

**NATIONAL TRANSMISSION & DESPATCH COMPANY LIMITED
(NTDCL), PAKISTAN**

Status of Pakistan Cross Border Interconnections & Expected Benefits

**South Asia Regional Workshop on Competitive Electricity Markets
– Design, Implementation & Benefits
Colombo, Sri Lanka**

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Contents of the Presentation

- 1. Overview of Pakistan Power System**
- 2. Cross-Border Interconnections of Pakistan**
- 3. Pakistan – Iran Interconnection**
- 4. Pakistan – Afghanistan – Tajikistan – Kyrghystan Interconnection (CASA-1000 Project)**
- 5. Pakistan – India Interconnection**

Overview of Pakistan Power System

Two Power Systems

1. National Transmission and Despatch Company Limited (NTDCL)

- Public limited Company.
- National Grid Company. Operates all over the country except Karachi.
- Acts as Transmission Network Operator and System Operator.
- Purchases power from Hydro Power Stations, GENCOs, IPPs etc. and Sells power to DISCOs. Exports power to K-Electric.
- Deals with Cross-border Electricity Trade.

2. K-Electric

(formerly known as Karachi Electric Supply Company (KESC))

- Private Limited Company.
- Generates, transmits and distributes power in Karachi city & some surrounding areas.
- Purchases power from IPPs located in its territory.
- Imports power from NTDCL.

Existing Generation Capacity of NTDCCL (MW) (Installed & Available)

1. Hydro

• WAPDA	6750
• IPPS	195
• Sub-Total	6945 (33.3%)

2. Thermal

• GENCOs	4829
• IPPs	8415
Sub-Total	13244 (63.2%)

3. Nuclear

665 (3.2%)

4. Wind

106 (0.5%)

TOTAL

20,960 MW

**Available Gen. Capacity
= 17,000 MW**

NTDCL SYSTEM HISTORICAL SURPLUS / DEFICIT

Years	Available Capability (MW)	Computed Peak Demand (MW)	Surplus/ Shortfall (MW)
2001-02	10894	10459	435
2002-03	10958	11044	-86
2003-04	11834	11598	236
2004-05	12792	12595	197
2005-06	12600	13847	-1247
2006-07	13292	15838	-2546
2007-08	12442	17398	-4956
2008-09	13637	17852	-4215
2009-10	13445	18467	-5022
2010-11	13193	18521	-5328
2011-12	12320	18940	-6620
2012-13	13577	18827	-5250

Existing Generation Capacity & Load Demand of K-Electric (MW)

1. Thermal

• Own Plants	1955
• IPPs& Others	273
Sub-total	2228 (94.2%)

2. Nuclear 137 (5.8%)

Total Installed Capacity 2365 MW

Present Status

- **Generation Constraints: Available generation is less than indicated abovedue to the de-rating of old thermal and Nuclear power plants.**
- **Load Demand: 2750 MW**
- **K-Electric imports 650 MW from NTDCL**
- **Load Shedding: 200-500 MW**

Country wide Load Forecast of NTDC & KESC (MW)

Year	NTDC	KESC	Country
2013-14	20238	2867	23105
2014-15	21208	3007	24215
2015-16	22230	3163	25393
2016-17	23351	3332	26683
2017-18	24487	3525	28012
2018-19	25644	3740	29384
2019-20	26846	3970	30816
2020-21	28119	4248	32367
2021-22	29432	4587	34019

Note:

NTDC demand is PMS based prepared in December 2013

KESC demand is Regression Based prepared in February 2014

Government Priorities to Improve Power Supply Position

- Addition of hydropower generation in North.
- Addition of imported-coal based generation in South near coast.
- Development of Indigenous coal based power generation in South at Thar.
- Addition of imported coal based generation at/near mid-country load centers.
- Addition of Renewable Energy:
 - *Wind Power Projects near coast*
 - *Solar power projects near load centers*
 - *Cogeneration power projects near load centers*
- *Import of Power through Cross-border Energy Trade.*

List of Generation Projects

Annual Summary of Generation Addition As of January, 2014

Sr. #	Fiscal Year	Name of Project	Agency	Fuel	Capacity (MW)	Comissioning Date	Addition/ year (MW)	Total Inst. Cap. (MW)
		Existing capacity						20839
	2013-14						1120	21959
1		Duber Khwar HPP	WAPDA	Hydel	130	Jan. 2014		
2		UCH-II	PPIB	Gas	404	Jan. 2014		
3		Guddu (1)	GENCOs	Gas	243	Apr. 2014		
4		Guddu Steam (2)	GENCOs	Gas	243	May. 2014		
5		Quaid-e-Azam Solar Park Phase-1	PPDB	Solar	100	Jun. 2014		
	2014-15						1466	23425
6		Quaid-e-Azam Solar Park Phase-2	PPDB	Solar	300	Sep. 2014		
7		Guddu Steam (3)	GENCOs	Gas	261	Sep. 2014		
8		Foundation Wind Energy-2	AEDB	Wind	50	Oct. 2014		
9		Foundation Wind Energy-1	AEDB	Wind	50	Jan. 2015		
10		Three Gorges Wind Farm	AEDB	Wind	50	Jan. 2015		
11		Nandipur Power project	GENCOs	Oil	425	Mar. 2015		
12		Sapphire wind	AEDB	Wind	50	Mar. 2015		
13		Yunus Energy	AEDB	Wind	50	Apr. 2015		
14		United Energy	AEDB	Wind	100	Apr. 2015		
15		Metro power	AEDB	Wind	50	May. 2015		
16		Tapal Wind Energy Pvt. Ltd.	AEDB	Wind	30	May. 2015		
17		Sachal Energy	AEDB	Wind	50	Jun. 2015		
	2015-16						1250	24675
18		Quaid-e-Azam Solar Park Phase-3	PPDB	Solar	600	Sep. 2015		
19		JHM-WPP#1	AEDB	Wind	50	Feb. 2016		
20		JHM-WPP#2	AEDB	Wind	50	Mar. 2016		
21		JHM-WPP#3	AEDB	Wind	50	Apr. 2016		10
22		JHM-WPP#4	AEDB	Wind	500	Apr. 2016		

