

Ex-Ante Evaluation (for Japanese ODA Loan)

1. Name of the Project

Country: The People's Republic of Bangladesh

Project: Matarbari Ultra Super Critical Coal-Fired Power Project (IV)

Loan Agreement: June 14, 2018

2. Background and Necessity of the Project

(1) Current State and Issues of the Power Sector and Priority of the Project in Bangladesh

In the People's Republic of Bangladesh, electric power supply has not kept up with the rapidly increasing demand resulting from the country's stable economic growth and industrialization in recent years. The government estimates that power demand will reach 13,300 MW by 2020 ("Power System Master Plan 2016," Ministry of Power, Energy and Mineral Resources), but the actual maximum power supply is currently 10,084 MW (Bangladesh Power Development Board [BPDB], 2018), which is about 70% of that demand. Although the power demand is estimated to increase by 9.3% per annum over the next decade from 2016 (Ministry of Power, Energy and Mineral Resources, 2016), the output of domestic natural gas will decline following its 2016 peak. Gas-fired power generation, which accounts for approximately 60% of the total power generation, depends on domestic natural gas as its energy source. Therefore, diversification of the country's energy sources is an important issue in terms of energy security.

In the 7th Five-Year Plan (FY2016/17–FY2020/21), which is regarded as the top-ranked plan under the national development strategy, the power sector is positioned as one of the most important sectors in Bangladesh, which aims to become a middle-income country by 2021. Also, the 2016 Power System Master Plan states that imported coal, LNG and nuclear power should be used as new energy sources for the country's power demand to supplement the domestic natural gas supply. The power sector is identified as one of Bangladesh's high-priority infrastructure improvement projects being carried out under the direct supervision of the Prime Minister of Bangladesh.

The Matarbari Ultra Super Critical Coal-Fired Power Project (hereinafter referred to as the "Project") is intended to address Bangladesh's rapidly increasing power demand and the need to diversify its energy sources by constructing a high-efficiency ultra super critical coal-fired power plant that utilizes imported coal.

(2) Japan and JICA's Cooperation Policy and Operations in the Power Sector

The JICA Country Analysis Paper for Bangladesh (May 2014) describes securing a stable power supply as a priority task and states that JICA will provide support to promote the importing of energy sources, such as coal, for that purpose. In addition,

Japan's Country Assistance Program for Bangladesh (February 2018) sets the acceleration of economic growth as a priority field and identifies the shortage of power as one of the largest barriers to economic development. The Project is, therefore, consistent with these policies and the analysis. Furthermore, because the construction of a power plant and its related facilities (including a port, a coal yard and transmission lines) will contribute to a stable power supply and greater energy diversification in Bangladesh, the Project will also contribute to SDG 7 ("Ensure access to affordable, reliable, sustainable and modern energy for all") and SDG 9 ("Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation").

Major forms of assistance provided in the power sector thus far are as follows.

- Loans: New Haripur Power Plant Development Project (FY2007 and FY2008), Bheramara Combined Cycle Power Plant Development Project (FY2010 and FY2013), National Power Transmission Network Development Project (FY2013), Dhaka Underground Substation Construction Project (FY2017), etc.
- Technical Cooperation: Dispatching of Power Sector Advisors (FY2004–FY2016), Strengthening Management and Performance Standards in Power Sector of Bangladesh through Promotion of TQM (FY2006–FY2009), Master Plan Study on Coal Power Development in Bangladesh (FY2009–FY2010), etc.

(3) Other Donors' Activity

The World Bank is providing support for the following: improvement of the core transmission network; provision of development assistance loans for the power sector; formulation of plans for the financial reform and restructuring of the power sector; and construction of gas-fired power plants. The Asian Development Bank is providing support for the following: improvement of the BPDB's management efficiency; establishment of the Bangladesh Energy Regulatory Commission (BERC); and construction of gas-fired power plants. The Asian Infrastructure Investment Bank is providing support for the development of power distribution networks and the reinforcement of gas distribution networks.

