

**DOCUMENT OF**  
The World Bank  
**FOR OFFICIAL USE ONLY**

Report No: PAD1446

INTERNATIONAL DEVELOPMENT ASSOCIATION  
PROJECT PAPER  
ON A  
PROPOSED ADDITIONAL CREDIT  
IN THE AMOUNT OF SDR 125.9 MILLION  
(US\$176.71 MILLION EQUIVALENT)  
TO  
THE PEOPLE'S REPUBLIC OF BANGLADESH  
FOR THE  
SIDDHIRGANJ POWER PROJECT

October 26, 2015

Energy & Extractives  
South Asia

This document is being made publicly available prior to Board consideration. This does not imply a presumed outcome. This document may be updated following Board consideration and the updated document will be made publicly available in accordance with the Bank's policy on Access to Information.

## CURRENCY EQUIVALENTS

(Exchange Rate Effective September 30, 2015)

Currency Unit = Bangladesh Taka  
Taka 77.78 = US\$1  
US\$ 1.40374 = SDR 1

## FISCAL YEAR

July 1 – June 30

## ABBREVIATIONS AND ACRONYMS

CAS	Country Assistance Strategy
CCPP	Combined Cycle Power Plant
CEIA	Cumulative Environmental Impact Assessment
CPF	Country Partnership Framework
DO	Development Objective
EGCB	Electricity Generation Company of Bangladesh
EIA	Environmental Impact Assessment
EIRR	Economic Rate of Return
EPC	Engineering, Procurement and Construction
GAAP	Governance and Accountability Action Plan
GTCL	Gas Transmission Company Limited
IDA	International Development Association
IP	Implementation Progress
kWh	Kilowatt-hour
mcf	Thousand cubic feet
mmscfd	Million standard cubic feet per day
MW	Megawatt
O&M	Operations and Maintenance
OE	Owner's Engineer
PGCB	Power Grid Company of Bangladesh
SIA	Social Impact Assessment
SCD	Systematic Country Diagnostic
SORT	Systematic Operations Risk Rating Tool
WTP	Willingness to Pay

Vice President:	Annette Dixon
Country Director:	Johannes C.M. Zutt
Senior Global Practice Director:	Anita Marangoly George
Practice Manager/Manager:	Julia Bucknall
Task Team Leader:	Md. Iqbal/Sheoli Pargal (Co-TTLs)



**BANGLADESH  
SIDDHIRGANJ POWER PROJECT ADDITIONAL FINANCING AND PROJECT  
RESTRUCTURING**

**CONTENTS**

Project Paper Data Sheet	iv
Project Paper	
I.    Introduction	1
II.   Background and Rationale for Additional Financing	2
III.  Proposed Changes	7
IV.  Appraisal Summary	10
V.   World Bank Grievance Redress	14
 Annexes	
Annex-1 Revised Results Framework and Monitoring Indicators	15
Annex-2 Economic and Financial Analyses	18



**ADDITIONAL FINANCING DATA SHEET**

**Bangladesh**

**Siddhirganj Power Project Additional Financing and Project Restructuring (P154127)**

**SOUTH ASIA**

**GEE06**

<b>Basic Information – Parent</b>									
Parent Project ID:	P095965			Original EA Category:	A - Full Assessment				
Current Closing Date:	30-Jun-2018								
<b>Basic Information – Additional Financing (AF)</b>									
Project ID:	P154127			Additional Financing Type (from AUS):	Scale Up				
Regional Vice President:	Annette Dixon			Proposed EA Category:	Category A (Full Assessment)				
Country Director:	Johannes C.M. Zutt			Expected Effectiveness Date:	31-December-2015				
Senior Global Practice Director:	Anita Marangoly George			Expected Closing Date:	30-Jun-2018				
Practice Manager/Manager:	Julia Bucknall			Report No:	PAD1446				
Team Leader(s):	Md. Iqbal, Sheoli Pargal								
<b>Borrower</b>									
Organization Name	Contact	Title	Telephone	Email					
Finance Division, Government of Bangladesh		Secretary							
<b>Project Financing Data - Parent ( Siddhirganj Power Project-P095965 ) (in USD Million)</b>									
Key Dates									
Project	Ln/Cr/TF	Status	Approval Date	Signing Date	Effectiveness Date	Original Closing Date	Revised Closing Date		
P095965	IDA-45080	Effective	30-Oct-2008	13-Nov-2008	31-Mar-2009	31-Mar-2016	30-Jun-2018		
Disbursements									
Project	Ln/Cr/TF	Status	Currency	Original	Revised	Cancelled	Disbursed	Undisbursed	% Disbursed
P095965	IDA-45080	Effective	XDR	222.60	222.60	0.00	166.71	55.89	74.89

<b>Project Financing Data - Additional Financing</b> <b>Siddhirganj Power Project Additional Financing (P154127 )(in USD Million)</b>					
<input type="checkbox"/>	Loan	<input type="checkbox"/>	Grant	<input type="checkbox"/>	IDA Grant
<input checked="" type="checkbox"/>	Credit	<input type="checkbox"/>	Guarantee	<input type="checkbox"/>	Other
Total Project Cost:		205.21		Total Bank Financing: 176.71	
Financing Gap:		0.00			
<b>Financing Source – Additional Financing (AF)</b>					<b>Amount</b>
BORROWER/RECIPIENT					28.50
International Development Association (IDA)					176.71
Total					205.21
<b>Policy Waivers</b>					
Does the project depart from the CAS in content or in other significant respects?					No
Explanation					
Does the project require any policy waiver(s)?					No
Explanation					
Has the waiver(s) been endorsed or approved by Bank Management?					
<b>Team Composition</b>					
<b>Bank Staff</b>					
<b>Name</b>	<b>Role</b>	<b>Title</b>	<b>Specialization</b>	<b>Unit</b>	
Md. Iqbal	Team Leader (ADM Responsible)	Senior Energy Specialist	Power Engineering	GEEDR	
Sheoli Pargal	Team Leader	Lead Energy Economist	Economics	GEEDR	
Tanvir Hossain	Procurement Specialist	Senior Procurement Specialist	Procurement	GGODR	
Zubair K M Sadeque	Financial Analyst	Senior Energy Specialist	Finance	GEEDR	
Mohammed Atikuzzaman	Financial Management Specialist	Financial Management Specialist	Financial management	GGODR	
Hisham A. Abdo Kahin	Counsel	Lead Counsel	Law	LEGES	
Iqbal Ahmed	Safeguards Specialist	E T Consultant	Environmental safeguards	GENDR	

Md. Bazlul Kadir	Team Member	Consultant	Procurement cum Technical	GGODR
Sabah Moyeen	Safeguards Specialist	Senior Social Development Specialist	Social safeguards	GSURR
Shakil Ahmed Ferdausi	Safeguards Specialist	Senior Environmental Specialist	Environmental safeguards	GENDR
Yusuf Salauddin	Team Member	Consultant	Technical aspects	GEE06
Miklos Bankuti	Team Member	Consultant	Financial and economic analysis	GEE06

### Extended Team

Name	Title	Location
------	-------	----------

### Locations

Country	First Administrative Division	Location	Planned	Actual	Comments
Bangladesh	Dhaka Division	Siddhirganj	X	X	
Bangladesh	Dhaka Division	Maniknagar	X	X	
Bangladesh	Chittagong Division	Bakhrabad	X	X	
Bangladesh	Dhaka Division	Dhaka District	X	X	
Bangladesh	Dhaka Division	Narayanganj District	X	X	
Bangladesh	Dhaka Division	Munshiganj District	X	X	
Bangladesh	Chittagong Division	Comilla District	X	X	

### Institutional Data

**Parent ( Siddhirganj Power Project-P095965 )**

### Practice Area (Lead)

Energy & Extractives

### Contributing Practice Areas

### Cross Cutting Topics

Climate Change

Fragile, Conflict & Violence

Gender

Jobs

Public Private Partnership

### Sectors / Climate Change

Sector (Maximum 5 and total % must equal 100)



Major Sector	Sector	%	Adaptation Co-benefits %	Mitigation Co-benefits %
Energy and mining	Thermal Power Generation	56		
Energy and mining	Oil and gas	22		
Energy and mining	Transmission and Distribution of Electricity	22		
Total		100		
<b>Themes</b>				
Theme (Maximum 5 and total % must equal 100)				
Major theme	Theme		%	
Financial and private sector development	Infrastructure services for private sector development		100	
Total			100	
<b>Additional Financing Siddhirganj Power Project Additional Financing ( P154127 )</b>				
<b>Practice Area (Lead)</b>				
Energy & Extractives				
<b>Contributing Practice Areas</b>				
Environment & Natural Resources, Governance, Other				
<b>Cross Cutting Topics</b>				
[X] Climate Change				
[ ] Fragile, Conflict & Violence				
[ ] Gender				
[ ] Jobs				
[ ] Public Private Partnership				
<b>Sectors / Climate Change</b>				
Sector (Maximum 5 and total % must equal 100)				
Major Sector	Sector	%	Adaptation Co-benefits %	Mitigation Co-benefits %
Energy and mining	Energy efficiency in Heat and Power	30		100%
Energy and mining	Oil and gas	30		
Energy and mining	Thermal Power Generation	30		
Information and communications	Information technology	10		

<b>Themes</b>		
Theme (Maximum 5 and total % must equal 100)		
Major theme	Theme	%
Financial and private sector development	Corporate governance	10
Financial and private sector development	Infrastructure services for private sector development	70
Environment and natural resources management	Climate change	20
Total		100
<b>Consultants (Will be disclosed in the Monthly Operational Summary)</b>		
Consultants Required? Yes.		