List of Generation Projects

	2016-17						3572	28247
23		JHM-WPP#5	AEDB	Wind	50	Aug. 2016		
24		JHM-WPP#6	AEDB	Wind	50	Aug. 2016		
25		JHM-WPP#7	AEDB	Wind	50	Sep. 2016		
26		JHM-WPP#8	AEDB	Wind	50	Sep. 2016		
27		JHM-WPP#9	AEDB	Wind	50	Sep. 2016		
28		JHM-WPP#10	AEDB	Wind	50	Oct. 2016		
29		JHM-WPP#11	AEDB	Wind	50	Oct. 2016		
30		JHM-WPP#12	AEDB	Wind	50	Oct. 2016		
31		JHM-WPP#13	AEDB	Wind	50	Nov. 2016		
32		JHM-WPP#14	AEDB	Wind	35	Nov. 2016		
33		JHM-WPP#15	AEDB	Wind	35	Nov. 2016		
34		Neelum Jhelum Hydrel	WAPDA	Hydrel	969	Nov. 2016		
35		Golen Gol HPP	WAPDA	Hydrel	106	Dec. 2016		
36		CHASNUPP-III-Punjab	PAEC	Nucl	340	Dec. 2016		
37		Patrind HPP	PPIB	Hydrel	147	Dec. 2016		
38		Phandar Hydro	WAPDA	Hydrel	80	May. 2017		
39		Tarbela 4th ext.Hydro	WAPDA	Hydrel	1410	Jun. 2017		
	2017-18						13874	42121
40		Coal Plant at Sahiwal	PPDB	Coal	1200	Jul. 2017		
41		Keyal Khwar	WAPDA	Hydrel	122	Oct. 2017		
42		CHASHNUPP-IV-Punjab	PAEC	Nucl	340	Oct. 2017		
43		Oracle Coalfields Thar	TCEB	Coal	600	Nov. 2017		
44		Green Field Coal Thar (Phase-1)	TCEB	Coal	660	Nov. 2017		
45		China Power International Holding	TCEB	Coal	1200	Dec. 2017		
46		Engro Thar Coal	PPIB	Coal	600	Dec. 2017		
47		Gaddani (1)	PPIB	Coal	1320	Dec. 2017		
48		Gulpurpoonch river	PPIB	Hydrel	100	Dec. 2017		
49		CASA	GoP	Imp.	1000	May. 2018		
50		Gaddani (2)	PPIB	Coal	5280	Jun. 2018		
51		Bin Qasim PP	PPIB	Coal	1320	Jun. 2018		
52		Rajdhani HPP	AJKHEB	Water	132	Jun. 2018		
	2018-19						3610	45731
53		TPS Jamshoro (Unit Add.) Phase-1	GENCOs	Coal	660	Sep. 2018		
54		Sehra HPP	PPIB	Hydrel	130	Dec. 2018		
55		TPS Jamshoro(Unit Add.) Phase-2	GENCOs	Coal	660	Mar. 2019		11
56		Dasu-1	WAPDA	Hydrel	2160	Jun. 2019		

List of Generation Projects

	2019-20					5731	51462
57		Green Field Coal Thar (Phase-2)	TCEB	Coal	660	Jul. 2019	
58		Engro Thar Coal	PPIB	Coal	600	Dec. 2019	
59		Lower Pallas Valley	WAPDA	Hydel	665	Dec. 2019	
60		Lower Spat Gah	WAPDA	Hydel	496	May. 2020	
61		Coastal Karachi	PAEC	Nucl	1110	Jun. 2020	
62		Karot HPP	PPIB	Hydel	720	Jun. 2020	
63		Azad Pattan HPP	PPIB	Hydel	640	Jun. 2020	
64		Suki Kinari HPP	PPIB	Hydel	840	Jun. 2020	

References:

i. As per data provided by WAPDA Hydel, GENCOs, AJKHEB, PPIB and PAEC information

Notes:

i. Tarbela 5th Extension has not been included because of no ground realities

ii. PPIB's plants i.e Star Thermal & Grange Holding have not been included due to no physical progress at site

iii. Harpo, Basha, Trappi and PHYDO plants have also not been included due to non-connectivity with National Grid.

iv. Lower Spat Gah and Lower Palas Valley projects are linked with schedule of Dasu due to power evacuation issues.

v. Gabral Kalam, Kalam Asrit, Asrit Kedam and Madyan are linked with Basha Dam project due to power evacuation issues.

vi. Wind Power Projects (1756 MW) and Quaid-e-Azam Solar Power Park (1000 MW) have not been included since they are just energy not firm Mega Watts

NTDCL SYSTEM FUTURE SURPLUS / DEFICIT

Years	Available Capability	Computed Peak Demand	Surplus/ Shortfall
2013-14	16867	20888	-4021
2014-15	17421	21858	-4437
2015-16	17461	22880	-5419
2016-17	19327	24001	-4674
2017-18	26496	25137	1359
2018-19	31061	26294	4767
2019-20	35528	27496	8032

