# Bihar: Transmission System Study for 13th Plan

## 1. Introduction

Presently, the unrestricted demand of the state of Bihar is of the order of 4500MW and demand met is about 3500MW. The state has been experiencing high power demand growth in recent times. Further, large scale system strengthening works are being carried out at sub-transmission and distribution level which will further enhance the power demand. Additionally, numbers of central sector generation project are under construction in ER from which Bihar has substantial amount of share:

| Sl. No. | Project | Unit Size | Installed Capacity (in MW) | Bihar Share (ex-bus in MW) | Commissioning Schedule |
|---|---|---|---|---|---|
| 1 | Barh-I & II | 3x660<br>2x660 | 1320+<br>1980 | 1883 | Uncertain<br>Commissioned |
| 2 | Nabinagar-I | 4x250 | 1000 | 100 | 2016-17 |
| 3 | Nabinagar-II | 3x660 | 1980 | 1295 (+169) | 2017-18 |
| 4 | North Karanpura | 3x660 | 1980 | 645 | 2018-19 |
| 5 | Darlipalli | 2x800 | 1600 | 154 | 2018-19 |
| 6 | Talcher-III | 2x660 | 1320 | 140 | 2019-20 |
| | | **Total** | **11180** | **3741 (ex-bus)** | |

Under the Govt. of India initiative of 24x7 power to all by 2018-19, power demand of Bihar is expected to increase to 8774 MW (50% agriculture load). This demand is expected to rise further on account of 100% segregation of the agriculture feeder and by 2021-22 (13th Plan end) demand of the state is expected to be about 11,000MW.

Accordingly, system studies have been carried out for 2021-22 time-frame for Bihar grid to identify the system strengthening requirements.

New state sector generation projects expected by 2021-22 are:

| Generation Complex | Existing | Addition | Schedule | Total |
|---|---|---|---|---|
| Muzaffarpur/Kanti (MTPS) | 2x110MW | 2x195MW | Oct'16/Dec'16 | 610MW |
| Barauni (BTPS) | 2x110MW | 2x250MW | Dec'16 | 720MW |

Further, three numbers of generation projects (Case-II bidding) at Buxar, Lakhisarai and Pirpainti each of 1320MW (2x660MW) capacity are also under consideration in Bihar and are expected by end of 2022.

## 2. Load Flow Study and Study Results

Following three no. of case studies have been performed:

(a) Base Case (2021-22) [without any additional strengthening]
(b) With new required system strengthening
(c) With new required system strengthening + Generation Linked scheme for three Case-II IPPs

All approved and under construction transmission system in Bihar by state and ISTS were considered in base case and the study results are at **Exhibit-1 (a) & (b)**.

High load growth in expected in the following areas as per data from BSPTCL and from base case study results it has been observed that numbers of transmission lines and ICTs are overloaded in these areas:

(i) West Champaran, East Champaran and Sitamarhi dist. – Motihari & Sitamarhi areas
(ii) Gaya, Aurangabad, Rohtas and Kaimur (Bhabua) districts – Gaya & Sasaram areas
(iii) Saharsa, Khagaria and Begusarai districts
(iv) Patna district

In view of the above, new 400kV substations have been proposed at Sitamarhi, Chandauti and Saharsa and new 220kV substations have been proposed at Karmnasa, Motihari and Korha (near Katihar).For Patna area three new 400kV substations were already evolved along with 12$^{th}$system. Space availability in and around state capital was reviewed and a modified scheme has been worked out.

Load flow study results with proposed new transmission system and system strengthening required in Bihar Grid to meet the 13$^{th}$ Plan end load of about 11,000MW is at **Exhibit-2 (a) & (b)**.

