*	Asian Woollyneck	VU
Birds	*Circus macrourus*	Pallid Harrier	NT
Birds	*Clanga hastata*	Indian Spotted Eagle	VU
Birds	*Columba elphinstonii*	Nilgiri Woodpigeon	VU
Birds	*Ephippiorhynchus asiaticus*	Black-necked Stork	NT
Birds	*Esacus recurvirostris*	Great Thick-knee	NT
Birds	*Eumyias albicaudatus*	Nilgiri Flycatcher	NT
Birds	*Falco chicquera*	Red-headed Falcon	NT
Birds	*Gallinago nemoricola*	Wood Snipe	VU
Birds	*Gyps bengalensis*	White-rumped Vulture	CR
Birds	*Gyps indicus*	Indian Vulture	CR

Taxonomic group	Species	Common name	IUCN Red List Category
Birds	*Icthyophaga ichthyaetus*	Grey-headed Fish-eagle	NT
Birds	*Leptoptilos javanicus*	Lesser Adjutant	VU
Birds	*Limosa limosa*	Black-tailed Godwit	NT
Birds	*Mycteria leucocephala*	Painted Stork	NT
Birds	*Neophron percnopterus*	Egyptian Vulture	EN
Birds	*Numenius arquata*	Eurasian Curlew	NT
Birds	*Pelecanus philippensis*	Spot-billed Pelican	NT
Birds	*Phylloscopus tytleri*	Tytler's Leaf-warbler	NT
Birds	*Psittacula eupatria*	Alexandrine Parakeet	NT
Birds	*Pycnonotus priocephalus*	Grey-headed Bulbul	NT
Birds	*Pycnonotus xantholaemus*	Yellow-throated Bulbul	VU
Birds	*Sarcogyps calvus*	Red-headed Vulture	CR
Birds	*Sterna acuticauda*	Black-bellied Tern	EN
Birds	*Sterna aurantia*	River Tern	NT
Birds	*Sypheotides indicus*	Lesser Florican	EN
Fishes	*Anguilla bicolor*	Shortfin Eel	NT
Fishes	*Labeo potail*	Deccan Labeo	EN
Fishes	*Tor khudree*	Black Mahseer	EN
Mammals	*Bos gaurus*	Gaur	VU
Mammals	*Cuon alpinus*	Dhole	EN
Mammals	*Elephas maximus*	Asian Elephant	EN
Mammals	*Herpestes fuscus*	Indian Brown Mongoose	VU
Mammals	*Hyaena hyaena*	Striped Hyaena	NT
Mammals	*Lutrogale perspicillata*	Smooth-coated Otter	VU
Mammals	*Macaca silenus*	Lion-tailed Macaque	EN
Mammals	*Manis crassicaudata*	Indian Pangolin	EN
Mammals	*Melursus ursinus*	Sloth Bear	VU
Mammals	*Panthera pardus*	Leopard	NT
Mammals	*Panthera tigris*	Tiger	EN
Mammals	*Platacanthomys lasiurus*	Malabar Spiny Tree Mouse	VU
Mammals	*Prionailurus rubiginosus*	Rusty-spotted Cat	VU
Mammals	*Rusa unicolor*	Sambar	VU
Mammals	*Semnopithecus hypoleucos*	Black-footed Gray Langur	VU
Mammals	*Tetracerus quadricornis*	Four-horned Antelope	VU
Other invertebrates	*Thrigmopoeus insignis*	Notable Large Burrowing Spider	VU
Other invertebrates	*Thrigmopoeus truculentus*	Karwar Large Burrowing Spider	NT
Reptiles	*Boiga beddomei*	Beddome's Cat Snake	DD
Reptiles	*Cnemaspis heteropholis*	Gund Day Gecko	NT
Reptiles	*Cnemaspis indraneildasii*	Das's Day Gecko	VU
Reptiles	*Crocodylus palustris*	Mugger	VU
Reptiles	*Ophiophagus hannah*	King Cobra	VU
Reptiles	*Plectrurus aureus*	Kerala Burrowing Snake	DD
Reptiles	*Plectrurus canaricus*	Karnataka Burrowing Snake	DD

source: IBAT (https://www.ibat-alliance.org)

4) Forest land

The exact locations of the reserved forest are not clear. But referring the topographic map (See Figure 6.3.4-4) and satellite image (See Figure 6.3.4-1), some reserved forests might be affected.

(2) Anxious points

Biodiversity is the most anxious points for the project because Biodiversity Hotspot covers the project site and 65 IUCN Red List species including Tiger and Elephant are reported around the project site. Social issues will not be so serious.

(3) Required Actions

Detail Biological survey in the early project design stage is the most important. After the detail biological survey the important habitat for the IUCN Red List species should be carefully avoided in design stage. Even if the project site is outside of the Sanctuary without careful design considering biological condition, it would be a bit difficult to get Environmental Clearance and Forest Clearance.

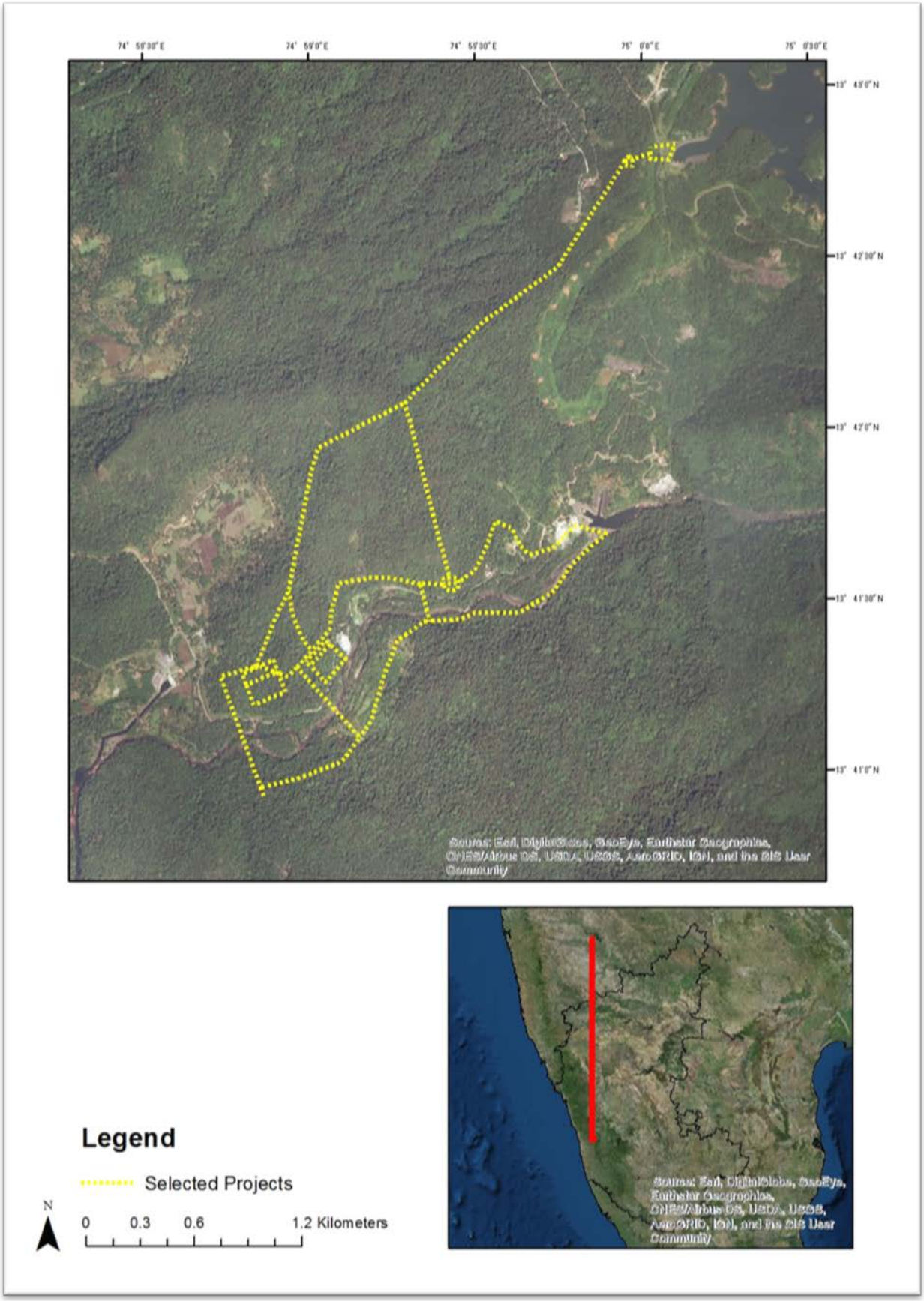
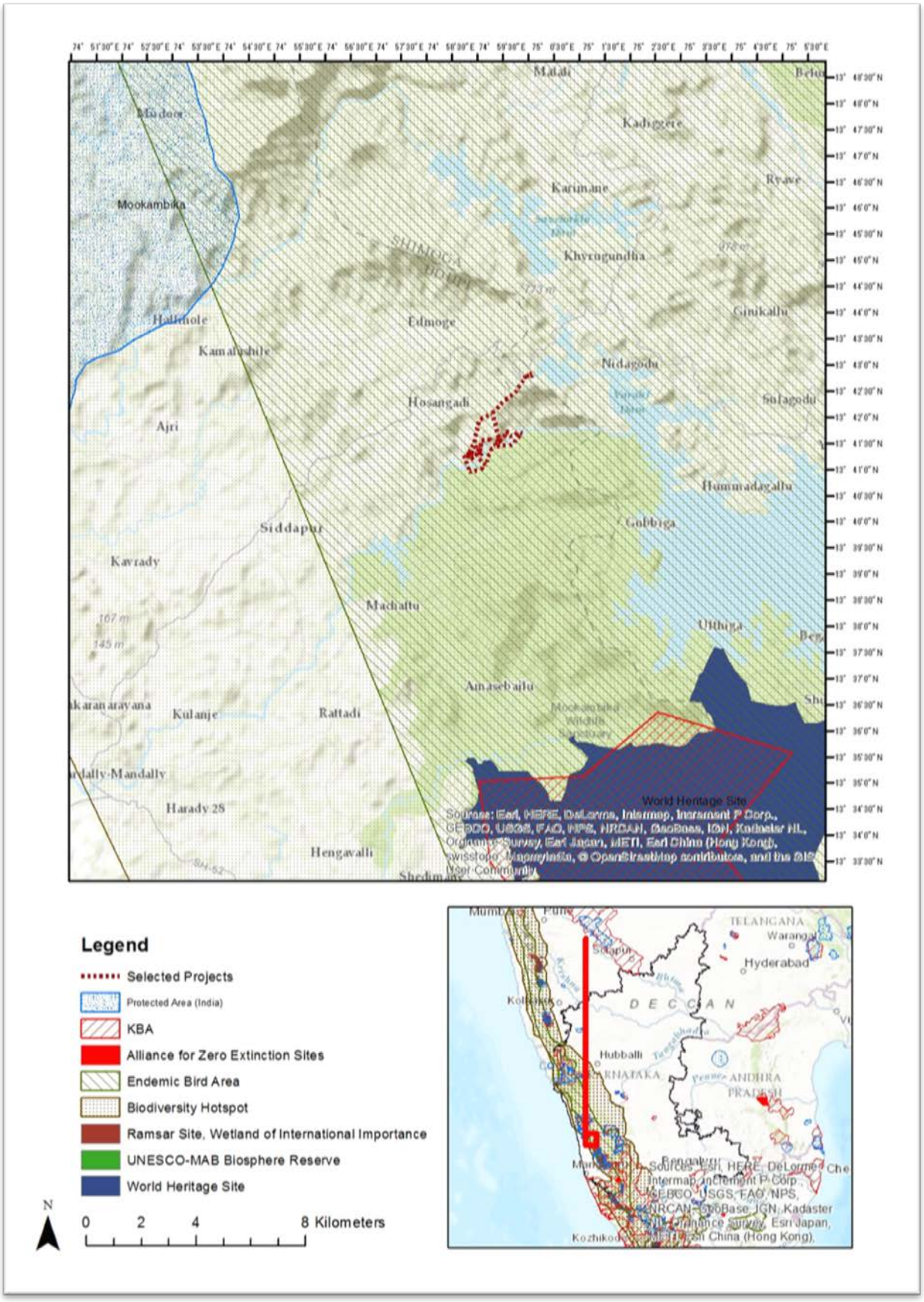
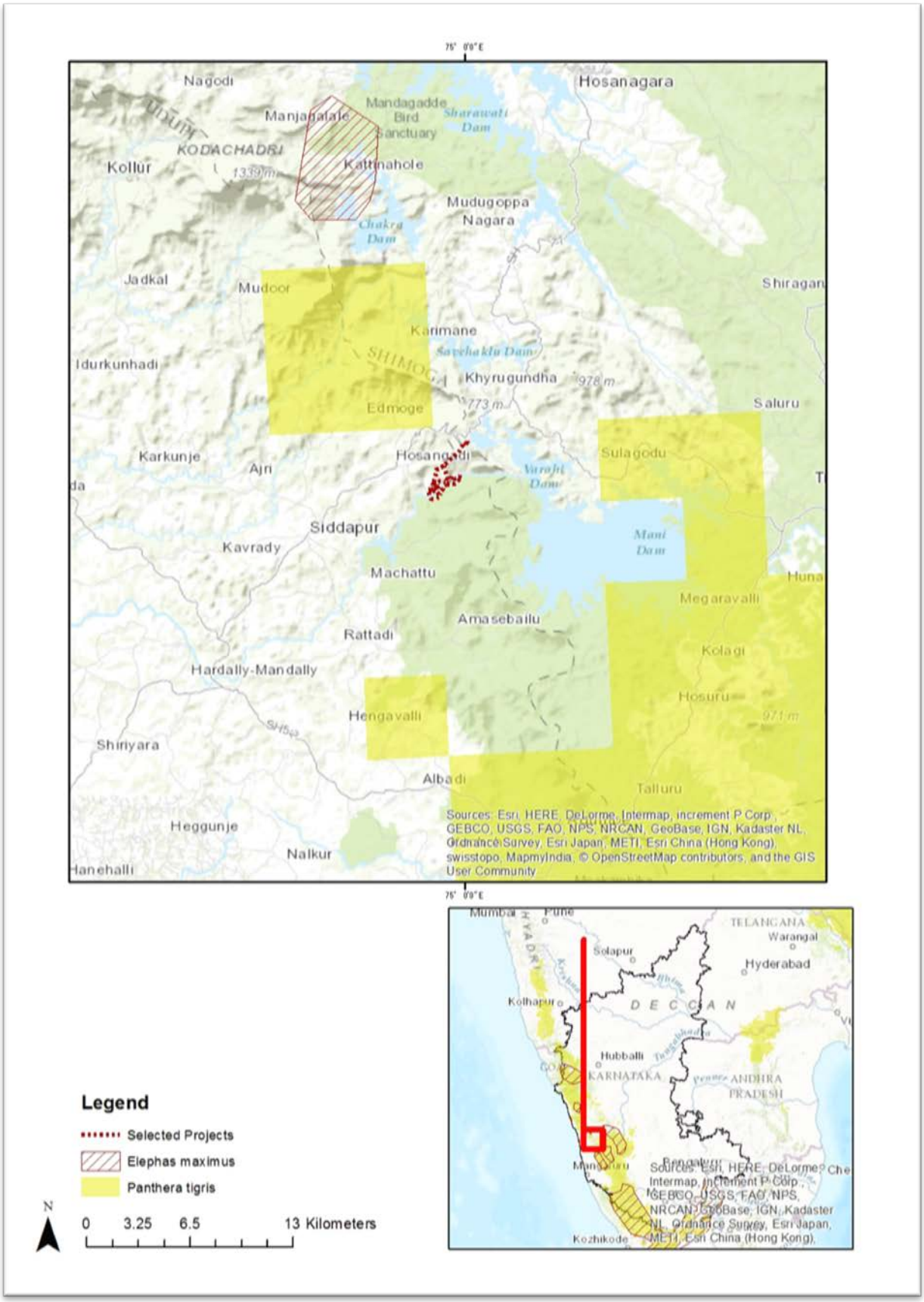


Figure 6.3.4-1 Satellite Image of Varahi PSP



source IBAT (https://www.ibat-alliance.org)

Figure 6.3.4-2 Protected Areas of Varahi PSP



source: IUCN (http://www.iucnredlist.org/)

Figure 6.3.4-3 Protected Species of Varahi PSP

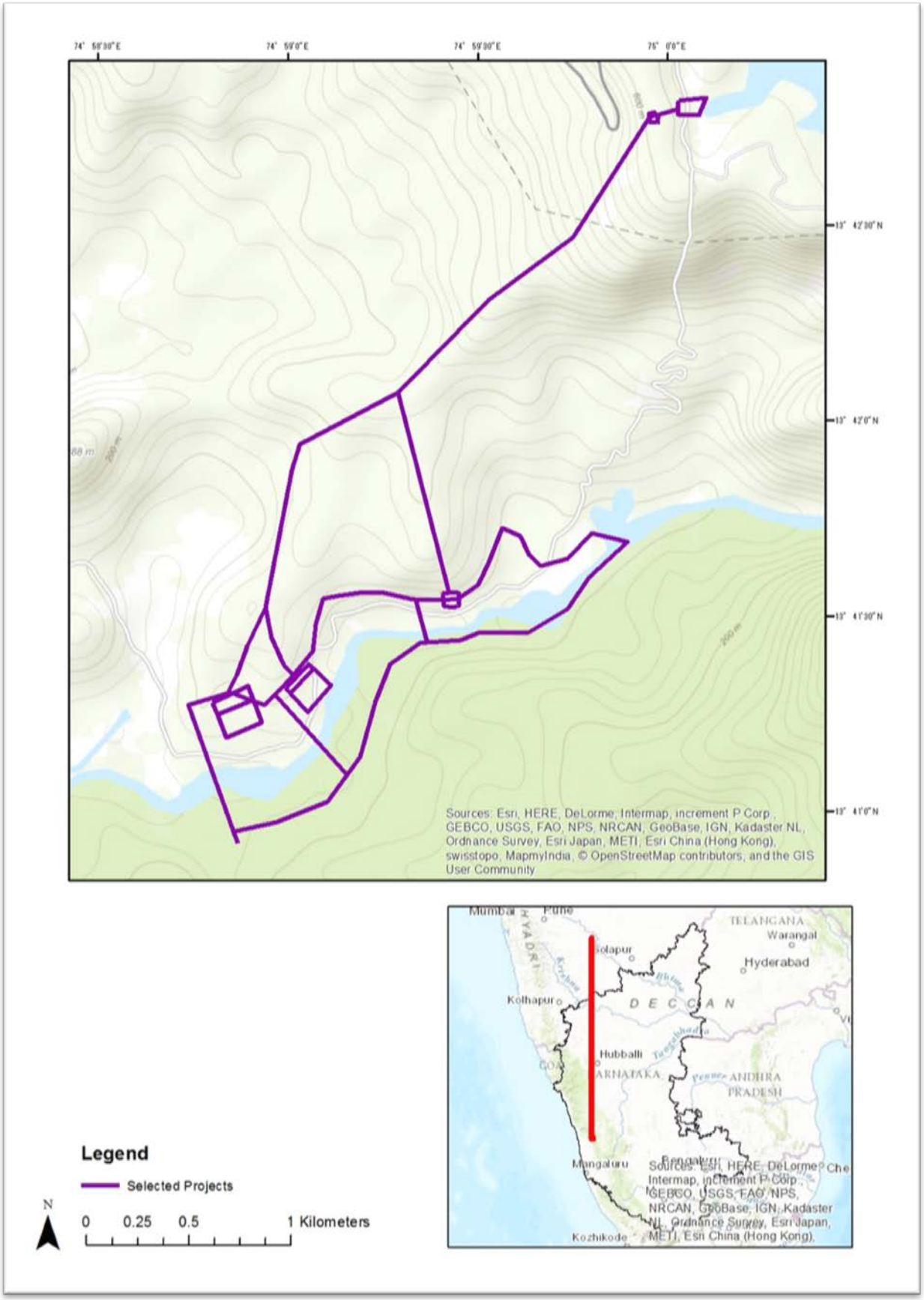


Figure 6.3.4-4 Topographic map of Varahi PSP

6.3.5 Sillahalla PSP

(1) Environmental Conditions

Sillahalla PSP locates The Nilgiris District and Coimbatore District. New Upper Pond is planned and existing Pillur reservoir is used for Lower Pond.

1) Land use

Major land cover around the project site is evergreen dense forest and agricultural land. Information of resettlement and land acquisition is not clear.

2) Protected areas

Project site is in KBA, Endemic Bird Area, Biodiversity Hotspots, 1.9km from The Nilgiri Biosphere Reserve, 7.3km from Mukurthi National Park, and 7.6 km from Western Ghats World Heritage Site (See Figure 6.3.5-2).

3) IUCN Red List Species

The project locates in the known Tiger and Elephant habitat. According to IBAT the number of protected species in the grid cell 71076 and 71157, which the project locate, are Globally Threatened (CR, EN, VU), Near Threatened (NT) and Data Deficient (DD) species 140 (See Table 6.3.5-1).

Table 6.3.5-1 Protected Species recorded near Silahalla PSP

Taxonomic group	Species	Common name	IUCN Red List Category	Cell1	Cell2
Amphibians	Clinotarsus curtipes		NT	71076	71157
Amphibians	Duttaphrynus microtympanum	Southern Hill Toad	VU	71076	71157
Amphibians	Duttaphrynus parietalis	Indian Toad	NT	71076	71157
Amphibians	Ghatixalus variabilis		EN	71076	71157
Amphibians	Ghatophryne rubigina	Kerala Stream Toad	VU	71076	71157
Amphibians	Hylarana aurantiaca		VU	71076	
Amphibians	Hylarana temporalis		NT	71076	71157
Amphibians	Indirana brachytarsus		EN	71076	71157
Amphibians	Indirana leptodactyla		EN		71157
Amphibians	Micrixalus fuscus		NT	71076	71157
Amphibians	Micrixalus gadgili		EN	71076	
Amphibians	Micrixalus nudis		VU	71076	71157
Amphibians	Micrixalus phyllophilus		VU	71076	71157
Amphibians	Micrixalus saxicola	Malabar Tropical Frog	VU	71076	
Amphibians	Microhyla sholigari		EN	71076	
Amphibians	Nyctibatrachus aliciae		EN	71076	
Amphibians	Nyctibatrachus beddomii		EN	71076	71157
Amphibians	Nyctibatrachus deccanensis		VU	71076	71157
Amphibians	Nyctibatrachus major		VU	71076	71157
Amphibians	Nyctibatrachus minor		EN	71076	
Amphibians	Pseudophilautus wynaadensis		EN	71076	
Amphibians	Ramanella anamalaiensis		DD		71157

Taxonomic group	Species	Common name	IUCN Red List Category	Cell1	Cell2
Amphibians	Ramanella montana		NT	71076	71157
Amphibians	Ramanella triangularis		VU	71076	71157
Amphibians	Raorchestes glandulosus	Southern Bubble-nest Frog	VU	71076	71157
Amphibians	Raorchestes signatus		EN	71076	71157
Amphibians	Raorchestes tinniens		EN	71076	71157
Amphibians	Rhacophorus lateralis	Small Tree Frog	EN	71076	
Amphibians	Uraeotyphlus malabaricus	Malabar Caecilian	DD	71076	
Amphibians	Uraeotyphlus narayani	Kannan Caecilian	DD		71157
Amphibians	Zakerana brevipalmata	Short-webbed Frog	DD	71076	
Amphibians	Zakerana murthii	Ghats Wart Frog	CR	71076	
Amphibians	Zakerana nilagirica		EN	71076	
Birds	Anhinga melanogaster	Oriental Darter	NT	71076	71157
Birds	Anthracoceros coronatus	Malabar Pied Hornbill	NT	71076	71157
Birds	Anthus nilghiriensis	Nilgiri Pipit	VU	71076	71157
Birds	Aythya nyroca	Ferruginous Duck	NT	71076	
Birds	Buceros bicornis	Great Hornbill	NT	71076	71157
Birds	Chaetornis striata	Bristled Grassbird	VU	71076	71157
Birds	Ciconia episcopus	Asian Woollyneck	VU	71076	71157
Birds	Circus macrourus	Pallid Harrier	NT	71076	71157
Birds	Clanga hastata	Indian Spotted Eagle	VU	71076	71157
Birds	Columba elphinstonii	Nilgiri Woodpigeon	VU	71076	71157
Birds	Ephippiorhynchus asiaticus	Black-necked Stork	NT	71076	71157
Birds	Esacus recurvirostris	Great Thick-knee	NT	71076	
Birds	Eumyias albicaudatus	Nilgiri Flycatcher	NT	71076	71157
Birds	Falco chicquera	Red-headed Falcon	NT	71076	71157
Birds	Ficedula nigrorufa	Black-and-rufous Flycatcher	NT	71076	71157
Birds	Ficedula subrubra	Kashmir Flycatcher	VU	71076	71157
Birds	Gallinago nemoricola	Wood Snipe	VU	71076	71157
Birds	Gyps bengalensis	White-rumped Vulture	CR	71076	71157
Birds	Gyps indicus	Indian Vulture	CR	71076	71157
Birds	Icthyophaga humilis	Lesser Fish-eagle	NT	71076	71157
Birds	Icthyophaga ichthyaetus	Grey-headed Fish-eagle	NT	71076	71157
Birds	Leptoptilos javanicus	Lesser Adjutant	VU	71076	71157
Birds	Limosa limosa	Black-tailed Godwit	NT	71076	71157
Birds	Mycteria leucocephala	Painted Stork	NT	71076	71157
Birds	Myiomela major	Nilgiri Blue Robin	EN	71076	71157
Birds	Neophron percnopterus	Egyptian Vulture	EN	71076	71157
Birds	Numenius arquata	Eurasian Curlew	NT	71076	71157
Birds	Phylloscopus tytleri	Tytler's Leaf-warbler	NT	71076	71157
Birds	Psittacula eupatria	Alexandrine Parakeet	NT	71076	71157
Birds	Pycnonotus priocephalus	Grey-headed Bulbul	NT	71076	71157
Birds	Pycnonotus xantholaemus	Yellow-throated Bulbul	VU	71076	71157
Birds	Sarcogyps calvus	Red-headed Vulture	CR	71076	71157
Birds	Schoenicola platyurus	Broad-tailed Grassbird	VU	71076	71157
Birds	Sterna acuticauda	Black-bellied Tern	EN	71076	71157
Birds	Sterna aurantia	River Tern	NT	71076	71157
Birds	Strophocincla cachinnans	Black-chinned Laughingthrush	EN	71076	71157
Birds	Sypheotides indicus	Lesser Florican	EN	71076	71157
Birds	Threskiornis melanocephalus	Black-headed Ibis	NT	71076	71157
Dragonflies and Damselflies	Caconeura t-coerulea		DD	71076	71157
Dragonflies and Damselflies	Calocypha laidlawi		DD	71076	
Dragonflies and Damselflies	Hylaeothemis indica		DD	71076	71157
Fishes	Anguilla bengalensis	Indian Mottled Eel	NT	71076	71157
Fishes	Anguilla bicolor	Shortfin Eel	NT	71076	71157
Fishes	Cirrhinus cirrhosus	Mrigal Carp	VU	71076	71157
Fishes	Glyptothorax davissinghi		EN	71076	

Taxonomic group	Species	Common name	IUCN Red List Category	Cell1	Cell2
Fishes	Labeo potail	Deccan Labeo	EN	71076	
Fishes	Puntius denisonii	Red Line Torpedo Barb	EN	71076	
Fishes	Tor khudree	Black Mahseer	EN	71076	71157
Mammals	Antilope cervicapra	Blackbuck	NT	71076	71157
Mammals	Aonyx cinerea	Asian Small-clawed Otter	VU	71076	71157
Mammals	Bos gaurus	Gaur	VU	71076	71157
Mammals	Cuon alpinus	Dhole	EN	71076	71157
Mammals	Elephas maximus	Asian Elephant	EN	71076	71157
Mammals	Feroculus feroculus	Kelaart's Long-clawed Shrew	EN	71076	
Mammals	Funambulus sublineatus	Dusky-striped Squirrel	VU	71076	71157
Mammals	Herpestes fuscus	Indian Brown Mongoose	VU	71076	71157
Mammals	Lutra lutra	Eurasian Otter	NT	71076	71157
Mammals	Lutrogale perspicillata	Smooth-coated Otter	VU	71076	71157
Mammals	Macaca silenus	Lion-tailed Macaque	EN	71076	71157
Mammals	Manis crassicaudata	Indian Pangolin	EN	71076	71157
Mammals	Martes gwatkinsii	Nilgiri Marten	VU	71076	71157
Mammals	Melursus ursinus	Sloth Bear	VU	71076	71157
Mammals	Mus famulus	Bonhote	EN	71076	
Mammals	Nilgiritragus hylocrius	Nilgiri Tahr	EN	71076	71157
Mammals	Panthera pardus	Leopard	NT	71076	71157
Mammals	Panthera tigris	Tiger	EN	71076	71157
Mammals	Petinomys fuscocapillus	Travancore Flying Squirrel	NT	71076	71157
Mammals	Platacanthomys lasiurus	Malabar Spiny Tree Mouse	VU	71076	71157
Mammals	Prionailurus rubiginosus	Rusty-spotted Cat	VU	71076	71157
Mammals	Prionailurus viverrinus	Fishing Cat	EN		71157
Mammals	Rattus satarae	Sahyadris forest rat	VU	71076	71157
Mammals	Ratufa macroura	Sri Lankan Giant Squirrel	NT		71157
Mammals	Rusa unicolor	Sambar	VU	71076	71157
Mammals	Semnopithecus hypoleucos	Black-footed Gray Langur	VU	71076	
Mammals	Semnopithecus priam	Tufted Gray Langur	NT	71076	71157
Mammals	Suncus dayi	Day's Shrew	EN	71076	
Mammals	Suncus montanus	Sri Lanka Highland Shrew	VU	71076	
Mammals	Trachypithecus johnii	Nilgiri Langur	VU	71076	71157
Mammals	Vandeleuria nilagirica	Nilgiri Long-tailed Tree Mouse	EN	71076	
Mammals	Viverra civettina	Malabar Civet	CR		71157
Other invertebrates	Onthophagus cavia		DD		71157
Other invertebrates	Poecilotheria striata	Striated Parachute Spider	VU	71076	71157
Reptiles	Ahaetulla dispar	G	NT	71076	71157
Reptiles	Ahaetulla perroteti	Perrotet's Vine Snake	EN	71076	71157
Reptiles	Boiga beddomei	Beddome's Cat Snake	DD	71076	71157
Reptiles	Boiga dightoni	Travancore Cat Snake	DD	71076	71157
Reptiles	Calliophis beddomei	Beddome's Coral Snake	DD	71076	71157
Reptiles	Cnemaspis anaikattiensis		CR		71157
Reptiles	Cnemaspis beddomei	Beddome	DD	71076	71157
Reptiles	Cnemaspis indica	Nilgiri Dwarf Gecko	VU	71076	71157
Reptiles	Cnemaspis jerdonii	Jerdon	VU	71076	71157
Reptiles	Cnemaspis littoralis	Coastal Day Gecko	DD	71076	
Reptiles	Cnemaspis nilagirica	Nilgiri Day Gecko	DD	71076	71157
Reptiles	Cnemaspis sisparensis	Sispara Day Gecko	NT	71076	71157
Reptiles	Cnemaspis wynadensis	Wynad Day Gecko	EN	71076	
Reptiles	Crocodylus palustris	Mugger	VU	71076	71157
Reptiles	Gerrhopilus tindalli	Tindall's Worm Snake	DD	71076	71157
Reptiles	Kaestlea palnica	Palni Hills Ground Skink	DD		71157
Reptiles	Oligodon brevicauda	Short-tailed Kukri Snake	VU	71076	71157
Reptiles	Oligodon travancoricus	Travancore Kukri Snake	DD	71076	71157
Reptiles	Ophiophagus hannah	King Cobra	VU	71076	71157
Reptiles	Peltopelor macrolepis	Large-scaled Pit Viper	NT	71076	71157
Reptiles	Plectrurus aureus	Kerala Burrowing Snake	DD	71076	

Taxonomic group	Species	Common name	IUCN Red List Category	Cell1	Cell2
Reptiles	Plectrurus guentheri	G	DD	71076	71157
Reptiles	Typhlops thurstoni	Thurston's Worm Snake	DD	71076	71157
Reptiles	Uropeltis nitidus	Southern Earth Snake	DD		71157
Snails and Slugs	Paludomus inflatus		DD	71076	71157

source: IBAT (https://www.ibat-alliance.org)

4) Forest land

Exact locations of the Reserved Forest are not clear. But referring the Topographic map (See Figure 6.3.5-4) and satellite image (See Figure 6.3.5-1) around the project area, the project might affect some Resaved Forest.

(2) Anxious points

The most anxious points of the project are biological issues. Even if it locates outside of the National Park, it is near the heart of the Western Ghats mountain chain. Number of the IUCN Red List species is 140 which is the highest among seven selected projects. Social issues and security issues are not so serious.

(3) Required Actions

Prior Environmental Clearance (Site Clearance), Forest Clearance, and Environmental Clearance will be required. It is recommended that detail biological survey is conducted and alternative designs are discussed for Prior Environmental Clearance (or should have been discussed).