Existing Transmission Network of NTDCL

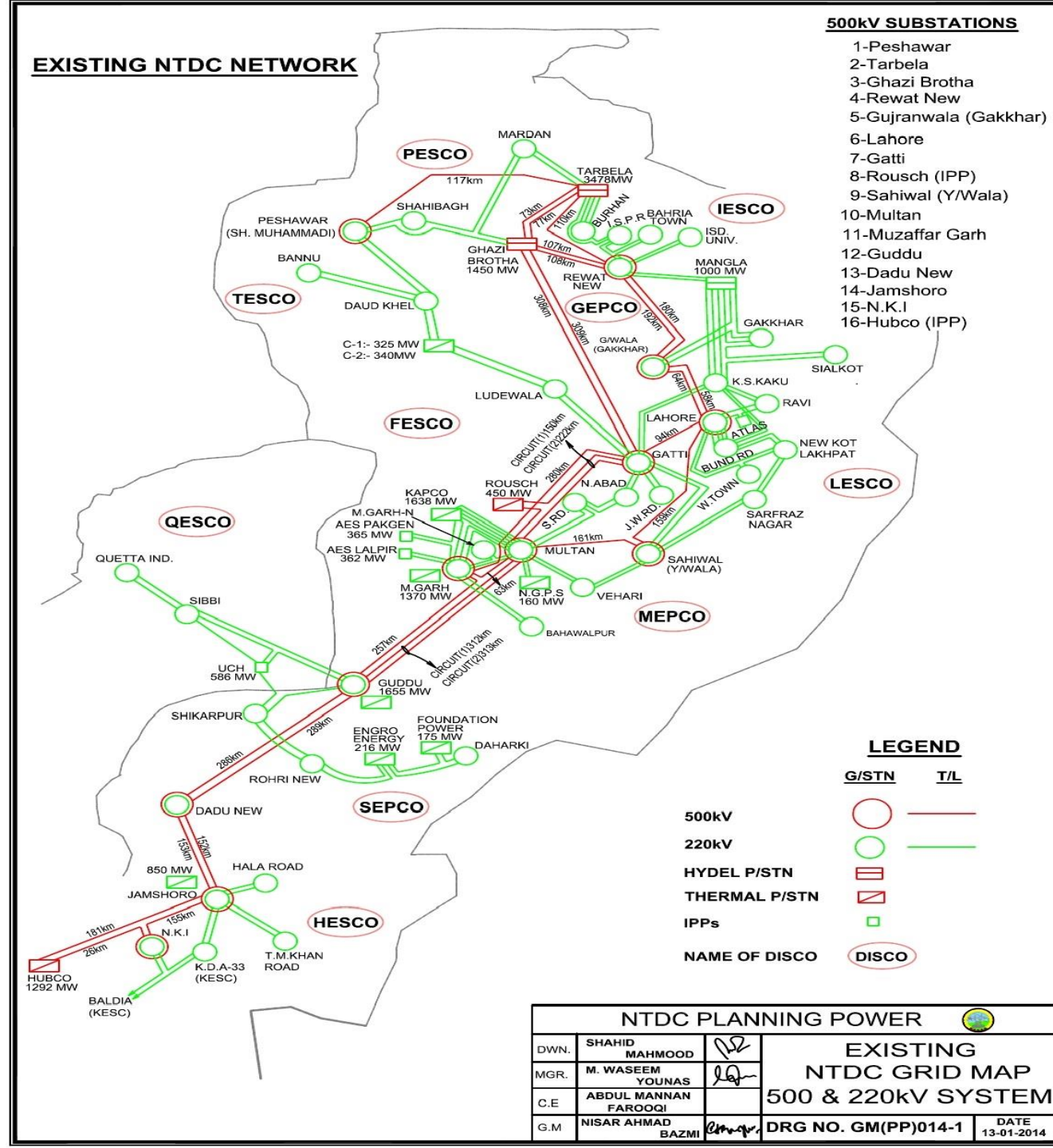
Existing Transmission Network of NTDC

- 500/220 kV Transformers (14,850 MVA)
- 220/132 kV Transformers (18,044 MVA)
- 500 kV Lines (5,078 km)
- 220 kV Lines (7,947 km)

(132 kV & 66 kV networks are handled by DISCOs)

Salient Features of NTDC Network

- North to South longitudinal network.
- Hydro generation in North and major thermal generation in South & in lower middle part of network
- Large load centers are remote from major generation sources.
- Seasonal variation in generation dispatch and in power flows