Following new transmission system and system strengthening is required in Bihar Grid for 13$^{th}$ Plan:

### A. New Substations

**1. Sitamarhi (New) S/s: 400/220/132kV, 2x500MVA + 2x200MVA**

(a) Darbhanga – Sitamarhi (New) 400kV D/c (Triple Snowbird)

(b) Sitamarhi(New) – Motihari 400kV D/c (Triple Snowbird)

(c) Sitamarhi(New) – Motipur 220kV D/c

(d) Sitamarhi (New) – Sitamarhi 132kV D/c (Single Moose)

(e) Sitamarhi(New) – Pupri 132kV D/c

**2. Motihari (New) S/s: 220/132kV, 2x200MVA**

(a) Sitamarhi(New) – Motihari (New) 220kV D/c (Twin Moose)

(b) Motihari (New) – Gopalganj 220kV D/c(Twin Moose)

(c) Motihari (New) – Raxaul 132kV D/c

(d) Motihari (New) – Betiah 132kV D/c (Single Moose)

**3. Chandauti (New) S/s: 400/220/132kV, 3x500MVA + 3x200MVA**

(a) LILO of Nabinagar-II – Gaya 400kV D/c (Quad) at Chandauti (New)

(b) LILO of Gaya (POWERGRID) – Sonenagar 220kV D/c at both Bodhgaya (BSPTCL)and Chandauti (New) substations, so as to form Gaya (POWERGRID) – Bodhgaya (BSPTCL) – Chandauti (New) – Sonenagar 220kV D/c line

(c) Reconductoring of Chandauti – Rafiganj– Sonenagar132kV S/c line with HTLS conductor of 240MVA (ampacity - 1050A)

(d) LILO of Chandauti – Rafiganj 132kV S/c line at Chandauti (New)

(e) Reconductoring of Chandauti – Sonenagar 132kV S/c line with HTLS conductor of 240MVA (ampacity - 1050A)

(f) LILO of Chandauti – Sonenagar 132kV S/c line at Chandauti (New)

**4. Karmanasa (New) 220/132kV S/s: 2x200MVA**

(a) LILO of Sasaram – Sahupuri 220kV S/c at Karmnasa (New)

(b) Karmnasa (New) – Pusauli (BSPTCL) 220kV D/c line (Twin Moose)

(c) Karmnasa (New) – Mohania 132kV D/c (Single Moose)

(d) Karmnasa (New) – Karmnasa 132kV D/c (Single Moose)

**5. Saharsa (New) 400/220/132kV S/s: 2x500MVA + 2x200MVA**

(a) LILO of Kishanganj – Patna 400kV D/c (Quad) at Saharsa (New)

(b) Saharsa (New) – Begusarai 220kV D/c

(c) Saharsa (New) – Khagaria (New) 220kV D/c

(d) Saharsa (New) – Saharsa 132kV D/c (Single Moose)

**6. Upgradation of Korha (New) 132/33kV to 220/132kV S/s with 2x100MVA* ICT**

(a) LILO of Purnea (POWERGRID) – Khagaria (New) 220kV D/c at Korha (New)

** To be utilised from ICTs available after replacement in other substations*

## B. ICT Augmentation

### (a) POWERGRID / ISTS ICT Augmentations

| Substation | kV-1 | kV-2 | Rating | Loading | N-1 Loading | Addition |
|---|---|---|---|---|---|---|
| Banka-PG | 132 | 400 | 2x200 | 2x169 | 238 | 3rd315 ICT |
| Biharsharif- B | 220 | 400 | 315 | 2x155 | - | 2nd500 ICT |

| Substation | kV-1 | kV-2 | Rating | Loading | N-1 Loading | Addition |
|---|---|---|---|---|---|---|
| Lakhisarai-PG | 132 | 400 | 2x200 | 2x188 | 213 | 3rd315 ICT |
| Motihari-New | 132 | 400 | 2x200 | 2x81 | 265 | 3rd315 ICT |

