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STEP 1 DUE DILIGENCE

DISPERSAL OF POWER FROM WIND POWER PROJECTS AT JHIMPIR AND GHARO

January 2014

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Acronyms

AEAI	Advanced Engineering Associates International
AEDB	Alternate Energy Development Board
AIS	Air Insulated Substation
COD	Commercial Operation Date
D/C	Double Circuit
DISCO	Distribution Company
ECNEC	Executive Committee of the National Economic Council
EPA	Energy Purchase Agreement
EPP	Energy Policy Program
FFCEL	Fauji Fertilizer Company Energy Ltd.
FWEL-I	Foundation Wind Energy Ltd-I
FWEL-II	Foundation Wind Energy Ltd-II
G2G	Government to Government
GENCO	Generation Company
GIS	Gas Insulated Substation
GOP	Government of Pakistan
GS	Grid Station
HESCO	Hyderabad Electric Supply Company
IPP	Independent Power Producer
kV	Kilo Volts
MOF	Ministry of Finance
MPNR	Ministry of Petroleum and Natural Resources
MW	Mega Watts
MWP	Ministry of Water and Power
NEPRA	National Electric Power Regulatory Authority
NTDC	National Transmission and Despatch Company
O&M	Operation and Maintenance
PC	Planning Commission

PPA	Power Purchase Agreement
PPI	Power Planners International
PSRP	Power Sector Reform Program
RE	Renewable Energy
S/C	Single Circuit
SDT	Single Strung Double Circuit Transmission Line
SS	Substation
T/L	Transmission Line
TGF	Three Gorges First
UEPL	United Energy Pakistan Ltd.
UoSC	Use of System Charge
USAID	United States Agency for International Development
USG	United States Government
WPP	Wind Power Plant
ZEPL	Zorlu Energy Pakistan Ltd.

Preface

USAID's Energy Policy Program (EPP) is a multiyear initiative that increases power generation, decreases system losses, and increases cost recovery in Pakistan's power sector. EPP works with selected energy infrastructure and the Government of Pakistan (GOP) to facilitate reform efforts with technical assistance and new technology. Activities undertaken by EPP are mostly demand driven with input from USAID and the GOP implementing partners. The "USG Energy Strategy for Pakistan" called for large, highly visible power generating projects and power plant rehabilitation programs that would make significant additions to power supply.

Advanced Engineering Associates Inc. (AEAI) is the implementing partner of EPP and is contracted under USAID contract AID-EPP-I-00-03-0004-00; Task Order No. AID-391-TO-12-0002.

As part of EPP's efforts, this Step I due diligence is intended to assist USAID's decision to conduct further due diligence as a precursor to possible USG funding to support the construction, by 2015, of transmission capacity sufficient for power dispersal from additional 750 MW out of the total 1,256 MW wind projects envisaged to be commissioned by 2016-2017 from Jhimpir and Gharo wind clusters.

Executive Summary

Background

This document acts as the first of a two-step evaluation process to support the implementation of transmission grid projects for power evacuation from the upcoming Wind Power Projects (WPPs) in the Jhimpir and Gharo wind clusters. Step 1 reviews the existing documents for adequacy to apply selection criteria and make a recommendation to USG. The selection criteria are based on technical feasibility, cost and overall approach. USAID tasked AEAI to conduct the Step 1 due diligence and confirm the facts from the National Transmission and Despatch Company (NTDC) and Hyderabad Electric Supply Company (HESCO); evaluate whether the project meets the USAID criteria described below, highlight any particular risk or concern that needs to be mitigated or addressed, and to make recommendations. EPP's findings relating to the evacuation of power from wind power projects at Jhimpir and Gharo wind clusters are summarized in the table below:

Technical Feasibility	
Will the proposed intervention actually contribute significantly to meeting Pakistan's energy and other vital development needs, while improving the country's energy security?	Yes, because: • The project is required to interconnect an additional 750 MW of wind power plant generation capacity with the National Grid and help to address Pakistan's growing energy deficit. • The project will enable the use of clean electricity generated through efficient use of renewable indigenous wind resources. • The project will stimulate the economy by purchasing both local and foreign goods and services and creating jobs for qualified locals in the project area and in the country.
Does project use domestic or imported resources?	Both
Does the project result in energy diversification?	Yes. The project will promote energy security through diversification of the energy mix to renewable indigenous wind resources and help reduce reliance on imported and diesel fuel for power generation.

Costs	
Is the cost reasonable?	EPP's conclusion is that the cost is very reasonable.
Can the project's full financing be arranged in a	With contribution from USAID through the

timely fashion?	EPP, this project can be financed quickly.
Overall Effect	
Is the project high visibility?	Yes
Is it a high priority for Pakistan?	Yes
Will the power generated and other benefits be worth the time and money?	Yes

Details

Pakistan is facing acute shortage of electrical power and requires the injection of new power sources on a fast track basis. Pakistan is endowed with abundant renewable resources such as wind, solar, biomass etc. Tapping this vast potential of renewable energy is of critical urgency to support peak demand and diversify Pakistan's skewed fuel mix, hence ensuring energy security. The Government of Pakistan established the Alternate Energy Development Board (AEDB) in 2003 to encourage the development of renewable energy. Due to substantial native wind resources, an estimated 50,000 MW is available in the Jhimpir and Gharo wind corridor in southern Sindh province. AEDB has allocated vast areas of land along this corridor to private investors i.e. Independent Power Producers (IPPs), for the development of wind power projects.

Under the Power Policy 2002 and RE Policy 2005, NTDC is obligated to ensure evacuation of power from all independent power producers. The interconnection with an IPP is normally through a 132 kV transmission circuit. In Pakistan, the 132 kV transmission lines are owned and maintained by the DISCO's. Therefore, for IPP interconnections, NTDC will design and construct the needed 132 kV transmission lines and substations and then turn them over to the relevant Distribution Company (DISCO), in this case HESCO.

