Report

on

the feasibility of

Additional Interconnection between India and Bangladesh

Joint Technical Team (JTT)

of

India and Bangladesh

July 2016

Contents

List of Exhibits

Additional Interconnection between India and Bangladesh

1.0 Background

At present, a cross border interconnection between India and Bangladesh comprising of a 500 MW HVDC Back-to-Back asynchronous link at Bheramara (Bangladesh) with 400kV Bheramara - Baharampur (India) double circuit link facilitates transfer power upto 500MW. Additionally, about 100 MW power is exported from Surajmaninagar in Tripura, India to eastern side of Bangladesh (Comilla) through radial interconnection. Further capacity upgradation of the existing Baharampur (India) – Bheramara (Bangladesh) interconnection to enable Import of additional 500MW power by Bangladesh is under implementation and expected to be commissioned by January 2018.

During the 7th Joint Steering Committee (JSC) meeting on Cooperation in Power Sector between India and Bangladesh held on 2-3 April, 2014, it was decided to prepare the detailed feasibility and project report for HVDC corridor through Bangladesh [Rangia (NER) – Barapukuria (Bangladesh) – Muzaffarnagar (NR) 7000MW HVDC bipole line with 1000MW terminal at Barapukuria and 5500MW terminal at Muzaffarnagar (NR)].

This DPR was presented in the 10th Joint Steering Committee (JSC) meeting on 27th Nov., 2015 wherein it was noted that the project may take some time to take off due to non-availability of surplus power in NER of India. In the said JSC meeting, Bangladesh has requested for additional inter-connections from top-north i.e. at Barapukuria and from down-south. The following was noted in the 10th JWG meeting held on 27-11-2015 at New Delhi :

"It was agreed that the JTT shall look into the possibility of utilizing the corridor through Bangladesh planned for the HVDC project for giving additional power supply to Bangladesh"

Joint Technical Team meeting was held on 10-11th March 2016 at Gurgaon and following alternatives were discussed in order to identify additional transmission interconnections from India to Bangladesh:

i. Additional power export to Bangladesh through Surajmaninagar (Tripura) - North Comilla (Bangladesh) Interconnection
ii. Interconnection of south-western part of Bangladesh with Eastern Region of India
iii. Interconnection of Northern part of Bangladesh with Indian Grid

This report is based on the studies carried out on Indian and Bangladesh side for possible additional transmission interconnections from India to Bangladesh.

2.0 Additional power export to Bangladesh through Surajmaninagar (Tripura) - North Comilla (Bangladesh) Interconnection

Surajmaninagar - South Comilla (400kV D/c line upto North Comilla, remaining portion 132kV D/c line) has been implemented to provide 100MW power to Bangladesh in radial mode from Palatana Generation Project in Tripura in North Eastern Region. For transfer of additional power in this corridor, following has been observed.

In Bangladesh portion, one part of the interconnecting line (North Comilla - South Comilla) has been designed at 132kV level and there is limitation for further enhancement of power supply considering N-1 contingency. Further, at present about 100MW of load has been radialised at 132kV Comilla South substation and for the additional power, adequate load may not be available to be connected at the substation in radial mode.

In Indian portion, power transfer from Pallatana generation project to Surajmaninagar S/s of Tripura was planned through Pallatana - Surajmaninagar 400kV D/c line to be initially operated at 132kV. Presently, due to non-availability of 132kV bay at Pallatana generation switchyard, only one circuit of the said line is in operation. Further, out of the planned 400/132kV, 2x125MVA ICTs only one 125MVA ICT is available at Pallatana generation switchyard.

Though Pallatana – Surajmaninagar and Surajmaninagar – North Comilla 400kV D/c lines (charged at 132kV) has sufficient capacity to supply additional power to Bangladesh, the terminal equipments at Surajmaninagar and Pallatana are designed at 132kV and therefore cannot handle additional power transfer with reliability.

In view of the above, additional power may not be transferred with reliability from Tripura side at present.

3.0 Interconnection of south-western part of Bangladesh with Eastern Region of India

Jeerat and Subhashgram are 400kV sub-stations in the southern part of Eastern Region in India adjacent to Bangladesh, which are supplying power to major loads in Kolkata/South Bengal area in India. The peak demand has already touched 1700-1800MW in that area. There is transmission constraint for supply of additional power in this area. Further, there is problem of under-voltage at these sub-stations.

