Integrated Nepal Power System (INPS)

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NEPAL

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Hydro Power Potential in Nepal

- Potential Capacity of Hydropower is estimated to be 83,000 MW
- Substantial economical Hydropower potential is 43,000 MW
- Present Installed Hydro generation in INPS is only 734 MW i.e. only 0.9 % of full capacity

Source : NEA report fiscal year 2013/2014

Portfolio of Generation Capacity

(a)	Total Capacity	783	MW
	Hydro	734	MW
	Thermal	53	MW
(b)	Under Construction (Hydro)	1044	MW
(c)	Planned & Proposed (Hydro)	1852	MW

Source : NEA report fiscal year 2013/2014

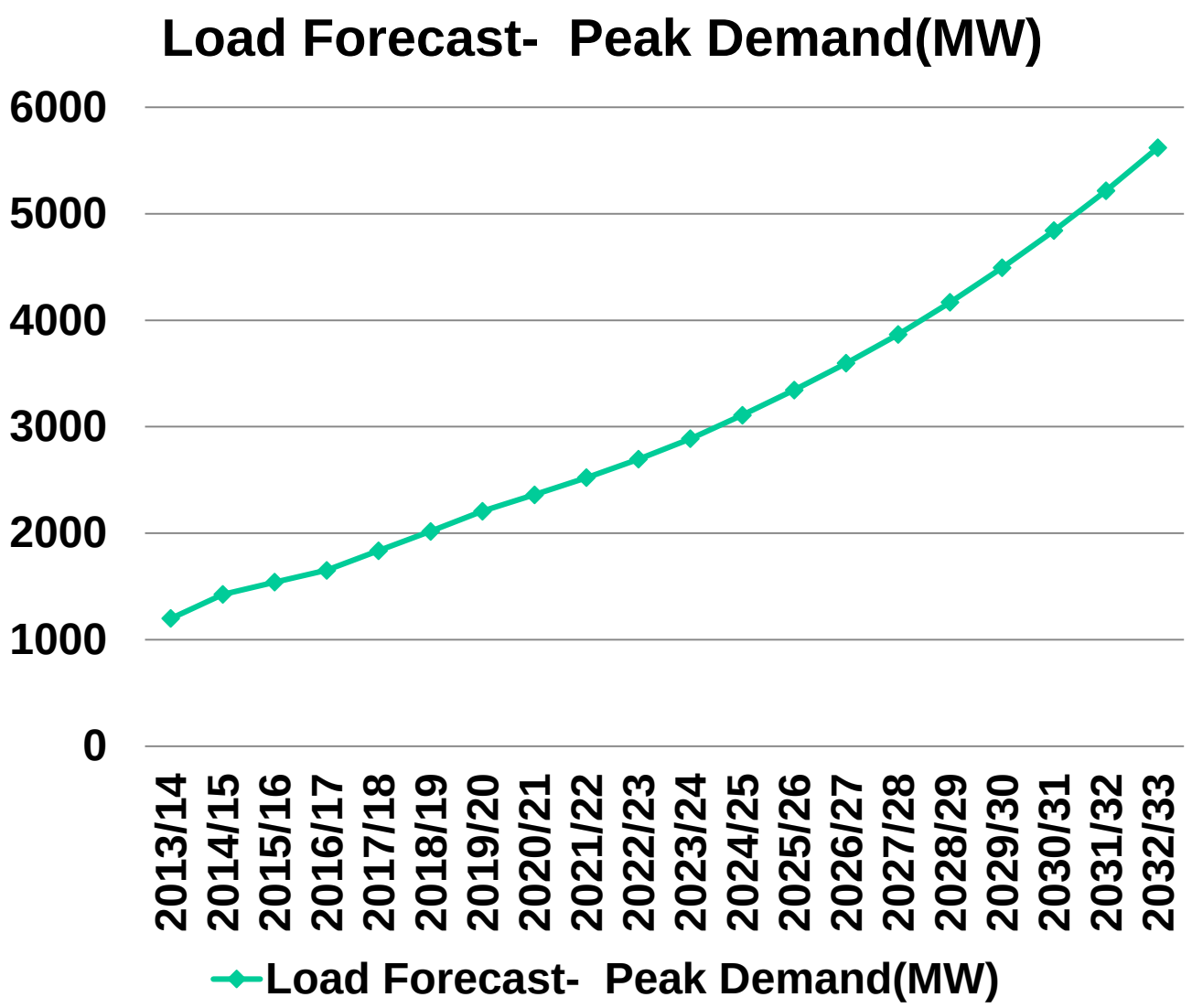
Generation in f/y 2013/2014

- System Peak Demand recorded is 1201 MW
- Generation of INPS is 675 MW
- Import from India is 116 MW
- 410 MW power have been shedded.

Source : NEA report fiscal year 2013/2014

Load Forecast

FY	Peak Demand(MW)
2013/14	1201
2014/15	1426
2015/16	1542
2016/17	1653
2017/18	1837
2018/19	2018
2019/20	2208
2020/21	2361
2021/22	2523
2022/23	2695
2023/24	2888
2024/25	3109
2025/26	3345
2026/27	3597
2027/28	3866
2028/29	4168
2029/30	4493
2030/31	4841
2031/32	5216
2032/33	5621



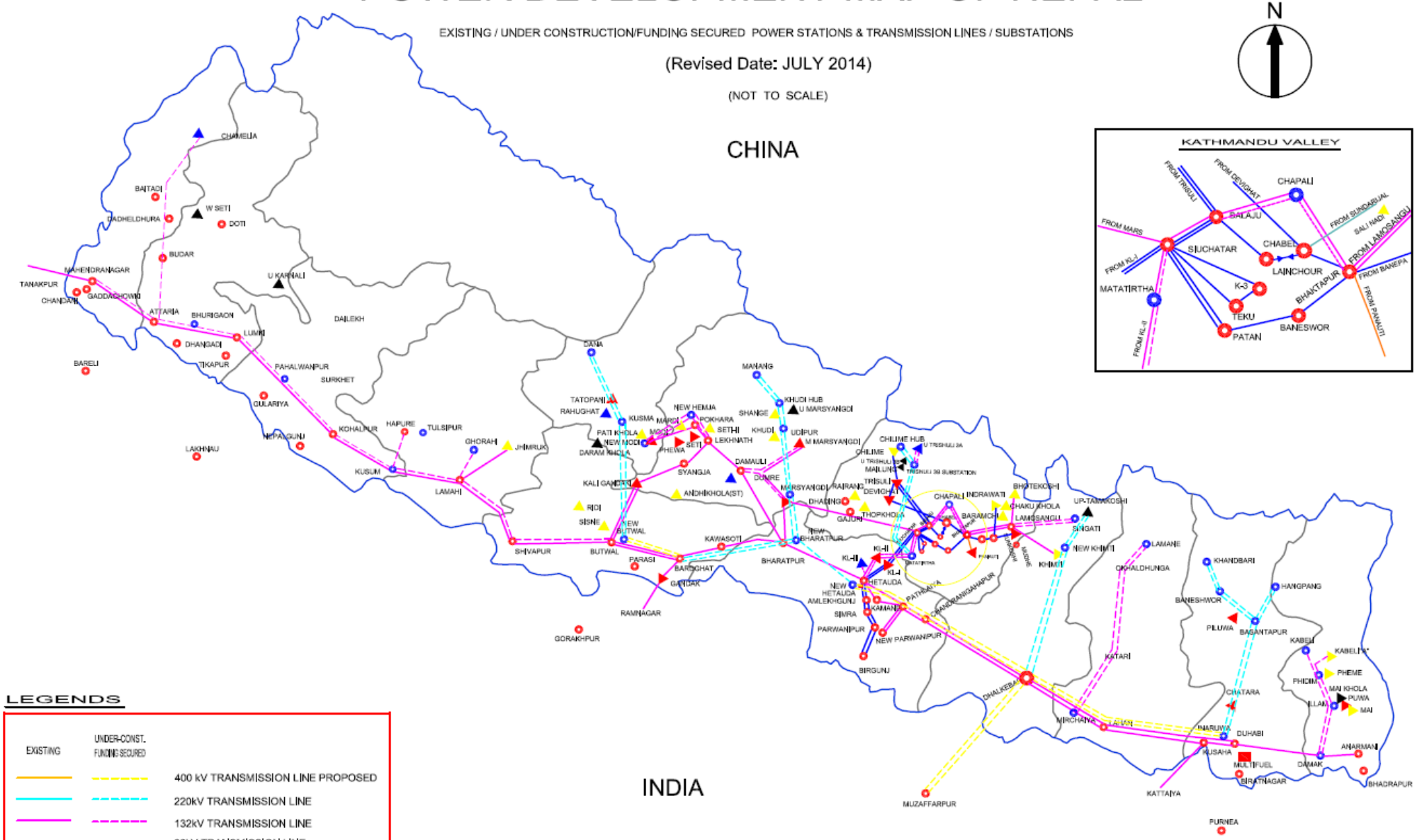
Source : NEA report fiscal year 2013/2014

