



Completion Report

Project Number: 37192-023
Loan Numbers: 2289 and 2290
September 2017

Pakistan: Power Transmission Enhancement Investment Program – Tranche 1

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Asian Development Bank

CURRENCY EQUIVALENTS

Currency Unit – Pakistan rupee/s (PRe/PRs)

		At Appraisal (13 November 2006)	At Project Completion (30 June 2012)
PRe1.00	=	\$0.0165	\$0.0106
\$1.00	=	PRs60.72	PRs94.50

ABBREVIATIONS

ADB	–	Asian Development Bank
DMF	–	design and monitoring framework
EIRR	–	economic internal rate of return
ESIC	–	environmental and social impact cell
FIRR	–	financial internal rate of return
GDP	–	gross domestic product
HVDC	–	high-voltage direct current
MFF	–	multitranchise financing facility
NEPRA	–	National Electric Power Regulatory Authority
NTDC	–	National Transmission and Despatch Company
PCR	–	project completion report
PMC	–	project management consultant
PMU	–	project management unit
SDR	–	special drawing right
SVC	–	static VAR compensator
TA	–	technical assistance
UoSC	–	use of system charge
WACC	–	weighted average cost of capital
WAPDA	–	Water and Power Development Authority

WEIGHTS AND MEASURES

GWh	–	gigawatt-hour
km	–	kilometer
kV	–	kilovolt
kW	–	kilowatt
MVA	–	megavolt-ampere
MW	–	megawatt

NOTES

- (i) The fiscal year (FY) of the Government and its agencies ends on 30 June. FY before a calendar year denotes the year in which the fiscal year ends, e.g., FY2009 ends on 30 June 2009.
- (ii) In this report, "\$" refers to United States dollars.

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BASIC DATA

A. Loan Identification

1.	Country	Pakistan
2.	Loan Numbers	2289 and 2290
3.	Project Title	Power Transmission Enhancement Investment Program – Tranche 1
4.	Borrower	Islamic Republic of Pakistan
5.	Executing Agency	National Transmission and Despatch Company
6.	Amount of Loan	
	(i) Loan 2289:	
	- Original Amount	\$226,000,000.00
	-First Partial cancellation (7 Feb 2011)	\$67,000,000.00
	-Second Partial cancellation (2 Apr 2012)	\$16,000,000.00
	-Final cancellation (8 Feb 2013)	\$14,253,213.88
	- Net Loan Amount	\$128,746,786.12
	(ii) Loan 2290:	
	- Original Amount	SDR6,777,000.00
	-Final cancellation (23 August 2017)	SDR3,958,372.37
	- Net Loan Amount	SDR2,818,627.63
7.	Project Completion Report Number	1663

B. Loan Data

1.	Appraisal	
	– Date Started	20 September 2006
	– Date Completed	29 September 2006
2.	Loan Negotiations	
	– Date Started	31 October 2006
	– Date Completed	1 November 2006
3.	Date of Board Approval	13 December 2006
4.	Date of Loan Agreement	16 January 2007
5.	Date of Loan Effectiveness	
	– In Loan Agreement	16 April 2007
	– Actual	11 May 2007
	– Number of Extensions	0
6.	Closing Date	
	– In Loan Agreement	Loan 2289: 30 December 2009 Loan 2290: 15 June 2017
	– Actual	Loan 2289: 30 June 2012 (loan closing) 8 February 2013 (financial closing) Loan 2290: 15 June 2017 (loan closing) 23 August 2017 (financial closing)
	– Number of Extensions	Loan 2289: 1

7. Terms of Loan
- (i) Loan 2289:
- Interest Rate London interbank offered rate plus 0.60% and 0.75% commitment charge per annum
 - Maturity (number of years) 20
 - Grace Period (number of years) 3
- (ii) Loan 2290:
- Interest Rate 1.0% per annum during grace period
1.5% per annum during amortization period
 - Maturity (number of years) 32
 - Grace Period (number of years) 8
8. Terms of Relending (if any)
- Interest Rate 17%
 - Maturity (number of years) 17
 - Grace Period (number of years) 2
 - Second-Step Borrower National Transmission and Despatch Company
9. Disbursements
- a. Dates

Initial Disbursement	Final Disbursement	Time Interval
Loan 2289: 5 March 2008	27 November 2012	56.8 months
Loan 2290: 6 April 2010	8 May 2017	85.6 months
Effective Date	Original Closing Date	Time Interval
Loan 2289: 11 May 2007	30 December 2009	31.7 months
Loan 2290: 11 May 2007	15 June 2017	121.2 months

- b. Amount (\$'000)

Loan 2289

Category	Original Allocation	Last Revised Allocation	Amount Canceled	Amount Disbursed
01A Civil works	9,000	9,000	(1,602)	10,602
01B Turnkey subprojects	98,000	64,000	46,384	17,616
02A 500-kilovolt transformers	18,000	18,000	(10,068)	28,068
02B 220-kilovolt transformers	21,000	21,000	(4,354)	25,354
02C Circuit breakers and isolators	4,000	4,000	(3,319)	7,319
02D CT, CCTV, CVT, and PTs	2,000	2,000	(11,812)	13,812
02E Relay panels	5,000	5,000	2,897	2,103
02F Grid station hardware	6,000	6,000	3,706	2,294
02G Transmission line	3,000	3,000	(10,206)	13,206
02H Telecom equipment	1,000	1,000	(540)	1,540
03 Interest and commitment charge	30,000	10,000	3,168	6,832
04 Unallocated	29,000	0		0
Total	226,000	143,000	14,254	128,747

CT = current transformer, CCTV = closed circuit television, CVT = capacitor voltage transformer, PT = potential transformer.

() = negative.

Note: Numbers may not sum precisely because of rounding.

c. Amount (SDR '000)

Loan 2290

Category		Original Allocation	Last Revised Allocation	Amount Canceled	Amount Disbursed
01	Consulting services	5,760	5,760	2,941	2,819
02	Unallocated	1,017	1,017	1,017	0
Total		6,777	6,777	3,958	2,819

10. Local Costs (Financed, Asian Development Bank Loan) — Not applicable

C. Project Data

1. Project Cost (\$'000)

Cost	Appraisal Estimate		Actual	
	Loan 2289	Loan 2290	Loan 2289	Loan 2290
Foreign Exchange Cost	226.0	10.0	128.70	4.27
Local Currency Cost	56.0	2.5	30.48	0
Total	282.0	12.5	159.18	4.27

2. Financing Plan (\$'000)

Cost	Appraisal Estimate		Actual	
	Loan 2289	Loan 2290	Loan 2289	Loan 2290
Implementation Costs				
Borrower Financed (NTDC)	56.0	2.5	30.48	0
ADB Financed	226.0	10.0	121.90	4.27
Total	282.0	12.5	152.38	4.27
IDC Costs				
Borrower Financed			0	0
ADB Financed			6.80	0
Total	282.0	12.5	159.18	4.27

ADB = Asian Development Bank, IDC = interest during construction, NTDC = National Transmission and Despatch Company.

3. Cost Breakdown by Project Component (\$'000)

Component	Appraisal Estimate	Actual
A. Loan 2289		
Civil Works	12.65	13.25
Turnkey subprojects	122.59	22.02
Equipment	77.82	117.11
IDC	31.63	6.80
Contingency	37.31	
Total	282.00	159.18

B. Loan 2290

ADB Financed

10.00**4.27**

IDC = interest during construction.

4. Project Schedule

Item	Appraisal Estimate ^a	Actual
Equipment Procurement (Loan 2289)		
Date of first equipment procurement contract	January 2007	August 2007
Date of final equipment procurement contract	June 2007	April 2012
First equipment delivery	April 2007	February 2008
Final equipment delivery	September 2008	September 2012
Civil Works and Equipment Installation (Loan 2289)		
Date of first equipment installation contract	October 2007	May 2008
Date of final equipment installation contract	...	November 2010
First completion date	March 2008	February 2009
Commissioning of final subproject	June 2010	June 2014
Consultancy Support (Loan 2290)		
Date of first consultancy contract	...	September 2009
Date of final consultancy contract		September 2016

^a Appraisal estimate does not include the additional subprojects to utilize loan savings.**5. Project Performance Report Ratings**

Implementation Period	Ratings	
	Development Objectives	Implementation Progress
Loan 2289		
From 1 January 2007 to 30 June 2007	Satisfactory	Highly Satisfactory
From 1 July 2007 to 31 December 2007	Satisfactory	Satisfactory
From 1 January 2008 to 30 June 2008	Satisfactory	Satisfactory
From 1 July 2008 to 31 December 2008	Satisfactory	Satisfactory
From 1 Jan 2009 to 30 June 2009	Satisfactory	Partly Satisfactory
From 1 July 2009 to 31 December 2009	Satisfactory	Partly Satisfactory
From 1 January 2010 to 30 June 2010	Satisfactory	Satisfactory
From 1 July 2010 to 31 December 2010	Satisfactory	Satisfactory
Overall Project Rating^a		
From 1 January 2011 to 30 June 2011	On Track	
From 1 July 2011 to 31 December 2011	On Track	
From 1 January 2012 to 30 June 2012	On Track	
Loan 2290		
From 1 January 2007 to 30 June 2007	Satisfactory	Highly Satisfactory
From 1 July 2007 to 31 December 2007	Satisfactory	Satisfactory
From 1 Jan 2008 to 30 June 2008	Satisfactory	Satisfactory

From 1 July 2008 to 31 December 2008	Satisfactory	Satisfactory
From 1 January 2009 to 30 June 2009	Satisfactory	Satisfactory
From 1 July 2009 to 31 December 2009	Satisfactory	Satisfactory
From 1 January 2010 to 30 June 2010	Satisfactory	Satisfactory
From 1 July 2010 to 31 December 2010	Satisfactory	Satisfactory

Overall Project Rating^a

From 1 January 2011 to 30 June 2012	On Track
From 1 July 2012 to 31 December 2012	Potential Problem
From 1 January 2013 to 30 June 2013	Potential Problem
From 1 July 2013 to 31 December 2016	On Track

^a In 2011, e-Operations replaced the project performance rating. The indicators used in performance rating are technical, procurement, disbursement, financial management, and safeguards. A single rating applies to the project.

D. Data on Asian Development Bank Missions

Name of Mission	Date	No. of Persons	No. of Person-Days	Specialization of Members ^a
Fact-finding	1–16 Aug 2006	9	135	a, c, d, g, i, j, n, o, aa
Appraisal	20–29 Sep 2006	9	90	a, c, d, g, i, k, n, o, aa
Inception	15–20 Jan 2007	2	12	a, y
Review 1	21–22 Nov 2007	1	2	a
Review 2	27 Apr–1 May 2008	3	15	a, o, v
Review 3	21–24 Oct 2008	5	16	a, l, m, q, y
Review 4	16–18 Feb 2009	6	18	a, a, c, o, t, y
Review 5	28 May–1 Jun 2009	5	25	c, h, f, q, y
Review 6	24 Feb–3 Mar 2010	5	40	b, i, q, r, y
Review 7	12 Jul–15 Jul 2010	3	10	r, u, v
Review 8	7–12 Feb 2011	4	35	b, i, q, v
Review 9	25 Jul 2011	1	1	p
Review 10	25 Nov 2011	4	4	e, i, p, v
Review 11	16–19 Apr 2012	6	19	c, i, p, s, v, x
Consultation	3–4 Jul 2014	2	4	c, c
Project completion review	27 Mar–12 Apr 2017	4	56	c, d, w, z

^a a = principal energy specialist and mission leader; b = senior energy specialist and mission leader; c = energy specialist; d = financial specialist; e = principal social development specialist; f = senior social development specialist, Pakistan Resident Mission (PRM); g = social development specialist; h = environment specialist; i = environment specialist consultant, PRM; j = project economist; k = project specialist; l = senior social safeguards specialist; m = social safeguards specialist; n = counsel; o = programs officer, PRM; p = senior project officer, PRM; q = project implementation officer, PRM; r = social safeguards officer, PRM; s = senior safeguards officer, PRM; t = procurement officer, PRM; u = project officer (energy), PRM; v = project analyst; w = economist consultant; x = operations analyst; y = associate project analyst; z = project analyst consultant; aa = administrative assistant.

I. PROJECT DESCRIPTION

1. The bulk of Pakistan's power generation capacity comprises hydropower plants located in the north of the country and thermal power plants in the south. A 500-kilovolt (kV) transmission backbone running the length of the country connects this generation to the major load center located in the middle of this backbone around Faisalabad, Islamabad, and Lahore. As a result, there are always significant power flow requirements from the north or south to the center, depending on the seasonal availability of hydropower. A 220 kV secondary transmission system moves power between this 500 kV backbone and the 132 kV sub-transmission systems operated by the country's 10 distribution companies and a vertically integrated electric utility for the Karachi region, K-Electric.

2. The power system has insufficient capacity to meet the growing demand for power, and electricity is routinely rationed at times of peak demand. This makes it difficult for the economy to develop to its full potential. Power system capacity constraints are manifested in (i) a shortage of generation; (ii) capacity constraints on the 500 kV network that prevent available generation being fully utilized at times of peak demand; and (iii) localized constraints due primarily to a lack of transformer capacity, which restricts the delivery of power to the distribution companies and to end users. In addition to these system constraints, the sector suffers from chronic shortage of funds. These originate largely in higher losses and lower collections than the regulator-determined levels, which leads to lack of financial resources at distribution companies to fulfill payment requirements to power generation companies.

3. The Asian Development Bank (ADB) approved up to \$800 million in loans over a 10-year period through a multitranche financing facility (MFF) to finance the development of increased transmission system capacity through the implementation of a range of subprojects, each selected to overcome a specific transmission constraint.¹ The project was the first of four tranches of the MFF, and comprised a total of 20 subprojects, each involving the construction of a transmission system augmentation, such as the installation of a new transformer or transmission line, or the replacement of an existing transformer with one of a larger capacity, to remove a capacity bottleneck. The subproject locations were spread nationwide.

II. EVALUATION OF DESIGN AND IMPLEMENTATION

A. Relevance of Design and Formulation

4. In 2006 when the project was formulated, the Government of Pakistan was working to achieve the economic growth targets set out in its Medium-Term Development Framework, 2005–2010.² Electricity is a key input to economic growth, but as the capacity of the power system was insufficient to meet the country's needs, electricity was being rationed, with 800 MW of unmet demand (around 6% of total demand) during summer peak of 2006 (footnote 1). The problem was not only a shortage of generation, but also bottlenecks in the transmission system, which were preventing the available generation from being used to its fullest extent. Bottlenecks included not only overloaded transmission lines, but also a lack of transformer capacity both within the transmission grid (500/220 kV) and at grid offtake points to distribution companies (220/132kV).

