Ex-Ante Evaluation(for Japanese ODA Loan)

South Asia Division 4, South Asia Department
Japan International Cooperation Agency

1. Name of the Project

(1) Country: The People's Republic of Bangladesh
(2) Project: Matarbari Ultra Super Critical Coal-Fired Power Project (VIII)
(3) Project Site / Target Area: Chattogram District (Population 9.17million, Census 2022), Chattogram Division, and Matarbari area (Population 0.05miliion, Census 2011), Cox's Bazar District, Chattorgam Division.
Loan Agreement: March 25, 2025

2. Background and Necessity of the Project

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

In Bangladesh, demand for electricity is increasing rapidly due to recent economic growth and industrialization, and is expected to grow by 9.3% between 2021 and 2041. On the other hand, the production of domestic natural gas, the fuel for gas-fired power generation on which approximately 60% of power generation (in 2019) depends, has peaked out, and to meet the rapidly growing energy demand, liquefied natural gas (hereinafter referred to as "LNG"), which is more expensive than domestic natural gas, has been imported since 2018. Excessive dependence on a specific energy source may cause energy security issues, and there are concerns that if any problems occur in the fuel supply or related facilities, energy supply disruptions and supply cost escalation may occur. Therefore, diversification of energy supply structure is an important issue. Bangladesh has limited potential for the introduction of renewable energies. As most of the country's land area is less than 9 m above sea level, potential for hydroelectric power generation is limited, and due to the high population density and difficulties in land acquisition, land suitable for large-scale solar power generation is also limited. Under these circumstances, there is a strong need to continue the development of highly reliable baseload power sources to ensure sufficient reserve capacity and stable power supply in the future to meet the strong increase in power demand, and this project will play a significant role in this regard. In addition, to diversify energy sources, the Government of Bangladesh is seeking means of power generation that is more

economical than imported LNG.

Furthermore, the Revisiting Power System Master Plan (2018) also indicates the use of imported LNG, imported coal, and nuclear power as energy sources to meet the growing demand for electricity that cannot be met by domestically produced natural gas. In addition, the Government of Bangladesh published its Nationally Determined Contributsions (hereinafter referred to as “NDCs”) in 2021, which sets their greenhouse gas emission reduction targets under the Paris Agreement. The NDCs states that, on the premise of financial and technical assistance from abroad, the introduction of renewable energy, improvement of the efficiency of existing power plants, and constructuction of power plants using more advanced technologies, including ultra-supercritical power generation, will be promoted.

Matarbari Ultra Super Critical Coal-Fired Project (hereinafter referred to as the “Project”) will address the rapidly growing demand for electricity in Bangladesh and will diversify the source of energy through the construction of a high-efficiency thermal plant which utilizes imported coal, and therefore can be positioned as an important project in the power sector of Bangladesh.

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

The Country Development Cooperation Policy for the People’s Republic of Bangladesh (February 2018) identifies acceleration of economic growth as one of the priority areas. The JICA Country Analysis Paper for the People’s Republic of Bangladesh (March 2023) identifies stable power supply as one of the development programs, while also stating climate change countermeasures as an important cross-sectoral issue, which JICA will also support in parallel with the Project . The Project is in line with these policies and analyses. Furthermore, the New Plan for a “Free and Open Indo-Pacific (FOIP),” announced by Prime Minister Kishida in March 2020, sets “Multi-layered Connectivity” as one of the pillars, and indicates to further promote the Bay of Bengal Industrial Growth Belt Initiatives, and thus the Project is in line with this plan.

In the Infrastructure System Overseas Promotion Strategy 2025 (Supplemented in June 2022), the Government of Japan states that “Execept in limited circumstances, new direct public support for the international fossil fuel energy sector, where no emission reduction measures have been taken, will be terminated by the end of 2022.” Since the Project was already under

implementation, it is exempt from the termination of support stated in this strategy.