Two wind power projects (FFCEL with 49.5 MW capacity and ZEPL with 56.4 MW capacity) at Jhimpir have started commercial operation and are feeding power to the 132 kV HESCO transmission lines. However, additional transmission line capacity must be added to evacuate the power from planned future wind projects.

NEPRA, at the request of wind power developers, conducted a meeting in March 2013 with NTDC, HESCO, wind power sponsors and Power Planners International (PPI) to prepare a comprehensive system study to determine the infrastructure improvements needed to disperse the power generated by the upcoming wind projects. All the upcoming projects at Jhimpir and Gharo are modeled in the PSS/E planning software at their planned implementation dates and connected capacity. Through this planning process, NTDC has developed a multi-stage transmission expansion scheme, described below, for the safe and reliable evacuation the power from the WPPs planned through 2016-2017.

Stage-1 (Currently in progress using NTDC and HESCO resources):

By March 2014 – 100 MW wind power at Gharo cluster to be evacuated through a 64 km, 132 kV D/C transmission line from FWEL-I (50 MW) and FWEL-II (50 MW) to the existing 132 kV Thatta GS. Rehabilitation of existing 132 kV transmission network in the vicinity of these WPPs is to be completed by HESCO by March 2014.

Stage-2 (Currently in progress using NTDC and HESCO resources):

By December 2014, a 50 MW WPP at Jhimpir (Three Gorges First (TGF)) and by March 2015, an additional 50 MW wind power (Sapphire WPP) will evacuate power through a second circuit added to the 30 km, 132 kV Jhimpir-Nooriabad Transmission Line.

Stage-3 (New unfunded work, estimated total cost: US$ 14 million):

By June 2015, an additional 200 MW wind power at Jhimpir cluster will be evacuated through a new 82 km, 132 kV D/C Transmission Line from Jhimpir New GS to existing 132 kV T.M Khan GS and new 25 km, 132 kV interconnection transmission line to the WPPs.

Stage-4 (New unfunded work, estimated total cost: US$ 61.5 million)

1. By December 2015, an additional 550 MW wind power at Jhimpir cluster to be evacuated by a new 70 km, 220 kV Transmission Line connected from the WWP's to the existing 220 kV TM Khan Road GS and by converting the Jhimpir New GS from 132 kV to 220 kV.
2. By June 2016, an additional 200 MW wind power at Gharo cluster will be evacuate by a new 75 km, 220 kV Transmission Line and the construction of the associated 220 kV GIS Gharo New GS.

The National Transmission and Despatch Company have requested USAID EPP to fund the transmission projects to be implemented under Stage-3 and Stage-4(a) (Jhimpir part only) for the dispersal of power from Jhimpir Wind Clusters **(estimated total cost US$ 46 million).**

The estimated cost for Stage-3 is US$ 14 million (1 US$= PKR 103) and US$ 32 million for Stage-4(a) (Jhimpir part only). The PC-1 for the proposed interconnection scheme is in the Planning Commission awaiting ECNEC approval.

The transmission improvements associated with Stage 3 and Stage 4 (Jhimpir part only) needs to be funded on war-footing basis.

Risks

The possible risks involved are obtaining transmission rights of way; and the law and order situations prevailing throughout the country, that could hurdle timely execution of the project.

The success of this project is closely linked with timely realization of the implementation schedule of the associated wind generation plants and the transmission network expansion to be done by NTDC and HESCO. The proposed transmission improvement project will have to be completed prior to the commercial operation dates of the generating source in order to harness full benefits of the project in a timely manner.

1. Project Summary

Name of Project	Interconnection Scheme for dispersal of power from Jhimpir Wind Power Plants
Location	Jhimpir-Sindh Province, Pakistan
Sponsoring Agency	Ministry of Water and Power, Government of Pakistan
Executing Agency	National Transmission and Despatch Company
Description of the Project	1. Stage-3: Power dispersal scheme at 132 kV Transmission level for additional 200 MW upcoming WPPs at Jhimpir wind cluster. 2. Stage-4(a) (Jhimpir part only): Power dispersal scheme at 220 kV Transmission level for additional 550 MW upcoming WPPs at Jhimpir wind cluster till December 2016.
Scope of the Project	NTDC has requested USAID EPP to support their scope by funding transmission improvement projects required for power dispersal from the Jhimpir WPPs at 132 kV and 220 kV Transmission levels.
Commencement Date	1. Stage-3 at 132 kV level- March 2014 2. Stage-4(a) (Jhimpir part only) at 220 kV level- March 2014
Completion Date	1. Stage-3 at 132 kV level- June 2015 2. Stage-4(a) (Jhimpir part only) at 220 kV level- December 2015
Total Estimated Cost	US$ 46 Million
Mode of Financing	Financing is being requested from USAID, Government of United States, under USAID Energy Policy Program for the evacuation of Power from Jhimpir WPPs.

Table 1: Estimate Project Cost

S. No.	Description	Estimated Cost (Million PKR)
Stage-3		
1.	132 kV Jhimpir New Collector Grid station	176
2.	Extension at existing 132 kV T.M. Khan Grid station	22
3.	132 kV D/C T/L from Jhimpir New to existing T.M. Khan Grid station (82 km)	954
4.	132 kV D/C T/L for interconnection of WPPs with 132 kV Jhimpir New Grid station (25 km)	295
	Sub-Total Stage-3 (Million PKR)	**1,447**
Stage-4(a) (Jhimpir Part only)		
1.	Up-gradation of 132 kV Grid station at Jhimpir New to 220 kV Grid station	990
2.	Extension at existing 220 kV T.M. Khan Road Grid station	55
3.	Extension at existing 500 kV Jamshoro Grid station	798
4.	220 kV Jhimpir – T.M. Khan Road D/C T/L (70 km)	1,440
	Sub-Total Stage-4(a) (Million PKR)	**3,283**
	Grand Total Stage-3 & Stage-4 (a) (Million PKR)	**4,730**
	Grand Total Million US$[1]	**46**

[1] The exchange rate used: 1 US$ = PKR 103.00

2. Project Description

The NTDC is responsible for the planning, construction, operation and maintenance of Pakistan's National Electric Power Grid. An extensive transmission network consisting of 500 kV and 220 kV transmission lines and substations have been built by NTDC for the dispersal of power generated by GENCOs, WAPDA & IPPs to the respective DISCOs.

