



## 1. Project Data

**Project ID**

P095965

**Project Name**

BD: Siddhirganj Power Project

**Country**

Bangladesh

**Practice Area(Lead)**

Energy &amp; Extractives

**L/C/TF Number(s)**

IDA-45080,IDA-57370

**Closing Date (Original)**

31-Mar-2016

**Total Project Cost (USD)**

422,527,623.63

**Bank Approval Date**

30-Oct-2008

**Closing Date (Actual)**

31-Dec-2019

**IBRD/IDA (USD)**
**Grants (USD)**

Original Commitment

350,000,000.00

0.00

Revised Commitment

448,122,497.47

0.00

Actual

422,527,623.63

0.00

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## 2. Project Objectives and Components

### a. Objectives

The original project development objectives (PDOs), as stated in the Financing Agreement, are “to increase the availability of power at peak times in the Recipient’s electricity supply industry and to strengthen the institutional capacity of the Implementing Agencies.”



The revised PDO, which was agreed at the January 2014 restructuring, is “to increase supply of electricity to Bangladesh grid network.” The revised PDO removed the institutional capacity strengthening objective, which was made into an intermediate outcome indicator in the restructured results framework.

In practical terms, the change in PDO meant that beyond the original objective of targeting the new plant capacity toward meeting peak electricity demand, the combined cycle power plant (CCPP) financed under the project would also add to baseload generation capacity.

The major change in PDOs and outcome indicators required a split rating in both the ICR and this ICR Review. For the purposes of this ICR Review, the following PDOs will be assessed:

PDO1 (originally approved in October 2008): To increase the availability of power at peak times in the Recipient’s electricity supply industry

PDO 1 (revised at the April 2014 restructuring): To increase supply of electricity to Bangladesh grid network

PDO 2 (originally approved in October 2008 and dropped at the April 2014 restructuring):

**b. Were the project objectives/key associated outcome targets revised during implementation?**

Yes

**Did the Board approve the revised objectives/key associated outcome targets?**

Yes

**Date of Board Approval**

11-Apr-2014

**c. Will a split evaluation be undertaken?**

Yes

**d. Components**

The Project included four components at appraisal:

**Component 1: Power Plant**

(The originally approved amounts totaled US\$357.75 million, of which US\$195.90 million was the original IDA Credit, and US\$161.85 million was Additional Financing [AF]. Actual disbursements totaled US\$302.46 million or about 85% of the approved amounts, of which US\$196.10 million was disbursed from the Credit, and US\$106.36 million from the AF.)

The Electricity Generation Company of Bangladesh (EGCB) initially planned to procure a peaking power plant; two O&M contracts, a Management Information System; and several individual consultancy contracts. The Procurement Plan was later revised to replace the peaking power plant with a 450 MW combined cycle power plant (CCPP), which was later amended to a 335 MW CCPP as a result of technical bids received.



Additionally, new procurement packages were introduced for the Enterprise Resource Planning system, Owner's Engineers, and the construction of the school building.

## **Component 2: Transmission Evacuation System**

(The originally approved amount was US\$43.3 million IDA Credit, of which US\$23.63 million or about 54% was actually disbursed. There was no AF for this component.)

This component included the construction and installation of one 11-km, 230-kV double-circuit transmission line between Siddhirganj and Maniknagar and two 230/132 kV substations at Siddhirganj and Maniknagar.

## **Component 3: Gas Pipeline**

(The originally approved amount was US\$76.9 million IDA Credit, of which US\$65.6 million or about 85% was actually disbursed. There was no AF for this component.)

This component included the construction of a 60 km, 30-inch diameter high-pressure gas pipeline and ancillary equipment to transport gas from the northeastern region of Bangladesh through Bakhrabad to Siddhirganj.

## **Component 4: Technical Assistance (TA)**

(The originally approved amounts totaled US\$48.76 million, of which US\$33.9 million was the original IDA Credit, and US\$14.86 million was AF. Actual disbursements totaled US\$30.82 million or about 63% of the approved amounts, of which US\$24.53 million was disbursed from the Credit, and US\$6.29 million was from the AF.)

The TA component was intended for three implementing entities. The TA for the Electricity Generation Company of Bangladesh (EGCB) included the provision of an O&M contractor for the 2 × 150 MW power plant and core management information systems (MISs). The TA for the Power Grid Company of Bangladesh (PGCB) included the provision of Owner's Engineer (OE) services to assist PGCB in the design of the transmission line and substations, preparation of the necessary bidding documents, evaluation of the bids, and supervision and management of the contracts. The TA for the Gas Transmission Company Limited (GTCL) included the provision of OE services to assist GTCL in the design of the gas pipeline, the preparation of the bidding documents, evaluation of the bids, preparation of contract, and supervision of all activities of the contractor from pipeline commissioning through to the provision of core MIS.

## **e. Comments on Project Cost, Financing, Borrower Contribution, and Dates**

**Project Cost.** The total project cost estimate, including the originally approved project and the Additional Financing, as well as the Borrower's contribution, was US\$839.6 million. This total amount was revised to US\$761 million, of which US\$422.5 million was disbursed. The zero actual disbursement of the originally expected Borrower's contribution explains the large difference between the revised total amount and the actual disbursement amount.



Financing. IDA financed an originally approved amount of US\$350 million (IDA-45080) and an Additional Financing of US\$176.7 million (IDA-57370), or a total IDA financing of US\$ 526.7 million. Actual disbursement was US\$422.5 million, of which US\$309.9 million was financed from the originally approved project and US\$112.6 million from the Additional Financing. Cancellations are indicated below under the project's fifth and sixth restructuring.

Borrower Contribution. The Borrower originally committed US\$312.9 million, of which no amount was disbursed.

Dates. the project was approved on October 30, 2008 and made effective on March 31, 2009. A mid-term review was conducted on January 21, 2014 followed by the first major restructuring of April 11, 2014. The original closing date was March 31, 2016. After several extensions (see below), the project closed on December 31, 2019 after an implementation period of 10.7 years.

The project underwent 6 restructurings, as described below.