## I. Introduction

1. This Project Paper seeks the approval of the Executive Directors to provide an additional credit in the amount of SDR 125.9 million (US\$176.71 million equivalent) to the Bangladesh Siddhirganj Power Project.

2. The proposed additional finance (AF) would fill the financing gap associated with the design, procurement, construction and commissioning of a 335 megawatt (MW) combined cycle power plant at Siddhirganj. The AF includes a Level II restructuring of the parent project which has been approved by Management involving: (i) changes to eligible expenditures and (ii) application of the most recent procurement guidelines to contracts in process of procurement.

3. Project objectives and design have changed since approval of the parent project. The Government of Bangladesh had originally planned to build a 300 MW open cycle gas turbine power plant at Siddhirganj to help meet peak demand for electricity in the country.<sup>1</sup> An IDA credit to support this project (the Siddhirganj Peaking Power project) was approved in 2008. For a variety of reasons, the Government was not successful in procuring the 300 MW power plant. It also became clear that domestic gas was likely to be in short supply going forward. The Government, therefore, decided to set up a combined cycle power plant (CCPP) at Siddhirganj instead of the open cycle peaking plant. While the CCPP would have a higher capital cost than the open cycle power plant, it would operate with higher thermal efficiency, delivering greater energy output per unit of gas input; and would meet both base-load and peak-load demands. The Government's proposal to build a CCPP was accepted by IDA. A contract was procured for the design, supply, installation, and commissioning of a new 335 MW CCPP in mid-2012. At that point, the Government was expecting to use its own resources to meet the financing gap ensuing from the higher capital cost of the CCPP. The Bank's Board of Executive Directors approved a Level 1 project restructuring in April 2014 to formalize the change. Level 1 changes were made to the project name, development objective, results framework, and component descriptions; the technical assistance component was expanded to include capacity building contracts associated with the CCPP and relocation of a primary school to ensure an adequate buffer with the proposed plant. No further changes to the project design are being proposed as part of the proposed Additional Financing.

4. The Government has subsequently asked IDA to provide the additional financing. The additional financing is required to fill a financing gap arising from: (i) the higher capital cost of the CCPP vis-a-vis that of the peaking power plant, the increased technical assistance costs, and the cost of relocating the primary school; and, (ii) the depreciation of the SDR against the US dollar, which has significantly reduced the value of the original credit in USD terms. There is no partner co-financing for this project, and the Government is unable to finance the full incremental cost from its own budget (however, the Government is increasing its contribution from the originally planned level).

5. The additional credit will finance eligible increased plant costs, capacity building TA, and relocation of a primary school, retroactive to 12 months prior to expected date of signing. Specifically, the proposed Credit would finance the following: i) additional capital costs of the CCPP construction contract; ii) price and physical contingencies associated with the CCPP contract; iii) additional cost of three Technical Assistance contracts - Operations and Maintenance, an Owner's Engineer for the CCPP, Enterprise Resource Planning for EGCB, and (iv) Primary School construction. The primary section of the school is housed in a dilapidated and unsafe building, and which is being relocated under the project.

---

<sup>1</sup> The project encompassed: a 300 MW open cycle peaking power plant; a 60 km natural gas pipeline; an 11 kilometer 230 kV transmission line for power evacuation, and associated substations; and technical assistance for capacity building.

6. Table-1 lays out the financing plan at approval, at restructuring (April 2014), and at time of proposed AF approval, showing the cost share between IDA and GOB financing. Table-2 provides the distribution of costs between the original credit and the additional financing credit by component.

**Table 1: Financing Plan (\$ Million)**

Components	IDA Finance			GOB Finance (CD, VAT, Taxes & Land Acquisition Costs)			Total Cost At AF
	At approval	At restructuring	At AF approval	At approval	At restructuring	At AF approval	
Component (a): Power Plant	195.90	195.90	333.00	82.00	240.82*	100.00	433.00
Price Contingency	0.00	0.00	20.00	0.00	20.00	0.00	20.00
Physical Contingency	0.00	0.00	4.75	0.00	4.75	0.00	4.75
Component (b): Electricity Transmission System	43.30	27.01	27.00	10.70	12.50	12.50	39.50
Component (c): Gas Transmission Pipeline	76.90	65.00	63.25	27.30	36.00	36.00	99.25
Component (d): Technical Assistance (inc. school)	33.90	50.52	56.00	0.00	0.0	0.00	56.00
Total	350.00	338.43	<b>504.00</b>	120.00	314.07	148.50	652.50

\*This includes \$161.85 million capital cost of Component (a).

**Table 2: Original Credit and Additional Financing by Component (\$ Million)**

	Original Credit	AF	Total
Component (a) CCPP	227.04	130.71	357.75
Component (b) Power line	27.00	0.00	27.00
Component (c) Gas line	63.25	0.00	63.25
Component (d) Technical Assistance (inc. school)	10.0	46.00	56.00
Total	<b>327.29*</b>	<b>176.71</b>	<b>504.00</b>
<b>o/w retroactive financing</b>		<b>34.66</b> <b>19.61%</b>	

\*Current value of Credit as of August 31, 2015.

7. **Restructuring.** Under the Level II Restructuring approved by Management, taxes on non-consulting services will be eligible for IDA financing under the proposed Additional Finance as well as under the Original Credit. The Original Financing Agreement will be amended to this effect, retroactive to December 2011. Procurement under process from the Original credit will accommodate the provisions of Bank's Procurement Guidelines 2011 or Consultant's Guidelines 2011, as the case may be, during bid/ proposal evaluation, contract signing and contract execution.

## **II. Background and Rationale for Additional Financing in the amount of \$176.71 million**

8. **Consistency with WB and Government Strategy.** The proposed Additional Financing support for the CCPP at Siddhirganj is consistent with the WB Systematic Country Diagnostic (SCD) for Bangladesh which recognizes that a shortage of power is a key constraint to growth and poverty reduction in the country and the Country Partnership Framework (CPF) (under preparation) is expected to prioritize support for investments related to increasing power generation and supply of electricity. The proposed Additional Financing is also fully consistent with the Government of Bangladesh's power

sector strategy, which seeks to quickly add new power generation capacity to address the country's severe power shortages and increase the efficiency of use of increasingly scarce domestic gas supplies.

9. **Sector Background.** The energy sector in Bangladesh has made significant strides over the past decade: access to electricity increased from below 50 percent to around 64 percent of the population in 2014; generation capacity has doubled in the last five years to over 11,000 MW; and transmission and distribution losses have halved, going down to 14 percent between 2002 and 2013. Bangladesh has also been a pioneer in renewable energy based distributed generation with more than 3.5 million solar home systems (SHS) installed as of May 2015. The government was able to attract private investment into power generation, including two IPPs with foreign investment in 2001. More recently, it has successfully negotiated the import of power from India to supplement domestic generation.

10. Despite the increase in power generation capacity, there is a growing gap between the demand for power and the supply available. In FY 2012/13, there was a shortfall in peak capacity of 22% and a 13% shortfall in terms of meeting non-peak demand – the highest level of demand served in 2013 was only 6,675 MW. Currently, peak demand is estimated to be 9,250 MW while available capacity is around 8,000 MW.

11. The availability and reliability of power supply is a key concern for businesses in Bangladesh. Data from the World Bank Enterprise Survey of 2013 indicate that outages resulted in an output loss of 2.87% of GDP in Bangladesh that year. Firms in Bangladesh face ten times as many outages in a typical month as the average for all countries for which Enterprise Survey data are available and five times as many as the average for low income countries. About 63% of Bangladeshi firms invest in back-up generation, which mitigates some of the actual impact of power outages on output, but the additional expense impacts the firms' cost of production.

12. Energy requirements are projected to rise nearly five-fold to over 190 terawatt hours (TWh) by 2030 (from the 2013 level) as efforts to increase access to grid electricity (presently only 53 percent of the population is connected to the grid) bear fruit and in view of 6 percent per annum projected economic growth. At 294 kWh/annum, per capita consumption of power in Bangladesh is one of the lowest levels in the world with considerable scope for growth. Electricity supply is constrained for several reasons, the most important of which is limited investment over the past decade in new base-load generation capacity and inadequate growth in fuel availability, mainly domestic natural gas. Many power plants are decades old and operate below their rated capacity due to inadequate operations and maintenance, with reduced output of electricity per unit of fuel. About 2,300 MW of the new capacity added in the past decade came through short-term rentals relying on relatively expensive imported fuel oil. The sector needs significantly more investment to keep up with the 8-10% projected increase in demand expected over the next decade.