¹ Asian Development Bank (ADB). 2006. *Report and Recommendation of the President to the Board of Directors: Proposed Multitranche Financing Facility to the Islamic Republic of Pakistan for the Power Transmission Enhancement Investment Program*. Manila.

² The Government of Pakistan. 2005. *The Medium-Term Development Framework, 2005–2010 (MTDF)*. Islamabad

5. ADB's country strategy supported the government's objective of increasing the capacity of the power system to promote economic development.³ ADB's assistance to Pakistan's power sector has focused on increasing the capacity of the transmission and distribution system more than on the development of new generation. Consistent with this strategy, the project was designed to increase the capacity of the transmission system. The project completion report (PCR) found that the peak loads on the transformers installed by the project were already high by international standards, which is testimony to the contribution of the project to the overall development of the power system and the need for the additional capacity.

6. The transmission system in Pakistan is owned and operated by the National Transmission and Despatch Company (NTDC), a state-owned corporation. Prior to appraisal, a project preparatory technical assistance (PPTA) consultant assisted the NTDC in analyzing the performance of the power system under various load and generation scenarios to (i) identify actual and expected constraints, and (ii) prioritize subprojects to address the shortfall in transmission capacity. The project, as designed at appraisal, included 19 high-priority subprojects. The subprojects were all relatively small, and there was a strong focus on addressing localized constraints through the installation of additional 220/132 kV supply transformer capacity. This arrangement allowed the project to be implemented quickly. Further, in most cases the transformers were to be installed in existing grid station switchyards, and there were no environment, land acquisition, or resettlement issues to address. In accordance with the government's requirements for the utilization of loan funding, each subproject was supported by a PC-1 planning report, prepared by the NTDC, which justified the need for the subproject within the broader context of the overall development of the power system.⁴

7. In addition to the installation of tangible transmission system assets financed by the loan from ADB's ordinary capital resources, the project included a supplementary SDR6.8 million loan from the Asian Development Fund for procurement of consulting services. These loan funds were to be used for (i) preparation of subprojects, (ii) detailed design, (iii) construction supervision and contract management, and (iv) other support to the NTDC approved by ADB. This loan was kept open for the duration of the MFF since the consulting services were not tied to the tranche 1 subprojects but were also available to all subsequent tranches.

B. Project Outputs

8. The project completed 18 of the 19 subprojects included in the appraisal design. In doing so, the project installed 6,125 megavolt-amperes (MVA) of power transformer capacity and constructed 50 kilometers (km) of new transmission lines. One of the original subprojects, the installation of a new static VAR compensator (SVC) at New Kot Lakhpat grid station, was removed from the project scope and transferred to tranche 2 of the MFF to allow for sufficient construction time within the loan period without extending the project.⁵ In addition, the project completed two further subprojects that were not in the appraisal design but were able to be implemented using loan savings. Under this additional scope, the project installed 1,590 MVA of transformer capacity and 250 km of new transmission lines. A schedule of the subprojects and the transmission assets installed by the project is provided in Appendix 2. These are all in service and working as designed.

³ ADB. 2003. *Pakistan: Country Strategy and Program Update, 2004-2006*. Manila.

⁴ PC-1 refers to the Planning Commission pro forma 1 for development projects, which requires information on the concept, justification, and implementation arrangements, among others, before approval.

⁵ SVCs are relatively modern devices and the technology was new to Pakistan. Initially, the subproject was delayed to allow further analysis to finalize the design.

9. All but two subprojects involved the installation of power transformer capacity at existing grid stations either to relieve equipment overloads or avoid equipment becoming overloaded during N-1 contingency situations.⁶ Capacity was added by adding transformers or, where space was not available, by replacing existing transformers with larger units. Two 132/11 kV grid stations at Bandala and WAPDA Town that were owned by a distribution company were transferred to NTDC and upgraded to 220/132 kV grid stations through the installation of 220 kV gas-insulated switchgear.⁷ These two subprojects included the construction of relatively short (approximately 10 km each) incoming 220 kV lines to supply the new 220/132 kV transformers.

10. Two subprojects involved the construction of new double-circuit 220 kV transmission lines without transformer installation. One of these lines was needed to reinforce the incoming supply to Mardan grid station to avoid overloading other 220 kV circuits in an N-1 contingency situation (footnote 6), while the second was to supply the new Loralai grid station.⁸

11. The project completed additional subprojects by utilizing loan savings. During the procurement phase of the project, equipment costs were found to be substantially lower than the appraisal estimates. NTDC requested that the loan savings be utilized to fund two additional subprojects comprising (i) seven new transformers at six existing 500 kV and 220 kV grid stations;⁹ and (ii) the 250 km double-circuit 220 kV transmission line to supply the new Loralai grid station (para. 10). These subprojects were subsequently added to the scope of work.¹⁰

12. The supplementary SDR6.8 million loan for consultancy support (Loan 2290) was used to (i) complete a feasibility study of a high-voltage direct current (HVDC) line between Lahore and Karachi, (ii) assist NTDC to develop subprojects for financing from the MFF tranche 4 loan, (iii) provide project management support for the implementation of MFF tranches 1 and 2 loan projects, and (iv) monitor compliance with ADB's environmental and social safeguard requirements.

C. Project Costs

13. The total project cost was 35% less than the baseline appraisal estimate.¹¹ There were three partial cancellations during the course of the loan totaling \$97.3 million, or 43% of the approved loan amount (Loan 2289). Its interest and commitment charge was reduced accordingly. A breakdown of project costs covered by the loan agreement is shown in Appendix 3. ADB paid 80% of all contract costs financed under the loan, and NTDC paid the balance. The costs shown in Appendix 3 include NTDC's contribution to these contracts but not NTDC's internal costs, including compensation paid to people affected by the project; project management unit (PMU) costs; and costs incurred by NTDC's design, procurement, and construction divisions in the management, supervision, and commissioning of the project. Furthermore, the schedule only shows project costs up to the date of loan closure on 30 June

⁶ The grid code requires the transmission network to be designed so that equipment will not be loaded above its emergency rating if a single transmission asset (N-1) is out of service. It must also be possible to reduce the loading to below its normal continuous rating within 15 minutes, if necessary using forced load shedding (i.e., load shedding that has not been planned in advance).

⁷ Gas-insulated switchgear uses sulfur hexafluoride rather than air as the insulating medium. It is much more compact than standard air-insulated high-voltage switchgear and is normally installed indoors.

⁸ The Loralai grid station was constructed under tranche 2 of the MFF. The incoming transmission line was also originally planned for tranche 2 but was brought forward when spare funds became available in tranche 1.

⁹ Work at each of the grid stations would have been categorized as a separate subproject in the original formulation.

¹⁰ ADB. 2009. *Major Change in Project Scope: Power Transmission Enhancement Investment Program – Tranche 1*. Manila.

¹¹ The baseline appraisal estimate excluded contingencies and loan financing charges.

2012. At that time, construction work on two subprojects (the incoming transmission line to Bandala grid station, and the Dera Ghazi Khan (D.G. Khan)–Loralai transmission line) still had to be completed, as right-of-way issues were still being resolved, and two other subprojects (Mardan and Peshawar) had yet to be commissioned.¹² All these four subprojects have since been completed using NTDC's own resources.

14. The total project cost was lower than the estimate at appraisal notwithstanding the addition of two subprojects using loan savings. While these additions were partly offset by the removal of the SVC, equipment costs were nevertheless significantly lower than assumed at appraisal. For four subprojects ((i) Tarbela extension, (ii) Mangla extension, (iii) Bandala grid station, and (iv) WAPDA Town new grid station subprojects) where turnkey contracts had been assumed at appraisal, the actual costs turned out to be lower. This was likely a result of using a multi-contract delivery approach, which caused design, procurement, and project management inputs that would have been provided by a turnkey contractor to be provided by NTDC instead; as a result, these were not recognized as ADB-financed project costs. However, the need to manage such a large number of contracts was an impediment to efficient project implementation, and the number of contracts in tranche 2 was reduced as a result.

15. These cost savings were significant. The appraisal estimate was prepared prior to the 2008 global financial crisis and was likely based on the prevailing costs in developed countries, as international competitive bidding was assumed for most of the contracts. However, most procurement was undertaken during the crisis at a time when the competition was intense and when there were depressed commodity prices, including for copper, steel, and aluminum. Most of the equipment for the project came from the People's Republic of China.

D. Disbursements

16. The project loan, Loan 2289, was approved on 13 December 2006 and became effective on 11 May 2007. The loan was financially closed on 8 February 2013 after one extension. The support facility loan to finance the engagement of consultants, Loan 2290, was left open for the whole of the MFF validity period. The loan was financially closed on 23 August 2017. Schedules showing the disbursements from each loan disaggregated by quarter are shown in Appendix 4.

17. Of all the contract payments, 80% were disbursed from the project loan, with the only exception being finance costs, which were fully covered by loan withdrawals. Disbursements from Loan 2290 covered 100% of all consultancy fees. Loan disbursements were paid in accordance with ADB's *Loan Disbursement Handbook* (2015, as amended from time to time) under direct payment or commitment procedures.

18. Total disbursements under both loans were substantially less than expected at appraisal. In the case of the tranche 1 project loan, this was because project costs were substantially lower than the appraisal estimate (para. 14). NTDC did not fully utilize the available funds in the support loan, Loan 2290, and used its own resources to engage consultants to monitor contractor performance on some of the larger projects in tranche 2.

19. There were disbursement delays, which were caused by (i) delayed material delivery due to type tests and pre-shipment tests; (ii) delayed letter of credit opening by the bidders and relevant processing by NTDC, resulting in delayed issuance of commitment letters by ADB; and (iii) delayed submission of signed civil works contracts by NTDC to ADB, as well as delayed

¹² Commissioning of subprojects was undertaken internally by NTDC.

submission of withdrawal application. The delay in material delivery is being addressed by revising the relevant part of the bidding documents under the succeeding MFF II. The delay in the issuance of commitment letters by ADB was addressed by having ADB's internal monitoring system in place.

E. Project Schedule

20. A comparison of actual project implementation with the appraisal schedule is given in Appendix 5, and the actual completion dates of all subprojects are shown in Appendix 2.

21. The project started smoothly. Most of the procurement contracts for goods were awarded within the first year thanks to advanced contracting and early signing of contracts. There were some delays at procurement of works and at the implementation stage due to various reasons,¹³ including a site change for the new Bandala grid station and the need for further detailed analysis to finalize the design of the SVC. There was one loan extension for the project loan, Loan 2289, from 30 December 2009 to 30 June 2012 due to these delays and to the additional subprojects that were completed utilizing loan savings. Eight subprojects had been commissioned by the original loan closing date, all of which were simple transformer extension projects. Four subprojects were commissioned after the loan closing date and finished using NTDC's own resources (para. 13). This PCR considers that the original three-year implementation schedule was not feasible given the number of subprojects, their diverse locations, NTDC's unfamiliarity with ADB's safeguard and procurement requirements and procedures. Although the procurement of goods was delivered within 6 months to 1 year following approval, it took 5.5 years following approval to have 80% of the project's original scope commissioned. The delay mostly appeared during the implementation stage. Four subprojects suffered from security concerns, which affected material delivery, and three transmission line subprojects had problems in obtaining right-of-way. Other causes of delay included (i) the time required to establish the PMU; (ii) commercial issues with contractors; (iii) damaged or faulty equipment; (iv) delayed approval of equipment and design; and (v) the longer time required for equipment tests, partly due to complex requirements in the technical specifications, late delivery of drawings, and problems interfacing new and existing equipment. Now that NTDC has gained experience with ADB's procurement requirements, many of the problems identified at the beginning of the project have been addressed.

22. Although the decision to add two subprojects (utilizing loan savings) may have contributed to a longer implementation period,¹⁴ the decision was justified since the additional benefits from transmission capacity improvements exceed the cost of such delays, especially under the MFF approach and its 10-year implementation window.

F. Implementation Arrangements

23. The borrower was the Islamic Republic of Pakistan and funds from the project loan were re-lent to NTDC through a subsidiary loan arrangement. NTDC was both the executing agency and implementing agency. The project was implemented with direct contributions from NTDC's internal design, procurement, and construction departments. As agreed in the project

¹³ At the Islamabad University grid station, only one of the two project transformers commenced operation in 2009 because its capacity was enough to meet demand. The second transformer started operation in 2012. Similarly, at New Kot Lakhpat grid station, two out of the three project transformers started operation in 2009, while the third transformer started operation in 2011.

¹⁴ The additional subprojects did not necessarily lengthen the implementation period because one of the original subprojects, the Bandala grid station, was the last to be commissioned (June 2014).

administration manual, a PMU was established under a General Manager (Projects) and was responsible for (i) coordinating the contribution of the different departments, (ii) ensuring that ADB's implementation and monitoring requirements were met, and (iii) communicating with ADB.

24. This PCR considers that the structure of the PMU could have been more effective. Firstly, the PMU did not have full control of all NTDC staff working on the project. Instead, the PMU's role was to liaise with ADB and to coordinate the project inputs provided by NTDC's planning, design, procurement, and construction departments. Secondly, as the PMU is organized along functional lines, with its staff responsible for managing all ongoing ADB projects. As a result, there was no dedicated project manager responsible for coordinating the different project inputs and anticipating and mitigating future issues and risks before they escalated.¹⁵ Thirdly, Environmental and Social Impact Cell (ESIC) could have been established earlier within the PMU to meet ADB's safeguard requirements.

G. Conditions and Covenants

25. The status of compliance with loan covenants is in Appendix 6. NTDC was generally in compliance with all nonfinancial covenants, although the project completion review mission was unable to confirm its level of compliance with the grid code. This is because the Code is an extensive document with a multitude of different requirements and NTDC's level of compliance can only be determined by a compliance audit. In developing countries, grid codes are often aspirational, so it is unlikely that such an audit would find full compliance. However, NTDC is understood to be generally compliant with key grid code requirements. Given the very high loading on the transmission system, some parts of the grid may not be fully compliant with the N-1 loading requirement at times of peak demand (footnote 6). Therefore, it would have been more appropriate to have required compliance with specific clauses of the grid code that were particularly relevant to the loan, rather than having generalized conditions, such as full compliance with the grid code.