The details of stage-wise interconnection scheme proposed by NTDC for dispersal of 1256 MW of power from the Wind Projects has been explained. The NTDC has requested, on a priority basis, USAID EPP fund the transmission projects to be implemented under Stage-3 and Stage-4(a) (Jhimpir part only) for the dispersal of power from Jhimpir Wind Clusters.

There are two existing 132 kV substations in the vicinity of Jhimpir wind cluster, 132 kV Jhimpir GS and 132 kV Nooriabad GS. These substations are connected through a single strung double circuit transmission line (SDT) with Cairo conductor. NTDC has determined that adding a second circuit on these (SDT) towers will be sufficient for dispersing power from the TGF and Sapphire WPP's schedule for completion by December 2014. This arrangement is sufficient to disperse power from these two WPPs only.

By June 2015 four additional WPPs (total generation capacity 200 MW) are expected to come on line at Jhimpir and the stage 3 interconnection arrangement described previously is adequate for disbursing the power. Additional WPP's are planned to come on line by December 2015 and December 2016 at 350 MW and 200 MW, respectively. Stage 4(a) work has to be completed by December 2015 to disburse the initial 350 MW but also adds sufficient transmission capacity to disburse the 200 MW's coming on line by December 2016.

March 2014-June 2015

Stage-3

Dispersal of 200 MW wind power will be done on 132 kV Transmission level in this stage. The following needs to be constructed by June, 2015.

1. 132 kV Jhimpir New Collector Grid station
2. 132 kV D/C Transmission Line (approx. 82 km) on Greeley conductor from 132 kV Jhimpir New collector station to the existing 132 kV T.M Khan Grid station.
3. 132 kV D/C Transmission Line (approx. 25 km) on Greeley conductor for looping in/out at the four WPPs with 132 kV Jhimpir New collector station.
4. Extension at 132 kV T.M Khan Grid station (adding two line bays).

March 2014-December 2015

Stage-4 (a) (Jhimpir part only)

For the additional 350 MWs of WPPs coming on line by December 2015, the following interconnection scope will adequately disperse power to the Grid. It should be noted that the

transmission capacity added in this stage will be sufficient to disperse the additional 200 MW planned to come on line at Jhimpir by December 2016.

1. Up-gradation of 132 kV Jhimpir new grid station to 220 kV by adding three 250 MVA 220/132 kV Transformers.
2. A 220 kV D/C Transmission Line (approx. 70 km) on twin-bundled Greeley conductor from 220 kV Jhimpir New GS to the existing 220 kV TM Khan Road GS.
3. Extension will be done at 220 kV TM Khan Road GS by adding two line bays.
4. This arrangement of power dispersal will affect the interconnected substations in the vicinity, therefore the addition of a 450MVA, 500/220 kV transformer is needed at the existing 500 kV Jamshoro GS.

The interconnection schematic diagrams are given on the following pages for both these stages.