13. Declining reserves of domestic gas mandate the use of the most efficient technology possible for power generation. Historically, 70% to 90% of power generation in Bangladesh was fueled by natural gas since the country had relatively abundant onshore gas reserves. Expert assessment<sup>2</sup> however, is that domestic production will peak at around 3,000 mmscfd in 2017 and then begin to decline. Currently operating fields will not be able to meet existing demand let alone supply sufficient fuel to sustain growth in demand. Even today many plants do not operate at full load due to a shortage of gas; around 1.5 GW of gas-fired capacity cannot run to its full dispatch potential. In recognition of this, the Government is diversifying away from gas (to coal and power imports), moving to repower existing plants and to import LNG while encouraging more exploration for gas. Gas, however, will remain an

---

<sup>2</sup> Dorsch Consult (India) Private Limited 2012. Consulting Services for Preparation of Implementation and Financing Plan for Gas Sector Development.

important element of the fuel mix in the foreseeable future, initially to fuel the base-load capacity that would otherwise be stranded and later to fuel peaking plants. So conserving the resource and using it efficiently are of utmost priority.

14. Upgrading the efficiency of the existing gas fleet is, hence, another key focus of the Government -- the average efficiency of the aging gas generation fleet is 34%, which is well below the 50-60% efficiency of new build plants. Efficient, combined-cycle gas power plants currently make up only 2.4 GW of the approximately 7 GW of gas-fired capacity. The Siddhirganj Power Project, which will add 335 MW of gas-fired combined cycle capacity to the power system in Bangladesh, is, therefore, a core element of the Government's least-cost expansion plan for the sector and its strategy to address infrastructure deficits in the country as efficiently as possible.<sup>3</sup>

15. **Project History and Performance.** The original credit was intended to support the Siddhirganj Peaking Power Project, an integrated gas-to-power project. The development objectives were to increase the supply of power during periods of peak demand in Bangladesh, and to strengthen the implementing agencies: Electricity Generation Company of Bangladesh (EGCB), Power Grid Company of Bangladesh (PGCB), and Gas Transmission Company Limited (GTCL).

16. The original credit amount of SDR 222.6 million (US\$ 350.00 million equivalent) against a project cost of US\$ 470 million was approved on October 30, 2008 and became effective on March 31, 2009. In 2010, following unsuccessful procurement of the proposed 300 MW peaking unit, resulting in an initial delay in implementation, the Government, with the Bank's agreement, decided instead to set up a combined cycle power plant.<sup>4</sup> The CCPP was bid out in October 2010. (The power evacuation system and gas transmission line remained as originally designed.) Bid evaluation and negotiations with the responsive bidder took 16 months due to the need for clarifications. The Government committed to cover the financing gap while alternative sources of funding were identified, and EGCB awarded the contract for construction of a new 335 MW combined cycle power plant to a Spanish/Korean consortium in mid-2012. The contract became effective in September 2012. The Environmental Impact Assessment (EIA) was updated to account for the change to CCPP and disclosed in the country and Info Shop in July 2012.

17. Construction work on the CCPP faced implementation delays due to an unanticipated need for soil consolidation at the site prior to construction. Implementation improved from mid-2014 onward, after the soil consolidation was completed, and has stayed largely on track despite disruptions resulting from the civil unrest of late 2014/early 2015. Disbursement has picked up, now that procurement is largely complete, and no further delays are expected.

18. Due to the implementation delays described above, the Implementation Progress (IP) rating was downgraded to moderately unsatisfactory (MU) status in December 2013 and the DO was downgraded to MU in May 2014. The Level 1 restructuring of the project in April 2014 changed the project name and the project development objective (PDO) to 'Increase the supply of electricity to the Bangladesh grid network'. The Results Framework was changed to reflect the change in PDO, and new indicators, and outputs provided. The component descriptions were changed to reflect the switch to a CCPP and to expand technical assistance for capacity building and relocate a primary school due to its proximity to the CCPP. Target dates for completion were updated to reflect the changed implementation schedule.

---

<sup>3</sup> A CCPP, being an energy-efficient power generating unit, provides higher energy with life-time fuel saving. The efficient combustion in gas turbine, use of gas turbine exhaust in HRSG to produce steam to run steam turbine, result in a life-time fuel saving of approx. 218.6 petajoules for the 335 MW CCPP over the alternative of the 300 MW peaking power plant.

<sup>4</sup> Procurement of the CCPP required a redesign – site constraints led to the decision to adopt a 1:1:1 plant configuration.

19. With a substantial improvement in performance over the second half of 2014, the IP rating was upgraded to MS in December 2014. Following additional performance improvements in early 2015, the credit closing date was extended by 27 months (Level 2 Restructuring) in April 2015, to allow sufficient time to achieve and document achievement of the PDO and to complete all capacity-building activities. The IP and DO ratings were upgraded to Satisfactory in May 2015. An exception to the 12 month S/MS performance guidance for Additional Financing has been obtained from the RVP with OPCS' concurrence.

20. The project is expected to meet its PDO within the revised implementation timeframe (June 30, 2018 closing date). Pre-commissioning activities have started and the plant is expected to start operating in open cycle mode in November 2015. The balance of plant for the combined cycle will be commissioned in August 2016. Other project components are on track: the power evacuation system is complete, with the transmission line supplying 235 MW of power from the other power plants in the Siddhirganj areas to the greater Dhaka region; the gas transmission pipeline is almost complete; gas supply to the greater Siddhirganj area has improved and gas for commissioning of the CCPP is available. The Government has committed to supplying the required gas to the CCPP and a gas supply agreement (GSA) has recently been signed between EGCB and Titas Gas.

21. Ninety two percent of the current Credit (SDR 205.00 million) has been committed and 74.89% disbursed. Four contracts (for capacity building and for preparing financial projections) are currently in the process of procurement, and the bid document for school construction is under preparation. No additional contracts are planned. The project is in substantial<sup>5</sup> compliance with loan covenants and there are no outstanding safeguards issues.

22. **Environmental Impacts and Management.** Overall, changing the power plant from a simple cycle to a combined cycle will reduce environmental impacts substantially. Apart from the efficiency of gas use, which will result in a lifetime savings of 218.6 peta joules equivalent of fuel compared to the peaking power plant originally planned, GHG emissions per unit of power generated will be lower and exhaust vented to the atmosphere from the CCPP will be much cooler than would have been the case under an open cycle plant. The CCPP also will not discharge hot water into the river.

23. A comprehensive environmental impact assessment (EIA) of the CCPP was completed in May 2012 and published. However, there are a large number of industries (e.g., textiles and dyeing, paper and pulp, pharmaceuticals, fertilizers), export processing zones, several urban developments, other power plants, brick kilns, etc., surrounding the project area, all of which contribute to stress on the physical environment. Since further development is envisaged in the area, the Government decided to undertake a Cumulative Environmental Impact Assessment (CEIA) of existing power plants, industries and other ongoing and planned activities in the greater Siddhirganj area<sup>6</sup>. The CEIA would provide an area-wide picture of environmental impacts associated with the future development, which would be a useful input into the planning process.

24. In view of this, the Power Cell under the Ministry of Power, Energy and Mineral Resources initiated recruitment of a global consulting firm to carry out the CEIA in the project area and its surroundings in mid-2012. Power Cell faced considerable difficulty in identifying qualified firms and was finally able to contract an international firm only in May 2015. Power Cell has also hired an

---

<sup>5</sup> The implementing agencies are not in compliance with the covenant requiring the preparation of 10-year financial projections. Consultants are being recruited, and the projections are expected by December 31, 2015.

<sup>6</sup> Several power plants are located in the Siddhirganj area and many industries have come up in the vicinity as well. The whole area has become an industrial zone and is known as a "power hub."



International Adviser to oversee the CEIA process. Under the terms of reference for this assignment, the CEIA is expected to identify Valued Environment Components (VECs) associated with the Siddhirganj power hub and its influence area. It is expected to document the current/base line conditions of VECs due to the cumulative effects of past and present activities of the industries, power plants, commercial enterprises, residential users, etc., located in the influence area; assess likely environmental impacts of growth/development and evaluate their significance in terms of cumulative impact on VECs' predicted future conditions; and, prepare an appropriate area development plan with a strategy/action plan for environmental/social management in consultation with stakeholders. This plan is intended to be focused on improving existing environmental/social conditions, mitigating anticipated future impacts, and, managing the residual impacts of future projects.

25. A preliminary report on the CEIA has been prepared, which describes the spatial and temporal boundaries of the influence area and has identified key VECs which have direct or indirect interaction with the power plants and operating industries within the Siddhirganj hub. A comprehensive analysis of cumulative impacts on VECs is now being initiated. This involves estimating the present and future state of the VECs that is likely to result due to the impact of present and future development in the area under consideration. Indicators will be established for capturing the condition of the VECs. The effects on all the indicators associated with each VEC will be aggregated. Management strategies and procedures would be designed to manage the cumulative impacts and for guidance in planning future projects. The final report is expected to be submitted by March, 2016. The CEIA will help the Government plan and permit future projects in the Siddhirganj power hub and design appropriate mitigation measures that these projects will be required to adopt.