3. Project Description

(1) Project Objective(s)

The objective of the Project is to satisfy Bangladesh's rapidly increasing power demand, address the need to diversify its energy sources, and reduce its greenhouse gas emissions by constructing a 1,200 MW (600 MW × 2 units) high-efficiency ultra super critical coal-fired power plant and related facilities (including a port, a coal yard and transmission lines) in the Matarbari area (Chittagong Division, southeast Bangladesh), thereby contributing to the revitalization of nationwide economic development and the mitigation of climate change in Bangladesh.

(2) Project Site / Target Area

Matarbari area, Moheshkhali region, Cox's Bazar District, Chittagong Division

(3) Project Component(s)

- 1) Ultra super critical coal-fired power plant (600 MW × 2 units), port and coal yard (water depth: approx. 15.3 m [Chart Datum Level: CDL])
- 2) Transmission lines (approx. 92 km of 400 kV transmission lines, electric power pylons, etc.)
- 3) Access roads (bridge: approx. 675 m; construction of new roads: approx. 7.4 km; repair of existing roads: approx. 36.5 km; etc.)
- 4) Electrification of the surrounding areas (132 kV transmission lines: approx. 25 km; 132/33 kV and 33/11 kV substations; and 33/11/6.35/0.4 kV distribution facilities)
- 5) Procurement of equipment and materials (large-sized vehicles, measuring instruments, equipment for disaster prevention, etc.)
- 6) Consulting services (detailed design, tender assistance, construction supervision, organization reinforcement, etc.)

(4) Estimated Project Cost (Loan Amount)

907,076 million Yen (Loan Amount in This Phase: 67,311 million Yen)

(5) Schedule

June 2014–January 2027 (152 months in total). The Project will be completed upon commencement of service at the facilities (July 2024).

(6) Project Implementation Structure

- 1) Borrower: The Government of the People's Republic of Bangladesh
- 2) Guarantor: N/A
- 3) Executing Agencies: Coal Power Generation Company Bangladesh Limited (CPGCBL), Power Grid Company of Bangladesh Limited (PGCB), Roads and Highways Department (RHD)
- 4) Operation and Maintenance System: CPGCBL, PGCB and RHD will carry out the operation and maintenance of the Project, and the Bangladesh Water Development Board will be in charge of the embankments that form part of the access roads.

(7) Cooperation and Sharing of Roles with Other Donors

- 1) Japan's Activity: N/A
- 2) Other Donors' Activity: N/A

(8) Environmental and Social Consideration / Poverty Reduction / Social Development

1) Environmental and Social Consideration

- ① Category: A
- ② Reason for Categorization: The Project falls into the thermal power sector under the JICA Guidelines for Environmental and Social Considerations (published in April 2010).
- ③ Environmental Permit: The Environmental Impact Assessment (EIA) Report on

the construction and maintenance of the power plant and port was approved by the Department of Environment (DOE) in October 2013, and the EIA Report on the construction and maintenance of transmission lines and access roads was approved in November 2013. Subsequent changes to power transmission line routes were included in the preparation of an EIA report for the Dhaka-Chittagong Main Power Grid Strengthening Project, and approved by the DOE in June 2016. The EIA Report on rural electrification (i.e., construction of a transmission line network) was approved by the DOE in October 2015. It has been confirmed that revisions to the EIA Report due to changes to the design of the access roads are not required.