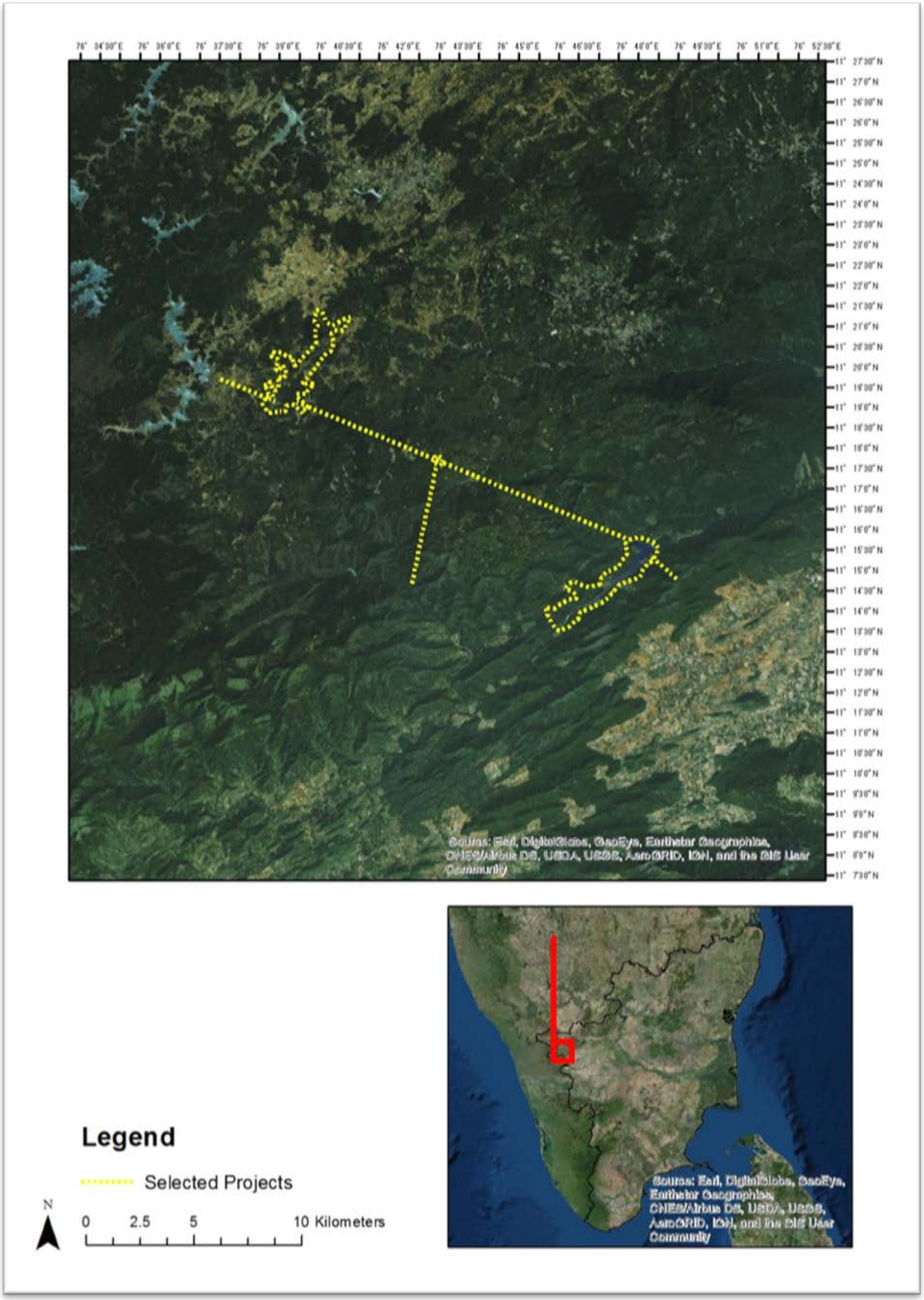
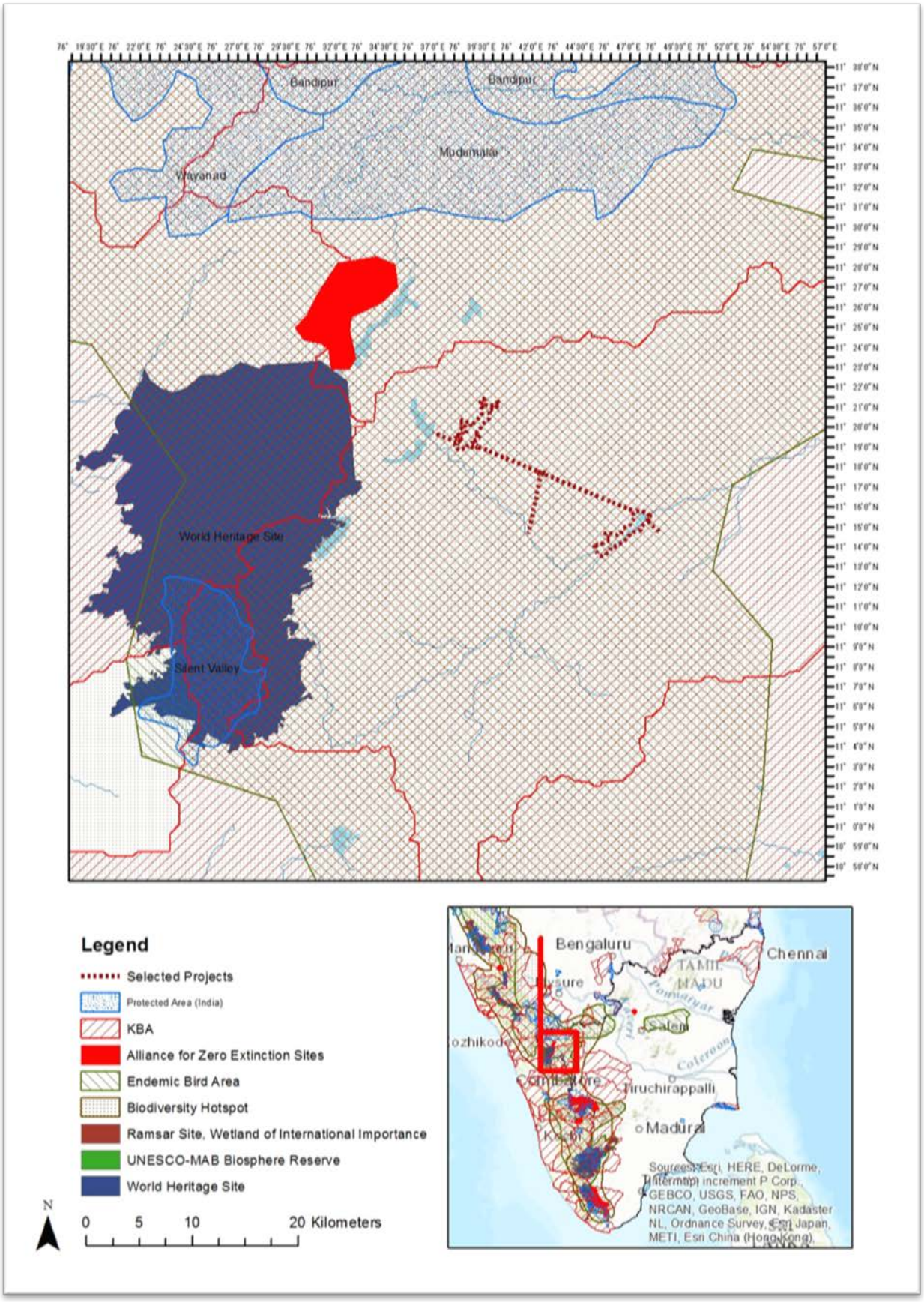
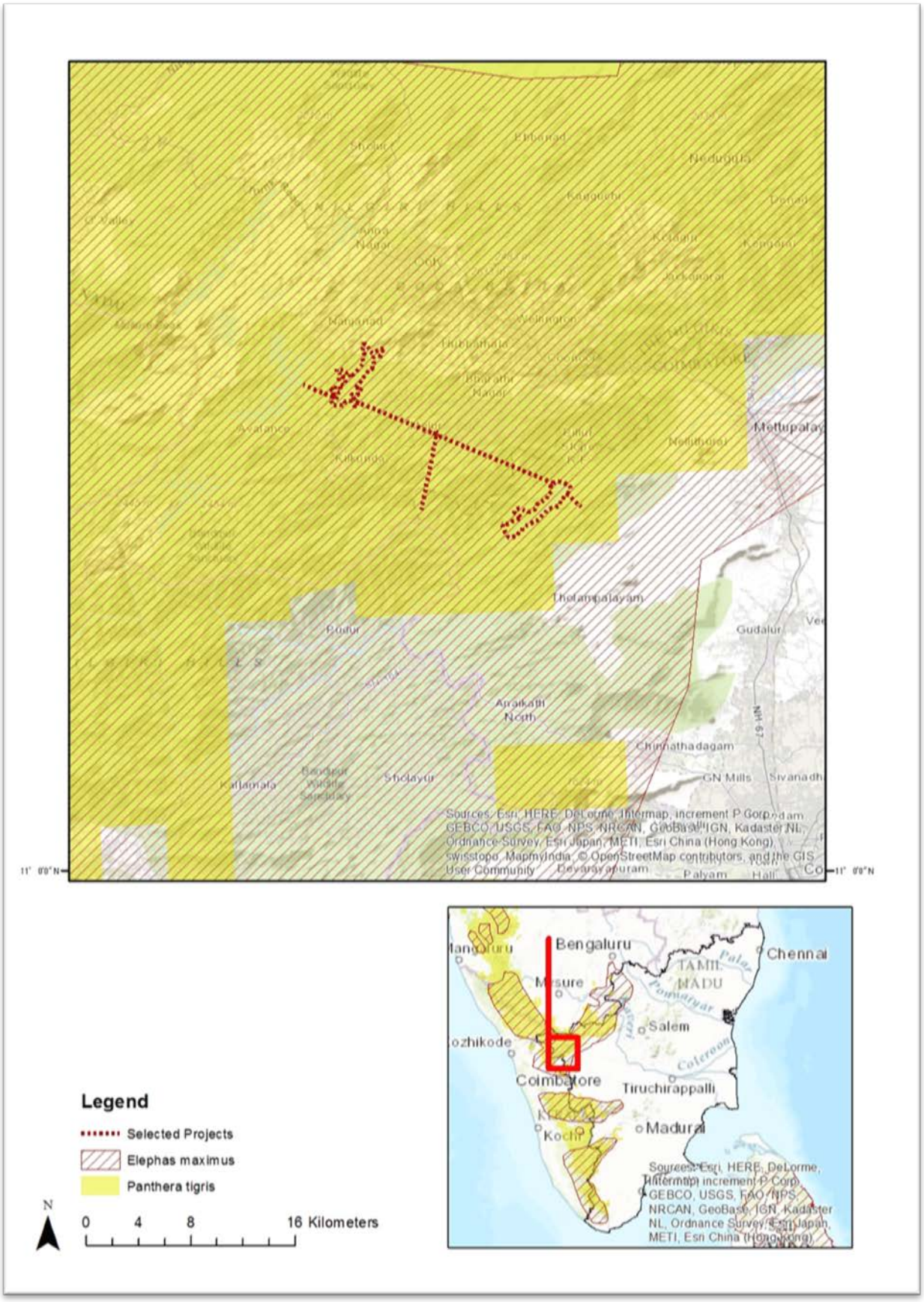


Figure 6.3.5-1 Satellite Image of Silahalla PSP



source IBAT (https://www.ibat-alliance.org)

Figure 6.3.5-2 Protected Areas of Silahalla PSP



source: IUCN (http://www.iucnredlist.org/)

Figure 6.3.5-3 Tiger and Elephant habitats around Silahalla PSP

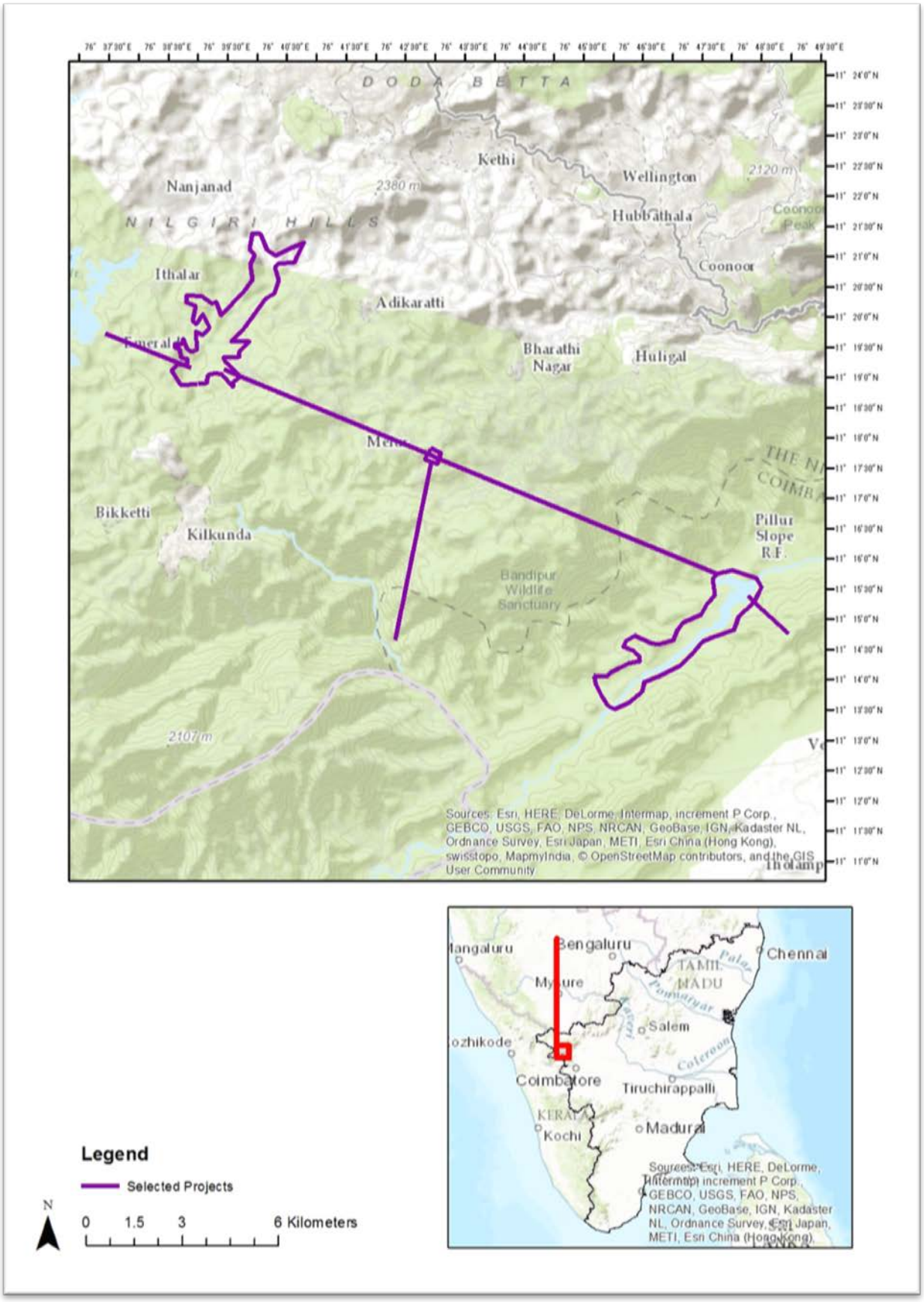


Figure 6.3.5-4 Topographic map of Silahalla PSP

6.3.6 Mettur PSP

(1) Environmental Conditions

Mettur PSP locates Salem District. New Upper Pond is planned and existing Stanley reservoir is used for Lower Pond.

1) Land use

Major land cover around the project site is Evergreen forest, Agricultural land and Urban area. Information of resettlement and land acquisition is not clear.

2) Protected areas

The project site is 7.9 km from the Nilgiri Biosphere Reserve (See Figure 6.3.6-2).

3) IUCN Red List Species

The project locates 5km from the known Tiger habitat and 10 km from the Elephant habitat. According to IBAT the number of protected species in the grid cell 71239, which the project locates, are Globally Threatened (CR, EN, VU), Near Threatened (NT) and Data Deficient (DD) species 95 (See Table 6.3.6-1).

Table 6.3.6-1 Protected Species recorded near Mettur PSP

Taxonomic group	Species	Common name	IUCN Red List Category
Amphibians	*Duttaphrynus microtympanum*	Southern Hill Toad	VU
Amphibians	*Duttaphrynus parietalis*	Indian Toad	NT
Amphibians	*Ghatixalus variabilis*		EN
Amphibians	*Micrixalus fuscus*		NT
Amphibians	*Ramanella montana*		NT
Amphibians	*Raorchestes glandulosus*	Southern Bubble-nest Frog	VU
Amphibians	*Raorchestes signatus*		EN
Amphibians	*Raorchestes tinniens*		EN
Birds	*Anhinga melanogaster*	Oriental Darter	NT
Birds	*Anthracoceros coronatus*	Malabar Pied Hornbill	NT
Birds	*Anthus nilghiriensis*	Nilgiri Pipit	VU
Birds	*Ardeotis nigriceps*	Great Indian Bustard	CR
Birds	*Aythya nyroca*	Ferruginous Duck	NT
Birds	*Buceros bicornis*	Great Hornbill	NT
Birds	*Chaetornis striata*	Bristled Grassbird	VU
Birds	*Ciconia episcopus*	Asian Woollyneck	VU
Birds	*Circus macrourus*	Pallid Harrier	NT
Birds	*Clanga hastata*	Indian Spotted Eagle	VU
Birds	*Columba elphinstonii*	Nilgiri Woodpigeon	VU
Birds	*Ephippiorhynchus asiaticus*	Black-necked Stork	NT
Birds	*Esacus recurvirostris*	Great Thick-knee	NT
Birds	*Eumyias albicaudatus*	Nilgiri Flycatcher	NT
Birds	*Falco chicquera*	Red-headed Falcon	NT
Birds	*Ficedula nigrorufa*	Black-and-rufous Flycatcher	NT
Birds	*Ficedula subrubra*	Kashmir Flycatcher	VU

Birds	*Gallinago nemoricola*	Wood Snipe	VU
Birds	*Gyps bengalensis*	White-rumped Vulture	CR
Birds	*Gyps indicus*	Indian Vulture	CR
Birds	*Icthyophaga humilis*	Lesser Fish-eagle	NT
Birds	*Icthyophaga ichthyaetus*	Grey-headed Fish-eagle	NT
Birds	*Leptoptilos javanicus*	Lesser Adjutant	VU
Birds	*Limosa limosa*	Black-tailed Godwit	NT
Birds	*Mycteria leucocephala*	Painted Stork	NT
Birds	*Myiomela major*	Nilgiri Blue Robin	EN
Birds	*Neophron percnopterus*	Egyptian Vulture	EN
Birds	*Parus nuchalis*	White-naped Tit	VU
Birds	*Phylloscopus tytleri*	Tytler's Leaf-warbler	NT
Birds	*Pycnonotus priocephalus*	Grey-headed Bulbul	NT
Birds	*Pycnonotus xantholaemus*	Yellow-throated Bulbul	VU
Birds	*Sarcogyps calvus*	Red-headed Vulture	CR
Birds	*Schoenicola platyurus*	Broad-tailed Grassbird	VU
Birds	*Sterna acuticauda*	Black-bellied Tern	EN
Birds	*Sterna aurantia*	River Tern	NT
Birds	*Strophocincla cachinnans*	Black-chinned Laughingthrush	EN
Birds	*Sypheotides indicus*	Lesser Florican	EN
Birds	*Threskiornis melanocephalus*	Black-headed Ibis	NT
Dragonflies and Damselflies	*Caconeura t-coerulea*		DD
Dragonflies and Damselflies	*Hylaeothemis indica*		DD
Fishes	*Cirrhinus cirrhosus*	Mrigal Carp	VU
Fishes	*Labeo potail*	Deccan Labeo	EN
Fishes	*Tor khudree*	Black Mahseer	EN
Mammals	*Antilope cervicapra*	Blackbuck	NT
Mammals	*Aonyx cinerea*	Asian Small-clawed Otter	VU
Mammals	*Bos gaurus*	Gaur	VU
Mammals	*Cuon alpinus*	Dhole	EN
Mammals	*Elephas maximus*	Asian Elephant	EN
Mammals	*Funambulus sublineatus*	Dusky-striped Squirrel	VU
Mammals	*Herpestes fuscus*	Indian Brown Mongoose	VU
Mammals	*Hyaena hyaena*	Striped Hyaena	NT
Mammals	*Lutra lutra*	Eurasian Otter	NT
Mammals	*Lutrogale perspicillata*	Smooth-coated Otter	VU
Mammals	*Manis crassicaudata*	Indian Pangolin	EN
Mammals	*Martes gwatkinsii*	Nilgiri Marten	VU
Mammals	*Melursus ursinus*	Sloth Bear	VU
Mammals	*Panthera pardus*	Leopard	NT
Mammals	*Panthera tigris*	Tiger	EN
Mammals	*Platacanthomys lasiurus*	Malabar Spiny Tree Mouse	VU
Mammals	*Prionailurus rubiginosus*	Rusty-spotted Cat	VU
Mammals	*Rattus satarae*	Sahyadris forest rat	VU
Mammals	*Rusa unicolor*	Sambar	VU
Mammals	*Semnopithecus priam*	Tufted Gray Langur	NT
Mammals	*Trachypithecus johnii*	Nilgiri Langur	VU
Mammals	*Vandeleuria nilagirica*	Nilgiri Long-tailed Tree Mouse	EN
Other invertebrates	*Onthophagus cavia*		DD
Other invertebrates	*Poecilotheria striata*	Striated Parachute Spider	VU
Reptiles	*Ahaetulla dispar*	G	NT
Reptiles	*Ahaetulla perroteti*	Perrotet's Vine Snake	EN
Reptiles	*Boiga beddomei*	Beddome's Cat Snake	DD

Reptiles	*Boiga dightoni*	Travancore Cat Snake	DD
Reptiles	*Calliophis beddomei*	Beddome's Coral Snake	DD
Reptiles	*Cnemaspis beddomei*	Beddome	DD
Reptiles	*Cnemaspis indica*	Nilgiri Dwarf Gecko	VU
Reptiles	*Cnemaspis jerdonii*	Jerdon	VU
Reptiles	*Cnemaspis nilagirica*	Nilgiri Day Gecko	DD
Reptiles	*Cnemaspis sisparensis*	Sispara Day Gecko	NT
Reptiles	*Cnemaspis wynadensis*	Wynad Day Gecko	EN
Reptiles	*Crocodylus palustris*	Mugger	VU
Reptiles	*Gerrhopilus tindalli*	Tindall's Worm Snake	DD
Reptiles	*Kaestlea palnica*	Palni Hills Ground Skink	DD
Reptiles	*Oligodon travancoricus*	Travancore Kukri Snake	DD
Reptiles	*Ophiophagus hannah*	King Cobra	VU
Reptiles	*Peltopelor macrolepis*	Large-scaled Pit Viper	NT
Reptiles	*Plectrurus guentheri*	G	DD
Reptiles	*Typhlops thurstoni*	Thurston's Worm Snake	DD
Snails and Slugs	*Paludomus inflatus*		DD

source: IBAT (https://www.ibat-alliance.org)

4) Forest land

It is not clear whether the reserved forest will be affected or not. But referring the Topographic map (See Figure 6.3.6-4) and Satellite image (See Figure 6.3.6-1) some part of the reserved forest seems to be affected.

(2) Anxious points

The most anxious points might be land acquisition and dust impact on the neighboring habitat because the project site locates relatively near the people's habitation. On the other hand, biological issue will not be so serious.

(3) Required Actions

Environmental Clearance and Forest Clearance will be required. The layout of Access roads and Rock dumping site should be carefully designed discussing local people examining alternatives in DPR stage.

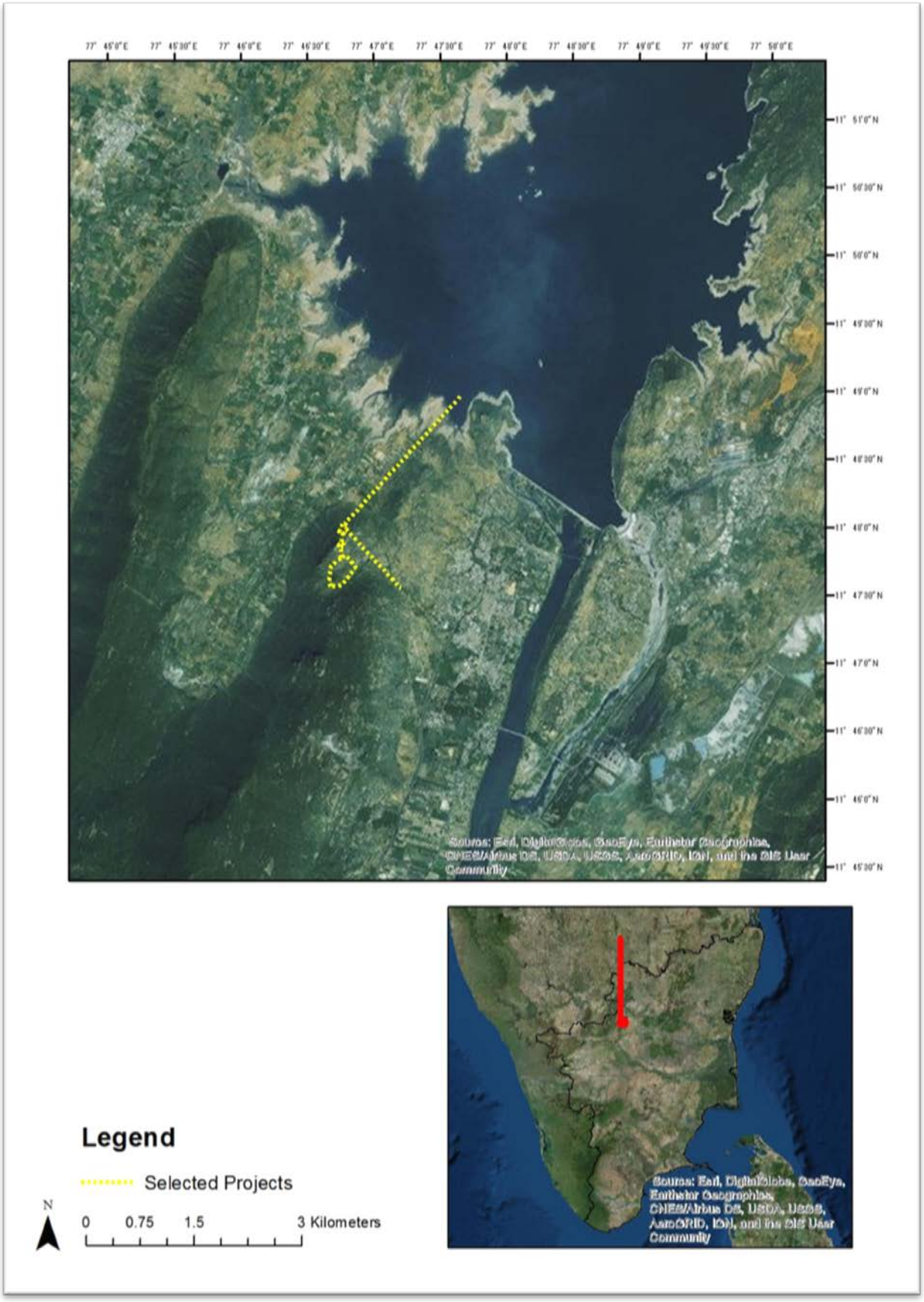
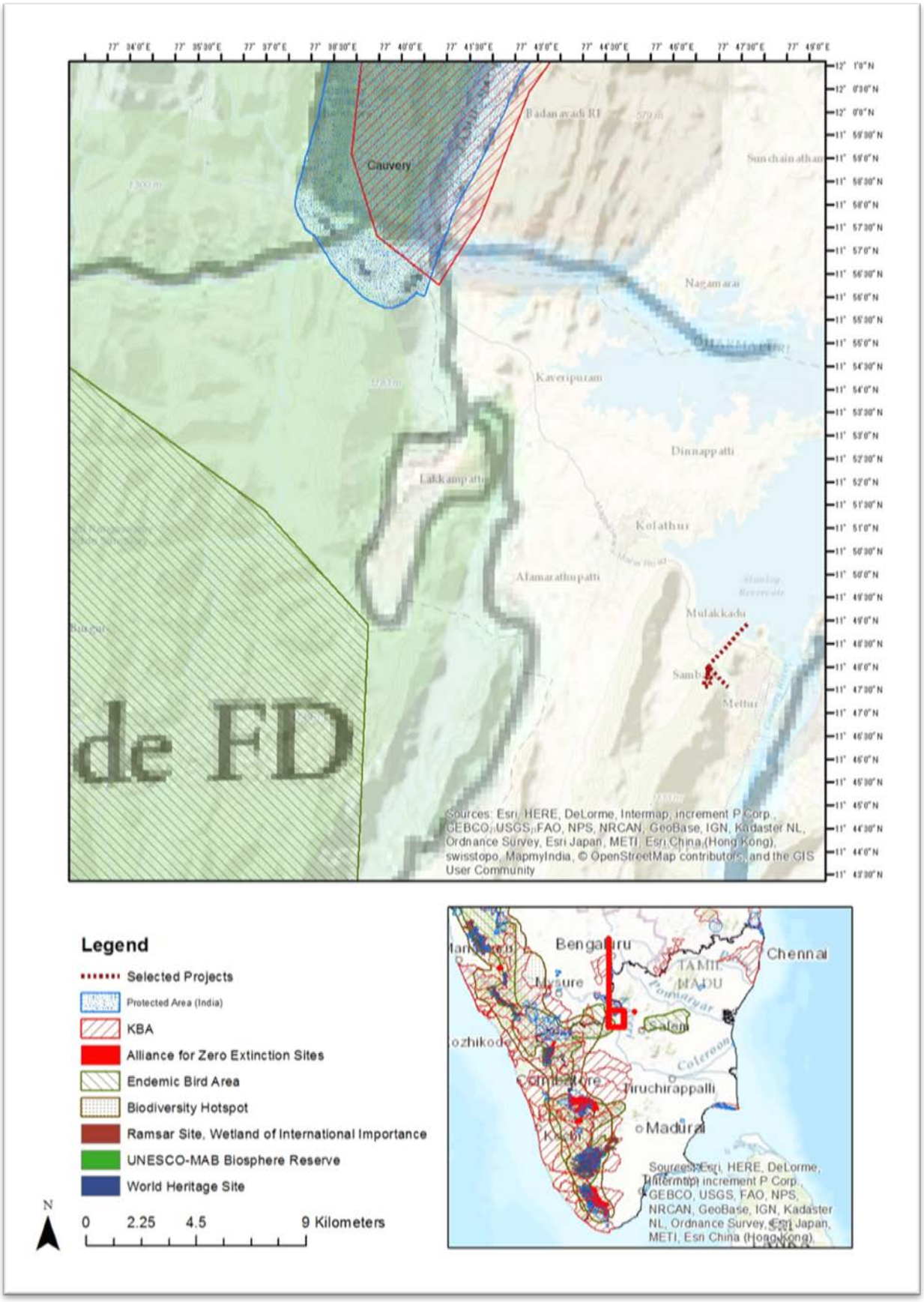
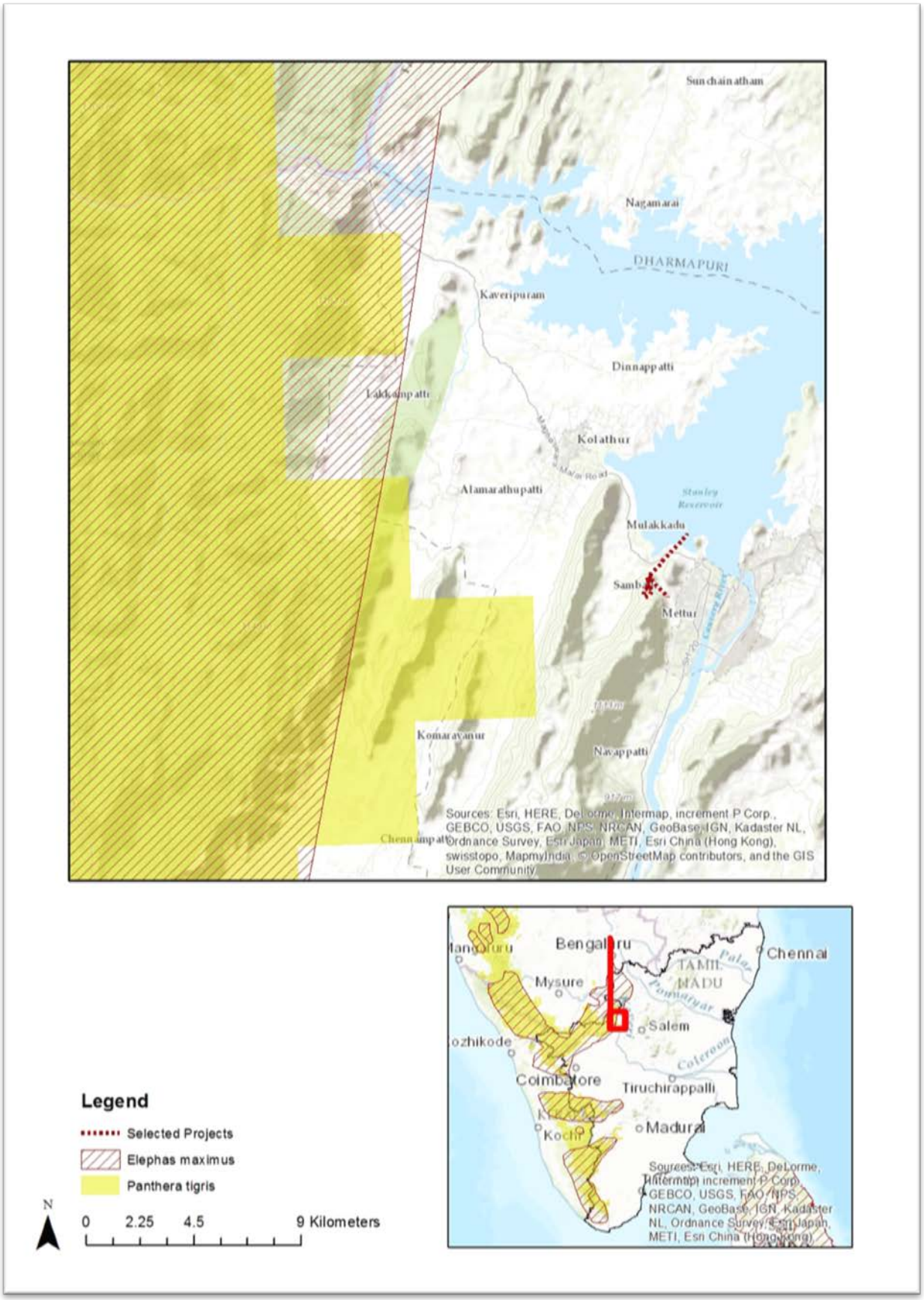


Figure 6.3.6-1 Satellite Image of Mettur PSP



source IBAT (https://www.ibat-alliance.org)

Figure 6.3.6-2 Protected Areas of Mettur PSP



source: IUCN (http://www.iucnredlist.org/)

Figure 6.3.6-3 Protected Species of Mettur PSP

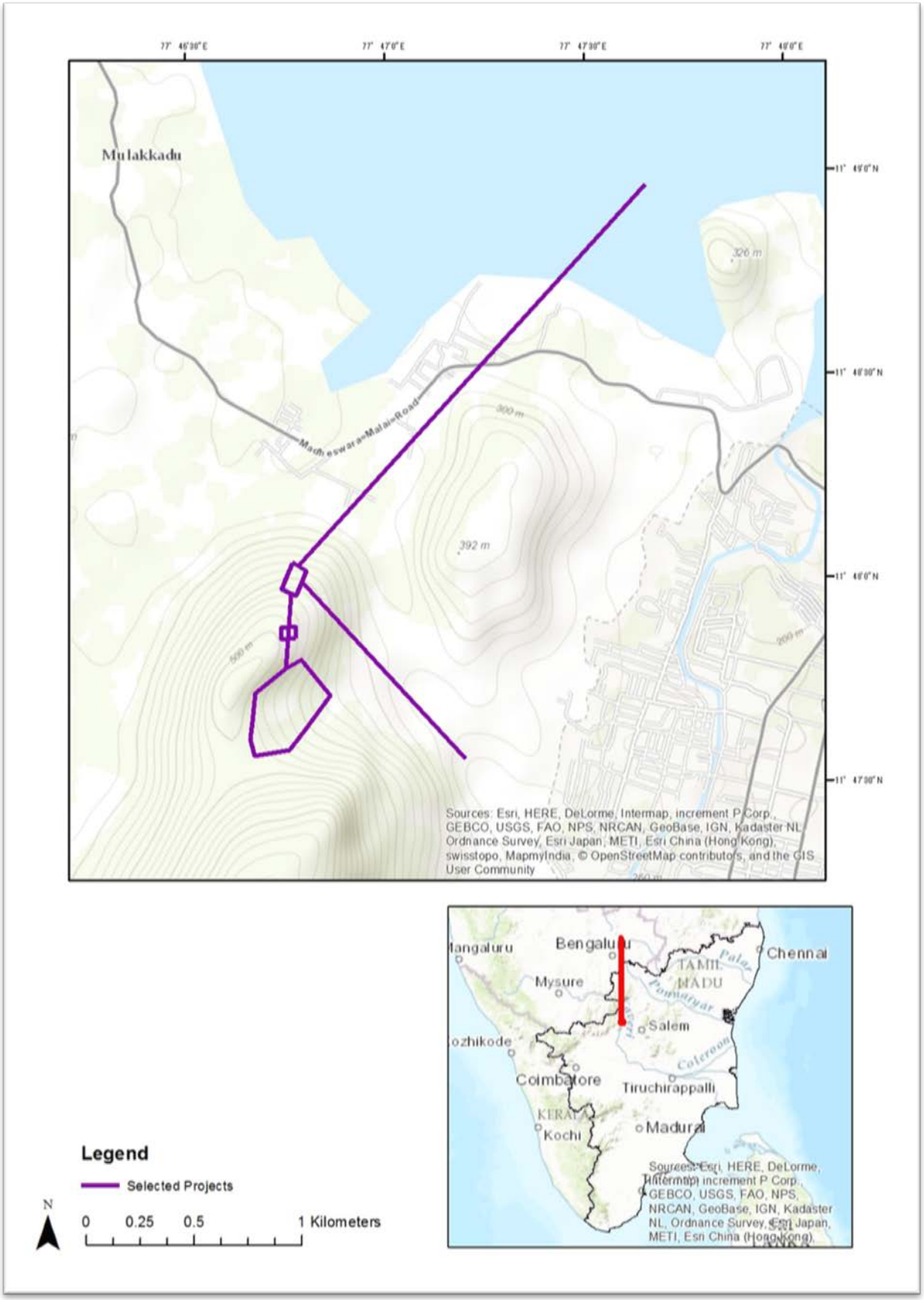


Figure 6.3.6-4 Topographic map of Mettur PSP

6.3.7 Turga PSP

(1) Environmental Conditions

Turga PSP locates Purulia District. New Upper Pond is planned and existing irrigation reservoir is expanded for the lower pond.

1) Land use

Major land cover around the project site is Broadleaf Deciduous Forest, Crop land and Open forest. Information of resettlement and land acquisition is not clear.

2) Protected areas

The project site is outside of the protected areas.

3) IUCN Red List Species

The project locates 30 km from the known Elephant habitat. According to IBAT the number of protected species in the grid cell 74256, which the project locates, are Globally Threatened (CR, EN, VU), Near Threatened (NT) and Data Deficient (DD) species 34 (See Table 6.3.7-1).

Table 6.3.7-1 Protected Species recorded near Turga PSP

Taxonomic group	Species	Common name	IUCN Red List Category
Birds	*Anhinga melanogaster*	Oriental Darter	NT
Birds	*Anthracoceros coronatus*	Malabar Pied Hornbill	NT
Birds	*Ciconia episcopus*	Asian Woollyneck	VU
Birds	*Circus macrourus*	Pallid Harrier	NT
Birds	*Clanga clanga*	Greater Spotted Eagle	VU
Birds	*Clanga hastata*	Indian Spotted Eagle	VU
Birds	*Falco chicquera*	Red-headed Falcon	NT
Birds	*Falco jugger*	Laggar Falcon	NT
Birds	*Gyps bengalensis*	White-rumped Vulture	CR
Birds	*Haliaeetus leucoryphus*	Pallas's Fish-eagle	VU
Birds	*Icthyophaga ichthyaetus*	Grey-headed Fish-eagle	NT
Birds	*Leptoptilos javanicus*	Lesser Adjutant	VU
Birds	*Limosa limosa*	Black-tailed Godwit	NT
Birds	*Mycteria leucocephala*	Painted Stork	NT
Birds	*Neophron percnopterus*	Egyptian Vulture	EN
Birds	*Pelecanus philippensis*	Spot-billed Pelican	NT
Birds	*Psittacula eupatria*	Alexandrine Parakeet	NT
Birds	*Sarcogyps calvus*	Red-headed Vulture	CR
Birds	*Sterna acuticauda*	Black-bellied Tern	EN
Birds	*Sterna aurantia*	River Tern	NT
Birds	*Sypheotides indicus*	Lesser Florican	EN
Birds	*Vanellus duvaucelii*	River Lapwing	NT
Fishes	*Anguilla bengalensis*	Indian Mottled Eel	NT
Mammals	*Cuon alpinus*	Dhole	EN
Mammals	*Diomys crumpi*	Crump's Mouse	DD
Mammals	*Elephas maximus*	Asian Elephant	EN
Mammals	*Lutrogale perspicillata*	Smooth-coated Otter	VU
Mammals	*Manis crassicaudata*	Indian Pangolin	EN
Mammals	*Melursus ursinus*	Sloth Bear	VU
Mammals	*Rusa unicolor*	Sambar	VU
Mammals	*Tetracerus quadricornis*	Four-horned Antelope	VU

Reptiles	*Brachysaura minor*	Hardwicke's Short Tail Agama	DD
Reptiles	*Crocodylus palustris*	Mugger	VU
Snails and Slugs	*Auriculodes gangetica*		DD

source: IBAT (https://www.ibat-alliance.org)

4) Forest land

1st Stage Request for the Forest clearance (FC) was submitted in 2013 but the FC has not been granted yet. Based on the EIA Report for Turga Pumped Storage Project, West Bengal (WBSEDCL, 2016) the affected forest area is 234 ha. The exact locations of the Reserved Forest are not clear but it seems to be around the upper reservoir (See Figure 6.3.7-1 and Figure 6.3.7-3).

(2) Anxious points

Serious anxious points do not exist for the project. Resettlement has been already avoided in designing stage. Scheduled Tribe rate of Purulia District is a bit higher which is 18.45%. Then the tribe might be an issue in construction stage.

(3) Required Actions

EIA report of Turga PSP was prepared and submitted to MoEFCC on 9th May 2016. Forest Clearance and the Environmental Certificate (EC) will be acquired soon (EC was issued on the condition FC be obtained). NOC from Archaeological Survey of India (ASI) with respect to protected monuments, Consent for Establishment (CfE), and Chemical storage permit should be acquired before construction. Environmental Management Plan should be updated following the design during Detail Design stage.

