Ex-Ante Evaluation (for Japanese ODA Loan)

South Asia Division 1, South Asia Department, JICA

1. Basic Information

Country: India
Project Name: Project for the Construction of Turga Pumped Storage (I)
Loan Agreement：November 2, 2018

2. Background and Necessity of the Project

(1) Current State and Issues of the Power Sector in India

India's energy consumption continues to increase with recent rapid economic growth. Accordingly, it has become the third largest power consuming country in the world after China and the USA (Source: International Energy Agency "Atlas of Energy 2015"). The countrywide electricity supply and demand in India indicates an actual supply shortage of 0.7% in FY2016 (supply amount was 1,135,334 GWh against demand amount of 1,142,929 GWh), and peak supply capacity lacked 1.6% (supply capacity was 156,934 MW against the demand amount of 159,542 MW). Although it had an improving tendency compared with FY2015 (supply shortage was 2.1%, and peak supply capacity shortage was 3.2%), electricity was still in short supply (Source: Central Electricity Authority of India "Load Generation Balance Report"). In addition, the Government of India upholds measures including diversification of power sources for the purpose of ensuring stable power supply by maintaining stable balance of energy, use of highly efficient power sources, and reduction of carbon dioxide emissions, as well as introduction and utilization of renewable energy as one of its measures to increase sustainability. The Ministry of New and Renewable Energy of the Government of India aims to introduce 100 GW of renewable energy by FY2019 and 175 GW by FY2022, adopting the "Renewable Energy 175 GW Plan."

Located in the eastern part of India, the state of West Bengal has the nation's fourth largest population of about 90 million people and is the tenth largest state in India in terms of electricity consumption, accounting for about 4.38% of energy consumption. Although the state runs short of electricity supply volume by 0.3% (FY2016) against the demand, the electricity supply is comparatively stable against the national average (0.7%). However, the state with the sixth largest economic scale in the country is expected to achieve further economic development and increase in electricity demand. Peak demands and required power generation amount are expected to increase from 7,544 MW and 52,358 GWh respectively in FY2015 to 11,172 MW and 62,926 GWh in FY2019 respectively. It is necessary to further improve the supply capacity (Source: Ministry of Power of the Government of India, Department of Power and Non-Conventional Energy Sources of the Government of West Bengal "Power for All - West Bengal").

The state government also established a renewable energy policy in 2012 aiming at expanding the renewable energy generation capacity to 2,706 MW by 2022. In 2014, West Bengal State was tasked with introducing renewable energy generation capacity of 5,386 MW by 2022 in a part of "Renewable Energy 175 GW Plan." On the other hand, the output of solar power generation fluctuates greatly due to weather and other factors. When the short-term supply and

demand balance breaks down, the frequency will exceed the appropriate value, which will lead to problems with the stable supply of electricity (securing quality). Under such circumstances, with the increase in electricity demand and the increase in the ratio of renewable energy, improvement of regulated power supply required to maintain the quality of supplied electricity is an urgent task. In order to respond to this task, pumped storage power generation, which can easily adjust power supply, is a suitable form. In “Draft National Electricity Plan” announced by the Central Electricity Authority of India in 2016, it is stated that there is a need to increase the number of pumped storage power plants as the power source contributing largely to power system stabilization and peak power supply under the situation where an increase in the renewable energy is expected. Project for the Construction of Turga Pumped Storage Project (hereinafter referred to as "this Project.") is positioned as an effort to contribute to the stable electricity supply in West Bengal State and the relevant region’s power system by strengthening peak power supply capacity and system stabilization measures.

(2) Japan’s and JICA’s Cooperation Policies for the Power Sector and the Priority of this Project

In Japan’s Country Assistance Policy for India (March 2016), diversification of power sources and others are listed as priority fields for the purpose of stabilized power supply as one of the measures for strengthening industrial competitiveness. JICA Country Analysis Paper for India (March 2018) also indicates the significance of taking measures in response to rapidly advancing urbanization and improving infrastructure for highly productive industry development. This Project coincides with the above policy and analysis. In addition, the 9th Japan-India Energy Dialogue (May 2018) launched “Japan-India Energy Transition Cooperation Plan,” which includes that both countries promote the cooperative ties in the efforts to install variable-speed type pumped storage power generators in order to clarify the roadmap for renewable energy promotion. This Project promotes variable-speed type pumped storage power generation, and it also meets the above policy. For the Indian power sector, there are 80 ODA loan approval cases totaling 1,243.1 billion yen as of September 2018. For the West Bengal State power sector, ODA loan was provided to Purulia Pumped Storage Project (total approved amount of 62.1 billion yen) for the past three periods, contributing to the stabilization and expansion of the power supply in the state.