Japan and JICA's major achievenemts in supporting the power and energy sector are as follows;

- Japanese ODA Loans: Matarbari Ultra Super Critical Coal-Fired Power Project (FY2014-), Dhaka-Chittagong Main Power Grid Strengthening Project (FY2015), Energy Efficiency and Conservation Promotion Financing Project (Phase 2) (FY2019)
- Technical Cooperation: Dispatching of Power Sector Advisors (FY2004-FY2016, FY2019-FY2021), The Project for Gas Network System Digitalization and Improvement of Operational Efficiency in Gas Sector in Bangladesh (FY2019-FY2022), The Integrated Energy and Power Master Plan Project (FY2021-FY2023)
- Private Sector Investment Finance: Sirajganj Combined Cycle Power Plant Project (FY2017, Co-financing with IFC), Moheshkhali Floating Strorage and Regasification Unit Operation Project (FY2017, Project Financing), Meghnaghat Combined Cycle Power Project (FY2020, Leading Asia's Private Infrastructure Fund (LEAP))

(3) Other Donors' Activities

The World Bank is providing support for the following in the power and energy sector of Bangladesh: improvement of 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 Bangladesh Power Development Board (BPDB) 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 Description

① Project Objective

The objective of the Project is to increase stable power supply and to diversify energy source in Bangladesh by constructing an ultra super

critical coal-fired power plant in Matarbari area, thereby contributing to nationwide economic development.

② Project Components

1) Ultra super critical coal-fired power plant (600MW*2units), port for coal transport
2) Transmission lines (approx. 94km of 400kV transmission lines, electric power pylons, etc.)
3) Access roads (bridge: approx. 0.8km, construction of new roads: approx. 7.4km, repair of existing roads: approx. 5km, etc.)
4) Electrification of the surrounding areas (transmission line: approx. 25km, substations, distribution facilities, etc.)
5) Consulting services (basic design/detailed design, tender assistance, construction supervision, organization reinforcement, etc.)
6) Long-term service agreement for power plant (resident technicians and/or dispatch of technicians for periodic inspections, support for operation and maintenance through remote monitoring, spare parts costs, etc.)

③ Project Beneficiaries（Target Group）

Users of electricity supplied to the Dhaka metropolitan area from the power plant of the Project

(2) Estimated Project Cost

1,002,898 million Yen
(Japanese ODA loan for this tranche: 57,120 million Yen)

(3) Project Implementation Schedule

June 2014-January 2029 (176 months). Commencement of operation (July 2024) is considered as the completion of the Project[1].

(4) Project Implementation Structure

1) Borrower: The Government of the People's Republic of Bangladesh
2) Guarantor: N/A

[1] Though the Project has already been completed at the time of the provision of this tranche, this tranche reponds to the cost of price fluctuation and long-term service agreement.

3) Executing Agency: Coal Power Generation Company Bangladesh Limited (CPGCBL), Power Grid Bangladesh PLC (Power Grid), Roads and Highways Department (RHD)
4) Operation and Maintenance System: CPGCBL will operate and maintain the power plant and the coal transport port. Power Grid will operate and maintain the power transmission lines. RHD will operate and maintain the access roads. In Addition, Chittagong Port Authority will operate and maintain the access channel, basin, and breakwaters. Bangladesh Water Development Board will be responsible for the embankments that form part of the access roads.

(5) Collaboration and Sharing of Roles with Other Donors

1) Japan's Activity

The power plant of the Project will be connected to the substation constructed in Dhaka-Chittagong Main Power Grid Strengthening Project (Japanese ODA Loan) and will supply electricity to the Dhaka metropolitan area. After the completion of the commercial port to be constructed in Matarbari Port Development Project (I) (Japanese ODA Loan), part of the port facilities constructed in the Matarbari Ultra Super Critical Coal-Fired Power Project will be used jointly with the commercial port. Furthermore, through the Integrated Energy and Power Master Plan Formulation Project (Technical Cooperation for Development Planning), JICA has supported the formulation of the master plan for realizing a low-carbon/decarbonized society and achieving sustained growth. This masterplan has been approved by the Government of Bangladesh in November 2023.