### (b) BSPTCL ICT Augmentations

| Substation | kV - 1 | kV -2 | Rating | Loading | N-1 Loading | Addition | Replace-ment |
|---|---|---|---|---|---|---|---|
| Bihta New | 132 | 220 | 2x160 | 2x180 | 257 | 3rd200 ICT | |
| Chapra New | 132 | 220 | 2x160 | 2x116 | 175 | 3rd160 ICT | |
| Darbhanga | 132 | 220 | 2x160 | 2x159 | 232 | 3rd160 ICT | |
| Gopalganj | 132 | 220 | 3x100 | 3x93 | 119 | | 3x100 by 3x200 |
| Hazipur | 132 | 220 | 3x100 | 3x88 | 108 | | 3x100 by 3x200 |
| Khagaul | 132 | 220 | 4x100 | 4x126 | 150 | | 4x100 by 4x200 |
| Kishanganj New | 132 | 220 | 2x160 | 2x162 | 238 | 3rd160 ICT | |
| Sipara | 132 | 220 | 2x150+1x160 | 2x142 +151 | 170 | | 2x150+160 by 3x200 |
| Sonenagar | 132 | 220 | 2x160 | 2x147 | 205 | 3rd160 ICT | |

After proposed ICT augmentations transformation capacity at various levels shall be as below (details at **Appendix-1**):

| Transformation Level | Capacity (in MVA) |
|---|---|
| 765/400kV | 7500 |
| 400/220kV | 15390 |
| 400/132kV | 2745 |
| 220/132kV | 17050 |
| 220/33kV | 200 |

## C. Re-conductoring of lines with HTLS

### (a) 220kV lines

1. Purnea – Purnea (New) 220kV D/c (line of POWERGRID)

### (b) 132kV lines with HTLS of 240MVA (1050A ampacity) – BSTPCL lines

1. Kanti – SKMCH 132kV D/c
2. Dehri – Banjari 132kV S/c

3. Barauni – Begusarai 132kV D/c
4. Mithapur – Karbhigaiya 132kV S/c
5. Arrah (POWERGRID) – Arrah 132kV S/c
6. Lakhisarai (POWERGRID) – Lakhisarai 132kV D/c
7. Chhapra (New) – Chhapra 132kV D/c
8. Kishanganj (Old) – Kishanganj (New) 132kV D/c
9. Chandauti – Tekari 132kV D/c
10. Kahalgaon – Sabour 132kV S/c
11. Kahalgaon – Kahalgaon (BSPTCL) 132kV S/c
12. Dehri – Sonenagar 132kV D/c
13. Biharsharif – Baripahari 132kV D/c

## D. Stringing of 2nd Circuit

1. Stringing of 2nd circuit of Saharsa – Sonebarsa 132kV S/c on D/c
2. Stringing of 2nd circuit of Muzaffarpur – SKMCH 132kV S/c on D/c

## E. Scheme modification

| Sl. No. | Old Scheme | New Scheme |
|---|---|---|
| 1 | Banka – Banka (New) 132kV D/c | Banka (POWERGRID) – Banka (New) 132kV D/c with HTLS |
| 2 | Bihta – Bihta (New) 132kV D/c with Panther | Bihta – Bihta (New) 132kV D/c with HTLS of 240MVA |
| 3 | Motihari (ISTS) – Motihari 132kV D/c (Panther) | Motihari (ISTS) – Motihari 132kV D/c with HTLS of 240MVA |

## F. New lines

1. Muzaffarpur – Chhapra 220kV D/c
2. Laukhi – Phulparas 132kV D/c (HTLS)
3. Vaishali – Hazipur 132kV D/c

## G. Issues

(a) It is proposed to re-conductor Khagaul – Digha and Bihta – Digha132kV S/c lines to feed about 250MW load of Digha. However, the same is not feasible as informed by BSPTCL. Needs to be resolved.

## H. Generation Linked Scheme

Transmission system for three new Case-II IPPs at Buxar, Lakhisarai and Pirpainti was evolved along with identification of transmission system requirement for meeting 12th Plan end load demand. The same evacuation system has been considered along with above proposed 13th Plan system and the study results are at **Exhibit-3 (a) & (b)**.