26. **Rationale for Additional Financing Request.** Additional funding is required to fill the financing gap arising from the higher capital cost of the CCPP vis-a-vis that of the peaking power plant that was budgeted for at the time of project approval; the costs of technical assistance associated with the CCPP also increased, and a primary school needs to be relocated to ensure adequate buffer with the CCPP. Additionally, the depreciation of the SDR against the US dollar has significantly reduced the value of the original credit in US dollar terms, from US\$ 350 to US\$ 327.3 million (end August 2015 data) leading to a need for additional funds.

27. **Alternatives to Additional Financing.** Government funding was explored and they have increased their contribution from US\$ 120 million to US\$ 148.50 million. However, fiscal constraints have made it difficult for the Government to allocate additional resources. Support from other donors (JICA, ADB) to fill the financing gap has not been forthcoming for this project given competing development needs. Without Bank financing, the Government will continue to implement the project either using its own resources (at the cost of other development expenditure) or by resorting to more expensive financing from commercial sources.

28. **Risks.** The overall risk rating of this project is “substantial” based primarily on fiduciary and perceived integrity risks. Institutional capacity risks are now considered “moderate” in view of the effective implementation by the EGCB and Power Division of mitigation measures to address the coordination challenges associated with multiple implementing agencies. Contract management by EGCB has improved, and risks related to timely completion of the CCPP and provision of energy to the grid are viewed as moderate. Appropriate mitigation measures for project risks are reflected in the Governance and Accountability Action Plan (GAAP) which was updated at the time of project restructuring and is under implementation. The task team will continuously track compliance of the Matrix of Actions of the GAAP and the fiduciary risk mitigation plan. The AF does not add to the implementation risks described above.

29. **Procurement.** All procurement under the project was provisioned for at the time of Level 1 project restructuring, which was approved by the Board in April 2014. The Additional Financing will largely go towards covering the shortfall in funding for the CCPP (the engineering, procurement and construction (EPC) contract value being USD 333 million), some capacity building (TA) contracts and the construction of a school building. The implementation of the CCPP contract is at an advanced stage and will be completed by August 2016. The contract price is adjustable and is subject to a price escalation formula. The implementation of the TA continues.<sup>7</sup> Risk mitigation measures have been put in place for the procurement of all contracts that are to be financed under the original project and the additional financing. The procurement risk is assessed as “moderate” as all procurement is at an advanced stage.

30. **Financial Management.** The Siddhirganj Power Project Additional Financing will continue to follow same FM and disbursement arrangements as the original Credit, with a separate books of accounts to be used solely for the additional financing. The implementing agency will maintain separate identifiable record for tax and duties which will be paid from counterpart funding. The audit will be same as the original Credit. There are no overdue audit reports for the original Credit.

31. **Institutional Capacity for Implementation.** As implementation of the infrastructure contracts of PGCB and GTCL is almost complete and these are in service, the risks to the project achieving its PDO are related to contract management of EGCB. Risks related to physical implementation and contractual disputes are being managed through the support of world class Owner’s Engineers and international consultants to EGCB. Coordination and integration of multiple agencies in implementation are being addressed through several measures (project implementation committee meetings led by EGCB; monthly progress review meetings of EGCB; and periodic Project Steering Committee meetings led by the Power Secretary to resolve critical issues and take policy decisions). Other mitigation measures include strengthening of the institutional capacity of all three implementing agencies. The Power Secretary regularly monitors progress of the CCPP and handles coordination of the multiple ministries/ agencies involved in different activities under the project. The proposed AF does not increase the risks that IDA is already exposed to through the original Credit.

32. **Project design.** This is a straight-forward investment project with three separate sets of physical infrastructure that will run in tandem, supported by Technical Assistance in implementation and operations management, to achieve sustainable results.

### III. Proposed Changes

Summary of Proposed Changes	
(i)	The proposed Additional Financing would fill a financing gap of \$176.71 million associated with the design, procurement, construction and commissioning of a 335 megawatt (MW) combined cycle power plant at Siddhirganj in place of the 300 MW open cycle peaking power plant that had been planned for under the parent (original) project. Revised costs are as follows: i) CCPP EPC contract US\$ 333 million; ii) Price contingency for the CCPP US\$ 20 million; iii) Physical contingency for the CCPP US\$ 4.75 million; iv) O&M contract US\$ 6 million; v) OE contract for US\$ 9 million; vi) ERP contract US\$ 11 million; and vii) Primary School

<sup>7</sup> Most contracts procured by EGCB, PGCB and GTCL under Original IDA Credit are at an advanced stage of implementation or have been completed. In addition, bids for three capacity building contracts have been received by EGCB and GTCL and are being evaluated. The procurement process for a new school building has not yet started; and individual consultants are in the process of being engaged to help prepare a 10-year financial projection for the implementing agencies and to carry out social safeguards activities.

construction US\$ 2.5 million; (ii) Updated procurement guidelines will apply to the Additional Financing. The January 2011 (revised July 2014) Procurement Guidelines and January 2011 (revised July 2014) Consultant Guidelines will apply to all new contracts to be financed fully from the Additional Financing; and, (iii) Taxes on non-consulting services will be eligible for IDA financing under the proposed Additional Finance as well as the Original Credit. The Original FA will be amended to this effect, retroactive to December 2011.	
Change in Implementing Agency	Yes [ <input type="checkbox"/> ] No [ <input checked="" type="checkbox"/> ]
Change in Project's Development Objectives	Yes [ <input type="checkbox"/> ] No [ <input checked="" type="checkbox"/> ]
Change in Results Framework	Yes [ <input type="checkbox"/> ] No [ <input checked="" type="checkbox"/> ]
Change in Safeguard Policies Triggered	Yes [ <input type="checkbox"/> ] No [ <input checked="" type="checkbox"/> ]
Change of EA category	Yes [ <input type="checkbox"/> ] No [ <input checked="" type="checkbox"/> ]
Other Changes to Safeguards	Yes [ <input type="checkbox"/> ] No [ <input checked="" type="checkbox"/> ]
Change in Legal Covenants	Yes [ <input type="checkbox"/> ] No [ <input checked="" type="checkbox"/> ]
Change in Loan Closing Date(s)	Yes [ <input type="checkbox"/> ] No [ <input checked="" type="checkbox"/> ]
Cancellations Proposed	Yes [ <input type="checkbox"/> ] No [ <input checked="" type="checkbox"/> ]
Change in Disbursement Arrangements	Yes [ <input type="checkbox"/> ] No [ <input checked="" type="checkbox"/> ]
Reallocation between Disbursement Categories	Yes [ <input type="checkbox"/> ] No [ <input checked="" type="checkbox"/> ]
Change in Disbursement Estimates	Yes [ <input checked="" type="checkbox"/> ] No [ <input type="checkbox"/> ]
Change to Components and Cost	Yes [ <input checked="" type="checkbox"/> ] No [ <input type="checkbox"/> ]
Change in Institutional Arrangements	Yes [ <input type="checkbox"/> ] No [ <input checked="" type="checkbox"/> ]
Change in Financial Management	Yes [ <input type="checkbox"/> ] No [ <input checked="" type="checkbox"/> ]
Change in Procurement	Yes [ <input checked="" type="checkbox"/> ] No [ <input type="checkbox"/> ]
Change in Implementation Schedule	Yes [ <input type="checkbox"/> ] No [ <input checked="" type="checkbox"/> ]
Other Change(s)	Yes [ <input checked="" type="checkbox"/> ] No [ <input type="checkbox"/> ]
<b>Development Objective/Results</b>	
Current PDO	
Increase supply of electricity to Bangladesh grid network.	
<b>Conditions</b>	
<b>Risk</b>	
<b>Risk Category</b>	<b>Rating (H, S, M, L)</b>
1. Political and Governance	Substantial
2. Macroeconomic	Moderate
3. Sector Strategies and Policies	Moderate

4. Technical Design of Project or Program	Low									
5. Institutional Capacity for Implementation and Sustainability	Moderate									
6. Fiduciary	Substantial									
7. Environment and Social	Low									
8. Stakeholders	Low									
9. Other										
OVERALL	Substantial									
<b>Finance</b>										
<b>Loan Closing Date - Additional Financing ( Siddhirganj Power Project Additional Financing - P154127 )</b>										
<b>Source of Funds</b>	<b>Proposed Additional Financing Loan Closing Date</b>									
IDA Credit	30-Jun-2018									
<b>Change in Disbursement Estimates (including all sources of Financing)</b>										
<b>Explanation:</b>										
The disbursement estimate will be updated to reflect AF disbursements.										
<b>Expected Disbursements (in USD Million)</b>										
Fiscal Year	2016	2017	2018	2019						
Annual	82.00	87.00	63.00	31.00						
Cumulative	323.00	410.00	473.00	504.00						
<b>Allocations - Additional Financing (Siddhirganj Power Project Additional Financing (P154127 )</b>										
<b>Explanation:</b>										
IDA financing for goods and works is exclusive of taxes and duties, while financing for consultant's services and non-consulting services is inclusive of taxes.										
Source of Fund	Currency	Category of Expenditure	Allocation		Percentage of Expenditure to be Financed					
			Proposed		Proposed					
IDA	XDR	Goods, Works, Non-Consulting Services and Consultant's Services	125.90		100					
<b>Components</b>										
<b>Change to Components and Cost</b>										
<b>Explanation:</b>										
The current cost below represents the costs at the time of Level-1 restructuring (April 2014). The proposed cost below represents the latest information on all component activities. The proposed costs of physical infrastructure are based on updated data that include price and physical contingencies. The proposed TA cost has increased to meet additional funding requirement of a few contracts and construction of the										

primary school. Three contracts are currently in the procurement process and will need to be updated at the contract documents negotiations stage to incorporate the updated guidelines requirements. The contract modification will incorporate adjustments for audit rights as required by the 2011 Procurement Guidelines.

