Islamic Republic of Pakistan

Secondary Transmission Lines and Substations Project (PK-P43)

External Evaluator: Global Group 21 Japan, Inc.
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0. Summary

This Project was undertaken as a part of the policy to provide stable power supply, which the Government of the Islamic Republic of Pakistan (hereinafter refer to as "Pakistan") is further aiming at for healthy socioeconomic development of the country. This Project has been highly relevant to Pakistan's development plans, development needs, and Japan's ODA policy as it assists economic infrastructure building and contributes to growth and smooth economic activity in Pakistan. Transmission lines and substations were constructed as originally planned. Although construction costs were within budget, services were commenced more than six years behind the original schedule due to delays of implementation and construction work etc. Therefore, the efficiency of this Project is medium. The Project has contributed to reducing power failure/power cut times and curtailing transmission losses in power supply systems, at the same time it has been useful for supplying power and improving high voltage transmission efficiency in the areas where power demand is increasing rapidly. National Transmission and Dispatch Company (NTDC) provides suitable management, organization of operation and maintenance, sufficient technology and financial ability for the Project, and the Project has so far been conducted in good condition. Therefore, it can be said that the evaluation of the Project is very high.

1. Project Description

Location of the Project

Rewet-Islamabad 220kV T/Line

1.1. Background

In 1993, peak power[1] was deficient by 1,117 MW[2] and annual power output by 2,600GWh in Pakistan. At the same time, power supply system losses were recorded at 24.2%, while it was forecast that power demand would increase by about 10% every year. The Water and Power Development Authority (WAPDA), which had taken over the power supply of Pakistan, responded to the increase

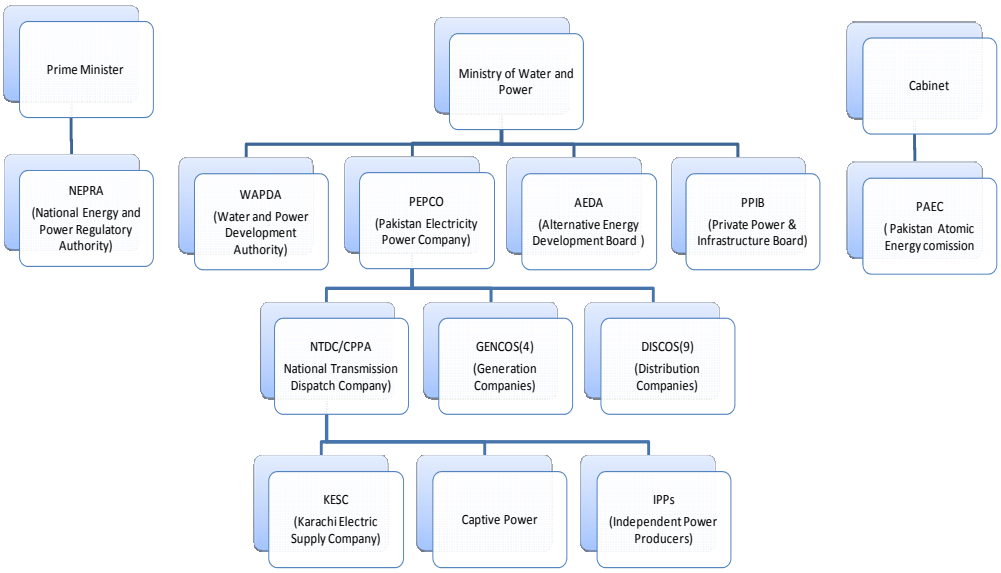
[1] Peak power is the maximum power demand during a certain period. In Pakistan, peak demand occurs at around 21pm of summer when the demand for air conditioning is large.

[2] Electric current of one ampere (A) and one volt (V) has electric energy of one watt (W). One mega-watt (MW) is one million watt, which is equivalent to 25,000 of fluorescent lamps of 40 W.

in power demand according to the energy policy target of the Government of Pakistan in the 8th 5-year plan.

In these regards, it was necessary to promote the efficient use of power through expanding the secondary transmission line[3] network in order to decrease power supply system losses. Loan agreement was signed for the Project to construct and expand secondary transmission line (220 kV) network and substations in March 1996.

Following the privatization of WAPDA in 1998, the power sector of Pakistan comprises WAPDA, Pakistan Electricity Power Company (PEPCO), four thermal power generation companies (GENCOs), National Transmission and Dispatch Company (NTDC)[4], nine power distribution companies (DISCOs), Pakistan Atomic Energy Commission (PACE), and Karachi Electricity Service Company (KESC)[5]. The organization chart of the Pakistani power sector is shown as follows.



Source：NTDC Planning Division (2011)

Fig-1 Organization Chart of Power Sector in Pakistan

1.2 Outline of the Project

By carrying out reinforcement/expansion/re-powering and the construction of eight secondary transmission lines (220kV) and two substations, the Project aims to improve transmission efficiency by high voltage transmission and stable power supply to high power demand areas. The Project is ex-

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[3] Trunk transmission lines with 500 kV which connect the north and south of the country are primary transmission lines, and transmission lines with 220 kV, 132 kV and 66 kV branched from them and connected to main markets are called secondary transmission lines.

[4] NTDC as a transmission company of PEPCO is in charge of transmission business in Pakistan excluding Karachi region and has a head quarter in Lahore and a central control center in Islamabad. PEPCO is the largest electric company in the country under which four GENCOs and 9 DISCOs are affiliated.

[5] KESC has been working in generation and transmission / distribution business in Karach city and its vicinity since before the privatization of WAPDA. It was privatized in 2005 and has been inter connected with NTDC through 220 and 132 kV transmission lines. KESC's share in the electricity market in the country is around 10%.

pected to contribute to the sound development of Pakistan's socioeconomy through efficient use of energy.