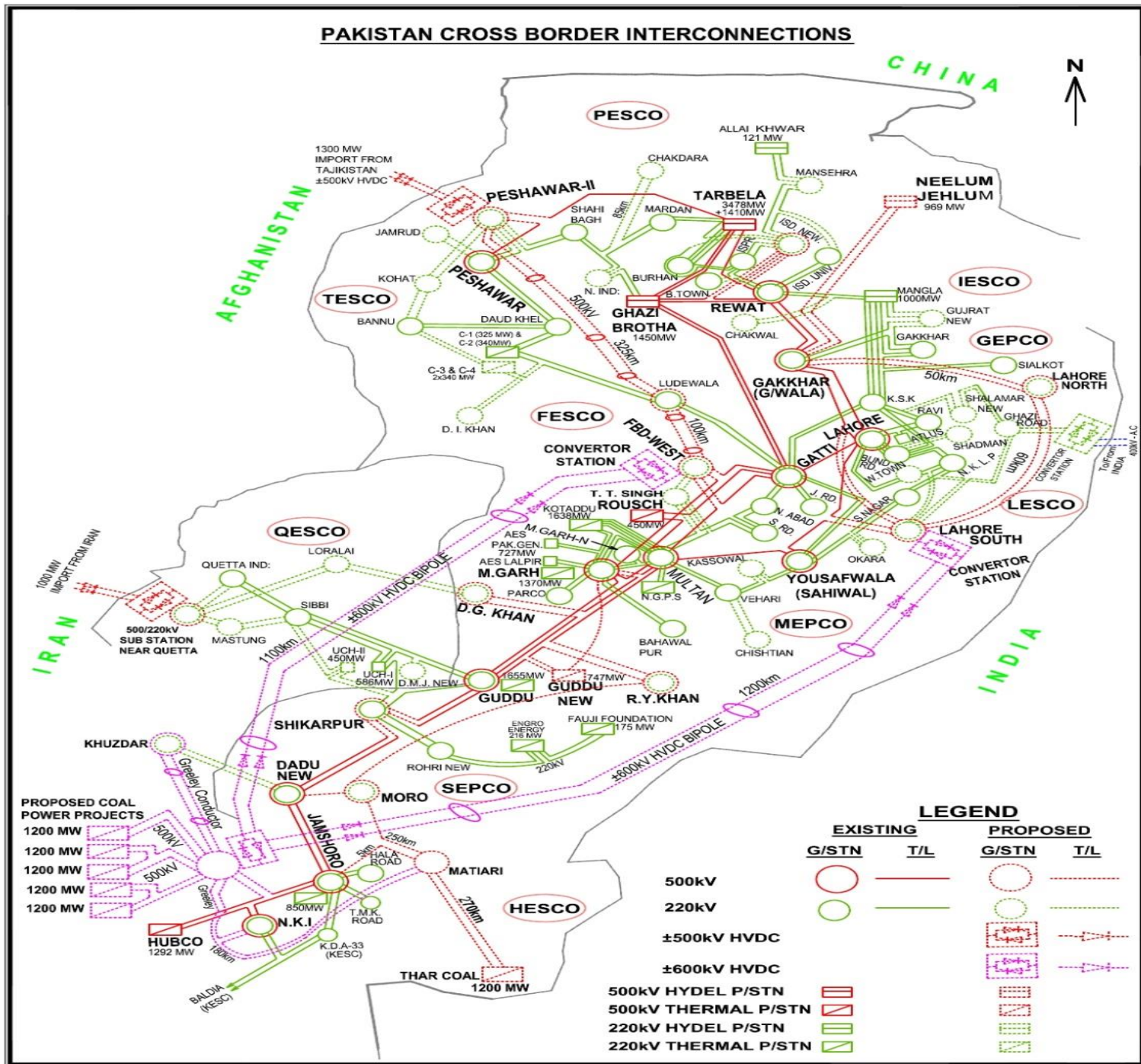
PAKISTAN

CROSS BORDER INTERCONNECTIONS

Cross-Border Interconnections

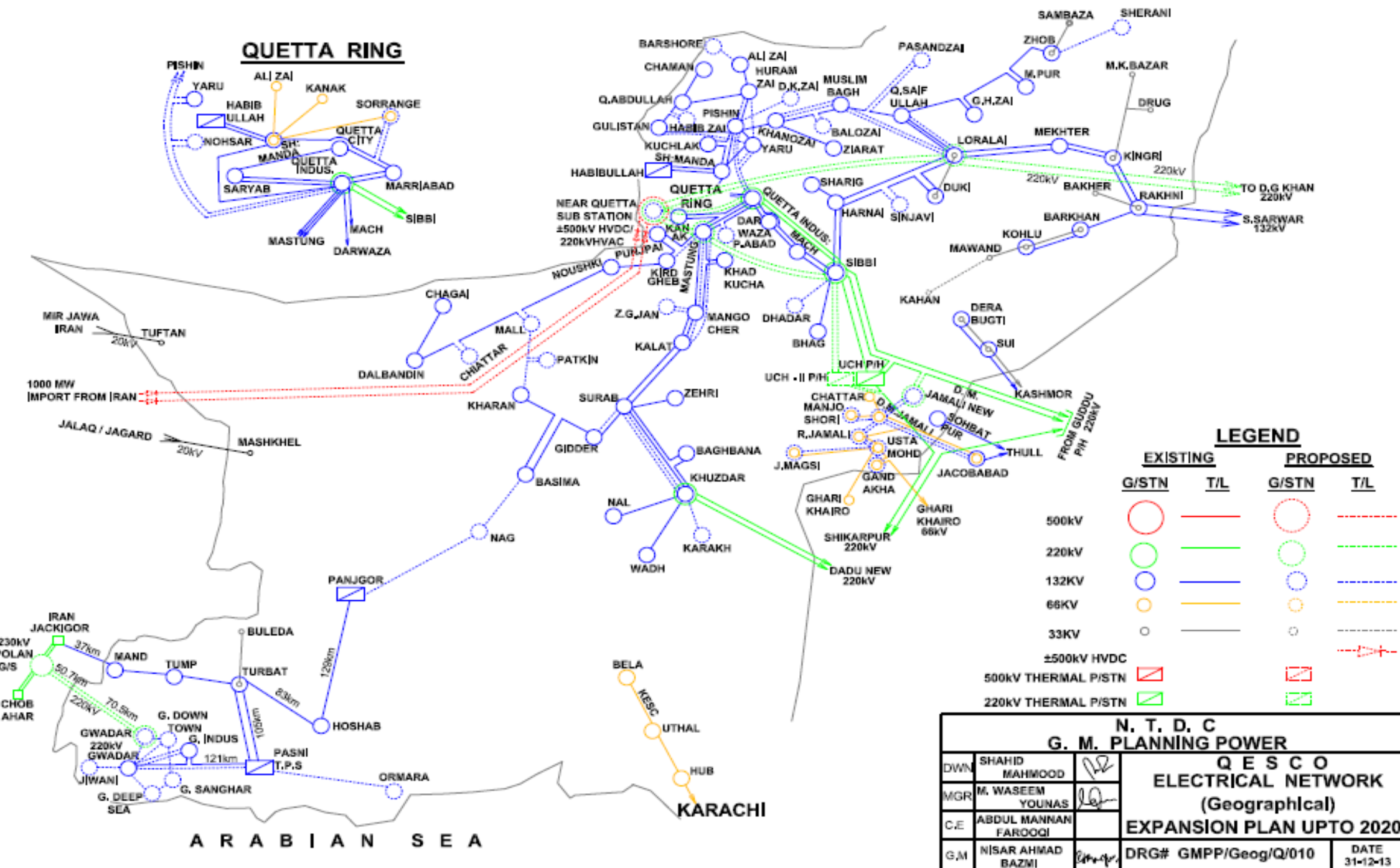
1. Import of Power from Iran
2. Import of Power from Tajikistan/Kyrgystan through Afghanistan (CASA-1000 Project)
3. Import of Power from India

PAKISTAN CROSS BORDER INTERCONNECTIONS



Pakistan - Iran Interconnections

QUETTA RING



LEGEND

EXISTING		PROPOSED	
G/S/STN	T/L	G/S/STN	T/L
500kV			
220kV			
132kV			
66kV			
33kV			
±500kV HVDC			
500kV THERMAL P/STN			
220kV THERMAL P/STN			

N. T. D. C			
G. M. PLANNING POWER			
DWN	SHAHID MAHMOOD		Q E S C O ELECTRICAL NETWORK (Geographical) EXPANSION PLAN UPTO 2020
MGR	M. WASEEM YOUNAS		
C.E	ABDUL MANNAN FAROOQI		
G.M	NISAR AHMAD BAZMI		
DRG# GMPP/Geog/Q/010			DATE 31-12-13

Pakistan – Iran Interconnection Projects

1. Existing Interconnection Projects:

Import of 74 MW Power by Pakistan in border areas of Pakistan (in Baluchistan Province):

- i. 70 MW at 132 kV (continued since 2003. Initially, it was 35 MW)
- ii. 4 MW at 20 kV (continued since 2002)
- iii. (Tariff: US cents 7-10. Contracts is renewed after every 3-years)

2. Planned Interconnection Projects:

- i. Import of 100 MW at Gwadar through 220 kV D/C T/Line (contract signed)
- ii. Import of 1000 MW at Quetta through ± 500 kV HVDC Bipole (MoU signed)

For import of power from Iran, Tariff is linked with International Oil prices.