**Appendix-1**

| Substation | Voltage Level | | Id | Rating |
|---|---|---|---|---|
| GAYA-PG | 765 | 400 | 1 | 1500 |
| GAYA-PG | 765 | 400 | 2 | 1500 |
| GAYA-PG | 765 | 400 | 3 | 1500 |
| GAYA-PG | 765 | 400 | 4 | 1500 |
| SASARAM-ER | 765 | 400 | 1 | 1500 |
| **Total** | | | | **7500** |
| PATNA | 400 | 220 | 1 | 500 |
| PATNA | 400 | 220 | 2 | 500 |
| BIHARSHARIF-A | 400 | 220 | 1 | 315 |
| BIHARSHARIF-A | 400 | 220 | 2 | 315 |
| BIHARSHARIF-B | 400 | 220 | 1 | 315 |
| BIHARSHARIF-B | 400 | 220 | 2 | 500 |
| GAYA-PG | 400 | 220 | 1 | 315 |
| GAYA-PG | 400 | 220 | 2 | 500 |
| GAYA-PG | 400 | 220 | 3 | 500 |
| MUZAFARPR-PG | 400 | 220 | 1 | 315 |
| MUZAFARPR-PG | 400 | 220 | 2 | 315 |
| MUZAFARPR-PG | 400 | 220 | 3 | 500 |
| SASARAM-PG | 400 | 220 | 1 | 500 |
| SASARAM-PG | 400 | 220 | 2 | 500 |
| SAHARSA NEW | 400 | 220 | 1 | 500 |
| SAHARSA NEW | 400 | 220 | 2 | 500 |
| PURNEA-NW-PG | 400 | 220 | 1 | 500 |
| PURNEA-NW-PG | 400 | 220 | 2 | 500 |
| BAKHTIYR-NEW | 400 | 220 | 1 | 500 |
| BAKHTIYR-NEW | 400 | 220 | 2 | 500 |
| SITAMARHI NW | 400 | 220 | 1 | 500 |
| SITAMARHI NW | 400 | 220 | 2 | 500 |
| DARBHANG-NEW | 400 | 220 | 1 | 500 |
| DARBHANG-NEW | 400 | 220 | 2 | 500 |
| KISHENGAN-PG | 400 | 220 | 1 | 500 |
| KISHENGAN-PG | 400 | 220 | 2 | 500 |
| NAUBATPUR | 400 | 220 | 1 | 500 |
| NAUBATPUR | 400 | 220 | 2 | 500 |
| JAKKANPUR-NW | 400 | 220 | 1 | 500 |
| JAKKANPUR-NW | 400 | 220 | 2 | 500 |
| CHANDAUTI NW | 400 | 220 | 1 | 500 |
| CHANDAUTI NW | 400 | 220 | 2 | 500 |
| CHANDAUTI NW | 400 | 220 | 3 | 500 |
| **Total** | | | | **15390** |
| BANKA-PG | 400 | 132 | 1 | 200 |
| BANKA-PG | 400 | 132 | 2 | 200 |
| BANKA-PG | 400 | 132 | 3 | 315 |
| LAKHISRA-PG | 400 | 132 | 1 | 315 |