The outline of the loan agreement for the Project is summarized as follows;

Table 1 summary of Loan Agreement

Approved Amount/ Disbursed Amount	12,022 million yen /11,750 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	October 1995/March 1996
Terms and Conditions	Interest Rate: 2.3%, Repayment Period: 30 years (Grace Period: 10 years) Conditions for Procurement: Untied
Borrower / Executing Agency	The President of Islamic Republic of Pakistan/Water and Power Development Authority (WAPDA), (National Transmission and Dispatch Company, NTDC at present)
Final Disbursement Date	July, 2006
Contractors	Siemens AG (Germany), Sichuan Electric Power Import & Export (China), I.C.C.(Pvt.) Limited (Pakistan), CCPG International Economic & Trade Co. Ltd. (China),
Consultant	National Engineering Services Pakistan, Ltd.
Feasibility Study, etc.	Feasibility Study by WAPDA
Related Projects	JICA was carrying out the syndicated loan with the World Bank and the Asian Development Bank, etc. for Ghazi/Barotha hydropower project of WAPDA.

2. Outline of The Evaluation Study

2.1 External Evaluator

K.NISHIWAKI (Global Group 21, Japan)

2.2 Duration of Evaluation Study

The ex-post evaluation was carried out as follows;

Study Period: November 2010 to September 2011

Field Survey: 1st Visit 17th January, 2011 to 5th February,2011

2nd Visit 19th to 26th April, 2011

2.3 Constraints during the Evaluation Study

In this evaluation, the hearing of details, particulars and circumstances of the Project implementation were carried out in WAPDA, PEPCO and NTDC, which are involved in this Project, and those related data were collected. Simultaneously, the hearing about the present conditions and issues of the power sector was conducted at the National Energy and Power Regulating Authority (NEPRA), which is the competent authority of the power sector. Since the Project sites are dispersed over 10

locations and the security in northwestern part of Pakistan was not good, the field survey was carried out at the sites of three transmission lines and one substation. The external evaluator has interviewed the engineers and the personnel of the sites about the actual progress of construction work and/or the actual condition of operation and maintenance after commencement of the Project.

3. Results of the Evaluation (Rating: A)

3.1 Relevance (Rating：③)

3.1.1 Relevance with the Development Policies of Pakistan

From the Project appraisal through to ex-post evaluation, the target in energy medium-to-long term plans in the development policy of the Government of Pakistan has been putting an emphasis on healthy socioeconomic development based on stable power supply, and it has continually strived to improve energy supply capacity in line with this. Specifically, the main policy has been the development of large-sized hydropower and coal-fired thermal power stations, while transmission lines have been constructed in line with this. Accordingly, this Project has had high relevance with the development policy of Pakistan.

3.1.2 Relevance with the Development Needs of Pakistan

As described in the background, the Project was implemented to respond to the growing demand for power, reduce power system losses and improve power efficiency through building high voltage transmission lines. It was considered an easier way than developing new power sources in order to achieve the energy policy targets of the Government of Pakistan in the 8th 5-year plan.

As of the ex-post evaluation stage, against the backdrop of rapidly growing power demand, power shortages are becoming worse rather than improving, and the efficient use of energy and stable power supply by high voltage transmission lines are very important issues still now. Therefore, the Project is highly relevant to the development needs of the Government of Pakistan.

3.1.3 Relevance with Japan's ODA Policy

Japan's ODA policy for Pakistan aims at assisting construction and development of a sustainable society, viewing construction of a "moderate and modernistic Muslim state" as essential for the peaceful and stable growth of Pakistan and peace and stability of South Asia in general. Accordingly, the Project supports power sector development plans as part of the policy for economic infrastructure development geared to the promotion of sound market economy, diversification of industrial structure and vitalization of the market economy, and it contributes to smooth economic activities through stabilizing the power supply system.

It is concluded that this project has been highly relevant with the country's development plan, development needs, as well as Japan's ODA policy, therefore its relevance is high.

3.2 Efficiency (Rating: ②)

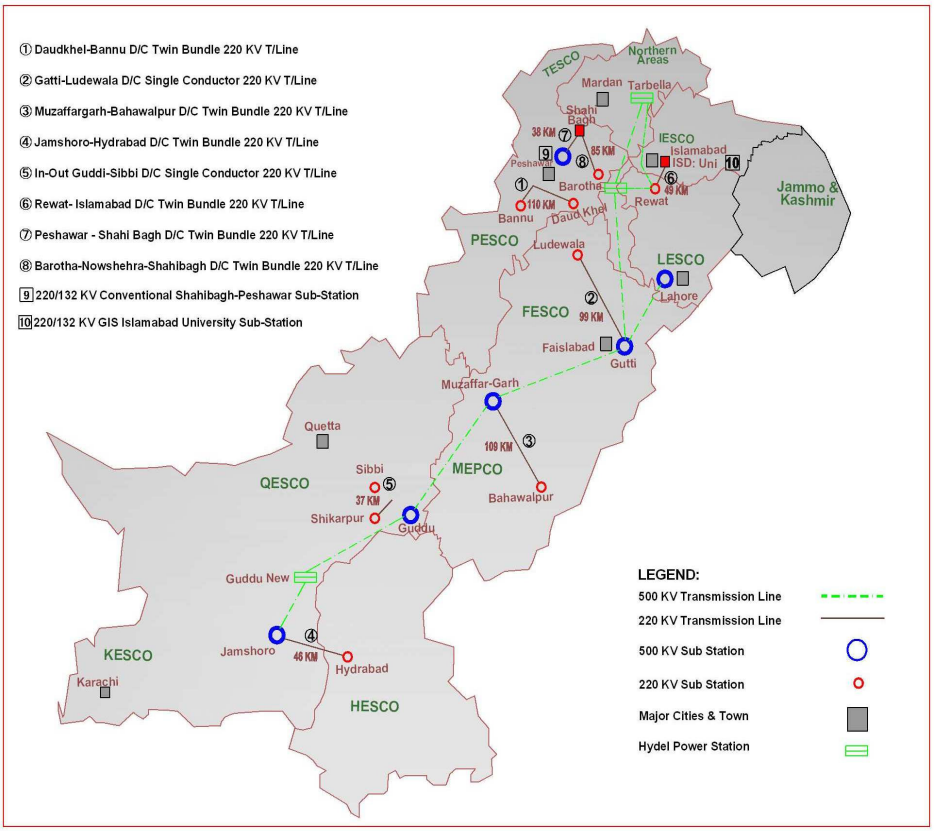
3.2.1 Project Outputs

At the time of appraisal, the Project was designed with three main components as shown below:

1) Eight 220 kV transmission lines with total length of 492 km
2) Two substations with capacity of 220 kV/132 kV, and

3) Procurement of consulting services for management and supervision

Out of the eight substations to be linked by these transmission lines six substations were scheduled for construction utilizing loans from the World Bank, Germany, Spain and Switzerland, and it was planned to finish these to coincide with completion of the Project. Figure-2 shows the location map of the Project and Table-2 summarizes the Project outputs.