Pakistan – Iran Interconnection Projects

Benefits to Pakistan:

1. Relative cheaper energy
2. Reliable energy source, Available throughout the year
3. National Grid is not required to be extended to remote border areas
4. Meeting short-term and long-term energy requirements.

100 MW Power Import from Iran at Gwadar

Interconnection Link:

- **Polan (Iran) - Gwadar (Pakistan) through 220 kV D/C Line**
- **220 kV D/C T/Line (about 50 km) from Polan upto Pak-Iran Border**
- **220 kV D/C T/Line (about 75 km) from Gwadar upto Pak-Iran Border**
- **220 kV Substation at Gwadar with 2x160 MVA T/Fs**

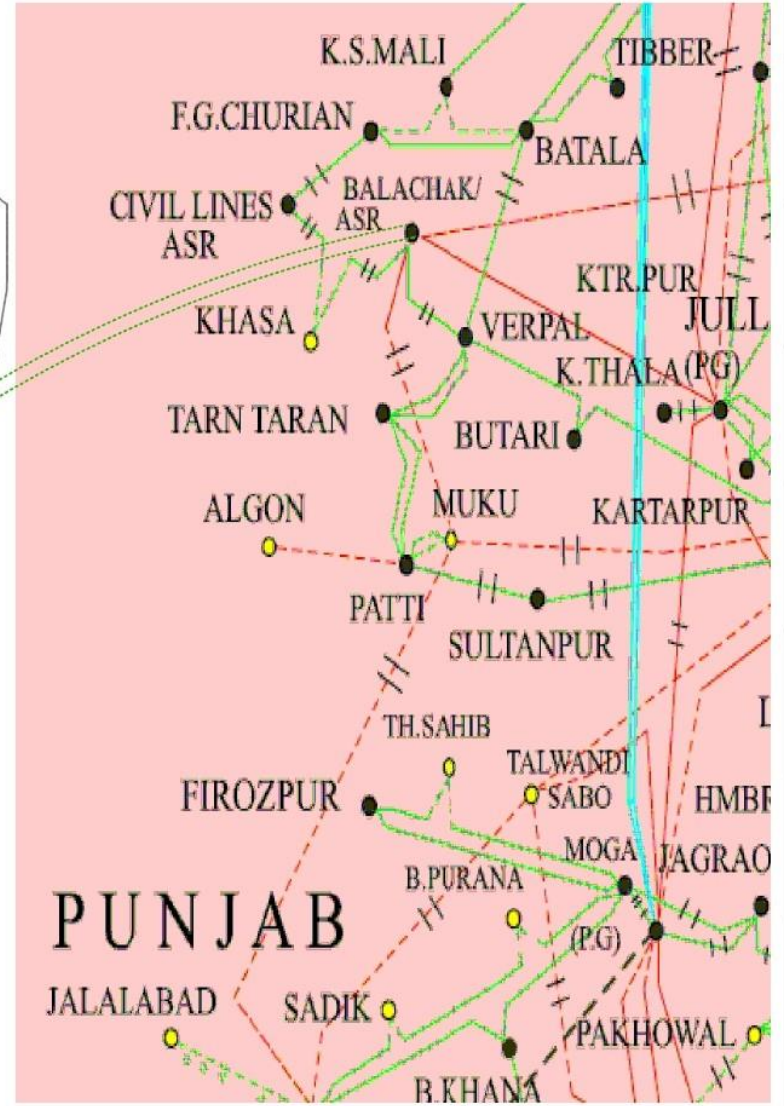
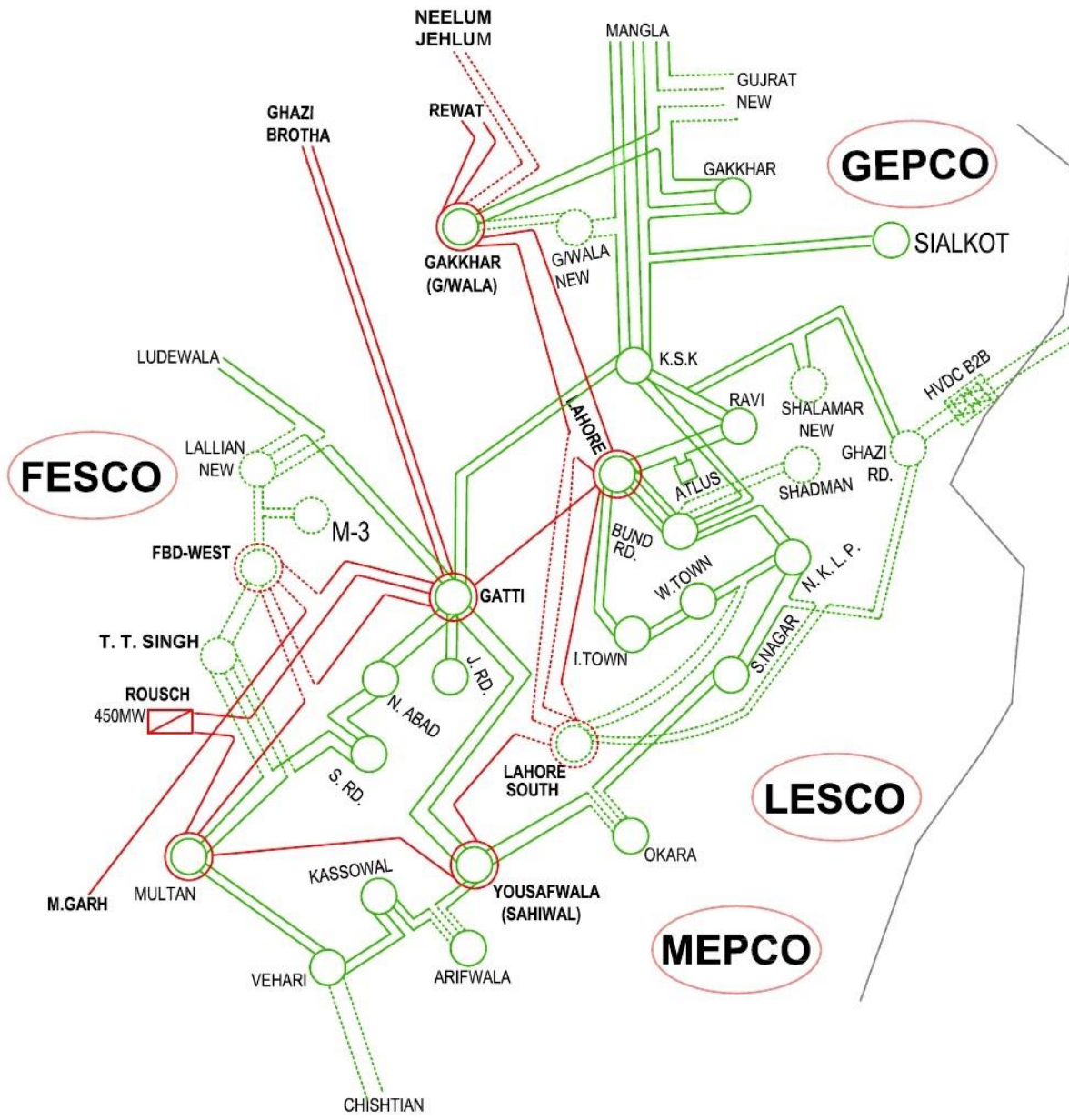
100 MW Power Import from Iran at Gwadar