- ④ Anti-Pollution Measures: The Project will incorporate seawater-based flue gas desulfurization equipment and a low-NO_x combustion system, so it is expected to meet the criteria for both sulfur oxide (SO_x) and nitrogen oxide (NO_x) exhausts from power stations in accordance with applicable domestic and international regulations (IFC Environmental, Health, and Safety Guidelines). The power station to be constructed in the Project is expected to meet both national standards and EHS Guidelines for atmospheric concentrations. Furthermore, the estimated (annual) PM₁₀ concentration level (42.4 to 62.4 µg/m³) for the power station's emissions exceeded the upper limit of Bangladesh's prescribed range, but this was the only instance in which the plant missed a threshold. This most likely reflected the impact of the pre-implementation concentration level (42 to 62 µg/m³) and the Project presumably contributed an insignificant amount of 0.4 µg/m³. The effects of PM will be minimized by adopting a high stack (275 m) and electric dust collectors. Seawater will be used for cooling in the Project, but no negative impact on the ecosystem is expected. By controlling the temperature of the water at discharge to within 7°C above the temperature at intake, the plant will comply with the national standard (less than 40°C). The noise impact is not expected to meet the standard for Bangladeshi or EHS guidelines during the construction or after the commencement of service.
- ⑤ Natural Environment: The target area of the Project is not located in or around vulnerable areas, such as national parks. Sonadia Island, designated as an "Ecologically Critical Area" by the Government of Bangladesh, is located approximately 15 km south of the Project site. However, no negative impact on Sonadia Island is expected because the mitigation measures noted in the anti-pollution measures will be taken and the effects of air pollution and water contamination will remain limited. To avoid any harm to the breeding of sea turtles, necessary measures will be taken during their breeding season, including dimming the intensity of light sources illuminated on the sea surface or the surrounding area during construction and limiting noise and vibration.

Project workers will be banned from gathering, harvesting, or hunting spoon-billed sandpipers and other rare species, or their eggs.

- ⑥ Social Environment: The size of the land that is to be acquired for construction of the power plant and port is approximately 572 ha, and these areas are currently used as salt fields in the dry season and as shrimp farms in the rainy season. Twenty households (Sixteen of which are illegal residents) will need to have relocated by the commencement of construction and improvements to the power station and port. The number of residents affected by the construction will be 2,156. The size of the land to be acquired for the construction, maintenance and repair of access roads (bridge: approx. 675 m; construction of new roads: approx. 7.4 km; and repair of existing roads: 5 km) is approximately 41 ha, and this work will involve the resettlement of 93 households and 545 people (none of which are illegal residents). The land acquisition and resettlement of residents will proceed according to Bangladesh's domestic procedures and the Resettlement Action Plan (RAP), which was created based on the JICA Guidelines for Environmental and Social Considerations. No land acquisition will be needed for the construction of transmission lines or for the electrification of surrounding areas since properties owned by either the executing agency or the government will be used. In discussions held with local stakeholders, no objections were raised with regard to the Project, but some requests were made for the environment to be properly managed and the infrastructure to be developed in the surrounding regions. The executing agency responded that they will take appropriate measures in response to these opinions and requests, and the understanding of the attendees was obtained.
 - ⑦ Other / Monitoring: For the resettlement of residents and livelihood restoration, the executing agency will conduct internal monitoring and third-party institutions will conduct external monitoring. With regard to the environment, the executing agency and the contractor will monitor the air quality, water quality, noise levels and vibrations during construction. After the commencement of service, the executing agency will continue monitoring these factors.
- 2) Cross-Cutting Issues: With support from consultants, activities will be carried out to raise awareness and educate construction workers about HIV/AIDS prevention. Also, with the use of the high-efficiency ultra super critical power technology, the new plant's production of greenhouse gas emissions will be approximately 0.4 million tons/year (CO₂) less than that of a similarly sized coal-fired power plant using subcritical technology, thereby contributing to the mitigation of climate change.
 - 3) Gender Category [N/A]: GI (Gender Mainstreaming Needs Assessment and

Analysis Project)

Reason for Categorization:

Gender-segregated interviews and gender-balanced stakeholder meetings have been conducted with regard to environmental and social considerations during the preparatory survey. Therefore, the Project is categorized as a Gender Mainstreaming Needs Assessment and Analysis Project.