26. NTDC needs to improve its compliance with the time requirement to submit audited entity financial statements to ADB within 6 months of the end of each financial year. The latest submission was for the 2013-14 financial year.¹⁶ These accounts show that NTDC complied with its covenanted financial ratios.

27. The government also needs to make efforts to comply with the loan covenant that requires it to ensure that government-owned entities provide prompt payment of amounts due to NTDC and to finance any shortfall. According to NTDC's financial statements, receivables from the government alone were PRs31 billion in FY2014. This is a part of a much larger circular debt problem in the Pakistan electricity subsector.¹⁷ The magnitude of this problem from 2012 to 2017 would have been difficult to predict at the time of project appraisal in 2006. For NTDC, this problem has largely been resolved, as the power sector's financial settlement function was separated as a Central Power Purchasing Agency-Guarantee, which took on the receivables and payables outside NTDC's transmission system operator functions.

¹⁵ This problem is being addressed in the preparation of MFF-II tranche 2. NTDC is reorganizing its structure to fully capture the project activity work flow.

¹⁶ Preparation of the entity financial statements and its audited report for 2014-15 financial year has been delayed due to NTDC's separation of power purchasing function and its account, through establishment of Central Power Purchasing Agency (Guarantee) Limited as a separate entity. ADB is supporting this major structural reform through TA and policy-based lending.

¹⁷ ADB.2017. *Report and Recommendation of the President to the Board of Directors: Proposed Policy-Based Loan for Subprogram 3, Islamic Republic of Pakistan: Sustainable Energy Sector Reform Program*. Manila.

H. Consultant Recruitment and Procurement

28. **Consultant recruitment.** Loan 2290 provided for the appointment of consultants to provide support to NTDC over the period of the MFF. These funds could be used not only to support the project, but also to provide technical and institutional support to NTDC. Using these funds, international consulting firms were engaged to undertake a feasibility study into the construction of a new HVDC line between Karachi and Lahore, and to prepare tranche 4 of the MFF. Loan funds were also used for the engagement of the project management consultant (PMC). These consultants were all recruited by the executing agency using quality- and cost-based selection procedures according to ADB's *Guidelines on the Use of Consultants* (2013, as amended from time to time). The loan was also used to fund the engagement of local consultants to monitor and report on NTDC's compliance with ADB's social protection and environmental requirements. These consultants were recruited through local advertising undertaken by the executing agency.

29. There were delays in the recruitment of consultants. The first consultancy contract was awarded in September 2009 and the PMC was appointed in October 2010, more than 3 years after the loan became effective and after the original loan closing date. Although an international consultant was expected to be engaged to advise NTDC on capacity development, this contract was not materialized. Frequent changing of NTDC's managing director may have affected the company's decision to recruit such consultants.

30. **Procurement.** The project ended up with more packages than designed (75 contracts), most of which took a multi-contract procurement approach where equipment for each subproject was procured from different suppliers. Advanced procurement was applied, with the contract for the first goods procurement contracts becoming effective in August 2007. Although four subprojects were originally intended to be delivered through turnkey contracts, they were delivered using multi-contract procurement, which is NTDC's standard approach to project delivery. Because the change was made by NTDC without notifying ADB beforehand, ADB asked NTDC to inform it in advance for similar cases in the future. While the positive aspects of using a multi-contract approach include cost reduction (mainly management cost), the negative aspects include a longer procurement period resulting from increased internal transactions on the part of NTDC.

I. Performance of Consultants, Contractors, and Suppliers

31. **Consultants.** The PMC, whose terms of reference covered all MFF tranches, was recruited in October 2010. The PMC monitored progress, prepared NTDC's quarterly progress reports, and prepared the executing agency's PCR for tranche 1. The PMC's contract was not renewed after the expiry of the 3-year contract term; from that point on, all project management was undertaken in-house by the PMU. No replacement PMC was appointed, partially due to the performance of the prior one, which was below NTDC's expectations. In hindsight, a better outcome would have been achieved if the PMC had been recruited earlier and had more experience in the implementation of ADB-financed projects in Pakistan's power sector.

32. Project implementation may have been more effective if a dedicated NTDC project manager had been assigned to the project. Alternatively, an effective PMC could have filled the role of project manager.

33. **Contractors and suppliers.** There were delays in some contracts becoming effective, generally due to the time taken by contractors to open letters of credit. This extended the time required to complete some subprojects. The project completion review mission inspected the equipment and works installed by the project at four sites.¹⁸ In all cases, the quality of the equipment supplied and the installation work was good. Some delays were due to delayed approval of equipment and design, and the longer time required for equipment tests, partly due to late delivery of drawings (para. 21).

J. Performance of the Borrower and the Executing Agency

34. The executing agency has been able to successfully commission all subprojects (apart from the SVC that was transferred to tranche 2 due to delays in resolving commercial issues with the contractor¹⁹) at a significantly lower cost than the estimate in the report and recommendation of the President (footnote 1). This is notwithstanding the addition of 1,590 MVA of transformer capacity and a 250 km double-circuit 220 kV transmission line to the original scope of work.

35. The delays in project implementation can be partially attributed to (i) the time required to establish a functioning PMU and to recruit a PMC; (ii) NTDC's unfamiliarity with ADB's procurement, environmental, and social protection requirements; and (iii) the large number of contracts and diversified lots. There was also concern about the leaking of confidential bid evaluation information, and NTDC was consequently required to tighten its bid evaluation procedures, primarily by reducing the number of staff with access to bid information during the evaluation period.²⁰ At the early stage, there were delays in NTDC's submission of signed civil work contracts to ADB, which caused delayed payment to the contractors. The problem was addressed later for the additional subprojects. NTDC changed the scope of the Bandala grid station subproject without notifying ADB.²¹ Going forth, NTDC confirmed that utmost care will be taken to prevent design changes and, if changes are necessary, ADB will be notified in advance.

36. NTDC is technically competent in the planning, design, and implementation of power transmission projects. Its ability to effectively manage the commercial issues associated with outsourced contracts could be improved further and NTDC could have better implementation oversight if, utilizing available funds in the support facility Loan 2290, it recruited a capacity development consultant to review its effectiveness, identify areas of strength and weakness, and recommend strategies for improvement in technical and commercial aspects. Such an initiative was planned but not materialized, possibly affected by the frequent changing of NTDC's managing director, which led to delayed decision-making by NTDC management.

37. Given this background, the performance of NTDC is rated *satisfactory*. This rating recognizes its technical competence and the fact that all planned project outputs were commissioned at an overall cost significantly lower than the appraisal estimate. However, while

¹⁸ The quality of the works at all the other sites was also confirmed by outsourcing the site visits to an individual consultant.

¹⁹ ADB's commitment letter expired on 30 June 2012, which was the loan closing date. This was not acceptable to the contractor, as the contract completion date was later than this. Transferring the subproject to tranche 2 allowed ADB to extend the term of its commitment to satisfy the contractor without extending the closing date of the tranche 1 loan.

²⁰ ADB. 2014. *Project Procurement-related Review. Loan 2289-PAK (Tranche 1) and Loan 2396-PAK (Tranche 2): Power Transmission Enhancement Investment Program*. Manila.

²¹ The project completion review mission was informed that NTDC increased the capacity of the transformers at the Bandala grid station without ADB notified upon the distribution company's request to meet growing demand.

its level of compliance with ADB's procurement, environmental, and social protection requirements improved over the course of the project, deficiencies in the structure of the PMU and the lack of a dedicated project manager likely resulted in reduced implementation efficiency. Opportunities for capacity development and institutional improvement were not taken up. The performance of the borrower, the government, is also rated *satisfactory*, because it responded to important aspects, such as the change in scope utilizing the loan savings, in a timely manner, and it supervised the executing agency well.

K. Performance of the Asian Development Bank

38. ADB's performance is rated *satisfactory*. ADB fielded 11 review missions during the course of the loan. Initially, review missions merely noted implementation delays, but by 2010, the monitoring became more detailed; progress was reported at the contract and subproject levels, and agreed actions by both parties, ADB and the executing agency, were documented.

39. ADB's review and approval of procurement documentation was completed in a timely manner and did not impede or delay project implementation unnecessarily. Although there were delays due to the processing of commitment letters by ADB, the problem was addressed (para. 19). ADB also tried to encourage the use of consultants with Loan 2290, and assisted NTDC to prepare terms of reference to fill the identified capacity shortfall. The frequent change in NTDC's management, however, appears to be a challenge for ADB to secure a strong commitment from NTDC, including the commitment to recruit a PMC earlier.

III. EVALUATION OF PERFORMANCE

A. Relevance

40. The project is rated *relevant*. Increasing the capacity of the power system is essential for the government to meet its economic development targets. Currently in Pakistan, power is being rationed because of generation shortages, consumers in urban areas are being disconnected for approximately 4 hours per day, and consumers in rural areas are being disconnected for even longer each day. A shortage of electricity—to the extent that supply needs to be rationed—is disruptive to businesses, limits employment opportunities, and makes the provision of essential services such as education and health care more difficult. Many consumers find it necessary to install their own generation for periods when a grid supply is not available, and this increases the country's economic cost of electricity supply.

41. The installation of additional transformer capacity relieved local overloads that would otherwise have prevented consumers from receiving electricity supply from the grid. The 3,328 MVA of net additional 220/132 kV supply transformer capacity installed by the project²² was 9% of NTDC's total installed supply transformer capacity as of 30 June 2013, and contributed to almost 50% of newly installed capacity during the project period from 2007 to 2013.²³ As a result of the project, grid constraints have now been addressed to the point where forced load shedding to manage grid equipment overloads is now rarely needed.

42. Some transformers installed by the project, such as those in WAPDA Town, are already very heavily loaded 5–6 years after their commissioning, indicating that ongoing investment is

²² This is net of the capacity that was removed to be replaced by larger transformers.

²³ National Electric Power Regulatory Authority. 2014. *State of Industry Report 2013*. Islamabad; and National Electric Power Regulatory Authority. 2011. *State of Industry Report 2010*. Islamabad. Total installed capacity of 220/132 kV grid stations: 9,688 MVA in June 2006, and 15,762 MVA in June 2012.

still required to provide even more capacity to meet the expected growth in demand. In 2014–2015, the latest year for which data is available, grid stations where transformer capacity was added by the project were loaded to 88.7% of installed capacity on average during the peak summer demand. This is significantly higher than international norms and indicates that the transmission system is heavily loaded. Therefore, ADB's support should continue focusing on increasing the capacity of the transmission system.

B. Effectiveness in Achieving Outcome

43. PCR noted that the MFF's report and recommendation of the President did not contain a design and monitoring framework (DMF) for tranche 1. This assessment is therefore based on the DMF in the report and recommendation of the President, i.e., the MFF DMF (footnote 1).²⁴ The DMF listed the following outcomes: (i) full compliance with the grid code and transmission license by 2009, (ii) 10.5 gigawatt-hours (GWh) annually of additional power supplied through the grid by 2011, (iii) a reduction in electricity outages by 30% in 2011, and (iv) grid-connected customers increased to 70% of the population in 2011. The second outcome was achieved, though this resulted partially from the lack of a tranche DMF and from the weak alignment between some facility output indicators and tranche 1's project design.

44. For the first outcome, the project contributed to meeting the grid code's N-1 standard by reducing the existing transformers' load with additional capacity, though this does not necessarily mean full compliance with the code (footnote 6). For the second outcome, electricity delivered by NTDC was 74,565 GWh in 2006–2007, 87,835 GWh in 2010–2011, 84,424 GWh in 2012–2013, and 94,909 GWh in 2015–2016. This equates to an overall annual growth rate of 2.8%, equivalent to around 2,000 GWh per year over the 10-year period (from 2006 to 2016), which well surpasses the appraisal target of 10.5 GWh.

45. For the third outcome, the amount of supply shortfall did not change significantly since appraisal. This, however, was not necessarily attributed to any shortfall in transmission capacity, but rather to a lack of generation.²⁵ In 2007–2008 the generation shortfall was estimated to be 4,400 megawatts (MW) and by 2014–2015 this had increased to an estimated 5,200 MW. The National Electric Power Regulatory Authority expects that this deficit will start to decrease significantly from 2016–2017 and should be eliminated by summer 2019 if a planned 10,000 MW of new generation capacity, largely from the China–Pakistan Economic Corridor, is commissioned.²⁶ Accommodating this new generation capacity could be a challenge for NTDC, as it will increase the amount of generation connected to the network by 77%. The new HVDC line investigated by the consultants financed by ADB Loan 2290 is being implemented by Chinese investors as an independent power project (para. 12). The capacity of this HVDC line is understood to be 4,000 MW, which alone will not resolve the transmission grid capacity shortage.

46. The National Electric Power Regulatory Authority's *State of Industry Report 2015* identified a number of generation plants where the evacuation of power would be challenging.²⁷ In most cases, the problem was frequent interruptions arising from high transmission network

²⁴ ADB. Forthcoming. *Completion Report: Multitranchise Financing Facility Pakistan: Power Transmission Enhancement Investment Program – Tranche 2*. Manila. The report recognized that the DMF for tranche 2 was prepared with the relationship of cause and effect with the MFF, i.e., facility output equals tranche outcome.

²⁵ Interview with National Power Control Center during the project completion review mission, April 2017.

²⁶ Prime Minister's Office Government of Pakistan, the Board of Investment. *Pak-China Investment and Business Prospects (English)*. Islamabad.

²⁷ National Electric Power Regulatory Authority. 2016. *State of Industry Report 2015*. Islamabad.

loadings, which cause generation to be interrupted whenever an N-1 contingency arises (footnote 6). In some instances, the problem appeared to be an issue with the 132 kV network and was thus only indirectly related to NTDC's assets.

47. For the fourth outcome, in 2006–2007 there were 18.5 million electricity consumers of all categories in Pakistan, and by 2014–2015 this had increased to 23.7 million. Over the same period, the number of electrified villages is estimated to have increased from 71% to 81%, though this does not necessarily mean that the share of grid-connected customers over the entire population exceeded 70%, as targeted.

48. The project is rated *less than effective*, because the project outcome and outputs were partially achieved. As mentioned at the beginning, however, this is partly because the assessment is for the MFF DMF, not the tranche DMF, and partly due to the weak alignment between the design of the project and some of the outcomes in the MFF DMF (para. 43). The project was designed to relieve localized grid capacity constraints, largely occurring at grid offtake points, and has thus directly contributed to NTDC being now generally able to avoid forced load shedding to manage grid capacity issues. It is beyond NTDC's responsibility to manage generation shortages, which was indicated as a project outcome, and the increase in the number of connections was not a direct outcome of the successful project implementation.