Source: Prepared by the External Evaluator (2011)

Fig-2 Location Map of the Project

Peshawar-Mardan line was replaced by Barotha-Nowshera-Shahibarg line, along which there is remarkable growth in demand, because the importance of Peshawar-Mardan line declined due to the Project delay; moreover, it became possible for the newly constructed Ghazi/Barotha hydropower station to supply power to the Peshawar area.

There were changes of alignment/route and length from the original design due to right of way (ROW) issues and route examination. For example, Jamhsore-Hyderabad line became more than one and half times longer because it was found to hinder air traffic routes in the implementation stage. In Shahibarg substation, the number of transformers was changed because of re-examination of power demand due to the Project delay. Many of these changes/modifications were originated due to the delay of the Project and they were judged to be appropriate to cope with the changes in the situations.

Table-2 The Project Output

Description	Original	Actual
220kV Transmission lines		
Daudkhel-Bannu D/C twin bundle 220KV T/Line	L=100km	L=110km
Gatti-Ludewala D/C single conductor 220KV T/Line	L=100km	L= 99km
Muzaffargarh-Bahawalpur D/C twin bundle 220KV T/Line	L= 90km	L=109km
Jamhsoro-Hyderabad D/C twin bundle 220KV T/Line	L= 30km	L= 46km
In-Out Guddi-Sibbi 220KV T/Line at Shikapur(D/C single conductor)	L= 60km	L= 37km
Rewat-Islamabad D/C twin bundle 220KV T/Line	L= 35km	L= 49km
Peshawar-Shahibagh D/C twin bundle 220KV T/Line	L= 21km	L= 38km
Peshawar-Mardan D/C single conductor 220KV T/Line	L= 56km	-
Barotha-Nowshehra-Shahibagh D/C twin bundle 220KV T/Line	-	L= 85km
Sub-stations(220/132kV)		
Conventional Sub-station at Shahibagh Peshawar	-2×220/132KV, 160MVA Autotransformer	-4×220/132KV, 160MVA Autotransformer
GIS Islamabad University Sub-station	-2×220/132KV, 160MVA Autotransformer	-2×220/132KV, 160MVA Autotransformer
Consulting Services	Assistance for management and supervision	Assistance for management and supervision

Source：External Evaluator made(2011)

Gatti-Ludewala D/C single conductor T/Line

Jamhsoro-Hyderabad D/C twin bundle T/Line

Jamhsoro-Hyderabad T/Line, Foundation work

Islamabad University Substation Transformer

Islamabad University Substation, Bus Bar

Islamabad University Substation, Control Room

3.2.2 Project Inputs

3.2.2.1 Project Cost

The Project has been completed by spending about 88% (15.5 billion yen including yen loan of 11.7 billion yen) of the estimated budget (17.7 billion yen, including yen loan of 12 billion yen) made at the appraisal. Although the Project cost was impacted by changed work quantities due to revised scope (replacement of transmission sections), lengthening of transmission lines and changes to sub-station specifications, as well as additional payments arising from works delays, higher consultant fees and major inflation in steel and aluminum prices, the eventual Project cost was lower than budget thanks to appreciation of the yen and depreciation of the rupee.

Table-3 Project Cost

	Original			Actual		
	F.C (Mil. ¥)	D.C (Mil. Rs.)	Total (Mil. ¥)	F.C (Mil. ¥)	D.C (Mil. Rs.)	Total (Mil. ¥)
220kV T/L	5,759	550	7,513.5	6,066	1,926	10,188
220/132kV Grid ST.	3,562	552	5,322.9	3,000	626	4,269
Physical Con.	712	529	2,399			
Contingency	1,003	163	1,524	-	-	-
Consultant fee	128	49	284		159	370
IDC	702	0	702	674		674
Project Cost	11,866	1,843	17,746	9,7939	2,711	15,501

Note: Exchange Rates (Plan) 1Rs.=3.19¥
(Actual) 1Rs.=2.13

Source: Prepared by the External Evaluator based on NTDC data (2011)

3.2.2.2 Project Period

It was scheduled to start all Project works by the end of August 1997, but in reality the contract of consulting services was made in October 1998, the construction work was contracted between October 2001 and June 2002, and long delays occurred before the work could actually start. The period necessary for completion of transmission lines was 55 months (original was 31 months), and the period necessary for substations was 44 months (original was 27 months). Finally, the total period became 126 months compared to the original plan of 49 months, and the Project was completed in December 2006, more than six years behind the original plan. According to NTDC, reasons for the delay in completion were the change in management policy brought about by privatization of WAPDA at the start of the Project, inadequacy of clerical processing capability in NTDC, NTDC's inexperience in dealing with the procedures of the Yen loan system, and compensation issues under transmission and distribution lines.
According to hearings conducted at NTDC, the major reasons for delays in each implementation phase were as follows.

1) Delays arising from consultant procurement

NTDC launched the procurement procedure for the external consultant to conduct design and construction supervision, however, upon examining this policy in review of its management principles in line with privatization, in June 1997 it applied to JICA to not utilize an external consultant but perform the work with its own engineers due to financial restrictions. However, because the Yen loan agreement was predicated of recruitment of an external consultant and the JICA side gave priority to this in consideration of past lessons, the JICA side initially refused this application. After that, NTDC conducted review and in February 1998 offered to recruit an external consultant upon reducing the contract amount. JICA accepted this and the consultant agreement was signed in October 1998. According to the plan, it was assumed that eight months would be needed until consultant procurement, however, in reality it took 31 months due to the said review and adjustments.