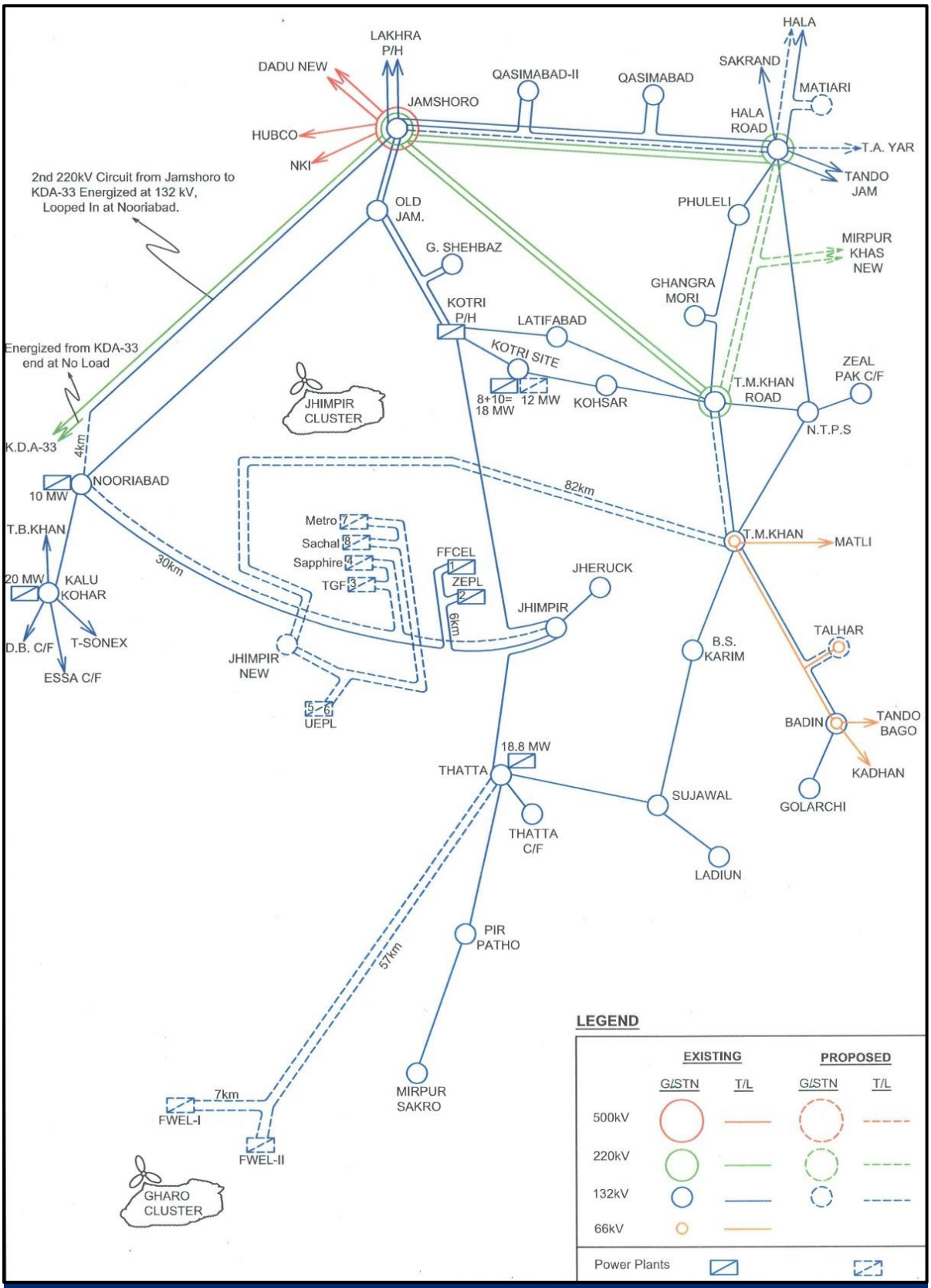

Figure 1: Stage 3 - Interconnection Schemes for Power Evacuation at Jhimpir & Gharo Clusters

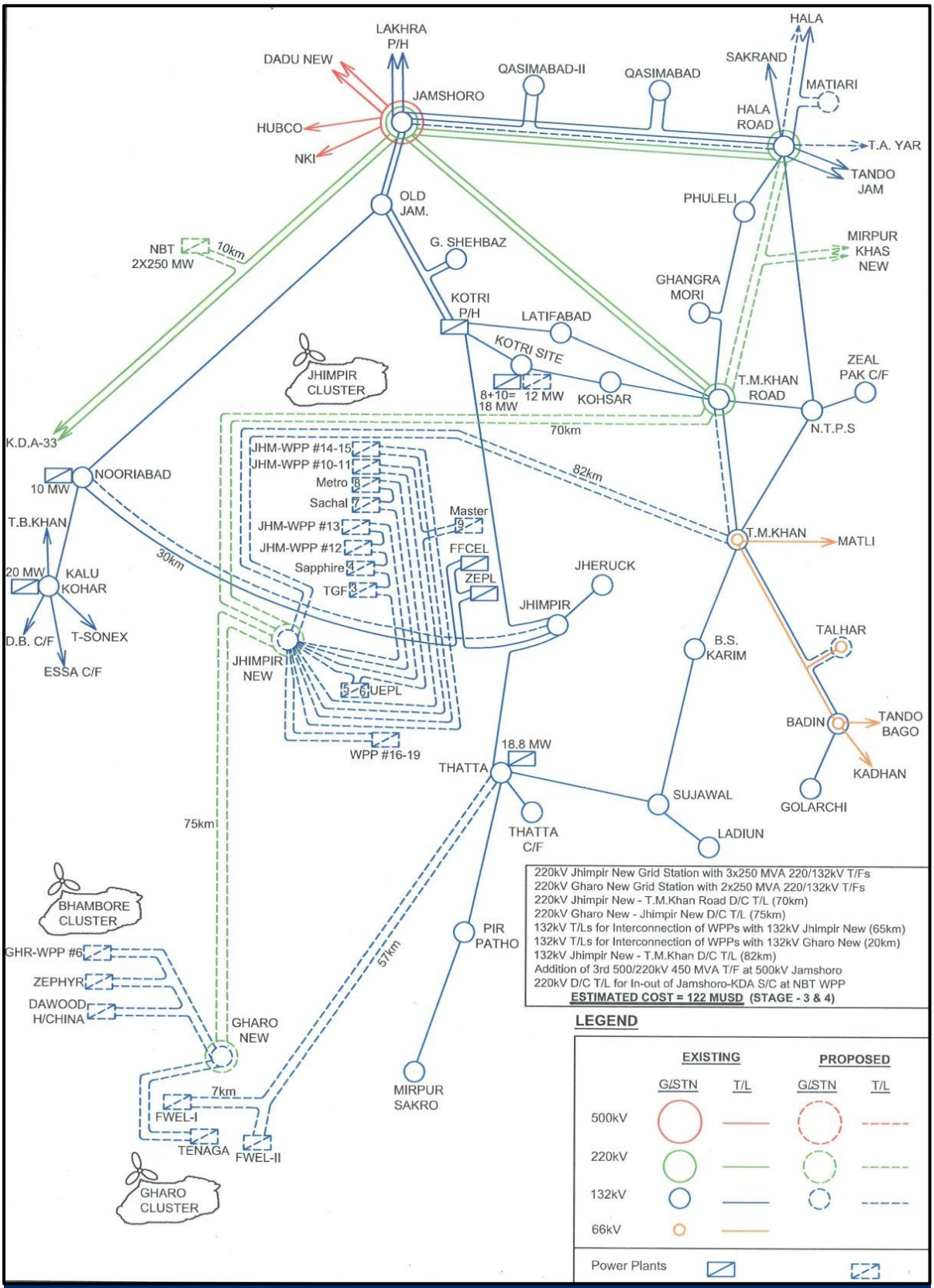

Figure 2: Stage 4: Interconnection Schemes for Power Evacuation at Jhimpir & Gharo/Bhambore Clusters

2.1 Load Flow Studies

Load Flow studies have been conducted by the NTDC Planning Department and by Power Planners International (PPI) to ascertain the impact of these upcoming projects on NTDC/HESCO electrical networks. The methodology of system studies is given below;

1. The complete system model of the National Grid has been simulated, i.e., system networks have been simulated for not only HESCO but all other DISCO's and the NTDC for the purpose of the analysis.
2. Load flow analysis has been carried out for normal and N-1 contingency conditions (as per NEPRA Grid Code requirement) in order to;
    a. Assess the adequacy of the network for the proposed project.
    b. Justification of proposed projects.