C. Efficiency in Achieving Outcome and Outputs

49. The project achieved all its planned outputs by completing all the planned subprojects, except the SVC at New Kot Lakhpat grid station, which was transferred to tranche 2. In addition, loan savings were utilized to install an additional seven new transformers at six substations with a total capacity of 1,590 MVA, as well as a 250 km double-circuit transmission line. This was achieved at a significantly lower cost than forecast at appraisal, with final loan withdrawals being only 57% of the approved loan amount. The loan was extended for 30 months.

50. Based on data from NTDC, some of the installed transformers were fully loaded to capacity within 5 years from commissioning. The benefit of the project, therefore, arises primarily from the increased capacity of grid stations through new or replaced transformers (net capacity 3,328 MVA of 220/132 kV supply transformers), which has enabled NTDC to supply an increased amount of electricity to the downstream transmission and distribution network. Although the analysis was conservative (it excluded the benefits by 550/220 kV transformers), it results in an economic internal rate of return (EIRR) of 21.5%, which is well above the economic opportunity cost of capital of 9% in ADB's *Guidelines for the Economic Analysis of Projects*,²⁸ the EIRR of 12% in the appraisal analysis (Appendix 8), and the EIRR of 18% in ADB's *Guidelines for the Evaluation of Public Sector Operations*.²⁹ The project is therefore rated *highly efficient*.

D. Preliminary Assessment of Sustainability

51. The project is rated *likely sustainable*. All subprojects have now been commissioned and form integral components of Pakistan's transmission grid. It has made an important contribution to the development of Pakistan's economy, and the government and NTDC are likely to maintain this contribution.

²⁸ ADB. 2017. *Guidelines for the Economic Analysis of Projects*. Manila.

²⁹ ADB. 2016. *Guidelines for the Evaluation of Public Sector Operations*. Manila.

52. **Financial sustainability.** NTDC's income is based on a fee the electricity regulator sets based on the maximum demand that its grid system can supply, called a use-of-system-charge (UoSC). Therefore, the benefits arise from the increased delivery capacity (in MW) from the additional 220/132kV transformers installed under the project. This analysis results in an estimated financial internal rate of return of 9.6%, which is higher than the estimated weighted average cost of capital of 5.5%, but is not as high as the appraisal estimate of 26.8%. This is largely because of some changes to assumptions (Appendix 7).

53. NTDC was charged relending interest of 17% by the government for ADB loans. New sovereign-backed loans are re-lent by the government to NTDC at a 12% interest rate to adjust for changes in macroeconomic conditions since the project was appraised. With these improvements, as a corporate entity, NTDC is considered to be financially sustainable.³⁰

54. **Institutional sustainability.** The subproject sites visited by the project completion review mission were all in service and were well designed, constructed, and maintained. All grid stations visited had staff dedicated to equipment maintenance, and routine maintenance plans were in place. NTDC will repair or replace any equipment installed by the project that fails in service. During project site visits, instances where failed equipment had been replaced were witnessed. Maintenance would be further improved if experts were more readily available to advise station managers of the appropriate response when an equipment fault or failure requires a non-routine maintenance intervention.

E. Impact

55. The impact of the project is rated *satisfactory*. The project has added a total of 3,328 MVA of net 220/132kV supply transformer capacity at interfaces between NTDC's transmission and distribution company networks across the country. This transformer capacity is needed for power generation fed into NTDC's transmission network to be delivered in bulk to the distribution company networks for onward distribution to electricity consumers. The current rate of augmentation of the transmission system is only just sufficient to accommodate imminent growth in the demand for electricity. Forced interruptions can still occur in N-1 situations when there is an unplanned failure of a critical transmission asset (footnote 6). Without the project, however, there would have been insufficient supply transformer capacity to meet consumer demand. This would have led to extensive forced supply interruptions during periods of high electricity demand because the transmission system would not have been able to deliver sufficient electricity to consumers even when the generation was available.

56. **First indicator: gross domestic product growth.** At appraisal, the targeted rate of economic growth during 2006–2015 was 6%–7%. However, actual growth rates averaged 3.4% from 2006 to 2011, and 3.9% from 2011 to 2015, after the project was completed. This growth took place despite the continuing fragile security situation and the impact of the 2010 floods that affected much of the country.³¹ As a consequence of economic growth, more than 3 million jobs were created from 2011 to 2015 and unemployment was stable at a relatively low 5.9%. Female participation in the workforce increased from 18.9% at appraisal in 2006 to 22.0% in 2015.³² The gross domestic product (GDP) growth target was not met, though this was partly

³⁰ ADB. 2016. *Report and Recommendation of the President to the Board of Directors: Proposed Multitranchise Financing Facility to the Islamic Republic of Pakistan for the Second Power Transmission Enhancement Investment Program*. Manila.

³¹ Pakistan has continued to experience severe flooding in the years following the 2010 event.

³² ADB. 2016. *Key Indicators for Asia and the Pacific, 2016*. Manila.

due to misalignment of the project design and the impact target. The availability of electricity was only one factor influencing GDP growth.

57. **Second indicator: Village and rural electrification program.** In 2006, when the project was formulated, there were approximately 81,000 electrified villages throughout the country. By 2015, this had increased by 60% to more than 129,600. Over the same period, the number of grid connections increased by 28% from 18.6 million to 23.7 million. This target can be considered as having been met, because the increase in the number of electrified villages meant that the electrification program was essentially implemented, although not necessarily by NTDC.

58. **Safeguard impact.** There was limited environmental impact because 17 of the 20 subprojects involved the installation of assets in existing grid station premises, which did not raise any environmental issues. A parcel of 5.33 hectares of land next to the existing Bandala 132 kV grid station switchyard was purchased by NTDC at its current market value, to be upgraded to a 220 kV grid station by the project.³³ The acquisition did not include any houses or other permanent structures, and did not result in any displaced residents.

59. Land acquisition and resettlement plans were prepared for the construction of the following transmission lines: (i) into and out of Bandala grid station, (ii) Ghazi Barotha–Mardan, and (iii) D.G. Khan–Loralai. These three subprojects resulted in compensation being paid to 1,610 affected persons mainly for the loss of crops and trees during construction. No resettlement of affected people was required, and no houses or other structures were affected. There was one significant right-of-way issue on the Ghazi Barotha–Mardan line, which was eventually resolved through a negotiated settlement with the owner. No infrastructure was demolished, but the owner had to redesign the layout of his plots to keep the right-of-way clear. Resettlement plan monitoring reports for these three subprojects have been disclosed on the ADB website. No indigenous people were affected by the project.

60. Initially there were problems during the project with NTDC's level of compliance with ADB's environmental and social requirements.³⁴ These arose because NTDC staff was unfamiliar with ADB's requirements. After the ESIC was established within the PMU in late 2009, corrective actions were put in place; all safeguard issues have now been resolved to the satisfaction of all parties, including ADB. The ESIC staff has a good understanding of ADB's requirements and procedures, and problems that arose during implementation of the first two tranches of the MFF are now being avoided.

IV. OVERALL ASSESSMENT AND RECOMMENDATIONS

A. Overall Assessment

61. The project is rated *successful*. A quantitative assessment of overall project performance is shown in Appendix 9. The project's rating recognizes that all subprojects (except the SVC subproject transferred to tranche 2) have been completed and commissioned at a cost significantly lower than the appraisal estimate. The design and construction were appropriate and the assets installed under the project are now fully utilized and highly loaded. Without the

³³ The existing WAPDA Town 132 kV grid station was also upgraded to 220 kV under a separate subproject. In that case, the additional switchgear and transformers could be accommodated within the existing grid station boundary.

³⁴ A number of initial environment examinations and environmental management plans for subprojects were not updated even though the sites and/or alignments were changed. ADB's Pakistan Resident Mission safeguard staff provided support to NTDC staff on this matter.

project, the offtake capacity of the transmission system would be much reduced and the power rationing required at periods of peak demand would be much higher than is currently the case.

62. The project has not been rated higher primarily because some impact and project outcomes set out in the MFF DMF were not achieved even though the project, as designed at appraisal, was successfully delivered by NTDC, albeit with some delay. NTDC's delayed decision to utilize the consultancy support funding to improve its capacity to operate as a true commercial entity, which was possibly affected by frequent changes of managing director, is also an impediment to a higher rating.

B. Lessons

63. **Project management unit design can be improved.** The lack of ownership by the project's PMU may be partially attributed to the implementation delay. The current PMU is organized along functional lines, with each division assigned to different stages and no single division responsible for the whole project. In this situation, project management tends to be reactive rather than proactive, as no one division is responsible for coordinating the different project inputs to minimize the need for redoing work and avoid scheduling delays. This is particularly important in situations where activities such as planning, design, procurement, and construction are delegated to various departments and undertaken by persons not reporting directly to the PMU. Considering the high number of contracts in the project (which also required logistics monitoring and equipment delivery arrangements), the project implementation delays could have been reduced if a dedicated PMU was formed immediately when implementation commenced. In addition, this would have resolved safeguard issues earlier, as the ESIC was established within PMU (para. 60). This lesson is being reflected in the preparation of MFF II – tranche 2.

64. **Project schedule.** The schedule prepared during appraisal needs to be cognizant of (i) the experience of the executing agency in implementing projects in accordance with ADB's requirements, and (ii) the time needed to implement procurement processes in accordance with ADB's requirements. The project was designed such that all the contracts were to be completed in 2.5 years. This was notwithstanding the fact that this was ADB's first loan to NTDC as a separate entity, and that the PMU at that time was only in the process of being established. Detailed due diligence should be performed at appraisal to develop a realistic schedule, especially when the project involves an executing agency with no ADB project experience. Three out of four transmission line subprojects were delayed by around 2 years from their original completion dates, mainly due to right-of-way issues. ADB and the executing agency should plan safeguard training sessions at project inception and during implementation as needs arise.

65. **Technical due diligence.** Projects including highly technical or first-of-their-kind components (such as the SVC at the New Kot Lakhpat grid station) would necessitate in-depth technical due diligence, resulting in a longer than average project period. In the case of the project, it took 3 years from project approval for the procurement for the SVC to be advertised due to the additional studies needed to finalize the design.

66. **Design and monitoring framework indicators.** Feasible DMF indicators aligned with the project design should be selected to better capture project output, following ADB's new DMF guidelines.³⁵ The alignment between the project design and the impact and outcome

³⁵ ADB. 2016. *Guidelines for Preparing a Design and Monitoring Framework*. Manila.

performance targets in the project DMF was weak, which made it difficult to evaluate the project's achievements. The targeted project outcomes in the DMF could have been better formulated and were difficult to use to evaluate the project's success.

C. Recommendations

1. Project Related

67. **Future monitoring.** Assets installed by the project are all in service and generally heavily loaded. As ADB is continuing to finance development of the transmission grid, specific monitoring of the performance of assets installed by the project is not considered necessary. The ongoing assessment of NTDC's performance associated with the implementation of current loan projects and the appraisal of planned new loans should suffice. A project performance evaluation report is also not considered necessary for the same reason.

68. **Covenants.** Most covenants were related to project implementation and are no longer relevant. The exceptions are covenants related to the management and financial performance of NTDC; these continue to be regularly monitored and updated as necessary in respect of the succeeding MFF II projects. Hence, no further monitoring of project-specific covenants is needed.

2. General

69. The project was relevant in addressing the Pakistan power sector's main problem by removing transmission capacity constraints. Considering most project facilities reached their installed capacities 3–8 years after being commissioned, ADB's support should continue to assist the government's plan to address power supply deficit by removing the bottleneck of the transmission network's capacity.

70. **Project appraisal.** Future projects should pay attention to the design of the PMU, specifically its responsibilities, so that projects will be well managed. The project schedule should be designed considering the executing agency's experience and capacity, as well as the scope of the project. When innovative technology is adopted, more attention should be paid to the scheduling for technical due diligence. Considering longer-term development effect, installing higher-capacity facilities that meet future demand would be appropriate. The average loading rate of installed transformers had reached 88.7% by 2014–2015, just 5–6 years after their commissioning (para. 42). Some project transformers, such as those in the Ludewala and Bahawalpur grid stations, were already replaced with larger capacity transformers. To make the project even more efficient, ADB could provide capacity building to equip NTDC's system planners with more robust local load forecasting abilities. Selection of the method of procurement through either a multi-contract or turnkey contract approach should be carefully examined, considering the project's scope; the executing agency's capacity and experience; and total costs, including NTDC's transaction cost. To enable the project's achievements to be assessed appropriately, the monitoring indicators should follow ADB's new DMF guidelines, with strong alignment between the indicators and the project design.

71. **Project implementation.** Considering that the support loan was not fully utilized (e.g., to hire PMC), ADB should reach an agreement with the executing agency about when new ideas should be implemented.

DESIGN AND MONITORING FRAMEWORK

Design Summary	Performance Targets/ Indicators	Achievements
Impact Sustained economic and social development	<p>GDP grows by 6%–7% annually in 2007–2015</p> <p>Village and rural electrification program is implemented by 2012</p>	<p>Not achieved. GDP grew by 3.4% per annum during 2006–2011 and 3.9% per annum during 2011–2015.</p> <p>Not achieved. Village electrification increased from 71% to 81% during 2006–2015.</p>
Outcome Reliable and quality power supplied and service coverage extended	<p>Full compliance with grid code and transmission license by 2009</p> <p>10.5 GWh of additional power annually supplied through the grid by 2011</p> <p>Electricity outages reduced by 30% in 2011</p> <p>Grid-connected customers increased to 70% of the population in 2011</p>	<p>Cannot be assessed. NTDC is understood to be generally compliant. However, the loss of some heavily loaded supply transformers at times of peak demand might cause other transformers to exceed their emergency ratings for short periods.</p> <p>Achieved. Power supplied through the transmission grid increased from 74,565 GWh in 2006–2007 to 87,835 GWh in 2010–2011 to 98,248 GWh in 2015–2016.</p> <p>Cannot be assessed. Planned electricity shutdowns are currently 4 hours per day in urban areas and 6 hours per day in rural areas. No data is available on the extent of shutdowns required at appraisal, but it is thought to have been about 6 hours based on anecdotal evidence. Unlike the situation at appraisal, almost all planned shutdowns are now due to a shortage of generation rather than a lack of transmission system capacity.</p> <p>Cannot be assessed. The number of connected customers is contract-based, which does not necessarily coincide with the number of actual people. The number of electricity connections to the grid increased from 18.5 million in 2007 to 23.7 million in 2015.</p>

Design Summary	Performance Targets/ Indicators	Achievements
Outputs 220 and 500 kV transmission systems rehabilitated, augmented, and expanded; system bottlenecks removed NTDC becomes a true commercial entity.	 Subprojects commissioned according to schedules indicated in the investment and expansion plan Distribution company tariffs determined and ratified by 2006 NTDC restructuring completed and operational and financial autonomy achieved by 2007 NTDC implements adequate project management and information systems by 2007	 Achieved late. All subprojects, apart from the SVC at New Kot Lakhpat have been commissioned, albeit with delays. Two additional subprojects were added by utilizing loan savings. The project installed a total of 7,715 MVA of transformer capacity and 300 km of transmission lines. Achieved. The National Electric Power Regulatory Authority's process for reviewing and adjusting the tariffs of ex-WAPDA distribution companies is in place and is now relatively mature. Achieved late. NTDC is now operating as an autonomous commercial entity. NTDC was restructured by establishing Central Power Purchasing Agency - Guarantee as a separate entity in 2015. Partly achieved. Completion of the project suggests that the systems in place are fit for purpose, but it was difficult to get all the information required for this project completion report.
Activities with Milestones^a 1. Bidding for procurement of equipment for tranche 1 subprojects completed by February 2007 and for civil works by May 2007 2. Implementation of tranche 1 subprojects begun by March 2007 3. Recruitment of project implementation and preparation consultants completed by June 2007 4. Procurement of equipment under tranche 1 completed by September 2007		 Bids for the final equipment supply contract for the original project scope (excluding the two additional subprojects) were opened in November 2017. The final bid for the civil works contract was opened in February 2009. The first equipment supply contract was signed in June 2007. The consultant was recruited in October 2010. Procurement of equipment for tranche 1 (original scope) was completed by September 2008.