First restructuring (April 11, 2014). The Level 1, first restructuring formalized changes that had already been materializing since 2010. The project name was changed from 'Siddhirganj Peaking Power Project' to 'Siddhirganj Power Project'. The PDO, results framework, and component descriptions were also changed, including the TA component, in which capacity-building contracts associated with the CCPP were added. Improvements in the results framework consisted of the following: (a) addition of a new PDO indicator related to increased electricity generation of at least 2.49 billion kWh; (b) removal of institutional strengthening as a PDO-level indicator, and inclusion of institutional strengthening activities (O&M and Enterprise Resource Planning) as an intermediate indicator instead; (c) addition of other intermediate indicators to monitor progress in the power plant, transmission evacuation system, and gas pipeline. The restructuring also made all indicators more specific; the target values and achievement dates were updated as well.

Second restructuring (April 2015): 27-month extension of the closing date through June 30, 2018.

Third restructuring and Additional Financing (October 26, 2015). This restructuring filled the financing gap of SDR 125.9 million (US\$176.71 million equivalent) associated with the first restructuring including (a) additional capital costs of the CCPP construction contract; (b) price and physical contingencies associated with the CCPP contract; (c) additional cost of three TA contracts (O&M, an OE for the CCPP, and ERP for EGCB); (d) primary school construction; and (e) depreciation of the SDR against the US dollar.

Fourth restructuring (June 21, 2018): 12-month extension of the closing date through June 30, 2019.

Fifth restructuring (May 29, 2019): extension of the closing date to December 31, 2019. Given project savings, the restructuring also cancelled SDR 11,656,850 from the original credit and SDR 16,790,000 from the AF credit (approximately US\$41 million equivalent) as a result of Project savings achieved.

Sixth restructuring (December 28, 2019): cancelled SDR 15,968,875 from the AF credit (approximately US\$22 million).



### 3. Relevance of Objectives

#### Rationale

Country and sector background. By 2008 when the project was appraised, Bangladesh had been experiencing economic growth and macroeconomic stability. The share of the population living in poverty had been reduced from 49 percent in 2000 to 40 percent in 2005. There were pressures, however, from increasing prices of food, energy, and other commodities. Low levels of administered energy and fertilizer prizes caused the state-owner enterprises to incur large losses, which were covered from an already strained public budget that was also coping in 2007 with major natural disasters. Inadequate infrastructure had become a major bottleneck on growth; more specifically, power supply constraints lowered GDP growth by as much as 2 percent each year. In 2005, the failure of generation to meet demand resulted in a severe power crisis, particularly during peak periods. In 2008, load shedding during peak hours was at least 500 MW, reaching as much as 1,000 MW during seasons of high demand, compared to a reliable total base generation capacity of only 4,300 MW, of which peak output was just 3,500 to 3,800 MW on most days. There was also an increasing shortage of natural gas, which fueled over 80 percent of installed generation capacity in 2008. Urgent measures were needed to meet peak power demand..

Faced with these major challenges, the Government of Bangladesh (GoB) encouraged private investment in upstream gas exploration and production and baseload generation, while seeking external public financing would for peak generation capacity, transmission, distribution, and rural electrification. Given the persistence and severity of load shedding during peak periods, GoB requested the World Bank's assistance, with the addition of peaking capacity as the most urgent need. The Bank was approached given the relatively low utilization rates of peaking plants, which were not considered as attractive and cost-effective investments for the private sector. The Bank's support for the project was based on this rationale as well as the need to sustain GoB's critical agenda of unbundling the sector, by strengthening the capacity of the Electricity Generation Company of Bangladesh (EGCB).

Due to protracted procurement delays since the 2008 approval, however, the simple cycle gas turbine (SCGT) was changed at the 2014 restructuring to a combined cycle power plant (CCPP). GoB requested the change from peaking to baseload capacity (hence the corresponding change in the PDO) given the worsening gas shortages in Bangladesh at that time. Also, while the project was experiencing procurement delays, GoB in the meantime had been renting small- to medium-size power plants and contracting large gas-fired IPPs to meet peak demand, yet power and gas shortages still persisted. The Bank agreed to the project's re-design in order to assist in addressing these shortages, while continuing to pursue sector reforms and the strengthening of sector institutions.

Alignment with Bank and Government Strategies. The PDOs are aligned with the Bangladesh-Country Partnership Framework (CPF) for FY16–FY21, which has been extended under the Performance Learning Review (PLR). Specifically, the PDOs are fully consistent with Focus Area 1: Growth and Competitiveness, which among other goals aimed to remove barriers to growth by “supporting increasing access to electricity supply.” The project contributes directly to the following outcome: “Increase Power Generation Capacity and Access to Clean Energy” (CPF Objective 1.1), while also being one of the low-cost and most efficient generation facilities in Bangladesh, based on its fuel and variable O&M cost (BDT 1.03 to 1.06 per kWh). In the medium term, any capacity of Bangladesh to export its excess electricity to neighboring countries would



further increase the relevance of the project's PDOs. The project also contributes directly to the PLR's Objective 1.1.3 that aims to "increase annual gas supply capacity," by enabling gas transmission from Bakhrabad to Siddhirganj; meeting the gas demand of power plants at Siddhirganj, Haripur, and Meghnaghat; and delivering adequate gas supplies to industrial, commercial, and other consumers in the area. The design change from a simple to a combined cycle plant enhanced operational efficiency, thus conserving gas for other domestic gas uses.

The Government's Vision 2021 and Seventh Five-Year Plan (7th FYP) for FY16–FY20 identify power supply constraints as a major hindrance to private investment, GDP growth, and overall economic development. The 7th FYP emphasizes the need to increase generation capacity while setting key focal areas, namely, the need to ensure efficient and least-cost generation as well as the long-term competitiveness of the power industry. However, the 7th FYP also highlights the increasing average cost of electricity and growing natural gas shortages, with power generation as the most inefficient of gas user. The Power System Master Plan (PSMP, 2016) and Revisiting PSMP 2016 (2018) include ambitious plans for expanding generation capacity and highlight as key sector issues the rapid growth in electricity demand and inefficient use of natural gas.

The alignment of the PDOs with the Bank current strategy and GoB's ongoing policy objectives was further enhanced by changing the generation technology (from a simple cycle to a combined cycle power plant) and adjusting the PDO, to enable low-cost and fuel-efficient power generation to serve both baseload and peak demand.