2) Delays in Packages 1~4 (common) (prior to the start of works)

Due to NTDC's inexperience with the necessary procedures, major delays arose in the procedures before the start of construction work; for example, the review of tender documents took 8~14 months (compared to the scheduled 1~2 months), JICA consent and approval of agreements took 2~12 months (compared to the scheduled 1 month), contract negotiations took 3.5~7 months

(compared to the scheduled 2 months), and establishment of the letter of credit (L/C) took 6~8 months (compared to the scheduled 1 month). Moreover, Packages 2 and 3 took 11 months and 6 months respectively due to the additional tender process including design review arising from the revision of scope.

3) Delays in Packages 1~4 (common) (after the start of works)

Time was used in revising transmission line routes and layout of substations and approving equipment specifications. Delays in payments to contractors due to paperwork deficiencies also caused delays in the works. The frequent turnover of NTDC employees also impeded construction supervision guidance on the NTDC side and slowed procedures with JICA, thus causing further delays in the works. In Package 4, the outbreak of SARS (Severe Acute Respiratory Syndrome) in 2003 caused delay of inspections at the manufacturing plant in China, and this too delayed the works. Moreover, in Packages 1 and 2 (transmission line works), holdups surrounding the right of way (RoW) [6] below lines were a further cause of delays.

Although the project cost was lower than planned, the project period was significantly longer than planned, therefore efficiency of the project is fair.

Table-4 Project Period

Package	Original Period (Month)	Start	Completion	Actual Period (Month)
(1)Transmission Lines	21	2002/01	2006/07	55
(2)Transmission Lines	24	2002/06	2006/12	55
(3)Substation	24	2002/07	2006/02	44
(4)Substation	20	2001/10	2003/12	27
Consultant Procurement	70	1998/10	2006/07	94

Source：External Evaluator made based on NTDC data(2011)

3.3 Effectiveness (Rating: ③)

3.3.1 Quantitative Effects

The primary objective of the Project was to realize stable supply of power and greater efficiency of power transmission in areas where the demand for electricity is increasing. The transmission lines and substations of this Project are secondary transmission lines and substations making up about 3% of the whole system and are connected to primary transmission lines and substations extended from various power plants. Moreover, since these secondary transmission lines and substations are linked to other transmission lines and power distribution companies not included in the Project, it is difficult to evaluate and check the above-mentioned effect individually. Accordingly, it was decided to evaluate effectiveness by analyzing the contribution of the Project based on changes in the operation effect index of the overall power system.

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[6] NTDC conducted RoW negotiations according to compensation criteria in Pakistan with a view to finishing by the start of construction work, however, it failed to reach agreement with landowners, leading to the prolonging of negotiations and even court cases, thereby delaying the start of works in many cases. According to hearings with NTDC staff and in site surveys, one of the reasons for the lack of progress in compensation negotiations was the different tenancy system adopted between landowners and farmers. Since negotiations often had to be conducted with absent landowners, it was necessary to travel long distances to meet them and time was taken up adjusting to the landowners' schedules and so on. Moreover, some landowners made exorbitant demands (claiming additional compensation because they intended to open a restaurant under lines and so on), while protective orders issued by law courts caused further delays. The NTDC side did not have a sufficient setup to deal with so many difficulties.

3.3.1.1 Results from Operation Effect Indicators

1) Utilization of the facilities

The present operating situation of transmission lines and substations is shown in Table-5.

Table-5 Facilities Operating Status

Distribution Areas	Facilities	Conrtibute to Peak Power	Conrtibute to Power Consumption
PESCO	Three transmission lines One grid station	○	—
IESCO	One transmission lines One grid station	—	○
FESCO	One transmission line	○	○
MEPCO	One transmission line	○	—
HESCO	One transmission line	○	○
QESCO	One transmission line	○	—

Source：Prepared by the External Evaluator based on NTDC data (2011)

Note: "—" shows areas where increases in peak power demand and power consumption are not recognized

These facilities are utilized to help increase supply of peak power and electric energy in various power consuming areas. The effect has shown up in reduction of power failure/power cut time over the whole power system. Power marketing data issued by NEPRA shows that the number of power consumers is increasing everywhere with an annual increase of about 5.6% as of 2009. It is more than the 4.9% anticipated at the planning stage of the Project. Thus, the effect of this Project has manifested as response to the increase of consumers.

2) Reduction of power failure / cut

The effect of the Project has shown up in shortening of power failure/power cut time. According to the data of NEPRA, power failure/power cut time of 399.4 hours was recorded in 2006 at the commissioning of the Project, but power failure/power cut time was reduced by half in the next year (2007). After that, work was continued on shortening power failure/power cut time and it was improved to 89.7 hours in 2009, about one fifth of the figure at the time of commissioning of the Project. Shortening of the power failure/power cut time of transmission lines contributes to better reliability of the whole power system, stable power supply and improvement of customer services.

3) Reduction of transmission loss

As for transmission loss, this was reduced to 3.58% in 2009 compared with 7.26% in 2006 at the time of commissioning of the Project. Although sufficient data has not been obtained on transmission loss on the Project transmission lines, according to the data collected in the field survey, Jamhsoro-Hyderabad line shows maximum transmission loss of 2.73%, which is lower than the loss over the whole transmission network. Therefore, it may be said that this Project has contributed to improvement of transmission loss.

Table-6 Reliability Indices

	2006	2009
Generation Loss (%)	2.21	1.98
Transmission Loss (%)	7.26	3.58
Distribution Loss (%)	15.12	17.48
System Loss in total (%)	24.59	23.04
Number of Power Failures/Power Cuts (/annual)	1,177	1,188
Hours of Power Failures/Power Cuts (hrs/annual)	399.4	89.7

Source：External Evaluator made based on NTDC data (2011)

4) Conclusion

Reductions of power failure/power cut time and transmission loss are seen over the whole power system, and this Project has actively contributed to supplying power to an area where power demand is increasing rapidly. It can be said that this Project has manifested the anticipated effects such as stable power supply and improvement of transmission efficiency based on high voltage transmission for an area of rapidly growing power demand.