Design Summary	Performance Targets/ Indicators	Achievements
	5. Installation of equipment for tranche 1 subprojects completed by December 2007 ^b	The final subproject (Bandala) was commissioned in June 2014.

GDP = gross domestic product, GWh = gigawatt-hour, km = kilometer, kV = kilovolt, MVA = megavolt-ampere, NTDC = National Transmission and Despatch Company, SVC = static VAR compensator, WAPDA = Water and Power Development Authority.

^a Three activities in the original framework were removed because they are pertinent to tranche 2.

^b This appears to be an error. The schedule in Appendix 7 of the report and recommendation of the President specified a milestone date of December 2009 for the completion of equipment installation. It provided another 6 months for testing and commissioning, presumably using NTDC resources, as the original loan closing date was 31 December 2009.

Source: Asian Development Bank.

EQUIPMENT INSTALLED BY PROJECT

Subproject	Description ^a	Substation	Voltage (kV)	Transformer Capacity (MVA)	Line Length (km)	Completion
1	Transformer extension	Tarbela	500/220	237		Dec 2011
2	Transformer extension	Mangla	220/132	138		Jul 2011
3	Transformer extension	Lahore	500/220	600		Jul 2009
4	Double circuit transmission line	Mardan (incoming line)	220		30	Dec 2012
5	Transformer extension	Gatti	500/220	450		Jul 2009
6	Transformer extension	Multan	500/220	480		Jun 2010
7	Transformer extension	Bannu	220/132	160		Apr 2012
8	Transformer extension	Yousafwala	220/132	160		Sep 2009
9	Transformer extension	Bahawalpur	220/132	160		Dec 2009
10	Transformer extension	Ludewala	220/132	160		Aug 2009
11	Transformer extension	Hala Road (Hyderabad)	220/132	160		Oct 2009
12	Transformer augmentation	Islamabad University	220/132	2x250		May 2012
13	Transformer extension	Peshawar	500/220	450		Dec 2012
14	Transformer extension	Muzaffargarh	500/220	600		Feb 2009
15	New grid station and transmission line	Bandala (including incoming line)	220/132	3x160	10	Jun 2014
16	Static VAR compensator	New Kot Lakhpat (Lahore)	Transferred to tranche 2			
17	Transformer extension	Ghakhar	220/132	160		Jun 2008
18	Transformer augmentation	New Kot Lakhpat	220/132	3x250		Feb 2011
19	New grid station and transmission line	WAPDA Town (Lahore)	220/132	3x160	10	May 2011
20A	Transformer extension	Dadu	500/220	450		Jun 2012
20B	Transformer extension	Dadu	220/132	160		Jun 2012
20C	Transformer extension	Burham	220/132	160		Mar 2012
20D	Transformer extension	Shikarpur	220/132	160		Sep 2010
20E	Transformer augmentation	Mardan	220/132	250		Mar 2012
20F	Transformer extension	Sheikh Muhammadi	220/132	160		Apr 2012
20G	Transformer augmentation	Rewat	220/132	250		Apr 2011
21	Double circuit transmission line	D.G. Khan–Loralai	220		250	Apr 2014

km = kilometer, kV = kilovolt, MVA = megavolt-ampere, WAPDA = Water and Power Development Authority.

^a A transformer extension is the addition of a new transformer, while a transformer augmentation is the replacement of a transformer with one of higher capacity.

Source: Asian Development Bank.

PROJECT COSTS
(\$ million)

Item	Foreign Exchange	Local Currency	Total Cost
A. Installation			
1. Civil and electrical installation works	3.60	9.66	13.26
2. Turnkey subprojects	8.62	13.40	22.02
Subtotal (A)	12.22	23.06	35.28
B. Equipment Procurement			
1. 500 kV transformers	35.09	0.00	35.09
2. 220 kV transformers	31.69	0.00	31.69
3. Circuit breakers and isolators	9.15	0.00	9.15
4. Protection and metering transformers	11.59	5.67	17.26
5. Relay panels	0.14	2.49	2.63
6. Grid station hardware	1.73	1.14	2.87
7. Transmission line equipment	11.50	5.01	16.51
8. Telecommunication equipment	1.85	0.07	1.92
Subtotal (B)	102.73	14.38	117.11
C. Finance Costs			
1. Interest and commitment charges	6.83	0.00	6.83
Subtotal (C)	6.83	0.00	6.83
Total (A+B+C)	121.78	37.44	159.22

kV = kilovolt.

Note: Numbers may not sum precisely because of rounding.

Source: Asian Development Bank.

LOAN DISBURSEMENTS

Table A4.1: Loan Disbursements – Loan 2289

(\$)

	Q1	Q2	Q3	Q4	Total
2007				48,088,096	48,088,096
2008	8,226,873	5,246,165	2,000,086		15,473,123
2009	1,001,876	4,537,464	763,791	431,304	6,734,435
2010	1,180,076	16,036,869	10,752,638	1,306,208	29,275,791
2011	2,246,395	12,211,745	2,022,597	1,211,806	17,692,543
2012	1,203,550	948,589	1,729,165	769,491	4,650,795
Total	13,858,770	38,980,832	17,268,277	51,806,905	121,914,784

Q = quarter.

Note: Finance costs not included. Numbers may not sum precisely because of rounding

Source: Asian Development Bank.

Table A4.2: Loan Disbursements – Loan 2290

(\$)

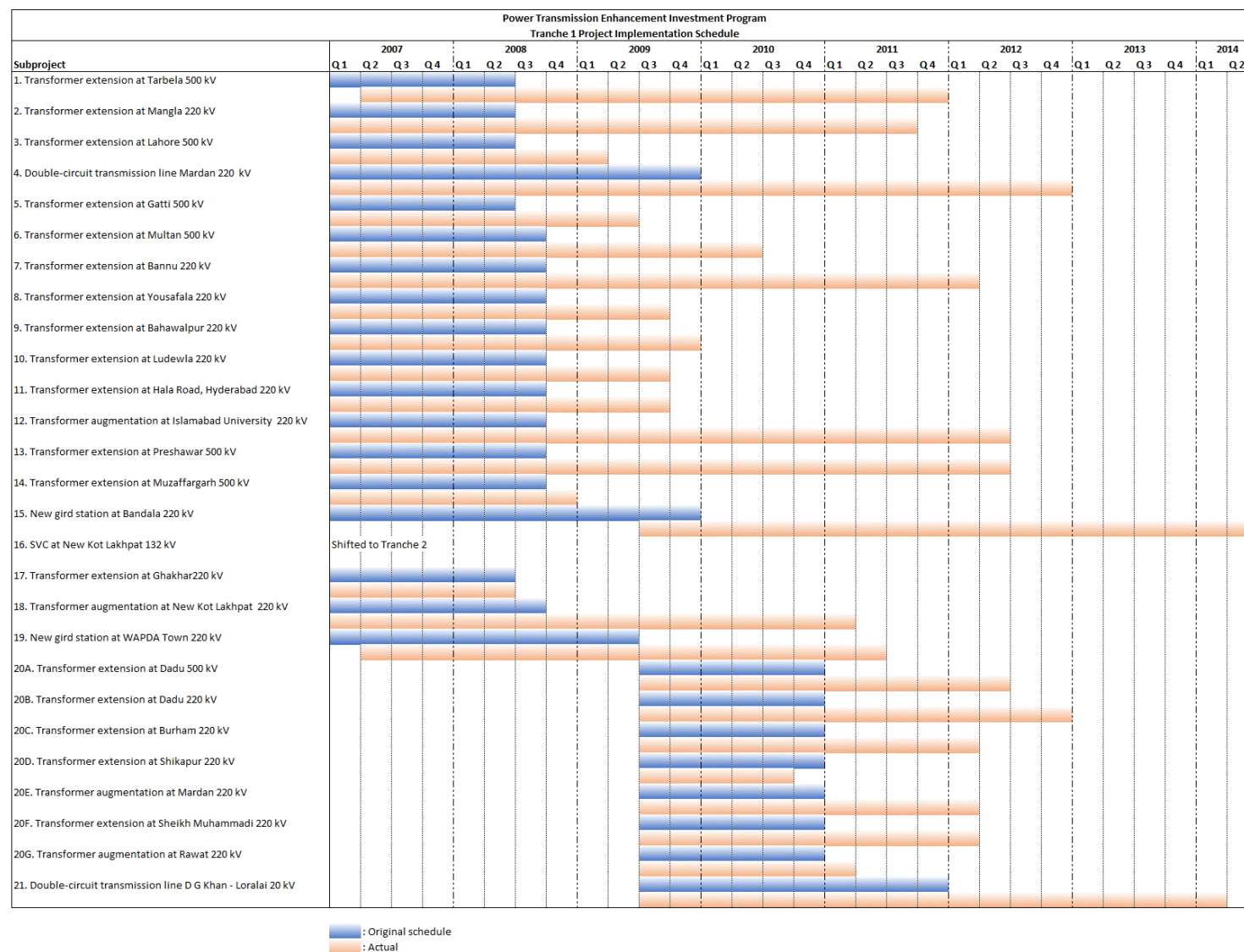
	Q1	Q2	Q3	Q4	Total
2010		21,238		243,213	264,451
2011	61,032	503,698	166,665	187,912	919,307
2012	190,496	534,676	287,128	475,260	1,487,560
2013	71,415	15,561	79,621	370,880	537,477
2014		224,636	56,900	109,860	391,396
2015	21,561	261,929	9,291		292,781
2016				67,561	67,561
2017	80,412	231,467			311,879
Total	424,916	1,793,205	599,605	1,454,686	4,272,412

Q = quarter.

Note: Finance costs not included.

Source: Asian Development Bank.

PROJECT IMPLEMENTATION SCHEDULE



kV = kilovolt, Q = quarter, WAPDA = Water and Power Development Authority.

Source: National Transmission and Despatch Company, 2012. *QUARTERLY PROGRESS REPORT No.20*, Lahore; and National Transmission and Despatch Company, 2013. *QUARTERLY PROGRESS REPORT No.24*, Lahore.

STATUS OF COMPLIANCE WITH LOAN COVENANTS

Covenant	Reference in Loan / Project Agreement	Status of Compliance
LOAN 2289		
The Borrower shall cause NTDC to carry out the Project with due diligence and efficiency and in conformity with sound administrative, financial, engineering, electrical transmission, and environmental practices.	LA Article IV Section 4.01(a); PA Article II Section 2.01(a)	Complied with.
In the carrying out of the Project and operation of the Project facilities, the Borrower shall perform, or cause to be performed, all obligations set forth in Schedule 5 to this Loan Agreement.	LA Article IV Section 4.01(b); PA Article II Section 2.01 (b)	Complied with.
The Borrower shall make available to NTDC, promptly as needed and on terms and conditions acceptable to ADB, the funds, facilities, services, land and other resources which are required, in addition to the proceeds of the Loan, for the carrying out of the Project.	LA Article IV Section 4.02; PA Article II Section 2.02	Complied with.
The Borrower shall ensure that the activities of its departments and agencies with respect to the carrying out of the Project and operation of the Project facilities are conducted and coordinated in accordance with sound administrative policies and procedures.	LA Article IV Section 4.03	Complied with.
The Borrower shall take all action which shall be necessary on its part to enable NTDC to perform its obligations under the Project Agreement, and shall not take or permit any action which would interfere with the performance of such obligations.	LA Article IV Section 4.04	Complied with.
The Borrower shall exercise its rights under the Onlending Agreement in such a manner as to protect the interests of the Borrower and ADB and to accomplish the purposes of the Loan.	LA Article IV Section 4.05(a)	Complied with.
No rights or obligations under the Onlending Agreement shall be assigned, amended, abrogated or waived without the prior concurrence of ADB.	LA Article IV Section 4.05(b)	Complied with.
<u>FFA</u> The Borrower shall ensure that the Project is carried out in accordance with the FFA, including all the Schedules (including Annexes) attached thereto, and specifically paragraphs 1, 2, 6, 7, 8, 9, 10, 11, 12, and 18 of Schedule 3 to the FFA.	LA Schedule 5 Para. 1 PA Schedule Para 1	Complied with.
LOAN 2290:		
In the carrying out of the Project, the Borrower shall perform, or cause to be performed, all obligations set forth in Schedule 5 to this Loan Agreement.	LA Article IV Section	Complied with.