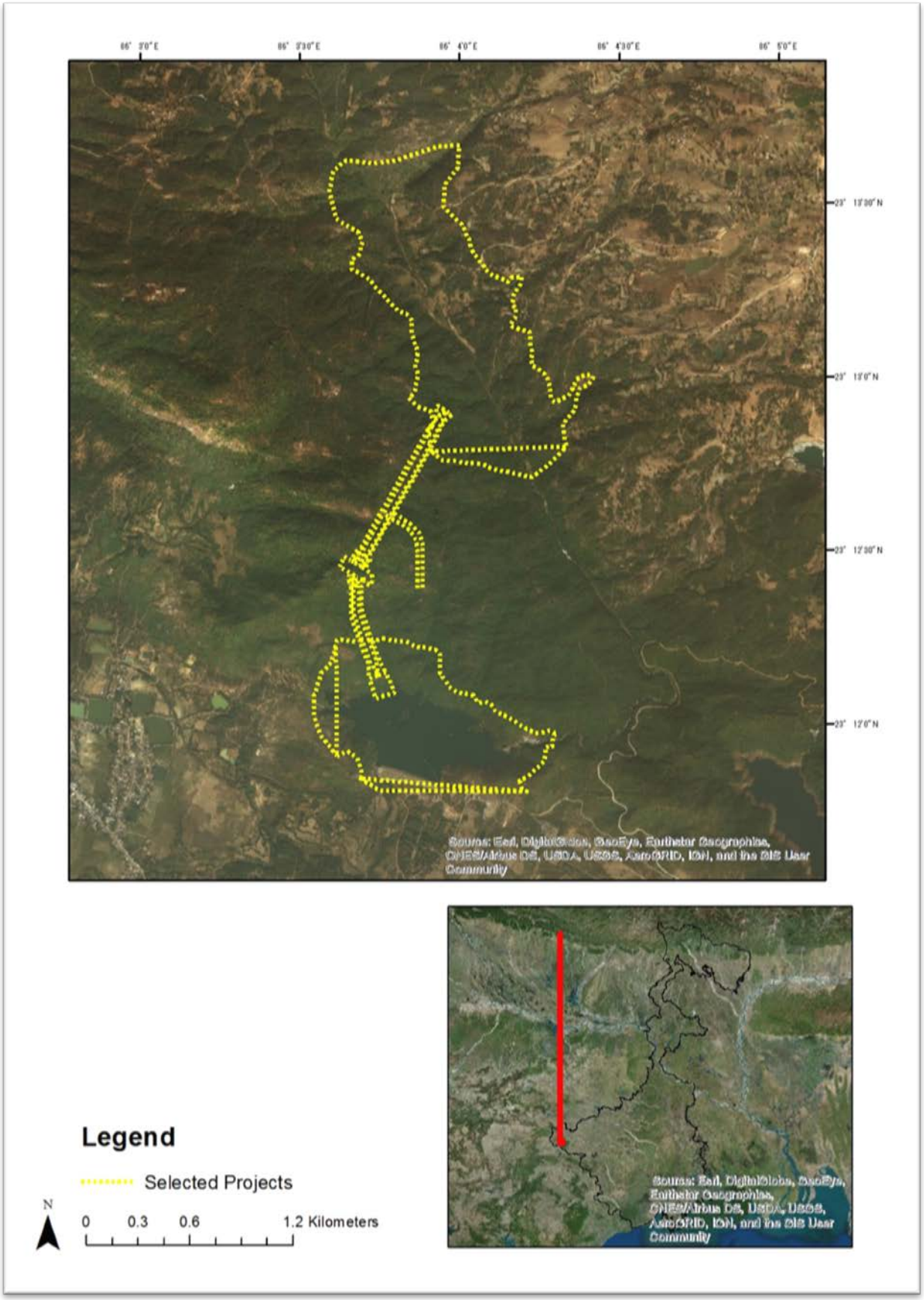
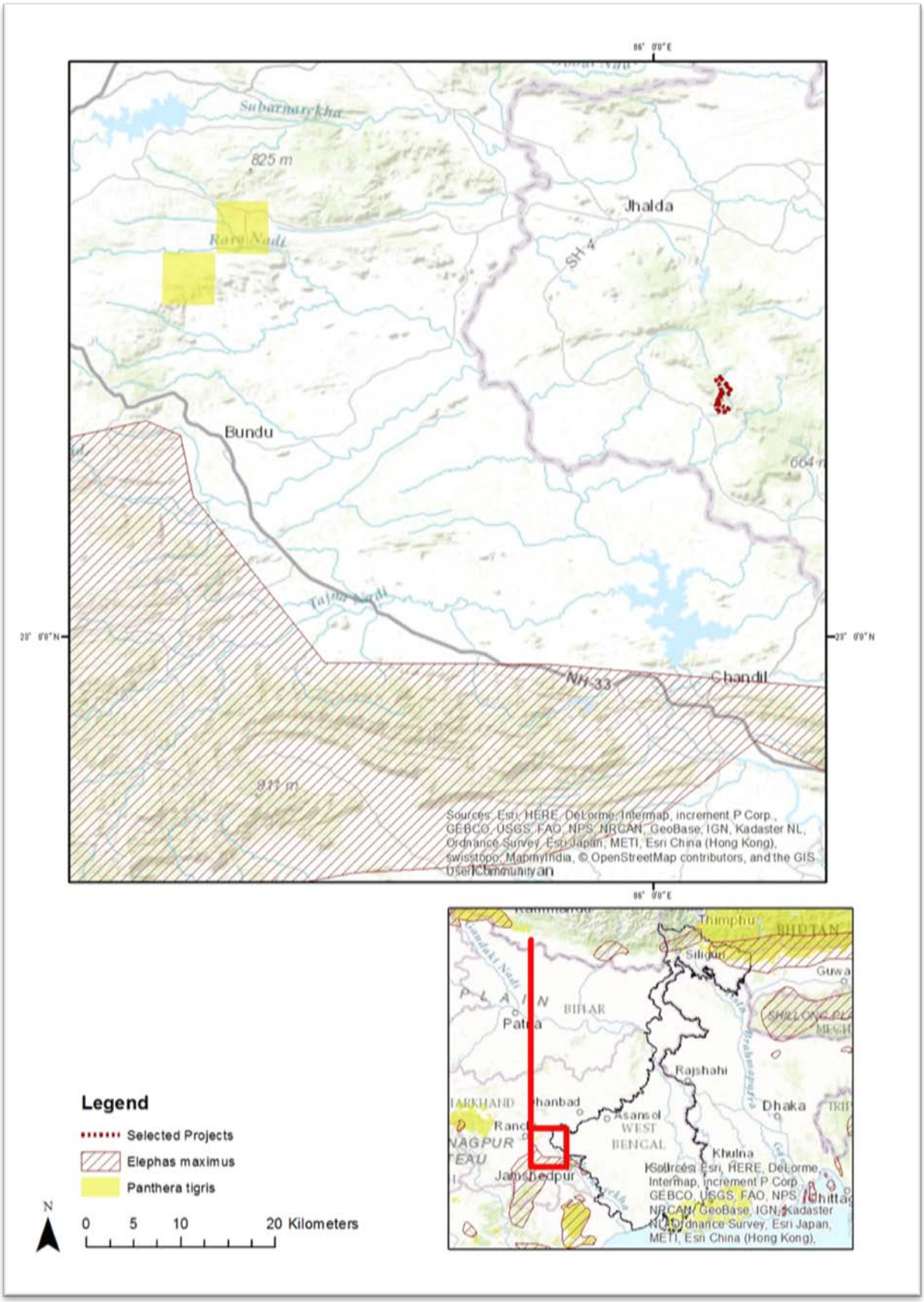


Figure 6.3.7-1 Satellite Image of Turga PSP



source: IUCN (http://www.iucnredlist.org/)

Figure 6.3.7-2 Habitat of Tiger and Elephant near Turga PSP

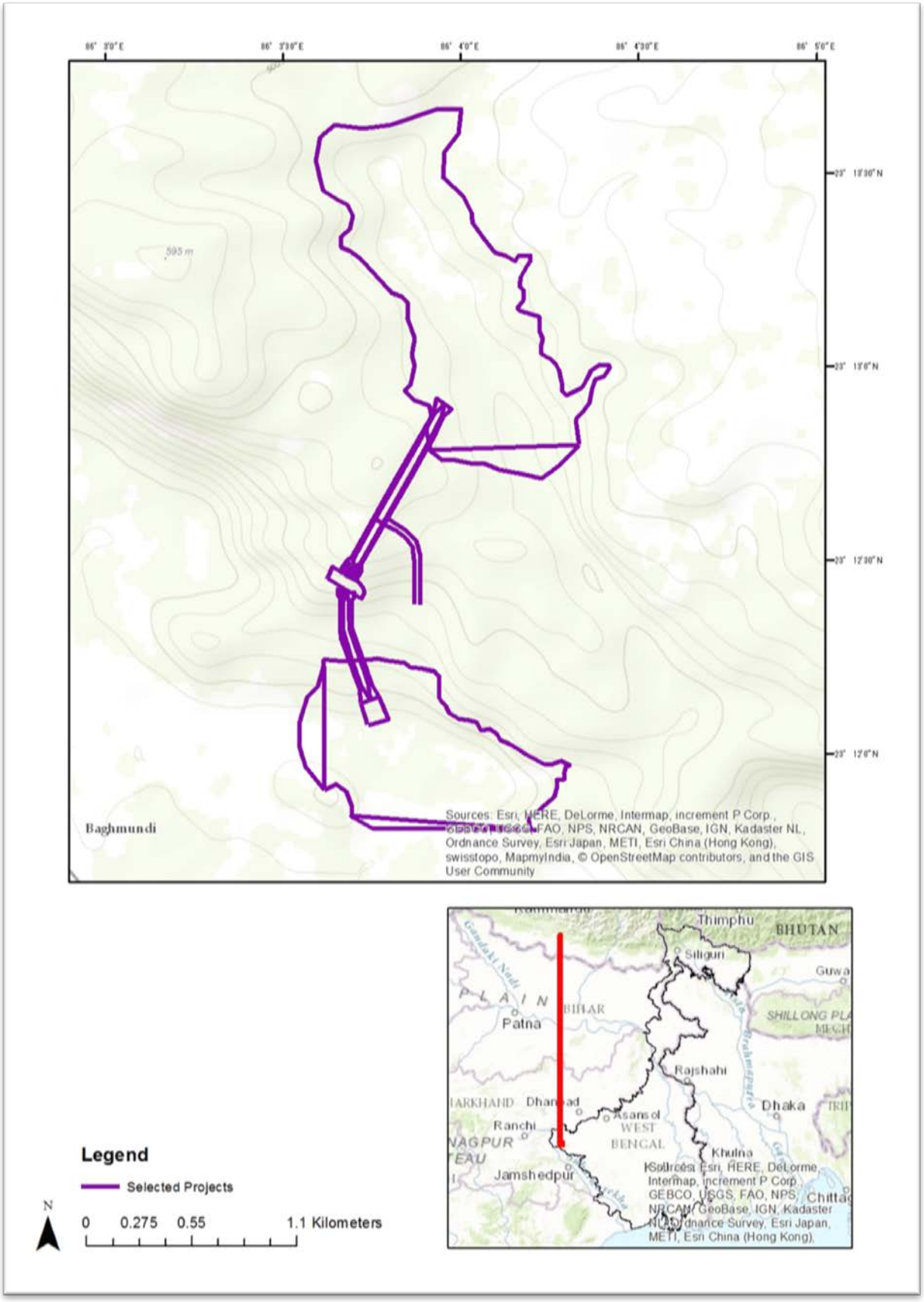


Figure 6.3.7-3 Topographic map of Turga PSP

6.4 PROMISING PROJECTS

All the above were considered and evaluated by the JICA team.

The following states and projects were selected as tentative promising projects. But still, it should be noted that the below information was at the end of Stage 3 survey as of November, 2016. These must be monitored onwards.

The summary of the project data in screening after Stage 2-3 survey is shown in the following Table. Basically, those are the projects to be followed up for the future project.

Table 6.4-1 Stage 2-3 Survey Summary – Promising PSP Projects

State	Project Name	Output (MW)	Estimated DPR completion	JICA team Evaluation	Stage 1	Stage 2-3
Odisha	Upper Indravati	4*150	2016 (planned) - 2019-20 (?)	Most advanced project in Odisha. DPR at very early stage by WAPCOS. DPR completion be delayed considering 3-4 years requirement in normal DPR. Seems least environmental restriction but EIA not yet. Adjustable machines can be implemented in the DPR. Must keep interactions with WAPCOS. Must wait EoI on JICA loan by OD until decision of NCEF grant.	76	60
Odisha	Upper Kolab	4*80	N/A. But after Upper Indravati.	No plan to initiate DPR unlcess NCEF granted. Envronmental restrction not confirmed.	56	50
Odisha	Balimela	4*100	N/A. But after Upper Indravati.	No plan to initiate DPR unlcess NCEF granted. Envronmental restrction not confirmed.	56	50
Karnataka	Sharavathy	450, 800, 900, 1,000	Mid. 2018	Most prioritized project in KN. DPR just initiated for 18mths by WAPCOS. Envronmental restrction not confirmed yet (it may affect WLS). Must keep interactions with WAPCOS. Finance dept. is negative in external loans.	72	60
Karnataka	Varahi	700 (250, 600, 1,000)	N/A	Tentatively next to Sharavati. PFR being revised by WAPCOS in 3mths. KPCL may initiate further actions afterwards. Must monitor it. Finance dept. is negative in external loans.	52	50
Karnataka	Kali	600, 1,000	N/A	Current PFR abondoned affecting envrionment. PFR being revised by WAPCOS. May initiate further actions afterwards. Must monitor it. Finance dept. is negative in external loans.	28	30
Tamil Nadu	Kundah	500	COD aimed at 2021-	Little possibility to revoke REC. Fixed type PSP designed.	88	-
Tamil Nadu	Sillahalla	2,000	2017 expected.	high head 1,500m unchanged. Voith may participate in bid. Impractical for JICA loan as no Japanese manufacturers may participate.	56	-
Tamil Nadu	Kodayar	500	N/A	TANGEDCO conducts investigation but head is too high for Japanese manufacturers.	40	-
Tamil Nadu	Manalar	500	N/A	TANGEDCO conducts investigation but head is too high for Japanese manufacturers.	52	-
Tamil Nadu	Mettur	500	N/A	TANGEDCO conducts investigation. Environmental restriction not confirmed. (It may affect Reserved Forest). Yet immature project after Kundah & Sillahalla. Head is applicable for Japanese manufacturers.	48	40
Tamil Nadu	New sites (tentative)		N/A	Just identified. Yet to be studied. Must wait until March 2017 for further communication with TANGEDCO.	N/A	N/A
West Bengal	Turga	1,000	Completed & Approved.	Most advanced PSP project in WB. Exploaration adit underway. DD tender on Jan., 2017 (earliest) for 24 mths. Shown interest on JICA loan but not secured it yet.	88	80
West Bengal	Bandhu (Bandu)	900	N/A	DPR tender being prepared & being ordered to domestic consultant. COD expected 2025-30 but not firm. WB already confirmed to assign it to ADB. Unless situations change no chance for JICA loan.	72	50
West Bengal	Kulbera	1,100	N/A	Just identified. Yet to be studied. Environmental restrcition unknown but WBSEDCL anticipates none at the moment.	32	30

At this Stage, Upper Indravati of Odisha (OD), Sharavathy of Karnataka (KN) and Turga of West Bengal (WB) shall be the ones of promising PSP projects.

As for Upper Indravati, the state put priority on NCEF grant. It is unknown when or if this result is feedback to the state. It is the expectation of the state Principal Secretary, Energy Dept. it would receive the outcome around March, 2017. If failed, he expressed intention to JICA loan. In any case it should be monitored.

The other 2 PSPs in Odisha, Upper Kolab and Balimela are suspended to study further to DPR until NCEF result comes to the state. They still remain as candidates.

As for Sharavathy, DPR was assigned to WAPCOS. It conducts revision of PFR first in 3 months then it initiates Survey and Investigation, DPR preparations in 18 months. EIA is also a part of WAPCOS work. No concrete recognition about affection/restriction of environmental issues was in KPCL. In order to conclude the design including adjustable type PSP machines, close data gathering from KPCL or rather from WAPCOS is necessary. Since JICA team (JPOWER) has a close interaction with WAPCOS, JPOWER initiated actions to discussions with WAPCOS. As of Dec., 2016, MOU with WAPCOS is being discussed.

Varahi and Kali are being worked to revise PFR by WAPCOS. Unless environmental issues are avoided in the initial layout, it would be difficult to obtain Prior Environmental Clearance for Survey & Investigation, so it is essential to define layout carefully at the initial stage. This work shall be monitored too.

But in Karnataka, the state finance division is against external loan. It requires high ranking political decision to go for JICA loan.

As for Turga, DD tender and its budget are not decided yet. WBSEDCL wishes to apply JICA loan to DD work, but it was against the regulation of Yen Loan. WBSEDCL intention to initiate DD earliest is firm so the issue should be brought to WBSEDCL executives. JICA team is monitoring this.

Bandhu is allocated to ADB in WBSEDCL and the state. Unless such situation changes, there would be little hope for JICA loan to come into. However, as there seems no fixed development target for Bandhu, it may be opportunities in the future.

Kulbera is just an identified stage but it is ranked 3rd in the PSP candidate lists in the state.

As for Tamil Nadu, the team found no promising PSP projects at the moment. Kundha and Sillahalla are the ones that there would be few chances for Japanese manufactures or JICA loan. Kodayar and Manalar also have the high head design that JICA loan is difficult. However, all those are the projects TANGEDCO claimed to pursue at the moment that require monitoring.

Fresh PSPs, as Mettur or new coming up identified projects may be candidates.

It is not meaningful to pursue “ranking evaluation” allocating points to each project.

However, as a preliminary trial, the JICA team just conducted rough point allocations to each project.

This was done as;

Stage 1 points : calculated in the same manner as chap. 5.2. but with updated data in Stage 2-3.

Stage 2-3 points : calculated based on the 1) Intention for Japanese Yen Loan, and 2) Opportunity for Japanese companies. It was done as: Allocating Stage 1 point : Stage 2-3 point = 60 : 40.

The total weighted ranking points are calculated as follows.

- Upper Indravati ; total 60
- Sharavathy ; total 60
- Turga ; total 80

Those are the PSP projects above 60 points.

The detailed information in the Stage 2-3 survey result was attached in the following table (colored sheets are the revised data during Stage 2-3 survey after Stage 1 survey).

The exact communications of updated information for states were attached as the Stage 2-3 Survey interviews minutes as in the Appendix.

The details of the selected projects, Upper Indravati, Sharavathy, Turga are detailed in the Table 6.4-3, 4, 5.

Table 6.4-2 Stage 2-3 Survey Project data after screening (3-1)

State	Project Name	Technical Evaluation						Economical Evaluation						
		Output(MW)	Design head (m)	Reservoir (existing, new)	Stage	Commissioning Year	Remarks	Evaluation	Project cost (Cr)	Project cost/MW (INR/kWh)	Levelized Tariff (INR/U)	Evaluation	Upper Dam	Lower Dam	Safety
Odisha	Upper Indravati	4*150	344	UD : Ext LD : New	DPR underway.	Delayed after 2022	DPR by May 2017 & COD in 2022 impractical. Delay highly likely.	B	1,601	26,675	2.5, or 3.25 (2016/June)	A	Kalahandi district	Kalahandi district	level 2
Odisha	Upper Kolab	4*80	251	UD : Ext LD : Ext	PFR completed. Waits for UI DPR	N/A	DPR action after completion of Upper Indravati DPR or NCEF grant approval.	B	813	25,419	3.0 (PFR)	A	Kolaput district	Kolaput district	level 2
Odisha	Balimela	4*100	246	UD : Ext LD : New	PFR completed. Waits for UI DPR	N/A	DPR action after completion of Upper Indravati DPR or NCEF grant approval.	B	1,404	35,090	3.13	A	Malkangiri district	Malkangiri district	level 2
Karnataka	Sharavathy	450, 800, 900, 1,000	436	UD : Ext LD : Ext	DPR initiated	2023	S&I, DPR, EIA by WAPCOS. PFR revised in 3mths & DPR in 18mths.	A	1449Cr (900MW) (PFR,2009)	16,100		A	Shimoga district	Uttara Kannad district	level 1
Karnataka	Varahi	700 (250, 600, 1,000)	476	UD : Ext LD : New	PFR being revised	N/A	Sharavathy 1st. PFR being revised by WAPCOS in 3mths. Go for DPR is up to the outcome.	B	3900(1000MW), 2346(600), 1025(250)	39,000(1000MW), 39,100(600), 41,000(250)		A	Shimoga district	Udupi district	level 1
Karnataka	Kali	600, 1,000	374	alt 1: UD:New, LD:Ext alt 2: UD:Ext, LD: Ext	PFR being revised	N/A	The current layout was suspended & no intention to continue. PFR being revised by WAPCOS.	B/C	1243.4Cr But to be redesigned.	20723.3 But to be redesigned.		To be redesigned.	Uttara Kannada district	Uttara Kannada district	level 1
Tamil Nadu	Kundah	500	236	UD : Ext LD : Ext	DPR completed	2021-	partial construction commences. Phase 1 & phae 2 tenders to come 2017.	A	1,831Cr (DPR)	36,633	5.64 (DPR)	B	Nilgiris district	Nilgiris district	level 1
Tamil Nadu	Sillahalla	2,000	1,599	UD : New LD : Ext	DPR completed. Being approved by state	2023 earliest (maybe unpractical)	DPR phase1 almost finalized. DPR phase2 tender delayed. Still intends to commence constrution 2019.	C	6,914Cr (PFR)	34,570	3.31 (PFR, conclusion)	A	Nilgiris district	Coimbatore district	level 1
Tamil Nadu	Kodayar	500	1,234	UD : Ext LD : Ext	PIR		Investigation is ongoing.	C	2,550Cr	51,000		C	Kanyakumari district	Kanyakumari district	level 1
Tamil Nadu	Manalar	500	1,050	UD : Ext LD : New	PIR		Investigation is ongoing.	C	3,350Cr	67,000		C	Theni district	Theni district	level 1
Tamil Nadu	Mettur	500	208	UD : New LD : Ext	PIR		Investigation is ongoing.	C	2,200Cr (500MW)	44,000		B	Salem district	Salem district	level 1
Tamil Nadu	Newsites (tentative)		less 800m	Varies			Just proposed by JICA team & to be studied by TANGEDCO.It may be availale in 2017.	N/A				N/A			
West Bengal	Turga	1,000	146	UD : New LD : New	DPR competed. DD tender being prepared.	2022	Approved and TEC issued (Oct., 2016) DD tender being prepared (expected in Jan., 2017)	A	4,519	45,188	6.07	B	Purulia district	Purulia district	level 1
West Bengal	Bandhu (Bandu)	900	N/A	UD : New LD : New	S&I	Undecided.	Topo & preliminary geotechnical investigation carried out. Preparation for DPR will be started soon.	B				ND	Purulia district	Purulia district	level 1
West Bengal	Kulbera	1,100	152	UD : New LD : Ext	Identified	N/A	PFR not done. S&I yet taken up (WBSEDCL, 2016/Sep.)	C				ND	Purulia district	Purulia district	level 1

Table 6.4-2 Stage 2-3 Survey Project data after screening (3-2)

State	Project Name											State Power Sector status	
		National Park, Reserved Forest	Wild Life Sanctuary	Tiger/ Elephant habitat	KBA	Endemic Bird Area	Biodiversity Hotspots	Scheduled Tribe Rate	EIA report, EC, FC	Remarks	Evaluation	Necessity/Justification of PSP from power sector status	Power Sector Evaluation
Odisha	Upper Indravati	Reserved Forest						28.50%		one temple resettelment Land required for private/forest lands. FC may take time. ST is comparably high. No EIA yet & environment needs to be clarified.	B	Securement of peak power and stabilization of the grid.	B
Odisha	Upper Kolab	Reserved Forest						56.56%		a few resettlement. Land required for private/forest lands. ST is very high.	C	Securement of peak power and stabilization of the grid.	B
Odisha	Balimela							57.83%		103ha forest submerged. Settlement to be studied in DPR	C	Securement of peak power and stabilization of the grid.	B
Karnataka	Sharavathy	Not certain til EIA but Forest may be affected.	In Sharavathi Valley WLS	Elephant and Tiger	5km	in	in	3.73%		KPCL has no data of protectd areas, leave All up to DPR&EIA by WAPCOS. But it locates in WLS, EBA, Hot Spot. EIA may take time. 50 acre is required to be obtained.	B	1st is to stabilize the grid, 2nd is to secure peak power.	A
Karnataka	Varahi	10km from Western Ghats WHS. Forest may be affected.	10 km from the Mookambika S (or possibly inside of WLS)	2.3km from known tiger habitat			in	4.49%		KPCL has no data of protectd areas. . lower reservoir (150acr) , 55 acr additionally required. Small villages resettlement.	B/C	1st is to stabilize the grid, 2nd is to secure peak power.	A
Karnataka	Kali	Reserved Forest	Dandeli WLS	tigere reserve, Tiger and Elephant	in	5km	in	2.38%		Will revise PFR. Unless avoid environmental restriction, suspension likely.	N/A	1st is to stabilize the grid, 2nd is to secure peak power.	A
Tamil Nadu	Kundah	2km from National Parks, 3km from Western Ghat WHS	4km from AZE	Tiger and Elephant	in	in	in	4.46%	EC obtained (2007)		A	Storage, securement of peak power, stabilization of the grid against many introduction of REN.	B
Tamil Nadu	Sillahalla	8km from Western Ghats WHS. 7.3km from NP. Protected Forest may likely be affected.	1.9km from Nilgiris Reserve	Tiger and Elephant	in	in	in	4.46% and 0.82%		TANGEDCO has no data on environment. It says All to be collected in DPR or later.	C	Storage, securement of peak power, stabilization of the grid against many introduction of REN.	B
Tamil Nadu	Kodayar	0.5km from Western Ghat WHS	Kalakad S, Mundanthurai S	0.5km from tiger reserve, Tiger and Elephant	in	in	in	0.39%			C	Storage, securement of peak power, stabilization of the grid against many introduction of REN.	B
Tamil Nadu	Manalar	KB Forcal Area, 0.5km from Western Ghat WHS	Megamalai WLS, 9.7km from Srivilliputhur S	0.5km from tiger resrve,Tiger and Elephant	in	in	in	0.15%			B	Storage, securement of peak power, stabilization of the grid against many introduction of REN.	B
Tamil Nadu	Mettur	Protected Forest may likely be affected. (possibly UD in RF)	7.9km from Nilgiris Reserve	5km from Tiger, 10km from Elephant				3.43%			C	Storage, securement of peak power, stabilization of the grid against many introduction of REN.	B
Tamil Nadu	New sites (tentative)										N/A		N/A
West Bengal	Turga			30km from elephant				18.45%	EC obtained (2016)	234ha forest	A	securement of peak power, stabilization of the grid for thermal power generation.	B
West Bengal	Bandhu (Bandu)							18.45%			A	securement of peak power, stabilization of the grid for thermal power generation.	B
West Bengal	Kulbera		location unclear	location unclear				N/A			C	securement of peak power, stabilization of the grid for thermal power generation.	B

Table 6.4-2 Stage 2-3 Survey Project data after screening (3-3)

State	Project Name	State Government Support						Stage 2-3 Evaluation			Stage 1	Stage 2-3
		Power/Energy Dept. Support	Finance Dept. Support	Debt-sustainability clearance	Consistency with the priorities of the State Governments	Remarks	Evaluation	Intention for Japanese Yen Loan	Intention for Japanese Yen Loan	Opportunity for Japanese companies	S1 : S2-3 60 : 40	
Odisha	Upper Indravati	A	A	C	A		A	Applied for NCEF. Consider JICA loan after fails (around March 2017)	B/C	Up to DPR (OHPC requested WAPCOS to study adjustbale machines)	76	60
Odisha	Upper Kolab	A	A	C	B		B	Applied for NCEF. Consider JICA loan after fails (around March 2017)	B/C	N/A	56	50
Odisha	Balimela	A	A	C	B		B	Applied for NCEF. Consider JICA loan after fails (around March 2017)	B/C	N/A	56	50
Karnataka	Sharavathy	A	C/B	A	B	KPCL admits Finance dept. remains negative towatd External Loans.	C	Undecided. KN considers REC, PFC or banks.	B/C	N/A.	72	60
Karnataka	Varahi	A	C/B	A	B	KPCL admits Finance dept. remains negative towatd External Loans.	C	Undecided. KN considers REC, PFC or banks.	B/C	N/A.	52	50
Karnataka	Kali	A	C/B	A	B	KPCL admits Finance dept. remains negative towatd External Loans.	C	Undecided. KN considers REC, PFC or banks.	B/C	N/A.	28	30
Tamil Nadu	Kundah	A	A	A	A		A	REC funded & no chance to revoke.	Impractical	Negative as Fixed machines designed	88	-
Tamil Nadu	Sillahalla	A	A	A	A		A	TN affirmative but practically difficult.	Impractical	C	56	-
Tamil Nadu	Kodayar	A	A	A	A		A	Practically difficult.	Impractical	High Head. Impractical.	40	-
Tamil Nadu	Manalar	A	A	A	A		A	Practically difficult.	Impractical	High Head. Impractical.	52	-
Tamil Nadu	Mettur	A	A	A	A		A	Undecided as future project	N/A	ND	48	40
Tamil Nadu	New sites (tentative)						N/A	N/A. This option was proposed by JICA team on the premises TN needs more PSPs and be attracted by JICA loan conditions.	N/A	ND	N/A	N/A
West Bengal	Turga	A	A	A	A		A	A/B. WBSEDCL expressed that it was not secured to utilize JICA loan as it's a board matter.	A/B	A	88	80
West Bengal	Bandhu (Bandu)	A	A	A	A		A	ADB decided to be utilized by WB	C	N/A	72	50
West Bengal	Kulbera	B	A	A	B		B	N/A	N/A	N/A	32	30

Table 6.4-3 Details of Selected Project (Upper Indravathi)

Description	Information
Current Status	PFR completed in 2012 Current Status: DPR, Survey and investigations under progress
Purpose of pumped storage project	1. Supply of Peak Power 2. Supply of Balancing Power to the Grid 3. Follow to Policy of the central government
Detailed Information of the project	
(i) Site location (map, general layout, etc.);	Upper dam - Kalahandi district Lower dam - Kalahandi district Upper dam - Upper indravati dam (existing) Lower dam - new dam (proposed) Location Map - Refer Appendices of Draft Final Report
(ii) Year to be programmed to be commissioned;	Planned to be commisssioned by 2021-22 1. Project has been proposed to be completed within 4.5 years (54 months) from award of works including pre-construction activities. 2. Currently DPR is under progress
(iii) Technical Information such as;	
- Installed capacity (capacity per unit, number of units);	600 MW (4 x 150 MW)
- Head (gross, net);	Rated Head : 344.37 m (generation), 379.17 m (pumping)
- Maximum discharge for power generation and pumping up;	208 m^3/s (generation) 164.80 m^3/s (pumping)
- Output duration per day;	5.50 hours generation
- Height of a dam;	Upper dam - 54.5 m Lower dam - 18.0 m
- Length of a dam's crest;	Upper dam - 630.5 m Lower dam - 1200 m
- Design flood discharge of a spillway;	Upper dam - 11,430 m^3/s Lower dam - Flood studies have not been carried out for lower reservoir in the PFR. It is learnt that detailed studies will be made during DPR stage
- Full reservoir level, Maximum drawdown level and available depth of a upper & lower reservoirs;	Upper dam: FRL: RL 642.00 m, MDDL: RL 625.00 m Lower dam: FRL: RL 281.50 m, MDDL: RL 269.00 m
- Internal diameter of a headrace, a penstock and a tailrace;	HRT - 7.5 m, Pressure shaft - 5.0 m (2 nos.) Penstock - 3.50 m (4 No.s) Tailrace - 2 Nos. 6.00 m (2 nos.)
- Thickness of lining or filling concrete of a headrace, a penstock and a tailrace;	HRT - 500 mm thick concrete lining Surgeshaft - 500 mm thick concrete lining
- Length of a headrace, a penstock and a tailrace;	HRT - 2700 m Pressure shaft - 450 m (2 nos.) Penstock - 160 m (4 nos.) Tailrace - 1600 m (2 nos.)
- Thickness of a steel penstock;	varies from 24 mm to 36 mm
- Plan area and height of a underground powerhouse;	2016 m^2, height 48.2 m

Description	Information
- Length of a main access tunnel;	Diameter - 7 m D-shaped. Length of MAT is not yet finalized during PFR stage. Will be available after DPR preparation
- Other features such as pure pumped storage or river pumped storage, pumped storage daily regulation or weekly regulation, utilizing the existing reservoir or not, etc.	Pure pumped storage project Pumping duration: 7 hours /day during 270 days. No pumping operation from July Ist to 30th Sep. For one unit the yearly pumped volume is 280 MCM. The average discharge per unit is 41.20 Cumecs and for the four units, the yearly volume (Pumping Mode) amounts to 1121 MCM. This is equivalent to 164.80 Cumecs discharge in pumping mode.
(iv) Capacity of transmission line planned to be connected and distance to the tranmission line	220 kv, Routing & length of transmission line is not yet finalized. Will be available after DPR preparation
(v) Natural environmental conditions such as:	
- Hydrology;	Catchment area; Upper dam - 2630 km2 Total inflow as per 90% dependable year is 1685.92 MCM. The yearly pumped volume is 1121.00MCM, which is about 66.50% 0f the total inflow.
- Geology	The geological features of the surrounding of the existing scheme are well established. In and around Upper Indravati Project, acid to intermediate charnockite, pyroxene granulite, leptynite and amphibolites are exposed. The general trend of the rocks is towards N.S. to N.E.S.W, However at the time of preparation of DPR detailed geological investigation needs to be carried out for fixation of most suitable layout of the proposed pumped storage scheme.
- Distribution maps and related information of protected area such as national parks,animal sanctuaries, biosphere reserves, Important Bird Areas, reserved forest, protected forest, etc.;	No protected areas like national parks, santuaries, biosphere reserves
- Distribution maps and related information of forest areas required Forest Clearance (i.e. Protected Forest stipulated in Indian Forest Act 1927) ;	Upper Indravati HEP is in operation since 2001. Upper Reservoir is already functional. The Lower reservoir has been proposed to be formed near Mukhiguda town in adjoining area of existing Switchyard. The predominant land use in the vicinity of project area is forest land as well as private land. The proposed reservoir will lead to submergence of about 80 Ha. of land. Submergence of protected/Reserved forests land around the project will be minimal. There are no sites or monuments of archaeological or national importance which would be affected by the project activities. The land will also be required for construction of power house complex and its apparent works i.e. HRT, surge shaft, penstocks and TRT etc. Total land required for the construction of various components is about 85 Ha. Most of land comes under the Category of forest and private land and situated nearby to the existing HEP.
(vi) Social environmental condition such as;	
- Land-use map;	Refer Appendices of Draft Final Report
- Distribution maps and related information of private land;	The predominant land use in the vicinity of project area is forest land as well as private land (land required for project is about 85 Ha). However, it is reported that details will be available after DPR preparation.
- Length of an newly-constructed access road to a dam or between a dam site and the existing road;	3 km of new road proposed to connect to existing motorable road
- Necessity of resettlement (If yes, number of people to be resettled is also to be collected.);	Project involves submergence of land for construction of lower reservoir. Extent of R&R - will be studied as part of EIA study during DPR stage

Description	Information
- Position of historical site and cultural heritage designated by government or international authority such as UNESCO, etc;	Nil
- Residential area of Indigenous Peoples with independent language and/or culture, etc.);	Nil
(vii) Logical reason why each pumped storage project is viable and its ground including economic analysis such as cost of power generation, economic efficiency against other power source, etc.	1. Total Project Cost INR 16005 Millions (at 2012 Price Level), Levellised conversion cost = INR 2.50 / kWh
(viii) Customers to sell electric power;	Odisha Power Transmission Corporation Limited
(ix) With or without power purchase agreement;	with PPA
(x) Situation to offer to Discom;	Not yet finalized. Learnt that, it will be finalized during DPR
(xi) Source of finance; from PFR (2012)	Debt-equity ratio considered for project is 70:30. The source of finance for debt component is not yet finalized by Govt. Of Odisha, as the project is in PFR stage. Details will be available after DPR preparation Reportedly application submitted to NCEF finance (Sep., 2016)
(xii) Movement of aid agencies such as World Bank, ADB, etc., except JICA;	Not yet finalized. Learnt that, it will be finalized during DPR
(xiii) Obstacle and difficulty, if any;	Involves land acquisition for lower reservoir (private/forest)

Table 6.4-4 Details of Selected Project (Sharavathy)

Description	Information
Current Status	**Current Status: Survey and investigations under progress.** **DPR is underway including the review of PFR**
Purpose of pumped storage project	**1. To meet the peak power requirement of Karnataka and stabilize the grid** **2. National Institute of Advanced Studies (NIAS), recommended to develop a 1000 MW installed capacity, 10 hour, pumped storage scheme for the year 2022**
Detailed Information of the project	
(i) Site location (map, general layout, etc.);	**Upper dam - Shimoga district** **Lower dam - Uttara Kannad district** **Refer Appendices of Draft Final Report for Location map of Sharavathy PSP** **As per PFR, Upper dam - Proposed on Hinni stream** **However, other alternative proposed is to utilise existing Talakalale reservoir** **Lower dam - Gerusoppa (existing)**
(ii) Year to be programmed to be commissioned;	**2023, Based on discussions with KPCL**
(iii) Technical Information such as; **(basically as per PFR 2008, KPCL)**	
- Installed capacity (capacity per unit, number of units);	**900 MW (4 x 225 MW) as per PFR 2008, KPCL** **Based on discussions, an installed capacity of 1000 MW is under consideration of KPCL, however, the capacity will be finalised after completion of DPR.**
- Head (gross, net);	**Rated Head : 436 m (genaration)** **Rated Head: 456 m (pumping)**
- Maximum discharge for power generation and pumping up;	**234 m^3/s (generation)** **180 m3/s (pumping)**
- Output duration per day;	**6 hours**
- Height of a dam;	**Upper dam : 26.70 m** **Lower dam : 62 m**
- Length of a dam's crest;	**Upper dam : 100 m** **Lower dam : 421 m**
- Design flood discharge of a spillway;	**Upper dam : N/A** **Lower dam : 6245 m^3/s**
- Full reservoir level, Maximum drawdown level and available depth of a upper & lower reservoirs;	**Upper dam: FRL: RL 500.00 m, MDDL: RL 480.00 m** **Lower dam: FRL: RL 55.00 m, MDDL: RL 43.50 m**
- Internal diameter of a headrace, a penstock and a tailrace;	**HRT - 9.0 m,** **Pressure shaft - 5.2 m** **Tailrace - 5 x 5m (D-shaped)**
- Thickness of lining or filling concrete of a headrace, a penstock and a tailrace;	**HRT - 300 mm thick** **TRT - 300 mm thick**

Description	Information
- Length of a headrace, a penstock and a tailrace;	HRT - 86 m Pressure shaft - 602 m Tailrace - 560 m
- Thickness of a steel penstock;	N/A
- Plan area and height of a underground powerhouse;	2040 m^2, height 45 m
- Length of a main access tunnel;	900 m
- Other features such as pure pumped storage or river pumped storage, pumped storage daily regulation or weekly regulation, utilizing the existing reservoir or not, etc.	Pure pumed storage project, Peak hour generation - 6 hours Pumping off-peak hours - 8 hours
(iv) Capacity of transmission line planned to be connected and distance to the tranmission line	220 kV & 25 km (approx)
(v) Natural environmental conditions such as:	
- Hydrology;	1. As per PFR 2008, Upper reservoir is newly proposed, with a catchment area of about 6.52 km^2, with a gross capacity of 5 MCM. Lower reservoir is proposed to utilise the existing Gerusoppa Reservoir having a storage of 131 MCM at FRL. 2. To overcome the Upper reservoir, an alternative of utilising both upstream and downstream reservoirs existing, upper reservoir Talakalale catering to existing Sharavathy Generation Station (1035 MW) & lower reservoir Gerusoppa catering for existing Gerusoppa HEP (240 MW) has been proposed.
- Geology;	The area where the project is proposed comprises of thick Laterite followed by Granite Gneiss formations. The general trend of foliation in granite gneiss rock is East-West dipping 70^0 northerly. The rock is medium to coarse grained, hard and massive in nature. For underground excavations, sufficient rock cover is expected to be available as gathered from surface geological studies.
- Distribution maps and related information of protected area such as national parks,animal sanctuaries, biosphere reserves, Important Bird Areas, reserved forest, protected forest, etc.;	Forest map near Sharavathy PSP is given in Appendices of Draft Final Report. It is seen that both upper and lower dam are away fromt the boundary of Sharavathy Wildlife Sanctuary
- Distribution maps and related information of forest areas required Forest Clearance (i.e. Protected Forest stipulated in Indian Forest Act 1927) ;	Information not available, however it is to be noted there are 3 plants exisitng in close to the proposed project vicinity.