With reference to above mentioned facts, it is recommended that at present additional inter-connection may not be feasible from Jeerat to south-western part

of Bangladesh namely Jessore. When some additional generation comes up in this part of the Eastern Region in India or planned transmission strengthening is taken up and the under-voltage position in Jeerat area improves, this proposal may be relooked.

4.0 Interconnection of Northern part of Bangladesh with Indian Grid

A 765kV (Initially to be charged at 400kV) high capacity AC link, using the RoW of proposed HVDC corridor, is proposed to interconnect Bangladesh with Eastern Region as well as North Eastern Region.

Interconnecting substation in India

In ER: In addition to the existing substations in northern part of ER near Bangladesh border, i.e. Kishanganj and New Pumea, which interconnects North Bengal and Sikkim with rest of the Indian Grid, it is felt that a new substation is required as a probable take-off point keeping in view the need for upgradation of the substation at 765kV in future. Accordingly, it is proposed to establish the substation at Katihar (in Bihar, south of Purnea) through LILO of both ckts of Rajarhat-Purnea 400kV D/c high capacity (triple snowbird) line (one ckt via Gokarna and other ckt via Farakka).

In NER: In view of space problem at existing Bongaigaon substation and to provide a reliable take off point in NER, it is proposed to establish a new substation at Bornagar (in Assam), about 50km away from Bongaigaon, through LILO of Bongaigaon - Balipara 400kV D/c (quad) line and extension of Alipurduar – Bongaigaon 400kV D/c (quad) line to Bornagar substation.

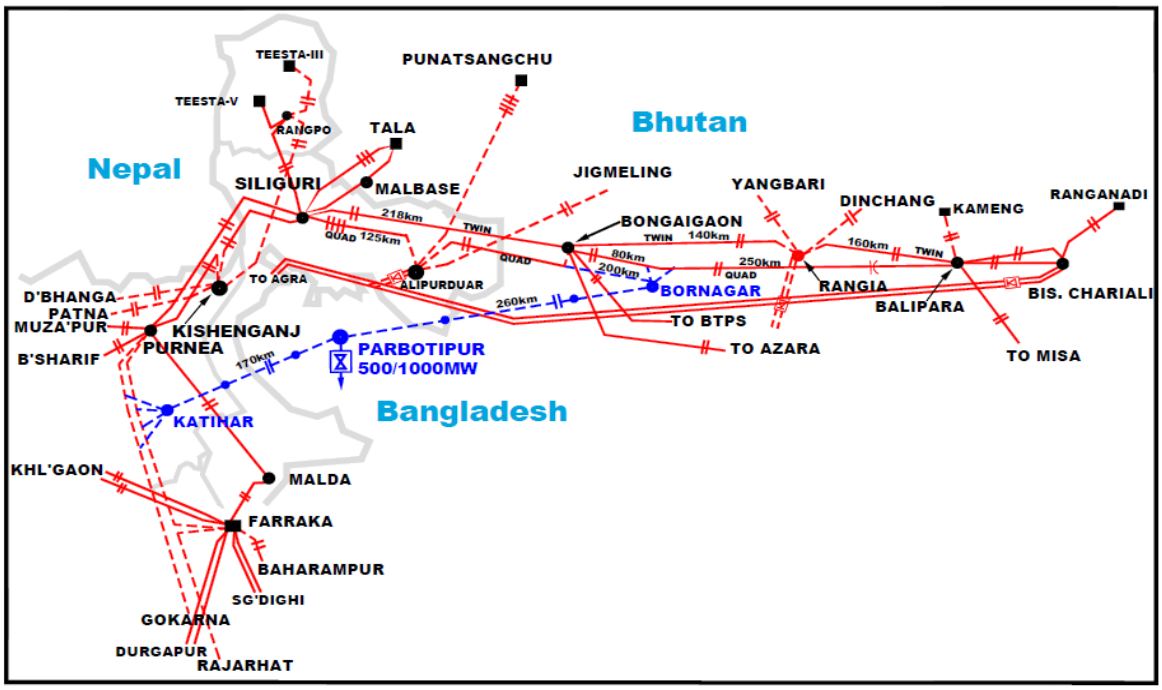
Interconnecting substation in Bangladesh: Land is identified at Parbotipur as probable interconnection substation in the northern part of Bangladesh which is about 6km north of previously identified Barapukuria substation.

