# Transmission Development in Indian Power Sector

# Present Supply Scenario

- Infrastructure growth remains the overriding priority for India Power Sector has a pivotal role to play

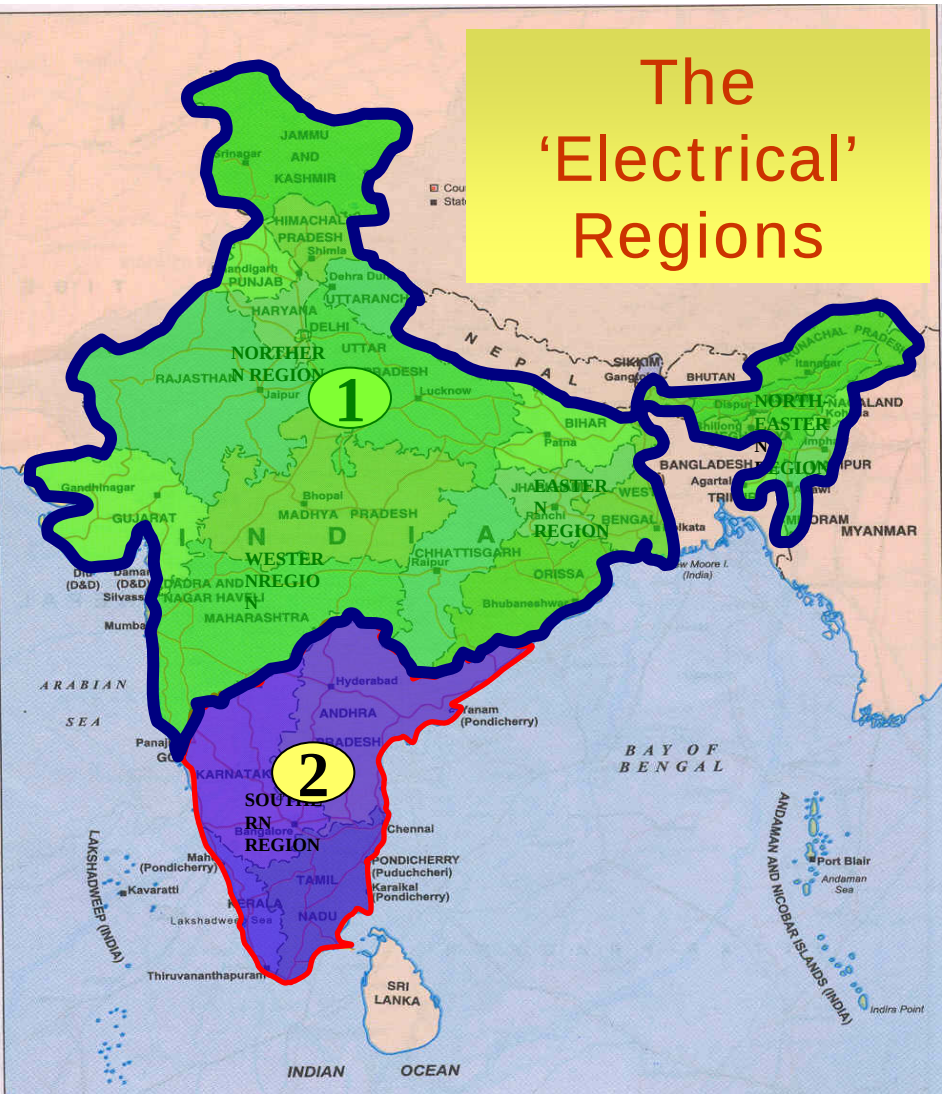
## Present Power Scenario

| | | |
|---|---|---|
| Installed Capacity | : | **159,400 MW** |
| Peak Power Demand | : | **118,000 MW** |
| Peak availability | : | **103,000 MW** |

## Generation Mix

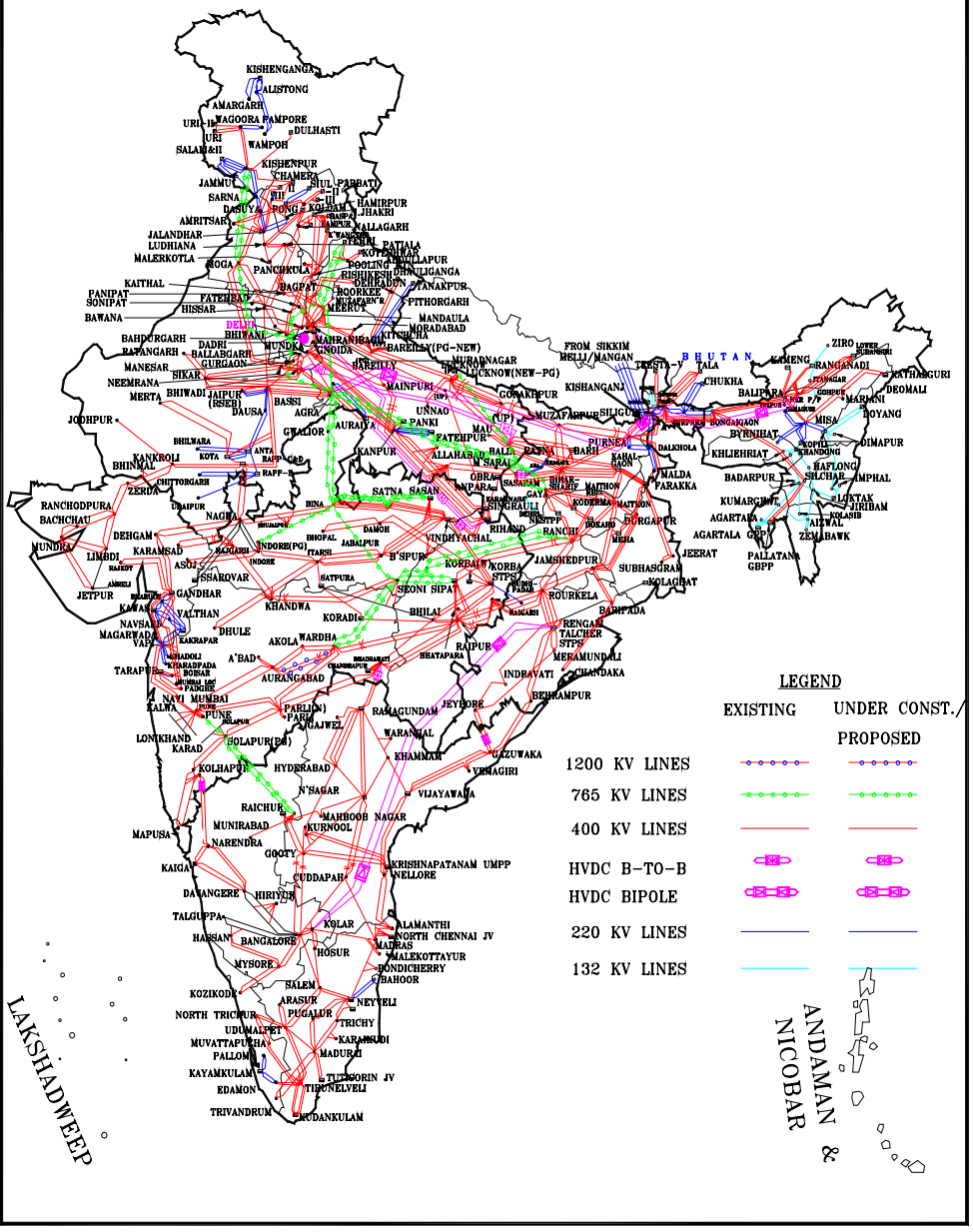
| | | | | |
|---|---|---|---|---|
| Thermal | 102450 MW(64%) | | Central | 50992 MW (32%) |
| Hydro | 36860 MW (23%) | | State | 79394 MW (50%) |
| Nuclear | 4560 MW(3%) | | Private | 29014 MW (18%) |
| RES | 15530 MW(10%) | | | |
| **TOTAL** | **159400 MW** | | | **159400 MW** |

# Transmission Network - Present




- Transmission network spread geographically over 3.3 million sq kms
- 765kV/400kV lines: 1,00,916 ckms
- 220kV lines: 1,28,000 ckms
- HVDC Bipole (±500kV) : 7,500 ckms
- National Grid – Inter-regional capacity: 20,800MW

# POWER MAP OF INDIA




# POWERGRID Transmission Network - Present

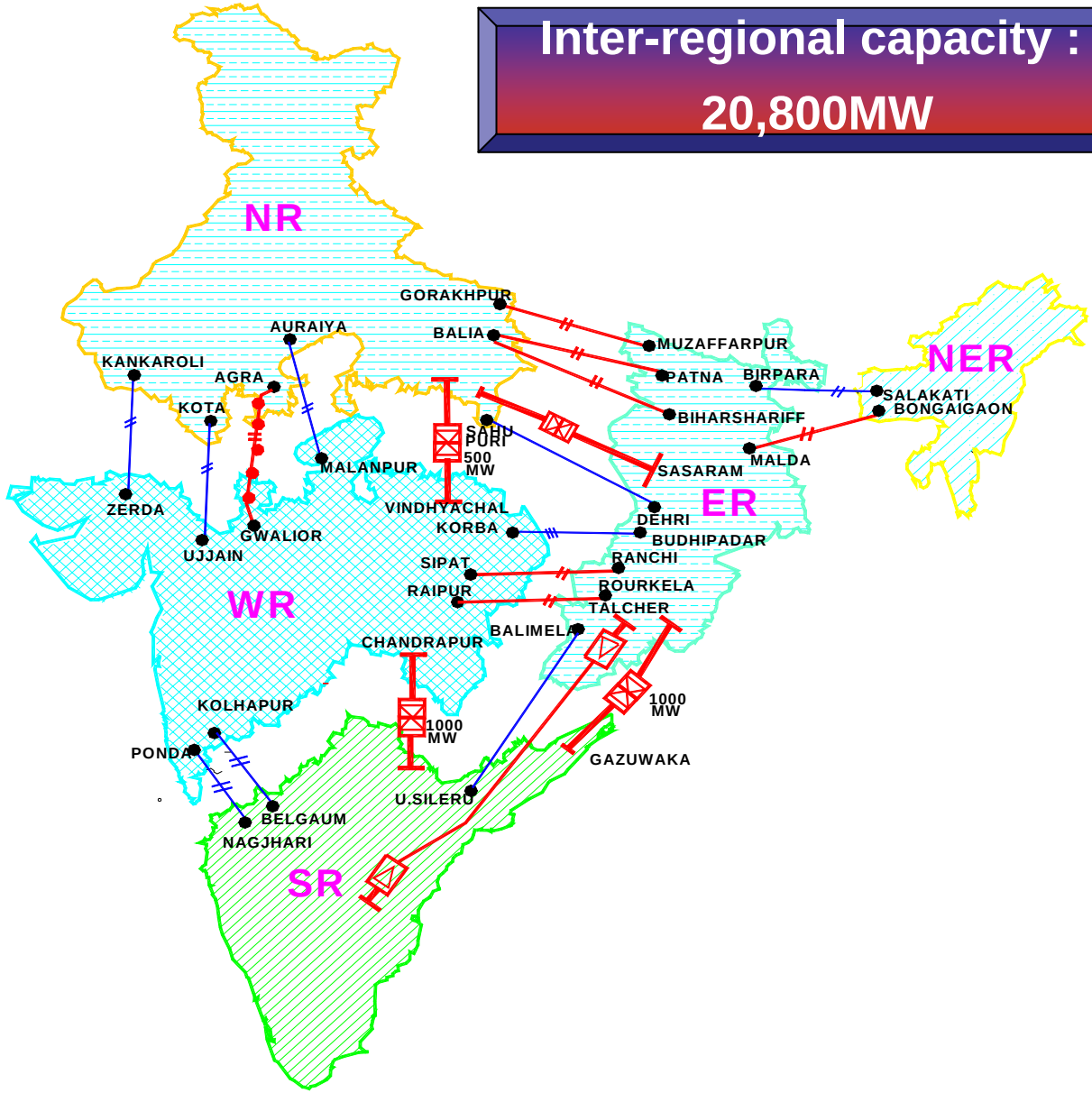
- 400kV Backbone Trans. Network - about 60,500 ckm (220kV: 10,000 ckm)
- Overlaying 765kV AC and 500kV HVDC system - about 7,000 ckm
- Substations 400kV & above – 131 nos. with 89,000 MVA
- 2 nos. HVDC Bipole (4000 MW) and 4 nos HVDC Back to Back System (3000 MW)