Description	Information
(vi) Social environmental condition such as;	
- Land-use map;	Refer Appendices of Draft Final Report
- Distribution maps and related information of private land;	Information not available as the project is at prelminary stage However, it is understood from KPCL, that the land required near the reservoirs for project components is already acquired by KPCL for earlier existing projects.
- Length of an newly-constructed access road to a dam or between a dam site and the existing road;	about 10 km
- Necessity of resettlement (If yes, number of people to be resettled is also to be collected.);	As per PFR, Resettlement may be necessary for upper reservoir. However, as per discussions, it is proposed to use both upper and lower existing reservoirs. Therefore, resettlement not anticipated.
- Position of historical site and cultural heritage designated by government or international authority such as UNESCO, etc;	No important historical site and cultural heritage sites near the project area.
- Residential area of Indigenous Peoples with independent language and/or culture, etc.);	Details not finalised, only preliminary studies carried out
(vii) Logical reason why each pumped storage project is viable and its ground including economic analysis such as cost of power generation, economic efficiency against other power source, etc.	Project cost (2008 price level) - INR 14490 Million Annual energy generation - 1971 Mu
(viii) Customers to sell electric power;	KPCL will be selling power generated to Discoms, Based on discussions with KPCL
(ix) With or without power purchase agreement;	With PPA, Based on discussions with KPCL
(x) Situation to offer to Discom;	Genarsting company will sell power to Discoms
(xi) Source of finance;	Learnt that, this will be taken up after finalisation of DPR
(xii) Movement of aid agencies such as World Bank, ADB, etc., except JICA;	Learnt that, this will be taken up after finalisation of DPR
(xiii) Obstacle and difficulty, if any;	Nil

Table 6.4-5 Details of Selected Project (Turga)

Description	Information
Current Status	1. DPR completed 2015 and reviewed by Central Goverment 2. Environmental Clearance issued by MoEF on Aug. 2016. 3. TEC issued by CEA on Oct. 2016.
Purpose of pumped storage project	1. Stabilisation of grid and a backup power for fluctuations in thermal power plants generations, 2. To secure peak power
Detailed Information of the project	
(i) Site location (map, general layout, etc.);	Upper dam - Purulia district Lower dam - Purulia district
(ii) Year to be programmed to be commissioned;	2022, (by EIA Report for Tunga PSP, West Bengal)
(iii) Technical Information such as;	
- Installed capacity (capacity per unit, number of units);	1000 MW (4 x 250 MW)
- Head (gross, net);	146.4 m (generation), 154 m (pumping)*
- Maximum discharge for power generation and pumping up;	Maximum discharge: 197 m^3/s (generation mode) per unit Maximum discharge: 196.7 m^3/s (pumping mode) per unit
- Output duration per day;	5 hours
- Height of a dam;	Upper dam - 63.50 m Lower dam - 64.00 m
- Length of a dam's crest;	Upper dam - 732 m Lower dam - 872 m
- Design flood discharge of a spillway;	Upper dam - 280 m^3/s Lower dam - 428 m^3/s
- Full reservoir level, Maximum drawdown level and available depth of a upper & lower reservoirs;	Upper dam: FRL: RL 464.00 m, MDDL: RL 444.40 m Lower dam: FRL: RL 316.50 m, MDDL: RL 280.40 m
- Internal diameter of a headrace, a penstock and a tailrace;	Headrace tunnel 9.0 m dia Penstock (steel lining): 9.0 m (2 Nos.), 6.4 m (4 Nos.) Tailrace: 7.0 m (4 Nos), 10 m (2 Nos.)
- Thickness of lining or filling concrete of a headrace, a penstock and a tailrace;	Design details not furnished in the available information
- Length of a headrace, a penstock and a tailrace;	Headrace tunnel: 618 m Penstock: 224 m (9.0 m dia) & 74 m (6.4 m dia) Tailrace tunnel: 126.90 m (7.0 m dia) & 419 m (10 m dia)
- Thickness of a steel penstock;	Design details not furnished in the available information
- Plan area and height of a underground powerhouse;	Plan area: 4000 m^2 & 53 m height
- Length of a main access tunnel;	430 m

Description	Information
- Other features such as pure pumped storage or river pumped storage, pumped storage daily regulation or weekly regulation, utilizing the existing reservoir or not, etc.	1) pure pumped storage project 2) 5 hours generation during peak hours
(iv) Capacity of transmission line planned to be connected and distance to the tranmission line	400 kV transmission line. The Switchyard is placed aboveground at the southeast of the Underground Powerhouse location in light of shortening of transmission line between the Switchyard and proposed new Purulia PSP 400 kV substation where electricity produced by Turga Pumped Storage Project is planned to be transmitted.
(v) Natural environmental conditions such as:	
- Hydrology;	The project envisages the construction of Upper Dam (C.A. 8.29 km^2) across Turga Nala, a tributary of Subarnarekha river and a water conductor system with an underground Power House on the downstream of Upper Dam and a Lower Dam having intermediate catchment of 4.37 km^2 . The Project is a Close Loop type Pumped Storage Scheme. It comprises two reservoirs at two different levels and water conductor system connects the two reservoir through an underground power house.
- Geology	1) The Turga Project area located in Ajodhya Hills, lies in the tectonic regime of Chhotanagpur Gneissic Complex (CGC).This covering an area of 100,000 km^2 forms the eastern extension of the Central Indian Tectonic Zone(CITZ). Chhotanagpur Complex (CGC) lies north of the E–W trending North Singhbhum Mobile Belt (NSMB) 2) The Turga Pumped Storage Project is located near Bagmundi on the southern margin of the plateau. The drainage around the project area two seasonal rivulets namely Kistobazar and Turga Nala, is structurally controlled by NE-SW and E-W trending fracture/ lineaments /prominent master joints display dendritic to sub-rectangular pattern.
- Distribution maps and related information of protected area such as national parks,animal sanctuaries, biosphere reserves, Important Bird Areas, reserved forest, protected forest, etc.;	1. There is no Wildlife sanctuary, National park or Biosphere Reserve present within the study area. 2. The forests in the proposed project area along the TurgaNalla fall in Purulia Forest Division of West Bengal. As per classification, the forest under this division is Northern tropical Dry Deciduous Forest (5B) typeand Dry peninsular sal forest (5B/C 1c). This is further classified as Reserved Forest, Protected forest, Unclassed state forest, khas forest, vested waste land, forest owned by corporate bodies and forest owned by private individuals.
- Distribution maps and related information of forest areas required Forest Clearance (i.e. Protected Forest stipulated in Indian Forest Act 1927) ;	Only reserved forest clearance applicable

Description	Information
(vi) Social environmental condition such as;	
- Land-use map;	1) The total land required for the project is 292.0 ha 2) Out of whih 234 ha of land is Forest land and the remaining (58 ha) is non-forest government land and /or Private Land. 3) Out of 58 ha of non-forest government land and /or Private Land, 34 ha of land will be transferred from I & W Directorate, Government of West Bengal to Turga Pumped Storage Project. Remaining 24 ha of land to be arranged temporarily on leased basis.
- Distribution maps and related information of private land;	
- Length of an newly-constructed access road to a dam or between a dam site and the existing road;	A total of about 13 km of new roads are to be constructed.
- Necessity of resettlement (If yes, number of people to be resettled is also to be collected.);	No family will be losing homestead. Some minimum private land is to be acquired on temporary basis and no permanent acquisition of private land is envisaged. Thus, issues related to Resettlement and Rehabilitation are not envisaged in the proposed Project.
- Position of historical site and cultural heritage designated by government or international authority such as UNESCO, etc;	No historical site and cultural heritage designated near Project area
- Residential area of Indigenous Peoples with independent language and/or culture, etc.);	No
(vii) Logical reason why each pumped storage project is viable and its ground including economic analysis such as cost of power generation, economic efficiency against other power source, etc.	1. Total Project Cost INR 42904.1 Millions (at 2014 Price Level), 2. Levellised conversion cost: INR 5.85 / kWh 3. Benefit Cost Ratio: 1.63 (this is to be being revised reflecting escalation from 2014)
(viii) Customers to sell electric power;	Distribution through Discoms
(ix) With or without power purchase agreement;	with PPA
(x) Situation to offer to Discom;	Peak power to WBSEDCL
(xi) Source of finance;	Debt-equity ratio is 70:30 The debt component required for development of project is proposed to be obtained from financial instituitions like JICA
(xii) Movement of aid agencies such as World Bank, ADB, etc., except JICA;	Developer has approached JICA for funding
(xiii) Obstacle and difficulty, if any;	Forest clearances

CHAPTER 7

RECOMMENDATION AND CONCLUSION

CHAPTER 7 RECOMMENDATION AND CONCLUSION

As the result of the study, the following matters are recommended for the future actions.

7.1 OVERVIEWS

The Study was carried out on the basis of the collection of disclosed and/or obtainable information in public domain sources and those data/information which had been submitted by the agencies of central and state sectors throughout the surveys.

Therefore,

- The JICA team has not conducted "Project identification and project formation Study" which the team extracts new fresh potential PSP sites in cooperation with proponent state agencies (counterpart). This process of evaluation was the approach conducted in "Master Plan Study on Pumped Power Storage Hydroelectric Power Development in Maharashtra" in 1988 and 2012 by the JICA study. This time, such action was not performed, except some proposals made in Tamil Nadu in Stage 2 Survey.
- The study did not include "Site Survey", thus basic local information as safety, accessibility, social & environmental circumstances including residents, lands, forestry, flora and fauna, geographic situations, river flows, other interfering activities, etc. are not confirmed directly. The team conducted the site survey at Turga and Bandhu, West Bengal. Those should be checked before/when particular project is selected for further JICA's consideration.
- The main focus was on the verification of basic features of PSPs prepared by executing agencies, focusing on basic technical features, development schedule, economical features, social & environmental status, power sector & state government's stances. The ground details of the design, layout, project cost were not examined in details. This must be reviewed in later stage for selected project.

It is expected that contacted state agencies will request the Japanese Yen Loan application process in the near future to JICA.

In this Study, as seen in Chap. 5 and 6, at the start to Stage 1 survey screening, the team had dealt with 76 potential candidate sites (including some in already operation). In final stage, 3 PSP projects (Upper Indravati, Sharavathy, Turga) have been summarized as promising projects to be financed by Japanese Yen Loan in the "limited future timeline" out of some 15 PSP selected projects. Those 3 projects are "short-listed" by the team and the other 12 PSPs are the potential projects to be considered by the states in the future which each state stated continuing development.

They may be worth monitored rather closely than others, although some Tamil Nadu projects are outside of the target unless they revise the design head.

It is recommended to monitor the progress of the listed projects periodically and extend the assistances to the agencies to formulate promising projects into Japanese Yen Loan.
JICA is also recommended to have the exchange of information periodically with CEA and MOP as the regulations surrounding Hydropower projects, PSPs, and Renewables.

7.2 RECOMMENDATION TO EACH STATE PROJECTS

7.2.1 Maharashtra

- Though there are many potential projects, the biggest hurdle is that state energy department and MAHAGENCO do not consider PSPs necessary and do not support PSPs development at the moment. Unless the situation is improved, it is hard to put projects forward for Japanese Yen Loans.
- During the survey in October, it was informed Maharashtra state intends to shift the design circle section of hydropower generation projects in GOMWRD to MAHAGENCO. It needs to be monitored if it makes some changes of MAHAGENCO judgements.
- CEA/MOP is aware of the state situation. They have been conducting regulatory and policy formulation for promotion of PSPs. In order to establish 10GW target of PSPs in India, Maharashtra is indispensable as it holds huge PSP potentials. JICA Study in 2012 also found PSP site (Warasgaon). It is recommended to contact CEA and MOP on the progress.

7.2.2 Odisha

- Upper Indravati is the promising project which has commenced DPR. The decision of NCEF must be monitored. It is likely central government dismiss the request. There is no guarantee or deadline from NCEF. Or if approved, 25% may be allocated to JICA loan as 75% is granted.
- OHPC is not aware of CEA approval process and ODA applications practically almost at all. As the state unanimously shows interest in JICA loan, it is recommended to assist OHPC in 2017 onwards.
- It is recommended to commit the design of DPR by WAPCOS to include adjustable PSP machines. Both approaches to WAPCOS as well as to the state agency (OHPC) are required. (JPOWER is willing to assist JICA on this issue)

7.2.3 Telangana

- It is not advisable to pursue the state for PSPs for the time being.

7.2.4 Karnataka

- The state decides to promote 1,000 MW PSPs. The state is in firm stance to promote PSPs. It is understood adoption of adjustable PSP machines can be agreed in the government rather easily.
- Sharavathy is the most promising project in the state's view, and it has commenced DPR.
- It is recommended to commit the design of DPR by WAPCOS to include adjustable PSP machines, to secure the adoption.
  (JPOWER is willing to assist JICA on this issue.)
- It is recommended to approach state finance divisions in several occasions to have it understand and promote Japanese Yen loan for PSPs.

7.2.5 Kerala

- Practically all of the projects are early stage. It is too immature to consider application to ODA loan. It is advised to see which projects will be taken up to next stage.
- It is recommended to advise the state that it must consider the PSP strategy as it is difficult to justify PSPs to central government.
- It is one option to introduce and conduct Master Plan Study on PSPs in Kerala as the state has poor capability to conduct itself and when the state keeps desiring PSPs with rational justification.

7.2.6 Tamil Nadu

- It is easier to establish consensus in the state for Adjustable PSP machine, as it recognizes the necessity of grid stabilization tools by a large variable renewable energy development. It is recommended to keep collecting update of PSPs (Mettur etc.) other than Kundah and Sillahalla periodically.
- It is advised to propose Master Plan Study for potential PSPs (such as Maharashtra PSP Master Plan) from early stage with TANGEDCO in order to increase Japanese manufactures participation. We must prepare development in a long timeline.
- The state chief minister J. Jayalalithaa passed away on December 2016. As she had stayed in the position for long, the situation of the state government needs to be carefully monitored.

7.2.7 West Bengal

- It is recommended to approach high ranking officials of West Bengal state to confirm Japanese Yen Loan application.

- Though Bandhu has little hope at the moment for JICA loan, but the timeline for Bandhu is in the distant future, it is recommended to monitor it.

7.2.8 Meghalaya

- At this stage, there is little hope the state pursue PSPs for intra state consumption. The basic study is necessary on PSPs for exporting Power to Bangladesh.
- The state also prioritizes conventional hydro projects to PSPs.
- The state has an interest to export power to Bangladesh for improve state economy using hydro powers (conventional of PSP). It has at present hurdles to overcome in project economics and physical availability. But it is possible in the future.
- As the Meghalaya has little budget to invest the above project on its own. It also does not have sufficient human resources on project development. So, it is considered that Master Plan Study on hydropower (and PSPs) development in the state river basins may help the state power development.

PART Ⅱ

COAL THERMAL

PROJECTS

PART II COAL THERMAL PROJECTS

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ABBREVIATION

Short Title	Official Term
AWRS	Ash Water Recycle System
BOP	Balance of Plant
CCL	Central Coalfields Limited
CEA	Central Electricity Authority
CIL	Coal India Limited
COD	Commercial Operation Date
C/P	Counterpart
DC	Designated Consumer
DPR	Detail Project Report
EIA	Environmental Impact Assessment
EPC	Engineering, Procurement and Construction
ERP	Enterprise Resource Planning
ESP	Electric Static Precipitator
FGD	Flue Gas Desulphurization
GDP	Gross Domestic Product
IDC	Interest During Construction
JICA	Japan International Cooperation Agency
LE	Life Extension
MPPGCL	Madhya Pradesh Power Generating Company Limited
MSPGCL	Maharashtra State Power Generation Company Limited
MoEF	Ministry of Environment and Forest
MoP	Ministry of Power
NCL	Northern Coalfields Limited
NDCT	Natural Draft Cooling Tower
NSDP	Net State Domestic Product
O&M	Operation & Maintenance
ODA	Official Development Assistance
OEM	Original Equipment Manufacturer
OJT	On the Job Training
PGCIL	Power Grid Corporation of India Limited
PH	Power House
PLF	Plant Load Factor
R&M	Renovation & Modernization
RLA	Remaining Life Assessment
SCCL	Singareni Collieries Company Limited
SLC	Standing Linkage Committee
SPM	Suspended Particulate Matter
TANGEDCO	Tamil Nadu Generation and Distribution Corporation Limited
UMPP	Ultra Mega Power Projects
UPPTCL	Uttar Pradesh Power Transmission Company Limited
UPRVUNL	Uttar Pradesh Rajya Vidyut Utpadan Nigam Limited
WB	The World Bank

CHAPTER 1

INTRODUCTION

CHAPTER 1 INTRODUCTION

1.1 OBJECTIVE OF THE SURVEY

The survey aims to collect the basic information and to conduct the preliminary selection study on the current status of aged coal fired power stations in India so as to identify the potential replacement coal-fired thermal power projects, where high efficiency power generation facility with Ultra-Super Critical (USC) steam condition and high-performance environmental protection facility are applicable. Also to sort out requirements for future project formation with the project outline regarding the most promising candidate sites.

1.2 SURVEY SCHEDULE

The survey started in March 2016 and completed in November 2016.

The outline is as follows;

(1) The first field work: from 18th of April to 23rd of April
Information collection and study for Thermal Power candidates (A-group)

(2) The second field work: from 14th of June to 24th of June
Information collection and study for Thermal Power candidates (B-group)
Follow-up survey for OBRA Project (A-group)

(3) The third field work: from 23rd of August to 30th of August
Information collection and study for Thermal Power candidates (C-group)

(4) The fourth field work: from 17th of October to 23rd of October
Information collection and study for Thermal Power candidates (Follow-up)

1.3 SURVEY PROJECTS

The following five candidate projects were chosen among those candidates including six states and fifteen projects nominated in TOR of the survey after initial preparatory work.

Group A: Obra 'A' (1 × 660 MW) Replacement project (Uttar Pradesh)
Yamna Nagar (1 × 660 MW) Extension project (Haryana state)

Group B: Satpura (2 × 660 MW) Replacement project (Madhya Pradesh)
Amarkantak (2 × 660 MW) Replacement project (Madhya Pradesh)

Group C: Sagardighi (1 × 660 MW) Extension project (West Bengal)

1.4 SCOPE OF SURVEY PROJECTS

The Scope of Survey Projects is shown in Table 1.4-1.

Table 1.4-1 The Scope of Survey Projects (1/2)

Gr	No	Project	State	Owner	Units/Capacity	Status of Existing Plant	Scope for rehabilitation/replacement	Planning of grid for rehabilitation/replacement	Existing feasibility study or Pre-FS for rehabilitation/replacement	Consideration on Finance	Applied Technology	Land	Water	Coal	PPA	EIA	Resettlement Action Plan (for local people)	Progress for Replacement
A	1	Yamnanagar	Haryana	HPGCL	#1-2: 300MWx2	No information	Add 1x660MW or 1x800MW	No information	No information	Yes. HPGCL is open to consider Japanese finance at low interest loan.	USC + DeSOx + DeNOx	Available	Available	Available	Available	Available		No progress has been made by HPGCL for preparing the DPR. Internal clearances are yet to be taken before proceeding further.
	2	Panki	UP	UPRVUNL	#3,4	After starting operation for new Units which is under consideration, #3,4 planned to be stopped.	New EPC tender. No Replacement or rehabilitation.	Grid lines has sufficient capacity for evacuation of power.	Feasibility Study is already completed on replacement of units. Tender is already floated of EPC contract.	Currently, Funding is planning from PFC & REC.	USC + DeSOx + DeNOx	Available	Available	Available	Available	Available	Completed	For new unit - EPC Tenders were floated. BHEL is lowest. Not going for replacement of old units.
	3	Harduaganji	UP	UPRVUNL	#1-7	#1-4, #6 No operation #5 Planned to be stopped #7 Completed R&M in 2015	New EPC tender. No Replacement or rehabilitation.	Grid lines has sufficient capacity for evacuation of power.	Feasibility Study is already completed on replacement of units. EPC contract is awarded to Toshiba JSW Power Systems Private Limited.	UPRVUNL has considered loan from PFC, India.	USC + DeSOx + DeNOx	Available	Available	Available	Available	Available	Completed	New Unit - EPC contract is awarded to Toshiba JSW Power Systems Pvt Ltd.
	4	Obra	UP	UPRVUNL	#1-4: 50MW #5-8: 94MW	#1-2 Planned to be stopped in 2015 #3-6 No operation #7 Under R&M #8 Planned to be stopped	New EPC tender. No Replacement or rehabilitation.	Grid lines has sufficient capacity for evacuation of power.	Feasibility Study is already completed on replacement of units. Tender is already floated of EPC contract.	Currently, Funding is planning from PFC & REC.	USC + DeSOx + DeNOx	Available	Available	Available	Available	Available	In process.	Obra - C - EPC Tenders were floated. Doosan is lowest. For replacement of Obra A - Units 1-8, FR has been given to UPRVUNL. They are likely to take up the issue in the Board of Directors meeting, to be held shortly, to get formal approval from Chairman to proceed further. Preparation of FR and EIA study will be carried out later.
	5	Parichha	UP	UPRVUNL	2x110MW	#2 Completed R&M but stopped operation due to incident #1 Approval for R&M completed, work will start in 2016	No Replacement or rehabilitation. R&M work is already under going.	Not Applicable.	Not Applicable.	Not Applicable.	Not Applicable.	Not Applicable.	Not Applicable.	Not Applicable.	Not Applicable.	Not Applicable.	Not Applicable.	Not Applicable.
	6	Anpara	UP	UPRVUNL	#1-3: unknown	R&M completed during 2008-2013年, Good PLF	Minor R&M is done in 2008-13. Major rehabilitation yet to be done. Scope of rehabilitationis yet to be decided.	Grid lines has sufficient capacity for evacuation of power.	Yet to be done.	Low rate Japanese financing consider at low interest loan in future.	Not Applicable.	Not Applicable.	Not Applicable.	Not Applicable.	Not Applicable.	Not Applicable.	Not Applicable.	Not Applicable.
B	7	Satpura	MP	MPPGCL	#1-5: 62.5MW #6-9: unknown	#1-5 No operation #6-9 bad Heat Rate	Not yet decided however there is strong possibility that MPPGCL will opt to replace to old units with new supercritical units through EPC tender. There is almost nil possibility for rehabilitation or replacement.	To be studied	Yet to be done.	Traditionally, MPPGCL prefer to consider funding from PFC or REC however financing at low interest rate from Japan may be an option.	Replacement SC + DeSOx + DeNOx	Available	Available	Available	Yet to be made.	Not yet done.	Not yet studied	MPPGCL has shown interest for replacement. They have floated tenders for preparing the DPR for replacement units.
	8	Amarkantak	MP	MPPGCL	2x120MW	Plan for stop operation in 2017	New EPC tender. No Replacement or rehabilitation.	Grid lines has sufficient capacity for evacuation of power.	Not yet done. It is expected that tender for feasibility study will out by first week of April 2016. The expected submission date will be April 27, 2016	Traditionally, MPPGCL prefer to consider funding from PFC or REC however financing at low interest rate from Japan may be an option.	Replacement SC + DeSOx + DeNOx	Available	Yes. Reservoir may required to be expanded	FSA yet to be made.	Yet to be made.	Not yet done.	The plant premises is not covering area of local people.	MPPGCL has shown interest for replacement. They have placed an order on DESEIN for preparing the DPR for replacement units.

Table 1.4-1 The Scope of Survey Projects (2/2)

Gr	No	Project	State	Owner	Units/Capacity	Status of Existing Plant	Scope for rehabilitation/replacement	Planning of grid for rehabilitation/replacement	Existing feasibility study or Pre-FS for rehabilitation/replacement	Consideration on Finance	Applied Technology	Land	Water	Coal	PPA	EIA	Resettlement Action Plan (for local people)	Progress for Replacement
C	9	DPL	WB	DPL	#1-5: unknown	#1-2 No operation #3-5 Planned to be stopped	No possibility for rehabilitation or replacement. It is decised to build up new SC units at the place of old units 1-5.	Grid lines has sufficient capacity for evacuation of power.	Pre feasibility study is done to build up new SC units. DPR is yet to be prepared.	Since there is no possibility of rehabilitation or replacement, finacing option is open to finance new SC units. Traditionally, DPL gets loans from Indian bank only.	SC + DeSOx + DeNOx	Available to build new SC units.	Available to build new SC units.	DPL has been allocated Trans-Damodar coal mine.	Yet to be made for new SC units.	Yet to be prepared for new SC units.	Plan to be finalized.	Old units shall be retired. Plan is approved. At the place of old units, new SC units to be built. There is no possibility of rehabilitation or replacement. Status to be checked after April 2016.
	10	Durgapur	WB	DVC	#3: 140MW	#3 Decided to stop operation	No possibility for Rehabilitation or replacement. No decision has been finalized for build up old units with new SC units. Proposal to demolish unit no 3 is approved.	Grid lines has sufficient capacity for evacuation of power. In case any shortfall, new lines can be built up. Howver detail study yet to be done.	Pre FS for replacement is done. DPR is not prepared.	Yes. DVC is open to consider Japanese finance at low interest loan in future.	USC + DeSOx + DeNOx	Available	Available	FSA yet to be made.	Not yet made.	Not yet done.	The plant primeses not covering area of local people.	DVC is not interested to replace / install new power plants
	11	Chandrapura	WB	DVC	#1-6: 130MW	#4-6 No operation	No possibility for Rehabilitation or repalcement. No decision has been finalized to demolish the old units and to replace with new supercritical units.	Grid lines has sufficient capacity for evacuation of power. In case any shortfall, new lines can be built up. Howver detail study yet to be done.	Pre FS for replacement is done. DPR is not prepared.	Yes. DVC is open to consider Japanese finance at low interest loan in future.	USC + DeSOx + DeNOx	Available	Available	FSA yet to be made.	Not yet made.	Not yet done.	The plant primeses not covering area of local people.	DVC is not interested to replace / install new power plants
	12	Bokaro	WB	DVC	2x210MW	Bad HR, bad PLF	No plan for commprehensive rehabilitation or replacement of the units in coming two years. DVC is planning to refurbish burners to reduce amount of unbrunt carbon and mills only. With the help of interenal study and internal modifications, Bokaro plant has been achieved improved HR.	Not applicable since no possibility of replacement or comprehensive rehabilitation.	Not applicable since no possibility of replacement or comprehensive rehabilitation.	Not applicable since no possibility of replacement or comprehensive rehabilitation.	Not applicable since no possibility of replacement or comprehensive rehabilitation.	Not applicable since no possibility of replacement or comprehensive rehabilitation.	Not applicable since no possibility of replacement or comprehensive rehabilitation.	Not applicable since no possibility of replacement or comprehensive rehabilitation.	Not applicable since no possibility of replacement or comprehensive rehabilitation.	Not applicable since no possibility of replacement or comprehensive rehabilitation.	Not applicable since no possibility of replacement or comprehensive rehabilitation.	Progress for Replacement
	13	Budge Budge	WB	CESC	2x250 MW	Running in good condition.	No possibility for Rehabilitation or replacement.	Not Applicable since there is no possibility of rehabilitation or replacement of old units.	Not Applicable since there is no possibility of rehabilitation or replacement of old units.	Not Applicable since there is no possibility of rehabilitation or replacement of old units.	Not Applicable since there is no possibility of rehabilitation or replacement of old units.	Not Applicable since there is no possibility of rehabilitation or replacement of old units.	Not Applicable since there is no possibility of rehabilitation or replacement of old units.	Not Applicable since there is no possibility of rehabilitation or replacement of old units.	Not Applicable since there is no possibility of rehabilitation or replacement of old units.	Not Applicable since there is no possibility of rehabilitation or replacement of old units.	Not Applicable since there is no possibility of rehabilitation or replacement of old units.	Not Applicable since there is no possibility of rehabilitation or replacement of old units.
D	14	Kota	Rajasthan	RRVUNL	2x110 MW and 2 x 210 MW	Poor Heat Rate	New EPC tender. No Replacement or rehabilitation.	Grid lines has sufficient capacity for evacuation of power.	Yet to be done.	Yes. RRVUNL is open to consider Japanese finance at low interest loan in future.	SC + DeSOx + DeNOx	It is available however to be studied.	It is available however detail study to be done.	FSA yet to be made.	Yet to be made.	Not yet done.	To be planned.	The proposal is submitted by RRVUNL to Government of Rajasthan seeking permission to decommission of old units. RRVUNL is planning to build new units through Case - II bidding basis (like UMPPs). The proposal is already submitted. It is advised to check the status at the end of months April 2016.
	15	Nasik	Maha state	MAHAGENCO	2x140MW	Scraped in June 2011	New EPC tender. No Replacement or rehabilitation.	Grid lines has sufficient capacity for evacuation of power.	Feasibility Study is already completed on replacement of units.	Yes. In end of year 2015, Govt of Maharashtra has called for investment in their power generation business.	SC + DeSOx + DeNOx	Available	Available	Available	Available	Available	Completed	Units are already scrapped.
	16	Ennore	TN	TANGENCO	5x90MW	Old units are scrapped.	New EPC tender. No Replacement or rehabilitation.	Grid lines has sufficient capacity for evacuation of power.	Feasibility Study is already completed on replacement of units.	No. Lanco may prefer funding from Chinese banks.	SC	Available	Available	Available	Available	Available	Completed	Awarded to Lanco in 2014.
	17	Sagardighi	WB	WBPDCL	1 x 660 MW	Old units are scrapped.	Replacement	Grid lines has sufficient capacity for evacuation of power.	Feasibility Study is already completed on replacement of units.	Yes. WBPDCL is open to consider Japanese finance at low interest loan.	USC + DeSOx + D	Available	Available	Available				Client is interested to replace the old units by 1 x 660 MW. They have prepared the DPR. They are in discussions with JICA. TOR has been given by MOEF.
		Bakreshwar	WB	WBPDCL	1 x 660 MW	Old units are scrapped.	Replacement	Grid lines has sufficient capacity for evacuation of power.										This project is not on priority for considering replacement of old units.

CHAPTER 2

OVERVIEW OF THERMAL POWER SECTOR IN INDIA

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2.1 NATIONAL ELECTRICITY POLICY ON REPLACEMENT & MODERNIZATION (R&M) AND COAL LINKAGE POLICES

Ministry of Power, in August 2015, requested CEA to prepare a report on "Replacement of old and inefficient units by supercritical units" for optimum utilization of scarce natural resources like land, water & coal.

Even though CEA had earlier given some suggestions on replacement of old and inefficient units with Ultra Mega Power Projects none of the proposals were accepted by the State Government, largely due to requirement of additional land and water for UMPP.

In order to assess the quantum of proposed replacement of old, inefficient & subcritical units by supercritical units/retirement/renovation, units having life span of 25 years or more have been considered. CEA maintains the data of such projects.

However, the operating practices are the most important factor responsible for the performance achieved and considerable improvements in performance are possible with good operating practices.

In view of the above it may be concluded that retirement of existing units should not be based on age but should be based on performance parameters. The units which are subjected to good operating practices, better maintenance can certainly be operated beyond the design life of 25 years. However, there are many such units which are not maintained properly, have deteriorated much earlier than the designed life and operation of these units have become uneconomical and unsafe. The states may be sensitized about in efficient operation of their stations and could be unsensitized to improve performance (PAT is one such measure already taken). The decision to take improvement measures or replacement would depend on techno economics and may be considered on case to case basis by concerned power utilities.

R&M Polices

One of the major achievements of the power sector has been a significant increase in availability and plant load factor of thermal power stations especially over the last few years. Renovation and Modernization for achieving higher efficiency needs to be pursued vigorously and all existing generation capacity should be brought to minimum acceptable standards. The Government of India is providing financial support for this purpose.

For projects performing below acceptable standards, R&M should be undertaken as per well-defined plans, featuring necessary cost-benefit analysis. If economic operation does not appear feasible through R&M, then there may be no alternative to closure of such plants as the last resort.

Coal Linkage Polices

Coal Linkage Transfer Policy in case of scrapping of old units by replacing them with new plants :

Ministry of Coal vide letter dated 17.09.2014 has issued detailed recommendations of SLC(LT) regarding automatic transfer of coal linkage in case of scrapping of old units by replacing them with new plants as under:

LOA/linkage granted to the old plant shall automatically be transferred to the new plant of nearest supercritical capacity.

If the capacity of the new supercritical plant is higher than the old plant, additional coal may be accorded priority subject to the availability of coal on the best effort basis from CIL.

New Emission Standards:

As per the MoEF notifications (S.O. 3305(E) dated 7th December, 2015), all new plants to be installed after 1st January, 2017 shall have to meet the following emission standards:

- Particulate Matters : 30 mg/Nm^3
- Sulfur Dioxides (SO_2) : 100 mg/Nm^3
- Oxides of Nitrogen (NOx) : 100 mg/Nm^3
- Mercury (Hg) : 0.03 mg/Nm^3

Table 2.1-1 New Emission standards in India

Sr. No.	Industry	Parameter	Standards
1	2	3	4
25.	Thermal Power Plant	**TPPs (units) installed before 31st December, 2003***	
		Particulate Matter	100 mg/Nm^3
		Sulphur Dioxide (SO_2)	600 mg/Nm^3 (Units Smaller than 500 MW capacity units) 200 mg/Nm^3 (for units having capacity of 500 MW and above)
		Oxides of Nitrogen (NOx)	600 mg/Nm^3
		Mercury (Hg)	0.03 mg/Nm^3 (for units having capacity of 500 MW and above))
		TPPs (units) installed after 1st January, 2003, upto 31st December, 2016*	
		Particulate Matter	50 mg/Nm^3
		Sulphur Dioxide (SO_2)	600 mg/Nm^3 (Units Smaller than 500 MW capacity units) 200 mg/Nm^3 (for units having capacity of 500 MW and above)
		Oxides of Nitrogen (NOx)	300 mg/Nm^3
		Mercury (Hg)	0.03 mg/Nm^3
		TPPs (units) to be installed from 1st January, 2017**	
		Particulate Matter	30 mg/Nm^3
		Sulphur Dioxide (SO_2)	100 mg/Nm^3
		Oxides of Nitrogen (NOx)	100 mg/Nm^3
		Mercury (Hg)	0.03 mg/Nm^3

* TPPs (units) shall meet the limits within two years from date of publication of this notification.

** Includes all the TPPs (units) which have been accorded environmental clearance and are under construction.

Souse: Indian Emission standard for New Power PI

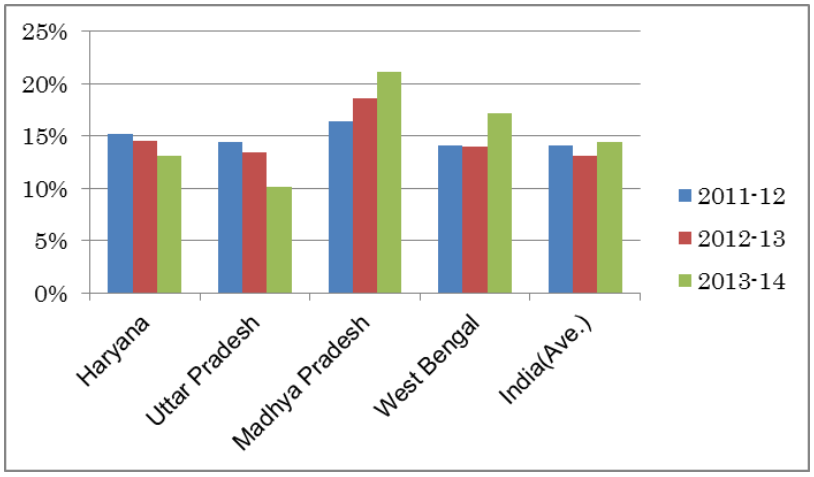
2.2 OVERVIEW OF TARGET STATE POWER SECTOR'S ECONOMIC SITUATION AND LOAD GENERATION BALANCE

(1) Net State Domestic Product (NSDP) Growth Rate for Recent Three Years (2011-12, 2012-13& 2013-14)

The NSDP growth rates of Haryana and Uttar Pradesh have decreased for three consecutive years from 15-14% in 2011-12 to 13-10% in 2013-14.