Transmission Interconnection: The transmission interconnection has been planned to connect Parbotipur/Barapukuria in Bangladesh to Katihar in ER and Bornagar in NER through 765kV D/c line to be initially operated at 400kV for supply of 500MW power to Bangladesh in Phase I. Bangladesh will draw the power at Parbotipur/Barapukuria through HVDC back to back for further dispersal of the same to their load centre.

Studies were carried out in this regard considering power scenario of 2018-19 time frame. In Phase-II, this interconnection would be taken up for transfer of about 1000MW power to Bangladesh with upgradation of associated AC substations and upgradation of HVDC terminal at Parbotipur/Barapukuria from 500MW to

1000MW. In this phase, the interconnecting line would be operated at its rated voltage depending on availability of power.

The transmission system considered is as given below:



Phase-I

Indian Side:

- New 400kV substation (upgradable to 765kV at a later date) at Bornagar (Assam) with LILO of Balipara - Bongaigaon 400kV D/c (quad) line.

- Disconnection of Alipurduar-Bongaigaon 400kV D/c (quad) line from Bongaigaon and extension of the same to Bornagar with 400kV Dlc (quad) line so as to form Alipurduar-Bornagar 400kV D/c (quad) line.

- New 400kV substation (upgradable to 765kV at a later date) at Katihar (Bihar) with LILO of both ckts of Purnea - Rajarhat 400kV D/c (triple snowbird) line (one ckt via Gokarna and other ckt via Farakka).

- Katihar (ER) - Parbotipur/Barapukuria (Bangladesh) - Bornagar (NER) 765kV D/c line to be initially operated at 400KV [160 + 260 km]

Bangladesh Side:

- 1x500 MW, Back-to-back HVDC converter station at Parbotipur/Barapukuria

Phase-II

Indian Side:

- Upgradation of Katihar and Bornagar substations from 400kV to 765kV

- Operation of Katihar - Parbotipur - Bornagar 765kV D/c line at its rated voltage
- Associated System Strengthening

Bangladesh Side:

- Upgradation of HVDC back-to-back substation at Parbotipur/Barapukuria (Bangladesh) by 1x500MW (total 2x500 MW)
- Upgradation of Parbotipur/Barapukuria substation from 400kV to 765kV