*World's 3rd largest Transmission Network*

# National Grid - Present

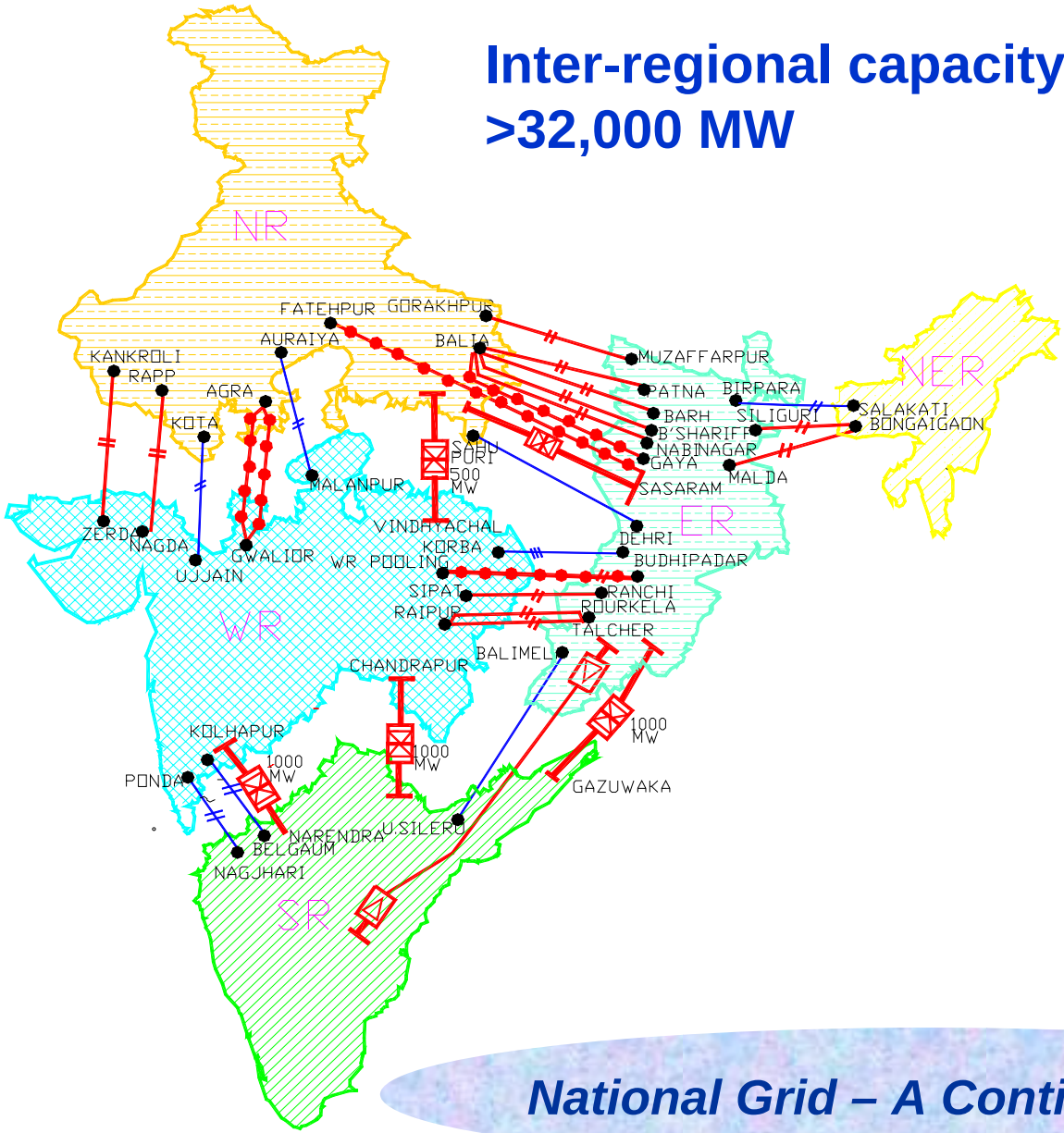
**Inter-regional capacity :**

**20,800MW**



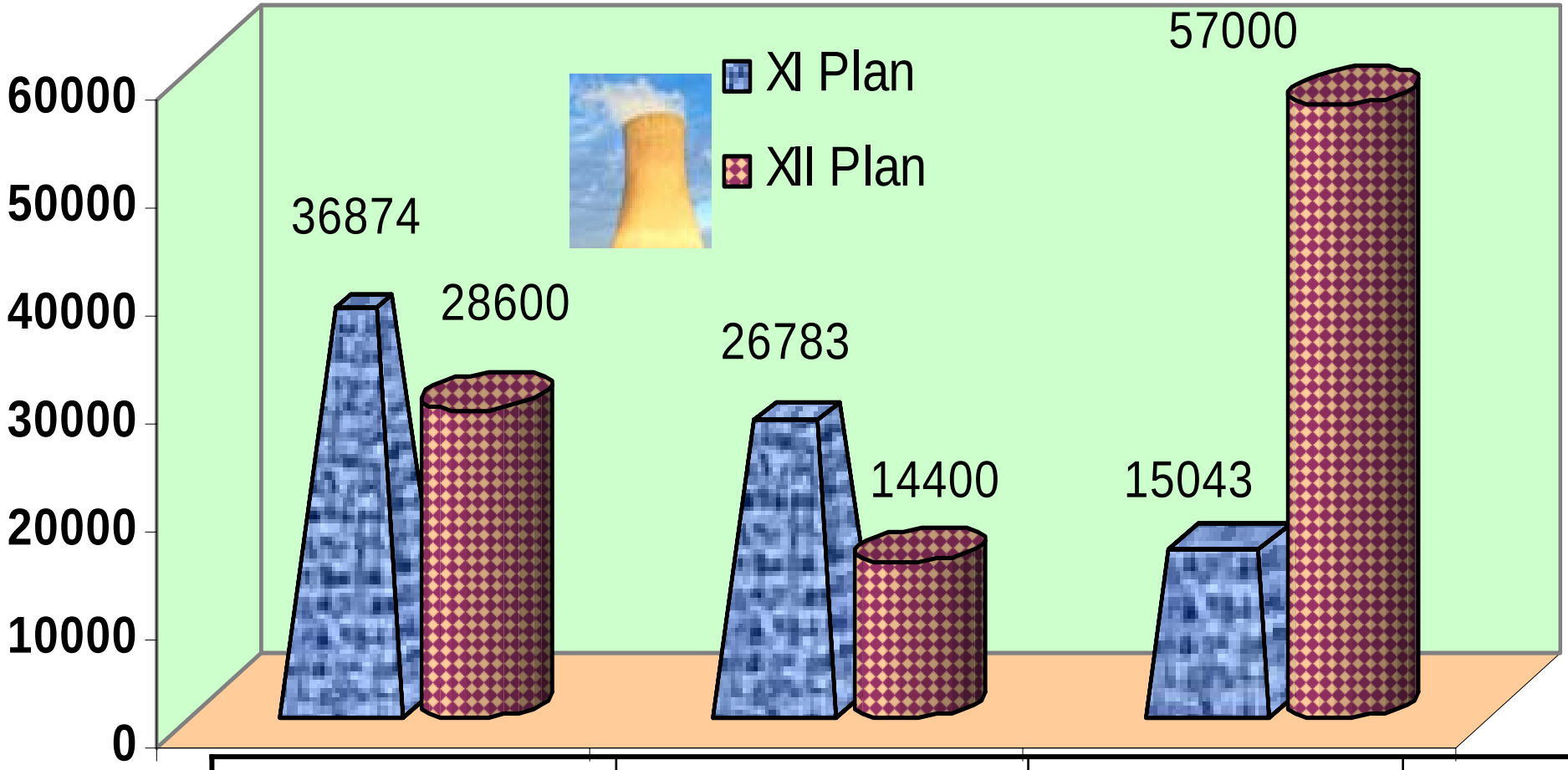
# National Grid – By 2012

**Inter-regional capacity :**
**>32,000 MW**




***National Grid – A Continuing Process***

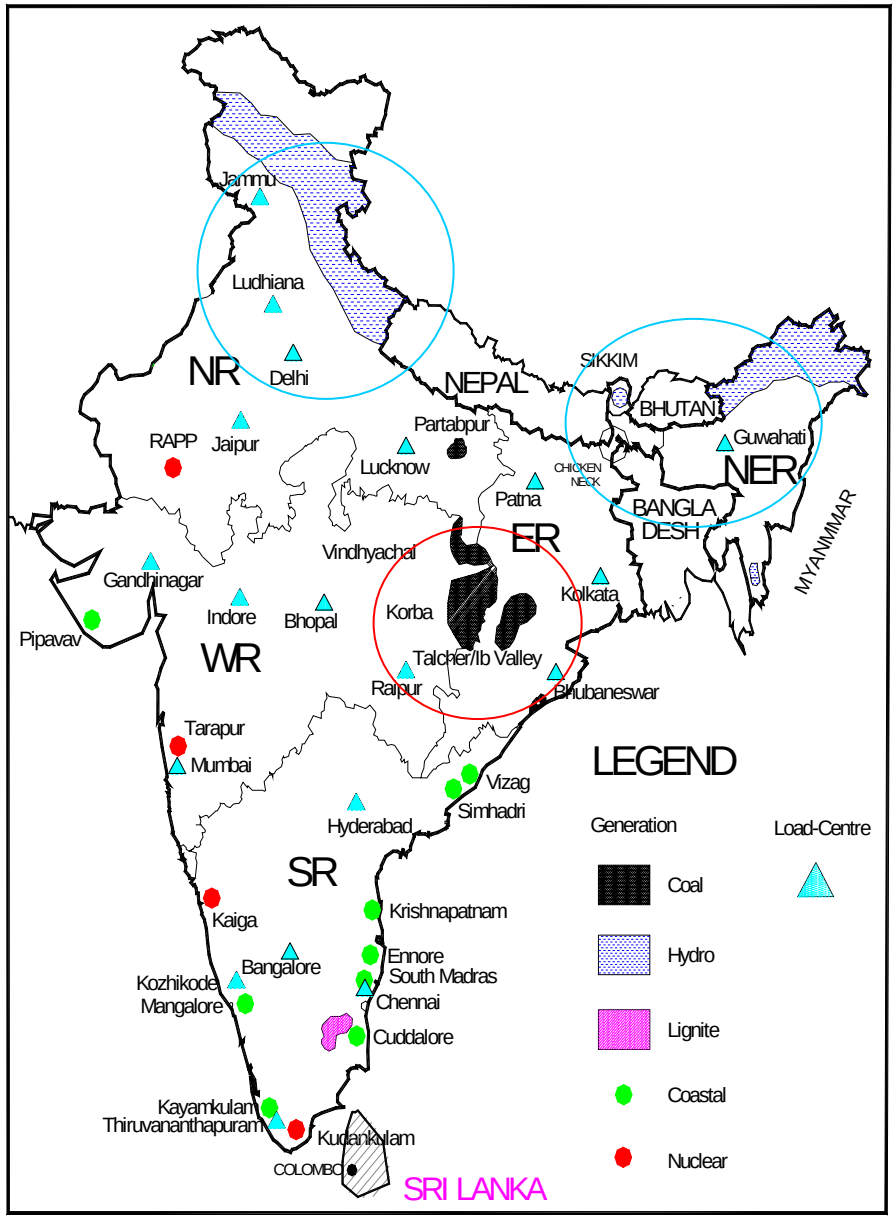
# Change in Generation Profile



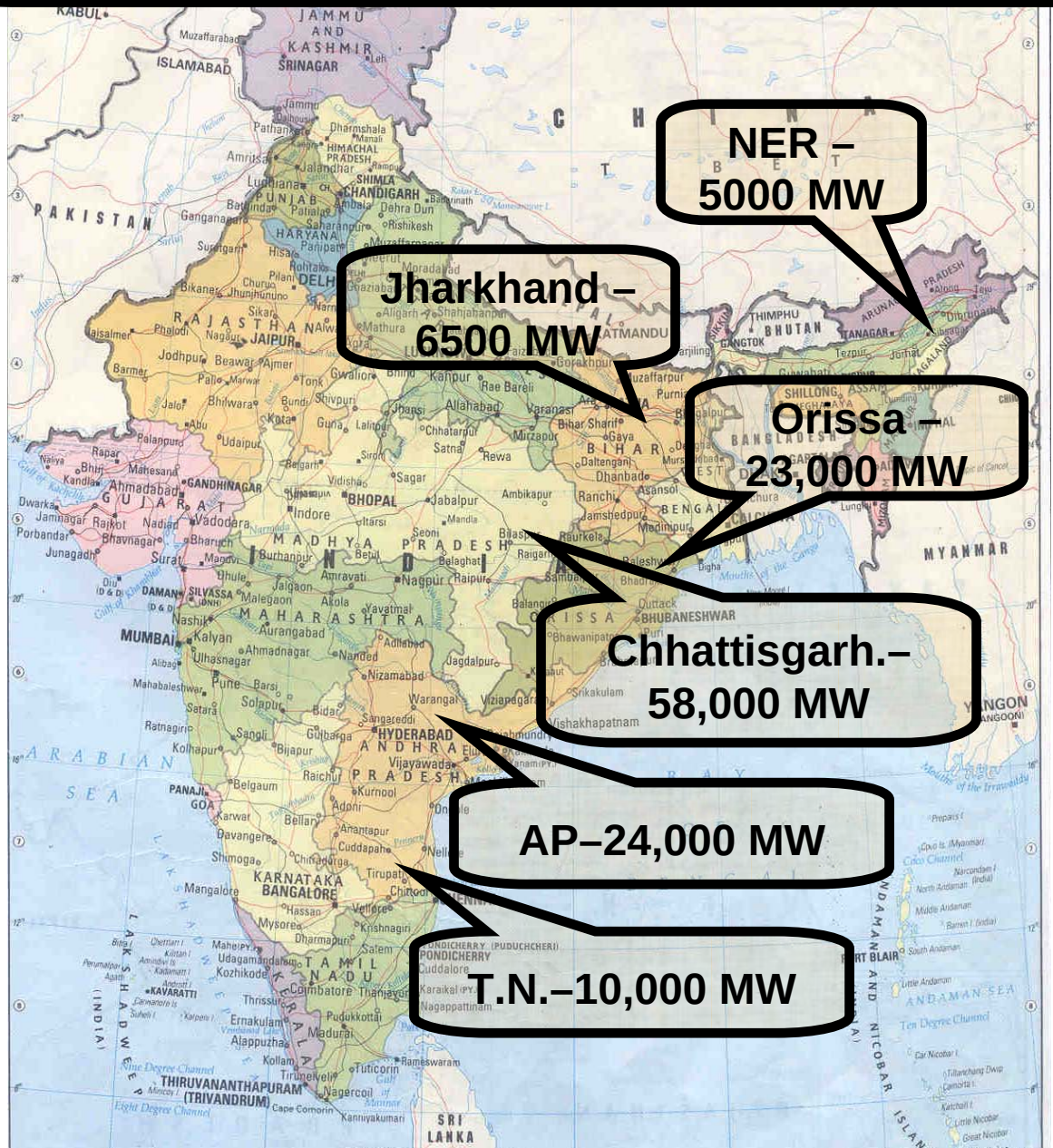

| | Central Sector | State Sector | Private Sector | Total |
|---|---|---|---|---|
| XI | 36874 (47%) | 26783(34%) | 15043(19%) | 78700 |
| XII | 28600 (28%) | 14400(15%) | 57000 (57%) | 100000 |

# Energy Resource Map

- Unevenly dispersed energy resources
  - Hydro in NER & NR