	4.01	
The Borrower shall enable ADB's representatives to inspect the Project, all other plants, sites, properties and equipment of the Borrower, and any relevant records and documents.	LA Article IV Section 4.02	Complied with.
The Borrower shall take all action, which shall be necessary on its part to enable NTDC to perform its obligations under the Project Agreement, and shall not take or permit any action which would interfere with the performance of such obligations.	LA Article IV Section 4.03	Complied with.
Fielding of Consultants. Except as ADB may otherwise agree, and except as set forth in the paragraph below, the Borrower shall apply quality-and-cost- based selection for selecting and engaging consulting services.	LA Schedule 4 Para B.3	Complied with.
FFA The Borrower shall ensure that the Project is carried out in accordance with the FFA, including all the Schedules (including Annexes) attached thereto and specifically paragraphs 1, 2, 6, 7, 8, 9, 10, 11, and 12 of Schedule 3 to the FFA.	LA Schedule 5 Para. 1	Complied with.
In the carrying out of the Project, NTDC shall employ competent and qualified consultants and contractors, acceptable to ADB, to an extent and upon terms and conditions satisfactory to ADB.	PA Article II Section 2.03 (a)	Complied with.
Except as ADB may otherwise agree, all Goods, Works, and consulting services to be financed out of the proceeds of the Loans shall be procured in accordance with the provisions of Schedule 4 to the Loan Agreements. ADB may refuse to finance a contract where Goods, Works or consulting services have not been procured under procedures substantially in accordance with those agreed between the Borrower and ADB or where the terms and conditions of the contract are not satisfactory to ADB.	PA Article II Section 2.03 (b)	Complied with.
NTDC shall carry out the Project in accordance with plans, design standards, specifications, work schedules and construction methods acceptable to ADB. NTDC shall furnish, or cause to be furnished, to ADB, promptly after their preparation, such plans, design standards, specifications and work schedules, and any material modifications subsequently made therein, in such detail as ADB shall reasonably request.	PA Article II Section 2.04	Complied with.
NTDC shall take out and maintain with responsible insurers, or make other arrangements satisfactory to ADB for, insurance of the Project facilities to such extent and against such risks and in such amounts as shall be consistent with sound practice.	PA Article II Section 2.05 (a)	Complied with.
Without limiting the generality of the foregoing, NTDC undertakes to insure, or cause to be insured, the Goods to be imported for the Project and to be financed out of the proceeds of the Loans against hazards incident to the acquisition, transportation and delivery thereof to the place of use or installation, and	PA Article II Section 2.05 (b)	Complied with.

for such insurance any indemnity shall be payable in a currency freely usable to replace or repair such Goods.		
NTDC shall maintain, or cause to be maintained, records and accounts adequate to identify Goods, Works and consulting services and other items or expenditure financed out of the proceeds of the Loans, to disclose the use thereof in the Project, to record the progress of the Project (including the cost thereof) and to reflect, in accordance with consistently maintained sound accounting principles, its operations and financial condition.	PA Article II Section 2.06	Complied with.
ADB and NTDC shall cooperative fully to ensure that the purposes of the Loans will be accomplished.	PA Article II Section 2.07 (a)	Complied with.
NTDC shall promptly inform ADB of any condition which interferes with, or threatens to interfere with, the progress of the Project, the performance of its obligations under this Project Agreement or the Onlending Agreements, or the accomplishment of the purposes of the Loans.	PA Article II Section 2.07 (b)	Complied with.
ADB and NTDC shall from time to time, at the request of either party, exchange views through their representatives with regard to any matters relating to the Project, NTDC and the Loans.	PA Article II Section 2.07 (c)	Complied with.
NTDC shall furnish to ADB all such reports and information as ADB shall reasonably request concerning (i) the Loans and the expenditure of the proceeds thereof; (ii) the Goods, Works and consulting services and other items of expenditure financed out of such proceeds; (iii) the Project; (iv) the administration, operations and financial condition of NTDC; and (v) any other matters relating to the purposes of the Loans.	PA Article II Section 2.08 (a)	Complied with.
Without limiting the generality of the foregoing, NTDC shall furnish to ADB quarterly reports on the execution of the Project and on the operation and management of the Project facilities. Such reports shall be submitted in such form and in such detail and within such a period as ADB shall reasonably request, and shall indicate, among other things, progress made and problems encountered during the quarter under review, steps taken or proposed to be taken to remedy these problems, and proposed program of activities and expected progress during the following quarter.	PA Article II Section 2.08(b)	Complied with.
Promptly after physical completion of the Project, but in any event not later than three (3) months thereafter or such later date as ADB may agree for this purpose, NTDC shall prepare and furnish to ADB a report, in such form and in such detail as ADB shall reasonably request, on the execution and initial operation of the Project, including its cost, the performance by NTDC of its obligations under this Project Agreement, and the accomplishment of the purposes of the Loans.	PA Article II Section 2.08 (c)	Complied with.
NTDC shall (i) maintain separate accounts for the	PA	Partially complied with.

Project and for its overall operations; (ii) have such accounts and related financial statements (balance sheet, statement of income and expenses, and related statements) audited annually, in accordance with appropriate auditing standards consistently applied, by independent auditors whose qualifications, experience and terms of reference are acceptable to ADB; and (iii) furnish to ADB, promptly after their preparation but in any event not later than six months after the close of the fiscal year to which they relate, certified copies of such audited accounts and financial statements and the report of the auditors relating thereto (including the auditors' opinion on the use of the proceeds of the Loans, compliance with the covenants of the Loan Agreements and the management letter from the auditors to NTDC), all in the English language. NTDC shall furnish to ADB such further information concerning such accounts and financial statements and the audit thereof as ADB shall from time to time reasonably request.	Article II Section 2.09 (a)	Audited Project Financial Statement (APFS) submitted (i) FY2008 (Loan 2289; Loan 2290) (ii) FY2009 (Loan 2289; Loan 2290) (iii) FY2010 (Loan 2289; Loan 2290) (iv) FY2011 (Loan 2289; Loan 2290) (v) FY2012 (Loan 2289; Loan 2290) (vi) FY2013 (Loan 2289; Loan 2290) (vii) FY2014 (Loan 2290) (viii) FY2015 (Loan 2290) (ix) FY2016 (Loan 2290) Audited Financial Statements (AFS) submitted (i) FY2007 (ii) FY2008 (iii) FY2009 (iv) FY2010 (v) FY2011 (vi) FY2012 (vii) FY2013 (viii) FY2014
NTDC shall enable ADB, upon ADB's request, to discuss NTDC financial statements and its financial affairs from time to time with the auditors appointed by NTDC pursuant to Section 2.09(a) hereabove, and shall authorize and require any representative of such auditors to participate in any such discussions requested by ADB, provided that any such discussion shall be conducted only in the presence of an authorized officer of NTDC unless NTDC shall otherwise agree.	PA Article II Section 2.09 (b)	Not applicable. There is no record of ADB's request for such meetings.
NTDC shall enable ADB's representatives to inspect the Project, the Goods and /works financed out of the proceeds of the Loans, all other plants, sites, properties and equipment of the NTDC and any relevant records and documents.	PA Article II Section 2.10	Complied with.
NTDC shall, promptly as required, take all action within its powers to maintain its corporate existence, to carry on its operations and to acquire, maintain and renew all rights, properties, powers, privileges and franchises which are necessary in he carrying out of the Project or in the conduct of its business.	PA Article II Section 2.11 (a)	Complied with.
NTDC shall at all times conduct its business in accordance with sound administrative, financial, electrical transmission, and environmental practices, and under the supervision of competent and experienced management and personnel.	PA Article II Section 2.11 (b)	Complied with.
NTDC shall at all times operate and maintain its plants, equipment and other property, and from time to time, promptly as needed, make all necessary repairs and renewals thereof, all in accordance with sound administrative, financial, electrical transmission, engineering, environmental, and maintenance and operations practices.	PA Article II Section 2.11 (c)	Complied with.
Except as ADB may otherwise agree, NTDC shall not sell, lease or otherwise dispose of any of its assets	PA Article II	Complied with.

which shall be required for the efficient carrying on of its operations or the disposal of which may prejudice its ability to perform satisfactorily any of its obligations under this Project Agreement.	Section 2.12	
Except as ADB may otherwise agree, NTDC shall apply the proceeds of the Loans to the financing of expenditures on the Project in accordance with the provisions of the Loan Agreements and this Project Agreement, and shall ensure that all Goods, Works and consulting services financed out of such proceeds are used exclusively in the carrying out of the Project.	PA Article II Section 2.13	Complied with.
Except as ADB may otherwise agree, NTDC shall duly perform all its obligations under the Onlending Agreements, and shall not take, or concur in, any action which would have the effect of assigning, amending, abrogating or waiving any rights or obligations of the parties under the Onlending Agreements.	PA Article II Section 2.14	Complied with.
NTDC shall promptly notify ADB of any proposal to amend, suspend or repeal any provision of its charter or license and shall afford ADB an adequate opportunity to comment on such proposal prior to taking action thereof.	PA Article II Section 2.15	Not applicable. There was no proposal on the part of NTDC to amend, suspend, or repeal any provision of its charter or license.
OTHER		
Established, Staffed, and Operating PMU or PIU. A Project Management Unit (PMU) will be established. The PMU manager will have been identified by the time of Appraisal Mission. The PMU manager will report all subproject related matters to the general manager of the planning department.	FFA Schedule 3 Para 1	Complied with late. The PMU manager (a general manager (project)) had not been identified at the time of loan approval and the structure of the PMU is still not optimal.
Counterpart Funding Pakistan will cause NTDC to ensure the availability and timely release of counterpart funding for the timely implementation of Subprojects. For this purpose, Pakistan will cause NTDC to ensure that (i) the annual development program incorporates revised estimates of the funding requirements for the related Subprojects under the Facility, and (ii) the funds are released to the assigned accounts.	FFA Schedule 3 Para 2	Complied with.
NTDC will provide, as necessary, respective counterpart staff, land facilities, and counterpart funding for related Subproject in accordance with the financing plan, the cost of making land available for the Subproject and assistance, and implementation and monitoring under the EARF (including cost of mitigating unforeseen environmental impacts, beyond the estimates), utility relocation, general management expenses, in a timely manner through approved annual budget allocations	FFA Schedule 3 Para 3	Complied with.
Performance Monitoring and Reporting. NTDC shall ensure that within 3 months of the effective date of the loan agreement, a Project Performance Monitoring System shall have been established by NTDC in a form and with a composition acceptable to ADB in accordance with the Investment Program and Subproject performance indicators.	FFA Schedule 3 Para 4	Complied with. Progress reports have been prepared and submitted to ADB, including the completion report.

<p>NTDC will prepare the quarterly progress reports on Subprojects' implementation and submit the same to ADB. Such reports shall include report on progress made during the period of review, changes if any on implementation schedule, problems or difficulties encountered and remedial actions taken, and work to be undertaken in coming quarter. The reports shall be submitted to ADB within 30 days from close of each quarter, shall also include a summary financial account for each Subproject, consisting of expenditures to date, and reports on environmental monitoring, benefit monitoring undertaken pursuant to the preceding paragraph of this Schedule.</p>	<p>FFA Schedule 3 Para 5</p>	<p>Complied with. Progress reports have been submitted to ADB.</p>
<p>Review. ADB, Pakistan, and NTDC shall meet regularly as required to discuss the progress of the individual tranche and any changes to implementation arrangements or remedial measures required to be undertaken towards achieving the objectives of the Subprojects and Investment Program. A Mid-term review of each Subproject will be undertaken by ADB, Pakistan and NTDC. The mid-term review will include review of issues and any problems or weaknesses in implementation arrangements, and agree on any changes needed to achieve the objectives of the Investment Program. A similar mid-term review of the Investment Program by ADB, Pakistan, and NTDC will be undertaken in the third year from date of approval of the Facility by ADB. NTDC will ensure submission to ADB of a Subproject completion report within 3 months of physical completion of the related Subproject, and /facility completion report within 3 months of physical completion of the Investment Program. These reports shall cover a detailed evaluation of Subprojects and the Facility respectively, covering the design, costs, contractors' and consultants' performance, social, environmental, and economic impact economic rate of return, and other details for each Subproject and the /facility as may be requested by ADB.</p>	<p>FFA Schedule 3 Para 6 (a), (b), (c), and (d).</p>	<p>Complied with. Regular meetings with the government and NTDC were conducted through detailed review missions, and the project completion report was prepared and submitted to ADB.</p>
<p>Policy Dialogue. The Government will ensure that ADB is kept informed about the Government's policies and programs related to the power sector that will materially affect the financial viability of each subproject under the Investment Program, and in particular the power generation policies and program, as well as the power transmission policies and program.</p>	<p>FFA Schedule 3 Para 7</p>	<p>Complied with.</p>
<p>Tariff. NTDC will submit a petition for tariff revision as required to maintain its financial viability. Following tariff determination by NEPRA, the Government will undertake to notify such tariff determination in a prompt manner. The Government will ensure that the tariff formulated for NTDC is adequate to cover its operating costs, maintenance, depreciation, and financing cost and to allow an acceptable return on the equity of NTDC.</p>	<p>FFA Schedule 3 Para 8 PA Schedule Para</p>	<p>Complied with. The process through which NTDC regularly submits tariff petitions for review and approval by NEPRA functions well now.</p>
<p>Governance.</p>	<p>FFA</p>	<p>Complied with.</p>