## **Rating**

Substantial

## **4. Achievement of Objectives (Efficacy)**

### **OBJECTIVE 1**

#### **Objective**

To increase the availability of power at peak times in the Bangladesh electricity supply industry

#### **Rationale**

##### Theory of Change

The project's theory of change as presented in the ICR (Figure1, page 10) is valid and relatively straightforward, given the mostly infrastructure content and highly technical nature of the project. The causal chain consists of investments in a simple cycle gas turbine that was subsequently amended to a combined cycle power plant at the project's 2014 restructuring, which would result in the direct outcomes of increasing power supply during peak hours and adding electricity supplies overall to the Bangladesh power grid. These incremental electricity supplies are expected to lead to improved energy security as well as improved





electricity services as the higher-order outcomes, while also saving limited gas supplies through more efficient use in a combined cycle system. With respect to the evacuation system, investments in transmission lines and substations were expected to result in increased transmission capacity in the congested area of the capital, Dhaka, as the immediate outcome. In addition, investments in a gas pipeline and ancillary equipment would also have the direct outcome of increasing annual gas supply capacity to Dhaka. The increased transmission and gas delivery capacity would lead to the higher-level outcome of lower electricity costs, which is expected to support longer-term economic growth and poverty reduction objectives.

The theory of change adequately identified critical assumptions, namely, that there are no force majeure events that would deflect demand from the Government's projections, that there is sufficient gas supply from domestic or imported LNG sources to operate the power plant, and that the economic merit order of power dispatch is strictly followed.

### Assessment of Outputs and Outcomes

Since the PDO was changed (as discussed separately under the Revised Objective 1 section below), It is important to note at the outset that EGCB initially planned to procure a peaking power plant; two O&M contracts (one for the Project, and one for the 2 × 120 MW ADB-financed peaking power project); a Management Information System; and several individual consultancy contracts. After the 2014 restructuring and the change in the PDO, the project's Procurement Plan was revised to replace the peaking power plant with a 450 MW combined cycle power plant (CCPP), later restructured to a 335 MW CCPP as a result of technical bids received. Additionally, new procurement packages were introduced for the Enterprise Resource Planning system, Owner's Engineers, and the construction of the school building.

The combined cycle power plant (CCPP) was constructed according to specifications and has increased electricity availability at peak times. Performance testing after the plant's commercial operation date yielded a net output of 345 MW, which was slightly higher than the 335 MW capacity that was guaranteed contractually. Prior to the 2014 restructuring, the PDO 1 indicator set a target of 1 billion kWh per year to be delivered to the grid during peak times. However, the PAD did not specifically define the "peak times" of power demand, assuming only that peak demand occurred for 6 hours daily. For monitoring & evaluation (M&E) purposes, the 1 billion kWh target assumed an operating period of nine hours. i.e., six hours of peak and a further three hours of off-peak demand.

The actual peak demand in Bangladesh, however, was found to be significantly lower, based on the hourly NLDC load curve from July 1, 2017 to June 30, 2020 and other available data. Thus, the PDO 1 indicator target needed to be adjusted to reflect the existing circumstances and use more accurate evidence, thus enabling the ICR's performance assessment to be based on a more realistic and appropriate indicator target. The ICR reviewed FY19 data for the NLDC hourly load curve and defined peak demand not just as the evening peak but as "any hour in the day when demand exceeds 80 percent of the annual peak", which meant any demand over 10 GW given the annual peak of 12 GW. On this basis, the peak demand period in Bangladesh was found to be 2.7 hours per day, which corresponded to a revised PDO 1 target of approximately 330,142,500 kWh per year.

Since its commercial operation date (COD) of September 10, 2019, the CCPP has delivered 240,247,440 kWh to the grid during peak times. This 87 percent capacity utilization (compared to the revised PDO target) represents a significant project achievement for the Project, in light of the current surplus generation capacity



in Bangladesh, the persistence of out-of-merit-order dispatch practices, the low demand season that followed right after the COD, and further demand reduction due to COVID-19. The positive outcomes from the associated gas and power evacuation infrastructure also clearly benefitted the achievement of PDO1.

Regarding the current surplus generation capacity mentioned above, one factor is that the coronavirus pandemic has depressed demand considerably during 2020. From a larger historical context, although installed generation capacity (on paper) is more than adequate to meet baseload demand, there are huge inefficiencies in actual production and distribution of electricity because of aged plant and equipment (that are running well below rated capacity), bottlenecks in transmission and distribution, and fuel shortages. While this situation is being rectified through new and on-going investments (e.g., through re-powering older plants), in part supported by the WB and IFC, demand is also projected to increase at a relatively rapid pace (the Bank's own estimate is greater than 10 per cent annually), hence further investments in generation are needed. Per capita consumption of electricity in Bangladesh is among the lowest in the world, leaving considerable headroom for expansion. Until recently access was constrained by a limited transmission network, making rural consumption reliant solely on solar PV off-grid systems; but with recent network expansion, this is likely to change. A nuclear power plant (some 2.25 GW capacity) at Roopur is planned to come on stream by 2025, to meet the expected increase in demand.

**Rating**

Substantial

**OBJECTIVE 1 REVISION 1****Revised Objective**

To increase supply of electricity to Bangladesh grid network

**Revised Rationale**Theory of Change

The theory of change remains the same as presented above, since the PDO modification essentially involved a change in plant design from a peaking plant to providing baseload capacity as well, while maintaining the fundamental goal of delivering electricity supplies.

Assessment of Outputs and Outcomes

The restructured PDO 1 of increasing the supply of electricity to the Bangladesh grid network has been achieved, insofar as the CCPP has been built to specifications, has exceeded its contractual performance obligations, and has the ability to meet the PDO target output of 2,490 GWh per year in the midterm. However, the plant has not been able to meet this target due to its low utilization stemming from inefficient dispatch practices in the system and other factors as discussed below.

Since its COD on September 2019, the CCPP has experienced low utilization rates despite (i) being one of Bangladesh's lowest-cost generation facilities (delivering at BDT 1.03–1.06 per kWh) and (ii) consistently having relatively higher priority in BPDB's merit order dispatch list at between sixth and ninth place out of 45





total baseload power plants. However, the plant has averaged a low 38 percent utilization rate with a total gross generation of 935 GWh delivered to the grid over the 10-month period since COD. Systemwide factors extraneous to the project have negatively affected the power plant's dispatch to date. First, the months of September 2019 to March 2020 that immediately followed the plant's COD corresponded to the low-demand season when lower power dispatch is also expected. Second, from March to June 2020, the global COVID-19 pandemic resulted in year-on-year reductions in electricity demand. Third, dispatch outside the merit order has resulted from persistently inefficient dispatch practices that are partly compelled by contractual terms that include take-or-pay obligations and penalty provisions. Hence, costlier emergency rental plants and Independent Power Producers (IPPs) take priority dispatch over the Siddhirganj power station. The large surplus capacity in the Bangladesh system exacerbates these inefficiencies in power dispatch. At present, the country's power system has more than 20 GW of installed (rated) capacity compared to 13 GW peak demand, with average demand at 8 GW or lower for 50 percent of the time.