| Substation | Voltage Level | | Id | Rating |
|---|---|---|---|---|
| LAKHISRA-PG | 400 | 132 | 2 | 200 |
| LAKHISRA-PG | 400 | 132 | 3 | 200 |
| MOTIHARI-NEW | 400 | 132 | 1 | 200 |
| MOTIHARI-NEW | 400 | 132 | 2 | 200 |
| MOTIHARI-NEW | 400 | 132 | 3 | 315 |
| #KAHALGAON-B | 400 | 132 | 1 | 200 |
| #KAHALGAON-B | 400 | 132 | 2 | 200 |
| #BARH | 400 | 132 | 1 | 200 |
| **Total** | | | | **2745** |
| #KANTI | 220 | 132 | 1 | 100 |
| #KANTI | 220 | 132 | 2 | 100 |
| #KANTI | 220 | 132 | 3 | 100 |
| SAMASTPR NEW | 220 | 132 | 1 | 160 |
| SAMASTPR NEW | 220 | 132 | 2 | 160 |
| HAZIPUR | 220 | 132 | 1 | 200 |
| HAZIPUR | 220 | 132 | 2 | 200 |
| HAZIPUR | 220 | 132 | 3 | 200 |
| FATUHA | 220 | 132 | 1 | 100 |
| FATUHA | 220 | 132 | 2 | 100 |
| FATUHA | 220 | 132 | 3 | 100 |
| FATUHA | 220 | 132 | 4 | 100 |
| FATUHA | 220 | 132 | 5 | 100 |
| BIHARSARIF | 220 | 132 | 1 | 150 |
| BIHARSARIF | 220 | 132 | 2 | 150 |
| BIHARSARIF | 220 | 132 | 3 | 150 |
| KHAGAUL | 220 | 132 | 1 | 200 |
| KHAGAUL | 220 | 132 | 2 | 200 |
| KHAGAUL | 220 | 132 | 3 | 200 |
| KHAGAUL | 220 | 132 | 4 | 200 |
| BODHGAYA | 220 | 132 | 1 | 150 |
| BODHGAYA | 220 | 132 | 2 | 150 |
| BODHGAYA | 220 | 132 | 3 | 150 |
| BODHGAYA | 220 | 132 | 4 | 150 |
| BODHGAYA | 220 | 132 | 5 | 160 |
| DEHRI | 220 | 132 | 1 | 100 |
| DEHRI | 220 | 132 | 2 | 100 |
| DEHRI | 220 | 132 | 3 | 100 |
| DEHRI | 220 | 132 | 4 | 100 |
| BEGUSRAI | 220 | 132 | 1 | 100 |
| BEGUSRAI | 220 | 132 | 2 | 100 |
| BEGUSRAI | 220 | 132 | 3 | 100 |
| BEGUSRAI | 220 | 132 | 4 | 100 |
| KARAMNASA | 220 | 132 | 1 | 200 |
| KARAMNASA | 220 | 132 | 2 | 200 |
| PURNEA-PG | 220 | 132 | 1 | 160 |