Load flow studies under both peak and off-peak conditions have been conducted for years 2015 and 2016 and the results were included by NTDC in the PC1 Performa. The study concludes that the power flows on transmission lines and transformers and the system voltage profile meet system specifications. The studies have been based on the following assumptions:

1. Latest load forecasts.
2. Latest generation expansion plan.
3. Maximum dispatch from the existing power plants and upcoming small power producers in HESCO, especially in the vicinity of the wind clusters.
4. Net electrical output and maximum dispatch of power from the existing and upcoming WPPs simultaneously.
5. The system has been operated in an interconnected manner, however, split bus arrangement has been assumed at some parts of the network as per the system requirements.
6. Rehabilitation of the following existing 132 kV transmission lines by HESCO in the vicinity of both wind clusters has been assumed to have been completed:
    a. Thatta-Jhimpir
    b. Jhimpir-Kotri
    c. Thatta-Sujawal
    d. Nooriabad-Old Jamshoro

3. Implementation

Proposed implementation schedule for both stages is given below:

Stage-3: (March 2014 – June 2015) - at 132 kV Transmission level

	Task Name	Duration	Start	Finish
1	**Dispersal of Power From WPPs in Jhimpir (132 kV Part)**	**340 days**	**Mon 3/3/14**	**Fri 6/19/15**
2	Survey, Spotting of towers, Soil Investigation, Environemntal Evaluation, Finalizing Route	2 mons	Mon 3/3/14	Fri 4/25/14
3	Line Design & preparation of RFP	1 mon	Mon 4/28/14	Fri 5/23/14
4	Invitation of Bids, Evaluation & Award of Contract for construciton	2 mons	Mon 5/26/14	Fri 7/18/14
5	Tendering & procurement of material	8 mons	Mon 7/21/14	Fri 2/27/15
6	Civil Works	5 mons	Mon 8/18/14	Fri 1/2/15
7	Installation and erection of towers	8 mons	Mon 10/13/14	Fri 5/22/15
8	Inspection, Testing and commissioning	1 mon	Mon 5/25/15	Fri 6/19/15
9	End of Project	0 days	Fri 6/19/15	Fri 6/19/15

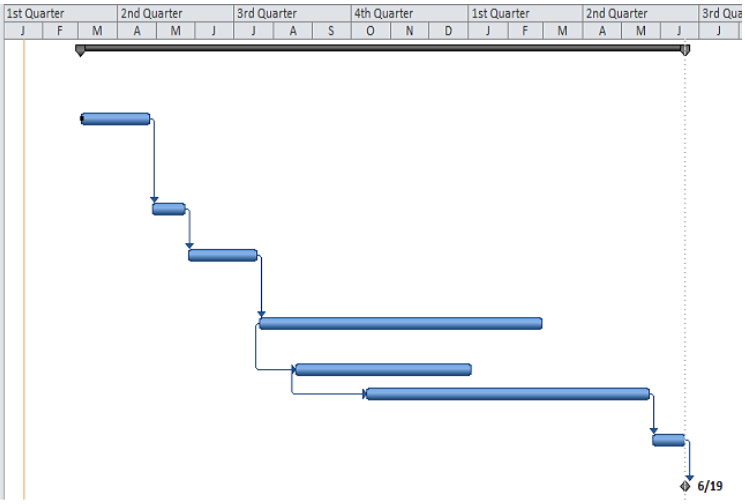

Figure 3: Stage 3 - Proposed Implementation Schedule (March 2014 – June 2015)

Stage-4(a) (Jhimpir part only): (March 2014 – December 2015) – at 220 kV Transmission level

	Task Mode	Task Name	Duration	Start	Finish
1		**Dispersal of Power From WPPs in Jhimpir (220 kV Part)**	**460 days**	**Mon 3/3/14**	**Fri 12/4/15**
2		Survey, Spotting of towers, Soil Investigation, Environemntal Evaluation, Finalizing Route	2 mons	Mon 3/3/14	Fri 4/25/14
3		Line Design & preparation of RFP	2 mons	Mon 4/28/14	Fri 6/20/14
4		Invitation of Bids, Evaluation & Award of Contract for construciton	3 mons	Mon 6/23/14	Fri 9/12/14
5		Tendering & procurement of material	12 mons	Mon 9/15/14	Fri 8/14/15
6		Civil Works	6 mons	Mon 10/13/14	Fri 3/27/15
7		Installation and erection of towers	12 mons	Mon 12/8/14	Fri 11/6/15
8		Inspection, Testing and commissioning	1 mon	Mon 11/9/15	Fri 12/4/15
9		End of Project	0 days	Fri 12/4/15	Fri 12/4/15