Status

- Financing: 70% by Export Development Bank of Iran and 30% by NTDC.
- Contract Cost is PKR 3630 million (US\$ 36 million).
- Survey work of Gwadar - Pak Iran Border 220 kV D/C T/L (75km) is in progress.
- Work of 220 kV GIS at Gwadar with 2x160MVA T/Fs awarded to contractor and contractor has been mobilized.
- Expected commissioning date was 31-12-2014.
- Project is not moving forward as per schedule due to Embargo on Financial Transactions for Iran.

Pakistan - India Interconnection

**ARRANGMENT FOR 500 MW TRANSFER THROUGH HVDC B2B
(PAKISTAN-INDIA INTERCONNECTION)**



Pakistan – India Interconnection

Status:

1. The working groups from both countries have met several times for import of power by Pakistan from India:
 - Pakistan delegation visited India in 2011 and 2014.
 - Indian delegation visited Pakistan in 2012, 2013 and 2014.
2. Summary of Discussions:
 - Both countries agreed to start with import of 500 MW power from India to Pakistan in the initial phase with potential to increase up to 1000 & beyond in the long term.
 - India has already indicated that Pakistan could purchase power from Indian suppliers through their power exchanges under a competitive trading of electric power regime. However, bilateral agreement between the two governments also has its significance for such trade.

Cont'd...

Pakistan – India Interconnection

Cont'd..

- India indicated to source the power from Balachak 400 kV grid station (Amritsar region) from an existing border side PGCIL grid station.
- Pakistan indicated to inject power at the Ghazi Road 220 KV Grid Station (Lahore region).
- The countries discussed to implement a 400/220 KV transmission line interconnection through a HVDC back-to-back Converter station that will be built in Pakistan, to facilitate power trading.
- Power ministries in both countries have recently met in March 2014 in India and agreed to form joint working groups to address technical, financial, commercial, legal and regulatory issues regarding implementation of power trade with India.

Pakistan – India Interconnection

Scope of Work:

A pre-feasibility study for import of 500 MW power by Pakistan from India was conducted by consultants (M/s Tetra Tech, USA and M/s Hagler Bailly, Pakistan in 2012-13. The study was funded by World Bank.

In the study report, the following scope of transmission interconnection was proposed:

- 400/220 kV HVDC Back-to-Back Converter Station in Pakistan
- 400 kV D/C T/Line (approx. 26 km) from Balachak to Pak-India Border.
- 400 kV D/C T/Line (approx. 10 km) from Converter Station to Pak-India Border
- 220 kV D/C T/Line from Ghazi Road to Converter Station

Cost Estimates: US\$ 119.4 million

Pakistan – India Interconnection

Benefits:

- Meeting short-term energy requirements at competitive price. Pakistan can readily absorb 500-1000 MW of power from India in the short to medium term in Lahore region without incurring significant investment in transmission infrastructure.
- Help in congestion management in Lahore region.
- Interconnection may be used for import/export (long term scenario) depending on generation scenarios in both countries in future .

**Import of 1000-1300 MW Power
through CASA-1000 Project
(Pakistan – Afghanistan – Tajikistan –
Kyrgystan Interconnection)**

CASA 1000 PROJECT

PRESENT STATUS & FUTURE TIMELINES

CASA-1000 Project

- **Transport of surplus power (1300 MW) during 5 summer months from Kyrgyz Republic and Tajikistan to Afghanistan (300 MW) & Pakistan (1000 MW)**
- **Scope of Work:**
 - 750 km \pm 500 kV HVDC Bipole between Tajikistan and Pakistan via Afghanistan; and Converter Stations at Sangtuda, Kabul & Peshawar
 - 477 km 500 V AC link between the Kyrgyz Republic (Datka) and Tajikistan (Khoujand)
 - AC system upgrades on existing lines



Uzbekistan

Kyrgyzstan

Tajikistan

China

Afghanistan








Pakistan

Regar Dushanbe
DUSHANBE

KABUL

Peshawar

CASA - 1000 project lines:
AC - Datka - Khodzhent,
Regar - Sangtuda
DC - Sangtuda - Kabul - Peshawar