3.3.1.2 Results of Calculations of Internal Rate of Return (IRR)

At the appraisal of the Project, the Financial Internal Rate of Return (FIRR) was estimated as 12%. FIRR was re-estimated assuming the Project benefits on the basis of 10% of revenue from power transmission business activity over the Project life (30 years), operation and maintenance cost of 1% of initial investment and the discount ratio as 12%. The result was an FIRR of 16%[7]. The FIRR exceeded the average interest rate of subleased cost (weighed average cost rate of capital); therefore this Project has not led to aggravation of the financial condition of NTDC. However, if the present market interest rate of about 15% is taken into consideration, the FIRR value is not sufficient to cover the exchange risk (calculated to be about 3%).
Economic Internal Rate of Return (EIRR) was not estimated in the appraisal of the Project. The Project cost was adjusted by multiplying with the Standard Conversion Factor (SCF) to arrive at true economic value of the investment made under the Project[8]. As a result, EIRR was 17.3%. Sensitivity analysis was conducted based on the following four scenarios: i) 20% increase of maintenance/operation cost; ii) 20% decrease of selling power; iii) simultaneous occurrence of i) and ii), and iv) shortening of equipment life by five years. Calculated results were 17.2%, 15.8%, 15.7% and 17.1% respectively. Sensitivity analysis proved the EIRR to be robust as it remained above the

[7] The Project residual value was set at 10%. The benefit was set at 10% of power sales revenue prorated according to the scale of transmission lines. Actual revenue was used up to 2009, while forecast values were used for 2010 onwards. Concerning transmission loss, it was assumed that the 3.5% as of 2010 will continue, while insurance premiums (0.35%) during operation were added. The rate of increase in power charges was assumed to be 5% per annum, while maintenance costs were assumed to increase at 10% per annum. Also, the inflation in consumer prices was set at 2% per annum. Incidentally, since the technique used to calculate costs at the time of review was unknown, no comparison was carried out with the new calculations.

[8] Adjustment for disparity between domestic and foreign prices (0.95)=(M+T)/((M+Tm)+(X-Tx)), where M: total value of imports, Tm: import tariff, X: total value of exports, Tx: export tariffs

threshold value of 15%. As sensitivity analysis proved the EIRR robust, it may be concluded that the Project is economically viable and can withstand all kinds of risks.

3.3.2 Qualitative Effects

According to demand forecast of WAPDA and NEPRA report, power shortages will continue for some time due to the remarkable growth in power demand in Pakistan. Power sources have been developed and power supply systems improved every year, and the effects of improvement are seen in reliability of power supply and reinforcement of transmission/distribution lines and substations. Some power distribution companies said that the Project's high voltage transmission system has led to stable power supply, improvement of customer services and increase in revenue to some extent, as well as contributing to sustainable and stable company operation.

This Project has largely achieved its objectives; therefore its effectiveness is high.

3.4 Impact

3.4.1 Intended Impacts

It was expected that this Project would contribute to efficient exploitation of energy and healthy socioeconomic development of Pakistan. Since fossil fuel resources such as oil, coal and natural gases are restricted, successive 5-year plans have called for reduction of energy losses through development of hydropower and construction of transmission and distribution lines, thereby contributing to reduction of fuel imports.

Development of high voltage transmission lines has been executed since the commissioning of the Project as shown in Table-7, and the improvement of transmission efficiency based on high voltage network system is still in progress.

Reduction of losses by energy saving effect and shortening of power failure/power cut time based on high voltage transmission have been seen in NTDC systems, and the Project has been effective in improving power supply reliability in areas of remarkable growth in power demand, which was one of the targets of this Project.

Since the energy saving effect enabled by the Project based on high voltage transmission system is minor, there is still a long way to go to resolve power shortages, and there are still rolling planned power cuts[9]. Therefore, it is necessary to drive forward development of power and provision/expansion of transmission systems and bring stable power supply and effective use of energy in order to respond to the rapidly growing power demand.

[9] According to the experience gained during the site surveys, rolling blackouts regularly occur even in the main cities such as Islamabad, Lahore and Karachi, and traffic signals do not operate at these times. There are also problems regarding the quality of electricity; for example, lighting suddenly goes off and back on again in restaurants. During the site survey of transmission lines, since there have been cases of power company employees being attacked by people unhappy with the power cuts, access to some sites was restricted.