<b>Current Component Name</b>	<b>Proposed Component Name</b>	<b>Current Cost (US\$M)</b>	<b>Proposed Cost (US\$M)</b>	<b>Action</b>
335 MW Combined Cycle Power Plant (CCPP)	335 MW Combined Cycle Power Plant (CCPP) including price and physical contingencies	460.17	457.57	Revised
230 kV Power Evacuation System	230 kV Power Evacuation System including price and physical contingencies	39.53	39.50	Revised
60 km, 30-inch gas transmission line	60 km, 30-inch gas transmission line including price and physical contingencies	101.10	99.25	Revised
Technical Assistance and MIS	Technical Assistance and MIS	50.52	56.00	Revised
	<b>Total:</b>	651.32	652.50	

#### **IV. Appraisal Summary**

##### **Economic and Financial Analysis**

###### **Explanation:**

*Summary of Economic and Financial Analysis:* The economic analysis shows that the project has net economic benefits that are robust to a range of sensitivities. The project EIRR is 31% while the net present value is US\$643 million. This is based on conservative assumptions regarding the cost of avoided power generation.

The financial analysis shows that the levelized tariff required for the 335 MW combined cycle power plant to cover its costs over its 30 year life would be 2.32Tk/kWh (US\$2.9/kWh at current dollar terms). This compares favorably with the current bulk supply tariff of about Tk 4.5/kWh of the off-taker Bangladesh Power Development Board (BPDB). In September 2013, EGCB signed a (provisional) Power Purchase Agreement (PPA) with BPDB ensuring a cost-recovery tariff for the 335 CCPP; the final PPA will be signed after the plant is commissioned and starts commercial operation at which point plant cost and dependable capacity will be known. The tariff would need to cover the costs of the power plant including the EPC contract and, over time, the O&M expenses including fuel and O&M contractor fees, taxes and interests, and a 12% return on equity.

An entity level financial analysis for EGCB was also carried out that shows that the financial position of EGCB will be strong throughout the analysis period, assuming that the terms of the PPA are honored. EGCB has entered into an interim PPA with BPDB for the ADB financed 2x120 MW power plants ensuring a cost recovery tariff for the plant. The provisional PPA signed with EGCB for the proposed 335MW power plant is similar to this PPA ensuring a cost recovery tariff. Detailed analyses are at Annex-2.

*Greenhouse Gas Analysis:* The Siddhirganj Power Project will result in the avoidance of 23.2 million tCO<sub>2</sub> over the life of the project. The 335 MW combined-cycle plant will replace fuel oil-based power generation units which are significantly more emission intensive and more expensive to operate. The plant will operate on natural gas as a baseload generation unit, providing power at 85% of the time. In recent years, the growth in demand for electricity exceeded the growth in natural gas production resulting in a shortage of gas supply. This has led to an increase in liquid fuel oil use for power generation and Bangladesh became a significant fuel oil importer in 2011.

#### **Siddhirganj Power Plant Emission Analysis**

<b>For Year Ending June 30</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>
Electricity Generated (GWh)	932	2,009	2,091	2,091	2,091
Emissions (MtCO <sub>2</sub> )	0.94	1.08	0.97	0.97	0.97
Baseline Emissions (MtCO <sub>2</sub> )	0.79	1.69	1.75	1.75	1.75
Net Emission (MtCO <sub>2</sub> )	-0.16	0.61	0.78	0.78	0.78

For the purpose of this analysis, it is assumed that reliance on fuel oil generation will be mitigated as a result of the Siddhirganj Power Project. The avoided emissions are correspondingly the differences in the emissions of the power plant and the emissions from existing and planned fuel oil power plants assuming that they generate the same amount of electricity as the Siddhirganj plant. The emission intensity of fuel oil generation was calculated based on the average emission of the existing and planned fuel oil-based fleet. The average emission intensity of the fuel oil plants slightly improves from 0.72tCO<sub>2</sub>/MWh in FY2015 to 0.71tCO<sub>2</sub>/kWh in FY2017 on a gross generation basis. Once fully operational, the Siddhirganj combined cycle plant will generate 2091 GWh of electricity per annum. The plant will have a long-run efficiency of 7032 kJ/kWh which corresponds to a 0.39 tCO<sub>2</sub>/KWh emission intensity on a gross basis. In December 2015 and in the first 8 months of 2016, the plant will operate in simple-cycle mode with relatively lower efficiency and higher emission intensity. This is reflected in the first fiscal year of operation when the plant will actually emit more CO<sub>2</sub> than the baseload fuel oil facilities which have higher efficiencies than the simple-cycle plants.

#### **Technical Analysis**

##### **Explanation:**

The capacity increase associated with changing to a 335 MW CCPP is modest (only 35 MW) but the important difference is a much higher efficiency and energy delivery than if the plant were an open cycle peaking plant. The CCPP has a higher capital cost, but produces more than twice the energy output per annum. It can meet both base load and peak load demands. Hence this design will help address the severe power shortage in the country, and also conserve scarce natural gas resources. Space and other constraints at the plant location dictate a 1:1:1 CCPP configuration (single gas turbine, one heat recovery steam generator, and one steam turbine) that was included in the bid document. Bid evaluation was designed based on a 'least lifetime cost' per unit of electricity produced, to include capital, operational and maintenance costs. This arrangement meets international norms. The plant design does not include direct cooling, which would require drawing water from the river, so does not increase river water temperature. Cooling is through closed cooling towers that require only 1% fresh water to make up losses.

**Gas Supply:** A major ingredient to the CCPP operation is natural gas, which is in short supply. The Government has recently committed full gas supply to the Siddhirganj 335 MW CCPP and a gas supply agreement (GSA) has been signed between EGCB and Titas Gas. The project-funded gas transmission pipeline is complete and operational. It has removed supply bottlenecks in and around the Siddhirganj region. The most likely problem with gas will be a periodic reduction in supply pressure, resulting in

power generation below full plant potential. However, the CCPP will still be available to the off-taker. The provisional PPA for the CCPP includes payment provisions for both the power plant's available capacity (measured in megawatts) and for the energy generated (measured in megawatt-hours). These payments are structured such that the capacity payments cover EGCB's fixed costs, including operation and maintenance. Under a partial gas supply scenario, EGCB would still be eligible for full capacity payments under the PPA, and thus would remain financially viable.

The task team modeled the economic and financial impact of partial gas supply and concluded that the project remains viable down to 30% plant load factor. EGCB has been receiving regular payments from BPDB for power supply from the existing 2x120 MW peaking units. Gas pipeline connectivity with the western region and Dhaka region has recently improved; this has resulted in a higher gas supply. Over the medium term, the Government is working to develop new production fields, both on-shore and off-shore. In addition, the Government is developing a Liquefied Natural Gas facility to address gas shortages in the interim before new domestic gas production comes on stream. These arrangements are the strongest practical measures available to minimize gas supply risks and the related financial risks to EGCB.

Alternate Fuel Option: Alternate fuels (diesel, HFO) for power generation were compared to the gas-based CCPP and found to be less attractive. Compared to the CCPP, both diesel and HFO fired engines are costly options (BDT 18 per kwh and 14 per kwh respectively vs. BDT 2.3 per kwh of the Siddhirganj CCPP), and are of lower thermal efficiency (42%-43% compared to 53.55% of the CCPP). The power plant was not designed to run as a dual fuel plant as gas supply commitment had been received during project preparation. A dual fuel CCPP (that can run on both gas and diesel/HFO) of 335 MW capacity would have a cost of BDT 3.18 per kwh if run on gas and BDT 7.768 per kwh if run on diesel. Moreover, the Siddhirganj site did not have the required space (20-26 acres) needed to construct a dual fuel CCPP of the same size.