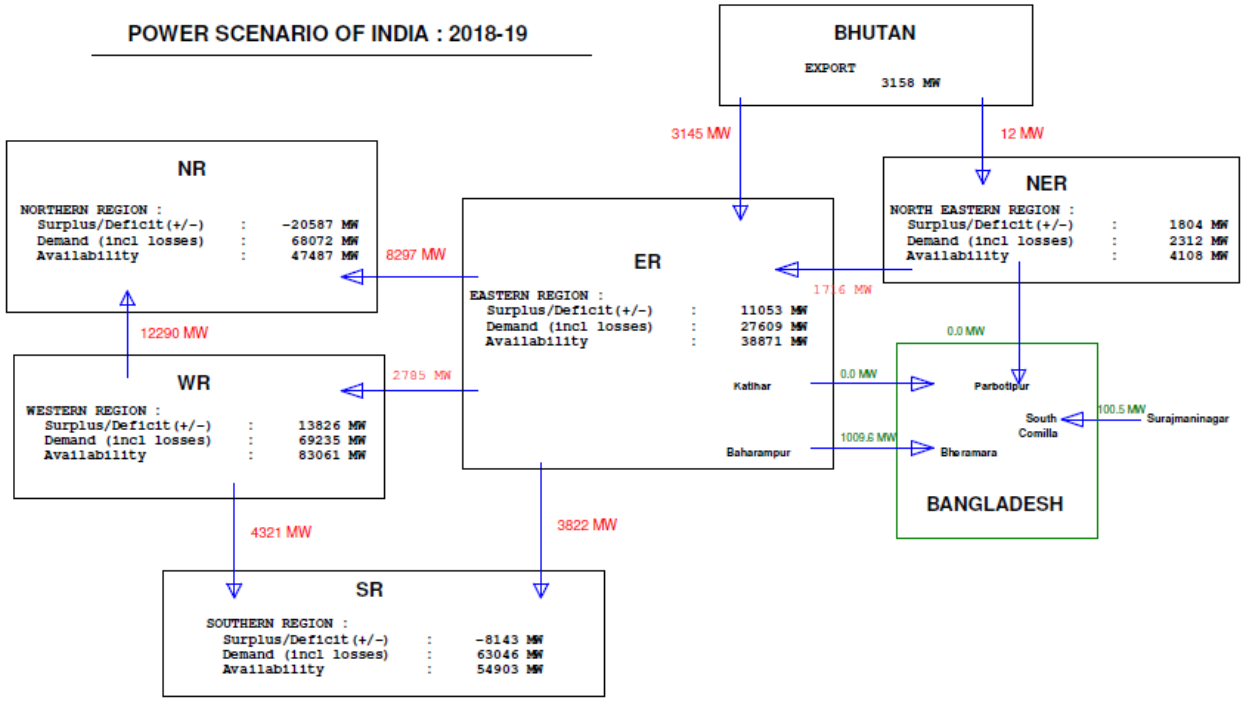
Phase-II would be taken up with the development of more generation projects in NER / northern part of ER. Additional system strengthening with Katihar & Bornagar in India and with Parbotipur/Barapukuria in Bangladesh may be required to ensure 1000MW power supply and dispersal to Bangladesh.

4.1 System Study – Indian Side

4.1.1 LGB Considered

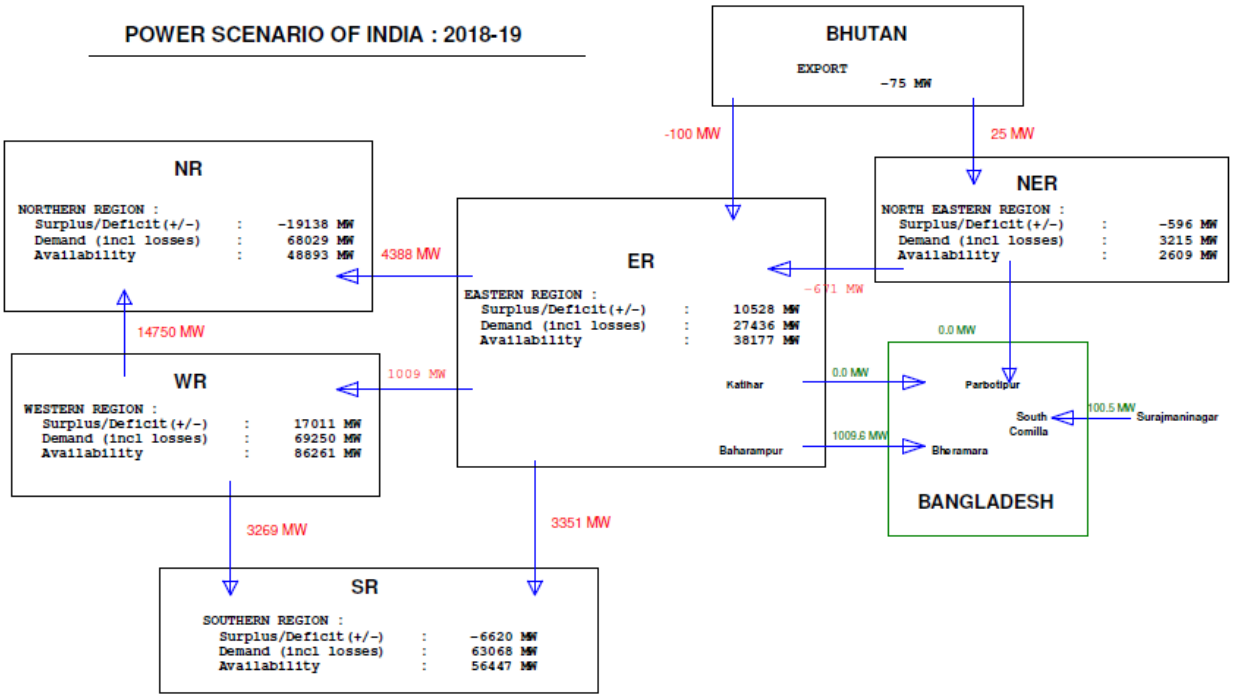
For the purpose of this study, two power scenarios have been considered, as mentioned below:

1. High Hydro – NER Surplus Scenario



In high hydro scenario, Eastern Region remains power surplus, thus to supply additional 500MW to Bangladesh, Eastern Region generation dispatch is increased.