Given these conditions and the recent COD of September 2019, the ICR developed an approach to measure annual performance of the power plant over the term of its Power Purchase Agreement (PPA) with BPDB. With in-house Bank support from a Senior Power Engineer of the Bank-executed Energy Sector Management Assistance Program, and in collaboration with the BPDB System Planning Division, short- and medium-term performance vis-à-vis the restructured PDO 1 was assessed based on a quantitative dispatch analysis for FY21–FY25, using a dispatch module of the Electricity Planning Model (EPM) developed by the Power System Planning Group of the World Bank.

Using the EPM module, a quantitative hourly dispatch simulation analysis was conducted that observes technical and commercial constraints while minimizing the fuel and O&M costs for the entire power system over the FY21–FY25 period and across 150 generating units in Bangladesh. The dispatch model, which was calibrated using FY19 and FY20 data, considered two scenarios:

- (a) an economic (ECON) scenario that follows a strict merit order dispatch and is subject only to technical constraints, thus relegating existing and new generation assets with high variable costs as stranded assets); and
- (b) a business-as-usual (BAU) scenario that departs from economic dispatch because contractual obligations and commercial constraints have been imposed.

The ECON analysis found that—if the inefficiencies in system dispatch can be removed in the coming years—the Siddhirganj power plant can maintain the PDO annual capacity utilization target of 85 percent for FY21–FY24, falling to 83 percent toward the end of the five-year period. The plant can reach the PDO target of 2,490 GWh per year over FY21–FY25 at 85 percent capacity utilization, or 2,431 GWh per year at 83 percent capacity utilization.

The BAU analysis showed, however, that plant utilization averages only 65 percent over the FY21–FY25 period. Although 78 percent (about 2,200 GWh) would be reached in FY21, the plant utilization decreases to 45 percent by FY25 (about 1,320 GWh). This would result from the large entry of new generation capacity comprised of several baseload plants that are in advanced stage of construction and many more that are in various stages of planning, including large additional capacity utilizing coal and LNG.

While suboptimal dispatch may be expected to persist, the Government and implementing entities are aware that following the strict economic dispatch could save the Government hundreds of millions of dollars annually. Moreover, under the Bank-financed Power System Reliability and Efficiency Improvement Project



(P159807), the Bank and the Government are moving toward more efficient dispatch practices by upgrading the power system to enable automated and integrated operations that at the same time optimizes dispatch by order of merit. Thus, the likely outcome is that the CCPP would operate somewhere in between the ECON and BAU scenarios, and with dispatch inefficiencies likely being removed from the system with ongoing Bank project support, the CCPP would achieve its target dispatch levels in the coming years.

### Intermediate Outcome Indicators

There were two associated outcome targets that are linked to measuring the achievement of PDO 1:

(a) Increase the transmission capacity and reliability of electricity supply for the Dhaka area.

The transmission evacuation system component (construction of the 11 km, 32 kV transmission line and two substations) was completed on April 25, 2014. The system, which has the capacity to transmit about 4,204 GWh from Siddhirganj to Maniknagar, has been and still is in current use. This evacuation system enhanced transmission network capacity and reliability by resolving voltage fluctuation issues and minimizing losses in the southeast part of Dhaka City, which is now largely free from load shedding or low-voltage issues. The project's transmission infrastructure has relieved congestion in the 132 kV transmission lines feeding the Maniknagar, Bangabhaban, and Narinda substations.

(b) Increase annual gas supply capacity to Dhaka area.

The 60 km × 30-inch diameter gas pipeline from Bakhrabad to Siddhirganj was completed and commissioned on November 26, 2014; all associated elements were finalized on December 26, 2018. The gas pipeline is able to transfer up to 164,250 mmcf of gas per year. To date, the pipeline transmits 116,800 mmcf per year on average. With the CCPP consuming about 7,698 mmcf per year, the Project has therefore enabled an additional 109,101 mmcf of gas supply for the Meghnaghat, Haripur, and Siddhirganj areas annually. At present, the pipeline serving power stations with a total capacity of 1,797 MW, as follows: (a) Meghnaghat 450 MW; (b) Summit Meghnaghat 337 MW; (c) Haripur 360 MW; (d) Haripur 412 MW; (e) Siddhirganj 2 × 120 MW; and (f) Siddhirganj 335 MW. Thus, based on the annual gas consumption data of these plants, the project's gas pipeline and associated infrastructure have enabled the delivery of an additional 14,266 GWh per year to the grid. Moreover, additional gas supply of about 5,475 mmcf per year is transported to industrial, commercial, and other consumers of the Adamzi Export Processing Zone Authority and Narayanganj areas.

The project also contributed to climate change adaptation in power sector operations. Electricity demand has been growing in recent years while natural gas was in short supply, thus leading to greater use of fuel oil for power generation. The project is expected to result in the avoidance of 23.2 million tCO<sub>2</sub> over its lifetime. Moreover, the CCPP over time is likely to replace fuel oil-based power generation units, which are costlier to operate and release emissions with much higher intensity.

On the basis of (i) the completion to specifications of the CCPP, which has exceeded its contractual performance obligations, and has the ability to meet the PDO target output of 2,490 GWh per year in the midterm, as discussed above; and (ii) the completion of two highly significant intermediate outcomes, namely, the increase the transmission capacity and reliability of electricity supply for the Dhaka area (now essentially



free of load-shedding and low-voltage issues), and the increase annual gas supply capacity also for the Dhaka area, the achievement of the revised Objective 1 would be rated High. However, in light of the remaining inefficiencies of merit order dispatch (likely to be addressed in the midterm), the achievement of the revised Objective 1 is rated Substantial.