  - Coal in ER
- Integration of energy resources through high capacity National Grid - a must



# Generation Profile of IPPs



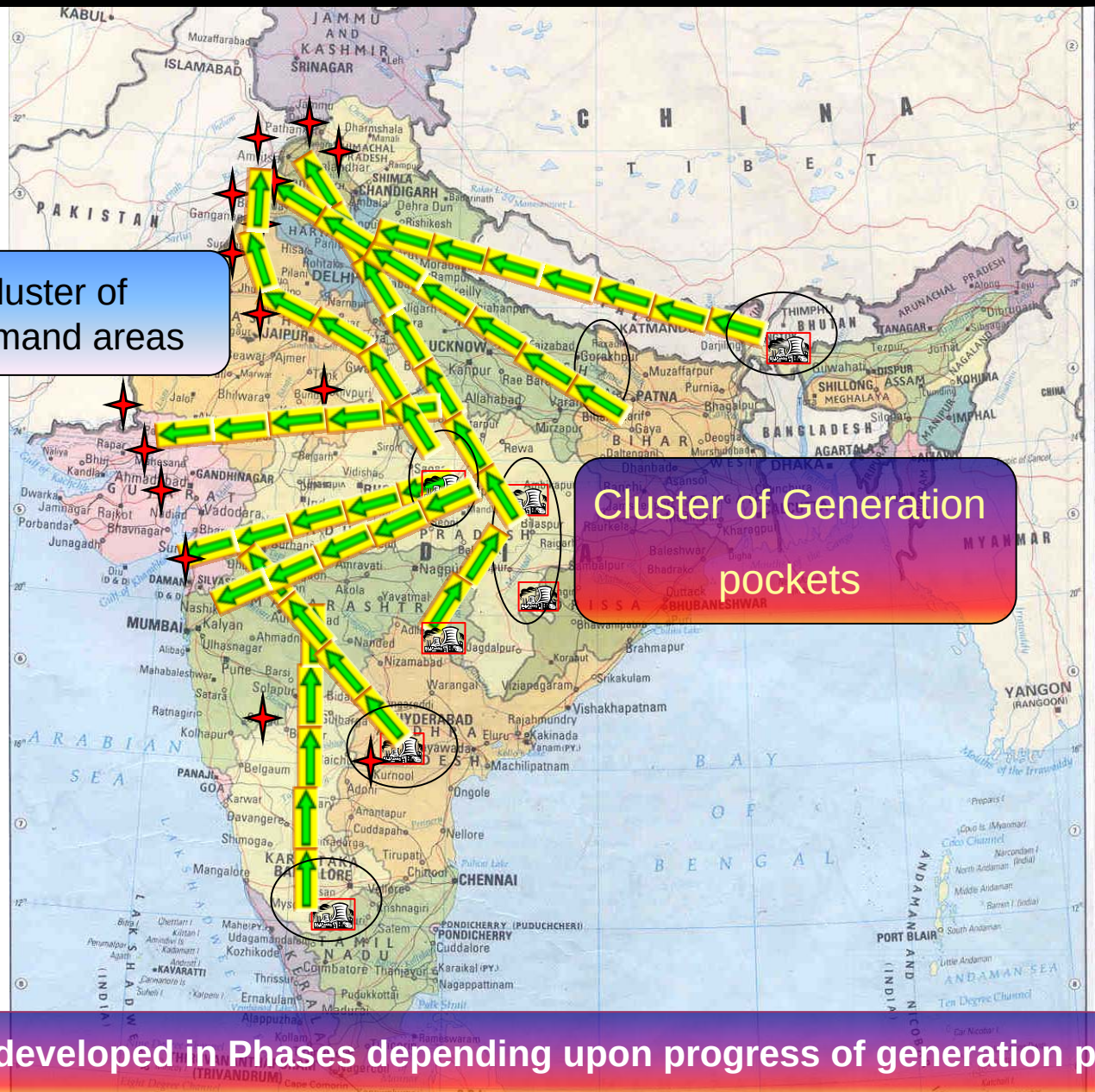
# New Regime of Power Sector

- Open Access in Transmission
- Generation de-license
- Power purchase through Tariff-based competitive bidding
  - Destination of power transfer not firmed-up when generation project is envisaged

# Need of New Initiatives in Transmission

- Change in generation profile
  - Quantity
  - Location of the generation project
- Scarce Right of Way
- Complex dynamism due to high technology
  - Reactive Power Management
  - Control of power flow
- Implementation in time
- Shortage of skilled manpower