The NSDP growth rates of Madhya Pradesh have increased for three consecutive years from 16% in 2011-12 to 21% in 2013-14. (This is over an Indian national average of 14%.)

The NSDP growth rates of West Bengal have increased from 14% in 2011-12 and 2012-13 to 17% in 2013-14.



Source: Reserve Bank of India,
Net State Domestic Product at Factor Cost (At Current Prices)

Figure 2.2-1 Growth of Per Capita Net State Domestic Product (%)

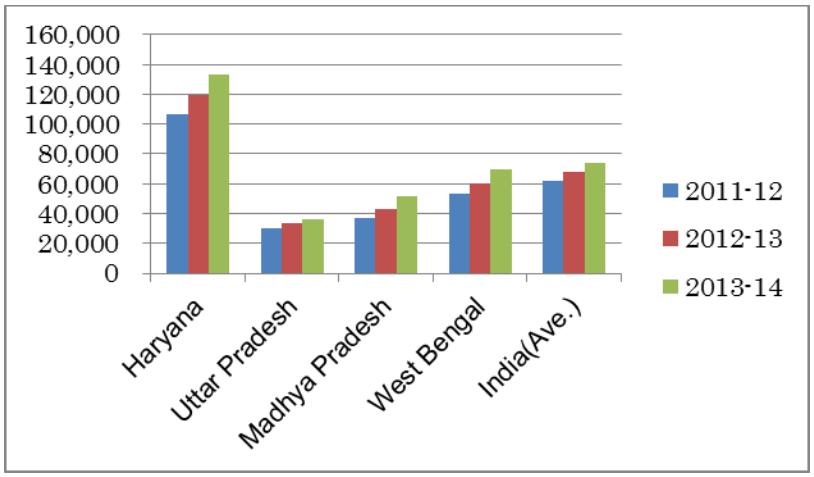
(2) Per Capita Net State Domestic Product (2011-12, 2012-13& 2013-14)

Per Capita Net State Domestic Product is increasing for the four states.

The value for Haryana (133,000 Rs in 2013-14) is substantially higher than the Indian average (74,000 Rs in 2013-14).

However, the values for Uttar Pradesh and Madhya Pradesh are much lower than the Indian average (standing at only 50% and 70% respectively of the 74,000 Rs average value).

The value for West Bengal is almost the same as the Indian average.



Source: Reserve Bank of India,
Per Capita Net State Domestic Product at Factor Cost (current prices)

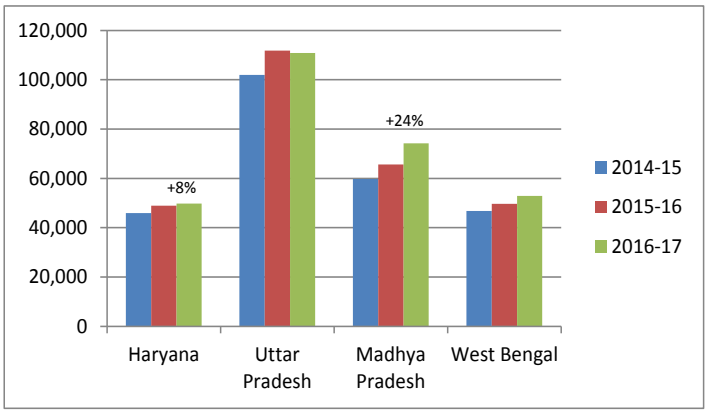
Figure 2.2-2 Per Capita Net State Domestic Product (Rs)

(3) Power ENERGY Requirement, Availability and Surplus/Deficit (MkWh) (2011-12, 2012-13, 2013-14)

Load Generation Balance Reports(LGBR) 2014-15,2015-16 and 2016-17 prepared by CEA in May, 2016 anticipate that Power ENERGY Requirement (MkWh) of the four states increase from 2014-15 to 2016-17 ranging from 8% (Haryana) to 24% (Madhya Pradesh) (Figure 2.2-3)

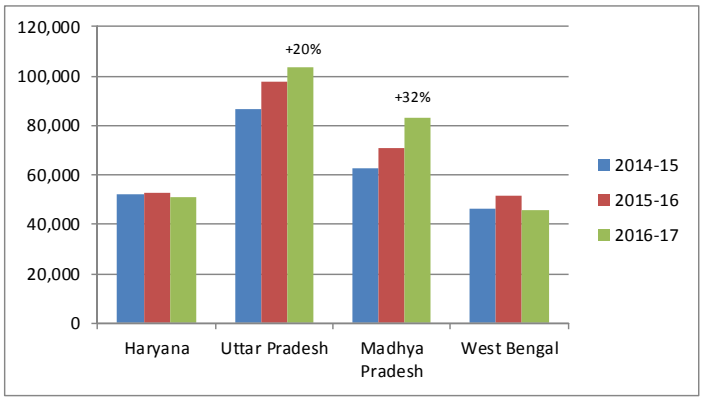
Power ENERGY Availability (MkWh) of two out of the four states are anticipated increasing from 2014-15 to 2016-17 ranging from 20% (Uttar Pradesh) to 32% (Madhya Pradesh) and decreased by 2% for the other states. (Figure 2.2-4)

There is still Power ENERGY Deficit (MkWh) of 6% and 14% in 2016-17 in Uttar Pradesh and West Bengal by approx.7,000 MkWh and approx.7,300 MkWh respectively while Power ENERGY Surplus (MkWh) is anticipated of the order of 1% in 2016-17 by approx.13,000 MkWh for all India. (Figure 2.2-5)



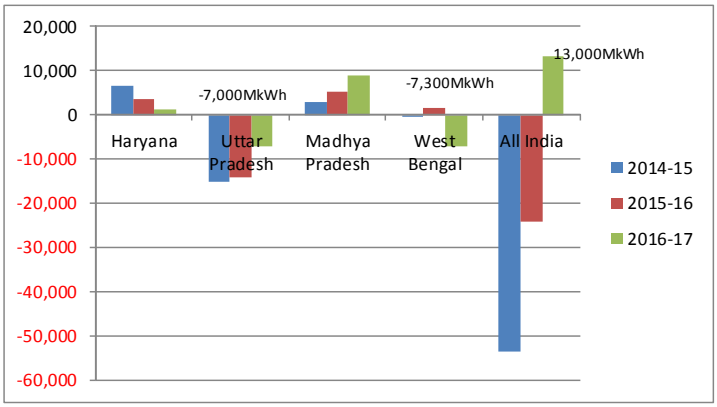
Source: LOAD GENERATION BALANCE REPORT (2014-15, 2015-16&2016-17)

Figure 2.2-3 Anticipated State-wise Power ENERGY Requirement (MkWh)



Source: LOAD GENERATION BALANCE REPORT (2014-15, 2015-16& 2016-17)

Figure 2.2-4 Anticipated State-wise Power ENERGY Availability (MkWh)



Source: LOAD GENERATION BALANCE REPORT (2014-15, 2015-16& 2016-17)

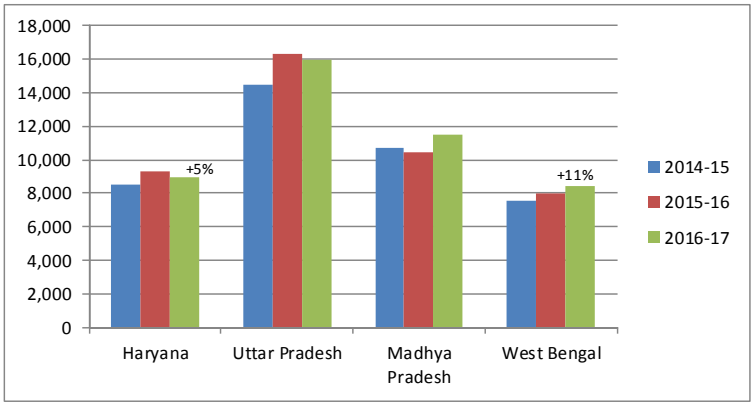
Figure 2.2-5 Anticipated State-wise Power ENERGY Surplus/Deficit (MkWh)

(4) Power PEAK Requirement, Availability and Surplus/Deficit (MW) (2011-12,2 012-13& 2013-14)

Power PEAK Requirement (MW) of the four states are anticipated increasing from 2014-15 to 2016-17 ranging from 5% (Haryana) to 11% (West Bengal) (Figure 2.2-6)

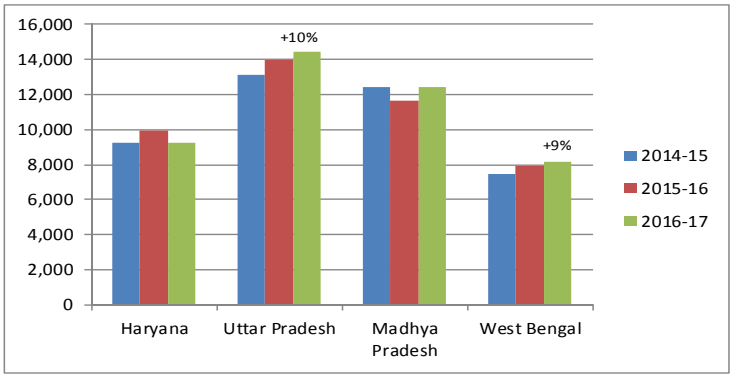
Power PEAK Availability (MW) of two out of the four states are anticipated increasing from 2014-15 to 2016-17 ranging from 9% (West Bengal) to 10% (Uttar Pradesh) and there is no change in other states. (Figure 2.2-7)

There is still Power PEAK Deficit (MW) of 10% and 4% in 2016-17 in Uttar Pradesh and West Bengal by approx.1,500 MW and approx.300 MW respectively while Power PEAK Surplus (MW) is anticipated of the order of 3% in 2016-17 by approx.4,000 MW for all India. (Figure 2.2-8)



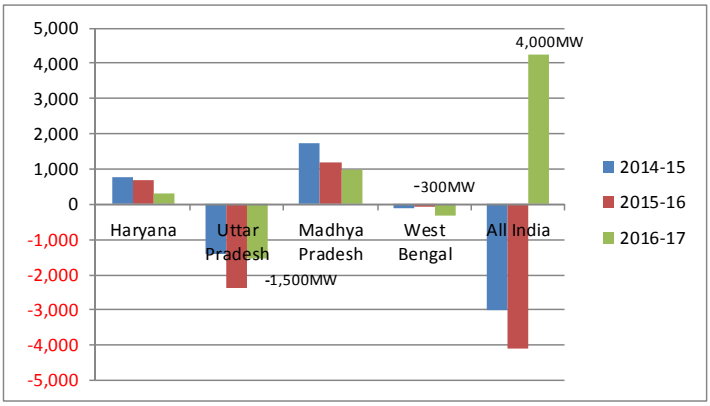
Source: LOAD GENERATION BALANCE REPORT (2014-15, 2015-16& 2016-17)

Figure 2.2-6 Anticipated State-wise Power PEAK Requirement (MW)



Source: LOAD GENERATION BALANCE REPORT (2014-15, 2015-16& 2016-17)

Figure 2.2-7 Anticipated State-wise Power PEAK Availability (MW)



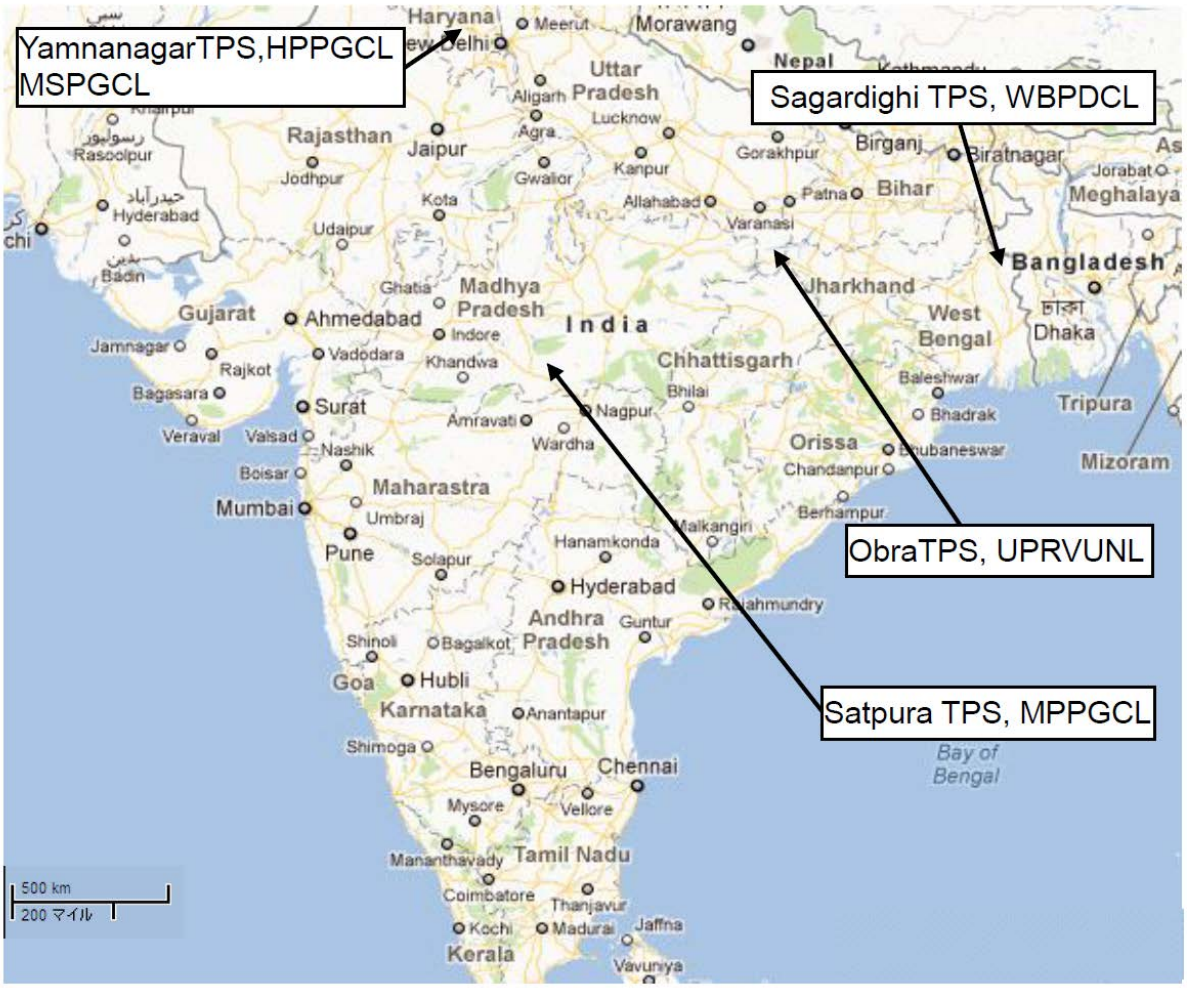
Source: LOAD GENERATION BALANCE REPORT (2014-15, 2015-16& 2016-17)

Figure 2.2-8 Anticipated State-wise Power PEAK Surplus/Deficit (MW)

CHAPTER 3

SITE SURVEY WORK

CHAPTER 3 SITE SURVEY WORK



Source: Google Map

Figure 3-1 Site Survey Locations

3.1 Site Survey Work - Phase 1 (A Group)

Site Survey Work Phase 1(for A-Group) was conducted in the period between April 18 and 23, 2016.

After preliminary selection study, JICA study team decided to focus on four (4) states (Haryana, Uttar Pradesh, Madhya Pradesh, West Bengal) to visit for field work. As first field work, JICA study team conducted following site survey.

The study team visited the head offices of UPRVUNL and HPGCL (electric utilities) to explain the purpose of JICA study and inquired about their cooperation, and then conducted the discussion on the target power stations.

After the survey on the target power companies, the study team reported to JICA in New Delhi.

The schedule of the Site Survey work phase 1 is shown in Table 3.1-1.

Table 3.1-1 Schedule of the Site Survey Work Phase 1

Itinerary for #1 Site Survey

				JICA Study Team	Remarks
Month	Day				
APR	18	Mon	Activity	Arrival at Delhi JL749 NRT(11:30) - DEL(17:35) Mr. Meguro NH0827 NRT(17:50) - DEL(00:05) Mr. Kusuda	
			Stay	Delhi	
	19	Tue	Activity	6E184 Delhi (9:05)-Lucknow(10:10) Meeting with UPRVUNL at Head Office (11:00) 6E185 Lucknow (18:30) - Delhi (19:45)	
			Stay	Delhi	
	20	Wed	Activity	Data and document arrangement work Meeting with others	
			Stay	Delhi	
	21	Thu	Activity	9W2651Delhi (9:15) - (10:25) Chandigarh Visit HPGCL-HQ Meeting with HPGCL SG2418 Chandigarh (19:20) - (20:15) Delhi	
			Stay	Delhi	
	22	Fri	Activity	Meeting with JICA (10:00) Depture Delhi to Japan JL740 Delhi (19:35) - (Mr. Meguro) NH0828 (01:25) - (Mr. Kusuda)	
			Stay	-	
	23	Sat	Activity	Arrival at Narita JL740 (07:45) Mr. Meguro Arrival at Haneda NH 0828 (13:00) Mr. Kusuda	
			Stay		

3.2 Site Survey Work - Phase 2 (B-Group)

This Site Survey work was conducted in the period between June 14th and June 24th, 2016.

The study team visited the Obra TPS of UPRVUNL to conduct preliminary feasibility study and correct site condition data. The study team also visited head office of MPPGCL and explained the purpose of JICA study and inquired about their interest of Japanese ODA.

The schedule of the Site Survey work phase 2 is shown in Table 3.2-1.

After the survey on the target power companies, the study team reported to JICA in New Delhi.

Table 3.2-1 Schedule of the Site Survey Work Phase 2

Itinerary for #2 Site Survey

				JICA Study Team	Remarks
Month	Day				
June	14	Tue	Activity	Arrival at Delhi JL749 NRT(11:30) - DEL(17:35)	
			Stay	Delhi	
	15	Wed	Activity	6E - 308 Delhi (0855) - Varanasi (1015) Varanasi to Obra P/S (Car) - 120 KM - 3.5 Hrs	
			Stay	Obra P/S	
	16	Thu	Activity	Obra P/S Site Survey	
			Stay	Obra P/S	
	17	Fri	Activity	Obra P/S Site Survey	
			Stay	Obra P/S	
	18	Sat	Activity	Obra P/S to Varanasi (Car) 6E 481 Varanasi (1500) Delhi (1625)	
			Stay	Delhi	
	19	Sun	Activity		
			Stay	Delhi	
	20	Mon	Activity	9W7164 Delhi (0940) - Bhopal (1055) Visit Secretary Energy - Meeting at (1500) 9W784 Bhopal(1850) - Delhi (2005)	
			Stay	Delhi	
	21	Tue	Activity	SG 2641 Delhi (1015)- Jabalpur (1200) Visit to MPPGCL Head Office (1500)	
			Stay	Jabalpur	
	22	Wed	Activity	SG 2642 Jabalpur (1610) - Delhi (1800)	
			Stay	Delhi	
	23	Wed	Activity	Meeting with JICA or INDURE Depture Delhi to Japan JL740 Delhi (19:35) -	
			Stay		
	24	Thurs	Activity	Arrival at Narita JL740 (07:45)	
			Stay		

Refer Day 20 – Did not travel to Bhopal but met him in Delhi

3.3 Site Survey Work - Phase 3 (C-Group)

This Site Survey work was conducted in the period between August 23rd and 30th, 2016.

The study team visited the head office of UPRVUNL to report the result of preliminary feasibility study which was conducted on Phase 2 site survey. The study team explained that the result of above study was positive and feasible from technical viewpoints.

The study team also visited head office of WBPDCL and DVC to explain the purpose of JICA study and inquired about their interest of Japanese ODA.

After the survey on the target power companies, the study team reported to JICA in New Delhi. The schedule of the field work phase 3 is shown in Table 3.3-1.

Table 3.3-1 Schedule of the Site Survey Work Phase 3

Itinerary for #3 Site Survey

				JICA Study Team	Remarks
Month	Day				
August	23	Tue	Activity	Arrival at Delhi JL749 NRT(12:30) - DEL(17:35) Mr.Meguro, NH 0827 (18:25) - DEL(00:05) Mr.Kusuda	
			Stay	Delhi	
	24	Wed	Activity	6E184 Delhi (9:05)-Lucknow(10:10) Meeting with UPRVUNL at Head Office (11:30 AM)	
			Stay	Lucknow	
	25	Thu	Activity	Lucknow (1705)-Kolkata(1935)	
			Stay	Kolkata	
	26	Fri	Activity	Meeting with DVC at Head Office (11:00) Meeting with WBPDCL at Head Office (14:00)	
			Stay	Kolkata	
	27	Sat	Activity	Mr. Meguro, Kolkata (1100) Delhi (1325)	
			Stay	Delhi	
	28	Sun	Activity	Mr. Kusuda Kolkata (02:00) BKK (06:10) BKK(07:35) Narita (15:45)	
			Stay		
	29	Mon	Activity	Meeting with JICA and INDURE Depture Delhi to Japan (Mr.Meguro) JL740 Delhi (19:35) -	
	30	Tues	Activity	Arrival at Narita JL740 (07:45)	

3.4 Site Survey Work - Phase 4 (DRAFT)

This Site Survey work was conducted in the period between October 17 and 23, 2016.

The study team found that promising project for ODA loan are Obra 'A' replacement project (UP) and Satpura replacement project (MP), therefore the study team explained the study results at the head offices of two target state electric utilities (UPRVUNL and MPPGCL). The study team followed-up their prospected projects to meet the schedule of Japanese ODA.

The schedule of the Site Survey work phase 4 is shown in Table 3.4-1.

Table 3.4-1 Schedule of the Site Survey Work Phase 4

Itinerary for #4 Site Survey

				JICA Study Team	Remarks
Month	Day				
Oct	17	Mon	Activity	Arrival at Delhi JL749 NRT(11:30) - DEL(17:35)	
			Stay	Delhi	
	18	Tue	Activity	6E184 Delhi (9:05)-Lucknow(10:10) Meeting with UPRVUNL at Head Office (12:00) 6E185 Lucknow (18:30) - Delhi (19:45)	
			Stay	Delhi	
	19	Wed	Activity	SG2641 Delhi (1015) - Jabalpur (1200) Visit Secretary Energy in the Afternoon	
			Stay	Jabalpur	
	20	Thu	Activity	Visit to MPPGCL Head Office SG 2642 Jabalpur (1610) - Delhi (1800)	
			Stay	Delhi	
	21	Fri	Activity	Delhi - Varanasi - Ghazipur - Varanasi - Delhi	
			Stay	Delhi	
	22	Sat	Activity	Meeting with Indure Depture Delhi to Japan JL740 Delhi (19:35)	
			Stay		
	23	Sun	Activity	Arrival at Narita JL740 (06:50)	
			Stay		

Day 19 – Instead of "Visit Secretary' it was Visit MPPGCL Head Office
All discussion on those meeting is attached as Attachment-1.

CHAPTER 4

THE RESULT OF SCREENING WORK

CHAPTER 4 THE RESULT OF SCREENING WORK

4.1 THE RESULT OF PRELIMINARY SELECTION STUDY IN JAPAN

The scope of this study is to collect and verify data on the Indian power sector so as to identify promising coal-fired thermal power stations which have possibility of installing new facilities and/or replacing the old & inefficient thermal power generating units by Ultra Supercritical (USC) units.

Prior to Site visit of this study, the Study Team conducted telephone interview through local partner, the following information, as well as their interest in Japanese ODA Loan, was obtained from each State Power Generation Company.

(1) Uttar Pradesh State

UPRVUNL have shown interest in Japanese ODA loan in the following priority order.

a). Obra 'A' TPS (5 × 50 MW, 3 × 100 MW)

b). Harduaganj TPS (3 × 30 MW, 2 × 50 MW, 2 × 55 MW, 2 × 60MW, 2 × 110 MW)

c). Parichha TPS (2 × 110 MW, 2 × 210 MW, 2 × 250 MW)

d). Panki TPS (2 × 32MW, 2 × 110 MW) (it may not be permitted because of location)

e). Anpara TPS (3 × 210 MW, 2 × 500 MW) (replacement not required)

(2) Maharashtra State

Regarding MAHAGENCO Nashik Replacement, Units 1 & 2 140 MW each are shutting down.

MAHAGENCO has plans to install a new 1 × 660 MW unit adjoining the existing power plant. They have not been able to get the chimney height (275 m) clearance from the Airports Authority of India (AAI) as the chimney is in the flight path of the nearby airport. MAHAGENCO has been trying to get this clearance for a couple of years.

Once the chimney height is cleared for their new project, they may look into the replacement also.

(3) Madhya Pradesh State

Madhya Pradesh Power Generating Company Ltd. (MPPGCL), Amarkantak TPS and Satpura TPS are candidate projects.

1) Amarkantak

- 2 × 30 MW – already dismantled
- 2 × 120 MW – dismantling will be taken up shortly

In place of the dismantled Amarkantak units MPPGCL is planning to install one or two units of 660 MW depending on the availability of space. Feasibility report will be

prepared shortly.

2) Satpura

- Units 1 - 5 – 5 × 62.5 MW - are under dismantling
- Unit 6 - 1 × 200 MW - likely to be decommissioned and will be dismantled
- Unit 7 - 9 – 3 × 210 MW - likely to be decommissioned and will be dismantled

In place of the dismantled Satpura units MPPGCL is planning to install two 660 MW units. Feasibility report (DPR) will be prepared shortly. (As at the end of September, the bidding process for selection of consultant was in progress)

MPPGCL is now planning to install 660 MW unit/s (replacement) at Satpura and Amarkantak for which feasibility reports will be prepared shortly. (As at the end of September, consultant selection process was in progress) MPPGCL is interested for Japanese ODA loan.

(4) Tamil Nadu State

1) Ennore

From preliminary information collected, TANGEDCO has no interest for using Japanese ODA loan. Therefore, TANGENCO is removed from the visiting list.

(5) Rajasthan State

Rajasthan: Kota TPS units, 1 & 2 (2 × 110 MW) are undergoing R&M and Units 3&4 (2 × 210 MW) are proposed for R&M. Representative from Rajasthan informed that these units are having good PLF and heat rate for these units are 2,600 to 2,700 kcal/kwh. RRVUNL intimated that MOEF & CC had not given clearance for increased chimney height due to aviation restriction in case of extension units.

As such Kota is not considered as potential site for replacement with super critical units. It was reiterated that RRVUNL should take necessary measures for heat rate improvement of these units.

(6) West Bengal State

WBPDCL mentioned that Bakreshwar (1 × 660 MW) will take another 3-4 years, however Sagardighi (1 × 660 MW) is the next priority of WBPDCL.

(7) Haryana State

HPGCL intends to install a 660 MW unit with Supercritical technology as an expansion of the existing 2 × 300 MW power plant at Yamunanagar.

A coal block at Mara-II Mahan in Singrauli district Madhya Pradesh with coal resources of about 950 MT approx, area 53 sq. km was allocated jointly to Government of NCT, Delhi (GNCTD) and

HPGCL in August 2006.

JVC of HPGCL & IPGCL (authorized by GNCTD for developing the coal block) was incorporated in the name of Yamunanagar Coal Company Private Limited (YCCPL).

The ToR, received from MoEF, to install a 660 MW / 800 MW units has also lapsed (after the initial period of 2 years). Fresh ToR will be required to proceed for MoEF clearance.

Other statutory & non-statutory clearances are also required to be taken.

After above preliminary selection study, target area was divided into four regions (Group) for field surveys.

The Study Team collected information about application needs in India for Japanese technology prior to field survey.

Group A: Uttar Pradesh State, Haryana State

Group B: Madhya Pradesh State

Group C: West Bengal State

Group D: Others (Rajasthan State, Maharashtra State, Tami Nadu State)

However, based on the information, Group D States are not interested in requests for Japanese ODA loan; therefore the study team removes these states from visiting schedule.
The Study Team narrowed down the candidate projects to promising projects through preliminary selection study in Japan.

The summary of above study is shown in Table 1.4-1.

4.2 SITE SURVEY FOR GROUP A

The Study Team conducted the first site survey in the States of Uttar Pradesh, Haryana (A- Group) which is located near New Delhi. The Study Team narrowed down the candidate projects to promising projects through interviews with the concerned State Governments/agencies/utilities following the questionnaire mentioned-above.

(1) UPRVUNL

Generally, the space of existing Obra 'A' area is available to use for the new replacement project of 1 × 660MW. Regarding coal linkage/allocation, it would not face any problem to get the coal linkage/allocation for new unit of 660 MW.

As regards water availability, the existing linkage will be sufficient and can be used for the new unit.

Regarding Ash Pond for the new unit, the land for this new project will have to be arranged, however,

land acquisition will be done as per the requirement.

The study team was asked to prepare preliminary feasibility report for UPRVUNL to proceed for further, namely preparation of Detailed Project Report (DPR).

As second site survey for UP State, the Study team conducted to prepare preliminary feasibility study report for UPRVUNL to make their decision easily in accordance with UPRVUNL's request.

(2) HPGCL

JICA study team visited HPGCL to confirm latest information and/or its progress.

HPGCL had a preliminary check done by their consultant wherein they confirmed that the land available would be sufficient for installing 1 × 800 MW with Ultra Super Critical (USC) technology.

As regards the coal linkage HPGCL have been allotted the coal block for which a Bank Guarantee of Rs. 15.5 Crores was to be given by HPGCL by 29th April 2016. HPGCL was arranging to submit the same. The agreement for coal block was signed on 30th March 2016

HPGCL had earlier planned to install a unit of 660 MW and had got environmental clearance for the same. However, now that they want to change the unit size from 660 MW to 800 MW, the terms of reference would have to be revised and fresh clearance will have to be obtained from MOEF. As regards other clearances from Airport Authority etc. those would also have to be obtained for the new unit.

The space for existing Ash Pond is sufficient; however, if the additional land is required, HPGCL will procure the same.

MOEF issued new regulation to reduce NOx & SOx & SPM for thermal power plant. To meet this regulation, Flue Gas Desulphurization (FGD) & Selective Catalyst Reduction (SCR) would also have to be installed. They have however approached the Government for getting an extension in time for installing FGD & SCR for the old units as it difficult to meet the deadline given by the Government for the old units.

4.3 SITE SURVEY FOR GROUP B

The Study Team conducted the second field survey in the States of Madhya Pradesh State (MP) (Group B) and Uttar Pradesh State for preliminary Feasibility Study of Obra 'A' replacement project for supporting the decision making process in UPRVUNL.

(1) MPPGCL

MPPGCL is planning to install 1 × 660 MW unit at Amarkantak and 2 × 660 MW at Satpura in pace of the existing old units at both the places. At Satpura the 5 × 62.5 MW units have already been dismantled.

Regarding USC (Ultra super critical) units instead of SC (Supercritical), MPPGCL agreed for the advanced technology.

Availability of water for the project is no problem and they informed that they have got allocation for the project; Coal blocks have been sanctioned for 1 × 660 MW (Satpura) plus 2 × 660 MW (Khandwa).

MPPGCL showed their keen interest and wanted to know more about the Japanese ODA loan; therefore MPPGCL wanted to know the advantages (better in what respect) of Japanese ODA loan over others like PFC and REC in order to decide that JICA is better suited to them.

4.4 SITE SURVEY FOR GROUP C

The Study Team conducted the third field survey in the States of West Bengal State (C-group).

The Study Team narrowed down the candidate projects to promising projects through interviews with the concerned State Governments/agencies/utilities.

(1) DVC (Damodar Valley Corporation)

Durgapur thermal power plant (DTP) units 1&2 (2 × 75 MW) are shutdown. Unit 3 (1 × 140 MW) was shutdown long back whereas in Chandrapur Units 4, 5 and 6 are dismantled and units 1, 2&3 (3 × 130 MW) are likely to be shut down in due course.

DVC has surplus capacity of 1,500 MW to sell. Therefore, in the present power scenario, there are no takers for the excess power.

DVC has no plans to add any more units for a few years.

DVC has no interest for Japanese ODA loan for their project.

(2) WBPDCL (West Bengal Power Development Co., Ltd.)

WBPDCL is keen on obtaining Japanese ODA loan Sagardighi (1 × 660 MW) is on priority. Bakreshwar Unit No.6 project (1 × 660 MW) will come up in the next 5 year plan. However, it is not in the rolling plan, as on date.

The DPR takes care of the new MOEF norms of installing a FGD and SCR.

For the 660 MW units, the following is available:

- Land
- Coal (own mines)
- Water allocation (total capacity 60 cusecs),
- Common facilities have already been built
- Ash disposal area

As on date WBPDCL has excess power. However the State Government (State Power Ministry) is projecting a higher demand for power in the next two years; hence they will require more power.

Considering another subject, WBPDCL is interested in using Japanese ODA loan for installation of FGD system to existing thermal power plant to clear MOEF's norm which was issued last year.

WBPDCL showed interested in installing Battery Storage system for Grid Power.

WBPDCL have seen it in the USA but there batteries were made in Japan.

4.5 RESULT OF SITE SURVEY

The Study Team conducted the study with regard to the four project sites in the States of Haryana, Uttar Pradesh, Madhya Pradesh and West Bengal States through 1st field survey to 3rd field survey.

As a result of site survey, the study team found that following projects are highly prioritized and considered feasible in each state, in terms of availability of infrastructures, water and land, and interested in using Japanese ODA finance.

(1) Obra 'A' (1 × 660MW) Replacement project (Uttar Pradesh)

(2) Satpura (2 × 660MW) Replacement project (Madhya Pradesh)

(3) Sagardigbi (1 × 660MW) Extension project (West Bengal State)

CHAPTER 5

EVALUATION OF POTENTIAL PROJECT

CHAPTER 5 EVALUATION OF POTENTIAL PROJECT

5.1 OBRA 'A' TPS REPLACEMENT PROJECT

5.1.1 Progress of the Project

UPRVNUL wants to proceed with Obra 'A' Replacement project and asked JICA Study team to support preparation of preliminary feasibility study report. (See Attachment 2&3)

The JICA study team investigated site condition in accordance with UPRVNUL's request and confirmed this project is feasible in the preliminary view point.

The following is the summary of preliminary feasibility report conducted by the JICA study team.

(1) Project Location

The project site is available after dismantling of Obra, 'A' TPS within the boundary of existing Obra TPS. It is located approx. 115 km south of Varanasi Airport as indicated in Figure 5.1.1-1. The nearest railway station is Obra Dam.

(2) Project Outline

According to UPRVUNL's record, Obra 'A' TPS consists of 5 retired units (#3, 4, 5, 6 and 8), and 3 operational units (# 1, 2 & 7) as indicated in Table 5.1.1-1.

Table 5.1.1-1 Obra 'A' Thermal Power Station

Stage	Units No.	Installed Capacity	Derated Capacity	Date of Synchronization	Date of Commercial Operation
'A' TPS	1	50 MW	50 MW	15.08.1967	15.08.1967
	2	50 MW	50 MW	12.02.1968	11.03.1968
	3	50 MW	Deleted	13.10.1968	13.10.1968
	4	50 MW	Deleted	11.06.1969	16.07.1969
	5	50 MW	Deleted	30.07.1971	30.07.1971
'A' TPS	6	100 MW	Deleted	04.10.1973	04.10.1973
	7	100 MW	94 MW	14.12.1974	14.12.1974
	8	100 MW	94 MW	15.09.1975	01.01.1976

New capacity will be 1 × 660 MW (USC's Steam Condition: 270 ata, 600/600°C.) in place of retired Obra, 'A' TPS (5 × 50 + 3 × 100 MW) area.

(3) Land for main plant & equipment

1) Land for main plant and equipment will be available after decommissioning and dismantling of Obra, 'A' TPS (5 × 50MW + 3 × 100 MW units).
2) For providing space for 400 KV switchyard, existing 220/132 kV switchyard of Obra, 'A' TPS will be dismantled and existing 5 nos.220 kV & 3 nos. 132 kV outgoing feeders bays from switchyard of Obra, 'A' TPS will be relocated.
3) On decommissioning of Obra, 'A' TPS, the CW pump House and the intake pond of Obra, 'A' TPS will become defunct. The CW pump house will be dismantled and the intake pond will be reused to provide space for the water facilities, cooling towers etc. of the proposed new unit.
4) Adequate area for coal storage and handling facilities is available. The coal feeding facilities of Obra, 'A' TPS will be dismantled to provide new coal handling system for the proposed unit.

(4) Coal supply

Obra 'A' power station mainly uses domestic coal (raw coal) available in the surrounding area, and thus has a stable supply.

UPRVUNL can use existing coal allocation for new replacement project.

Coal requirement will be about 2.99 mtpa. Coal for existing stages of the power station is received from NCL & CCL by rail system. For the proposed unit, coal linkage will be as granted by NCL/CCL. Coal will be transported by Indian Railway System.

(5) Ash dump area

For dumping of ash, the land originally provided for the Obra, 'A' TPS of the existing units has been filled up over the period and it will be used for material storage & fabrication yard. A new ash dyke area of 150 acres is being developed adjacent to the proposed 'C' TPS ash dyke.

Adequate area of ash pond shall be located at approx. 4 km from plant boundary for the proposed unit.

(6) Raw Water

Consumptive water requirement of 660 MW will be made available by pumping from Obra Dam to water treatment plant for plant water requirement.

(7) Transmission and Switchyard facilities

The generated power from the power plant switchyard will be evacuated at 400 kV voltage level, 400 kV switchyard will be provided. For power evacuation, there will be 10 nos. bays in switchyard. There will be two (2) nos. outgoing feeders to the destinations as may be identified by UPPTCL.

(8) Environmental Considerations

As per the MoEF notifications (S.O. 3305(E) dated 7th December, 2015), all new plants to be installed after 1st January, 2017 shall have to meet the following Emission Standards:

Particulate Matters :	30 mg/Nm^3
Sulphur Dioxide (SO_2) :	100 mg/Nm^3
Oxides of Nitrogen (NOx) :	100 mg/Nm^3
Mercury (Hg) :	0.03 mg/Nm^3

To control NOx emission, Ultra-supercritical boilers having advanced low NOx generation system will be installed. In addition, Selective Catalytic Reduction (SCR) system will be installed.

Wet FGD system will be provided to bring down SO_2 emission to comply with the standards now specified.