**Social Analysis**

**Explanation:**

Social and environmental assessments for all the three physical infrastructure components (combined cycle power plant; power evacuation system; and gas transmission line package) satisfactory to the Bank have been prepared and disclosed in country and Info-Shop. Acquisition of land and distribution of compensation related to laying the gas transmission pipe-line and power transmission line has advanced satisfactorily. The compensation distribution is complete for the power line and 80% complete for the gas line. The CCPP requires an additional three acres of land (total 9.24 acre) over the amount required for the peaking plant. The original and the additional plots of land were allotted to EGCB as per a land lease agreement. The route of the 230 kV power transmission line had to be changed in one segment to avoid social impacts and dislocations in a densely populated area. The ESIA was updated to take account of the rerouted transmission route and to reflect the change to a 335 MW CCPP and disclosed in country and in the Bank's Info Shop in July 2012. No resettlement of people is required for the CC power station site and the new route for the power transmission line does not impact on any residential structures and has a minimal social impact. A grievance redress mechanism is in place with opportunity for project affected peoples or communities and individuals to submit complaints or grievances in Complaint Box located at various places of project locations, for resolution. The complaints received have been reviewed to address project-related concerns.

**Environmental Analysis**

**Explanation:**

The change in technology of the power plant (from peaking power plant to combined cycle power plant) has resulted in higher efficiency, lower environmental pollution per kWh produced, and conservation of

primary energy. Overall environmental impacts are also substantially lower -- compared to the peaking power plant of the original design, exhaust gases vented to the atmosphere from the CCPP are much cooler and the CCPP does not discharge hot water into the river. A detailed Environmental Impact Assessment (EIA) was carried out in 2012 before the project was restructured. The EIA was cleared by the Bank and disclosed in-country and in the Info Shop. As with the original design, the CCPP operates on clean natural gas. The project triggered the Environmental Assessment (OP/BP 4.01) safeguard policy, and was classified as Category 'A.' No additional safeguards policy has been triggered for the additional financing. As per EIA recommendations, EGCB engaged an EPC contractor with a certification of ISO 14001-2004 (Environmental Management Standard) and OHSAS 18001:1999 (Occupational Health & Safety Management Systems). The EPC Contractor has prepared an Environmental Action Plan (EAP) in line with the work methodology, schedule of work and equipment standards to mitigate specific environmental impacts, mainly those associated with the construction of the CCPP. The construction of the power plant is on-going and quarterly monitoring reports are regularly prepared and disclosed by the client. The project is in compliance with the requirements of the Environmental Management Plan (EMP) and EAP. The Additional Financing will cover the cost of a continuous Air Quality Monitoring agreed in the EIA of the CCPP.

The CCPP incorporates a 'closed loop' cooling system, which reduces significantly the water required (1% loss) and does not generate any thermal effluent to be discharged into the river system. Other important physical-chemical parameters that are likely to be affected by project activities include air quality and noise level. The noise generated from the power plant might become a source of annoyance at the school located close to the project site. To reduce noise exposure at the school during plant operation, the location of the water treatment plant (WTP) and effluent treatment plant (ETP) has been shifted. A seven meter wide natural barrier will be established by planting trees in the corridor between the school and the power plant. In addition, the project is financing a new six-storied school building 100 meter away from the current location where the primary section of the school will be relocated. The modeling undertaken indicates that the CCPP will not significantly increase NOx and PM emissions. The use of low nitrogen oxide burners, as specified in the bid documents (guarantee is 25 µ-gm/cu-meter) of this project, will result in significantly lower NOx emissions compared to older plants.

A limited impact assessment has shown that there are a large number of industries, other power plants, brick kilns, etc., surrounding the project area, all of which contribute to pollution of the physical environment. In view of this, the Power Cell under the Ministry of Power, Energy and Mineral Resources has decided to undertake a Cumulative Environmental Impact Assessment (CEIA) in the project area and surrounding Siddhirganj power hub to assess these impacts, evaluate their significance for Valued Environmental Components (VECs), predict future conditions, and prepare appropriate management plans for projects that will come up in the future, including planned power generation projects. Power Cell faced considerable difficulty in identifying qualified firms to undertake the CEIA and finally hired an international firm from May 2015. Power Cell has also hired an International Adviser to oversee the CEIA process.

The CEIA consultants have submitted an interim report on July 29, 2015. The report describes the spatial and temporal boundaries of the influence area and has identified key VECs which have direct or indirect interaction with the power plant and operating industries within the Siddhirganj hub. A comprehensive analysis of cumulative impacts on VECs is now being initiated. This involves estimating the present and future state of the VECs that may result from the impacts of present and future development in the area under consideration. Indicators will be established for capturing the condition of the VECs. The effects on all the indicators associated with each VEC will be aggregated. Management strategies and procedures would be designed to manage cumulative impacts and for guidance in planning future projects. The final report is expected to be submitted by March, 2016.



<b>Risk</b>
<b>Explanation:</b> The overall risk rating of this project is “substantial” based primarily on fiduciary and perceived integrity risks. Institutional capacity risks are now considered “moderate” in view of the effective implementation by the EGCB and Power Division of mitigation measures to address the coordination challenges associated with multiple implementing agencies. Contract management by EGCB has improved, and risks related to timely completion of the CCPP and provision of energy to the grid are viewed as moderate. Appropriate mitigation measures for project risks are reflected in the Governance and Accountability Action Plan (GAAP) which was updated at the time of project restructuring and is under implementation. The task team will continuously track compliance of the Matrix of Actions of the GAAP and the fiduciary risk mitigation plan. The AF does not add to the implementation risks described above.

## V. World Bank Grievance Redress

33. Communities and individuals who believe that they are adversely affected by a World Bank (WB) supported project may submit complaints to existing project-level grievance redress mechanisms or the WB's Grievance Redress Service (GRS). The GRS ensures that complaints received are promptly reviewed in order to address project-related concerns. Project affected communities and individuals may submit their complaint to the WB's independent Inspection Panel which determines whether harm occurred, or could occur, as a result of WB non-compliance with its policies and procedures. Complaints may be submitted at any time after concerns have been brought directly to the World Bank's attention, and Bank Management has been given an opportunity to respond. For information on how to submit complaints to the World Bank's corporate Grievance Redress Service (GRS), please visit <http://www.worldbank.org/GRS>. For information on how to submit complaints to the World Bank Inspection Panel, please visit [www.inspectionpanel.org](http://www.inspectionpanel.org).

## RESULTS FRAMEWORK<sup>8</sup>

Annex-1

Project Name:	Siddhirganj Power Project Additional Financing (P154127)			Project Stage:	Additional Financing	Status:	
Team Leader(s):	Md. Iqbal	Requesting Unit:	SACBD	Created by:	Md. Iqbal on 09-Apr-2015		
Product Line:	IBRD/IDA	Responsible Unit:	GEE06	Modified by:	Md. Iqbal on 03-Aug-2015		
Country:	Bangladesh	Approval FY:	2016				
Region:	SOUTH ASIA	Lending Instrument:	Investment Project Financing				
Parent Project ID:	P095965	Parent Project Name:	Siddhirganj Power Project (P095965)				
<b>Project Development Objectives</b>							
Current Project Development Objective - Parent: Increase supply of electricity to Bangladesh grid network.							
Proposed Project Development Objective - Additional Financing (AF): Increase supply of electricity to Bangladesh grid network.							
<b>Results</b>							
Core sector indicators are considered: Yes				Results reporting level: Project Level			
<b>Project Development Objective Indicators</b>							
Indicator Name	Core	Unit of Measure		Baseline	Actual(Current)	End Target	
Additional annual electricity delivered to grid (in billion kWh): peak and off-peak: 2.49	<input type="checkbox"/>	Text	Value	0	0.00	At least 2.49 billion kWh delivered to grid. Peak:0.624 billion kwh Off-peak :1.87 billion kWh	
			Date	01-Apr-2009	03-Aug-2015	30-Dec-2017	
			Comment		No kWh generated as CCPP is under construction.		

<sup>8</sup> The Results Framework was revised during Level -1 restructuring in April 2014, to formalize changes on account of change from peaking unit to CCPP.