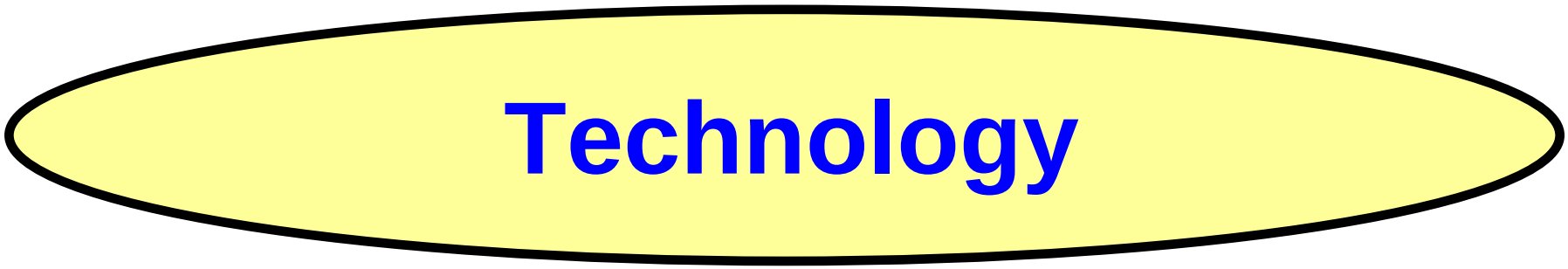
# High Capacity Corridors




**Need to be developed in Phases depending upon progress of generation projects**

# Challenges in Transmission Development

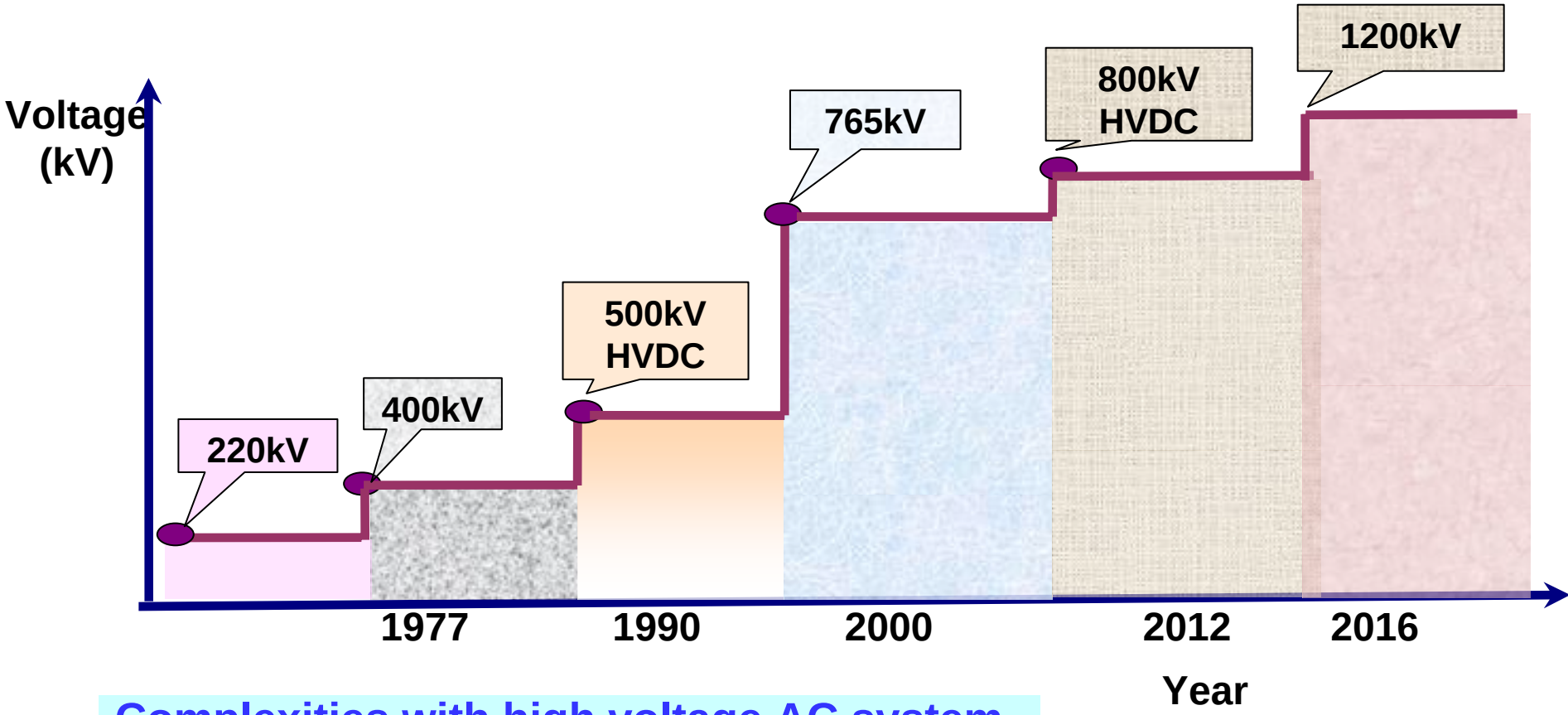
- **Creation of high Capacity Transmission Corridor**
  - Minimum cost per MW transfer
  - Optimal Transmission losses
- **Minimization of Right of Way**
- **Protection of flora & fauna**
- **Strengthening of National Grid**


Technology

# Technology being Adopted

- **High Voltage line**
  - EHVAC : 400kV → 765kV → 1200kV
  - HVDC : ±500kV → ±800kV
- **Increase the capacity of trans. corridor through HSIL/re-conductoring with HTLS /Upgradation**
- **Utilisation of transmission lines upto full thermal capacity –** Series capacitors, SVC, FACTS
- **Optimization of Tower design –** tall tower, multi-ckt. tower
- **GIS substation**

# Voltage Upgradation

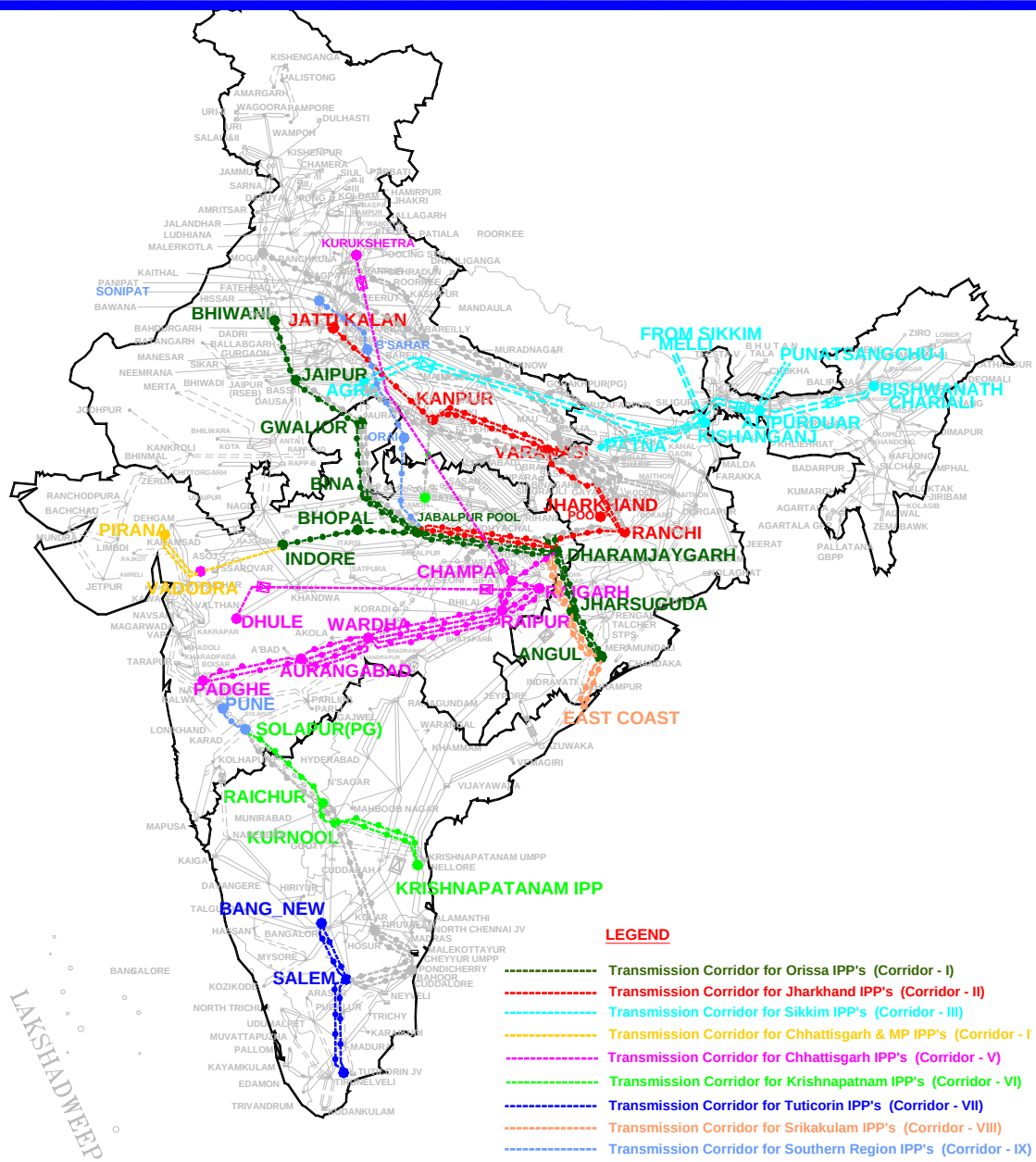



**Complexities with high voltage AC system**

- Reactive Power Management
- Availability of switchgear
- Corona Loss
- Sustainability of grid during contingencies