2. Minimum Hydro and NER deficit Scenario



In this scenario, low hydro scenario with minimum dispatch has been simulated. The generation from Bongaigaon TPS and Pallatana GBPP is also scaled down to create about 600MW power deficit in NER. This is the most severe case where ER is feeding loads in NER and additional 1000MW power is to be fed.

In order to supply 500MW to Bangladesh, equivalent dispatch from thermal generations increased in Western Region.

4.1.2 Load Flow Study

Study results are tabulated below:

Sl. No.	Scenarios	Exhibit#
1	**High Hydro – NER Surplus** - **Base Case**:– No Interconnection - With 500MW export to Bangladesh	 1(a) 1(b)
2	**Minimum Hydro – NER Deficit** - **Base Case**:– No Interconnection - With 500MW export to Bangladesh	 2(a) 2(b)

Scenario-1: High Hydro Generation in ER & NER and Off-peak load in NER

In this scenario, additional power is supplied to Bangladesh from Eastern Region surplus. No critical loadings are observed in this case.

Scenario-2: Minimum Hydro Generation in ER & NER and Low Thermal generation in NER

In this scenario, only Minimum hydro generation dispatch has been considered, and half dispatch is considered from Bongaigaon TPS and Pallatana. Additional 500MW power is supplied to Bangladesh from thermal generation in Western Region.

Justification:

From the study results mentioned above, it is seen that there are no transmission bottlenecks envisaged at this stage in the various scenarios. The proposal appears to be technically feasible.

4.2 System Study: Parbotipur Interconnection – Bangladesh Side

Considering 1000 MW power import in two phases (500 MW in each phases) at Parbotipur from Katihar (near Purnea) – Parbotipur – Bornagar (Bongaigaon Assam) 765 kV link (operated at 400 kV initially), detail load flow study has been conducted for 2018 (Phase-I) and 2021 (Phase-II) to identify the system strengthening requirement in Bangladesh part. Several case studies have been done for normal and contingencies both for peak and off peak demand. The outcome of the load flow studies are tabulated below:

Case#	Scenario	Case Details	Observations
Case A	2018(Peak) 1x500 MW HVDC at Barapukuria (Attachment: Load flow diagram **Exhibit - 3A**)	(1) Planned network of 2018 **with** Loop In – Loop Out of Barapukuria – Bogra 230 kV line at Parbotipur 230kV Switchyard	Loading of related transmission lines are within limit.
		(2) Planned network of 2018 **with** Loop In – Loop Out of Barapukuria – Bogra 230 kV line at Parbotipur 230kV Switchyard ***Outage* of *Serajganj-Sripur 230kV S/C***	Loading of related transmission lines are within limit.
		(3) Planned network of 2018 **with** Loop In – Loop Out of Barapukuria – Bogra 230 kV line at Parbotipur 230kV Switchyard ***Outage* of *Parbotipur(Barapukuria)-Bogra 230kV S/C***	Loading of related transmission lines are within limit
Case B	2018 (Offpeak) 1x500 MW HVDC at Barapukuria (Attachment: Load	(1) Planned network of 2018 **with** Loop In – Loop Out of Barapukuria – Bogra 230 kV line at Parbotipur 230kV Switchyard	Loading of related transmission lines are within limit