(9) Civil work (Existing Foundation & Soil Condition)

The existing Obra, 'A' TPS has no piling in existing foundation. The main plant area is generally open type foundation with maximum depth up to 8 meters.

In this area soil type is rocky based on recent Obra, 'C' TPS soil data.

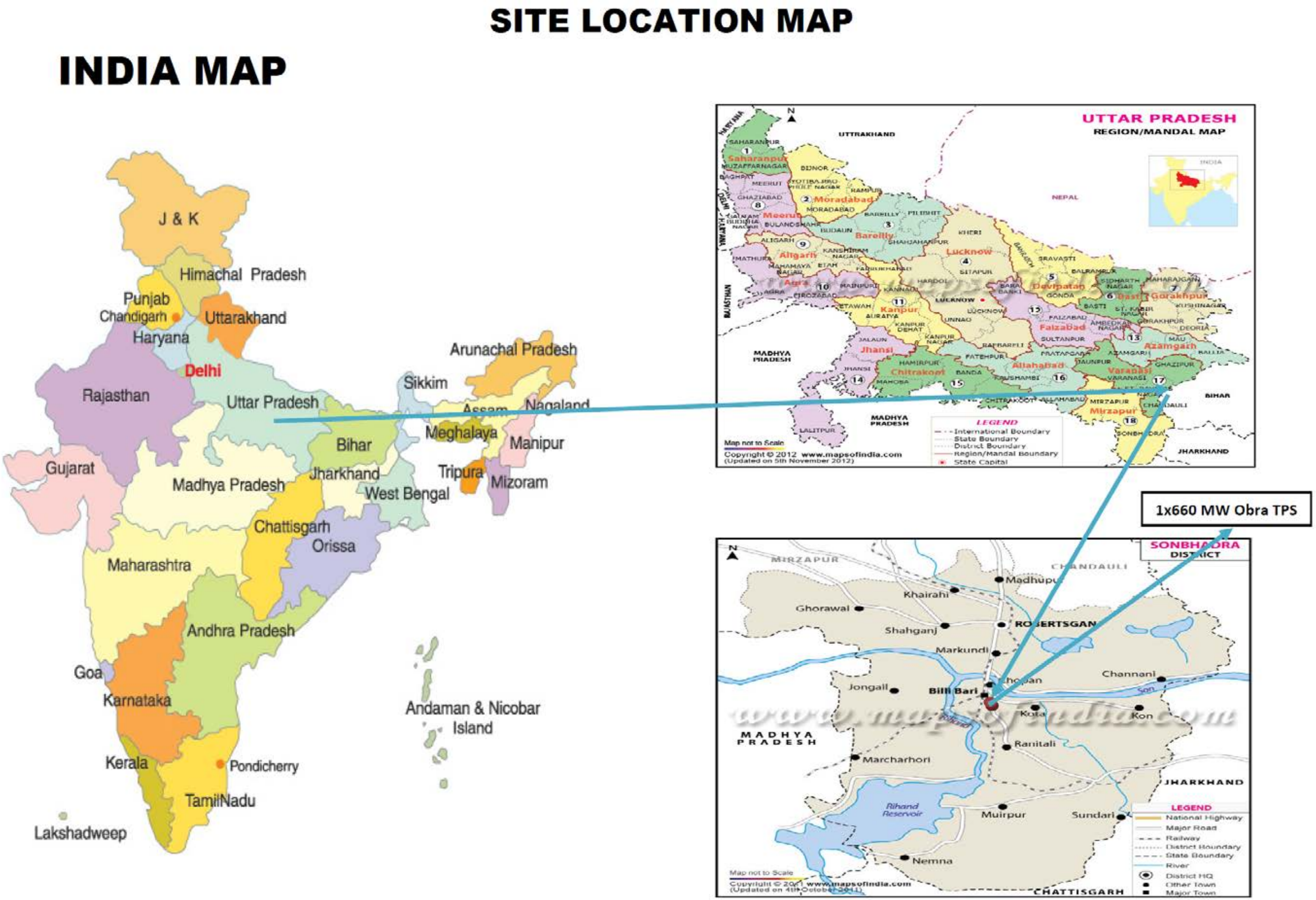


Figure 5.1.1-1 Site Location Map

5.1.2 Preliminary Feasibility Study Report

The result of Preliminary Feasibility Study is attached in this report as Attachment-3.

5.2 SATPURA TPS REPLACEMENT PROJECT (MADHYA PRADESH STATE)

5.2.1 Progress of the Project

MPPGCL is planning to install 1 × 660 MW unit at Amarkantak and 2 × 660 MW at Satpura in place of the existing old units at both the places. At Satpura the 5 × 62.5 MW units have already been dismantled.

The units at Satpura - 1 × 200 MW (Unit 6), 3 × 210 MW (Units 7, 8&9) are 35 years old and due to their high heat rate, MPPGCL will decommission these units also. The new units of 2 × 250 MW (Units 10& 11) are working in good condition.

One unit of 660 MW will be installed in place of units 1-5, and the second unit in place of units 6-9, therefore they plan to run the units 6-9 till at least the construction of the first unit of 660 MW is complete.

MPPGCL agreed for installation of USC (Ultra super critical: 270 ata, 600/600°C.) units instead of SC (Supercritical). They informed that with the new environment norms they will have to adapt latest technology and USC is welcome.

Composition of existing power station is as follows;

Table 5.2.1-1 Satpura Thermal Power Station

Stage	Unit	Rated Output (MW)	Year of Commercial Operation Year
1	1	62.5	1967
1	2	62.5	1968
1	3	62.5	1968
1	4	62.5	1968
1	5	62.5	1970
2	6	200	1979
2	7	210	1980
3	8	210	1983
3	9	210	1984
4	10	250	2013
4	11	250	2014

Source: Satpura Power Station, MPPGCL

(1) Project Location

Satpura power station (Address: Sarni, District: Betul, Madhya Pradesh, at latitude 22.111128 north and longitude 78.174591 east) is located in the southeast part in the State of Madhya Pradesh, and it

takes about six hours by car from the nearest airport, Jabalpur.

(2) Land for main plant & equipment

Satpura power station Units 1 to 5 (5 × 62.5 MW) called Power House 1 (PH-1) have already demolished, Units 6 and 7 (1 × 200 MW & 1 × 1,210 MW) called PH-2, and Units 8 and 9 (2 × 210 MW) called PH-3 are still remaining. Units 10 and 11 (2 × 250 MW) are constructed at the site adjacent to Unit 9.

(3) Coal supply

Coal blocks have been sanctioned for 1 × 660 MW (Satpura) + 2 × 660 MW (Khandwa) – Gondbehera, Ujhaini, MP near Sasan.

Other than the above, coal is coming from Western Coalfields Ltd. (WCL) coalmine at Pathakheda (by conveyor) and Penchkanal, Nagpur by road transportation. About 6-7000 MT is coming from Pathakheda coal mines by conveyor belt (3-5 km) and about 12-13,000 MT from Penchkanal, Chinchinwad near Nagpur by road transport.

(4) Ash dump area

There are two ash ponds, now under construction. One is 111 ha ash pond for PH-1, 2 and 3 and the other 130 ha for PH-4 (250 MW × 2). Bottom ash from the 660 MW unit will be dumped to the 111 ha ash pond, while fly ash is to be disposed to either the 111 ha or the 130 ha ash ponds.

The ash pond no. 1 is already full, but it will be available by building ash dyke on top of existing ash pond. The 2nd ash pond is available. Units 10 & 11 will have a separate ash pond.

(5) Raw water supply

Raw water is supplied from the Satpura reservoir located near the power station. The water taken from the reservoir is used mainly for condenser cooling, and then returned back to the reservoir. The same system is also applied to PH-2 and PH-3. PH-4 adopts the natural draft cooling tower system.

As regards water, MPPGCL informed that there is absolutely no problem and that they have got allocation for about 110 m cu.ft – the one year capacity of their reservoir. Charges for the water are one time (per year) only irrespective of how much is drawn. The catchment area is about 2,839 acres.

According to the draft DPR, the water volume to be taken from Satpura Reservoir for a 660 MW unit is approximately 1,800 m^3/hr.

(6) Transmission and Switchyard facilities

While the switchyard facilities are owned by MPPGCL, the power generation company, the

transmission lines outside of the switchyard are owned by MPPTCL, the power transmission company. Electric power from PH-1 (Power House 1) is transmitted from the 220 kV switchyard. The existing adjacent 400 kV switchyard has a tie line with the said 200 kV switchyard.

The addition of yard facilities of 400 kV and transmission lines should be investigated jointly with MPPTCL.

(7) Environmental Considerations

MOEF issued new environmental regulations in December 2015; in the case of new installation from 1st January, 2017 which are as follows:

In order to clear this figure, all new thermal power stations shall install FGD and SCR.

Table 5.2.1-2 Standards applicable for TPPs (units) to be installed from 1st January, 2017

Parameters	Limits
Particulate Matter	30 mg/Nm^3
Sulphur Dioxide (SOx)	100 mg/Nm^3
Oxides of Nitrogen (NOx)	100 mg/Nm^3
Mercury (Hg)	0.03 mg/ Nm^3

Source: MOEF's Change Notification dated 7th December 2015

(8) Civil work (Existing Foundation & Soil Condition)

Excavate and remove the concrete mats of the unit base to clear the site. The existing bearing piles in the ground will not be removed during the removal work and the layout of such bearing piles should be taken into account in the foundation design for the new unit. Nevertheless, if some existing bearing piles interfere with new piles actually in spite of prior evasion by designing, such piles should be broken down by the drilling of new piles without excavation/removal in a separate work process.

After the existing units are removed, the replacement work should be carried out according to the drawings and specifications.

5.3 SAGARDIGHI TPS REPLACEMENT PROJECT

5.3.1 Progress of the Project

(1) Project Location

TPS is located in the village Manigram in Murshidabad district of West Bengal, India. The site is about 20 km from National Highway (NH-34) and an access road is laid to connect the station with road network of the country. The nearest broad gauge (B.G.) railway station is Manigram on Bandel-Barhawara branch of Eastern Railway.

The major relevant site data of the project at Sagardighi are given below:

Location **:**	Manigram village, Sagardighi,Raghunathganj sub-division, Murshidabad District, West Bengal.
Approach Road **:**	20 km from National Highway (NH-34)
Nearest Railhead **:**	Manigram railway station on Bandel-Barhawara branch line 1 km from site.
Source of Water **:**	Bhagirathi River - 5 km
Source of Coal **:**	Pachwara (North) mine block in Jharkhand.

(2) Project Outline

The West Bengal Power Development Corporation Limited, a company fully owned by the Government of West Bengal formed in the year 1985, has commissioned 2 × 300 MW Thermal Power Plant together with all other infrastructure at Sagardighi Thermal Power Project.

Presently WBPDCL is also working on their under-construction Phase-II extension project of 2 × 500 MW at Sagardighi. The WBPDCL proposes to extend their on-going Phase-II extension project of 2 × 500 MW at Sagardighi by adding one super critical unit of 660 MW as Phase-III extension unit.

Rated steam temperature of Sagardighi Phase-III project is around 25MPa, 568°C (±5°C) and the reheater rated steam temperature is around 596°C (±5°C).

(3) Land Requirement & Availability for Phase-III Unit

The Phase-I station implemented along with the space for Phase-II &Phase-IIIUnit#5 is located within a common boundary covering an overall area of about 365 ha excluding the ash dump area, township etc. The layout in Phase-I (2 × 300 MW) and Phase-II (2 × 500 MW) was developed on the basis of ground survey and soil investigation conducted earlier keeping adequate space provision for extension of one more unit of 500 MW set (as conceived earlier).

(4) Water Requirement & Availability

The station has an allocation of 60 Cusec of raw water for Phase-II. The estimated raw water requirement for Phase-II & Phase-III station together works out around 5,068 m^3/hr (50.7 cusec). Raw water availability from the Bhagirathi River is assured and it may be summarized thus the water for the Phase-II & III units would be available from the present allocation.

(5) Fuel Requirement

Sagardighi Thermal Power Station is linked to the mines of ECL. Coal is planned to be transported in rake loads through the existing Pakur-Tildanga-Dhulian-Monigram broad gauge line or through Pakur-Nalhati (proposed)–Takipara-Gosaingram-Poradanga-Monigram broad gauge line.

Pachwara (North) Block is one of the linked mines allotted for Sagardighi Thermal Power Project. Geological reserve of the block is about 609.35MMT whereas mineable reserve of the block is estimated as 392.84 MMT.

Coal consumption for 2 × 500 MW (Phase-II) and 1 × 660 MW (Phase-III) is estimated to be around 1140 TPH in TMCR condition and 1,250 TPH in BMCR running condition.

Hence, it can be concluded that with the present selected guaranteed capacity of 2000 TPH for coal conveyor stream, coal requirement of Phase-II & III units can be met.

(6) Ash Disposal

Ash handling plant was earlier conceived as lean slurry disposal both for bottom ash (BA) and Fly ash (FA) for 3 × 500 MW i.e. for Phase-II &Phase-III combined. Accordingly the ash handling plant has been designed for Phase-II station, which can also cater the requirement of newly proposed 1 × 660 MW unit instead of 1 × 500 MW unit under Phase-III with suitable augmentation.

(7) Power Evacuation

Power generated from 660 MW extension Unit #5 would be evacuated at 400 kV level through existing lines/ new double circuit line of WBSETCL at Sagardighi TPS.

For this existing 400 kV switchyard of Phase-II will be extended to accommodate following bays:

- 1 No. Generator Transformer
- 1 No. Station Transformer
- 2 Nos. future Lines/bays

(8) Basic Information for Environmental Clearance

The area does not have any major industry or large habitation within 25 km from the proposed plant location. The background pollution level, in terms of SPM, SOx, NOx etc. of the area is expected to be well within the prescribed limits of The Central Pollution Control Board (CPCB). The major facilities of the site are more than 500 m away from any of the River Flood Plain / State & National Highway/Railway Line.

Project authority need to institute a separate study on Environmental Impact Assessment (EIA) to identify the effect of the project on the surrounding environment. As such the plot identified for the project does not involve any eviction and thus no rehabilitation would be necessary. Thus, no adverse economic impact is foreseen.

The proposed power station would be equipped with state-of-the-art pollution control devices to bring down the emission/discharge of pollutants within the acceptable norms of the country.

To control NOx emission, Ultra-supercritical boilers having advanced low NOx generation system

will be installed. In addition, Selective Catalytic Reduction (SCR) system will be installed.

Wet FGD system will be provided to bring down SO_2 emission to comply with the standards now specified.

CHAPTER 6

CONCLUSION

CHAPTER 6 CONCLUSION

6.1 SURVEY RESULTS

Site selection is one of the most significant decisions in basic planning of coal-fired power station, as it is related based on environmental acceptance and availability of land, fuel, water, transmission lines, and ash disposal area. Potential projects were selected based on the above mentioned principles as below.

(1) Replacement of Obra 'A' Power Station to a new 660 MW unit (Uttar Pradesh State)

UPRVUNL informed the study team that it would prepare Detailed Project Report (DPR) based on the outcome of Pre-Feasibility Report which the study team has prepared.

According to the Pre-Feasibility Report, UPRVUNL has confirmed the land required for construction of new 660MW unit. No substantial concerns are envisaged for coal and water supplies as they have existing facility and resources.

Further, since firm rock bed rests under the existing plant site, foundation piling will not be necessary as it had not been the case for the existing plant foundation, which helps quoting foundation cost with better accuracy. In view of environmental social aspect, no critical issues such as relocation of local residents are envisaged.

For Yen-loan funding arrangements, UPRVUNL needs to take necessary action in a timely manner as the implementing agency.

(2) Replacement of Satpura TPS to 2 × 660 MW (Madhya Pradesh State)

MPPGCL showed keen interest in the study team a Japanese Yen Loan funding for replacement of Satpura Power Station and discussed with them the procedures required for such funding and technical tasks. For Satpura's replacement, MPPGCL has already secured coal supply from existing adjacent coal mine, water supply and land required for ash disposal. No major issues of environmental social aspect are envisaged.

MPPGCL has started demolishing the existing Satpura plant and planned to complete the work by November 2017. They have also contracted out the work of new DPR, which shall be revised from the old DPR with single 660 MW units. They are currently preparing EIA Study tender.

For the forthcoming procedures, MPPGCL needs to appeal its progress of their planning and discuss the matter with the central government, in order to expedite the loan arrangement.

(3) Extension of 660 MW unit at Sagardighi TPS (West Bengal State)

WBPDCL has already finalized the DPR for construction of Sagardighi unit no. 5 (phase-III), Ultra Super-critical 660 MW unit. Further to Sagardighi's existing common facility being designed for

potential extension, WBPDCL has secured land, coal supply and cooling water supply, required for the new 660 MW unit. Although this project has not been listed in JICA's candidate Yen-loan Projects, WBPDCL has indicated their keen interest in Yen Loan application and funding

WBPDCL needs to coordinate the priority within the state in requesting Yen-loan, especially with precedent Turuga PSPP (Pumped Storage Power Project).

6.2 FORTHCOMING ISSUES (COMMON)

(1) Requirements of Yen-loan funding include adoption of Ultra Super-critical thermal power equipment as per Japanese Government policy. Such adoption is agreed with and corresponding the needs of the State Electricity Boards. However, proper setup of pre-qualification requirements for EPC bidders shall be established.

(2) Switch-yard connection of transmission lines falls under the scope of transmission company. Planning of such inter-connection shall be discussed in detail among the relevant parties.

Taking into consideration the above mentioned issues, the status of each project shall be monitored.

ATTACHMENT – 1

MINUTE OF MEETING

Attachment – 1

Minute of Meeting

April 20, 2016

Subject: **UPRVUNL - Replacement Units**

A meeting was held between J Power & UP Rajya Vidyut Utpadan Nigam Limited (UPRVUNL) at Lucknow on 19th April 2016

The following were present:

J POWER	**UPRVUNL**
1. Mr. K. Meguro	1. Mr. Rakesh Trivedi, Director
2. Mr. T. Kusuda	2. Mr. Bidya Sagar Tiwari, Director
3. Mr. Rakesh Bhargava (**INDURE**)	3. Mr. S. Chakravorty, Chief Engineer
	4. Mr. B.N. Srivastava, Chief Engineer
	5. Mr. Ashok Saxena, Supdt.Engineer
	6. Mr. Anurag Bajpai, Supdt.Engineer
	7. Other Engineers

- Mr. Kusuda gave a general introduction about the activities of J Power and their interest for replacement projects (Obra, Panki, Parichha, Harduaganj) in Uttar Pradesh.

- JICA had, earlier in the 2012, prepared a report for the replacement unit for Obra 'A' TPS (5 × 50 MW + 3 × 100 MW) wherein it was suggested to replace Unit 1 to 8 by a single unit of 660 MW.

- It was agreed to concentrate on Obra 'A' TPS replacement units, as the first project, hence discussions were limited to this power plant.

- It was generally informed by UPRVUNL that the space available in Obra 'A' would be sufficient for the replacement unit of 1 × 660 MW. This aspect would however have to be studied from the available plot plan which will be given by UPRVUNL.

- On a query from J Power regarding coal linkage/allocation UPRVUNL informed that they would not face any problem to get the coal linkage/allocation for new unit of 660 MW.

- As regards water availability, UPRVUNL informed that the existing linkage will be sufficient and can be used for the new unit.

- Regarding Ash Pond for the new unit UPRVUNL informed that the land for this will have to be arranged, however, land acquisition will be done as per the requirements.

- With regard to JICA report which was conducted in year 2012, UPRVUNL showed their concern regarding high cost and high time for putting into operation for the new unit. The Director (Technical) informed that the cost indicated by JICA was earlier approx. Rs. 12 crores per MW. However, as per the JICA report under Clause 6 – Budgetary Scale, the cost shown was Rs. 3,498 Crores i.e. Rs. 5.3 Crores per MW to which UPRVUNL agreed that this is reasonable.

- Under Clause 3 of JICA report the financial situation of UPRVUNL shown as a cumulative loss of Rs. 454 Crores, was highlighted to UPRVUNL, however, they informed that at present there are no losses.

- UPRVUNL informed that considering replacement unit, J Power should consider to squeeze the time and price as far as practicable considering that there is a general reduction in EPC prices for the new units for which UPRVUNL has received bids.

- UPRVUNL are at present installing the following 660 MW power plants for which the bids have been received/or will be received in due course:

  - 1×660 MW Harduaganj
  - 2×660 MW Obra
  - 1×660 MW Panki
  - 2×660 MW Jawaharpur
  - 2×660 MW Karchhana

- Regarding demolition of the foundation unit 1 to 8, J Power suggested that this could be done by UPRVUNL, however, UPRVUNL informed that this can be discussed later. However the price for demolishing should be taken into account in the feasibility report.

- For preparing the feasibility report J Power suggested that this can be got done by UPRVUNL at their cost however, UPRVUNL informed that J Power should arrange for this preliminary feasibility report through JICA or any other source.

- J Power agreed to discuss this with JICA in the proposed meeting on 22nd April 2016.

- UPRVUNL informed that once the report is prepared and they find the installation of new unit feasible at Obra 'A' then they will take-up the issue with Board of Directors considering the use of existing land and resources and if prices are comparable with new green field project.

- J Power was also informed that because of a new norms given by MoEF, Flue Gas Desulphurisation (FGD) & Selective Catalyst Reduction (SCR) would also have to be installed and the same will have to be taken into account in the feasibility report.

- On query from UPRVUNL, J Power informed that it would take approximately 36 months to install a new unit after demolishing the old units.

- J Power wanted to know whether the drawings for the foundations are available with UPRVUNL. UPRVUNL informed that drawings are not available with them.

- To proceed further it was agreed that J Power will talk to JICA for preparation of preliminary feasibility report and on submission of feasibility report to UPRVUNL, UPRVUNL will take up the issue with Board of Directors. In case it is found economically feasible then a Detailed Project Report (DPR) will be prepared and the same will be taken up at Government level to request for funding from JICA.

- UPRVUNL informed that the feasibility report should also include the cost related to dismantling the foundation and compacting the ground.

- The transmission voltage to be considered for 660 MW shall be 676 kV and the cost up to the switchyard is to be considered in the feasibility report.

- UPRVUNL also informed that the existing transmission line would not be sufficient for 660 MW and they will have to consider installing a new transmission line.

- After the meeting with Mr. Trivedi, we met Mr. A K Agrawal, Director (Finance). General discussions were held with him who informed that they are getting funds from Rural Electrification Corporation (REC) & Power Finance Corporation (PFC) at an interest rate of about 11% without any foreign exchange variation. In case of JICA funding, foreign exchange variation will also have to be considered.

- For the Ghatampur project the funding has been arranged from State Bank of India (SBI). In the Ghatampur project Neyveli Lignite Corporation (NLC) owns 51% share and UPRVUNL owns 49% share.

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April 22, 2016

Subject: **Yamunanagar TPS New Unit of 1 × 800 MW**

A meeting was held between J Power & Haryana Power Generation Corporation Limited (HPPGCL) at Chandigarh on 21st April 2016

The following were present:

J POWER	**HPPGCL**
1. Mr. K. Meguro	1. Mr. A.K. Sood, Director (Generation)
2. Mr. T. Kusuda	2. Mr. S.K. Khungar, CE (Planning)
3. Mr. Rakesh Bhargava (INDURE)	3. Mr. Sunil Sharma, SE (Planning)
4. Mr. Yogesh Sharma (INDURE)	4. Mr. Ashok Kumar, EE (Planning)
	5. Mr. B.B. Gupta, Controller (Finance)
	6. Mr. A.K. Dua, SE (O&M), Panipat

- J Power gave a general introduction about the activities of J Power and their interest in setting up a new unit of 1 × 800 MW at Yamunanagar with JICA funding.

- At the onset Mr. B.B. Gupta mentioned that they have been talking into JICA for funding of the subject project.

- It was clarified to HPPGCL that JICA is interested in funding the subject project and funds are available with JICA. JICA had requested J Power to visit HPPGCL in connection with the above project to get the latest information with regard to the project including coal linkage, water availability, airport clearance, land availability, environmental clearance etc.

- Based on the discussion with JICA, J Power had planned their visit to HPPGCL.

- J Power also informed that the deadline of JICA to arrange funding is Autumn 2016, hence, the urgency to get the data from HPPGCL.

- J Power informed HPPGCL that they would be meeting JICA on Friday, 22nd April 2016 wherein this project would also be discussed. All relevant documents with regard to clearances etc. would be shown to JICA.

- HPPGCL informed that they have been allotted a new coal block at ‘’Kalyanpur”, in Jhakhand State exclusively for the 3rd unit of 1 × 660 MW/1 × 800 MW. The capacity of this unit is yet to be finalised as it depends on obtaining the required clearances and economic feasibility.

- HPPGCL informed that they had a preliminary check done by their consultant M/s Tata Consulting Engineers (TCE) wherein they confirmed that the land available would be sufficient for installing 1 × 800 MW unit.

- HPPGCL had earlier planned to install a unit of 660 MW and had got environmental clearance for the same. However, now that they want to change the unit size from 660 MW to 800 MW, the terms of reference would have to be revised and fresh clearance will have to be obtained from MOEF. As regards other clearances from Airport Authority etc. those would also have to be obtained for the new unit.

- Airport Authority has already given clearance for the chimney height of 275 meter and the same height would be applicable for the 800 MW unit. Fresh clearance would however be required.

- As regards the coal linkage HPPGCL have been allotted the coal block for which a Bank Guarantee of Rs. 15.5 Crores has to be given by HPPGCL by 29th April 2016. HPPGCL is arranging to submit the same. The agreement for coal block was signed on 30th March 2016

- HPPGCL informed that while planning for 800 MW unit they would be interested in Ultra Super Critical (USC) technology.

- The environmental clearance for their coal mine is also to be obtained and only after obtaining Stage-I clearance for the coal mine, they will be in a position to proceed for environment clearance for the power plant.

- J Power informed that a new Detailed Project Report (DPR) would be required. HPPGCL informed that they have already floated 'Notice Inviting Tender (NIT)' for preparing the DPR and they will proceed for preparing the project report.

- The transmission of power for 660 MW unit was planned at 220 kV whereas for the 800 MW unit it would be 400 kV. The new transmission line would have to be erected. Haryana Vidyut Prasaran Nigam Limited (HVPNL) will take up the work of new transmission line once it has been decided to install 800 MW as against 660 MW.

- The decision for installing a 800 MW unit would be taken up by the Government after they find that this size would be economical.

- As per HPPGCL the space for existing Ash Pond will be sufficient, however, in case more land is required then they will procure the same. In this context HPPGCL informed that Lapra Village has given an understanding that they will give the additional land for the Ash Pond.

- HPPGCL also informed that it would take about 48 – 60 months (April 2016 to April 2021) to install a power plant after receiving Stage-I clearance for the coal mine.

It would take three months for preparing a DPR after the order is placed for the same.

- HPPGCL informed that as per the environmental norms Flue Gas Desulphurisation (FGD) & Selective Catalyst Reduction (SCR) would also have to be installed. They have however approached the Government for getting an extension in time for installing FGD & SCR for the old units as it difficult to meet the deadline given by the Government for the old units.

- HPPGCL also informed their intention to use Petcoke with the calorific value of approximately 8,500 kcal/Kwh with sulphur contents of about 5% and wanted to know whether CFBC boiler would be available in the range of 800 MW.

- J Power informed that they have installed FGD & SCR for 1,000 MW units.

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June 20, 2016

MPPGCL

1. Mr. I C P Keshari, Principal Secretary, MP Government

J Power

1. Mr. M Sakurai
2. Mr. K Meguro
3. Rakesh Bhargava - Indure

Subject : Replacement Units of MPPGCL – Satpura and Amarkantak

A meeting was held on Monday, June 20, 2016 at New Delhi. The meeting originally to be held in Bhopal was cancelled as Mr. Keshari had to come to New Delhi for another meeting. Mr. Keshari agreed to meet J Power in New Delhi.

The following was discussed.

J Power gave a brief introduction about their company and the purpose of this meeting. Mr. Keshari informed that he is fully aware about JICA as MPTRANSCO has recently got a loan from JICA.

Mr. Keshari informed that MPPGCL is planning to install 1 $\times$ 660 MW unit at Amarkantak and 2 $\times$ 660 MW at Satpura in pace of the existing old units at both the places. At Satpura the 5 $\times$ 62.5 MW units have already been dismantled.

He wanted a concept note giving the timeline for installing the replacement units.

J Power asked Mr. Keshari's views on installation of USC (Ultra super critical) units instead of SC (Supercritical). Mr Keshari agreed for the advanced technology and requested J Power to give a techno economic comparison between USC and SC considering Indian coal, which would be available for the two power plants. They would like to know the advantages of USC over SC before taking a decision.

Mr. Keshari informed that a project report would be prepared by MPPGCL and can be given to J Power for them to take up with JICA.

June 21, 2016

MPPGCL

1. Mr. A P Bhairve, MD
2. Mr. Manjeet Singh, Director (Commercial)
3. Mr. A K Tailor, Director (Technical)

J Power

1. Mr. M Sakurai
2. Mr. K Meguro
3. Rakesh Bhargava - Indure

Subject : Replacement Units of MPPGCL – Satpura and Amarkantak

A meeting was held on Tuesday June 21, 2016 at MPPGCL's office at Jabalpur.
We first met Mr. Manjeet Singh with whom we had detailed discussions and then he took us to meet Mr. Bhairve and Mr. Tailor

The following was discussed:

J Power gave a brief introduction about their company and the purpose of this meeting.

Mr. Manjeet Singh informed that MPPGCL is planning to install 1 × 660 MW unit at Amarkantak and 2 × 660 MW at Satpura in pace of the existing old units at both the places. At Satpura the 5 × 62.5 MW units have already been dismantled.

The units at Satpura - 1 × 200 MW (Unit 6), 3 × 210 MW (Units 7,8,9) are 35 years old and due to their high heat rate, MPPGCL will decommission these units also. The new units of 2 × 250 MW (Units 10, 11) are working in good condition.

Coal is coming from Western Coalfields Ltd. (WCL) coalmine at Pathakheda (by conveyor) and Penchkanal, Nagpur by road transportation. About 6 – 7000 MT is coming from Pathakheda coal mines by conveyor belt (3 – 5 km) and about 12 – 13,000 MT from Penchkanal, Chinchinwad near Nagpur by road transport.

A PPA is signed with MP Power Management Company (MPPMC) and any replacement of units is covered under the PPA, without open bidding.

There was a plan (with NTPC) to renovate the old units (4 nos) but due to liquidity constraints this fell through. MPPGCL has issued a termination letter to NTPC.

Satpura – The ash pond no. 1 is full. The 2nd ash pond is available. Units 10&11 have a separate ash pond.

As MPPGCL would not like to give up the coal allocation, they plan to run the units – 6 – 9, till the time they can even if they are not performing well and also during the construction stage of the new replacement units of 2 × 660 MW.

One unit of 660 MW will be installed in place of units 1-5, and the second unit in place of units 6-9, therefore they plan to run the units 6-9 till atleast the construction of the first unit of 660 MW is complete.

J Power asked Mr. Singh's views on installation of USC (Ultra super critical) units instead of SC (Supercritical). Mr Singh informed that with the new environment norms they will have to adapt latest technology and USC is welcome.

As regards water, MPPGCL informed that there is absolutely no problem and that they have got allocation for about 110 m cu.ft – the one year capacity of their reservoir. Charges for the water are one time (per year) only irrespective of how much is drawn. The catchment area is about 2839 acres.

Coal blocks have been sanctioned for 1 × 660 MW (Satpura) + 2 × 660 MW (Khandwa) – Gondbehera, Ujhaini, MP near Sasan.

The manpower at present is about 2.2 /MW but now they plan to reduce the same to 0.6/MW with the installation of new more efficient 660 MW units.

The existing man power (after 7 years) at the time the new unit of 660 MW comes into operation will also be re-deployed for the new unit.

MPPGCL posted a profit of Rs. 95 cr in FY 2015 – 16, and is profit is projected at Rs. 300 cr for the FY 2016 – 17. This does not take care of the accumulated losses of Rs. 3,000 cr of which Rs. 700 cr is on account of pension. MPPGCL is now financially sound except for the accumulated losses. The old losses may continue for 5/6 years.

J Power informed that the ODA loan will be Government to Government. The present rate is less than 4%. The loan is for the total project cost (excluding land).

Mr. Singh wanted to know the advantages (better in what respect) of JICA loan over others like PFC and REC in order to decide that JICA is better suited to them.

MPPGCL showed their keen interest and wanted to know the following:

a. MPPGCL wanted to know JICA's criteria for evaluating a company's eligibility for their loan as they would have limited funds.
b. Is there any evaluation format that can be made available to MPPGCL?
c. Is it based on Project financing or Balance sheet financing?
d. Financials of the project / company?
e. Does the interest rate include hedging for foreign exchange?
f. What is the tenure of the loan?
g. What is the moratorium period and the repayment period?

h. What is the approximate time required for approving this loan?

The approx. time line for the new unit is as under:

a. One year for arranging the loan
b. One to One and a half years for placing the order on ICB route
c. Four and a half years for the erection and commissioning.
d. A total of about 7 years for the commissioning of the unit.

This in effect gives MPPGCL sufficient time to run and the later decommission the units 6-9 at Satpura.

J Power informed that the ODA loan will be Government to Government. The present rate is less than 4% (which will be confirmed). The loan is for the total project cost (excluding land). The moratorium period is 10 years and the repayment period is 15 years. Government of India guarantee will be required. The loan amount is approx. 80 – 85% of the EPC project cost.

On a query from MPPGCL, J Power informed that the bidding for the project would be on ICB basis based on the specifications prepared by them.

J Power informed that for them to consider the project viable, they would require, a project report, EIA study and a letter of intention to avail the JICA loan.

J Power informed that this visit is a preliminary visit to identify projects which can be considered for loan and they have initially identified Obra (UP) and Yamunanagar (Haryana) for further investigation.

Amarkantak – The old units of 1 $\times$ 20 MW and 1 $\times$ 30 MW have already been decommissioned, whereas 2 $\times$ 120 MW units have recently been retired.

After the meeting with Mr. Manjeet Singh, he took us to meet the MD and Dir(T). Mr. Manjeet Singh briefed MD and Dir (T) about the discussions held with him for Satpura and Amarkantak, adding that J Power is looking at 4 States – UP, Haryana, MP and WB.

MPPGCL informed that they can provide all details to J Power / JICA as and when required. The project reports for Satpura an Amarkantak will be prepared in about three months. EIA work would also be taken up for these two projects.

June 23, 2016

Haryana – Yamunanagar Power Project

A meeting was held in Panchkula in April 2016 to discuss the above project.

HPPGCL informally informed that as on date the work for preparation of a Project report has not been awarded and various decisions for taking up this project are yet to be taken.

Meetings - August 2016

August 24, 2016 – UPRVUNL, Lucknow

UPRVUNL

1. Mr. B S Tewari, Dir(T)
2. Mr. Rakesh Trivedi, Dir(P)
3. Mr. Ashok Rathi, CE, O&M

J POWER

1. Mr. K Meguro
2. Mr. T Kusuda
3. Mr. Chandan Mishra (Indure)
4. Rakesh Bhargava (Indure)

The following points were discussed:

1. Copies of the pre-feasibility report, prepared by JPower / Indure for replacement of units 1-8 at Obra 'A' Power Station, by 1 × 660 MW USC unit, was handed over to UPRVUNL.
2. The plot plan for installation of a new Ultra Super Critical (USC) unit of 660 MW was discussed at length.
3. UPRVUNL wanted to know if two units of 660 / 800 MW could be installed in the existing space.
4. It was explained to them that with the constraints at site, wherein the proposed site is surrounded by the Marshalling Yard, Railway tracks, Coal handling Plant, water canal, transmission lines etc, there is not enough space to install two units of 660 / 800 MW units.
5. Various options of relocating the cooling tower, water system and other BOP auxiliaries were discussed but it was explained to them that due to the existing facilities at site which are required for Obra 'B' 5 × 200 MW units, it was not practically possible to accommodate 2 units with all the auxiliaries in the existing space available.
6. It is practical to relocate the existing facilities required for running the Obra 'B' Power Station.
7. In case this relocation aspect is to be considered then the cost would shoot up drastically making the project unviable.
8. Constraints of availability of land already in possession of UPRVUNL were also discussed.

9. UPRVUNL informed that unit no. 7 (100 MW) is under-going renovation and as such, would not be available for dismantling, immediately.
10. It was informed to them that the installation of a new unit would take a few years and by then unit no. 7 could also be considered as obsolete. In any case as per the CEA report, it was also suggested to dismantle the old units 1 – 8 of Obra 'A' power station.
11. After deliberations it was unanimously agreed that installation of one unit of 660 / 800 MW is practical at the available site. The unit size can be decided in due course.
12. UPRVUNL informed that they will put up this proposal in the meeting of the Board of Directors (BOD) which is to be held at the end of this month, in order to get a formal approval from the Chairman, UPRVUNL, before proceeding further.
13. J Power informed them that a DPR and EIA report will be required by JICA for considering the financing of the Obra replacement unit to which UPRVUNL informed that after getting their Board 's approval, they will get the DPR prepared and get an EIA study conducted.
14. During discussions it was also informed to them that MPPGCL, Jabalpur has already gone ahead by placing an order on DESEIN for preparing the DPR for Amarkantak TPS. The tender for preparing a DPR for Satpura TPS has also been floated.
15. Director (Projects) of UPRVUNL advised the CE (R&M) to prepare a note, within three days, for the BOD, in association with CE (PPMM).

August 26, 2016 – DVC, Kolkata

DVC

1. Mr. Andrew W K Langstieh, IA&AS
2. Mr. Pulak Datta, ED (Projects)

J POWER

1. Mr. K Meguro
2. Mr. T Kusuda
3. Rakesh Bhargava (Indure)

The following points were discussed:

1. J Power gave a brief introduction about their company and informed DVC the purpose of their visit.

   DVC informed:

2. DVC informed that in Durgapur units 1&2 (2 × 75 MW) are shutdown. Unit 3 (1 × 140 MW) was shutdown long back whereas in Chandrapur Units 4, 5, 6 are dismantled and units 1, 2&3 (3 × 130 MW) are likely to be shutdown in due course.
3. DVC has surplus capacity of 1,500 MW to sell.
4. In the present power scenario, there are no takers for the excess power.
5. DVC has no plans to add any more units for a few years.
6. The FGD installation will cost around Rs. 1.5 cr/MW. Instead of cheaper power, this will increase the cost of power.
7. They plan to consolidate the existing setup, and will not be investing in new projects.
8. DSP Unit no. 4 is to be retired. Any renovation will not be economical.