POWER DEVELOPMENT MAP OF NEPAL

EXISTING / UNDER CONSTRUCTION/FUNDING SECURED POWER STATIONS & TRANSMISSION LINES / SUBSTATIONS

(Revised Date: JULY 2014)

(NOT TO SCALE)



LEGENDS

EXISTING	UNDER-CONST. FUNDING SECURED	
		400 kV TRANSMISSION LINE PROPOSED
		220kV TRANSMISSION LINE
		132kV TRANSMISSION LINE
		66kV TRANSMISSION LINE
		GRID SUB-STATION
		HYDRO-POWER STATION
		IPP's HYDRO-POWER STATION
		DIESEL/M-F POWER STATION

NEPAL ELECTRICITY AUTHORITY
TRANSMISSION DIRECTORATE
GRID DEVELOPMENT DEPARTMENT

Status of Transmission Line in INPS

(a)	Existing Transmission Line		
	132 KV	2130	ckt. kM
	66 KV	511	ckt. kM
(b)	Under Construction		
	132 KV	972	ckt. kM
	220 KV	373	ckt. kM
	400 KV	570	ckt. kM
(c)	Planned &Proposed		
	132 KV	1540	ckt. kM
	220 KV	1235	ckt. kM
	400 KV	1308	ckt. kM

Source : NEA report fiscal year 2013/2014

EXISTING INDO NEPAL INTERCONNECTIONS

- 132 kV level (165MW): All operate radially

  1.–Kusaha-Kataiya (100 MW)

  2.–Gandak-Ramnagar(25 MW)

  3.–Mahendranagar-Tanakpur(40 MW)

- Around 14 nos. of 33 kV & 11kV interconnections(53MW)

  –all operate radially

- 400 kV Level: To be operated in Synchronous mode

  -Under Construction

  -Dhalkebar-Muzaffarpur(DM)

Generation Plan in INPS

- Nepal is facing Huge power shortage even 14 hour shedding in dry season last year and is estimated to increase
- Load forecast shows 10 % yearly load growth.
- After 2020 A.D., Hydro projects under construction will be surplus of more than1000 MW Hydro Generation
- According to signed COD of IPP, surplus hydro generation shall increases rapidly.
- Many captive generation have not yet been included in INPS
- Many Mega Hydro generation projects are planned for exporting power to India.