<p>Pakistan acknowledges that ADB, consistent with its commitment to good governance, accountability and transparency, reserves the right to investigate directly, or through its agents, any possible corrupt, fraudulent, collusive or coercive practices relating to the subprojects. To support these efforts, Pakistan shall ensure that:</p> <p>(a) NTDC in its bidding documents for each Subproject, includes a provision specifying the right of ADB to audit and examine the records and accounts of, and all contractors, suppliers, consultants and other service providers as they relate to each Subproject;</p> <p>(b) NTDC cooperates with any such investigations and extends all necessary assistance, including access to all relevant contracts, accounting and bookkeeping records, as well as engagement of independent experts that may be needed for satisfactory completion of such investigations; and</p> <p>(c) All external costs related to such investigations as described in this Schedule are borne by the applicable subproject.</p>	<p>Schedule 3 Para 9</p>	
<p>Establishment of CPPA.</p> <p>The Government, through MOWP, and NTDC will ensure that the CPPA is established as an entity that is independent from NTDC and that all of the trade debt incurred by NTDC for its single buyer role is transferred to CPPA or otherwise separated from NTDC. The Government, through MOWP, will cause CPPA to define its corporate identity, devise a business plan and a strategic development road map to have a single corporate body accountable for the single buyer business. NTDC will ensure it submits to NEPRA an application to revise its license to reflect the establishment of CPPA as a separate entity from NTDC.</p>	<p>FFA Schedule 3 Para 10</p>	<p>Complied with. Commercial operation of an independent CPPA commenced in mid-2015 when the transfer of functions from NTDC was formalized and completed.</p>
<p>Financial Performance.</p> <p>The Government of Pakistan will ensure that NTDC maintains a debt service coverage ratio (DSCR) of at least 1.2 from 2010 onward and a self-financing ratio (SFR) of at least 20% from 2008 onward.</p>	<p>FFA Schedule 3 Para 11; PA Schedule Para 2(a)</p>	<p>Complied with. NTDC's 2014 accounts disclosed a self-financing ratio of 27.9% and its debt service coverage ratio was 4.5.</p>
<p>Financial Autonomy.</p> <p>The Government of Pakistan will ensure that NTDC bills the paying authority, directly and in a timely manner, for the transmission services rendered to its customers. The Government of Pakistan will ensure that the paying authority provides prompt payment to NTDC, and in case of any shortfall from the paying authority, the Government of Pakistan will finance such shortfall in a timely manner.</p>	<p>FFA Schedule 3 Para 12</p>	<p>Partially complied with. NTDC is operating as a financially autonomous entity and is billing its customers in a timely manner. However, receivables from related government-owned entities increased from PRs44 billion in 2013 to PRs73 billion in 2014 and receivables from the government remained unchanged at PRs31 billion over the same period.</p>
<p>Financial Governance.</p> <p>The NTDC will ensure that its internal controls will be in accordance with the National Accounting Standards, and an independent and autonomous internal audit department will be set up within NTDC.</p>	<p>FFA Schedule 3 Para 13</p>	<p>Complied with.</p>
<p>Gender.</p> <p>NTDC will follow the principles of the ADB's policy on gender and development during each subproject implementation, including taking all necessary actions</p>	<p>FFA Schedule 3 Para 14</p>	<p>Complied with.</p>

to encourage women living in the subproject area to participate in planning and implementing subproject activities. NTDC will monitor the subproject effects on women during each subproject implementation, through, where relevant, gender-disaggregated data collected pursuant to the monitoring and evaluation system referred to in the subproject performance monitoring system.		
Sexually Transmitted Diseases. With the assistance of the relevant local authorities, NTDC will cause contractors to distribute information on the risks of sexually transmitted diseases to those employed during each subproject construction.	FFA Schedule 3 Para 15	Complied with. NTDC distributed relevant information to all local and foreign workers, contractors, and consultants employed during each subproject construction activity.
Women and Child Labor. NTDC will ensure that (i) there is no differential payment between men and women for work of equal value, and (ii) civil works contractors do not employ child labor in the construction and maintenance activities in accordance with the relevant laws and regulations of the Government.	FFA Schedule 3 Para 16	Complied with.
Execution of Civil Works. NTDC will ensure that, subsequent to award of civil works contract under any subproject, no section or part thereof under the civil works contract will be handed over to the contractor unless the applicable provisions of the LARF and Resettlement Plans, including, in particular, the timely delivery of compensation to affected families, Indigenous Peoples Development Framework and Indigenous Peoples Development Plans, and the EARF/EMPs have been complied with. Any changes to the location, land alignment of facilitating roads, or environment impacts on account of detailed designs of related subprojects will be subject to prior approval by ADB or related agency in accordance with the subproject selection criteria and procedures included in the FFA.	FFA Schedule 3 Para 17	Complied with late. Three subprojects required environmental and social protection monitoring. The level of compliance with ADB's requirements was poor during the early stages of the project, but corrective actions were taken and all relevant requirements were eventually met.
Auditing and Accounting. NTDC to ensure that proper accounts and records are maintained in a timely manner to adequately identify the use of tranche proceeds in such a manner and details as may be specified in each Loan Agreement and Project Agreement. Audited financial reports of NTDC will be submitted to ADB within 6 months after fiscal year end.	FFA Schedule 3 Para 18 PA Article II Section 2.09	Not complied with. NTDC only recently submitted its audited financial report for 2013–2014, and reports for subsequent years are yet to be submitted.
Subproject Selection Criteria. The Government and NTDC shall ensure that all subprojects are selected in accordance with the agreed criteria set out in the FFA, which adhere to the relevant requirements of the power transmission investment plan and other applicable guidelines for subproject implementation.	FFA Schedule 4 Items (i) – (x)	Complied with.
Land Acquisition and Resettlement. NTDC will ensure that: (i) all land and rights-of-way required by the subprojects are made available in a timely manner; (ii) the provisions of the resettlement plans are	PA Schedule Para 4	Complied with. Only one subproject (Bandala grid station) required land acquisition, and no resettlement was required for any subproject. The amount paid included the full market price,

<p>implemented promptly and efficiently according to its terms, all applicable laws and regulations of Pakistan, ADB's Policy on Involuntary Resettlement (1995), and the land acquisition and resettlement framework (LARF);</p> <p>(iii) the resettlement plans are updated based on the detailed design, prepared in full consultation with the affected persons and disclosed to them prior to submitting the resettlement plans to ADB;</p> <p>(iv) the commencement of civil work or a similar milestone will be subject to ADB's review and approval of the relevant resettlement plans;</p> <p>(v) the contractors' activities are in compliance with requirements of the resettlement plans, the LARF, applicable domestic laws, and ADB's Policy on Involuntary Resettlement;</p> <p>(vi) an independent monitor acceptable to ADB is engaged to carry out monitoring and evaluation and report to ADB in accordance with the requirements of the resettlement plans.</p>		<p>compound interest, and acquisition charges. Where required, social safeguards were implemented in accordance with the land acquisition and resettlement framework, the approved land acquisition and resettlement plans, Pakistan's national laws, and ADB's safeguard policies.</p>
<p>Indigenous Peoples.</p> <p>NTDC will ensure that all subprojects affecting ethnic minorities are constructed and operated in accordance with the requirements of ADB's Policy on Indigenous Peoples (1998) as specified in the Indigenous Peoples Development Plans (or resettlement plans). NTDC shall ensure that the Ethnic Minorities Development Plans (or resettlement plans) are monitored and evaluated by an independent agency.</p>	<p>FFA Schedule 4 Subproject Selection Criteria Item (vii)</p>	<p>Not applicable. No indigenous peoples were affected by the project.</p>
<p>Environment.</p> <p>NTDC will ensure that:</p> <p>(i) the subprojects are constructed and operated in accordance with national and local environmental procedures and guidelines and with ADB's Environment Policy (2002);</p> <p>(ii) the subprojects are designed, constructed, and operated in accordance with the environment management plans (EMPs) as reflected in the initial environment examinations and the Environment Assessment Review Framework;</p> <p>(iii) the EMPs will be incorporated in bidding documents and civil work contracts and implemented; and</p> <p>(iv) environmental performance reports will be submitted to ADB twice annually during the construction period, including progress made on the mitigation measures, monitoring data, problems encountered, enforcements, plan, and any violation.</p>	<p>PA Schedule Para 5</p>	<p>Complied with late. Three subprojects required environmental and social protection monitoring. The level of compliance with ADB's requirements was poor during the early stages of the project, but corrective actions were taken and all relevant requirements were eventually met.</p>

ADB = Asian Development Bank, FFA = framework financing agreement, LA = loan agreement, PA = project agreement.

FINANCIAL ANALYSIS

A. Introduction

1. The report and recommendation of the President examined the overall financial performance of the National Transmission and Despatch Company (NTDC), and the project's financial viability was only discussed in a supplementary appendix.¹ The analysis at project appraisal showed that the financial internal rate of return (FIRR) was estimated at 26.8% against the weighted average cost of capital (WACC) of 8.1%. This financial analysis reexamines the original financial analysis in the report and recommendation of the President using data obtained from the project completion review process.

B. Background and Assumptions

2. NTDC delivers electricity in bulk, through 220/132-kilovolt (kV) supply transformers, to the distribution companies for onward distribution to consumers. The amount of electricity that NTDC can deliver is constrained by the capacity of these supply transformers. Augmentation of the transmission system upstream of these transformers, such as the installation of transmission lines and 500/220 kV transformers at 500 kV substations, is also needed to give the system sufficient capacity to deliver power to these supply transformers. These upstream transmission lines and power transformers have relatively high capacity increments, so these upstream system investments tend to be in bulk, whereas the 220/132 kV supply transformers at the distribution system interface are smaller and can be installed incrementally to match demand. This analysis therefore assumes that the revenue that the project can generate is determined by the total capacity of the 220/132 kV transformers installed by the project, but also includes the cost of the upstream investments included in the project since such investments are also required if the full capacity of the supply transformers is to be utilized.

3. The transmission system in Pakistan is heavily loaded and at the time of the project completion review mission, most supply transformers installed by the project were already loaded during periods of peak summer electricity demand to 80%–100% of their rated capacity, even though they had been in service for an average of only about 6 years each. A few transformers were loaded to more than 100% of their rated capacity. As the system is further developed, these supply transformer loadings will fluctuate, since adding in a new transformer will allow the loadings on other transformers to be reduced, irrespective of whether these other transformers are situated in the same or neighboring substations. The National Electric Power Regulatory Authority (NEPRA) classifies a transformer as overloaded if its loading during periods of peak demand exceeds 80% of its rated capacity under normal system operation conditions. This analysis therefore assumes that over the longer term, the rate of transmission system development will be calibrated to ensure that transformer loadings exceed 80% of rating only when other transmission elements are out of service due to an unplanned fault.

4. It is also assumed that a supply transformer installed by the project is loaded at times of peak demand to 50% of its rated capacity in the year after commissioning, and that this increases linearly to 80% after it has been in service for 5 years during summer peak demand. After this 5-year period, it is assumed that all transformers continue to be loaded at 80% capacity. However, this peak demand occurs only in the middle of summer, and during the

¹ Asian Development Bank (ADB). 2006. *Report and Recommendation of the President to the Board of Directors: Proposed Multitranchise Financing Facility to the Islamic Republic of Pakistan for the Power Transmission Enhancement Investment Program*. Manila.

winter, peak transformer loading decreases to around 66% of peak summer demand, based on information published by NEPRA.² The analysis assumes that the transition between peak summer and peak winter demand is linear, which indicates that upon commissioning, a transformer will be loaded, to an average of 42% of its nameplate rating, increasing to 66% after 5 years of operation.

5. **Benefits.** NTDC earns revenue from use of system payments by the distribution companies, with the payments determined by a use of system charge (UoSC) set by NEPRA. This is based on the peak half-hourly demand in each calendar month, measured in kilowatts (kW)/month. This same tariff applies across the distribution network, irrespective of location.

6. The additional 220/132 kV supply transformer capacity installed by the project is 3,328 megavolt-amperes (MVA).³ The project capital cost is the total cost of the project (Appendix 3). This is increased by 15% to provide for the NTDC project inputs that have not been accounted for, including project design and management costs, as well as land acquisition, environment, and resettlement costs. An exchange rate of PRs82.34 per \$1 has been assumed, which is the weighted average exchange rate calculated from an analysis of the loan disbursement data.

7. In calculating the revenue to NTDC from the project, a UoSC of Rs85.91/kW/month has been used as the basis. This is the NEPRA-determined UoSC that was applied in 2011 and 2012 when most subprojects were completed.⁴ Since 2011, the annual compounded average increase of the UoSC in real terms has been 4.2%.⁵ Based on this historical data, this analysis assumes that the UoSC increases by 4% in real terms each year to avoid overestimation of benefits for future years (para. 11). Other key assumptions required for the revenue estimate are a power factor of 0.85 and a load factor of 67%, which is taken from NEPRA's published power industry statistics. Operation and maintenance costs are assumed to be 1.5% per annum, and the project life is assumed to be 30 years.

8. **Costs.** The table comprising Appendix 3 shows the breakdown of the project cost. While it can be inferred from this table that approximately 10% of the costs were for civil works, the table does not include (i) NTDC costs, and (ii) sufficient information with which to make an informed estimate of the cost of NTDC's own inputs or the magnitude of the cost components to which shadow pricing should be applied. Therefore, for this analysis, the capital cost in Appendix 3 has been increased by 15% to allow for NTDC's contribution.

9. **Weighted average cost of capital.** The WACC of the project is estimated at 5.5% using

² National Electric Power Regulatory Authority. 2016. *State of Industry Report 2015*. Islamabad;

³ Many subprojects were supply transformer augmentations where a new 250 MVA transformer replaced an existing 160 MVA unit. In these cases the additional capacity installed was only 90 MVA per transformer.

⁴ UoSCs in 2009 and 2010 were higher at PRs100.15/kW/month, which was determined in 2006. Therefore, the 2012 rate of PRs85.91/kW/month is assumed to be a conservative estimate for 2009–2011. The UoSC was reduced in 2011, the first year of petition by NTDC since 2006. Since there was strong demand growth during 2006–2011, the overall revenue base of NTDC was substantially increased, which in turn reduced the per kW revenue requirement. This is unlikely in the future, as the current problem is the insufficient capacity of the network to meet demand. The needed capacity expansion will require substantial investments and additional revenue requirements beyond growth in supplied demand.

⁵ The determined UoSC was PRs85.91/kW/month in 2012, PRs126.75/kW/month in 2015, and PRs136.07/kW/month in 2017. This accounts for a 58.4% increase from 2012 to 2017. Over the same period, the compounded impact of inflation (with an estimated inflation of 6% for 2017) was 30.2%, the compounded annual average increase in tariff was 9.6%, and the compounded annual average inflation was 5.4%. This results in a compounded annual increase in tariff (in real terms) of 4.2%.

May 2017 values (Table A7.1). While the Asian Development Bank loan is based on a floating interest rate, the relending interest rate from the government to NTDC has been fixed at 17% since the beginning of the project. The cost of equity of NTDC has been estimated by NEPRA to be 15% in the latest UoSC determination for NTDC.⁶ The inflation rate is forecast to be 6%.⁷

Table A7.1: Weighted Average Cost of Capital of the Project
(%)

Description	Financing Component		Total
	ADB Loan	NTDC Equity	
A Weighting	80.8	19.2	100.0
B Nominal cost	17.0	15.0	
C Tax rate	35.0	0.0	
D Tax-adjusted nominal cost (B x [1 - C])	11.1	15.0	
E Inflation rate	6.0	6.0	
F Real cost $([1 + D] / [1 + E] - 1)$	4.8	8.5	
G Weighted cost (F x A)	3.8	1.6	5.5
WACC (real)			5.5

ADB = Asian Development Bank, NTDC = National Transmission and Despatch Company, WACC = weighted average cost of capital.

Source: Asian Development Bank estimates.

C. Financial Internal Rate of Return and Sensitivities

10. A summary of the financial analysis of the project is shown in Table A7.2 and a sensitivity analysis is shown in Table A7.3. For the base case, the estimated FIRR for the project is 9.6%, above the WACC of 5.5%. The net present value is estimated to be PRs12,605 million.