DVC did not show any interest in investing in new power plants, hence were not interested to talk about JICA loan.

August 26, 2016 – WBPDCL, Kolkata

WBPDCL

1. Mr. Santanu Basu, IAS, CMD
2. Mr. Debkumar Gupta, Dir (F&A)
3. Mr. Indranil Dutta, ED (Proj. & Plg.)

J POWER

1. Mr. K Meguro
2. Mr. T Kusuda
3. Rakesh Bhargava (Indure)

The following points were discussed:

1. J Power gave a brief introduction about their company and informed WBPDCL the purpose of their visit.

   WBPDCL informed:

A. Sagardighi / Bakreshwar – 660 MW unit

2. WBPDCL informed that they are interested to install 1 × 660 MW at Sagardighi on priority.
3. Bakeshwar unit of 1 × 660 MW is not on priority. It will come up in the next 5 year plan. It is not in the rolling plan, as on date.
4. Sagardighi – TOR has been given by MOEF for 660 MW unit. Earlier the TOR was for a 500 MW unit but it was changed to 660 MW unit. DPR has also been prepared for 660 MW. A copy of the DPR was given to J Power.
5. Debt portion will be Rs. 3,500 cr. 70% financing will be required. Equity of about Rs. 770 cr. Will be provided by State Government.
6. WBPDCL is already in touch with JICA representative – Ms. Aditi Puri – and clarifications to their queries have also been replied to by WBPDCL. A copy of the correspondence between JICA and WBPDCL was given to J Power.
7. The DPR takes care of the new MOEF norms of installing a FGD and SCR.
8. The project cost, as per the DPR is Rs. 3,695 cr for the 660 MW unit, i.e. Rs. 5.6 cr /MW. (JY 9.52cr/MW)

9. The rate of JICA loan is about 0.15 – 0.2% (rate taken from Kolaghat project), and the hedging charges are about 7.5%, say the total interest rate would be about 8 %, which is far lower than PFC (11.5%) and SBI (10.2%).
10. Six mines have been allotted to WBPDCL for coal mining out of which 4 MDO (Mine Development & Operator) have been selected. Two mines will start operating from January 2017. The total capacity is about 500 mMT. The lease period of the mines is about 30 years.
11. The first 500 MW unit was commissioned in November 2015, the second unit is expected to be commissioned soon. The capacity of the third unit of 500 MW has been changed to 660 MW.
12. For the 660 MW unit - the following is available:
    i. Land
    ii. Coal (own mines)
    iii. Water allocation (total capacity 60 cusecs),
    iv. Common facilities have been already built
    v. Ash disposal area
13. As on date WBPDCL has excess power. The State Government (State Power Ministry) is projecting a higher demand for power in the next two years, hence they will require more power.
14. The pumped storage projects are under WBSDCL – WB State Distributing Company Limited.
15. WBPDCL was keen on obtaining JICA loan for Sagardighi.

B. Kolaghat – Units 1, 2, &3

1. FGD is to be installed in Unit no. 3 first.
2. They are in touch with JICA for this project – with Ms. Aditi Puri.

C. Battery Storage system for Grid Power

1. Mr. Santanu Basu, CMD – showed interest in installing 10 – 15 MW storage capacity for each power station.
2. They have seen Battery Storage for Grid Power in USA. This helps in plant load to be stable. Technology is available with USA. AES has installed one such unit in USA.
3. The batteries for this unit are made in Japan.
4. CMD wanted to know whether this technology is available in Japan and wanted to discuss this further. Financing for this can also be discussed from Japan (JICA).

5. 85% recovery within 12 hrs.
6. CMD was interested to discuss Technology and Financing from Japan & JICA respectively.

October 20, 2016

UPRVUNL

– Meeting held on 18/10/2016 in Indure's office, New Delhi
– The following were present:

J Power	UPRVUNL	Indure
Mr. M Sakurai	Mr. B S Tewari Dir(T)	Mr. N P Gupta
Mr. K Meguro	Mr. R K Trivedi	Mr. Chandan Mishra
	Mr. S Chakravarty	Rakesh Bhargava

1. The Preliminary Feasibility Report was given to UPRVUNL in August.
2. J Power explained the procedure for obtaining the Japanese ODA loan and gave them a flow chart. JPOWER identified the work that has to be carried out by UPRVUNL before JICA can take it up at their end. It would be a Government (Japan) to Government (India) loan.
3. UPRVUNL has not yet put up the case in their Board for getting an official approval to proceed with the project, even though the case has been discussed with the Board members informally and they have approved of it.
4. They expect to do so in the next Board meeting expected in November.
5. They are very keen for this project.
6. During discussions on the layout UPRVUNL suggested to consider 2 × 660 MW units as against 1 × 660 MW by using the space of Units 6, 7 & 8.
7. UPRVUNL requested J Power / Indure to look into in this aspect and plan a trip to Obra wherein Director (Technical) would also like to accompany.
8. UPRVUNL, internally has to decide and nominate a Chief Engineer for this work. Mr Tewari advised that Mr. Rathi CE will be the co-ordinator.
9. Mr. Tewari promised to move fast on this.

October 19, 2016

MPPGCL

– Meeting held on 19/10/2016 in MPPGCL's office, Jabalpur
– The following were present:

J Power	MPPGCL	Indure
Mr. M Sakurai	Mr. A P Bhairve MD	Rakesh Bhargava
Mr. K Meguro	Mr. A K Tailor Dir (T)	
	Mr. Manjeet Singh Dir(C)	
	Mr. H S Namdeo CE	
	Mr. Saxena Addl. CE	

1. First the meeting was held with Mr. Manjeet Singh, Mr. Namdeo and Mr. Saxena. After this meeting, the meeting was held with MD to apprise him of the developments.
2. J Power explained the procedure for obtaining the Japanese ODA loan and gave them a flow chart. JPOWER identified the work that has to be carried out by MPPGCL before JICA can take it up at their end. It would be a Government (Japan) to Government (India) loan.
3. MPPGCL informed that the reports for Satpura (Sarni) and Amarkantak would be ready by mid November 2016.
4. A copy would be given to J Power.
5. They will take out a tender for conducting EIA study for the two projects by the end of November (which was changed to October in MD's office)
6. They have had discussions with CEA also on these projects.
7. CEA informed that they have an MOU with J COAL for preparing the Feasibility Report.
8. J Power informed that it would not be necessary to carry out a Feasibility Report by J COAL as the work of F/S report / DPR is already underway.
9. MPPGCL informed that the Satpura project is already under dismantling and also shared some photographs of the project site. The work is expected to be completed by November 2017 as per the contract.
10. MPPGCL was wondering as to why this loan did not get through earlier (about 2-3 years back). Probably it was because of the bad financial

position of MPPGCL at that time. Now MPPGCL is in a sound financial position as informed by them.

11. MPPGCL will give a copy of their balance sheet to JPower.

12. Investment decision will be taken up in the 13th Five year Plan – April 2017 – March 2022. However MPPGCL will put in all efforts to put this in for approval in the current 12th Five Year Plan – ending in March 2017.

13. The Board meeting is expected to take place in November.

14. The layout for Satpura was discussed in Mr. Namdeo's office.

15. A copy of the MPPGCL's order for dismantling was given to J Power for their reference wherein the time schedule is shown.

ATTACHMENT – 2

OBRA SURVEY PHOTO

Attachment - 2

Obra 'A' Replacement Area and those Facilities

Obra 'A' Thermal Power Station

Switch Yard

Water intake

CWP Pump house (for Obra 'B')

Water intake channel

Scrap yard

Obra Dam (Lower stream)

Obra Dam (Upstream)

Coal storage yard (A)

Coal storage yard (B)

Coal unloading facilities

Coal transportation

ATTACHMENT – 3

PRELIMINARY FEASIBILITY STUDY REPORT OF OBRA 'A' REPLACEMENT PROJECT

(Draft)

PRELIMINARY FEASIBILITY REPORT ON OBRA TPS

Uttar Pradesh Rajya Vidyut Utpadan Nigam Limited
(UPRVUNL)

Electric Power Development Power Co., Ltd.
(J-POWER)

AUGUST 2016

INDEX

SITE LOCATION MAP

INDIA MAP

1x660 MW Obra TPS

PROJECT HIGHLIGHTS

Owner	Uttar Pradesh Rajya Vidyut Utpadan Limited (UPRVUNL)	
Project	Obra Thermal Power Station, Obra, Sonebhadra District, Uttar Pradesh, India	
Plant Capacity	660 MW	
Plant Configuration	1×660 MW	
Location	In the area after dismantling Obra 'A' TPS (5 × 50 MW & 3 × 100 MW) units within the premises of existing Obra Thermal Power Plant.	
	Distance from Varanasi City : 115 km	
	Distance from Obra town : 1 km	
	Latitude : 24 27'N	
	Longitude : 82 59'E	
	Height above MSL : 76 Metres	
	Seismic Zone : III as per IS : 1893-2002	
Nearest Railway Station	Obra Dam	
Nearest National Highway	Varanasi- Shakti Nagar : 8 km	
Nearest Airport	Varanasi : 120 km	
Nearest Port	Mumbai : 1,532 km	
Land Requirement	**A. Within the plant boundary**	**Area in Acres**
	1. Main plant & equipment's	16.00
	2. Switchyard	4.00
	3. Water facilities including Cooling tower	31.00
	4. Coal Handling Plant	24.00
	5. Misc. (Plant Boundary, Road etc.)	23.00
	6. Green Belt	33.00
	Total (A)	**131.00**
	Outside the plant boundary	
	1. Ash Dyke area	150.00
	Total (B)	**150.00**
	Grand Total (A+B)	**281.00**
Meteorological Data		
Ambient temperature	• Daily maximum (mean)	29.1°C
	• Daily minimum (mean)	24.3°C
Relative humidity	• Maximum	83°C
	• Minimum	23°C
Rainfall	• Maximum per annum	1,969 mm
	• Average per annum	1,948 mm
Wind Speed		26 kmph
Source of Water	Obra dam	

Water Requirement	1,730 m^3/hr.
Cooling System	Closed cycle cooling system with Induced Draft Cooling Tower
Primary Fuel & Source	Coal from NCL & CCL coal mines
Support Fuel & Source	LDO/HSD from nearest refinery/oil depots
Fuel Requirement	
• Primary fuel (Coal)	2.99 mtpa (With GCV of coal as 3,700 kcal/kg Station Heat Rate 2,248 kcal/kwh at 85% PLF).
• Support fuel (LDO/HSD)	5,780 KL per year
Transportation	
Coal	By Railway System
Support Fuel	By Railway System
Steam Generator	Steam Generator will be of Ultra-supercritical pressure parameters, balanced draft furnace, single reheat, radiant, dry bottom type, suitable for outdoor installation designed for firing pulverized coal as main fuel.
Steam Turbine	The Steam Turbine will be multi cylinders, tandem compound single reheat, regenerative, condensing unit directly coupled to AC Generator giving a continuous rated output at generator terminals. USC's Steam Condition: 270 ata, 600/600°C.
FGD	Wet / Dry type Flue Gas De-Sulphurising System (FGD) for SOx control.
SCR	Selective Catalytic Reactor (SCR) for NOx abatement
Station Operation Philosophy	Base Load
Chimney	One single flue chimney of 275 meter high
Power Evacuation plan	Through 400 kV transmission lines
Project Commissioning Schedule	45 months from 'Zero date'.

1.0 INTRODUCTION

JICA has conducted Preliminary Feasibility Study for 1 × 660 MW Super Critical Unit in place of Obra 'A' TPS (5 × 50 + 3 × 100 MW) units in 16th & 17th June, 2016.

The study including collecting information and investigating the current status of existing Obra Thermal Power Station. The details of Obra 'A' TPS are as follows:

Table: 1

Stage	Units No.	Installed Capacity	Derated Capacity	Date of Synchronization	Date of Commercial Operation
'A' TPS	1	50 MW	50 MW	15.08.1967	15.08.1967
	2	50 MW	50 MW	12.02.1968	11.03.1968
	3	50 MW	Deleted	13.10.1968	13.10.1968
	4	50 MW	Deleted	11.06.1969	16.07.1969
	5	50 MW	Deleted	30.07.1971	30.07.1971
'A' TPS	6	100 MW	Deleted	04.10.1973	04.10.1973
	7	100 MW	94 MW	14.12.1974	14.12.1974
	8	100 MW	94 MW	15.09.1975	01.01.1976

Obra 'A' TPS, Units # 1 to 8 are not operating and hence are to be replaced (scrap-and-build) by Ultra-Super Critical (USC) thermal-power plant with highly efficient units.

The main purpose of This Preliminary Feasibility Study Report (the Report) is to confirm the most important criteria for planning TPS such as availability of land, fuel, water and acceptability from environmental considerations.

The findings will serve as basic information for considering Japanese ODA loan assistance and will be followed by due needs assessment with respect to complete replacement, together with cost-benefit analysis.

Preliminary Feasibility Report has been prepared as per Central Electricity Authority (CEA) guidelines and Central Electricity Regulatory Commission (CERC) / State Electricity Regulatory Commission (SERC) norms.

2.0 OVERVIEW OF CURRENT FACILITIES

Obra 'A' TPS consists of Units 3 to 6, these are already retired, and Units # 1, 2, 7 & 8 are currently in operation as per UPRVUNL record. Refer Table: 1.

Facilities for Replacement

(1) Site for power generation facilities

The site of the power station consists of those for Obra 'A' (Units 1 to 8) and Obra 'B' (Units 9 to 13). There is a linked turbine building for Obra 'A' and B.

The coal storage yard is located on the south east side behind the stacks of Obra 'A', which can be connected to the coal stock yard for Obra 'B' in emergency. Further to the southeast, there is a railway for transporting coal.

The facilities of switchyard and its land on the northeast side of Obra 'A' are owned by UPRVUNL.

There is no site available for a new 660 MW unit except for the site of existing units inside the power station compound.

(2) Coal transportation facilities

There is a railway coal transportation facility. The annual coal receiving amount is approximately 5 million tons for Obra 'A' and Obra 'B'. the total coal consumption at Obra 'A', units #1,2,7&8 currently in operation, is approximately 1.2 million tons in 2010- 11.

(3) Fuel supply

Obra 'A' power station mainly uses domestic coal (raw coal) available in the surrounding area, and thus has a stable supply.

(4) Ash pond

The ash pond has an area of 75 ha. Land preparation was minimized by developing the ash pond utilizing the natural terrain. Bottom ash from Obra 'A' and B is transferred to the ash pond as slurry. Before the pond is filled up, the existing dyke will be raised to provide capacity for 25 to 30 years (for Obra 'A' and 'B').

Currently, discharge water from the ash pond (ash water) is treated through sedimentation before release into the nearby river. The Discharge water from the ash pond (ash water) is measured once a month to monitor oil content, pH and turbidity.

The existing ash pond has a clay layer at the bottom to prevent penetration of ash water.

(5) Raw water supply system (cooling water, etc)

Raw water is supplied from the Obra Dam located close to the power station. The water from the dam is mainly used for condenser cooling, and then returned to the dam (a once-through system). Obra 'B' uses the same system.

(6) Waste water

Waste water from the power station is released directly to the nearby river without treatment.

(7) Transmission lines

While the switchyard facilities are owned by UPRVUNL, the power generation company, the transmission lines are owned by UPPTCL, the power transmission company. The electric power from Obra 'A' is transmitted from the 220 kV switchyard and that from Obra 'B' from the 400 kV switchyard.

(8) Access condition for heavy load equipment

Obra power station has witnessed the transportation of heavy load equipment for 200 MW units while the main road before branching out toward Rihand near the power station has been utilised for the transportation of heavy load equipment for 500 MW to 660 MW units.

(9) New project (Obra 'C')

Near the existing power station (approximately 1.5 km to the northeast), the site of Obra 'C' plant (660 MW × 2) exists. Price Bid for Obra 'C' was already open. Land has been secured, and part of it is being leveled.

(10) Environmental regulations and social considerations

Main environmental regulations are as follows.

Criteria and current conditions of flue gas at stack outlets, waste water and noise:

(a) Flue gas at smokestack outlets

(b) Waste water

(c) Noise: The noise limit is 90 dB (1 m from machine)

(d) Environmental monitoring: Regulatory objectives (quality of ambient air and water) required by law are measured and the environmental monitoring report containing the measured data is submitted to CEA every month.

(e) Utilization of coal ash: Currently, ash is not efficiently used (utilization is around 10% total for Obra 'A' and 'B') and

the majority is disposed of in the ash pond. The power station aims at achieving the target set by the Ministry of Environment and Forestry in November 2009 (utilization of fly ash shall be 100% by 2014 for coal/lignite thermal power stations in operation at that time or by 4 years after COD in the case of new power station after that time).

(f) Problems concerning the social circumstances: The SPM emission exceeds the standards at the stack outlet. The SPM emissions are higher at Obra 'B' and they exceeded 6,000 mg/Nm^3 at the stack outlet of Units 10, 12, and 13. ESP of Unit 9 is under R&M and ESPs of Units 10, 11, 12 and 13 are planned to use R&M for reducing dust in accordance with the instruction of the state Pollution Control Board. The EIA report for Obra 'C' describes the total amount of dust emissions of Obra 'A', 'B' and 'C'.

3.0 BASIC REQUIREMENTS

3.1 Infrastructure Requirements

A power station requires a number of basic inputs such as land, fuel, water etc. Installation of power station is primarily governed by the following basic considerations:

(1) Dismantling work

(2) Site Restoration

(3) Availability of land

(4) Rail / Road accessibility

(5) Availability of fuel

(6) Availability of water

(7) Load demand / Power absorption plan

(8) Environmental consideration

(9) Recommendations

The most important criteria for selection of site for TPS are availability of land, fuel, water and acceptability from environmental considerations.

3.2 Site Features

The project site is occupied after dismantling of Obra 'A' TPS within the boundary of existing Obra TPS. Nearest Railway station is Obra Dam. Varanasi Airport is 125 km away.

The site is located under Seismic Zone-III as per IS: 1893-2002.

Site features and adequacy etc. has been examined in details in the Report. However, these are briefed below.

(1) Dismantling Work

Dismantling activities are initiated after completing the engineering and planning process for the new unit(s) proposed to be installed on the land cleared after dismantling. The sequence of activities will be determined at the time of dismantling, but typically a sequence would include the following items:

(a) Removing coal yard equipment, including unloading structures, conveyors, transfer towers, and reclaim systems.

(b) Removing above-ground storage tanks

(c) Removing large equipment from rooftops or at higher elevations

(d) Removing equipment that must be removed prior to start of

boiler structure removal, including fly-ash handling, coal handling, burner fuel supply, scrubbers, air and flue gas ducts, etc.

(e) Removing electrostatic precipitator and bag houses by cutting casings and connecting gas ducts

(f) Removing the top of the boiler enclosure to allow access to the platens

(g) Removing the boiler water walls

(h) Removing steam drum and de aerator by severing all connections and lowering to grade

(i) Removing boiler structural steel

(j) Disassembling the turbine/generator and condenser

(k) Removing all other equipment and components required prior to structures demolition

(l) Removing the turbine building superstructure and interior floors

(m) Blasting/dismantling the concrete turbine-generator pedestal(s)

(n) Removing siding from buildings

(o) Dismantling steel framing

(p) Demolishing structural concrete

(q) Removing the stack(s)

(r) Removing cooling tower(s) and / or cooling water intake and discharge structures

(s) Removing all other site structures within the scope of the dismantling program

(t) Sorting and organizing materials for pickup by the scrap dealer(s)

(u) Size reducing concrete rubble to enhance its suitability for backfill

(v) Removing any temporary services used to support the dismantling effort (lighting / ventilation / electrical / groundwater management)

(2) Site Restoration

Site restoration activities are initiated following completion of the dismantling operations. The objective of site restoration in this estimate is to restore the station grounds to a configuration that does not pose a safety hazard, and plant vegetation for erosion control As such, landscaping will be limited to grading, placement of top soil, and seeding. A typical site restoration sequence would be:

(a) Backfill below grade voids with recycled concrete rubble (reinforcing steel removed from concrete) or with additional fill, if necessary

(b) General grading of the station

(c) Placement of top soil or other suitable surface material necessary to maintain erosion control

(d) Landscaping to the extent necessary to re-vegetate the station (grass or similar plant materials)

(e) Demobilizing personnel and equipment

(3) Land

(a) Land for main plant & equipment

a) Land for main plant and equipment will be available after decommissioning and dismantling of Obra 'A' TPS ($5 \times 50 + 3 \times 100$ MW units).

b) For providing space for 400 kV switchyard, existing 220/132 kV switchyard of Obra 'A' TPS will be dismantled and existing 5 nos. 220 kV & 3 nos. 132 kv outgoing feeders bays from switchyard of Obra 'A' TPS will be relocated.

c) On decommissioning of Obra 'A' - TPS, the CW pump House and the intake pond of Obra 'A' TPS will become defunct. The CW pump house will be dismantled and the intake pond will be reused to provide space for the water facilities, cooling towers etc. of the proposed new unit.

d) Adequate area for coal storage and handling facilities is available. The coal feeding facilities of Obra 'A' TPS will be dismantled to provide new coal handling system for the proposed unit.

(b) Ash dump area

For dumping of ash, land has been originally provided for all

the Obra 'A' TPS of the existing units land will be used for material storage & fabrication yard. Over the period the ash dump area has been filled up. A new ash dyke area of 150 acres is being developed adjacent to the proposed 'C' TPS ash dyke.

Ash dump area requirement based on MoEF notification dated 03.11.2009, is 50 Ha for 500 MW capacity having ash content in coal as 45%.

(c) Green Belt

Green belt will be developed as per MOEF guidelines in the area.

(4) Rail/Road Accessibility

The nearest town Obra is about 1 km from site which is connected through railway head (broad gauge) is at Obra Dam. The site is also well connected by road to National Highway (Varanasi-Shakti Nagar). Road network is already available for approach to site.

Dedicated railway link from Obra Dam Railway siding to site is available for the transportation of coal and fuel oil for the proposed power plant. The rail system will be augmented/new system will be developed based on the study of the Consultant assigned for the work. No problem is envisaged in accessibility and transportation of heavy equipment to site by road or rail.

(5) Source and availability of Fuel & transportation

Coal requirement will be about 2.99 mtpa. Coal for existing stages of the power station is received from NCL & CCL by rail system. For the proposed unit, coal linkage will be as granted by NCL/CCL. Coal will be transported by Indian Railway System.

Support fuel will be transported by Indian Railway system. Start-up

/support fuel for the proposed project will be LDO/HSD.

(6) Source and availability of Water

Water requirement of existing power station is being met from Obra Dam constructed on Son River for the TPS.

(7) Power evacuation facility

The generated power from the power plant switchyard will be evacuated at 400 kV voltage level, 400 kV switchyard will be provided. For power evacuation, there will be 10 nos. bays in switchyard. There will be two (2) nos. outgoing feeders to the destinations as may be identified by UPPTCL.

(8) Environmental aspects

The Power Plant will be developed based on the guidelines of the State Environmental Authorities and that of MoEF. Suitable provisions will be incorporated in the design of buildings, structures, and selection of equipment so that there are no adverse effects due to emissions, noise, and contamination of soil, water and air.

One single flue stack of 275 meter will be provided for 660 MW unit for wider dispersion of pollutant as per environmental guidelines.

UPRVUNL will approach Expert Appraisal Committee of MoEF for obtaining Terms of Reference (ToR) once the ToR presentation before the committee is held, the ToR letter is usually issued by MoEF (usually within a month) and consist their recommendation which need to be complied to in the EIA report.

(9) RECOMMENDATION

Replacement plan for Obra TPS

After due consideration of availability of land, fuel, water and acceptability from environmental considerations ect., it is recommendable to construct One (1) Unit of Ultra-supercritical (USC)thermal power plant on the dismantled and restored land by utilizing current existing resources like water from OBRA dam, existing coal linkage subject to comprehensive cost-benefit analysis.

4.0 TECHNOLOGY & UNIT RATING

4.1 Adoption of Ultra-Supercritical Technology (USC)

The proposed 660 MW units will have Ultra-supercritical steam parameters to achieve higher efficiency and hence, lower cost of generation. Steam parameters of Ultra-supercritical technology are as follow:

Pressure	:	270 kg/cm² (a)
Main Steam Temperature	:	600°C
Reheat Steam Temperature	:	600°C

The main advantages of adopting higher unit size of 660 MW with Ultra- supercritical parameters are brought out below:

(1) From Plant Performance Point of View:

- Reduction in coal consumption.
- Reduction in Ash generation.
- Reduction in effluent gasses to atmosphere.
- Reduction in suspended particulate matters to environment.
- Better performance during off-design operation due to variable “Evaporate End Point”.

(2) From Operation Point of View

- Better heat rate at full load as well as partial load.
- Lesser percentage of auxiliary consumption, hence increase in net power export.
- Lesser start-up time and hence less consumption of start-up fuel and power.
- Quicker load following capabilities i.e. better response to load rise / fall.
- Lesser consumption of cooling water.
- Boiler drum is eliminated hence no need of level control.
- More favorable for frequent start / stop even for two-shift operation.
- Lesser requirement of service like compressed air; water etc. because of reduction in number of units.

(3) From Plant Upkeep Point of View

- Lesser requirement of manpower for the operation & maintenance.
- Lesser number of equipment to maintain, hence lesser

inventory.

- Increase in cost due to expensive materials to withstand higher pressure and temperature is off-set for reduction in size of balance of plant as well as number of units.

Ultra-Supercritical Pressure power plant is envisaged in view of above indicated benefits.

5.0 TECHNICAL FEATURE OF THE BOILER & TG PLANT

5.1 Steam Generator

The steam generator will be Ultra-supercritical technology designed for firing coal as primary fuel, balanced draft furnace suitable for semi-outdoor installation. Boiler including auxiliaries will be designed for operation with 100% coal.

(1) Draft System

(2) Air Heater

(3) Coal Feeding and Burning System

(4) Coal Mill Rejects Handling System

(5) Secondary Fuel Oil System

(6) Soot Blowing System

(7) Electrostatic Precipitators (ESP)

(8) Flue Gas De-Sulphurising System (FGD)

(9) Selective Catalytic Reactor (SCR) for NOx abatement

5.2 Steam Turbine and Auxiliaries

The turbine component and its auxiliaries will be designed and selected to meet the stringent requirements in respect of superior thermal performance, excellent product reliability & operational flexibility.

The turbine will be designed based on modular design approach that divides the turbine into three main parts:

- High-pressure (HP) section
- Intermediate-pressure (IP) section and
- Low-pressure (LP) section

The turbine will have one single flow HP, one double flow IP and two double flow low-pressure cylinders exhausting downwards into condensers. All components will be selected based on long-proven records and standardized modules. The turbines will be of the tandem compound design. The individual shafts of the cylinders and the generator rotor shaft will be coupled rigidly together.

5.3 TURBINE AUXILIARIES

(1) Gland Steam Sealing System

(2) Oil System

(3) Control Fluid System

(4) Governing Systems

(5) Turning Gear

(6) Turbine Protection System
(7) HP-LP Bypass Station
(8) Condensing System
(9) Air Extraction
(10) Condensate Extraction Pumps
(11) Regenerative Feed Heating Cycle
(12) Boiler Feed Pumps (BFP)
(13) Lube Oil Purification System

6.0 DESCRIPTION OF MAJOR SYSTEMS

6.1 Mechanical Systems

6.1.1 Coal Transportation, Unloading Facilities and Handling Plant

The coal will be transported to power plant from coal mines through Rail system.

The Coal Handling Plant (CHP) will be designed to operate throughout the year with coal with calorific value of 3,700 kcal/kg.

The Coal Analysis is enclosed as **Annexure – 6.1**.

Gross Station Heat Rate of 2,248 kcal/kwh, the coal requirement for all units works out at full load with GCV of coal as 3,700 kcal/kg as:

Tonnes per hour (tph)	$\frac{1 \times 660 \times 2{,}248}{3{,}700} = 400.99$
Tonnes per day (tpd)	9,623.72
Million tonnes per year at 85% PLF (mtpa)	2.99

2 Nos. Wagon Tippler Complex are proposed so that stock building and rake unloading operations can be carried out expeditiously.

Suitable Marshaling Yard shall be provided as per requirement of Wagon Tippler Complex.

6.1.2 Fuel Oil System

A fuel oil system for boiler start-up as well as for flame stabilization during low load operation will be provided. Essentially HSD will be used for the boilers. However, for ignition of furnace Light Diesel Oil (LDO) will be utilized.

6.1.3 Ash Handling Plant

6.1.3.1 The ash handling system will be designed to meet the following requirements:

1.	Coal consumption at full load per hour		:	400.9 THP
2.	Ash content		:	41%
3.	Ash generated		:	164.41 TPH
4.	Bottom ash generated	20%	:	32.88 TPH
5.	Coarse ash generated	10%	:	16.44 TPH
6.	Fly ash generated	90%	:	147.96 TPH

6.1.3.2 Ash pond

Adequate area of ash pond shall be located at approx. 4 km from plant boundary for the proposed unit.

6.1.4 PLANT WATER SYSTEM

6.1.4.1 Raw Water

Consumptive water requirement of 660 MW will be made available by pumping from Obra Dam to water treatment plant for plant water requirement.

6.1.4.2 Water is required in a thermal power station for:

(1) Cooling Tower make-up.

(2) Auxiliary cooling water system - Water for bearing cooling and other auxiliary systems through closed loop circulation

(3) Boiler make-up.

(4) Potable water

(5) Plant services

(6) Fire fighting

(7) Ash handling

(8) Flue gas desulphurization

6.1.4.3 Composite Water Balance

The Raw Water Analysis is enclosed as **Annexure – 6.2** & Composite Water Scheme is enclosed as per **Annexure – 6.3.**

The consumptive water requirement of 1 × 660 MW unit is worked out as follows:

A.	**DM Water Requirement**	**Unit**	**Quantity**
-	Make-up water in power cycle	cu.m/hr	21
-	DM CW make-up	cu.m/hr	1
-	Stator Cooling make up	cu.m/hr	1
-	Chemical dosing	cu.m/hr	1
-	Condensate polishing unit regeneration	cu.m/hr	5
-	DM regeneration	cu.m/hr	5
	Total	cu.m/hr	34
	DM streams (1 operating + 1 standby) each of capacity 40 m^3/hr.		
	Potable water	cu.m/hr	5
	DMF backwash waste water	cu.m/hr	1
	Total	cu.m/hr	40

	DMF streams (1 operating + 1 standby) each of capacity 50 m^3/hr.		
B.	**FILTERED water requirement**		
a.	Feed to DM plant including regeneration requirement	cu.m/hr	40
b.	Service water	cu.m/hr	35
b.	AHP seal water requirement	cu.m/hr	140
c.	FGD Water	cu.m/hr	130
d.	CW Makeup	cu.m/hr	1380
	Total	**cu.m/hr**	**1725**
	Raw water requirement	**cu.m/hr**	**1730**

6.2 ELECTRICAL SYSTEM

The electrical system will be designed to assure high reliability of operation and high availability of the power plant through use of proven equipment conforming to International Standards, Codes and Practices and adequate level of redundancy. The electrical systems & equipment will also have to comply with the guide lines issued / notified by Indian Statutory Authorities viz. the Central Electricity Authority (CEA), Central Board of Irrigation & Power (CBIP), Indian Electricity (IE) Rules & Act, National Electrical Code (NEC), etc.

1.	Rated continuous active power output, kW	660,000
2.	Rated Power Factor	0.85
3.	Rated terminal voltage, kV	21~27
4.	Rated Frequency, Hz	50
5.	Rated Speed, RPM	3,000

6.2.1 Switchyard

In existing Obra 'A' switchyard total 8 Nos. of outgoing bays (5 Nos. of 220 kV & 3 Nos. of 132 kV) with 2 Nos. of ICT (220/132 kV) for Obra Hydro.

400 kV New Switchyard (proposed)

Power generated will be stepped up to 400 kV for evacuation.

For evacuation of power 400 kV Gas Insulated Switchyard is considered. The configuration of 400 kV GIS shall be follows:

Description	No of bays
Generator Transformer Bays	1
Line Feeder Bays	2
Station Transformer Bays	2
Bus Reactors	1
Bus VTs	2
400/220 kV ICT	2
Total	**10**

The two (2) Nos. of 400/220 kV ICT shall be connected to the existing 220 kV Switchyard.

6.3 Control and Instrumentation

Composition of Control system are including following systems;

(1) Distributed Digital Control System (DCS)

(2) Operation, Monitoring & Diagnostic System

(3) Communication System

(4) Interface with other Systems

6.4 CIVIL AND STRUCTURAL ENGINEERING ASPECTS

6.4.1 Basic Design considerations

The plot of land for the proposed project is fairly level. The site elevation generally varies from 190m to 150 m above MSL. The plant grade level will be formed above the HFL of the area and will be finalized during detailed engineering stage.

Type of foundations will be decided based on the geotechnical investigation.

The power station is located under Zone - III as per IS: 1893 (part-I) :2005. Analysis and design of structures to resist the seismic forces will be carried out as per the provisions of IS: 1893. The applicable zone factor will be considered during detailed engineering.

The applicable design wind pressure will be computed during design of buildings and structures as per IS: 875 (latest version) for the zone in which the proposed power station is located.

6.4.2 Existing Foundation & Soil Condition

In existing Obra 'A' TPS has no piling in existing foundation. The main plant area is generally open type foundation in maximum depth up to 8 meters.

In this area soil type is rocky soil based on recent Obra 'C' TPS soil data.

(1) Special Foundation Requirements for Rotating Equipment

The foundation systems for rotating equipment will be sized and proportioned not to exceed the bearing and settlement criteria and to assure satisfactory performance of the equipment. In addition to all rotating equipment will be provided with vibration isolation spring system mounted foundations. The vibration isolation system supplied will be of proven make, the vibration isolation foundation system will be provided for Turbo-generator, Boiler feed pumps, ID/FD/PA fans, Coal mills and Coal crushers.

(2) Structural Works

Structural works will be designed for dead-load plus adequate live-load plus worse of wind load and earthquake load with importance factor of

1.5 and seismic load as per IS: 1893 as applicable for zone-III.

6.4.3 Roads & Culverts

The roads in the plant area will be of adequate thickness and width as per requirement of various areas. It is proposed to have wet mixed macadam (WMM) roads during construction stage and the same will be finished with asphalt surfacing during completion stage. Adequate plant roads/culverts, grading and drainage will be provided. All roads will be designed as per applicable IRC/MOR&T standards.

6.4.4 Liquid Retaining Structures

RCC Water retaining structures will be leak proof and designed as uncracked section.

6.4.5 Civil Works for Plant Water System

(1) Intake Water System

The consumptive water requirement will be drawn from the Obra Dam through dedicated intake. Intake water pump house will be provided at suitable location with pumping facilities. The makeup water pumping station will be of RCC construction. The pretreatment plant will consist of clariflocculators, clarified water tank, sludge disposal system

(2) Waste Water Management

As a part of waste water system management, adequately sized settling sump oil water separator; settling pond; waste treatment plant sumps will be provided in RCC construction lined inside with suitable materials. Plant drainage system will be designed as

per the area drainage pattern. The surface run off the power plant area and also the process water taken out of the buildings will be taken to natural drainage system through a designed storm water drains, open drains & pipes.

6.4.6 Civil Works for Coal Handling System

Conveyors galleries, supporting trestles, superstructures of crusher house and transfer houses will be of fabricated structural steel work. All components will be of welded fabrication with bolted/welded joints for erection and assembly in the field. Intermediate floors and roof in transfer houses and crusher house will be of reinforced concrete supported on structural steel framing.

6.4.7 Civil Works for Ash Handling Plant Works

The blower/compressor room will be separate RCC construction in flat roof construction located close to ESPs to accommodate the blowers/ compressors with its auxiliaries.

Pipe rack for conveying the ash to ash silo will be of structural steel framed construction having its columns mounted on the RCC foundations. Suitable head room clearance will be maintained below the pipe rack for free movement of the cranes and other mobile equipment.

6.4.8 Switchyard Civil Works

Civil work for 400 kV switchyard will consist of tower foundations, equipment foundations, foundations for lighting mast towers, control room building and cable trenches, roads, drains and chain link fencing.

6.4.9 Chimney

One (1) single flue with insulation (insulated outside the flue) RCC chimney will be provided. The height of the chimney will be 275 M. Chimney will be fitted with suitable capacity elevator, staircase inside the windshield of RCC slip form construction. Chimney will be fitted with pollution measuring apparatus.

Chimney will be provided with lightning arrestor, aviation warning lights as per statutory requirement. The top of the chimney shell will be painted with alternate red and white bands conforming to aviation safety standard requirement.

6.4.10 Auxiliary Buildings

In addition to the power plant technological structures/buildings, following non- technological buildings/structures will be also provided.

(1) Fire house
(2) Service building
(3) Administrative building
(4) Workshop, canteen, store
(5) Security gate and time keeping office
(6) Guard / watch towers spaced adequately around the boundary wall
(7) Motor car shed etc.

7.0 PLOT PLAN AND GENERAL ARRANGEMENT

7.1 Plot Plan

Annexure – 7.1 shows the plot plan of the 1 x 660 MW Power Plant.

The Plot Plan of the project shows the location of main plant equipment with its auxiliaries, coal storage area, and switchyard. The plant layout has been developed keeping in view the following:

(1) Location within the designated area best suited from the point of view of available land offering least site grading costs.

(2) Wind rose directions

(3) Proximity to road network.

(4) Accessibility to water source and intake system.

(5) Accessibility to power evacuation corridor.

The Plot Plan has been developed considering the location of available land, its approach, proximity for coal transportation and water conveying facilities etc.

Coal brought by trucks to the stock yard in the plant premises is fed into hoppers, crushed further and conveyed to the boiler bunkers. Facilities have been provided for 10 days Coal stock at power plant end.

Ash silos have been provided from where ash will be removed in dry form by trucks for ash utilization facilities.

Except for the semi-outdoor boiler and outdoor transformers and switchyard, all other equipment will be located indoors.

The main plant equipment and auxiliary system are located based on the unit system design concept except for common facilities such as 400 kV switchyard, water system, coal and fuel oil unloading and handling facilities, ash disposal system.

The layout provides for:

(6) Storage space for coal and secondary fuel.

(7) FGD Plant

(8) Coal Handling Plant.

(9) Green belt all around the plant.