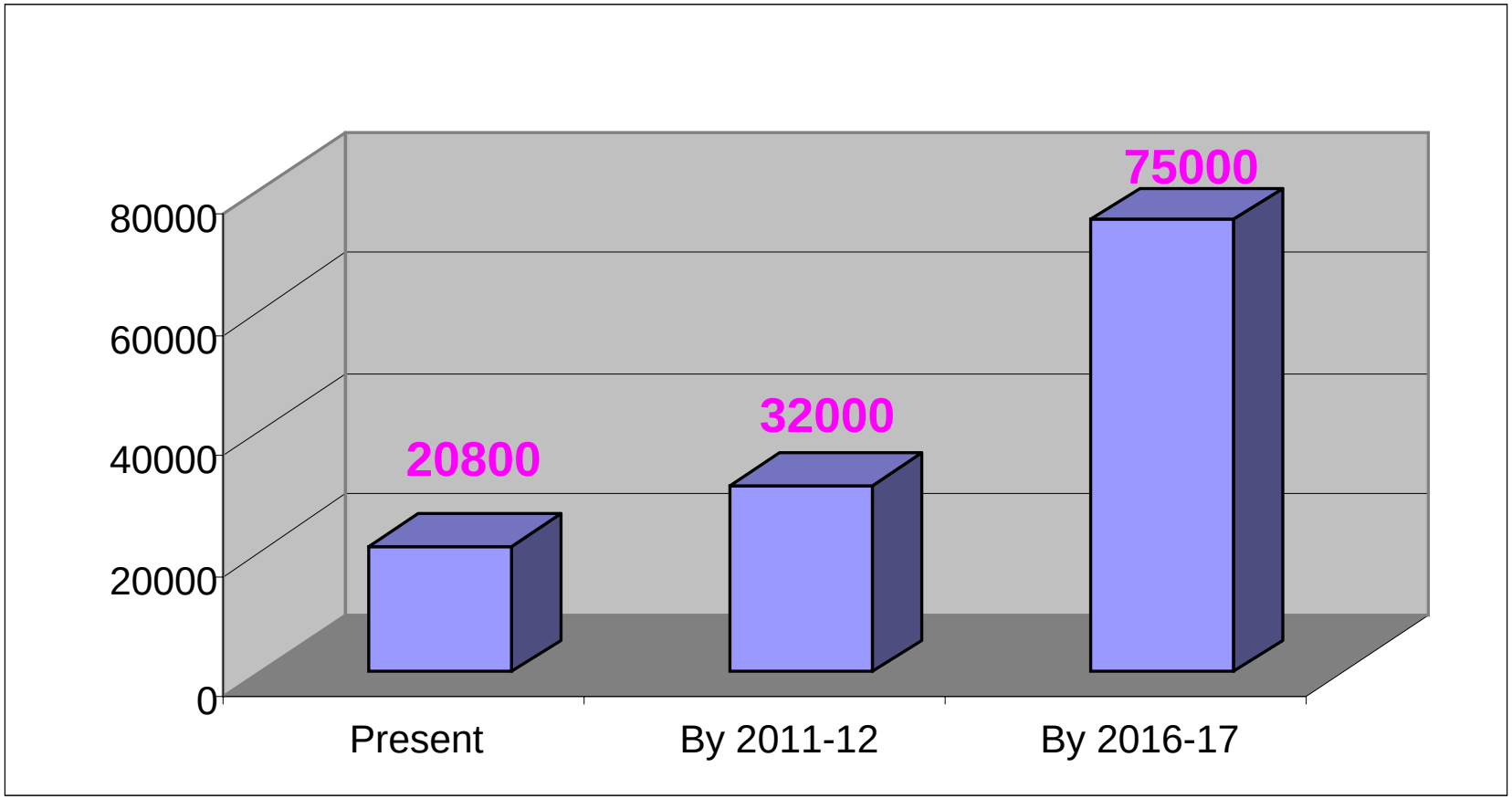
# Development Plan

# High Capacity Transmission Corridor



# Strengthening National Grid

- **Planned to enhance the National Grid capacity progressively to about -**




***National Grid – A Continuing Process***

# Road Map for Transmission

- 400kV Transmission System – Present Backbone
- 765kV Transmission system – 2700 ckm under operation, about 7000 ckm under different stages of execution
- 765kV transmission lines are mostly double circuit
- HVDC system - ±800kV 6000MW NER- Agra under execution
- 1200kV AC Transmission System – under development : expected operation by 2016-17


Plan Target

# POWERGRID 11th Plan Target

| Item | 11th Plan Target | Achieved So far(Mar'10) | Balance |
|---|---|---|---|
| Transmission line 400kV & above (Ckm) | 35500 | 18400 (5515) | 17100 |
| No.of EHV substations(400kV & above) | 45 | 27 (7) | 18 |
| MVA capacity | 56000 | 30080 (10290) | 25920 |
| Investment (USD billion) | 12 | 5.6 (2.3) | 6.4 |

***(*) Achieved in 2009-10***

# POWERGRID Transmission Augmentation Plan (Next 7-8 years)

| Item | Estimated Addition Programme in 12th Plan (2102-16) |
|---|---|
| Transmission line 400kV/765kV & above (Ckm) | 80,000 – 90,000 |
| No.of EHV substations (400kV & above) | 90-100 |
| MVA capacity | 150,000 – 170,000 |

- **Estimated Investment : About USD 22 billion**

# POWERGRID Physical Target (Next 7-8years)

- **Transmission Lines : 80,000 – 90,000 Ckt.kms**
  - ± 500kV/800kV HVDC: 5,000 – 6,000 ckt km
  - 765 kV AC : 30,000 – 35,000 ckt km
  - 400kV AC : 45000 – 50,000 ckt. km
- **New Substations – 90 - 100 Nos.**
  - 765/400kV : 35 – 40 Nos.
  - 400/220/132kV : 55 - 60 Nos.
  - 1200/765/400kV : 1 – 2 Nos.
- **Transformation Capacity (MVA)- 1,50,000 – 1,70,000 MVA**
  - 765/400kV : 80,000 – 90,000 MVA
  - 400/220/132kV : 70,000 – 80,000 MVA
- **Series Compensation : 22 nos. on 400kV lines**


Thank You

# Interconnection with Neighbouring Countries

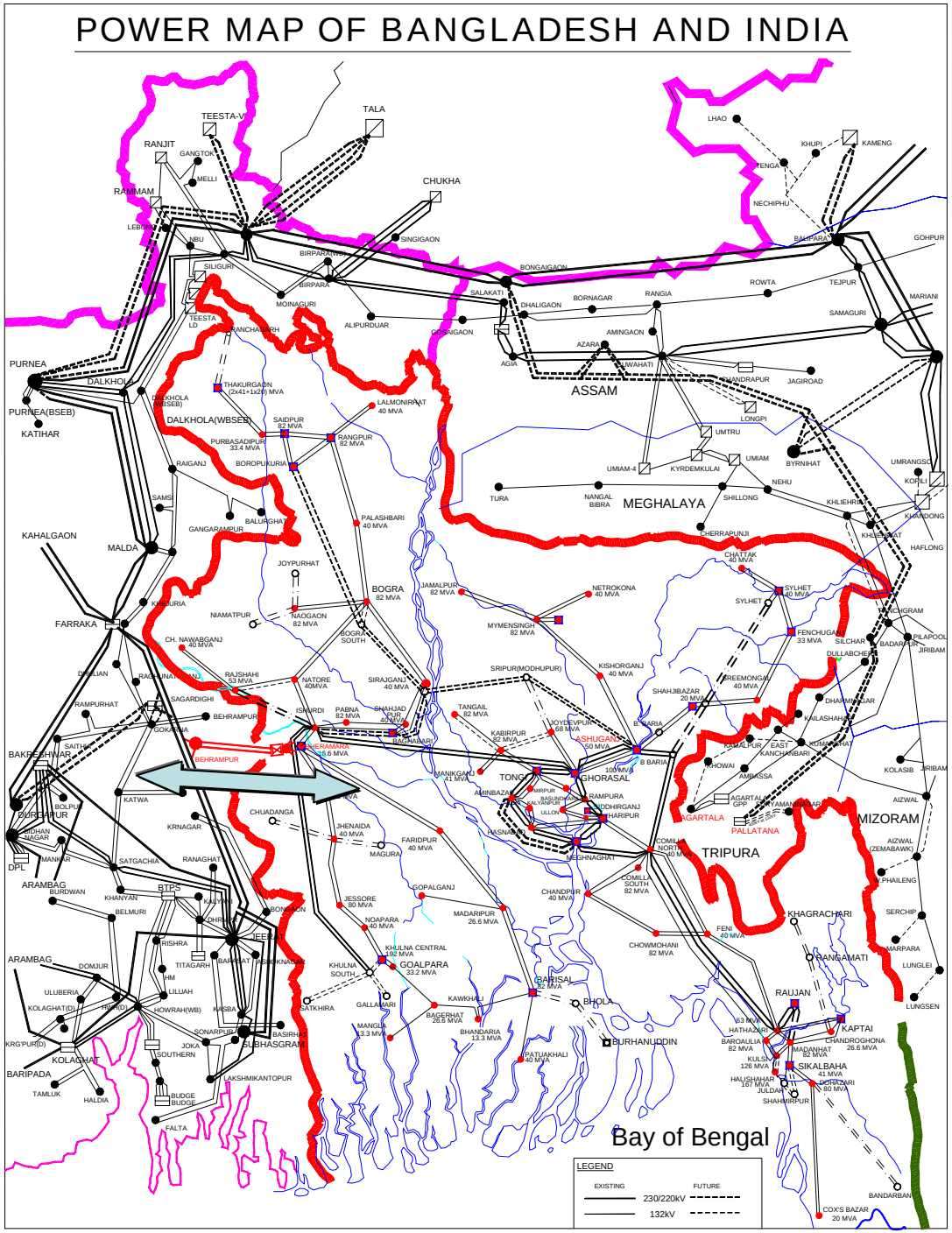
# INTERCONNECTION OF INDIA WITH BANGLADESH

# India & Bangladesh Interconnection

- Asynchronous Interconnection between the two countries agreed in a meeting between Indian Delegation and BPDB & PGCB officials, Bangladesh on November 24, 2009 at Dhaka.

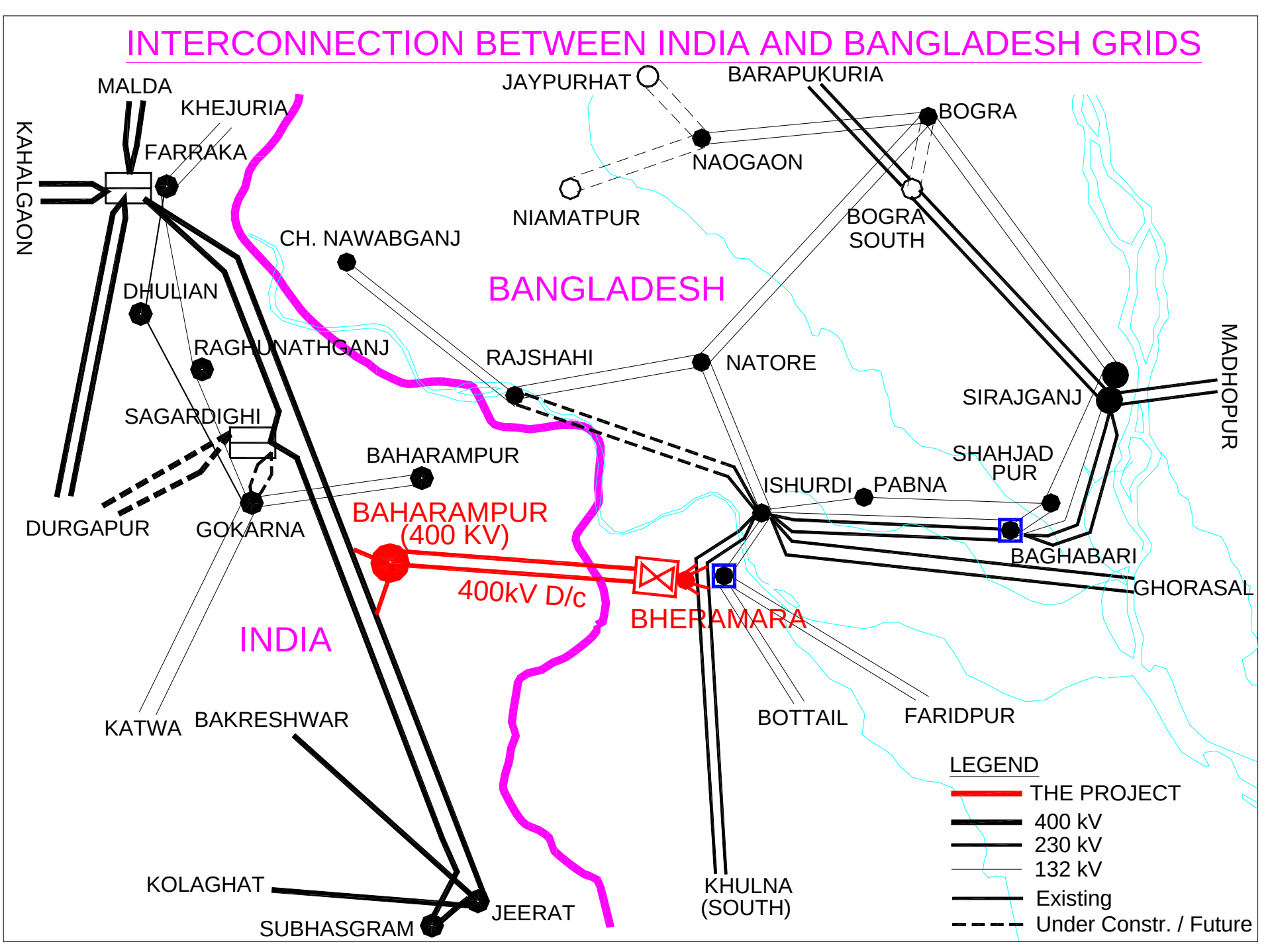
- Scope of Interconnection :
  - Establishment of 400kV Sw. Stn. at Baharampur(India) by LILO of Farakka-Jeerat 400kV S/c line
  - Baharampur(India) – Ishurdi/Bheramara(Bangladesh) 400kV D/c line.
  - Installation of HVDC back-to-back station (400/230 kV) at Ishurdi/ Bheramara(Bangladesh).