	flow diagram **Exhibit -3B**)	(2) Planned network of 2018 **with** Loop In – Loop Out of Barapukuria – Bogra 230 kV line at Parbotipur 230kV Switchyard ***Outage of Serajganj-Sripur 230kV S/C***	Loading of related transmission lines are within limit
		3) Planned network of 2018 **with** Loop In – Loop Out of Barapukuria – Bogra 230 kV line at Parbotipur 230kV Switchyard ***Outage of Parbatipu(Barapukuria)-Bogra 230kV S/C***	*Parbatipu(Barapukuria)-Bogra second circuit is overloaded.Which can be minimized by reducing some generation /Import at Barapukuria area.*
Case C	2021(Peak) 2x500 MW HVDC at Barapukuria (Attachment: Load flow diagram **Exhibit -4A**)	(1) Planned network of 2021 **without** new Infrastructure	Line Loading: • Serajganj-Sripur 230kV Line Highly Loaded • Parbatipur -Bogra 230kV Line Highly Loaded
		(2) Planned network of 2021 **with** - New Bogra-Kalikoir 400kV Double Ckt line energized at 230kV	Line Loading: • Parbatipur -Bogra 230kV Line Highly Loaded
		(3) Planned network of 2021 **with** - New Bogra-Kalikoir 400kV Double Ckt. line and Parbatipur-Bogra 400 kV double ckt both energized at 230kV	Line Loading: • Loading of related transmission lines are within limit
		(4) Planned network of 2021 **with** - New Bogra-Kaliakoir 400kV Double Ckt. line energized at 230kV ***Outage* of *Serajganj-Sripur 230kV S/C***	Line Loading: Loading of related transmission lines are within limit
Case D	2021 (Offpeak) 2x500 MW HVDC at Barapukuria (Attachment: Load flow diagram **Exhibit -4B)**	(1) Planned network of 2021 **with** -New Parbatipur (Barapukuria)-Bogra 400kV Double Ckt line energized at 230kV - New Bogra-Kaliakoir 400kV Double Ckt line energized at 230kV	Line Loading: Loading of related transmission lines are within limit
		(2) Planned network of 2021 **with** - New Parbatipur (Barapukuria)-Bogra 400kV Double Ckt line energized at 230kV - New Bogra-Kaliakoir 400kV Double Ckt line energized at 230kV ***Outage* of *Serajganj-Sripur 230kV S/C***	Line Loading: Remaining ckt is overloaded which will have to be reduced by minimizing Import/Generation.

Additional Network Strengthening requirement in Bangladesh side ;

From the above mentioned load flow study results, it is envisaged that in addition to planned transmission facilities, the following additional system strengthening will be required in two phases :

Phase-I : By 2018

a) Approximately 190 km of Bornagar-Parbotipur and Katihar – Parbotipur 765 kV (Hexa Zebra) double circuit transmission line in Bangladesh territory (to be energized at 400 kV)
b) 500 MW Back –to-Back (400 kV – 400 kV) HVDC Station at Parbotipur
c) 400/230 kV 750 MVA (4x250 MVA single phase ICTs) substation at Parbotipur
d) Loop In – Loop Out of Barapukuria – Bogra 230 kV double circuit line at Parbotipur 230kV Switchyard.

Phase-II : By 2021

a) 765/400kV substation at Parbotipur with 1500MVA (4x500 MVA, 1 ph) ICT along with associated 765kV bay and 4 nos. 765kV line bays for termination of Bornagar-Parbotipur and Katihar – Parbotipur 765kV D/c lines.
b) Energization of 190 km of Bornagar-Parbotipur and Katihar – Parbotipur 765 kV (Hexa Zebra) double circuit transmission lines in Bangladesh territory at its rated voltage
c) 500 MW HVDC Back-to-Back (400 kV – 400 kV) 2nd block at Parbotipur
d) Capacity enhancement of 400/230 kV Parbotipur substation by 750 MVA (3x250 MVA single phase ICTs)
e) Parbotipur (Barapukuria) – Bogra – Kaliakoir 400 kV (to be energized at 230 kV) 260 km double ckt transmission line.
f) New 230 kV switchyard at the location of proposed Bogra 400/230 kV substation.
g) Two 230 kV bay extension at Kaliakoir substation.

Note: 1000 MW import can be absorbed in 230 kV system. When Bogra 400/230 kV substation will be ready, Parbotipur – Bogra – Kaliakoir section will be energized at 400 kV.

Study results are attached at Exhibit–3 & 4 for 500MW and 1000MW import respectively.