Future Generation in INPS

-PDA has been signed recently for mega Hydro projects like Upper Karnali & Upper Seti

-Arun-III, Karnali Chisapani, Pancheswar are in pipe line for PDA

- All Mega projects are export oriented
- There is need of synchronized link with Indian Power Grid

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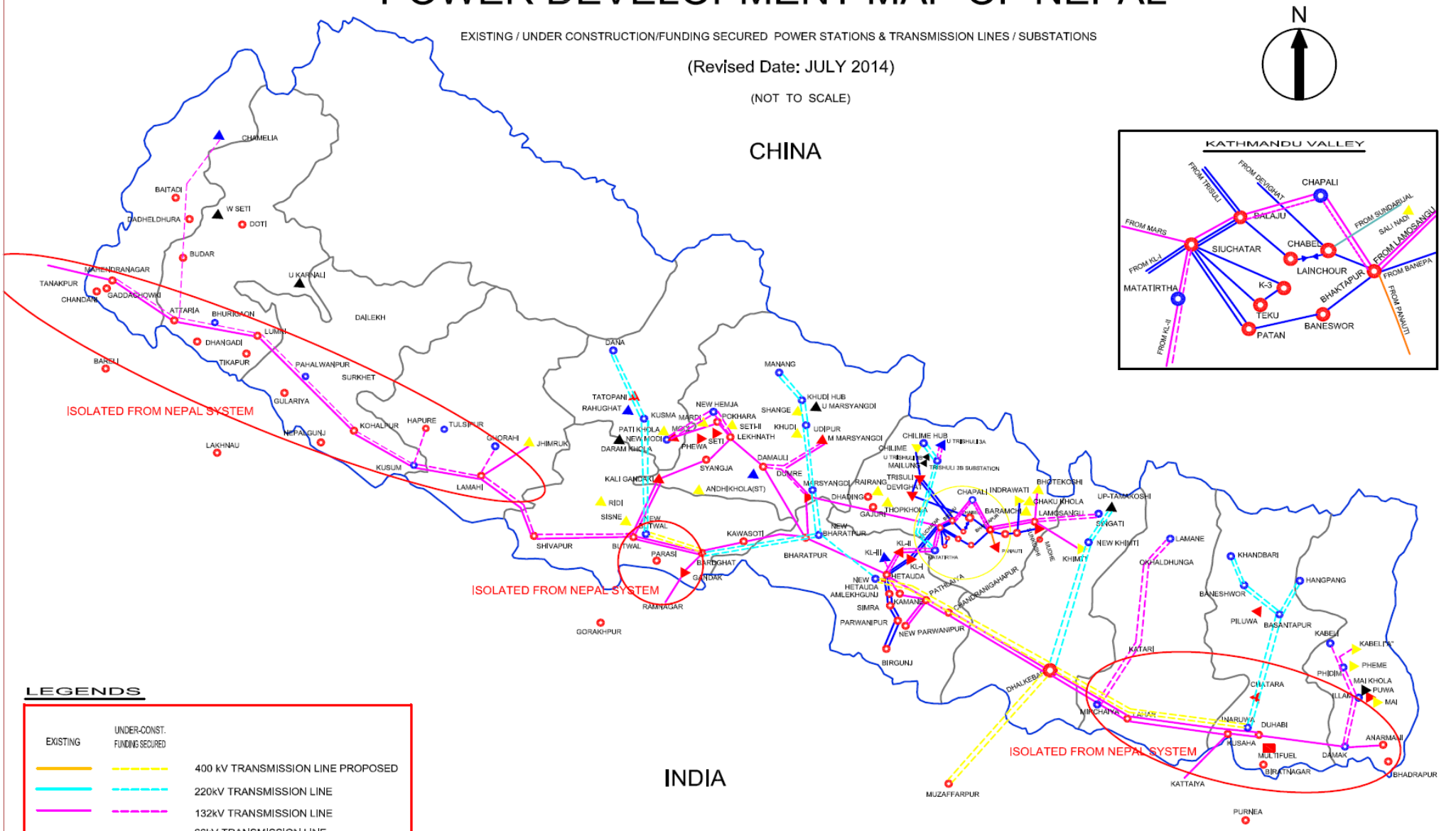

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Prepared by : Manager Gagan Manandhar

Impact of Radial mode operation

- Fragmentation of INPS
- Low Load factor
- Poor Reliability & quality of supply
- Loose Control over System
- Lack of coordination in system control
- Frequent on/off operation of switchgear for shifting supply among substation