## **Revised Rating**

Substantial

## **OBJECTIVE 2**

### **Objective**

To strengthen the capacity of the implementing agencies

### **Rationale**

#### Theory of Change

The theory of change for this PDO consists of a credible and valid causal chain whereby inputs (consisting of technical assistance, training and advisory services provided to the three implementing agencies) would result in Operation & Maintenance as well as Owner's Engineer contracts, and timely annual reporting on the operation of the Enterprise Resource Planning/Enterprise Management Planning (ERM/ERP) systems. These, in turn, would provide an array of performance improvements in the areas of financial management, environmental and social management and reporting, corporate governance and implementation efficiency--thus signaling strengthened capacity among the implementing agencies as stated in PDO 2.

#### Assessment of Outputs and Outcomes

This objective seeks to address important areas that the Bank identified as requiring improvements, namely, financial accountability, corporate governance, and institutional capacity of the implementing agencies--EGCB, PGCB, and GTCL. However, the PAD did not define "strengthening" specifically, although it did set indicators to improve (i) implementation efficiency, and (ii) governance, financial performance, and E&S impact management. For example, from a baseline of inadequate corporate governance reporting, a target was set related to annual reporting requirements and timely implementation of project components. This ICR Review concurs with the ICR 's assessment that these targets lacking specificity and are inadequate for measuring PDO 2. Thus, additional evidence was taken into account to more fully assess the achievement of PDO 2 as presented in the project's results framework.

#### **(a) Operations & Maintenance (O&M) and Owner's Engineer (OE) contracts**

Under the project's technical assistance (TA) component, the O&M and OE contracts were aimed at helping EGCB to improve its implementation efficiency and build its institutional capacity, including governance aspects. The O&M contract for the two 120 MW ADB-financed peaking power project was signed in December 2011 and operated for six years. EGCB staff were provided continuous classroom and on-the-job training in all areas related to the operation, maintenance, and management of the plant. Moreover, 26 EGCB engineers attended O&M training programs abroad. These activities resulted in developing EGCB's in-house O&M capability for both peak and baseload units. A significant outcome is that EGCB's staff and engineers



have become transferable among EGCB's power plants, thus transferring knowledge and good practices across the power stations. According to the ICR (paragraph 49): "EGCB has developed sufficient in-house O&M capacity to manage the O&M of all its power plants, including the CCPP, to international standards."

**(b) Owner's Engineer (OE) contracts**

The project financed consultancy contracts for OEs to support PGCB, GTCL, and EGCB in procurement, financial management, and implementation of their respective components. Specifically, the OEs were intended to assist in bid document preparation and evaluation, contract negotiations, on-site testing, plant and equipment commissioning, and technology transfer to their personnel. PGCB's OE quickly appointed, thus allowing more time to improve procurement processes and transfer knowledge. Appointment of the OEs for EGCB and GTCL was delayed, which caused further implementation delays downstream. The implementing agencies indicated that timeliness in mobilizing OEs is critical to maximizing the full value of OE services. Overall, the implementing agencies indicated during interviews for the ICR that they obtained value from the OE services in the areas of improved procurement processes and knowledge sharing.

**(c) Enterprise Resource Planning (ERP) and Enterprise Resource Management (ERM) Systems**

ERP/ERM software tools were introduced in both EGCB and GTCL, both of which have reported that these systems have enabled them to automate the corporate information systems and strengthen internal process controls, by transitioning away from manual and slow business processes that waste much time and cause delays. In addition to time and cost savings, facilities have also become more available and reliable. Training courses were provided at highly recognized training institutes to 38 staff from EGCB in the areas of financial accounting, material management, project management, contract management, procurement, human resource management, and other programming modules. The ERP systems are currently being used by utility staff and managers on a daily basis. In addition to improving and streamlining company operations, the ERP/ERM systems have been integrated with other supervisory control and data acquisition (SCADA) systems to perform centralized O&M protocols. The ICR (paragraph 51) indicates that: "Over time, these systems are gradually changing the working culture of both the utilities including improved governance and financial reporting."

**(d) Annual reporting and environmental social management**

Annual reporting started slowly. PGCB and GTCL did not submit reports from 2010-2013. However, with support from the OEs, much progress has been made that according to the ICR (paragraph 52) "has resulted in improved transactions, faster project implementation, regular reporting, and financial management." Environmental and social units (ESUs) were established in each of the implementing agencies established separate E&S units (ESUs), which the ICR indicates "has led to capacity enhancements in E&S impact assessment work and in dealing with project-related social issues." The ESUs and their improved capacity are now serving other projects, including ones financed by the Bank.

**Rating**

Substantial



## OVERALL EFFICACY

### Rationale

The project's achievement of PDO 1 as originally approved in 2008 is substantial. The achievement of the revised PDO 1 after the 2014 restructuring is also substantial. PDO 2's achievement is also substantial. The project's overall efficacy is rated substantial.

### Overall Efficacy Rating

Substantial

## 5. Efficiency

### Economic Analysis

Both the PAD and the ICR carried out economic analyses, which were methodologically sound. Economic values were applied to the cost streams, while the benefit streams were calculated based on the economic cost of the alternative fuel, i.e., diesel generation. This amounted to BDT18 per kWh, the current cost of power from diesel generation units. The benefits comprised the incremental power supplies to consumers that helped meet both peak and off-peak electricity demand. Until FY20, the actual amount of energy produced by the peaking plant and the CCPP was used; as from FY21, the ECON scenario was used, i.e., with the power plant attaining 83 percent capacity factor under optimal economic dispatch practices and without gas constraints.

At completion, the economic analysis comprising the CCPP, transmission line, and gas pipeline indicated that at a 12 percent discount rate, the net present value (NPV) is US\$698 million, compared to US\$643 million when the project was appraised at restructuring. The economic internal rate of return (EIRR) based on the ECON scenario of optimal dispatch sequencing is 26.33 percent, compared to the (restructuring) appraisal EIRR of 31 percent. Under the BAU scenario of lower capacity utilization, the EIRR is estimated as 24.17 percent, which is still significantly higher than the discount rate.

Cost savings during implementation have resulted in a total project cost that is 19 percent less than appraisal estimates. However, the completion EIRR is less than the appraisal EIRR mainly due to implementation delays and actual electricity sales until FY20 that were below the projections made at appraisal. More specifically, up to June 2020, the cumulative electricity generated from the Simple Cycle Gas Turbine (SCGT) and the Combined Cycle Gas Turbine (CCGT) was 75 percent lower than appraisal estimates; moreover, the peaking plant's operations started two years late in 2018 instead of 2016 as planned, and the CCPP became operational only in FY20.