(9) Other Important Issues

N/A

4. Targeted Outcomes

(1) Quantitative Effects

1) Performance Indicators (Operation and Effect Indicators)

| Indicator | Unit | Baseline (Actual value in 2013) | Target (2026) (Expected value 2 years after project completion) | |
|--|---------------------|---------------------------------------|--|-------|
| [Operation Indicators] | | | | |
| Power Plant | | | | |
| Maximum output | MW | - | 1,200 | |
| Utilization ratio | % | - | 80 | |
| Operation rate | % | - | 85 | |
| Auxiliary power ratio | % | - | 6.48 | |
| Gross thermal efficiency | % | - | 41.29 | |
| Unit downtime ^(*) | Human errors | hours/year | - | 0 |
| | Mechanical troubles | hours/year | - | 218 |
| | Regular inspections | hours/year | - | 1,096 |
| Frequency of suspension of operations ^(*) | times/year | - | 10 | |
| Transmission Lines | | | | |
| Transmission loss rate | % | - | 0.4 | |
| Ports and Harbors | | | | |
| Berth operation rate | % | - | 60 | |
| Total cargo volume | 1,000 tons/year | - | 4,000 | |
| Volume of dredged soil | Cubic meters/year | - | 360,000 | |
| [Operation and Effect Indicators] | | | | |
| Net electric energy production | GWh/year | - | 7,865 | |
| CO ₂ emissions ^(*) | 1,000 tons/year | - | 3,416 | |
| NO _x emissions ^(*) | 1,000 tons/year | - | 6.1 | |
| SO _x emissions ^(*) | 1,000 tons/year | - | 10.9 | |
| Dust generated ^(*) | 1,000 tons/year | - | 0.7 | |
| Fuel consumption ^(*) | 1,000 tons/year | - | 1,863 | |

* Per unit.

(2) Qualitative Effects

Revitalization of nationwide economic development in Bangladesh and mitigation of climate change.

(3) Internal Rate of Return

According to the following preconditions, the Project's Economic Internal Rate of Return (EIRR) will be 13.8%. The Financial Internal Rate of Return (FIRR) will be 2.1% for power generation and 11.7% for power transmission.

[EIRR]

Cost: Project costs (excluding tax), fuel costs, and maintenance/operation costs

Benefit: Difference between the cost of generating power using coal (this Project) and the cost of generating power using petroleum (including maintenance/operation costs, etc.)

Project Life: 25 years

[FIRR] (Power generation, port and harbor, and road construction)

Cost: Project costs (for the construction of a power plant, port, harbor, and roads), fuel costs, and maintenance/operation costs

Benefit: Sales revenue for electric power (PPA)

Project Life: 25 years

(Power transmission)

Cost: Project costs (for transmission lines) and maintenance/operation costs

Benefit: Power transmission fees

Project Life: 25 years

5. Preconditions / External Conditions

(1) Preconditions: N/A

(2) External Conditions: There will be no delays to the civil engineering work, etc., due to natural disasters (e.g., cyclones).

6. Lessons Learned from Past Projects

The results of the ex-post evaluation of the Mombasa Diesel Generating Power Plant Project in the Republic of Kenya demonstrates that appropriate support from the manufacturers enhances the sustainability of power plant projects. For the Project, a maintenance and operation system will be built and established by means of a technology transfer for operation and maintenance management through consulting services and a Long Term Service Agreement with the manufacturers. The handling of the Long Term Service Agreement in terms of the tender evaluations and contract conditions is clarified in the tender documents.

7. Evaluation Results

The Project is consistent with Bangladesh's development issues and policies and

with the assistance policies and the analysis of the Government of Japan and JICA. Through the construction of a power plant and related facilities (including a port, a coal yard and transmission lines), the Project will contribute to a stable power supply and greater energy diversification in Bangladesh, thereby contributing to Goal 7 (“Ensure access to affordable, reliable, sustainable and modern energy for all”) and Goal 9 (“Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation”) of SDGs. Thus, the necessity for JICA to support the Project is substantial.

8. Plan for Future Evaluation

(1) Indicators to be Used

As described in (1)-(3) of Section 4.

(2) Timing

Ex-post evaluation: Two years after the project completion