- The target date of commissioning is July, 2012.




# Interconnection between India & Bangladesh Grids

- Purpose :
  - Exchange of Power between India and Bangladesh
- Interconnection :
  - Baharampur(India)-Bheramara(Bangladesh) 400kV D/c line
  - 500MW HVDC B/b stn at Bheramara(Bangladesh)
- Type of connection :
  - Asynchronous(HVDC)
- Transfer Capacity :
  - 500MW (upgradable to 1000MW)


INTERCONNECTION BETWEEN INDIA AND BANGLADESH GRIDS
MALDA
KHEJURIA
FARRAKA
KAHALGAON
JAYPURHAT
BARAPUKURIA
BOGRA
NAOGAON
NIAMATPUR
BOGRA SOUTH
CH. NAWABGANJ
BANGLADESH
DHULIAN
RAGHUNATHGANJ
RAJSHAHI
NATORE
SIRAJGANJ
MADHOPUR
SAGARDIGHI
BAHARAMPUR
ISHURDI
PABNA
SHAHJAD PUR
DURGAPUR
GOKARNA
BAHARAMPUR (400 KV)
400kV D/c
BHERAMARA
BAGHABARI
GHORASAL
INDIA
KATWA
BAKRESHWAR
BOTTAIL
FARIDPUR
KOLAGHAT
JEERAT
SUBHASGRAM
KHULNA (SOUTH)
LEGEND
THE PROJECT
400 kV
230 kV
132 kV
Existing
Under Constr. / Future