Table-7 Development of Transmission Facilities

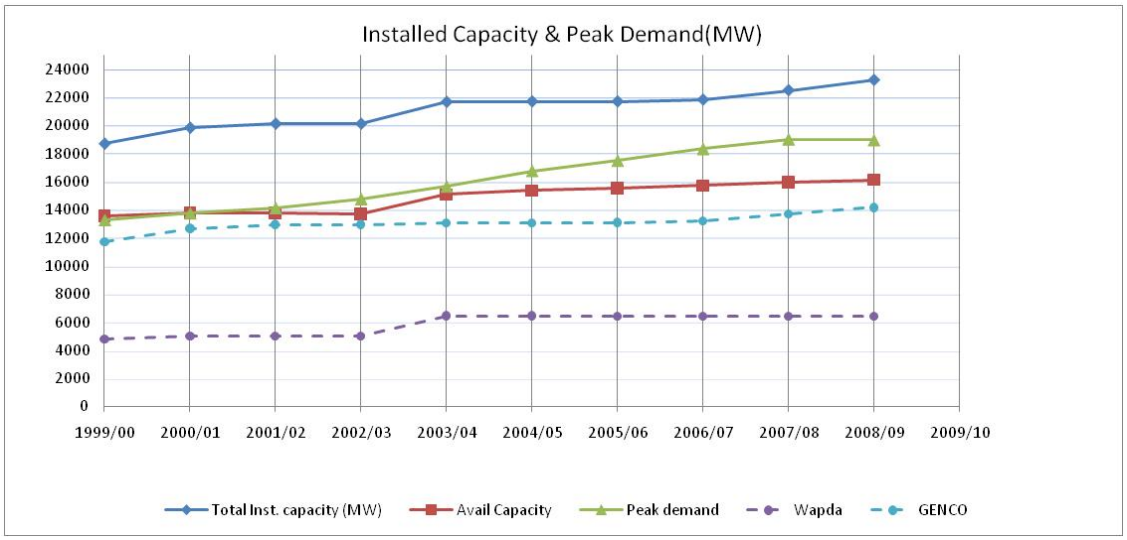
	Transmission Line(km)			Grid Station				
				500KV		220KV		Total Grid Station
	500KV	220KV	Total (km)	Grid Station	Capacity (MVA)	Grid Station	Capacity (MVA)	
2006	4,453	6,993	11,446	10	8,874	27	9,688	37
2007	4,712	7,318	12,030	10	11,400	26	10,403	36
2008	4,748	7,318	12,066	11	12,000	26	11,190	37
2009	5,078	7,325	12,403	12	13,800	26	14,829	38
2010	5,108	7,337	12,445	12	14,850	27	15,744	39

Source：External Evaluator made based on NTDC data(2011)

(1) Improvement of Demand/Supply Balance

It was predicted that power demand-and-supply balance would get worse at the time of Project review, and since demand for power has increased faster than predicted, the supply and demand balance has deteriorated in reality.

WAPDA forecasts that the power demand will grow at an annual rate of about 7~8% in line with the improvement of living standards. The maximum demand occurs in summer due to air conditioning demand. As is shown in Fig-3, peak demand has continued to grow in excess of possible generation output since 200010.



Source：External Evaluator made based on NTDC data (2011)

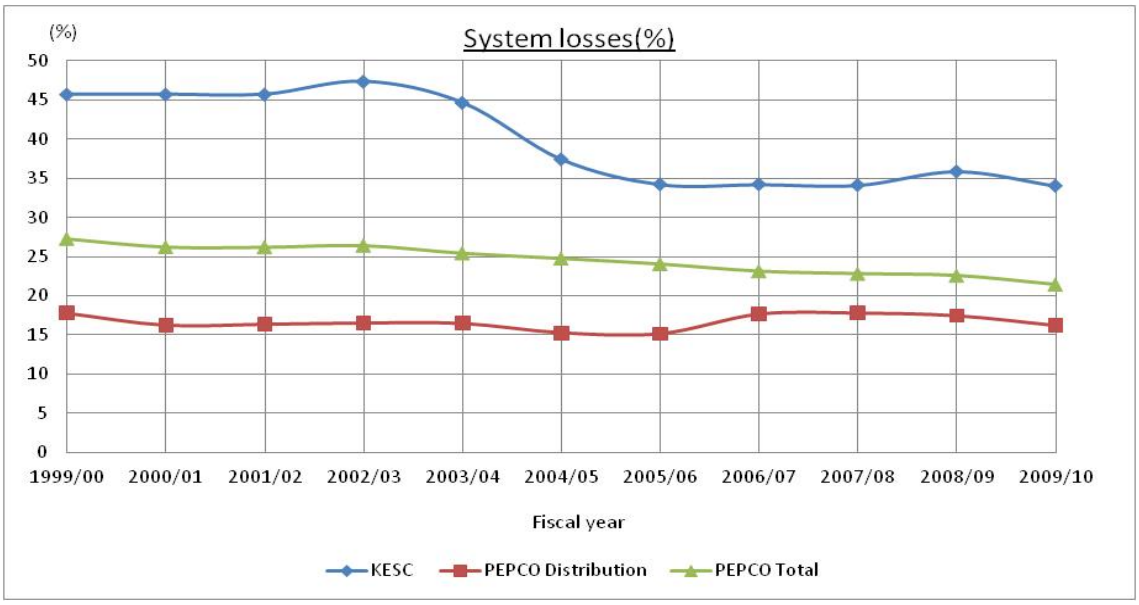
Fig-3 Power Capacity and Peak Demand

[10] Plant output of WAPDA facilities as of June 2010 is 21,665 MW (hydropower 6,555 MW, thermal power 14,576 MW, nuclear power 463 MW, other 71 MW). The annual total amount of generated electrical energy in future is planned as 99,450 GWh (hydropower 28,228 GWh, thermal power 68,228 GWh, nuclear power 2,667 GWh, other 327 GWh). NTDC transmits approximately 90% of this electricity.

According to NEPRA, the greatest concern for commerce and industry is the continuation of power cuts due to inadequate supply capacity. Therefore, it must be said that consumer awareness of the contribution to power supply reliability arising from the Project is limited.

(2) Reduction of System Losses (Operation loss, Technical loss and Commercial loss)

NTDC assumed the total system losses at the original commissioning of the Project (2000) were 26%. In reality, these system losses remained until 2003. From 2004, the loss rate decreased and reached 22.8% as of 2010 as shown in Fig-4 following commissioning of the Project (2006). On the other hand, distribution loss has been increasing from 2006, and it implies that a part of the reduction of transmission loss has been offset to distribution loss.
The official target for system loss improvement over the entire power sector was set as 14.5% by 2017 at the time of the ex-post evaluation, and efforts are being continued with a view to achieving this. In addition, NTDC is striving to reduce commercial loss, and there was almost no commercial loss in NTDC at the time of the ex-post-valuation survey.



Note：Difference between PEPCO Total and PEPCO Distribution indicates transmission losses.

Source：Prepared by the External Evaluator based on NTDC data (2011)

Fig-4 Change of System Losses

3) Electrification Rate

The average electrification rate of the country was about 72.3% as of 2005 according to JICA data, and there are still rural areas not served by power supply. The rural electrification rate in the vicinity of the Project areas is rising except for the area managed by MEPCO[11]. It must be said that this Project has contributed to expansion of the power supply area.