-  Existing 500 kV lines and substations
-  Planned 500 kV AC lines for CASA - 1000
-  500 kV substation under construction
-  Proposed CASA - 1000 DC line and converters
-  Existing 220 kV lines and substations
-  Existing 110 kV lines and substations
-  Cities

Philosophy Behind CASA-1000 Project

- Regional cooperation
- Creation of a Regional Power Pool
- Free access to energy corridor for member countries

Estimated Cost

- Approximate 10 cents
- 6 cents energy cost
- 4 cents infrastructure cost
- Payback period is 15 years
- Project life is 35 years
- Infrastructure cost shall be borne by the purchasers

CASA-1000

Cost Break Up

USD Million

CAPITAL EXPENDITURE	KYRGYSTAN	TAJIKISTAN	AFGHANISTAN	PAKISTAN	TOTAL
EPC Costs (AC+DC)	160	182	238	153	733
Environmental & Social Costs	0	2	11	3	16
Network Reinforcement Costs	-	24	4	6	34
Owner's Engineer Cost	3	4	5	3	15
Contingencies	16	18	24	15	73
Total Hard Cost	180	230	282	180	871
Financing/Soft Cost	20	27	25	23	95
Total Project Cost	200	257	307	203	966

Key Facts

- Estimated Feasibility Level Cost is US\$ 966 million (including IDC). According to a World Bank study, these costs still hold true.
- However, for our analyses of estimated tariff, we are assuming 15 to 25% cost over-run.
- The estimated guaranteed energy is around 4250~4500 GWh per year (to be delivered in 5 summer months)
- The initial Agreement Term would be for 15 years.
- 71 km HVDC T/L & Converter Station inside Pak territory.

Present Status

- After a long period of relative slow progress, the CASA project has entered a fast-track mode after the successful Sept 2013 IGC (Inter Government Committee) meeting at Islamabad.
- Commitment of the 4 founding member countries & the major lenders (World Bank & IsDB).

Current Timelines

1. Funding - Banks Approval

- By March/ April, 2014, the project to be submitted to the Bank's Board.
- Loan negotiations between the Banks and countries April-September, 2014.
- Financial close by October,2014.

(Cont'd...)

Current Timelines

EPC Bidding Process

- Award of EPC Contract: November 2014
- Construction Start: December 2014
- Completion: December 2017
- First Supply of Energy: 1st May, 2018

Current Timelines

2. Core project agreements

- A series of meetings have been held since Sep, 2013, in which the PPAs have substantially been finalized and the master agreement.
- By July 2014, All Core Project Agreements, including Prices to be Finalized, Project Security, O& M etc., will be made.

(Cont'd...)

Current Timelines

3. EPC Bidding Process

- For HVDC converter Stations, pre-qualification application receipt in Jan 2014.
- Finalization of pre-qualification by end March, 2014.
- Preparation of Bidding Documents and issuance to the pre-qualified contractors by in April, 2014.

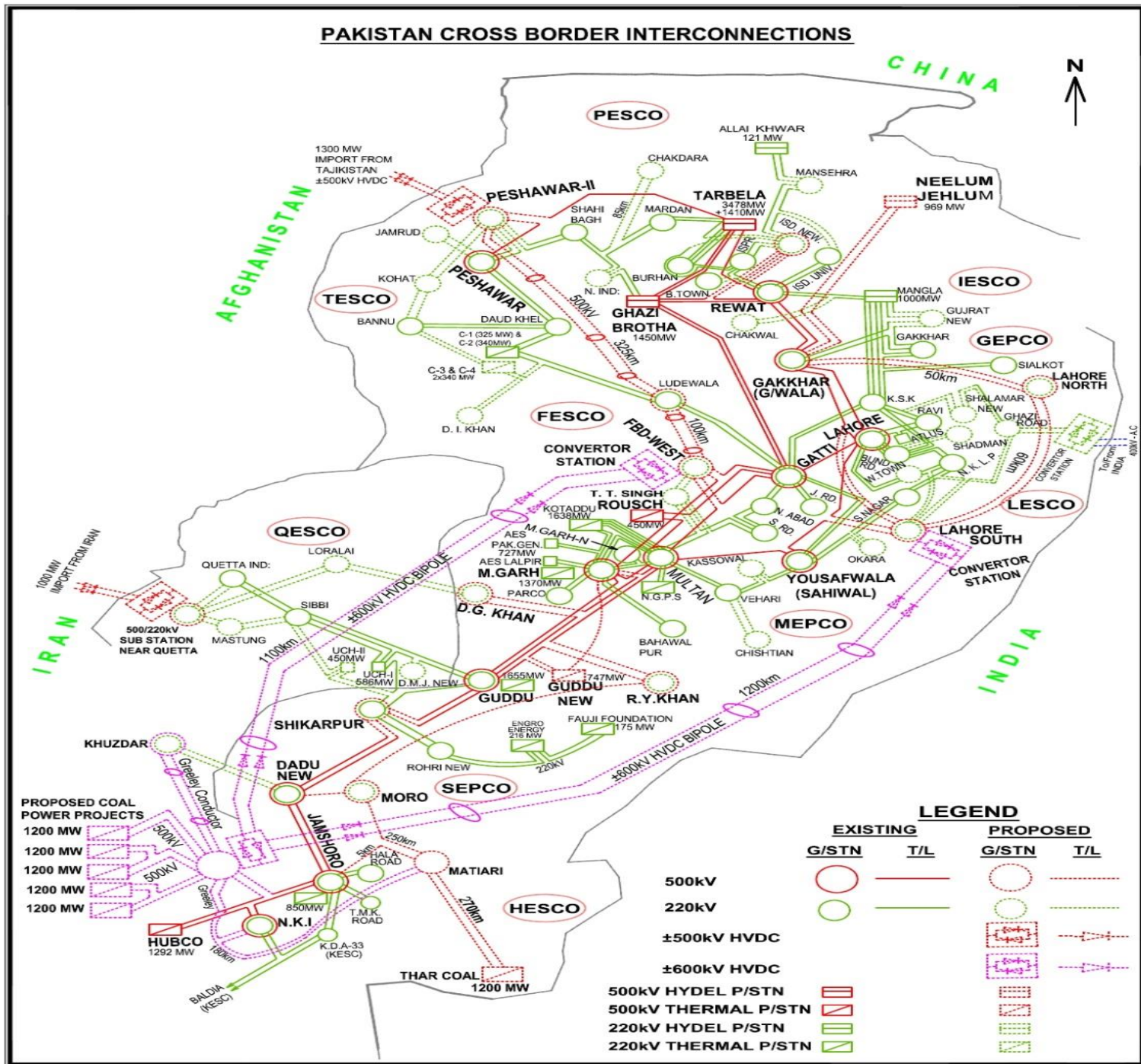
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Current Timelines