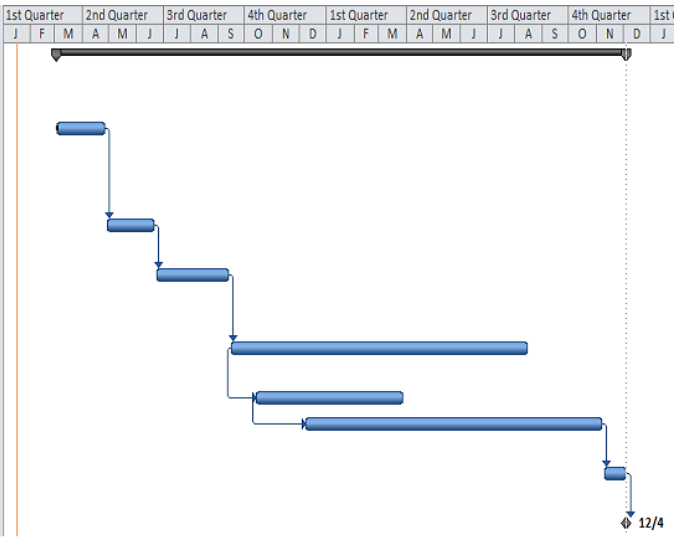

Figure 4: Stage 4(a) - Proposed Implementation Schedule (March 2014 – December 2015)

4. Cost and Benefits

S. No.	Project Description	Total Cost in Million PKR
	Stage-3	
1.	**132 kV Jhimpir New Collector Grid station**	
	Four 132 kV line bays consisting of circuit breakers, isolators, C.Ts, P.Ts, L.As, control & protection equipment and other allied equipment.	160
	Civil Works and erection @ 10%	16
2.	**Extension at 132 kV T. M. Khan Grid station**	
	Two 132 kV line bays consisting of circuit breakers, isolators, C.Ts, P.Ts, L.As, control & protection equipment and other allied equipment.	20
	Civil Works and erection @ 10%	2
3.	**132 kV D/C T/L from Jhimpir New to Existing 132 kV T. M. Khan GS (82 km)**	
	Steel Towers	225
	Conductor	290
	Overhead Ground Wire (OPGW)	35
	Insulator strings	25
	Insulator Hardware, grounding material, stringing & construction equipment and accessories	40
	Civil works @ 25%	154
	Erection @ 30%	185
4.	**132 KV D/C T/L for interconnection of WPP with 132 kV Jhimpir-New GS (25 km)**	
	Steel Towers	75
	Conductor	85
	Overhead Ground Wire (OPGW)	10
	Insulator strings	8
	Insulator Hardware, grounding material, stringing & construction equipment and accessories	12
	Civil works @ 25%	48
	Erection @ 30%	57
	Stage-4(a) (Jhimpir Part only)	
1.	**Up gradation of 132 kV Jhimpir-New to 220 kV Grid station**	
	Four 220 kV line bays and three 250 MVA T/F bays consisting of circuit breakers, isolators, C.Ts, P.Ts, L.As, control & protection equipment and other allied equipment.	810

S. No.	Project Description	Total Cost in Million PKR
	Eight 132 kV line bays consisting of circuit breakers, isolators, C.Ts, P.Ts, L.As, control & protection equipment and other allied equipment.	90
	Civil Works and erection @ 10%	90
2.	**Extension at existing 220 kV T. M. Khan Road GS**	
	Two 220 kV line bays consisting of circuit breakers, isolators, C.Ts, P.Ts, L.As, control & protection equipment and other allied equipment.	50
	Civil Works and erection @ 10%	5
3.	**220 kV D/C T/L from 220 kV Jhimpir to existing 220 kV T. M. Khan Road GS (70 km)**	
	Steel Towers	380
	Conductor	420
	Overhead Ground Wire (OPGW)	25
	Insulator strings	60
	Insulator Hardware, grounding material, stringing & construction equipment and accessories	45
	Civil works @ 25%	232
	Erection @ 30%	278
4.	**Extension at 500 kV Grid station Jamshoro**	
	One 500 kV T/F bay with 500/220 kV 450 MVA T/F consisting of circuit breakers, isolators, C.Ts, P.Ts, L.As, control & protection equipment and other allied equipment.	695
	220 kV circuit breakers, isolators, C.Ts, P.Ts, L.As, control & protection equipment and other allied equipment.	30
	Civil Works and erection @ 10%	73
Total (Stage 3 & Stage 4 Jhimpir Part) in Million PKR		**4,730**
Total (Stage 3 & Stage 4 Jhimpir Part) in Million US$		**45.9**

The source of the quoted cost estimates for equipment has been prepared on the basis of recent contracts awarded by NTDC for similar equipment.

4.1 Economic Benefit

The completion of the project will allow new wind generation to come on line and produce the following economic benefit by reducing load shedding in Pakistan.

Table 2: Load Distribution Data

Type of User	Total Energy Consumed (TWh)	Percentage of Total (%)	Outage Cost Effect on Economy (US$*/kWh)
Domestic	25.8	45.9	0.219

Commercial	4.2	7.47	0.648
Industrial	15.8	28.1	0.505
Agricultural	6.6	11.7	0.276
Government	3.5	6.23	-
Street Lights	0.3	0.53	-

Source: PEPCO monthly statistics

* 1 US$ = 105 PKR

Table 3: Reduction in Economic Loss from Load-shedding due to Availability of New Wind Generation

Capacity of Additional WPPs in Jhimpir by 2016-2017 (MW)	Total Annual Energy Generated @30% Plant Capacity Factor (GWh)	Total Annual Energy Transmitted @3% Transmission Losses + 9% Distribution Losses (GWh)	Reduction in Annual Loss to Economy (US$ Million)
750	1,980	1,748	1,326.3

4.2 Financial Analysis

Addition of new wind generation sources will increase NTDC's revenue by the application of wheeling fees to move the energy from the generators through the NTDC grid to the DISCOs. The internal rate of return from the added investment in the transmission grid and recovered by the wheeling fees over the 40 year life of the asset is 18.34%.