| Substation | Voltage Level | | Id | Rating |
|---|---|---|---|---|
| PURNEA-PG | 220 | 132 | 2 | 160 |
| PURNEA-PG | 220 | 132 | 3 | 160 |
| KHIZIRSARAI | 220 | 132 | 1 | 160 |
| KHIZIRSARAI | 220 | 132 | 2 | 160 |
| BIHTA NEW | 220 | 132 | 1 | 200 |
| BIHTA NEW | 220 | 132 | 2 | 160 |
| BIHTA NEW | 220 | 132 | 3 | 160 |
| #BARAUNI | 220 | 132 | 1 | 150 |
| #BARAUNI | 220 | 132 | 2 | 150 |
| SONENAGAR | 220 | 132 | 1 | 160 |
| SONENAGAR | 220 | 132 | 2 | 160 |
| SONENAGAR | 220 | 132 | 3 | 160 |
| PUSAULI BSPT | 220 | 132 | 1 | 150 |
| PUSAULI BSPT | 220 | 132 | 2 | 150 |
| SIPARA | 220 | 132 | 1 | 200 |
| SIPARA | 220 | 132 | 2 | 200 |
| SIPARA | 220 | 132 | 3 | 200 |
| MADHEPURA | 220 | 132 | 1 | 100 |
| MADHEPURA | 220 | 132 | 2 | 100 |
| MADHEPURA | 220 | 132 | 3 | 100 |
| MADHEPURA | 220 | 132 | 4 | 100 |
| DUMRAON NW | 220 | 132 | 1 | 160 |
| DUMRAON NW | 220 | 132 | 2 | 160 |
| ARRAH-PG | 220 | 132 | 1 | 100 |
| ARRAH-PG | 220 | 132 | 2 | 100 |
| ARRAH-PG | 220 | 132 | 3 | 160 |
| DARBHANGA | 220 | 132 | 1 | 160 |
| DARBHANGA | 220 | 132 | 2 | 160 |
| DARBHANGA | 220 | 132 | 3 | 160 |
| CHAPRA NEW | 220 | 132 | 1 | 160 |
| CHAPRA NEW | 220 | 132 | 2 | 160 |
| CHAPRA NEW | 220 | 132 | 3 | 160 |
| GOPALGANJ | 220 | 132 | 1 | 200 |
| GOPALGANJ | 220 | 132 | 2 | 200 |
| GOPALGANJ | 220 | 132 | 3 | 200 |
| LAUKHI | 220 | 132 | 1 | 160 |
| LAUKHI | 220 | 132 | 2 | 160 |
| SABOUR-NEW | 220 | 132 | 1 | 160 |
| SABOUR-NEW | 220 | 132 | 2 | 160 |
| JAMALPUR NEW | 220 | 132 | 1 | 160 |
| JAMALPUR NEW | 220 | 132 | 2 | 160 |
| KISH-NW-BSEB | 220 | 132 | 1 | 160 |
| KISH-NW-BSEB | 220 | 132 | 2 | 160 |
| KISH-NW-BSEB | 220 | 132 | 3 | 160 |
| SITAMARHI NW | 220 | 132 | 1 | 200 |

| Substation | Voltage Level | | Id | Rating |
|---|---|---|---|---|
| SITAMARHI NW | 220 | 132 | 2 | 200 |
| MOTIHAR1 NW | 220 | 132 | 1 | 200 |
| MOTIHAR1 NW | 220 | 132 | 2 | 200 |
| BAKHTIYR-NEW | 220 | 132 | 1 | 160 |
| BAKHTIYR-NEW | 220 | 132 | 2 | 160 |
| KHARWA-NWADA | 220 | 132 | 1 | 320 |
| MOTIPUR | 220 | 132 | 1 | 160 |
| MOTIPUR | 220 | 132 | 2 | 160 |
| SHEKHPURA NW | 220 | 132 | 1 | 160 |
| SHEKHPURA NW | 220 | 132 | 2 | 160 |
| MUSHAR-SKMNW | 220 | 132 | 1 | 160 |
| MUSHAR-SKMNW | 220 | 132 | 2 | 160 |
| HATIDAH-NEW | 220 | 132 | 1 | 160 |
| HATIDAH-NEW | 220 | 132 | 2 | 160 |
| JAKKANPUR-NW | 220 | 132 | 1 | 160 |
| JAKKANPUR-NW | 220 | 132 | 2 | 160 |
| JAKKANPUR-NW | 220 | 132 | 3 | 160 |
| KORHA | 220 | 132 | 1 | 100 |
| KORHA | 220 | 132 | 2 | 100 |
| KHAGARIA NEW | 220 | 132 | 1 | 160 |
| KHAGARIA NEW | 220 | 132 | 2 | 160 |
| CHANDAUTI NW | 220 | 132 | 1 | 200 |
| CHANDAUTI NW | 220 | 132 | 2 | 200 |
| CHANDAUTI NW | 220 | 132 | 3 | 200 |
| SAHARSA NEW | 220 | 132 | 1 | 200 |
| SAHARSA NEW | 220 | 132 | 2 | 200 |
| NAUBATPUR | 220 | 132 | 1 | 160 |
| NAUBATPUR | 220 | 132 | 2 | 160 |
| **Total** | | | | **17050** |
| BHUSAULA | 220 | 33 | 1 | 100 |
| BHUSAULA | 220 | 33 | 2 | 100 |
| **Total** | | | | **200** |

[#] : Generation Switchyard