Intermediate Results Indicators						
Indicator Name	Core	Unit of Measure		Baseline	Actual(Current)	End Target
Generation Capacity of Conventional Generation constructed under the project	<input checked="" type="checkbox"/>	Megawatt	Value	0.00	0.00	335.00
			Date	01-Apr-2009	03-Aug-2015	30-Dec-2016
			Comment		Construction of 335 MW Siddhirganj CCPP is ongoing.	335 MW CCPP built and operational.
Transmission lines constructed under the project	<input checked="" type="checkbox"/>	Kilometers	Value	0.00	11.00	11.00
		Sub Type	Date	01-Apr-2009	03-Aug-2015	31-Mar-2015
		Breakdown	Comment		Installation of Power evacuation system is complete and evacuating 235 MW of power of other power stations.	11 km 230 kV power evacuation system built, transfers at least 2.49 billion kWh to grid.
60 km gas transmission line constructed	<input type="checkbox"/>	Kilometers	Value	0.00	60.00	60.00
			Date	01-Apr-2009	03-Aug-2015	30-June-2016
			Comment		Pipeline installation complete and flowing upstream gas. Pre-commissioning gas for CCPP is available.	60 km gas supply line supplies gas to 335 MW CCPP and the other 1,300 MW power plants at Siddhirganj.
Projected lifetime fuel savings	<input checked="" type="checkbox"/>	Peta Joules (PJ)	Value	0.00	0.00	218.60
			Date	01-Apr-2009	03-Aug-2015	30-June-2018
			Comment		0.00 The CCPP is not yet ready to burn fuel.	218.6 Peta Joule projected life time fuel saving achieved.
O&M Contracts budgeted and implemented	<input type="checkbox"/>	Text	Value	Limited O&M capacity of EGCB	O&M for Siddhirganj 2x120 MW peaking units is providing O&M service to EGCB. Contracting of the other O&M (335 MW CCPP) is underway and likely to conclude in October 2015.	EGCB runs the 335 MW CCPP on global O&M protocols.
			Date	01-Apr-2009	03-Aug-2015	31-Dec-2019

			Comment		Rebidding done as no responsive bids received in the first round bidding. Bids are under evaluation.	
ERP functional and generating reports	<input type="checkbox"/>	Text	Value	Information based on past data and records	Information is based on past data and records. Both EGCB and GTCL have earned some knowledge on ERP design in preparation of the bid documents. Contracting of two separate ERP Vendors (EGCB and GTCL) is underway and likely to be concluded in October 2015.	ERP live and is generating reports.
			Date	01-Apr-2009	03-Aug-2015	31-Dec-2016
			Comment		Rebidding done as no responsive bids received in the first round bidding. Bids are under evaluation.	

## Economic and Financial Analyses

### Economic Analysis

1. A cost-benefit methodology was employed to estimate the net present value (NPV) and economic rate of return (EIRR) of investment in the 335 MW base-load combined cycle plant, discounted at 12% per annum. The EIRR is 31% and NPV is \$643 million under the assumptions that the plant will be operating at least 85% of the time. Sensitivity analysis carried out on a range of scenarios shows that the economic returns from this project are robust.

2. The economic cost of the CCPP project including the plant, generation equipment and all transmission facilities required for the operation of the plant, netting out financial transfers in the form of taxes, duties, and contingencies, is calculated to be US\$486 million. The fuel used is natural gas; the economic price of natural gas is taken to be US\$10/mcf over the period 2016-2025 and thereafter US\$15/mcf. This is based on the marginal cost of increased gas supply which will most likely come from LNG imports, barring any significant gas discoveries in Bangladesh. The landing price for LNG in India was US\$7.8/mcf in June 2015 hence the assumption that over the first 9 years of operation LNG import prices (the best estimate of the economic price of gas) will average around US\$10/mcf. The World Bank expects crude oil benchmark prices for LNG to return to US\$120/bbl by 2025 and given the price linkage between LNG and crude oil, LNG prices are expected to rise.

3. Project economic benefits are calculated as the revealed willingness to pay for power – which is proxied by the cost of alternative generation, in this case electricity from fuel oil or from diesel generation, which would be replaced by the project. This is taken to be Tk15/kWh which is the current cost of power from generation units that rely on fuel oil or diesel. Fuel oil and diesel plants currently provide around 18% of the power supplied to the grid and are the highest cost options for power supply.

4. Note that both the willingness-to-pay and the economic price of gas are subject to changes in oil prices and are expected to move in tandem as oil prices increase.

5. It is assumed that the plant would operate 85% of the time and that the plant will start simple cycle operation (i.e. gas turbine starting generation) in November 2015. The full combine cycle operation is expected to commence in August 2016. Sensitivity around delays shows that even if the project was to be delayed by 10 years, the net-present value would still be positive at a 12% discount rate.

**Table 1.1: Assumptions for the Economic Analysis**

	Unit	Baseline	Switching Value
Economic price of gas (2016-2025)	\$/mcf	10	18.2
Economic price of gas (2025-2045)	\$/mcf	15	18.2
Alternate value of energy	Tk/kWh	15	10.5
Technical losses	%	15%	40%
Capacity factor	%	85%	34%
Cost overrun	%	0%	151%
Discount Rate	%	12%	31%

**Table 1.2: Sensitivity Analysis (delays and discount rate)**

Start Delayed by Months	IRR	Discount Rate	NPV (millions)
1	30.29%	0%	\$4,406
2	29.85%	5%	\$1,831
3	29.41%	10%	\$856
4	28.98%	15%	\$420
5	28.56%	20%	\$199
6	28.14%	25%	\$78
7	27.72%	30%	\$8
8	27.32%		

### Financial Analysis

6. A project level financial analysis for the 335 MW combined cycle power project and an entity level financial analysis for the implementing agency EGCB were carried out<sup>9</sup>.

#### *Project Level Financial Analysis*

7. The total financial cost of the combined cycle power plant includes equipment costs, associated civil works, costs of owner's engineer, long-term service agreement, interest charges, duties and taxes, and contingencies. The total cost of the plant and all required installations is US\$ 448 million. This the relevant costs for EGCB power plant and associated TA that are to be recovered through tariff under the power purchase agreement between EGCB and off-taker, BPDB.

8. Total IDA financing proposed for the power generation component is estimated at US\$348 million (as opposed to the original estimate of US\$195 million for the original peaking power plant design). Of the remaining US\$ 100m cost of the power plant, 60% is expected to be on-lent to EGCB by the Government of Bangladesh at 4% interest rate (for a period of 20 years including a grace period of 5 years); 40% will be provided to EGCB as GOB equity.

9. The project level financial analysis calculates the tariff required to recover all financial costs and allow the operator to earn a 12% return on equity over the life of the project. The levelized tariff<sup>10</sup> for the 30 year life of the 335 MW combined cycle plant is calculated to be Tk 2.3/kWh, equivalent to USc 2.9/kWh at current dollar terms. This calculation is based on an 85% load factor, current gas prices of Tk79.82/mcf which is assumed to grow by 4% every year, a 12% return on equity, and a discount rate of 12% (the hurdle rate currently used by the World Bank). Table 3.1 shows the cost recovery tariff during the 30-year life of the project in (USc/kWh).

<sup>9</sup> The financial analysis for the purpose of the Additional Financing was limited to EGCB only, as the additional financing is proposed only for EGCB for the CCP and associated TA. The other two entities (PGCB for power transmission) and GTCL (for gas transmission) were not included in this analysis. The power transmission and gas transmission components have already been completed within the cost estimates of the original project appraisal.

<sup>10</sup> Project cash flows are discounted at 12%. The net-present value of the future cash flows is then amortized over the life of the project, using the same 12% discount rate, to derive the levelized tariff.

**Table 2.1: Breakdown of Levelized Tariff Calculation**

	Fixed Costs	Variable O&M	Fuel Cost	Total
Levelized Cost (USc/kWh)	1.89	0.10	0.95	2.94

10. The levelized tariff compares favorably with the current bulk supply tariff of Tk 4.5/kWh at which BPDB sells power to the distribution utilities. The levelized tariff is significantly lower than the cost of the most expensive power procured by BPDB from diesel plants, which is currently around Tk18/kWh. Assumptions used for the analysis are listed in Table 2.2

**Table 2.2: Key Assumptions**

As of July 2015	Unit	Values
Combined-Cycle Plant Start of Operation		August 2016
Capacity	MW	335
Plant Load Factor	%	85%
Plant Life	Years	30
Heat Rate	KJ/kWh	7,032
Project Cost	US\$ million	448
Return on Equity	%	12%
Discount Rate	%	12%
Corporate Income Tax	%	38%
Local Inflation	%	7%
Foreign Inflation	%	3%
Current Gas Price	US\$/GJ	1
IDA Loan	US\$ million	348
IDA Interest Rate	%	4%
Government Loan	US\$ million	60
Government Interest Rate	%	3%
Government Equity	US\$ million	40

### ***Project Robustness***

11. The required tariff will go up with increases in gas prices since fuel costs are fully passed through in the tariff. In the base case, the gas price is assumed to remain flat over time. However, if the gas price were to increase by 4% every year over the project life, it would require a levelized tariff of Tk 2.3/kWh (USc 2.9/kWh in current dollar terms). If gas prices went up by 10% every year from the current level, the levelized tariff would be Tk 3/kWh (USc 3.8/kWh in current dollar terms). This is still below BPDB's current bulk supply tariff. It should be noted that in recent years the domestic price of gas has not kept up with inflation; the price at which power plants buy gas has remained unchanged since 2009.

12. Considering the gas shortages, government has undertaken an LNG import project. This import will imply a significant increase in the sourcing cost of natural gas that will likely impact the price paid for gas by the power plants in the future. The below sensitivity analysis shows the impact of gas price increase on the cost of electricity generated from the plant. An increase of the gas price to US\$5/mcf on average over the life of the plant, which is roughly the price Indian power plants pay for regulated gas

supply, implies that the levelized cost of power would increase to US\$5.4/kWh. If gas was priced on an import parity basis, assuming a US\$10/mcf LNG supply cost, the tariff would rise to US\$8/kWh.