# INTERCONNECTION OF INDIA WITH SRI LANKA

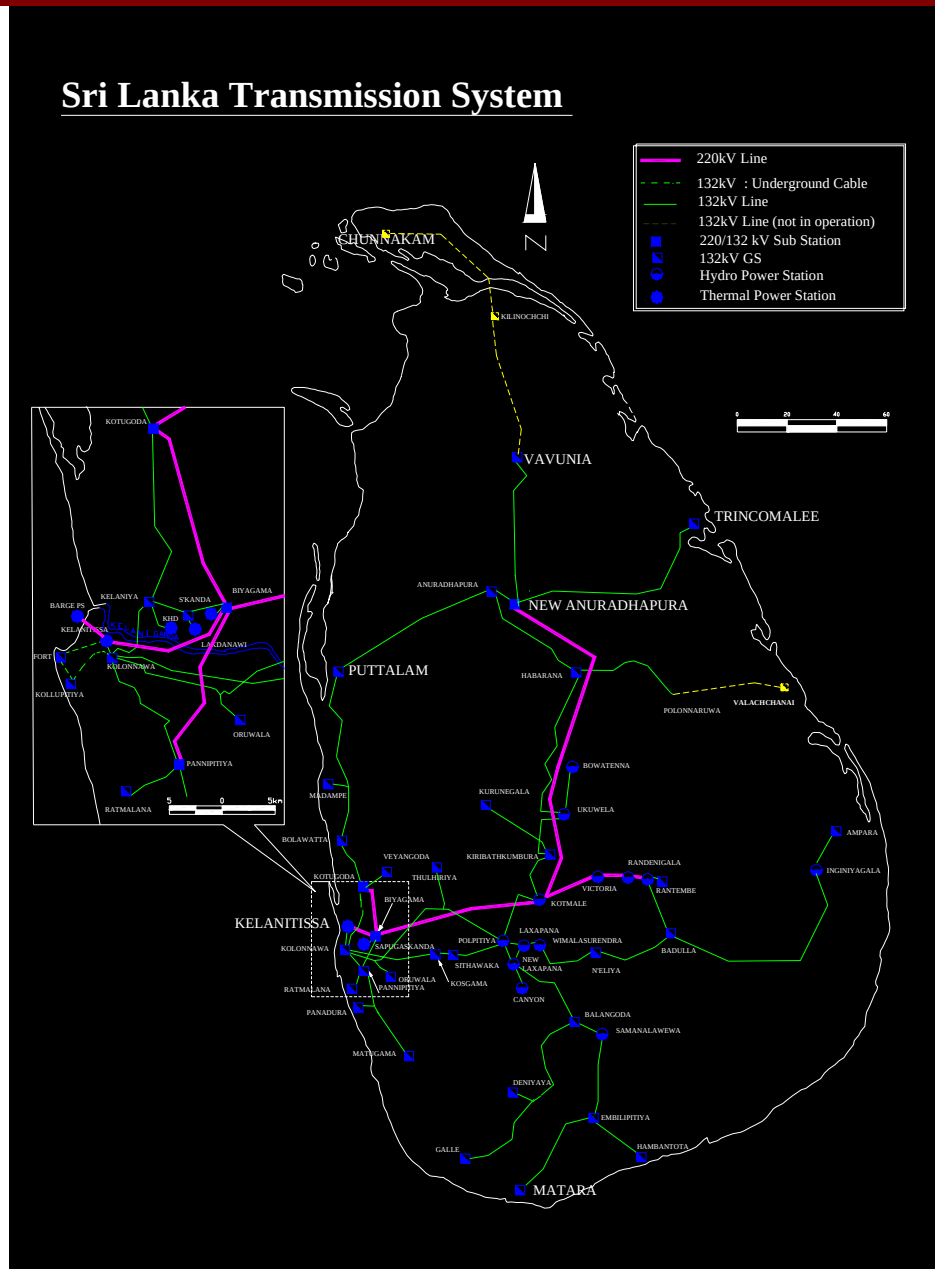
# Sri Lanka : Present Power Scenario

- **Installed Capacity : 2411 MW (Hydro – 50%, Thermal-46% )**

**Maximum Demand : 1922MW**

**Demand Growth : 8 %**

**Hydro potential : 2000 MW, out of which 1000 MW already harnessed**

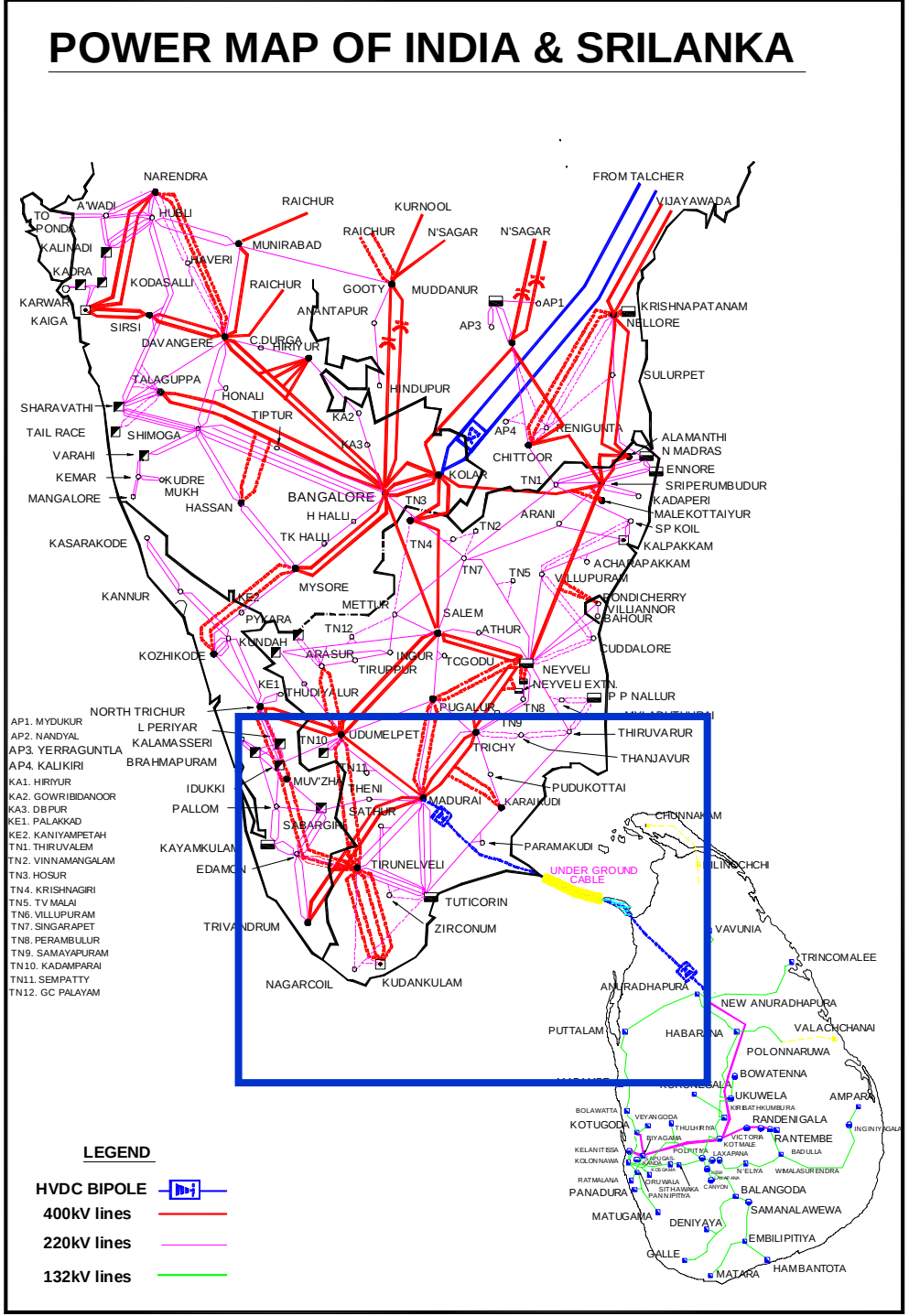


# India – Sri Lanka interconnection

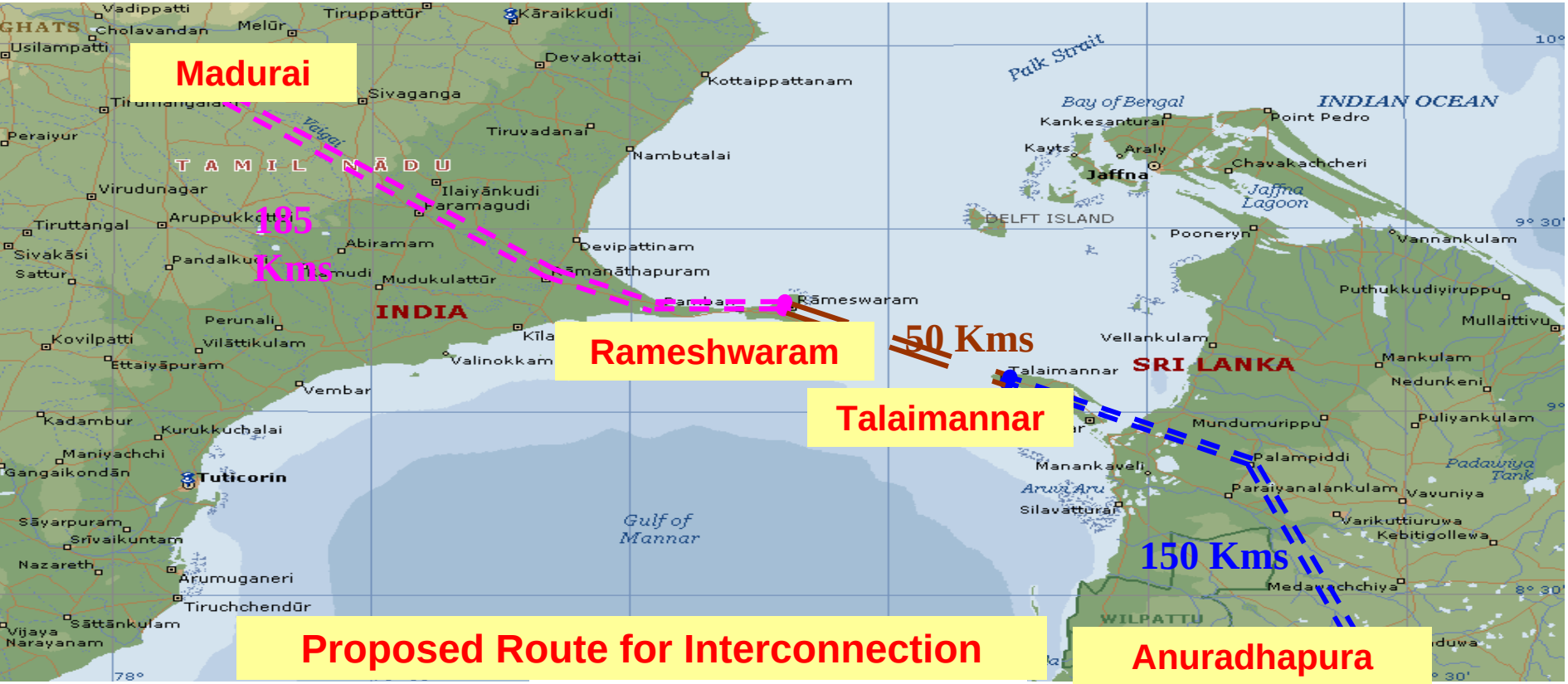
## Quantum of Power Exchange : 1000 MW

## Proposed Interconnection

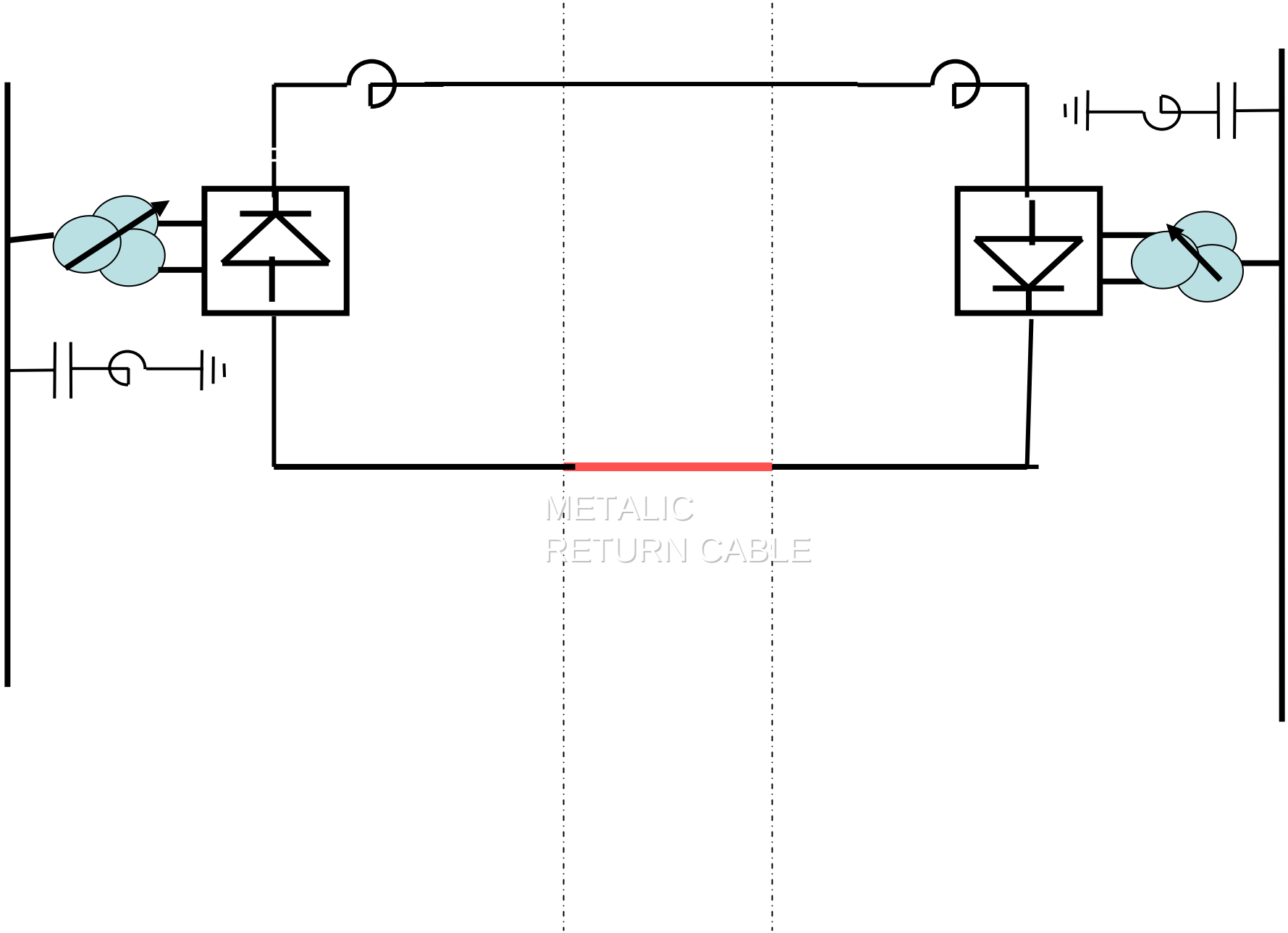
- **Madurai – Anuradhapura HVDC Bipole Line with :**
  - 1x500MW HVDC Terminal (Stage-I)
  - 2x500 MW HVDC Terminal (Stage-II)



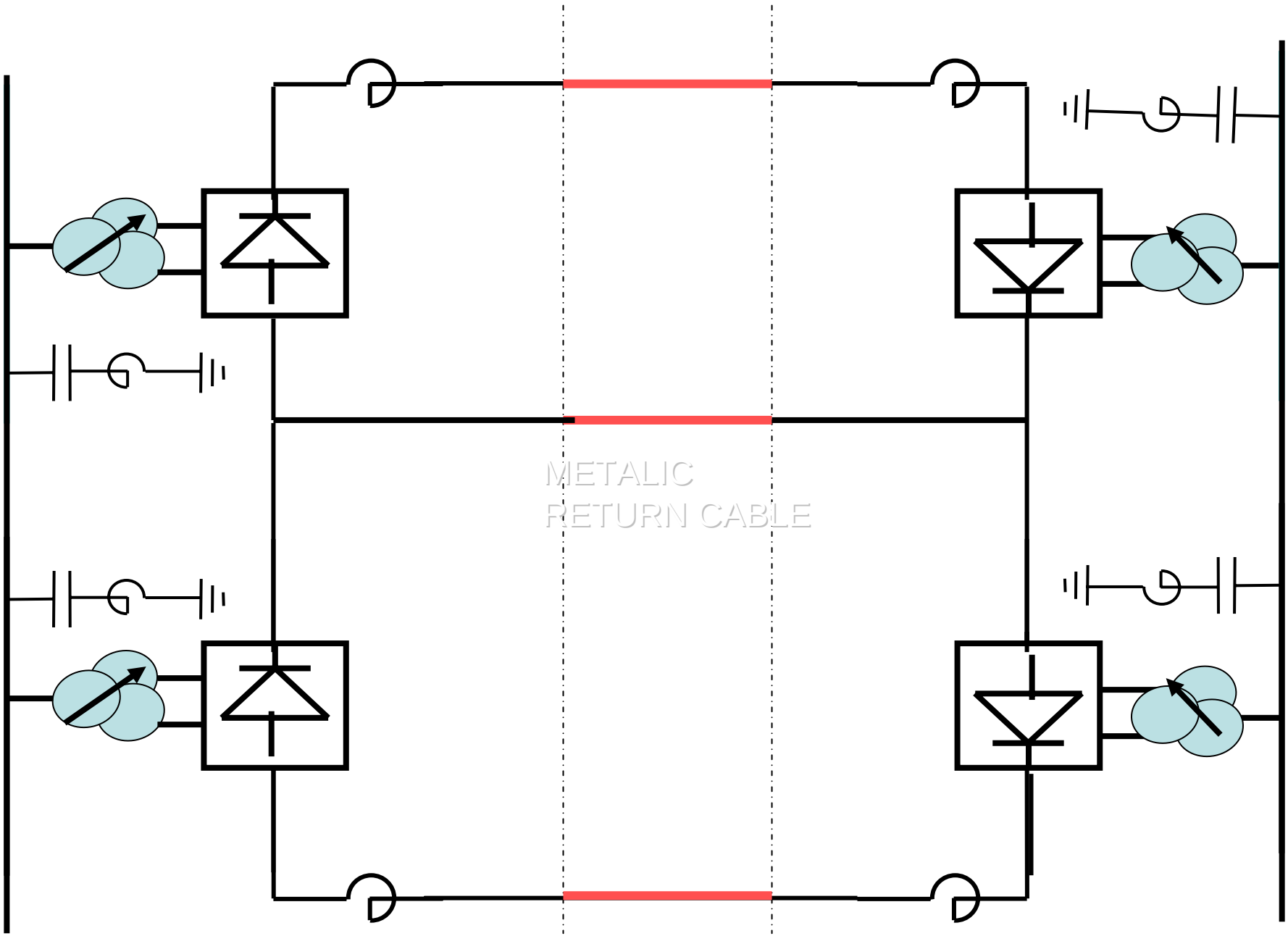
# India : Interconnection with Sri Lanka