The following assumptions have been made in determining the rate of return to the NTDC from the project:

- The analysis is based on constant values, i.e. NTDC Use of System Charge (UoSC) as well as O&M cost during the project's useful economic life. Variation in power/energy cost, taxes and duties etc. imposed by the Government will be treated as pass through items.
- NTDC Use of System Charge (UoSC) to the tune of Rs. 109.95 per kW per month as determined by NEPRA has been used for revenue/benefit purposes.
- The project's useful economic life has been assumed as 40 years.
- Nominal Discount rates of 10% & 12% have been used for Net Present Value calculations. Auxiliary use @ 5.25% and Transmission losses @ 3% has been used for arriving at the net power.
- A gross capacity of 900 MW (including the effect of stage 1 & stage 2 WPPs) at Jhimpir has been taken into account.

Table 4: Project Financial Analysis Summary

Benefit/Cost Ratio @10%	Benefit/Cost Ratio @12%	Internal Rate of Return
1.65	1.43	18.34%

The detailed spreadsheet of the financial analysis performed is given below as Table 5.

Table 5: Detailed Project Financial Analysis

	Financial year ending 31st December	Project Cost					Project Benefits					Discounted Cost @		Discounted Benefits @		Net Benefits
		Stage-3		Stage-4 (Jhimpir Part only)												
		Investment Cost	O&M Cost	Investment Cost	O&M Cost	Total Cost	Net Avg. Power Flow	Use of System Charge @ 109.95 Rs/kW	Annual Use of System Charges @ 109.95 Rs/kW	Other Savings	Total Benefits	10%	12%	10%	12%	
		$'m	$'m	$'m	$'m	$'m	MW	¢/kW	$'m	$'m	$'m	$'m	$'m	$'m	$'m	$'m
0	2014	8.43		12.75		21.18	-	-	-	-	-	21.18	21.18	-	-	(21.18)
1	2015	5.62	0.02	19.12		24.76	367.63	106.75	2.24	-	2.24	22.51	22.11	2.03	2.00	(22.52)
2	2016		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	1.10	1.06	8.32	8.02	8.74
3	2017		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	1.00	0.94	7.56	7.16	8.74
4	2018		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.91	0.84	6.88	6.40	8.74
5	2019		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.82	0.75	6.25	5.71	8.74
6	2020		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.75	0.67	5.68	5.10	8.74
7	2021		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.68	0.60	5.17	4.55	8.74
8	2022		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.62	0.54	4.70	4.07	8.74
9	2023		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.56	0.48	4.27	3.63	8.74
10	2024		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.51	0.43	3.88	3.24	8.74
11	2025		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.46	0.38	3.53	2.89	8.74
12	2026		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.42	0.34	3.21	2.58	8.74
13	2027		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.38	0.30	2.92	2.31	8.74
14	2028		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.35	0.27	2.65	2.06	8.74
15	2029		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.32	0.24	2.41	1.84	8.74
16	2030		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.29	0.22	2.19	1.64	8.74
17	2031		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.26	0.19	1.99	1.47	8.74
18	2032		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.24	0.17	1.81	1.31	8.74
19	2033		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.22	0.15	1.65	1.17	8.74
20	2034		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.20	0.14	1.50	1.04	8.74
21	2035		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.18	0.12	1.36	0.93	8.74
22	2036		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.16	0.11	1.24	0.83	8.74
23	2037		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.15	0.10	1.12	0.74	8.74
24	2038		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.13	0.09	1.02	0.66	8.74
25	2039		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.12	0.08	0.93	0.59	8.74
26	2040		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.11	0.07	0.84	0.53	8.74
27	2041		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.10	0.06	0.77	0.47	8.74
28	2042		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.09	0.06	0.70	0.42	8.74
29	2043		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.08	0.05	0.63	0.38	8.74
30	2044		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.08	0.04	0.58	0.34	8.74
31	2045		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.07	0.04	0.52	0.30	8.74
32	2046		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.06	0.04	0.48	0.27	8.74
33	2047		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.06	0.03	0.43	0.24	8.74
34	2048		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.05	0.03	0.39	0.21	8.74
35	2049		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.05	0.03	0.36	0.19	8.74
36	2050		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.04	0.02	0.33	0.17	8.74
37	2051		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.04	0.02	0.30	0.15	8.74
38	2052		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.04	0.02	0.27	0.14	8.74
39	2053		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.03	0.02	0.24	0.12	8.74
40	2054		0.21		1.12	1.33	827.17	106.75	10.07	-	10.07	0.03	0.01	0.22	0.11	8.74
	Total	14.05		31.87		97.67			394.81	-	394.81	55.45	53.04	91.32	75.99	297.14
												Benefit/Cost Ratio		1.65	1.43	
												Net Present Value		35.87	22.95	
												Internal Rate of Return (IRR) =				18.34%

4.3 Social Benefits

The power demand in the country as a whole is continuously increasing due to momentum of economic activities, particularly in the agricultural sector and manufacturing.

- In the overall analysis, improvements in available electricity will bring about substantial economic gains for the people in the project area and across all Pakistan.
- The availability of more electricity provides incentive for the establishment of new industries based on local raw materials, creating gainful employment opportunities throughout Pakistan.
- Providing a basic electricity infrastructure in rural areas will go a long way to check large scale migration of rural labor force to urban centers.

4.4 Environment and Resettlement

Detailed Environment Impact Assessment studies will need to be carried out before the implementation of the project as a part of the Step 2 due diligence. The NTDC has

conducted preliminary environmental study and no environmental issues are expected in the project area. However, during the construction of the transmission projects, maximum efforts will be made to mitigate any possible environmental hazards.

- The work on the project will be carried out in a manner so that the impact is minimal on natural landscape, forests, crops, wild life, livestock, both private and public buildings, archaeological centers and buildings of historical significance.
- Effective coordination will be maintained with the concerned local authorities to ensure that the route of new transmission line will be selected to have minimum environmental impact on urban and rural areas.
- The construction equipment used on this project will have acceptable noise limits.
- Adequate safety standards will be followed to minimize hazards to human life and property.
- NTDC's design and protective specifications provide reliable safety by specifying suitable clearances for transmission lines.
- Proper occupational health safety practices will be adopted in the installation and maintenance of the project facilities.