(10) Administrative building.

(11) Adequate space for built-up and open area for construction offices, stores, fabrication yard, pre-assembly yard etc.

Power Plant roads will be laid and connected to provide access to various

areas of the proposed station, taking due care for convenience of movement of materials. Water intake & disposal points indicated are provisional. These will be finalized during detailed engineering.

7.2 General Plant Layout

The general disposition of furnace with its supporting columns; FD, PA and ID fans with drives and handling columns; Rotary air pre-heaters etc. will be located as applicable to 2-pass construction, front wall fired/corner fired/down-shot burner configuration boiler. The layout is subject to revision based on the final selection of the steam generator (either single pass tower type or 2-pass conventional type). In any case, the pulverizers will be located in between the boiler air heaters and Electrostatic precipitator for better maintenance access and to reduce the critical piping lengths. The flue gas ducts from the air heater pass below feeder floor for connection to ESP and then will be connected to a 275M high RCC single flue stack, connected through two (2) ID fans.

ESP control room will be provided separately.

8.0 ENVIRONMENTAL CONSIDERATIONS

The Environment (Protection) Act of the Ministry of the Environment and Forests (MoEF) is an umbrella act that covers the EIA notification. The proposed thermal power project attracts Environmental Impact Assessment (EIA) requirement of the notification and thus requires Environmental Clearance. The MoEF has recently re-engineered the process of Environmental Clearance vide its Notification dated 14th September, 2006 suppressing the EIA Notification of 27th January, 1994 and its various amendments.

The new procedure has defined four stages of environmental clearance process. These stages in sequential order are as follows:-

- Stage (1) screening
- Stage (2) scoping
- Stage (3) public consultation
- Stage (4) appraisal

The above notification requires industries to carry out EIA study in accordance with MoEF & State environment guidelines after scoping and determination of the Terms of Reference (ToR) on likely impacts on the existing environment. Based on studies carried out in respect of identified activities including atmospheric emission and effluent discharge, predictions are made on the anticipated effects. To ensure that expected levels fall within prescribed limits, delineation of mitigation including environmental management plan is necessary for compliance. The notification also provides public consultation to mitigate public concerns for the proper compensation and rehabilitation of project affected persons.

Coal fired thermal power station contribute to environmental pollution as follows:

(1) Atmospheric pollution through particulate and gaseous emissions.

(2) Thermal pollution of the surroundings.

(3) Pollution due to discharge of liquid and solid wastes.

(4) Noise pollution.

8.1 Air Pollution Control System

As per the MoEF notifications (S.O. 3305(E) dated 7th December, 2015), all new plants to be installed after 1st January, 2017 shall have to meet the following Emission Standards:

- Particulate Matters : 30 mg/Nm^3
- Sulfur Dioxides (SO_2) : 100 mg/Nm^3

- Oxides of Nitrogen (NOx) : 100 mg/Nm^3
- Mercury (Hg) : 0.03 mg/Nm^3

The entire system will be therefore designed to keep the pollutant emission within specified norms under worst operating condition. To control the emission of particulates electrostatic precipitators (ESPs) will be provided. The ESPs will be so designed as to limit the particulates emission <30 mg/Nm^3 under worst operating condition.

To control NOx emission, Ultra-supercritical boilers having advanced low NOx generation system will be installed. In addition, Selective Catalytic Reduction (SCR) system will be installed.

Wet FGD system will be provided to bring down SO_2 emission to comply with the standards now specified.

For a proper dispersion of the pollutants, One (1) single flue stack of 275 m height has been considered at in accordance with the EPA Notification G.S.R. 742 (E), dated 30th August 1990. In the latest MoEF&CC Notification S.O.3305(E) dated 7th December, 2015, stack emission of NOx and SO_2 have now been brought down to 100 mg/Nm^3 which is substantially lower than the limits acceptable earlier. In view of this stricter emission norm, if the Ministry recommends lowering of chimney height, then the chimney height will be revised accordingly. For the control of fugitive dust emission within and around the coal handling plant, coal dust extraction and suppression systems will be provided.

8.2 Water Pollution Control System

The reservoir water will be used to meet the entire consumptive water (2.5 m^3/MWh) requirement. Treatment facilities will be provided in all wastewater streams so as to ensure collection of treated wastewater.

A state-of-the-art rain water harvesting system will be provided to collect the run-off for ground water recharging.

Effluent management scheme will be implemented with the objective of optimization of various water systems so as to reduce intake water requirement which will result in lesser waste water discharge. Adequate treatment facilities will be provided to all the waste streams emanating from the power plant to control water pollution.

8.3 Noise Pollution

Ambient noise inside and outside the plant area will conform to the prescribed noise levels for various land use categories as per National Standards for Ambient Noise. This will be ensured through proper designing of the equipment with adequate acoustics permitting the ambient noise levels without exceeding the specified criteria from the

source.

Green belt of adequate width will be provided around plant boundary and strategic locations.

8.4 Solid Waste Management

The ash management scheme for the ash generated from power plant will involve dry collection of fly ash, supply of ash to entrepreneurs for utilization, promoting ash utilization and disposal of unused ash.

8.5 Ash Management

Ministry of Environment and Forests (MoEF) Notification dated 3rd November, 2009) stipulate that "new coal and, or lignite based thermal power station and, or expansion units commissioned after this notification to achieve the target of fly ash utilization as per Table III given below:

S.N.	Fly ash utilization level	Target date
1.	At least 50% of fly ash generation	One year from the date of commissioning
2.	At least 70% of fly ash generation	Two years from the date of commissioning
3.	90% of fly ash generation	Three years from the date of commissioning
4.	100% of fly ash generation	Four year from the date of commissioning

The unutilized fly ash in relation to the target during a year, if any, shall be utilized within next two years in addition to the targets stipulated for these years and the balance unutilized fly target) shall be utilized progressively over next five years in addition to 100% utilization of current generation of fly ash."

Considering the above guidelines & stipulations regarding utilization of fly ash the project proponent will take necessary steps.

Terms of Reference (ToR) for conducting EIA studies is being processed by the Environmental Impact Assessment Authority and the report will be prepared based on the TOR and submitted for MOEF clearance.

8.6 ENVIRONMENT MANAGEMENT PLAN

During the construction process, the impact will be minimal and temporary in nature. So the scope of EMP during the construction phase will be limited to dust suppression and noise attenuation. Care has to be taken to reduce the SPM level of the project area.

9.0 EXECUTION AND MANAGEMENT

For a project of this magnitude, it is essential to have an effective project management and control system to ensure that the project is implemented within the stipulated time frame, budgeted cost and required quality levels. Despite a well prepared schedule, in practice, it is common to see undue delays in the execution of projects due to improper planning and inadequate control during the various phases of execution. To avoid such pitfalls, BMPL shall use reasonable endeavors for monitoring the achievement of the development milestones assessing program towards the plant implementation and will attempt to resolve any difficulties that may arise during the course of implementation.

UPRVUNL will take all the necessary measures to meet the commissioning schedule for the boiler, steam turbine generator and the unit as a whole.

UPRVUNL will engage an experienced engineering consultant for consultancy and for project management activities. In order to execute the project effectively, adequate staff of UPRVUNL will be stationed at project site.

9.1 Construction

UPRVUNL will mobilize the infrastructure such as offices etc. to start work at site for arranging construction power & water supply and for construction of temporary offices etc. immediately on making the decision to implement the project.

UPRVUNL will mobilize to execute the project through a well-defined turnkey EPC contract. The EPC Contract will be finalized through competitive bidding. The contract will be a fixed price EPC contract with an entity with substantial financial backing and significant experience in the engineering, procurement and construction of similar plants.

The Engineering-Procurement-Construction (EPC) contract will include provisions necessary to attract project financing and ensure the prescribed cost and performance for the term of the contract. This contract will incorporate completion guarantees, performance guarantees and liquidated damage provisions sufficient to preserve the project's ability to service its debt and meet its obligations to its customers if the facility does not achieve commercial operation in time or does not meet expected performance levels.

The construction workforce and all sub-contractors will be hired by the EPC contractor. The construction workforce will be sourced from the nearby areas.

9.2 Operation & Maintenance

The O&M organization will be headed by plant Manager having overall

administration as well as technical control of the power plant. Optimum level of suitable technical and administrative personal will be placed.

9.3 Completion Schedule

The project will be scheduled to go into commercial operation in 45 months after the 'zero date'.

The Project commissioning schedule with dismantling schedule is enclosed as **Annexure – 9.1.**

10.0 PROJECT COST

10.1 Cost Estimates

The following assumptions have been made in the preparation of the cost estimates:-

1. The land for the main plant area is in the possession of UPRVUNL and as such the cost has not been included in the cost estimate.
2. The estimate of civil and structural works has been prepared assuming no piling, Natural Draft Cooling Towers and chimney etc.
3. Freight @ 4% and insurance @ 1% for the equipment have been taken.
4. Cost of spares has been taken as 4% of the equipment cost i.e. Turbo-Generator, steam generator and balance of plant equipment.
5. Erection, testing and commissioning has been taken as 10% of equipment cost.
6. 25% of Working Capital requirement is capitalized and included as margin money. The margin money has not been considered for the purpose of tariff calculation.
7. Excise duty @ 12.50% including education cess of equipment cost.
8. Service tax @ 15% has been considered on Erection, testing & commissioning and freight & insurance cost.

10.2 Financing Structure

It is proposed to finance the project such that Capital structure is built up of:-

Equity Capital	-	30%
Loan Capital	-	70%

The equity capital will be arranged by UPRVUNL/State Contribution.

The debt capital, comprising loan capital and Interest During Construction, will be financed by JICA.

10.3 Interest During Construction

Fixed interest rate of 5.00% has been considered.

Also the payment of interest has been worked out at the end of each quarter of construction period in line with GoI (Finance Department) requirements.

10.4 Working Capital

Provision for working capital requirement has been made in line with

CERC guidelines. These estimates are worked on the basis of

i. 1 month O&M expenses
ii. 2 months receivables
iii. 2 months fuel charges (coal)
iv. 2 months support fuel charges
v. Maintenance & spares 20% of O&M charges.
vi. Interest rate for working capital has been considered as 1.04% per annum.
vii. Discount factor is considered as 13.10%.

10.5 Cost of Generation

Assumptions for working out cost of generation are given below. GOI guideline & CERC indices, wherever utilized, are marked with asterisk.

➢	Plant Capacity	1 × 660 MW
➢	Auxiliary Consumption	5.25%
➢	Station Heat Rate	2248 kCal/Kwh
➢	Depreciation	For Year 1 – 12 @ 5.28% For Year 13-25 @ 2.05%
➢	O&M	16.27 Lac/MW/Year @ 6.32% annual Escalation
➢	Loan period	18 years
➢	Loan repayment	72 equal quarterly installments including 7 years deferment period.
➢	GCV of coal	3,700 kcal/kg
➢	Present day Coal Price	Rs. 2,400/tonne on delivered basis @ 2% annual escalation.
➢	GCV of Support fuel	10,000 k.cal/kg
➢	Support fuel present day price	Rs. 45,000/tonne
➢	PLF	85%
➢	Return on equity	15.50% (base rate)
➢	Completion Schedule	45 months
➢	Life of plant	25 years
➢	Cost of Project excluding IDC	Rs. 3,880.60 crores
➢	Interest During Construction	Rs. 219.94 crores
➢	Cost of Project including IDC	Rs. 4,100.54 crores
➢	Cost/ MW	Rs. 6.21 crores
➢	First year tariff at 85% PLF	Rs. 3.01 /kwh
➢	Levellised Tariff at 85% PLF	Rs. 3.33 /kwh
➢	Internal Rate of Return	13.09
➢	Average DSCR	2.52

The Detailed Financial analysis are enclosed as **Annexure – 10.1.**

COAL ANALYSIS

Heating Values		
LHV	3,472.6	kcal/kg
HHV	3,683.3	kcal/kg
Ultimate Analysis (weight %)		
Moisture	12.00	%
Ash	41.00	%
Carbon	37.14	%
Hydrogen	2.70	%
Nitrogen	0.70	%
Chlorine	0.00	%
Sulfur	0.46	%
Oxygen	6.00	%
Total	100.00	%
Proximate Analysis (weight %)		
Moisture	12.00	%
Ash	41.00	%
Volatile Matter	22.90	%
Fixed Carbon	24.10	%
Total	100.00	%

Source: NCL & CCL.

RAW WATER ANALYSIS

S.No.	Parameter	Unit	Value
1	**Physical Characteristics**		
	pH at 25°C	----	7.8
	Turbidity	NTU	0.86
	Conductivity at 25°C	µs/cms	294
	Total Dissolved Solids	ppm	196
	Total Suspended Solids	ppm	44
2	**Cations**		
	Calcium Hardness	ppm as $CaCO_3$	56
	Magnesium Hardness	ppm as $CaCO_3$	40
	Sodium + Potassium	ppm as $CaCO_3$	17.45
	Iron	ppm as $CaCO_3$	0.38
	Total Cations	ppm as $CaCO_3$	113.83
3	**Anions**		
	M-Alkalinity	ppm as $CaCO_3$	80
	Chlorides	ppm as $CaCO_3$	19.74
	Sulphates	ppm as $CaCO_3$	11.44
	Nitrates	ppm as $CaCO_3$	1.62
	Fluoride	ppm as $CaCO_3$	1.03
	Total Anions	ppm as $CaCO_3$	113.83
4	Total Hardness	ppm as $CaCO_3$	96
5	P-Alkalinity	ppm as $CaCO_3$	Nil
6	Reactive Silica (Dissolved)	ppm as $CaCo_3$	----
7	Colloidal Silica	ppm as $CaCo_3$	Traces
8	COD	ppm	10
9	BOD	ppm	0.5
10	Total Coliform	MPN/100ml	110

Source: Son D

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ANNEXURE-6.3

REFERENCE DRAWINGS.

NOTES
1. DO NOT SCALE, ASK WHEN IN DOUBT.
2. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.

REVISIONS

PROJECT: 1x660 MW OBRA THERMAL POWER STATION

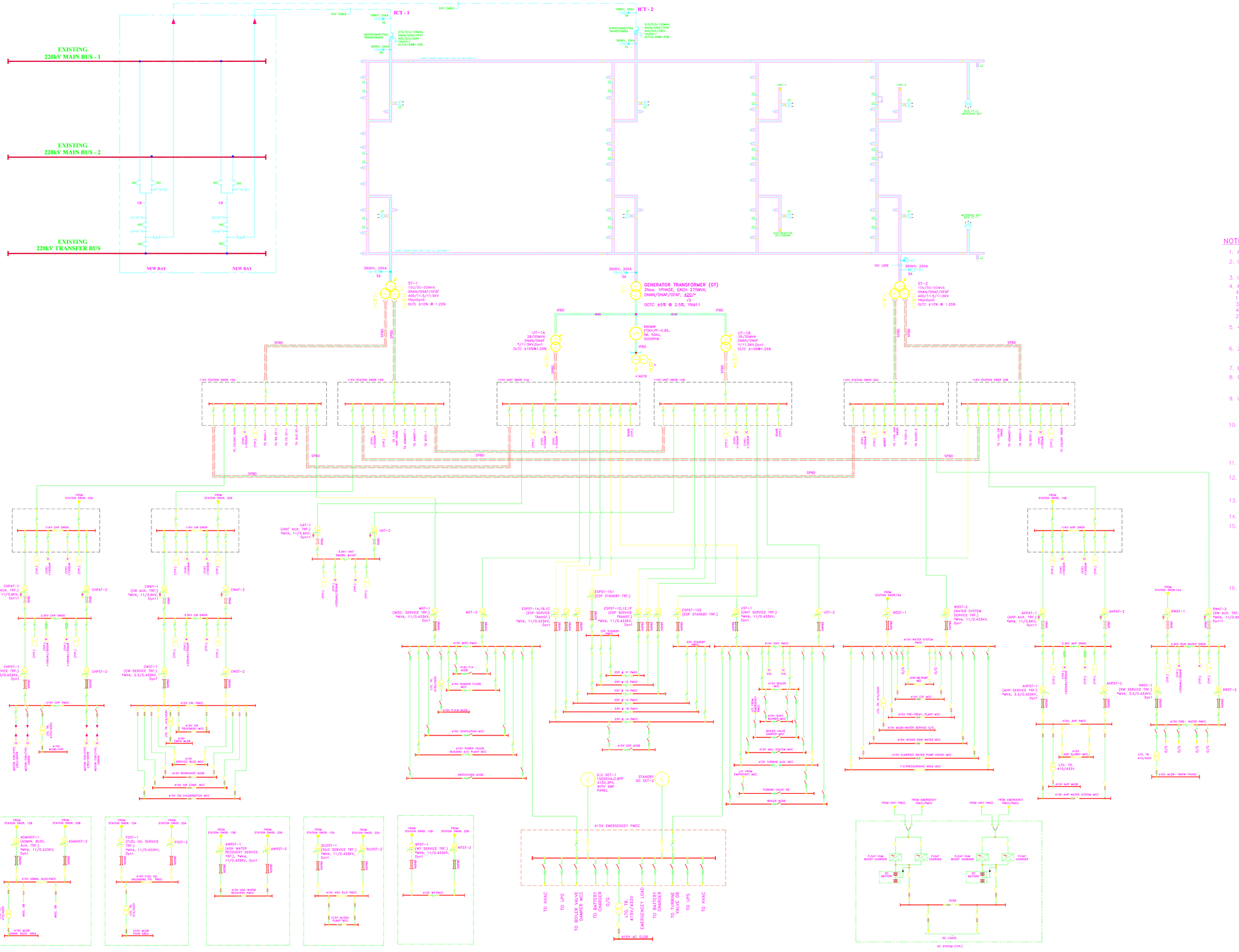
TITLE: COMPOSITE WATER SCHEME

SCALE: NTS

JOB. No. I-0161

DWG. No. 111-12-3100 REV. 0

APPRD. FOR CONSTRUCTION:



LEGEND:–	DESCRIPTION	LEGEND:–	DESCRIPTION
	GENERATOR		SEGREGATED PHASE BUSDUCT
220kV / 440kV	INTERCONNECTING TRANSFORMER		NON SEGREGATED PHASE BUSDUCT
	THREE WINDING POWER TRANSFORMER WITH ON LOAD TAP CHANGER (OLTC)		BATTERY CHARGER
	TWO WINDING TRANSFORMER WITH OLTC		CABLE CONNECTIONS
	TWO WINDING TRANSFORMER WITH OCTC		SURGE ARRESTOR
M	MOTOR	R	NEUTRAL GROUNDING RESISTOR (NGR)
	FUSE SWITCH UNIT		220V DC BATTERY
	NEUTRAL GROUNDING TRANSFORMER	CVT	VACUUM CONTACTOR
	ISOLATED PHASE BUSDUCT	ISO	CAPACITIVE VOLTAGE TRANSFORMER
	EARTH SWITCH		220kV/400kV ISOLATOR
CB	220/400kV CIRCUIT BREAKER		SOLIDLY EARTHED
	CIRCUIT BREAKER (HV&LV) DRAW OUT TYPE		

NOTES:–

1. ALL BREAKER RATINGS WILL BE CONTINOUS RATING AT 50°C AMBIENT.
2. UNLESS OTHERWISE STATED THE TOLERANCE ON PARAMETERS SHALL BE AS PER SPECIFICATION/ BIS / INTERNATIONAL STANDARDS.
3. UNLESS OTHERWISE STATED BASE MVA IS THE HIGHEST RATED CAPACITY.
4. MINIMUM FAULT LEVEL WITHSTAND :–
   400KV ..... 50KA FOR 1 SEC.
   11KV ..... 50KA FOR 1 SEC.
   3.3kV ..... 40KA FOR 1 SEC.
   415V ..... 50KA FOR 1 SEC.
   220V DC .... 25KA FOR 1 SEC.
5. 415V SYSTEM WILL BE 3 PHASE, 4 WIRE WITH NEUTRAL SOLIDLY EARTHED. 11kV AND 3.3kV SYSTEM NEUTRALS WILL BE RESISTANCE EARTHED LIMITING EARTH FAULT CURRENT TO 300A FOR 10 SEC.
6. 220V DC BATTERIES WILL BE RATED TO CATER THE DC LOADS OF UNIT. AS WELL AS STATION LOAD DURING COMPLETE BLACKOUT CONDITION, 48V DC BATTERIES WILL BE RATED TO CATER OPGW LOAD.
7. BATTERIES WILL BE UNGROUNDED HAVING FLOATING NEUTRAL.
8. GEN. BUSDUCTS WILL BE ISOLATED PHASE TYPE, 11KV & 3.3KV HV BUSDUCTS WILL BE SEGREGATED PHASE BUSDUCT AND 415V LT BUS DUCTS WILL BE NON SEGREGATED PHASE TYPE.
9. UNDER NORMAL OPERATION OF 415V PMCC/MCC/ACDB HAVING TWO INCOMING BREAKERS/ISOLATORS AND ONE BUS SECTION BREAKER/ISOLATOR, THE INCOMING BREAKERS/ISOLATORS WILL BE CLOSED AND BUS SECTION BREAKER/ISOLATOR WILL BE OPEN
10. 11kV SYSTEM UNIT BUSES EMPLOY FAST BUS TRANSFER SCHEME FOR RESTORATION OF SUPPLY FROM STATION TRANSFORMER IN CASE OF SUPPLY FAILURE FROM THE RESPECTIVE UNIT TRANSFORMER. MANUAL LIVE CHANGEOVER WITH CHECK SYNCHRONISATION AND SLOW AUTO CHANGEOVER FACILITY AS A BACK–UP IS ALSO PROVIDED FOR THESE BUSES. 11kV SYSTEM STATION BUSES EMPLOY MANUAL LIVE CHANGEOVER.
11. 3.3kV/415V SYSTEM BUSES ARE PROVIDED WITH MANUAL LIVE CHANGEOVER WITH CHECK SYNCHRONISATION AS WELL AS AUTOMATIC SLOW CHANGEOVER.
12. UNIT 415V BUS SECTIONS ARE ADDITIONALLY PROVIDED WITH MANUAL LIVE CHANGEOVER FACILITY WITH CHECK SYNCHRONISATION AND AUTOMATIC CHANGEOVER, WITH THEIR RESPECTIVE DG BUS.
13. ALL BATTERY CHARGERS SHALL HAVE PROVISION FOR RECEIVING 2 INPUT SUPPLIES ALONG WITH SUITABLE AUTOMATIC CHANGEOVER BETWEEN THE SOURCES.
14. 3.3kV TERTIARY WINDING OF ICT SHALL BE UNLOADED.
15. VECTOR GROUPS SHALL BE AS FOLLOWS.
    a) GT :YNd11
    b) ST :YNynOyn0
    c) UT :Dyn1
    d) ICT :YNaOd11
    e) UAT/RWAT/ AHPAT/CHPAT/CWAT :Dyn11
16. FOR ESPs ONE STANDBY TRANSFORMER TO BE PROVIDED FOR A MAXIMUM OF 3 ESP TRANSFORMERS.

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ANNEXURE–6.4

SR. No.	PARTY
11	
10	
9	
8	
7	
6	
5	
4	
3	
2	
1	

PRINT DISTRIBUTION

REFERENCE DRAWINGS.

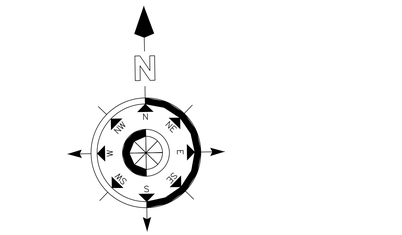
NOTES

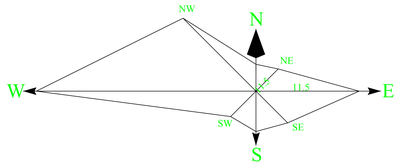
1. DO NOT SCALE, ASK WHEN IN DOUBT.
2. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.

ZONE	MARK	PARTICULARS	DATE	HOD	STRUCT	MECH.	ELEC.
	0	REVISIONS	APPRD. BY		CLEARED BY		

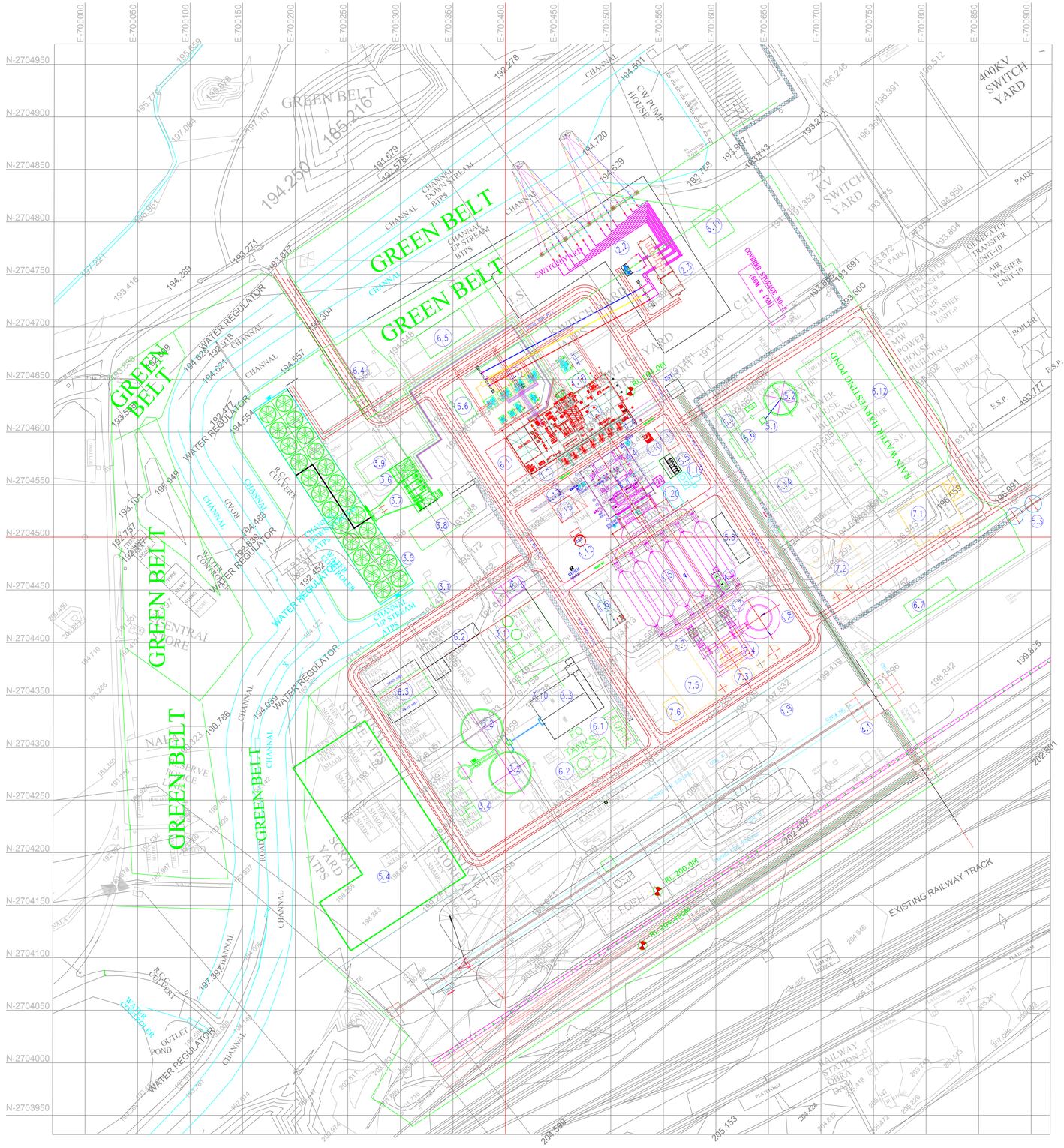
PROJECT:	1x660 MW OBRA THERMAL POWER STATION
TITLE	KEY SINGLE LINE DIAGRAM
DRAWN	
DESIGNED	
CHECKED	
SCALE	NTS
JOB. No.	I–0161
DWG. No.	112–10–0100
Sheet No.	of
REV.	0
APPRD. FOR CONSTRUCTION:	

For Print DISCLAIMER





WIND ROSE



SR. NO.	DESCRIPTION OF STRUCTURES
1.0	POWER BLOCK AREA
1.1	TG BUILDING
1.2	TG CENTRAL CONTROL ROOM BUILDING
1.3	BOILER
1.4	MILLS & BUNKERS
1.5	ESP
1.6	ESP CONTROL ROOM
1.7	ID FANS
1.8	CHIMNEY
1.9	SPACE FOR FGD
1.10	MILL REJECT SILO
1.11	PLANT & MILL REJECT COMPRESSORS & EDC BUILDING
1.12	CONDENSATE STORAGE TANK & PUMP AREA
1.13	AIR WASHER ROOM (ON ROOF OF CCR BUILDING)
1.14	AUX. BOILER
1.15	DG ROOM
1.16	AIR WASHER ROOM
1.17	–
1.18	–
1.19	NH3 PUMPING SKIDS-1 & 2
1.20	AQUEOUS NH3 STORAGE DYKE
2.0	SWITCHYARD & TRANSFORMER YARD AREA
2.1	TRANSFORMER YARD
2.2	GIS SWITCH YARD (400kV)
2.3	SWITCHYARD CONTROL ROOM
3.0	WATER SYSTEM
3.1	RAW WATER & ASH WATER PUMP HOUSE
3.2	PTP CLARIFIER
3.3	CLARIFIED WATER RESERVOIR
3.4	CHEMICAL HOUSE AND ELECTRICAL & CONTROL ROOM
3.5	INDUCE DRAFT COOLING TOWER
3.6	CW, ACW PUMP HOUSE & CW + IDCT ELECTRICAL ROOM
3.7	FOREBAY & CHANNEL
3.8	CW SIDE STREAM FILTRATION PLANT
3.9	CHLORINATION PLANT FOR CW SYSTEM
3.10	DM PLANT AREA INCL CPU REGENERATION PLANT
3.11	DM WATER STORAGE TANKS
3.12	RAIN WATER HARVESTING POND
4.0	COAL HANDLING PLANT
4.1	CRUSHER HOUSE
4.2	CHP MCC / CONTROL ROOM
4.3	BUNKER MCC ROOM NEAR BOILER
4.4	TRANSFER TOWER (UNDER GROUND)
5.0	ASH HANDLING PLANT & EFFLUENT TREATMENT PLANT
5.1	CLARIFIED WATER STORAGE TANK FOR AWRS
5.2	CLARIFIER FOR ASH RECOVERY WATER
5.3	DRY ASH SILO
5.4	EFFLUENT TREATMENT PLANT
5.5	ASH WATER SUMP/PUMP HOUSE
5.6	B.A. SLURRY SUMP/PUMP HOUSE
5.7	AHP CONTROL ROOM
5.8	AHP COMPRESSOR HOUSE
6.0	NON-PLANT BUILDING
6.1	SERVICE BUILDING
6.2	WORK SHOP BLDG.
6.3	PERMANENT STORE/ROTOR SHED
6.4	WEIGHT BRIDGE
6.5	ADMINISTRATIVE BUILDING
6.6	CANTEEN
6.7	SITE OFFICE
7.0	WFGD PLANT
7.1	LIME STONE UNLODING BUILDING
7.2	LIME STONE PREPARATION BUILDING
7.3	SLURRY RECYCLE PUMP HOUSE & AIR BLOWER
7.4	ABSORBER
7.5	GYPSUM DE WATERING BUILDING
7.6	WFGD CONTROL & ELECTRICAL BUILDING

FOR Pre.F.R. ONLY

ANNEXURE-7.1

REFERENCE DRAWINGS.	NOTES
	1. DO NOT SCALE, ASK WHEN IN DOUBT. 2. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.

ZONE	MARK	PARTICULARS	DATE	HOD	STRUCT	MECH.	ELEC.
		REVISIONS	APPRD. BY		CLEARED BY		

SR. No. PARTY
PRINT DISTRIBUTION

PROJECT: 1x660 MW OBRA THERMAL POWER STATION

TITLE: PLOT PLAN

DRAWN | DESIGNED | CHECKED

SCALE: NTS

JOB. No. I-0161

DWG. No. 111-29-0100 Sheet No. of

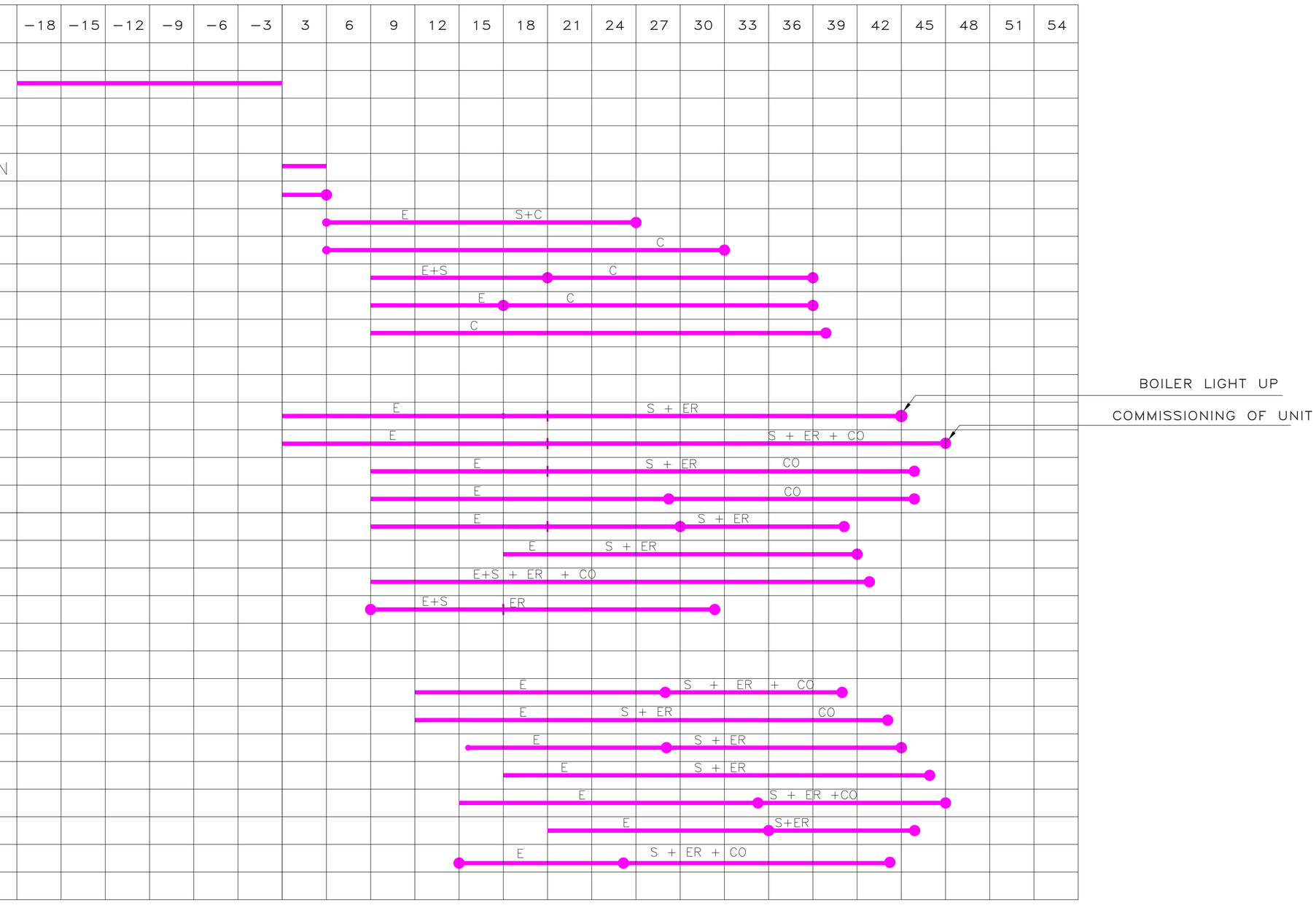
REV. 0

APPRD. FOR CONSTRUCTION:

For Ref. DRAWING

Size A1

S.No.	ACTIVITIES
A	DISMANTLING
1	A–TPS 5x50MW & 3x100MW UNITS
B	CIVIL STRUCTURAL & ARCH.
1	SOIL INVESTIGATION & SITE PREPARATION
2	CONSTRUCTION FACILITIES
3	FOUNDATIONS
4	MAIN PLANT BUILDING
5	COOLING TOWERS
6	CHIMNEY
7	ROADS
C	MECHANICAL
1	STEAM GENERATOR & AUXILIARIES
2	STG SET & AUXILIARIES
3	COAL HANDLING SYSTEM
4	ASH HANDLING SYSTEM
5	WATER SUPPLY SYSTEM
6	COMPRESSED AIR SYSTEM
7	MISC. MECHANICAL EQUIPMENT
8	E.O.T. CRANE
D	ELECTRICAL
1	TRANSFORMERS
2	SWITCHGEAR & MCC
3	BUS DUCTS
4	CABLING
5	INSTRUMENTATION & CONTROLS
6	LIGHTING & INTER.COMM.SYSTEM
7	SWITCHYARD



DISMANTLING OF UNITS 18 MONTHS.
COMMISSIONING OF UNIT 45 MONTHS.

E–ENGINEERING
S–SUPPLY
C–CONSTRUCTION
ER–ERECTION
CO–COMMISSIONING

FOR Pre.F.R. ONLY

ANNEXURE–9.1

REFERENCE DRAWINGS.	NOTES
	1. DO NOT SCALE, ASK WHEN IN DOUBT. 2. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.

ZONE	MARK	PARTICULARS	DATE	HOD	STRUCT	MECH.	ELEC.
REVISIONS			APPRD. BY		CLEARED BY		

PROJECT:	1x660 MW OBRA THERMAL POWER STATION
TITLE	PROJECT SCHEDULE
DRAWN	
DESIGNED	
CHECKED	
SCALE	NTS
JOB. No.	I-0161
DWG. No.	
REV.	0
APPRD. FOR CONSTRUCTION:	
Sheet No. ... of ...	

SP. IN. PARTY
PRINT DISTRIBUTION

File No. DRAWING

ATTACHMENT – 4

DISMANTLING WORK AT SATPURA POWER STATION (PH-1)

Attachment – 4

Dismantling work at Satpura Power Station (PH-1)

Boiler Building and ESP

Scrap yard

Turbine floor (HP Heater / CCR)

Turbine floor (TG base)

Turbine Building (Transformer)

Turbine Building

ESP

Stack yard

Conveyer area

Turbine Building

ESP

Conveyer area