# Proposed HVDC Interconnection – Initial Stage



# Proposed HVDC Interconnection



# INTERCONNECTION OF INDIA WITH BHUTAN

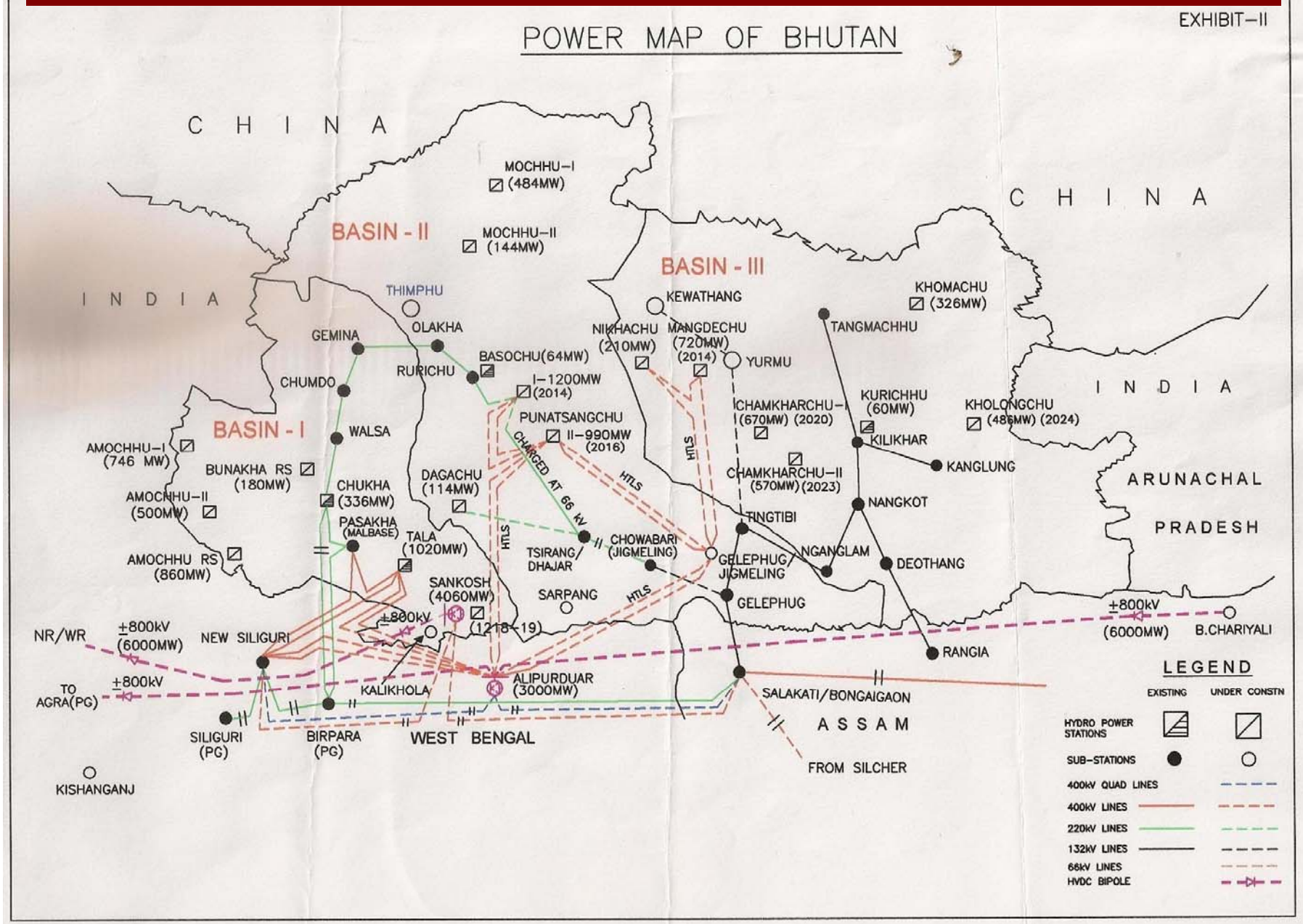
# India - Bhutan : Existing Interconnections

- **For import of power from Chukha HEP (4x84 MW)**
  - Chukha – Birpara 220kV 3 ckts
- **For import of power from Kurichu HEP (4x15 MW)**
  - Kuruchu - Geylegphug(Bhutan) – Salakati(NER) 132 kV S/c
- **For import of power from Tala HEP (6x170 MW = 1020 MW)**
  - Tala – Siliguri 400kV 2x D/c line

# India - Bhutan : Future Potential

- Hydro Potential in Bhutan : About 21000 MW
- About 11,000MW identified to be implemented in future
  - Punatsangchu –I : 1200 MW
  - Punatsangchu –II : 1000 MW
  - Mangdechu : 720 MW
  - Sankosh : 4000 MW
  - Chamkhar Chu -I : 670 MW
  - Kurigongre : 1800 MW
  - Amochu : 620 MW
  - Kholongchu : 486 MW
  - Wangchu : 900 MW
  - Bunakha : 180 MW
- Major portion of power from the future generation projects in Bhutan is envisaged to be imported into Indian grid.
- The 1st of the future projects to be commissioned in Bhutan is Punatsangchu-I (1200 MW) in 2014-15.

# India – Bhutan Interconnection

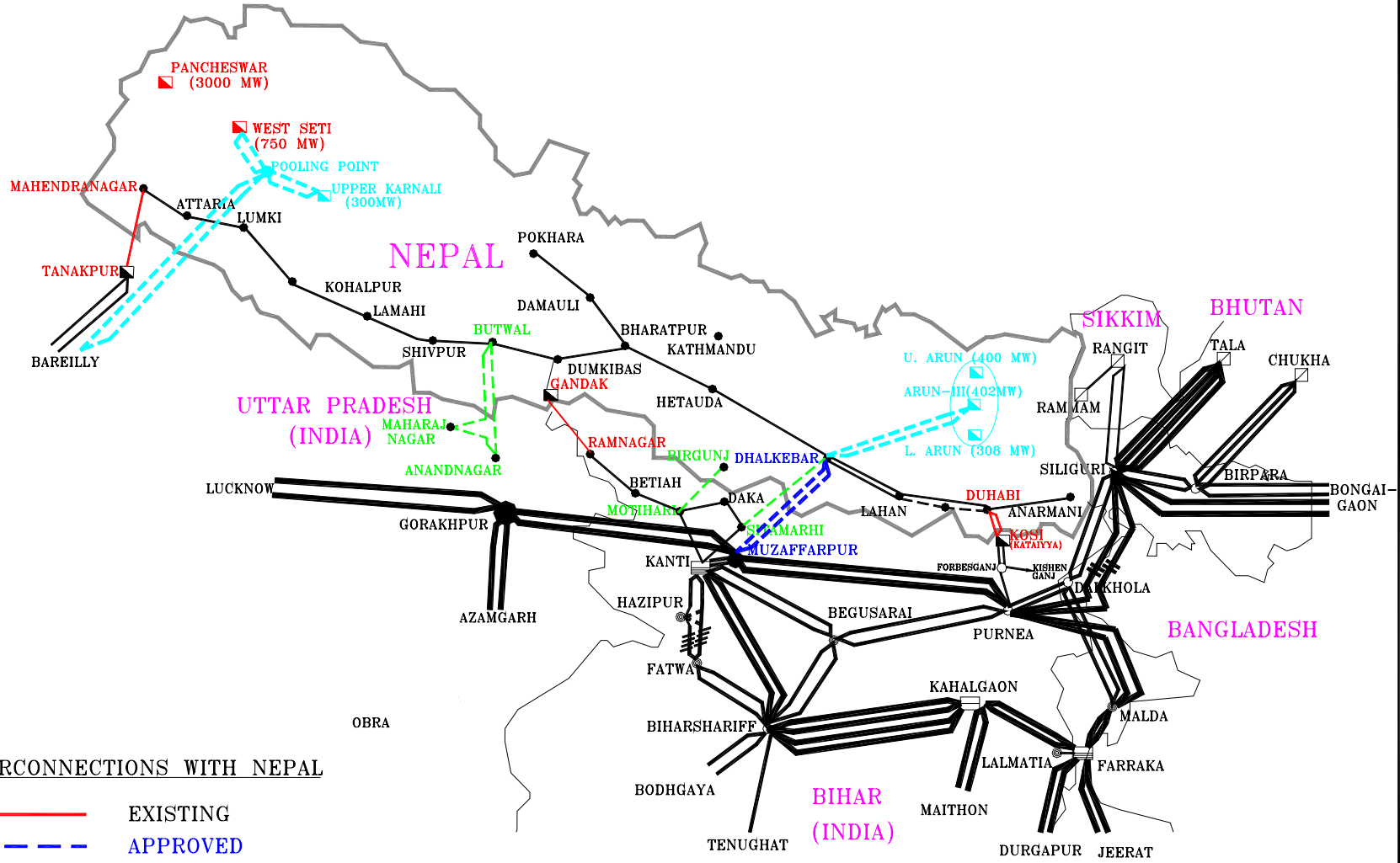


# INTERCONNECTION OF INDIA WITH NEPAL

# India - Nepal : Present Interconnection

- **Power Scenario in Nepal**
  - Installed Capacity : 607MW (Hydro – 91%)
  - Demand : 600 MW
- **Over 16 links at 132/33/11 kV**
  - About 50 MW of power being exchanged
  - Net export to Nepal (about 10% of demand of Nepal met from India)
- **Supply of 70MU/annum from Tanakpur (India) to Nepal**

# INDIA–NEPAL INTERCONNECTION



# India – Nepal : Future

- **A 400 kV inter-connection (initially op. at 220kV level) between Muzaffarpur(India) and Dhalkebar(Nepal) planned**
- **The scheme is to be developed by a private developer (IL&FS) in participation with POWERGRID**
- **For its implementation, two separate JV companies, one for Indian portion (ILFS, PTC, POWERGRID) and other for Nepalese portion (ILFS, PTC, NEA) are proposed**
- **Two separate DPRs for Indian and Nepalese portion have been prepared by POWERGRID and submitted to IL&FS in Feb-09 & March-09 respectively**
- **Formation of Joint Venture is under progress**

# India – Nepal : Future

Hydro Potential of Nepal : about 80,000 MW

Large potential projects being considered for development and export of power to India

| | | |
|---|---|---|
| Karnali | - | 10,800 MW |
| Pancheshwar HEP | - | 6,500 MW |
| Sapta Koshi | - | 3,300 MW |
| Arun HEP | - | 1,000 MW |
| West Seti HEP | - | 750 MW |
| Arun HEP | - | 685 MW |
| U. Marsyangdi – 2 | - | 600 MW |