3. EPC bidding Process

- Receipt of bids for HVDC converter stations by June, 2014.
- Evaluation and approval (By countries and Banks) for award of contracts for converter stations by November, 2014.
- For HVDC line and HVAC lines in Tajikistan/ Kyrgyz Republic, the consultants have been asked to schedule the activities accordingly.

PAKISTAN CROSS BORDER INTERCONNECTIONS



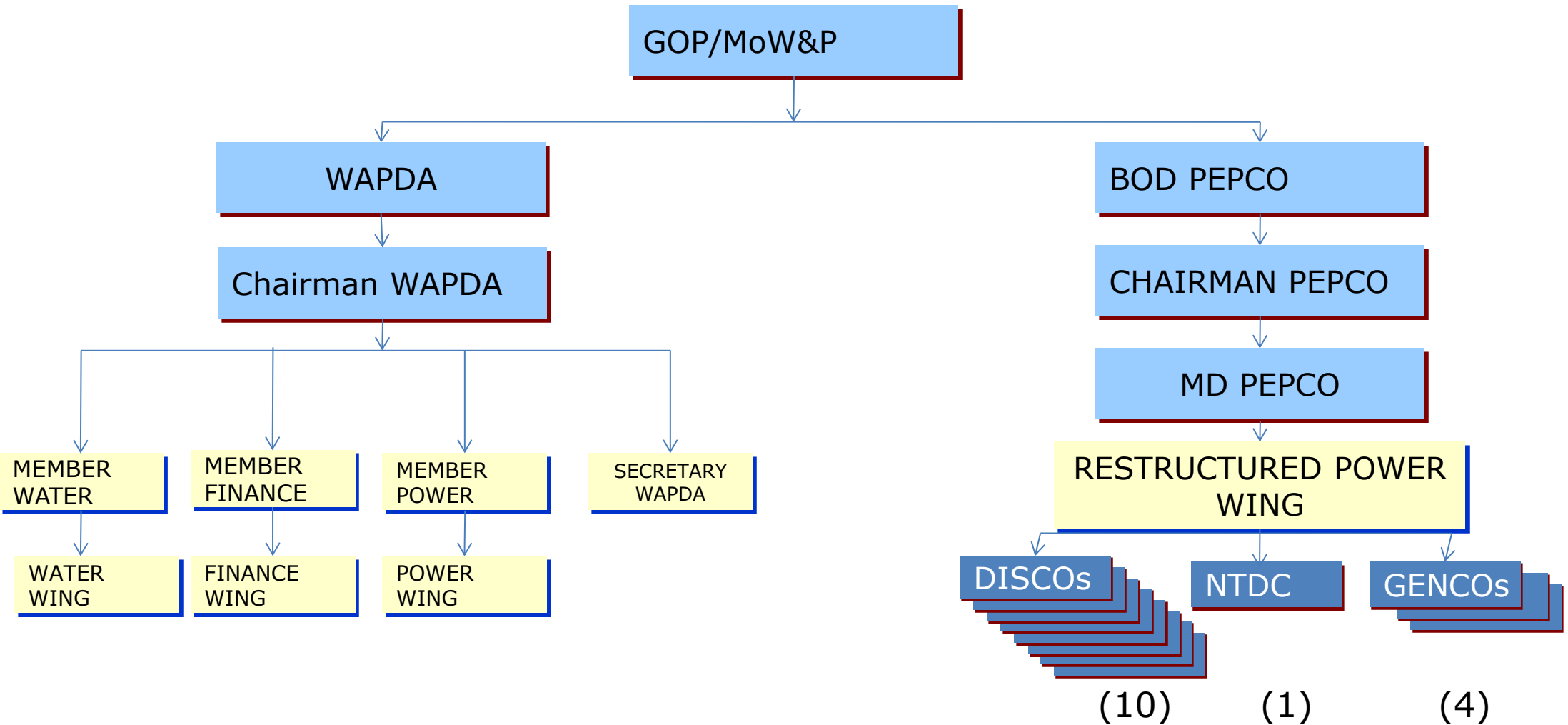
Thank you
for
your



PAKISTAN POWER SECTOR: BACKGROUND

- Pakistan Power Sector Strategic Plan was approved in 1992 for restructuring the power sector and introducing reforms.
- Power wing of WAPDA was unbundled into;
 - 10 Distribution Companies (DISCOs),
 - 4 Generation Companies (GENCOs) and
 - 1 National Transmission and Despatch Company (NTDC)

NEW FACE OF PAKISTAN POWER SECTOR



INCORPORATION OF NTDC

- National Grid Company being regulated by National Electric Power Regularity Authority (NEPRA) of Pakistan.
- NTDC was incorporated in 1998.
- It was organized to take over from WAPDA all the properties, rights, assets, obligations and liabilities of 500 kV and 220 kV Network.

Segments of NTDC

1. **Central Power Purchasing Agency (CPPA) Responsible for:**
 - Procurement of power on behalf of Distribution Companies
2. **System Operator (SO) Responsible for:**
 - Operation and control of transmission and dispatch from the generation facilities
3. **Transmission Network Operator (TNO) Responsible for:**
 - Operation and maintenance (O&M) of 500 kV and 220 kV system
4. **Contract Registrar and Power Exchange Administrator (CRPEA) Responsible for:**
 - Recording and notification of contracts related to bilateral trading (**Not Operational Yet**)