2) Other Donors' Activity: N/A

(6) Environmental and Social Consideration

① Category: A
② Reason for Categorization: The Project falls into the themal power sector under the JICA Guidelines for Environmental and Social Considerations (April 2010).
③ Environmental Permit: The Environmental Impact Assessent (hereinafter referred to as "EIA") Report on the construction and maintenance of power plant and port was approved by the Department of Environment

(hereinafter referred to as “DOE”) in October 2013, and the EIA Report on the construction and maintenance of transmission lines and access roads was approved by DOE in November 2013. The EIA Report on the electrification of the surrounding areas was approved by DOE in October 2015. Since then, the need of additional construction of port facilities (expansion of shipping channel and breakwater construction) rose, thus this was included in the EIA Report for Matarbari Port Development Project, and was approved by DOE in October 2015. Similary, since the routes of the power transmission lines was changed, this was included in the EIA Report for Dhaka-Chittagong Main Power Grid Strengthening Project, and was approved by DOE in September 2016. In addition, due to the change in route of the access road, the EIA Report has been revised multiple times, and the latest version for construction and maintenance has been approved by DOE in January 2022 and June 2022, respectively.

④ Anti-pollution measures: The Project will incorporate seawater-based flue gas desulfurization equipment and a low-NOx combustion system, and thus it is expected to meet the criteria for both sulfur oxide (SOx) and nitrogen oxide (NOx) exhausts from power stations in accordance with applicable domestic and international regulations (IFC Environmental, Health, and Safety Guidelines; hereinafter referred to as “EHS Guidelines”). 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 most likely reflect the impact of the pre-implementation concentration level (42 to 62 μg/m3) and the Project presumably contributes only by an insignificant amount of 0.4 μg/m3 . The impact of PM will be minimized by adopting a high stack (275 m) and electric dust collectors. Furthermore, water will be sprinkled to prevent coal dust from scattering mainly during the dry season during operation. Seawater will be used for cooling in the Project, but by controlling the temperature of the water at discharge within 7°C above the temperature at intake, the plant will comply with the national standard (less than 40°C), and thus negative impact on the ecosystem will be mitigated. The noise impact is expected to meet the domestic and EHS guidelines’ standards during the construction and operation.

⑤ Natural Environment: The target area of the Project is not located in nor

around vulnerable areas, such as national parks. Sonadia Island, designated as an “Ecologically Critical Area” by the Government of Bangladesh, is located approx. 15 km south of the Project site. However, no negative impact on Sonadia Island is expected because mitigation 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 has been taken during their breeding and hatching season, including dimming the intensity of light sources on the sea surface and limiting noise and vibration. Project workers has been banned from gathering, harvesting, or hunting spoon-billed sandpipers and other rare species, or their eggs. In addition, the additional environmental impact due to the additional construction of port facilities will be minor, since mitigation measures will be taken to minimize the impact on benthic organisms, fish, and other organisms. For example, the diffusion of pollution will be minimized by selecting a sea area with a sufficient distance and depth from offshore as a candidate site for ocean disposal, installation of a pollution diffusion prevention film, and other measures.

⑥ Social Environment: The area of land acquired for the construction of power plant and port is approximately 709 ha, and parts of the land were used as salt fields during the dry season and for shrimp cultivation during the rainy season. A total of approximately 2,500 residents has been affected by the power plant and port construction. The area of land required for the access road is approx. 41 ha, out of which approximately 11 ha has been acquired. Due to the land acquisition, the resettlement of 102 households (including non-title holders) / 580 people occurred. For the transmission line construction and electrification of the surrounding area, public land has been used, thus neither land acquisition nor resettlement occured. The compensation for the affected people of the entire project has been completed in large, and the remaining compensation will be done according to the Resettlement Action Plan (hereinafter referred to as “RAP”) prepared in line with the Bangladesh domestic procedures and JICA Environmental Guidelines. Local stakeholder meetings have been held in accordance with the RAP, and the executing agency has responded to the requests heard during the stakeholder meetings.