This Project is considered to contribute to Goal 7of the SDGs "Ensure access to affordable, reliable, sustainable and modern energy for all."

(3) Other Donors’ Activities

The World Bank is providing support for the power transmission and distribution network reinforcement project in the northeastern states including Meghalaya State and Assam State. In addition, the Asian Development Bank supports Assam State in strengthening its power sector, as well as providing assistance in terms of improvement in transmission and distribution networks, hydro power generation, energy efficiency improvement, etc.

3. Project Description

(1) Project Objective

This Project aims to strengthen peak power supply capacity and power system stabilization measures by constructing pumped storage power plants (two fixed-speed pumping units and two variable-speed pumping units) in Purulia

District in the state of West Bengal of eastern India. Thereby it also aims at contributing to the economic development and improvement in living standard of the state.

(2) Project Site/Target Area
Purulia District in West Bengal State (State population: 91,270 thousand people [2011], State area: 88,752 km^2)

(3) Project Components
1) Civil works: Upper dam (rockfill dam), lower dam (concrete dam), spillway, powerhouse construction, etc.
2) Hydro mechanical equipment: Construction of power intake, penstock, etc.
3) Electro mechanical equipment: Construction installation, etc. of two fixed-speed pumping units (250 MW), two variable-speed pumping units (250 MW), and one power transformer.
4) Transmission line: Construction of 400 kV transmission line, etc. (Paid by the executing agency)
5) Preparatory work: Improvement of a main access road, an access tunnel, etc. (partly paid by the executing agency)
6) Consulting services (basic design, detailed design, bidding assistance, construction supervision, organizational capacity development, etc.)

(4) Estimated Project Cost
112,134 million yen (of which, the total ODA loan amount is 81,018 million yen with 29,442 million yen as the tranche 1)

(5) Schedule
October 2018 – November 2028 (122 months in total). Completion of trial operation of all power generators (scheduled for May 2027) shall be the completion of the project.

(6) Project Implementation Structure
1) Borrower: President of India
2) Guarantor: None
3) Executing Agency: West Bengal State Electricity Distribution Company Limited (WBSEDCL).
4) Operation and maintenance agency: WBSEDCL

(7) Collaboration and Division of Roles with Other Projects and Donors
1) Japan's assistance activities
JICA had been assisting Purulia Pumped Storage Project for three periods since 1994 (the project was completed in 2008). The above project and this Project contribute to the stabilization and expansion of the power supply in the state in a mutually complementary manner.
2) Other development partners' assistance activities:
None in particular

(8) Environmental and Social Consideration/Poverty Reduction/Social Development
1) Environmental and Social Consideration
(i) Category: A
(ii) Reason for Categorization
This Project falls into the power sector and has influential characteristics, both being shown in the JICA Guidelines for Environmental and Social Considerations (proclaimed in April 2010).
(iii) Environmental Permit
Report of Environmental Impact Assessment (EIA) was formulated by WBSEDCL in April 2016. According to India's Environmental Impact

Assessment Notification of 2006, an environmental clearance was obtained from the Ministry of Environment, Forest & Climate Change in July 2018. Tree felling permission (forest clearance) was obtained in April 2018

(iv) Anti-Pollution Measures

As wastewater and waste disposal of excavated soil will be generated from work site and the labors' camps during the construction works, they are scheduled to be disposed of in the surrounding areas of the construction site after wastewater treatment such as installation of sedimentation pond and reuse of excavated soil during the construction work.