[11] Looking at the rate of change in the rural electrification rate, according to NEPRA data, the Peshawar system has remained the same at 72%, the Islamabad system increased from 93% in 2006 to 95% in 2009, the Faisalabad system rose from 80% in 2006 to 91% in 2009, the Multan system changed from 79% in 2006 to 70% in 2009, the Hyderabad system rose from 43% in 2008 to 58% in 2009, and the Quetta system rose from 39% in 2006 to 67% in 2009.

3.4.2 Other Impacts

1) Impacts on the natural environment

At the time of review, it was concluded that the Project is not in a sector that is liable to impact the natural environment and that it doesn't target a vulnerable area. Therefore, it was guessed that there is little negative impact/influence on the natural environment. In the field survey and from NTDC, it was confirmed that there has been no large-scale reclamation, land development/cleaning, nor large-scale deforestation in and around the Project area, and that the Project doesn't contain national parks, protected areas, swamp areas, residential areas for ethnic minorities and indigenous peoples, cultural heritage areas, and so on.

NTDC had conducted the local consultation hearings/meetings and social/natural environmental impact assessments prior to the Project implementation in order to deepen understanding of the Project to the persons concerned.

According to the monitoring during construction by the external consultant, "noise caused by unloading work at nighttime", "leaving of unsuitable excavated materials", and "delay of payment for compensation of vegetation etc." were pointed out as environmental problems during the construction period. Since immediate correspondences and measures by NTDC and contractors were made, these did not develop into the serious problems such as delay of construction.

After commissioning, the department of social and natural environmental assessment in NTDC is in charge and is continuing such monitoring.

According to the report of NTDC, at the ex-post-valuation stage, conditions having a bad influence on social/natural environment are not seen, and there are no complaints about the natural environment from locals, etc. Therefore, the influence on the natural environment by the Project is at a minimum. In the field survey too, conditions having a bad influence on social/natural environment have not been seen.

2) Land Acquisition and Resettlement

No resettlement was done, and land acquisition for substations was conducted prior to the Project implementation. On the other hand, trouble/conflict over compensation of transmission line routes occurred along the transmission route (so-called ROW problems) and led to suspension of works and major delays in progress. Some of these compensation disputes have gone to court and are still ongoing.

3) Social Impact in the vicinity of the Project

On average 85 persons per day were employed as daily wage workers during the construction period. Moreover, 45 persons continued to be employed as NTDC local personnel after commissioning. NTDC says that there has been no female participation in construction work and there have been no gender problems. Also, there has been no racial or religious discrimination of workers or labor disputes, etc.

3.5 Sustainability (Rating: ③)

3.5.1 Institutional Aspects of Operation and Maintenance

After privatization of the power sector in 1998, NTDC is developing its business in its role as power system operator (same as transporter of power). Its main duties are purchasing power from generating companies, conveying power through its transmission line network and selling power to distribution companies. Purchasing power is managed/administrated by the Central Power Purchasing Agency established in December 2008 (CPPA). Moreover, NTDC conducts transmission line projects in line with progress of power development by generating companies. Current status of operation/maintenance of transmission lines and substations is performed smoothly for 24 hours by three teams working in four shifts. The number of staff is about 100 persons in total at 220 kV substations and 200 persons at 500 kV substations, respectively. Inspection of transmission facilities is carried out once per month according to a standard, and data are recorded and used for improvement.

3.5.2 Technical Aspects of Operation and Maintenance

NTDC provides sufficient structures for operation/maintenance of its facilities such as quality of staff assignment, engineer level and organization. Especially, its staffs are the former WAPDA personnel, who soundly perform management of daily operation/maintenance and recording of measuring/controlling data. Therefore, in the field survey by the evaluator, it can be said that they had sufficient technology on the operation and maintenance. For example, since power failures/forced power cuts tend to occur more frequently on foggy days, conventional insulator supports are being replaced with fog-countering ones and hotline maintenance for shortening of power failure time of maintenance work, etc. is performed actively[12].

Training/skill improvement of operation/maintenance technology for staffs is carried out at appropriate intervals at WAPDA training center. This center is equipped with repair kits for transmission lines/substations and a substation operation simulator[13], and it accepts more than 1,000 trainees per year. Moreover, the personnel who obtain basic skills at the training center are also aiming to brush up skills by on-the-job training using actual sized imitation facilities at each job site.

Therefore, it was recognized that NTDC is fully equipped with technology for operation and maintenance.

3.5.3 Financial Aspects of Operation and Maintenance

The income of NTDC is composed both of capacity charges (constant cost for peak demand) and energy charges (valuable cost for transmitted power). All power tariffs are collected to an escrow account and the share of NTDC is paid from the escrow account through NERPA. Moreover, stable income is secured with charges set at an appropriate tariff level by NEPRA[14]. This means that NTDC is guaranteed its operating cost by the government for healthy operation and maintenance of power

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[12] Hotline maintenance is the technique whereby insulation supports (glass), etc. are washed in water while lines remain electrically charged.

[13] The simulator was granted by GTZ (Deutsche Gesellschaft Technische Zusammenarbiet) in Germany.

[14] Transmission charge is set at the price that constitutes necessary costs plus appropriate profit.

systems and avoids negative impacts on operation and maintenance due to problems in its financial affairs[15].

In the past, NTDC conducted direct power transactions with power companies but its revenue declined due to non-collection and non-payment of charges so it calculated profit and losses combining power transactions with the transmission utility. However, following establishment of NEPRA, financial statements have been compiled for the transmission utility alone from 2009 onwards. According to financial indicators from 2009, figures were good with profitability (net profit / net fixed assets) at 18%, financial soundness (equity capital ratio = capital / (borrowing + capital)) at 33%, cash management (own fund ratio = own funds / new financial investment) at 200% and debt ratio (debt ratio = own funds / debt repayments) at 103%. This shows that NTDC has sufficient own funds to appropriately carry out operation and maintenance.