⑦ Other/Monitoring: For resettlement and livelihood restoration, internal monitoring by the executing agency and external monitoring by third-party institutions will be conducted. For air, water, noise, vibration, and ecosystem, the executing agency and contractors will conduct monitoring during construction, and the executing agency will conduct monitoring during operation.

(7) Cross-Sectoral Issues: N/A

(8) Gender Category: [N/A] GI (Gender Mainstreaming Needs Assessment and Analysis Project)
<Details of Activities/Reason for Categorization> Although gender mainstreaming needs were investigated and confirmed under the Project, it did not lead to the implementation of specific efforts to contribute to gender equality or women's empowerment. Gender-segregated interviews and gender-balanced stakeholder meetings have been conducted in regards to environmental and social considerations during the preparatory survey.

(9) Other Important Issues: N/A

4. Targeted Outcomes

(1) Quantitative Effects

Outcomes (Operation and Effect Indicators)

Indicator			Baseline (Actual value in 2013)	Target (2026) (Expected value 2 years after project completion)
Power Plant	Net electric energy production (GWh/year)		N/A	7,865
	Utilization ratio (%)		N/A	80
	Operation rate (%)		N/A	85
	Auxiliary power ratio (%)		N/A	6.48
	Gross thermal efficiency (%)		N/A	41.11
	Unit down time*	Human errors (hours/year)	N/A	0
		Mechanical troubles (hours/year)	N/A	218
		Regular inspections (hours/year)	N/A	1,096
	Frequency of suspension of operations (times/year)*		N/A	10
	Fuel consumption (1,000 tons/year)*		N/A	1,863
Transmission Lines	Transmission loss rate (%)		N/A	0.4
Ports and Harbors	Berth occupancy rate (%)		N/A	60
	Total cargo volume (1,000 tons/year)		N/A	4,000

* Per unit

(2) Qualitative Effects

Diversification of energy sources

Stabilization of electricity supply through strengthening of supply capacity

(3) Internal Rate of Return

Based on the assumptions listed below, the economic internal rate of return (EIRR) for the Project is 14.7%,and the financial internal rate of return (FIRR) is 1.9% for the power generation / port and harbor / access road, and 9.8% for power transmission.

【EIRR】

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

Benefit: The difference in cost between electricity generated by the Project (with-project case) and electricity purchase from private power producers (without-project case) (including operation and maintenance cost)
Project Life: 41 years

【FIRR】
<Power generation / Port and harbor / Access road>
Cost: Project cost (for the power plant, port, harbor and access road), fuel costs, operation and maintenance costs
Benefit: Sales revenue for electricity (Power Purchase Agreement)
Project life: 41 years

<Power transmission>
Cost: Project cost (for transmission lines), operation and maintenance costs
Benefit: Revenue from transmission charges
Project life: 41 years

5. External Factors and Risk Control

(1) Preconditions: Conclusion of procurement agreements for imported coal needed to operate the power plant.
(2) External Factors: N/A

6. Lessons Learned from Past Projects

The results of the ex-post evaluation of the Mombasa Diesel Generating Power Plant Project (evaluated in 2005) in the Republic of Kenya demonstrates that appropriate support from the manufacturers enhances the sustainability of power plant projects. For the Project, technology transfer from the Consultant and long-term service agreement with manufacturers will enhance the operation and maintenance structure, and organizational strengthening consultants will be employed to enhance the administrative capacity of the executing agency.

7. Evaluation Results

Under the Project, a highly efficient coal-fired power plant that runs on imported coal will be constructed to contribute to the diversification of energy sources and expand the capacity of Bangladesh to supply electricity in response to rapidly increasing demand for electricity; therefore, 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. The project will also contribute 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 indicated in Sections 4.

(2) Future Evaluation Schedule

Ex-post evaluation: Two years after the project completion

END