**Table 2.3: Sensitivity Analysis**

Gas Price (US\$/mcf)	Levelized Tariff (US\$/kWh)	Plant Load Factor	Levelized Tariff (US\$/kWh)
1	2.7	20%	8.8
2	3.3	30%	6.1
3	4.0	40%	4.8
4	4.7	50%	4.0
5	5.4	60%	3.4
10	8.8	70%	3.1
15	12.0	80%	2.8
20	15.3	90%	2.6

13. The final PPA will be signed after the plant starts commercial operation and all costs are accounted for. Since end-user electricity prices in Bangladesh are set on a cost-plus basis, construction cost overruns and inflation will be passed through into the tariff. Further, in the event of a gas shortage resulting in the plant operating at a lower load factor, EGCB will still be eligible for capacity payments and will hence cover its fixed costs.

14. In reality, the bulk supply tariff of BPDB is inadequate to cover its cost of power purchase (which has significantly increased with the introduction of short term rental plants running on expensive liquid fuel), making BPDB dependent on Government budget transfers. The subsidy provided to the power sector amounted to Tk 60 billion (US\$785 million) in FY14, up from Tk 40 billion each year since FY11. This subsidy was despite adjustments to the bulk supply tariff by 80% in phases since February 2011 (and retail tariff adjustments of over 40% during the period). Combined cycle power plants like the one supported under the project will help to reduce the costs of power generation, which in turn will contribute towards reduction in the sectoral deficit. The average efficiency of the gas fleet in Bangladesh is around 34%; the Siddhirganj project will significantly contribute to the efficient use of an increasingly scarce resource.

#### ***Entity Level Financial Analysis***

15. The entity level financial analysis looked at the financial position of EGCB as a whole taking into account historical figures from the audited accounts of EGCB for FY07-14 and projections for FY15-20. In addition to the 335 MW plant to be financed under the Project, EGCB is currently operating two other power plants: the ADB financed 2x120 MW plant and the JICA financed Haripur 412 MW plant. EGCB financial projections included all these assets and the associated liabilities.

16. With two power plants currently under operation by EGCB (ADB financed 2x120 MW and JICA financed 412 MW power plant), EGCB has started to earn revenues from selling power to BPDB. Assuming that the power plant supported under the project to be fully operational in FY16, EGCB financial statements were projected for FY15-20. If EGCB receives the cost recovery tariff as stipulated in the PPAs, the financial position of EGCB will be healthy during the projection period. Tables 2.4-2.7 present the actual financial positions of EGCB during FY07-14, and the projected financial positions during FY15-20.



**Table 2.4: Siddhirganj 335 MW Combined Cycle Power Plant Tariff Calculations – Base Case (Figures in Million Taka, except where noted)**

For Year Ending June 30	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Energy Charges	568	1,507	1,662	1,720	1,779	1,841	1,906	1,972	2,042	2,114	2,189	2,267	2,348	2,432	2,519
Capacity Charges - Non Escalable	2,723	4,099	4,392	4,410	4,427	4,441	4,4	4,4	4,4	4,4	4,4	4,4	4,4	4,4	4,4
Capacity Charges - Escalable	157	835	904	918	932	658	664	62	65	66	63	56	44	27	05
Total Cost	3,447	6,441	6,958	7,048	7,138	6,940	7,022	7,061	7,159	7,256	7,354	7,451	7,548	7,643	7,738
Energy Sent Out (GWh)	900	2,307	2,458	2,455	2,453	2,450	2,448	2,446	2,443	2,441	2,438	2,436	2,433	2,431	2,428
<b>Average Revenue Rate (Tk/kWh)</b>	<b>3.83</b>	<b>2.79</b>	<b>2.83</b>	<b>2.87</b>	<b>2.91</b>	<b>2.83</b>	<b>2.8</b>	<b>2.8</b>	<b>2.9</b>	<b>2.9</b>	<b>3.0</b>	<b>3.0</b>	<b>3.1</b>	<b>3.1</b>	<b>3.1</b>
For Year Ending June 30	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Energy Charges	751	1,516	1,515	1,513	1,512	1,510	1,507	1,504	1,501	1,498	1,495	1,492	1,489	1,486	1,483
Capacity Charges - Non Escalable	3,318	4,359	4,380	4,400	4,417	4,431	4,443	4,451	4,459	4,466	4,473	4,479	4,485	4,491	4,497
Capacity Charges - Escalable	192	89	90	93	66	628	651	676	701	72	754	3	812		
Total Cost	4,260	6,765	6,798	6,830	6,860	6,598	6,658	6,666	6,666	6,666	6,666	6,669	6,670	6,671	6,671
Energy Sent Out (GWh)	1,218	2,458	2,455	2,453	2,444	2,444	2,443	2,443	2,443	2,436	2,433	2,431	2,428	2,426	2,424
<b>Average Revenue Rate (Tk/kWh)</b>	<b>3.50</b>	<b>2.75</b>	<b>2.77</b>	<b>2.78</b>	<b>2.80</b>	<b>2.70</b>	<b>2.70</b>	<b>2.70</b>	<b>2.71</b>	<b>2.72</b>	<b>2.73</b>	<b>2.74</b>	<b>2.75</b>	<b>2.76</b>	<b>2.77</b>

**Table 2.5: Income Statement of EGCB (Figures in Million Taka)**

For Year Ending June 30	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Installed Capacity (MW)						210	210	622	622	831	935	955	954	954
Plant Load Factor (%)						40%	25%	19%	70%	74%	75%	75%	75%	75%
Net Energy Sent Out (GWh)						702	420	992	3,688	4,584	5,988	6,135	6,129	6,123
<b>Average Tariff (Tk/KWh)</b>						<b>3.05</b>	<b>4.80</b>	<b>4.34</b>	<b>2.82</b>	<b>3.08</b>	<b>2.91</b>	<b>2.94</b>	<b>3.00</b>	<b>2.97</b>
Total Revenues						2,166	2,135	4,391	10,598	14,404	17,794	18,426	18,768	18,561
Total Operating Expenses						1,932	1,147	1,799	6,247	8,798	10,681	10,945	11,199	10,918
Interest & Taxes						88	681	1,284	1,901	2,363	3,385	3,489	3,763	3,746
<b>Net Income</b>						<b>146</b>	<b>307</b>	<b>1,308</b>	<b>2,449</b>	<b>3,243</b>	<b>3,728</b>	<b>3,992</b>	<b>3,807</b>	<b>3,897</b>

**Table 2.6: Balance Sheet of EGCB (Figures in Million Taka)**

For Year Ending June 30	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Net Fixed Assets	8	9	9	15	29	10,899	10,600	38,414	36,325	68,253	64,833	61,412	57,991	54,571
Work in Progress	0	4,835	8,247	9,185	13,171	12,447	28,071	11,987	23,438	11	11	11	11	11
Current Assets	57	136	457	1,633	876	3,955	3,996	6,970	6,816	13,601	20,031	26,542	31,600	36,634
<b>Total Assets</b>	<b>65</b>	<b>4,980</b>	<b>8,713</b>	<b>10,833</b>	<b>14,076</b>	<b>27,301</b>	<b>42,666</b>	<b>57,371</b>	<b>66,579</b>	<b>81,865</b>	<b>84,874</b>	<b>87,965</b>	<b>89,603</b>	<b>91,216</b>
Total Equity	0	848	1,399	1,791	1,906	3,638	4,337	6,855	10,684	15,904	19,632	23,624	27,431	31,328
Long Term Debt	0	3,913	6,848	7,395	11,282	21,991	36,027	46,975	55,526	65,513	64,637	63,713	61,523	59,262
Current Liabilities	65	218	466	1,647	887	1,672	2,302	3,541	369	448	605	627	648	625
<b>Total Equity and Liabilities</b>	<b>65</b>	<b>4,980</b>	<b>8,713</b>	<b>10,833</b>	<b>14,076</b>	<b>27,301</b>	<b>42,666</b>	<b>57,371</b>	<b>66,579</b>	<b>81,865</b>	<b>84,874</b>	<b>87,964</b>	<b>89,602</b>	<b>91,215</b>

**Table 2.7: Cash Flow Statement of EGCB (Figures in Million Taka)**

For Year Ending June 30	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Cash Flows from Operations		107	90	807	-891	-958	1,971	753	3,129	5,203	6,897	7,387	7,293	7,406
Cash Flows from Investment		4,837	3,414	945	4,002	10,434	15,897	12,668	11,173	11,921	0	0	0	0
Cash Flows from Financing		4,762	3,485	939	4,003	12,294	14,428	13,111	9,931	11,964	-876	-924	-2,190	-2,261
Increase/Decrease in Cash		32	161	801	-891	902	503	1,196	1,886	5,246	6,021	6,463	5,103	5,146
Cash Balance		53	214	1,015	124	1,026	1,528	2,725	3,657	8,903	14,924	21,388	26,491	31,636