### Financial Analysis

At the time of the AF, project-level financial analysis was conducted in order to calculate the tariff level that would be required to enable the recovery of all financial costs while allowing the operator to earn a 12 percent return on equity (ROE) over the 30-year life of the 335 MW CCPP. The levelized tariff was calculated at BDT 2.3



per kWh, or US 2.9 cents per kWh on dollar terms at the time of the AF, and assuming an 85 percent capacity factor, gas prices of BDT 79.82 per mcf, and a 12 percent discount rate.

At project completion, the financial analysis demonstrated the financial viability of the power plant. The tariff was recalculated using the same approach above but using updated costs and current gas prices (BDT 4.45 per m<sup>3</sup>). The levelized tariff at completion was BDT 3.06 per kWh (or US 3.65 cents per kWh at the prevailing exchange rate), which is significantly less than the average tariff of BDT 7.13 per kWh in Bangladesh and even less compared to that of HSD plants. The Siddhirganj PPA is a take-or-pay contract, hence EGCB should be able to pay off its debt obligation and earn the allowed ROE of 12 percent through the capacity charges which are independent of the utilization factor of the plant.

The financial analysis of the transmission line and gas pipeline also demonstrate their financial viability. At completion, the actual gas transmission charge of BDT 0.432 per m<sup>3</sup> is higher than the level of BDT 0.32 per m<sup>3</sup> that was assumed at appraisal. The calculated financial internal rates of return for the transmission line and gas pipeline were 15 and 17 percent, respectively.

### Implementation Efficiency

Due to long and repeated delays, the project's implementation period spanned almost 11 years from the original approval date. Procurement experienced lengthy delays due to contract management and other issues (see the procurement discussion in Section 10-Other Issues below) Significant cost savings materialized due to design changes in the transmission component, contract cancellations, and exchange rate fluctuations. Total project costs were 22 percent less than appraisal estimates. Over 96 percent of the funds committed (net of savings) had been disbursed by project closing.

On balance, while taking into account the implementation delays, the project's efficiency rating is substantial, based on the cost savings, the EIRRs achieved, and the financial viability of the project investments.

## Efficiency Rating

Substantial

a. If available, enter the Economic Rate of Return (ERR) and/or Financial Rate of Return (FRR) at appraisal and the re-estimated value at evaluation:

	Rate Available?	Point value (%)	*Coverage/Scope (%)
Appraisal	✓	31.00	95.00 <input type="checkbox"/> Not Applicable
ICR Estimate	✓	26.00	95.00 <input type="checkbox"/> Not Applicable





\* Refers to percent of total project cost for which ERR/FRR was calculated.

## 6. Outcome

The relevance of project objectives is substantial. The project's overall efficacy in achieving the two project objectives is substantial (the efficacy sub-ratings for PDO 1 and PDO 2 are both substantial). Efficiency is also substantial. With respect to the overall outcome rating, this review differs from the ICR's split rating calculation in that the shortcoming related to merit order dispatch inefficiencies seems to have been factored in twice, or "double counted" in the ICR. The rating of Substantial for the revised PDO 1 (after restructuring) already takes into account that electricity dispatch shortcoming. However, for that same reason, the outcome rating was down-rated again in setting the outcome rating after restructuring, as explained in the footnote to that ICR table. When this "double-counting" is corrected, the outcome rating after restructuring would be Satisfactory, which, taken together with the Satisfactory rating prior to restructuring, results in an overall outcome rating of Satisfactory. (This is not strictly an upgrade of the outcome rating; rather, it is a correction of having downrated the rating twice, i.e., at the revised PDO 1 level and at the post-restructuring outcome level, for the same reason.)

### a. Outcome Rating

Satisfactory

## 7. Risk to Development Outcome

The project's development outcomes face two principal risks. The first risk is the continuation of the business-as-usual scenario characterized by significant out-of-merit-order dispatch and supply surplus. Future dispatch of the CCPP to its full availability could be jeopardized by: (i) the power system's large surplus generation capacity, with additional ones in various planning stages; and (ii) the uneconomic, out-of-merit-order power dispatch. The second risk is the impact of COVID-19. While still under assessment, the initial findings indicate a reduction in demand during March to June 2020. Peak demand appears to have recovered in July 2020, but major uncertainties still remain regarding the resurgence of COVID-19 in Bangladesh, which could negatively affect electricity demand and the project's ability to dispatch electricity.

## 8. Assessment of Bank Performance

### a. Quality-at-Entry



The ICR (paragraphs 99 and 100) highlights three aspects of project preparation that demonstrate the project's satisfactory quality at entry. First, the Bank team was proactive in pursuing the project's first restructuring and the Additional Financing, which helped to ensure that the issues related to the initial design flaws in the results framework were straightened out. Second, the Bank was instrumental in helping ensure the completion of this complex project, which may not have materialized otherwise. The project took about 37 months to prepare and present to the Board; moreover, a major change in design—from a peaking power station to a baseload CCPP—was decided by both GoB and the Bank about one year after project effectiveness. These, in tandem with the Bank's debarment of a major equipment supplier, led to significant delays in procuring the power station. However, the Bank—by conducting a thorough selection and vetting of the JV partnership for the power station—helped ensure that when the majority JV partner abandoned the site due to financial difficulties, the minority JV partner was able to assume the contractual obligations of the JV partnership. Third, the Bank team was able to manage and mitigate risks by taking a strong approach to risk identification. The PAD rated the project's overall risk as substantial, given the sector-level policy challenges and the limited experience of the implementing agencies with World Bank financing. These contract administration and procurement risks were mitigated by several measures, including the introduction of a procurement risk mitigation framework.

To address risks with the country's fiduciary environment, the Project was designed to have as few contracts as possible. Thus, the Bank financed only nine contracts, for which funds flowed directly from the Bank to contractors. The Bank also set up a Transparency and Accountability Strategy and Risk Control Matrix (TASRCM) that included provisions for annual audit, procurement, human resource development, and annual corporate governance reports from the boards of the implementing agencies. The TASRCM highlighted key risks, mitigating controls for these risks, and respective reporting and oversight duties for the implementing agencies.