3.5.4 Current Status of Operation and Maintenance

According to NTDC, there have been no large-scale accidents or operation mistakes/troubles in transmission lines and substations of the Project since commissioning of commercial operation.

Preventive maintenance actions, such as early exchange of insulators and adoption of maintenance techniques for shortening power failure times, have been taken, and technical transfer and training have been carried out. Therefore, it must be said that NTDC provides sufficient operation and maintenance technique and management/organization.

On the other hand, the present facilities have had almost no spare capacity in the several years after commissioning of commercial operation, and the future issue will be how to carry on the reinforcement/re-powering/updating of facilities in line with the rapidly increasing power demand. According to NTDC, although countermeasures are being planned and designed, the major stumbling block is the lack of funds to invest in new equipment.

To sum up, no major problems have been observed in the operation and maintenance system, therefore sustainability of the project is high.

4. Conclusion, Recommendations and Lessons Learned

4.1 Conclusion

This Project was undertaken as a part of the policy to provide stable power supply, which the Government of the Islamic Republic of Pakistan (hereinafter refer to as "Pakistan") is further aiming at for healthy socioeconomic development of the country. This Project has been highly relevant to Pakistan's development plans, development needs, and Japan's ODA policy as it assists economic infrastructure building and contributes to growth and smooth economic activity in Pakistan. Transmission lines and substations were constructed as originally planned. Although construction costs were within budget, services were commenced more than six years behind the original schedule due to delays of implementation and construction work etc. Therefore, the efficiency of this Project is medium. The Project has contributed to reducing power failure/power cut times and curtailing transmission losses in power supply systems, at the same time it has been useful for supplying power and improving high voltage transmission efficiency in the areas where power demand is increasing rapidly. National Transmission and Dispatch Company (NTDC) provides suitable management, organization of opera-

[15] In order to realize full privatization (public stock release) of the entire electric power sector including NTDC, which is the basic policy objective of the Government of Pakistan, it is necessary to raise the value of stock.

tion and maintenance, sufficient technology and financial ability for the Project, and the Project has so far been conducted in good condition. Therefore, it can be said that the evaluation of the Project is very high.

4.2 Recommendations

4.2.1 Recommendations to NTDC

It is necessary to take the following points into consideration which are based on experience of the delay of six years to completion due to problems in consultant procurement and ROW.

1) Concerning reconsideration of the EPC (Engineering, Procurement and Construction) contract, NTDC is recommended to dispatch its engineers to the Project sites at an early stage for the execution of field investigation, survey, planning and detailed design and make its own efforts to detect problems in field. This will mitigate the friction with locals and lead to smooth instruction to contractors, quality control, and justin-time completion.
2) Decisions concerning whether to revise design or conduct new tender should be made upon considering the level of cost increase and losses arising from delay in the commissioning of Project activity.
3) Assignments delegated to the staff need consideration and should not disturb the consistency of performance of the Project.
4) In order to avoid prolonged compensation negotiations, examine measures such as enhancing the local liaison and adjustment setup and locally procuring human resources and materials for works, and prepare fully for negotiations.

4.2.2 Recommendations to JICA

None in particular

4.3 Lessons Learned

In order to minimize delays in implementation of project such as that caused by preparation and procurement of an external consultancy services, it is important for both JICA and concerned organizations to share the recognition about the necessity of the consultancy services. Especially in those projects where employment of an external consultancy service is crutial, both sides are required to perform sufficient exchange of opinions in advance and form common views on it. Moreover, such a common view should be clearly shown in agreed documents such as M/D.

Comparison of the Original and Actual Scope of the Project

Item	Original	Actual
1. Project Outputs	(Package-1) 1)Daudkhel-Bannu D/C twin bundle 220KV T/Line（L= 100km） 2) Gatti-Ludewala D/C single conductor 220KV T/Line（L= 100km） 3) Muzaffargarh-Bahawalpur D/C twin bundle 220KV T/Line（L=90km） 4) Jamhsoro-Hyderabad D/C twin bundle 220KV T/Line（L=30km） 5) In-Out Guddi-Sibbi 220KV T/Line at Shikapur(D/C single conductor)（L=60km） (Package-2) 6) Rewat-Islamabad D/C twin bundle 220KV T/Line(L=35km) 7) Peshawar-Shahibagh D/C twin bundle 220KV T/Line（L=21km） 8) Peshawar-Mardan D/C single conductor 220KV T/Line（L=56km） (Package-3) 220/132KV Conventional Sub-station at Shahibagh Peshawar（2units） (Package-4) 220/132KV GIS Islamabad University Sub-station（2units）	(Package-1) 1)Daudkhel-Bannu D/C twin bundle 220KV T/Line（L= 110km） 2) Gatti-Ludewala D/C single conductor 220KV T/Line（L= 99km） 3) Muzaffargarh-Bahawalpur D/C twin bundle 220KV T/Line（L=109km） 4) Jamhsoro-Hyderabad D/C twin bundle 220KV T/Line（L=46km） 5) In-Out Guddi-Sibbi 220KV T/Line at Shikapur(D/C single conductor)（L=37km） (Package-2) 6) Rewat-Islamabad D/C twin bundle 220KV T/Line(L=49km) 7) Peshawar-Shahibagh D/C twin bundle 220KV T/Line（L=38） 8) Peshawar-Mardan D/C single conductor 220KV T/Line（L=85） (Package-3) 220/132KV Conventional Sub-station at Shahibagh Peshawar（4 units） (Package-4) 220/132KV GIS Islamabad University Sub-station（2 units）
2. Project Period	March,1996 – March,2000 (49 months)	October,2001 – December,2006 (63 months)
3. Project Cost **Foreign currency** **Local currency** **Total** **Loan portion** **Exchange rate**	 11,886 million yen 5,879 million yen （Local currency 1,843Mil. Rs.） 17,746 million yen 12,022 million yen 1Rs.＝3.19yen （May, 1995）	 9,740 million yen 5,761 million yen （Local currency 2,711Mil. Rs.） 15,501 million yen 11,739 million yen 1Rs.＝2.13yen （Oct. 2001～June. 2002）