Remedy of Radial Impact

Linking INPS with INDIAN POWER GRID

Option:-

1. Synchronous Link(AC Link)

   -suitable for small scale power transfer

2. Asynchronous Link(DC Link)

   -economical for large scale power transfer

Incentive of synchronizing radial links

- Improved System Load Factor Utilizing Load Diversity
- Enhanced Efficiency and Reliability of Power Supply
- Utilization of Natural Resources for Regional Development
- Benefit from Economies of Scale in Power Generation

Feature of PTA

- Power Trade Agreement (PTA) has been signed with India.
- PTA enable to develop TL interconnections, power exchange trading through governmental, public and Pvt. Enterprises of two country.
- PTA allows non - discriminatory access to cross border Interconnections for all authorized IPP & public sector participants in common electricity market.
- PTA also allow joint venture investments in infrastructures including government, public and private sectors of two countries.
- PTA ensure unrestricted flow of power subjected to safety, security, stability and reliability requirements of respective Grid.

Implementation of PTA

- There is need of planning, investment and construction of strong TL and multiple cross border interconnections
- Operate both Grid in synchronous mode.
- Utilize cross border interconnections for exchange of power and sustainable development of indigenous hydro resources in Nepal.
- Reforms in regulations accordingly.

Cross Border 400 kV Link

- Under Construction

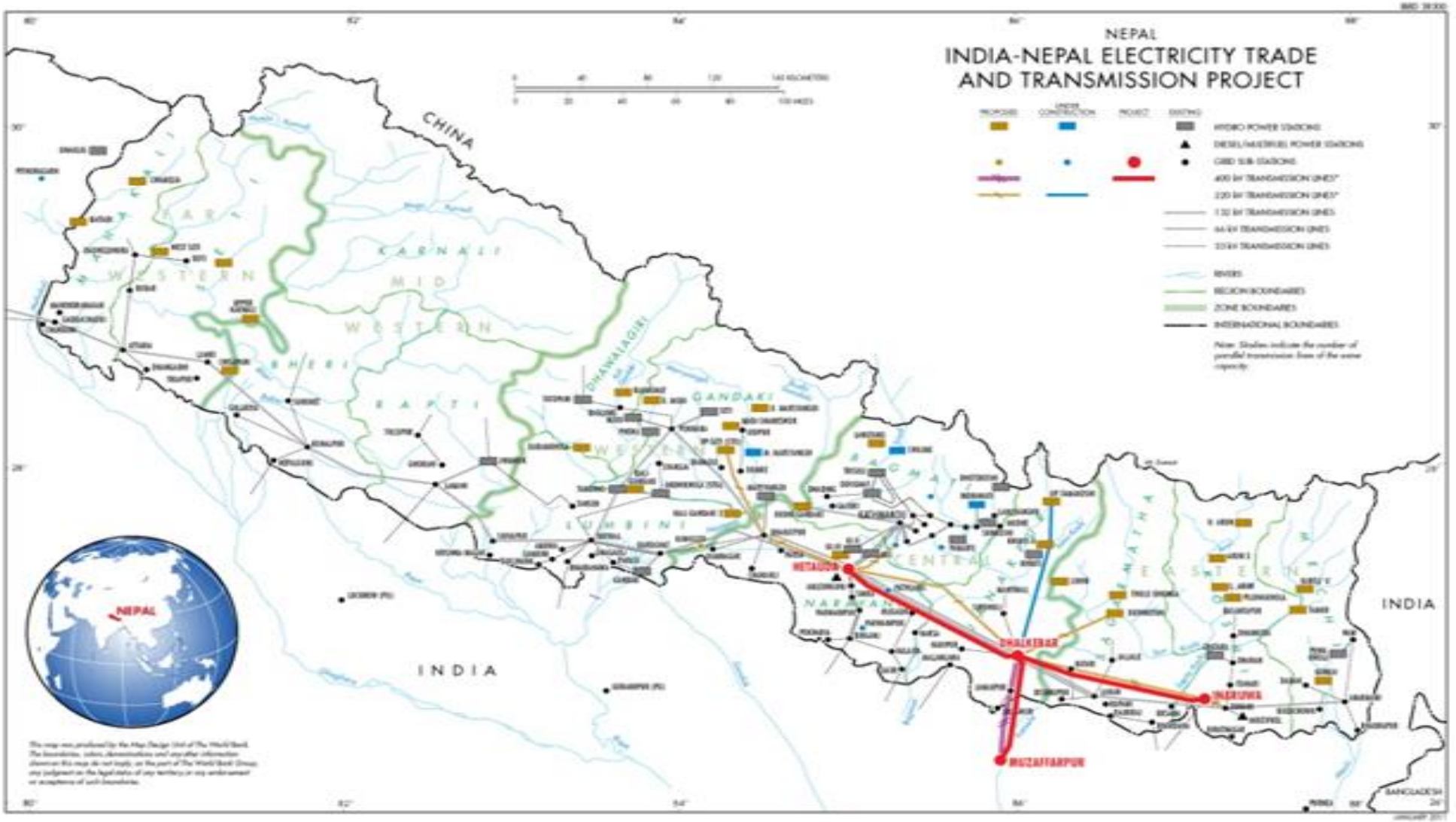
  400 kV Dhalkebar(Nepal)- Muzaffarpur(India) (D-M) line of 1000 MW capacity but presently charged at 220 kV to import 150 MW only.