### **Quality-at-Entry Rating**

Satisfactory

### **b. Quality of supervision**

The ICR (paragraphs 101 and 102) highlighted several aspects of the Bank team's satisfactory supervision of the project. Given the project's intensive investment activities, there were two Task Team Leaders (TTLs) throughout the project's lifetime, with the primary TTL located in-country to enable close supervision. Implementation support was rigorous and provided regularly for the project's various components. A total of 23 implementation support missions were conducted, during which the Bank team engaged intensively with the implementing agencies. This engagement was most intense in dealing with the debarment issue and CCPP procurement issues.

During the operation, approximately 23 implementation support missions were carried out. The team engaged with the implementing agencies intensively early on, especially to deal with the debarment issue and consequent procurement difficulties related to the power station. The Bank team also quickly addressed the repeated difficulties with M&E activities, including reporting. Upon management clearance, the team quickly restructured the project in 2014 and addressed with shortcomings in the results framework and M&E system. More specifically, the team realigned the PDO outcome indicators and targets given the



more specific objectives and developed clear baseline information. The team was transparent in managing disbursement expectations, by explicitly delineating the low estimates for the first few years of the project.

**Quality of Supervision Rating**

Satisfactory

**Overall Bank Performance Rating**

Satisfactory

**9. M&E Design, Implementation, & Utilization****a. M&E Design**

There were initial shortcomings in the results framework and the associated M&E framework at the design stage. The PAD did not clearly explain the results chain as embedded in the results framework. The PDO 1-level indicators were not directly useful in measuring PDO-level outcomes. For example, a clear baseline definition of 'peak hours' was not provided and the target of kWh (a unit of energy quantity) was used to measure power generation (a unit of electricity flow). The PAD also used an indicator to measure power plant performance that was dependent on external factors that were not within the direct control of EGCB and/or the Project itself to deliver. Moreover, PDO 2-level indicators were not specific or relevant for measuring institutional capacity improvements and no clear baselines were provided. Consequently, the second Implementation Status and Results Report (ISR) already noted the absence of baseline and target information for the main PDOs. There was no clear link from activities to outputs to outcomes. At the same time, some intermediate indicators were used to cover gaps in the PDO indicators, but they were inadequate in two respects. First, they were not time bound. Second, they were not comprehensive in that they did not capture the contribution of the all the components and outputs, specifically those related to the power evacuation system and gas pipeline. The results framework however improved significantly after the first restructuring in terms of their comprehensiveness (e.g., the intermediate outcome indicator related to the gas pipeline) as well as a more transparent time frame for meeting the specific targets.

**b. M&E Implementation**

During the project implementation period that stretched out to almost 11 years, the operation of the M&E system depended entirely on the implementing agencies, with support from their respective Owner's Engineer, to report on all aspects of collecting data procurement and project performance. The agencies developed reporting formats to keep records and report to the Bank regarding compliance with the Environmental Management Plan (EMP). However, there is no clear evidence whether those prescribed reporting formats were followed. Quarterly reports were initiated shortly after project effectiveness. At the early stages of implementation, the agencies were late in submitting their annual financial management reports; only EGCB submitted annual governance reports for 2010 and 2011, while PGCB and GTCL did not to meet this requirement; and the agencies also did not submit their quarterly procurement reports.



The Bank had to intervene and required the various Board committees of the agencies to become directly involved and demonstrate more ownership.

### **c. M&E Utilization**

In 2012, the Bank agreed with the implementing agencies on a Governance and Accountability Action Plan (GAAP) to mitigate risks related to governance, reporting and corruption. The GAAP was updated and incorporated with the Financing Agreement during the first restructuring. The GAAP built upon the existing TASRCM and delineated institutional arrangements and additional specific measures to minimize governance and corruption risks. The GAAP, which was implemented successfully after the first restructuring, added measures to mitigate project risks that were not part of the earlier TASRCM. Data collection and monitoring of environmental and social aspects were conducted regularly, thus enabling careful monitoring of compliance with safeguards throughout the Project and beyond its closing date.

### **M&E Quality Rating**

Substantial

## **10. Other Issues**

### **a. Safeguards**

The information regarding the project's performance with respect to environmental and social (E&S) safeguards is based on pages 33 and 34 of the ICR.

The Project, which was classified as Category A, triggered the Bank's Environmental Assessment (OP/BP 4.01) and Involuntary Resettlement (OP 4.12) safeguard policies. During project preparation, the respective implementing agencies prepared site-specific Environmental Impact Assessments (EIAs) and Social Impact Assessments (SIAs), which were prepared, updated, and disclosed in a timely manner within Bangladesh and at the Bank's InfoShop. Through the careful design and implementation of an Environmental Management Plan (EMP), the project's mostly localized environmental impacts were minimized, avoided, or compensated. In addition to the EMP, the Engineering, Procurement and Construction unit prepared its own Environmental Action Plan (EAP) based on the equipment specifications, the construction schedule, and the World Bank and GoB standards.

Resettlement Action Plans (RAPs) were prepared and implemented before the start of any physical works. The RAP preparation process involved extensive consultations, resulting in a change in the location of tower construction at one side in response to the preferences of local residents. The project compensated over 20,000 affected households for temporary and permanent impacts from the PGCB and GTCL works and construction of towers, grids, and gas transmission lines, which involve land acquisition, land use, and loss of crops or livelihoods. Noise and emissions from the CCPP were also identified as a health risk to students at a nearby school, which was resolved by EGCB constructing a new, modern and better-equipped school at a safe distance and handing it over to BPDB. The ICR indicates that: "The grievance redress mechanism (GRM) was fully functional and effective."



To monitor emissions during plant operations, the power plant equipment included the continuous system for monitoring CO, NOX, SOX, and other emissions. Wastewater pollution control measures were also taken. Power plant performance tests done on September 26, 2019 gave test results showing that emissions and effluents were within the threshold values, and the segregation of solid, liquid and hazardous wastes was being properly managed. To reduce health and safety hazards for workers, personal protective equipment is used.

## **b. Fiduciary Compliance**

Financial Management. The ICR (page 32) indicates that throughout the project period, the implementing agencies complied with the submission of quarterly interim unaudited financial reports (IUFRs) and audit reports. With a few delayed submissions, the IUFRs were acceptable to the World Bank. The implementing agencies submitted project and entity audit reports on time, and there was unqualified audit opinion on the project financial statements. However, throughout the project period, PGCB repeatedly received qualified audit opinions on entity financial statements due to its inadequate audit trail and incomplete fixed asset and inventory register. At the time of the ICR's preparation, PGCB was hiring an accounting consultancy firm (accredited by the International Federation of Accountants) to address the audit qualifications; this is being supported under the Bank-financed Enhancement and Strengthening of Power Network in the Eastern Region Project (P159974).