5. Status, Risks & Recommendations

5.1 Status

The time schedule for the associated projects is given below.

Table 6: Time Schedule of Associated Projects

Power Dispersal Scheme from WPPs in Jhimpir and Gharo									
Stages	**Wind Power Project (WPP)**	**Location**	**Commercial Operation Date of WPP**	**WPP Output in MW**	**Added Transmission capacity in MW**	**Timeline for Transmission activities**	**Transmission/ Interconnection Activities**	**Estimated Cost in Million US $**	
STAGE-1	FFCEL	Jhimpir	May 2013	49.5	Already Completed	Already Completed	• 132kV D/C T/L for looping In/Out of existing 132kV S/C Jhimpir-Nooriabad T/L	NTDC own resources	
	ZEPL		July 2013	56.4					
	FWEL-II	Gharo	July 2014	50	In progress	under progress- to be completed by March 2014	• A 132kV D/C T/L from WPPs in Gharo to existing 132kV Thatta GS (approx. 64km) on Greeley conductor to be done by NTDC	NTDC own resources	
	FWEL-I		November 2014	50		under progress- to be completed by March 2014	• Rehabilitation of the existing 132kV T/Ls in the vicinity of WPPs i.e. Jhimpir-Kotri, Jhimpir-Thatta, Thatta-Sujawal and Nooriabad-Old Jamshoro to be done by HESCO	HESCO Funded	
STAGE-2	TGF	Jhimpir	December 2014	49.5	In progress	under progress- to be completed by January 2014	• Stringing of 2nd circuit of 132kV Jhimpir-Nooriabad on cairo conductor to be done by HESCO	HESCO Funded	
						to be completed by June 2014	• A 132kV D/C T/L for looping In/Out of 132kV Jhimpir-Nooriabad 2nd circuit to be done by NTDC	NTDC own resources	
	Sapphire		March 2015	49.5			• Conversion of two 132kV isolator bays to line bays at Nooriabad GS.		
STAGE-3	Yunus Energy	Jhimpir	Expected June 2015	50	A D/C Greeley conductor transmission capacity at 132kV: 260 MW	to be completed by June 2015	• A 132kV AIS Jhimpir New collector SS to be done by NTDC	$1.71M	Total: $ 14M
	Sachal Energy			49.5			• A 132kV D/C T/L on Greeley conductor from Jhimpir New to existing 132kV T.M Khan SS (approx. 82km) to be done by NTDC	$9.27M	
	Metro Power			50			• 132kV D/C T/Ls for interconnection of WPPs to Jhimpir New collector station (25km) to be done by NTDC	$2.87M	
	Tapal Wind			30			• Extention at existing 132kV TM Khan SS	$0.22 M	
STAGE-4	UEPL I & II	Jhimpir	Expected December 2015	100	A D/C twin-bundled Greeley conductor transmission capacity at 220kV: 600 MW	To be completed by December 2015	• Up-gradation of 132kV AIS Jhimpir New SS to 220kV Substation	$9.62 M	Total: $ 32M
	Dewan Energy			50					
	Master Wind			50					
	Finergy			50					
	Gul Ahmed Wind			50			• A 220kV D/C T/L Jhimpir New to existing 220kV TM Khan Road SS (approx. 70km) on twin-bundled Greeley conductor to be done by NTDC	$14 M	
	Hawa Energy			50					
	China Sunec		Expected December 2016	50			• Extention at 220kV TM Khan Road SS to be done by NTDC	$0.54 M	
	Wind Eagle I & II (taken over by TGF)			100					
	Titan			10			• Extention at 500kV Jamshoro SS to be done by NTDC by additing one 450MVA Transformer	$7.80 M	
	Hartford Alternate			50					
	Hydro China Dawood	Gharo	Expected December 2015	100	A D/C twin-bundled Greeley conductor transmission capacity at 220kV: 600 MW	To be completed by June 2016	• A 220/132kV GIS Gharo New SS to be done by NTDC	$10.50 M	
	Tenaga			50					
	Zephyr Power		Expected December 2016	50			• A 220 D/C T/L from Gharo New SS to Jhimpir New SS (approx. 75km) on twin-bundled Greeley conductor to be done by NTDC	$19 M	
				Total WPP Outlook: 1246 MW	Transmisison Capacity to be added 1460 MW				
		NTDC Seeking Urgent Funding							

5.2 Risks

Obtaining transmission rights of way can be a great hurdle in timely completion of a transmission project, especially when the line passes through thickly populated areas. In this case the lines pass mostly through areas with scattered villages and the right of way should not be as big a challenge.

Law and order situations prevailing throughout the country could be a risk in the timely execution of the project.

The success of this project is closely linked with timely realization of the implementation schedule of the associated wind generation plants and all other necessary Transmission expansions to be done by NTDC and HESCO. This transmission improvement project will have to be scheduled prior to the commercial operation dates of the generating source in order to harness full benefits of the project in a timely manner. There will be a need of close coordination throughout the project execution.

5.3 Recommendations

The proposed transmission improvement project promotes the development of alternate energy in the country and enhances the opportunity of diversifying the energy mix to renewable indigenous wind resources. It will help in supporting the peak load requirement of the HESCO and NTDC electrical network and help reduce severe load shedding problem in Pakistan. Furthermore, this project will create substantial economic gains for the people by creating jobs in the project area and in the country.

Furthermore, analyzing the results of load flow studies, financial analysis and schedules of all associated generation projects, this transmission improvement project is cost effective and highly visible, and will be completed on a schedule that helps meet Pakistan's energy crisis. This is a priority project for the Government of Pakistan and the National Transmission and Despatch Company and meets all relevant USAID criteria and is recommended be funded by the EPP technical team.

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