- Proposed and Planned

  400 kV Butwal(Nepal) – Gorakhpur(India) Line

➢ Each 400 kV Links are of 1000 MW capacity and planned to be operated in synchronous mode.

Dhalkebar-Muzzafarpur-400 kV Link



Issues in synchronization

- Technical issues

  -Load flow study

  -system stability for sudden faults (Transient type) & small signal stability (Oscillatory type)

  -Identification of Incremental fault level & Coordination of switchgears.

  -Loop flows into multiple interconnection point

  -Grid code harmonization

  -Security standards and operational protocols

  -adequacy of load dispatch & communication facilities

Issues in Synchronization

- Financial issues
  - –Optimization of existing switchgears & governors in all existing major generating Stations of INPS

- Rule regulation
  - -NEA still vertically integrated Government entity responsible for planning, Generation, Transmission & Distribution
  - -Lack of regulatory commission.

Technical Issues .....

Indian Power Grid was appointed for the study of Technical issues in synchronization of INPS with Indian Grid, and detail reports have been submitted with proper recommendations.

Recommendations for INPS

- Harmonization of Grid Code for voltage and frequency and other standards for system security.

- Enhancement of transmission line in INPS and thus 400 kV Hetauda-Dhalkebar-Duhabi (HDD) TL is being implemented under WB funding.

- In order to mitigate the adverse effect of high transient and oscillatory stability, installation of Tuned power system stabilizers(PSS) in major Generating Station.

- INPS being small in capacity, Huge size of Indian Grid causes increment in fault level, hence accordingly replacement of switchgears.

Recommendation of study report

- PSSC Load flow shows Loop flows of power through existing multiple cross Boarder interconnection point, which gives financial impact as multiple tariff exist at each link point under different bilateral agreements.

Option are either

-Arrange for controller to prevent loop flows.

or

-Operate weak links radially

Finally at present

Operate 400 KV links in synchronized mode and remaining 132 kV weak links in radial mode.

Conclusion

- In spite of having huge Hydropower Potential, Nepal is facing acute Power Crisis at Present
- PTA has been signed between India & Nepal, it facilitate trading of electricity as commodity in common market.
- Enhance INPS & operate it in Synchronized mode with Indian Grid.
- Develop multiple strong HV Cross Border links to Mitigate Present Power Crisis in Nepal by Importing power from India
- Same Cross Border TL Links facilitate Power Export to India Later When Nepal has anticipated Surplus Power
- Need for Regional Cooperation for Regional Power Grid in South Asia

Thanks

For

Your Attention