Procurement. Procurement was delayed significantly due to contract management issues. The CCPP procurement started in September 2010 but the EPC contract was signed only 20 months later in May 2012. The majority JV partner abandoned the site in December 2016, which led to a protracted negotiation to amend the EPC contract so that the remaining member of the JV partnership could become the sole contractor and take charge of the works. Both the EPC contract and the project's closing date had to be extended to enable contract completion.

Procurement of the O&M contractor for the CCPP failed; however, O&M procurement was successful for the 2 × 120 MW ADB-financed peaking power project. The CCPP O&M contract suffered long delays due to the change in course and the lack of a responsive bid after two procurement attempts. Since CCPP construction was also slow, EGCB decided not to rebid the package.

Regarding the ERP system, a consultant hired to assist EGCB and GTCL in preparing bidding documents did not perform satisfactorily, hence a few local consultants and one international consultant were recruited to prepare the bidding documents. The first bidding process failed and a contract was awarded only after a rebid of the ERP supply and installation system for EGCB.

Effectively coordinating the three implementing agencies proved to be a challenge, especially since all the major contracts were interlinked across the components. The Bank took the initiative to use a project management tool (MS Project) to monitor critical path activities and to ensure overall project completion. However, initial usage of this tool by the implementing agencies was limited, thus hindering from the very outset the coordination of the implementation of high-value contracts.



Overall, the ICR (paragraph 94) concludes that “the performance of PGCB in procurement and contract implementation was satisfactory, while the implementation of the gas pipeline managed by GTCL was delayed due to contract management issues.”

**c. Unintended impacts (Positive or Negative)**

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**d. Other**

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**11. Ratings**

Ratings	ICR	IEG	Reason for Disagreements/Comment
Outcome	Moderately Satisfactory	Satisfactory	The shortcoming related to inefficiencies in merit order dispatch were factored in twice, once in rating the revised PDO 1, and again in rating the outcome after restructuring. Upon correction of this "double-downgrade", the overall project outcome is Satisfactory in accordance with the guidelines. As such, this is not strictly an upgrade of overall outcome rating, but rather a correction of having downrated twice for the same reason.
Bank Performance	Satisfactory	Satisfactory	
Quality of M&E	Substantial	Substantial	
Quality of ICR	---	Substantial	

**12. Lessons**





**A separate policy-level project component should be included in project design to ensure a closer sector-level engagement with the government in addressing fundamental sector governance issues, thereby promoting sustainability of World Bank operations.** Projects need to operate in the right policy environment in order to achieve success and give governments the full benefits of cleaner generation projects. Fundamental inefficiencies in the Bangladesh power system, specifically relating to out-of-merit-order dispatch of generation assets, may inhibit the achievement of the project's PDOs. The World Bank-financed Power System Reliability and Efficiency Improvement Project (P159807) is supporting the GoB in pursuing needed sector reforms to instill discipline in the dispatch process and enable significant annual savings for the country. As a forward-looking measure, government regulators/dispatchers should link economic dispatch to SCADA so that any possibility to arbitrarily adjust dispatch is removed and discipline is instilled in the dispatch process.

**Efficiency and flexibility in procurement management are important elements in facilitating implementation success.** The World Bank needs to give rapid decisions on procurement clearances. The Project suffered numerous procurement challenges, which inevitably led to significant delays in project implementation. A number of these delays resulted from slow decisions and clearances from the World Bank's side, including lengthy procurement reviews. Detailed Project Procurement Strategy for Development (PPSD) and qualifications of JV partners need to be carefully evaluated. A detailed PPSD should be in place where complex projects are being procured to avoid failed bidding processes. Moreover, the qualifications of JV partners must be carefully evaluated to ensure that each JV partner is qualified to carry out the contract awarded. In the case of the debarment of the major equipment supplied, the World Bank/INT should make a significant effort to communicate clearly to country teams where these processes are ongoing at the corporate level to ensure that clients are aware of potential implications and can avoid delays. Finally, robust contract management mechanisms, including a comprehensive TA and capacity building component, need to be in place to ensure the successful completion of complex projects.

**In designing the results framework, indicator targets need to be independent of external factors and remain within the control of the project implementing units.** The indicator to measure performance of the power plant, as designed in the original PAD and restructured RF, made the Project outcomes dependent on and measurable against external factors that were outside the control of EGCB and/or the Project itself. To ensure an accurate assessment of project outcomes, the indicator targets, against which PDOs indicators are measured, need to be designed such that the achievement of these targets remains (to the extent possible) independent of external factors outside of the control of a project or project implementing units.

**Good community relations are important and should be a key feature of project implementation.** These should include personal visits to the communities together with a well-functioning GRM and established Grievance Redress Committee (GRC). Both the components implemented by PGCB and GTCL involved the relocation of people. In both cases, the implementing agencies together with the World Bank team helped to ensure that effective GRMs and well-functioning GRCs were in place. In particular, the GRC should hold frequent meetings with the communities to deal with grievances raised through the GRM. The GRC should be involved early on



in all disputes with local communities to ensure timely problem-solving with the community, as was demonstrated effectively in the Project.

### 13. Assessment Recommended?

No

### 14. Comments on Quality of ICR

The well-prepared ICR was comprehensive and gave a full account of the project's implementation experience. It was candid and highly transparent, by providing detailed evidence on each of the project's activities. For such a complex project, the ICR's Box 1 did a commendable job in giving a full and easily understandable account of the major changes in the project's PDOs and components, linked to the implementation timeline. The ICR also benefited from rigorous analysis of the project's efficacy, notably with the assistance provided by the Bank's Energy Management Assistance Program (ESMAP) in assessing the revised PDO1, for which a separate approach had to be developed given the inadequacies of some of the performance indicators and the lack of data. The ICR's split derivation of the overall outcome rating was consistent with the Bank's and IEG's guidelines.

There were some shortcomings, however. Some inconsistencies were significant, i.e., the procurement section delineated numerous contract management issues and resulting lengthy delays, yet the economic analysis section partly credits the project cost savings to "efficient procurement". There was also repetition of text in parts of the report, which contributed to a much longer document than advised by the guidelines.

#### a. Quality of ICR Rating

Substantial