5.0 Conclusion

Studies have been carried to explore the feasibility of additional interconnections between additional transmission interconnections from India to Bangladesh and the following has been observed:

i. Additional power export to Bangladesh through Surajmaninagar (Tripura) - North Comilla (Bangladesh) Interconnection

In view of the transmission constraints on Bangladesh and Indian side, additional power may not be transferred from Tripura side to Bangladesh in the present configuration with N-1 reliability.

ii. Interconnection of south-western part of Bangladesh with Eastern Region of India

It is recommended that due to transmission constraint in southern part of West Bengal Area, at present additional interconnection may not be feasible between Eastern Region of India and south-western part of Bangladesh.

iii. Interconnection of Northern part of Bangladesh with Indian Grid

High Capacity AC Transmission interconnection has been planned to connect Parbotipur/Barapukuria in Bangladesh to Katihar in ER and Bornagar in NER through 765kV D/c line to be initially operated at 400kV for supply of 500MW power to Bangladesh in Phase-I. Bangladesh will draw the power at Parbotipur/Barapukuria through HVDC back to back for further dispersal of the same to their load centre.

The following transmission system has been identified for supply of 500MW power to Bangladesh in Phase-I :

Interconnection of Indian Grid with Northern part of Bangladesh

Indian Side:

- New 400kV substation (upgradable to 765kV at a later date) at Bornagar (Assam) with LILO of Balipara - Bongaigaon 400kV D/c (quad) line.
- Disconnection of Alipurduar-Bongaigaon 400kV D/c (quad) line from Bongaigaon and extension of the same to Bornagar with 400kV Dlc (quad) line so as to form Alipurduar-Bornagar 400kV D/c (quad) line.
- New 400kV substation (upgradable to 765kV at a later date) at Katihar (Bihar) with LILO of both ckts of Purnea - Rajarhat 400kV D/c (triple snowbird) line (one ckt via Gokarna and other ckt via Farakka).

- Katihar (ER) - Parbotipur (Bangladesh) - Bornagar (NER) 765kV D/c line to be initially operated at 400KV [160 + 260 km]

Bangladesh Side:

- Approximately 190 km of Bornagar-Parbotipur and Katihar – Parbotipur 765 kV (Hexa Zebra) double circuit transmission line in Bangladesh territory (to be energized at 400 kV)
- 500 MW Back-to-Back (400 kV – 400 kV) HVDC Station at Parbotipur
- 400/230 kV 750 MVA (4x250 MVA single phase ICTs) substation at Parbotipur
- Loop In – Loop Out of Barapukuria- Bogra 230 kV double circuit line at Parbotipur 230 kV Switchyard.

For additional 500MW power (total 1000MW) export to Bangladesh in Phase-2, the following transmission system strengthening has been identified in Bangladesh :

- 765/400kV substation at Parbotipur with 1500MVA (4x500 MVA, 1 ph) ICT along with associated 765kV bay and 4 nos. 765kV line bays for termination of Bornagar-Parbotipur and Katihar – Parbotipur 765kV D/c lines.
- Energization of 190 km of Bornagar-Parbotipur and Katihar – Parbotipur 765 kV (Hexa Zebra) double circuit transmission lines in Bangladesh territory at its rated voltage
- 500 MW HVDC Back-to-Back (400 kV – 400 kV) 2nd block at Parbotipur
- Capacity enhancement of 400/230 kV Parbotipur substation by 750 MVA. (3x250 MVA single phase ICTs)
- Parbotipur (Barapukuria) – Bogra – Kaliakoir 400 kV (to be energized at 230 kV) 260 km double circuit transmission line.

  [When Bogra 400/230 kV substation will be ready, Parbotipur – Bogra – Kaliakoir section will be energized at 400 kV.]
- New 230 kV switchyard at the location of proposed Bogra 400/230 kV substation.
- Two 230 kV bay extension at Kaliakoir substation.

Suitable system strengthening would be identified in Indian side to enable transfer of 1000MW of power along with upgradation of this link to its rated voltage at a later date.

This JTT report would be submitted to JSC/JWG prior to the next JWG/JSC meeting on cooperation of power sector between the India and Bangladesh.

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