11. The sensitivity analysis was conducted using (i) a 10% reduction in revenue, which could arise if NTDC is unable to collect all revenue or if tariff increases are lower than assumed; (ii) a 10% increase in operation and maintenance costs; and (iii) no real UoSC increase (Table A7.3). All cases show sustained financial viability. As indicated in para. 7, the historical compounded annual average increase of UoSC in real terms was 4.2% from 2012 to 2017—a fairly long period of evidence. Further, NTDC has filed new UoSC petitions on a more regular basis since 2012, which increases confidence in NTDC's initiatives to keep its UoSC up to date. Finally, if there was no real UoSC increase, the project would have an FIRR of 5.9% and would still show financial viability.

D. Conclusion

12. While this analysis still shows financial viability, with an FIRR above the WACC, the financial analysis at appraisal showed a much higher FIRR of 26.8%. While detailed calculations of the appraisal analysis could not be located in preparing this report, the written descriptions show at least three reasons why estimates were much higher.

⁶ National Electric Power Regulatory Authority. 2017. *Determination of the Authority in the matter of Petition filed by National Transmission & Despatch company Ltd. (NTDC) for Determination of Transfer/Wheeling Charges for the FY 2015-16 and FY 2016-17 -Case No. NEPRA/TRF-365/NTDC-2016*. Islamabad.

⁷ ADB's standard inflation rate for Pakistan as of May 2017.

13. First, the appraisal analysis assumed a 3-year implementation period for new grid stations and transmission lines, and 2 years for transformers. As discussed in this report (para 64), this schedule was not feasible and the implementation took longer. The majority of subprojects were completed in 2011 or 2012, 5–6 years after loan approval. This means that benefits started accruing much later in the financial analysis, and this has had a negative impact on the estimated FIRR. Second, the analysis at appraisal included the SVC at New Kot Lakhpat rid station, which took up a large portion of the investment cost and showed a very strong FIRR of 35.7%. This component is not included in this analysis, as this subproject was shifted to tranche 2. Third, the appraisal FIRR included a provision for the financial benefits of loss reduction. However, this is not included in this analysis, as the subprojects were in multiple locations of the NTDC's transmission system, and detailed data to verify loss reduction could not be made available with the resources available for this report. Further, while a reduction in losses has clear economic benefits, the financial benefits from loss reduction are contingent on the transmission loss level of the NTDC system (para. 14). The analysis in this report is realistic and conservative, but it still shows an FIRR above the re-estimated WACC.

14. There are also unquantified benefits that can further strengthen the result of this analysis. For example, while the transmission system remains very heavily loaded, the project will assist NTDC to reduce the risk of asset failure due to thermal overload. Asset failures have financial implications for NTDC, including the cost of repair or replacement, and potential loss of revenue while the asset is out of service. Further, loss reductions are not accounted for by this analysis, although this may also have a positive financial impact. NTDC currently does not charge generation or distribution companies by volume in kilowatt-hours but only for the capacity it serves in terms of kW. However, any transmission losses beyond the regulator-allowed levels are charged as a penalty to NTDC. Therefore, if losses become higher with deteriorating assets, the project assets can prevent such financial losses by reducing losses with new transmission lines and assets. In addition to the financial viability of the project shown in this analysis, the combination of these unquantified benefits, the assessment of NTDC's corporate financial sustainability,⁸ and the strong economic viability shown by the economic analysis (Appendix 8) enables a project rating of *likely sustainable*.

⁸ ADB. 2016. *Financial Management Analysis in the Report and Recommendation of the President to the Board of Directors: Proposed Multitranchise Financing Facility to the Islamic Republic of Pakistan for the Second Power Transmission Enhancement Investment Program*. Manila.

Table A7.2: Project Financial Analysis
(PRs million)

Year	Capital Cost	Operation and Maintenance Cost	Tax	Revenue	Net Benefit
2007	6,388	0	0	0	(6,388)
2008	2,055	0	0	0	(2,055)
2009	895	140	9	56	(988)
2010	3,889	198	29	182	(3,934)
2011	2,350	234	59	371	(2,272)
2012	618	243	131	821	(171)
2013	0	243	219	1,367	906
2014	0	243	255	1,593	1,095
2015	0	243	324	2,025	1,458
2016	0	243	364	2,273	1,667
2017	0	243	395	2,468	1,831
2018	0	243	416	2,603	1,943
2019	0	243	439	2,744	2,062
2020	0	243	457	2,854	2,154
2021	0	243	475	2,968	2,250
2022	0	243	494	3,087	2,350
2023	0	243	514	3,210	2,454
2024	0	243	534	3,339	2,561
2025	0	243	556	3,472	2,674
2026	0	243	578	3,611	2,790
2027	0	243	601	3,755	2,912
2028	0	243	625	3,906	3,038
2029	0	243	650	4,062	3,169
2030	0	243	676	4,224	3,305
2031	0	243	703	4,393	3,447
2032	0	243	731	4,569	3,595
2033	0	243	760	4,752	3,749
2034	0	243	791	4,942	3,908
2035	0	243	822	5,139	4,074
2036	0	243	855	5,345	4,247
2037	0	243	889	5,559	4,427
2038	0	243	925	5,781	4,613
2039	0	243	962	6,012	4,808
2040	0	243	1,000	6,253	5,010
2041	0	243	1,040	6,503	5,220
FIRR					9.6%
NPV @ WACC					12,605

() = negative, FIRR = financial internal rate of return, NPV = net present value, WACC = weighted average cost of capital.

Note: Numbers may not sum precisely because of rounding

Source: Asian Development Bank estimates.

Table A7.3: Sensitivity Analysis

Scenario		FIRR (%)	NPV (PRs million)
1.	Base case	9.6	12,605
2.	Revenue reduced by 10%	8.7	9,622
3.	Operation and maintenance cost increased by 10%	9.5	12,288
4.	No real UoSC increase	5.9	935

FIRR = financial internal rate of return, NPV = net present value, UoSC = use of system charge.

Source: Asian Development Bank estimates.

ECONOMIC ANALYSIS

A. Introduction

1. In assessing the efficiency of Asian Development Bank (ADB) financing and the project, the economic viability of the project was reexamined. This analysis follows the principles of ADB's *Guidelines for the Economic Analysis of Projects*,¹ and shares the technical and financial assumptions of the financial analysis (Appendix 7). At appraisal, the economic internal rate of return (EIRR) for the project was estimated to be 36.8% against the economic opportunity cost of capital of 12%.

B. Assumptions

2. **Costs.** The analysis is conducted as a comparison of with- and without-project scenarios. The financial costs discussed in the financial analysis (Appendix 7) have been converted to economic values by applying a standard conversion factor of 0.9 to non-traded components and further adjusted by a multiplier of 0.85 to non-skilled labor.² Operation and maintenance is assumed to be 1.5% of the capital cost. As this economic analysis is conducted on the system level (i.e., values are accrued at consumption), the associated electricity generation and distribution costs have also been accounted for in calculating the benefits. For analysis purposes, actual costs and benefits have been adjusted to constant prices, with 2016 as the base year.

3. **Benefits.** The same assumptions of economic cost conversion have been applied to the benefits. As was done for the financial analysis, for the economic analysis the project has been simplified for analysis purposes to include the installation of a supply transformer rated at 3,328 megavolt-amperes. It is assumed that this transformer is loaded at its commissioning at 50% of its rated capacity, and that this increases linearly to 80% capacity after it has been in service for 5 years. A power factor of 0.85 and a load factor of 67% are assumed. The energy supplied to distribution companies in 2009, the year after commissioning of the first transformer, was assumed to be 399 gigawatt-hours (GWh), but only 325 GWh was sold to consumers after allowing for distribution losses. All 220/132-kilovolt (kV) supply transformers are assumed to be fully loaded in 2019, when it is assumed that an additional 10,825 GWh is supplied to consumers as a result of the project.

4. Since there have been significant supply constraints in the system, and since almost half of the electricity consumption in Pakistan is by residential customers, most of the increased supply is assumed to be incremental and valued at willingness to pay. According to the National Electric Power Regulatory Authority's 2012 State of Industry report, its determined average electricity price, inclusive of tariff differential subsidies, was PRs11.89/kilowatt-hour for 2011–2012. This National Electric Power Regulatory Authority-determined price of electricity is used for this analysis as a proxy to willingness to pay, as it reflects the unsubsidized cost of supply. The benefits accrued to the project comprise the willingness to pay, net of generation and distribution costs, and adjusted by the standard conversion factor.

¹ ADB. 2017. *Guidelines for the Economic Analysis of Projects*. Manila.

² ADB. 2016. *Report and Recommendation of the President to the Board of Directors: Proposed Multitranchise Financing Facility to the Islamic Republic of Pakistan for the Second Power Transmission Investment Enhancement Program*. Manila.

5. A small portion of the increased supply is assumed to be non-incremental and measured using resource saving value, as customers such as industrial electricity users often use diesel generators to compensate for the lack of supply from the electricity grid. The difference between the cost of the fuel required for diesel generation and the electricity tariff paid by customers is used as a proxy to this resource-saving value. This is estimated to be PRs12.58/kilowatt-hour.

C. Economic Internal Rate of Return and Sensitivity Analysis

6. An analysis based on the cost and benefit assumptions in paras. 2 to 5 results in an EIRR of 21.5%, well above the economic opportunity cost of capital of 9% and that of the appraisal analysis of 12% (Table A8.1) (footnote 1).

7. A sensitivity analysis also shows strong economic viability in the cases where benefits are reduced either as a whole or only on non-incremental benefits for which the unit value is higher. In both cases, economic viability remains robust. Some reductions in benefits or costs would not significantly impact the economic viability of the project. The EIRR is also comparable to the appraisal estimate. However, with the publication of ADB's new guidelines in 2017, the economic opportunity cost of capital has been revised to 9%, which further strengthens the positive result of this analysis (footnote 1).

D. Conclusion

8. This economic analysis already shows an EIRR well above the hurdle rate, but the unquantified benefits in the financial analysis are still applicable to this analysis. Any savings in transmission losses would reduce the cost of generation, and the potential electricity shortages and outages would have posed more challenges than under the National Transmission and Despatch Company's current conditions. The robust economic viability of the project, even with the conservative estimates adopted by this analysis and the potential unquantified benefits, enables the project to be rated *highly efficient*.

Table A8.1: Project Economic Analysis

Year	Capital Cost (PRs million)	Maintenance Cost (PRs million)	Additional supply (GWh)	Incremental Benefits (GWh)	Non-Incremental Benefits (GWh)	Incremental Benefits^a (PRs million)	Non-Incremental Benefits (PRs million)	Net Benefits (PRs million)
2007	6,216							(6,216)
2008	2,000							(2,000)
2009	871	140	325	293	33	68	397	(546)
2010	3,784	198	1,025	932	92	217	1,124	(2,642)
2011	2,287	234	2,004	1,844	160	429	1,955	(137)
2012		243	4,264	3,966	298	922	3,639	4,319
2013		243	6,826	6,416	410	1,492	4,993	6,243
2014		243	7,646	7,263	382	1,689	4,661	6,107
2015		243	9,344	8,970	374	2,086	4,557	6,400
2016		243	10,087	9,784	303	2,276	3,689	5,722
2017		243	10,532	10,322	211	2,401	2,568	4,726
2018		243	10,679	10,572	107	2,459	1,302	3,518
2019		243	10,825	10,825	0	2,518	0	2,275
2020		243	10,825	10,825	0	2,518	0	2,275
2021		243	10,825	10,825	0	2,518	0	2,275
2022		243	10,825	10,825	0	2,518	0	2,275
2023		243	10,825	10,825	0	2,518	0	2,275
2024		243	10,825	10,825	0	2,518	0	2,275
2025		243	10,825	10,825	0	2,518	0	2,275
2026		243	10,825	10,825	0	2,518	0	2,275
2027		243	10,825	10,825	0	2,518	0	2,275
2028		243	10,825	10,825	0	2,518	0	2,275
2029		243	10,825	10,825	0	2,518	0	2,275
2030		243	10,825	10,825	0	2,518	0	2,275
2031		243	10,825	10,825	0	2,518	0	2,275
2032		243	10,825	10,825	0	2,518	0	2,275
2033		243	10,825	10,825	0	2,518	0	2,275
2034		243	10,825	10,825	0	2,518	0	2,275
2035		243	10,825	10,825	0	2,518	0	2,275
2036		243	10,825	10,825	0	2,518	0	2,275
2037		243	10,825	10,825	0	2,518	0	2,275
2038		243	10,825	10,825	0	2,518	0	2,275
2039		243	10,825	10,825	0	2,518	0	2,275
2040		243	10,825	10,825	0	2,518	0	2,275
2041		243	10,825	10,825	0	2,518	0	2,275
EIRR								21.5%
ENPV @ 9%^b								15,482
ENPV@12%^b								9,108

() = negative, EIRR = economic internal rate of return, GWh = gigawatt-hour, NPV = net present value.

^a Incremental benefits are based on willingness-to-pay net of generation costs and distribution costs to account for the delivery cost of electricity to customers.

^b Economic net present value (ENPV) at economic opportunity cost of capital of 9% and 12% respectively.

Note: Numbers may not sum precisely because of rounding

Source: Asian Development Bank estimates.

Table A8.2: Sensitivity Analysis

Item	EIRR (%)	ENPV at 9% (PRs million)	Switching Value: 9% Hurdle Rate (%)	ENPV at 12% (PRs million)	Switching Value: 12% Hurdle Rate (%)
Base case	21.5	15,482		9,108	
Benefits reduced by 10%	19.4	12,509	52.1	6,904	41.3
Value of resource saving decreased by 10%	20.2	14,009	100.1	7,909	75.9

EIRR = economic internal rate of return, ENPV = economic net present value.

Source: Asian Development Bank estimates.

QUANTITATIVE ASSESSMENT OF OVERALL PROJECT PERFORMANCE

Criterion	Assessment	Rating (0–3)	Weight (%)	Weighted Rating
Relevance	Relevant	2	25	0.50
Effectiveness	Less than effective	1	25	0.25
Efficiency	Highly efficient	3	25	0.75
Sustainability	Likely sustainable	2	25	0.50
Overall Rating^a	Successful			2.00

^a Based on the following ranges: 2.50 or above = highly successful, 1.75–2.49 = successful, 0.75–1.74 = partly successful, and 0.74 or below = unsuccessful.

Source: Asian Development Bank estimates.