(v) Natural Environment

The target area of the project does not fall within or near areas susceptible to the impact of the construction works such as national parks, etc. It is identified that individuals or a small group of Asian elephants sometimes appear during the agricultural harvesting period. The area does not fall into the category of habitat. According to the policy of this Project, when Asian elephants appear in the project site, they shall be induced outside of the project site using crackers and torches without hurting them. In addition, information on Asian elephant appearance is to be gathered by the contractors. In order to integrate ways to contact the Local Ranger Office, it is planned to establish a stakeholder committee consisting of Divisional Forest Office of Purulia, local residents, and the contractor. Although 241 ha of deforestation is planned, the forest does not fall under a primeval forest or a tropical natural forest prescribed by the JICA guidelines. Accordingly, substitution trees for the same land space will be planted under the management of Forest Department of the state government, and the environmental impact will be reduced.

(vi) Social Environment

This Project requires 292 ha for the pumped storage power plant and the related facilities, and 7.8 ha for ROW for transmission lines and the base of pylons, among which 285 ha is public land and 14.8 ha is private property. There is a possibility that the private property will be used as a soil collection site. In case it is decided to be used as such, a lease contract will be exchanged and no land acquisition will occur. Meanwhile, as several households are engaged in farming on some of the public lands, it is planned that livelihood recovery support measures will be taken according to Indian domestic laws and JICA guidelines.

(vii) Other/Monitoring

Based on the environmental control plan and the environmental monitoring plan, the contractors monitor the water quality, waste, ecosystem, livelihood, etc. under the supervision of the consultant during construction works. At the time of service, WBSEDCL will conduct monitoring on water quality, accidents, etc.

2) Cross-cutting Issues:

Measures against infectious diseases: Since it is assumed that many workers engaged in this Project will be living without family, the risk of HIV infection will be high. Accordingly, plans for HIV prevention activities shall be formulated, so that the contractors will be obliged to take measures based on the plan.

3) Gender Classification:
(GI) Gender informed
<Activities/Classification Rationale>
In this Project, although gender mainstreaming needs were investigated in the preparatory survey, concrete measures for gender equality and women's empowerment was not taken. This Project is therefore categorized as "Gender informed."

(9) Other Important Issues
None in particular

4. Targeted Outcomes

(1) Quantitative Effects
1) Performance Indicators (Operation and Effect Indicator)

Indicator	Baseline (Actual value in FY2018)	Target (2029) [Expected value 2 years after project completion]
(1) Operation Indicator		
Operating time • Pumping (hours/year) • Power generation (hours/year)	 - -	 2,466 1,825
Change in output speed (%/min)	-	100*1
(2) Effect indicator		
Generation Capacity in West Bengal State (MW)	16,318*2	17,318
Maximum output (MW)	-	1,000
Energy generation of transmission end (GWh/year)	-	1,803

*1 The faster the output change speed, the more quickly it is possible to adjust the supply volume according to the electricity demand.
Reference) Thermal power plant (coal, petroleum), 1-3%/min
Thermal power plant (natural gas), 1-8.3%/min

*2 Based on materials provided by the executing agency

(2) Qualitative Effects
• Power supply stabilization in the state
• Investment promotion through improvement of infrastructure environment
• Economic development and improvement of standard of living in West Bengal State

(3) Internal Rate of Return
Under the conditions indicated below, the economic internal rate of return (EIRR) and the financial internal rate of return (FIRR) will be 32.1% and 9.4%, respectively.

[EIRR]
Cost: Project, operation, and maintenance expenses (excluding tax)
Benefits: Reduction of alternative materials (project costs and operation and maintenance costs of combined cycle power plants that can supply electricity equivalent to this Project)
Project Life: 44 years

[FIRR]
Cost: Project, operation, and maintenance expenses
Benefits: Power sales income
Project Life: 44 years

5. Prerequisites / External Factors

(1) Prerequisites
None in particular
(2) External Factors
None in particular

6. Lessons Learned from Past Projects

In the ex-post evaluation results of India's "Umiam Hydro Power Station Renovation Project" (Evaluation year: fiscal 2006), etc., personnel changes frequently occurred among the power generation, transmission, and distribution sections within the executing agency, and between the operation section and maintenance section of the power plant, which made it difficult to train personnel with expertise. The lesson taken from this is that it is necessary to maintain knowledge and know-how in power plants over the medium to long term and to develop human resources appropriately through providing training to engineers working at the power plants, etc. In this Project, a consensus is built with the executing agency: to minimize personnel transfers of core persons, to conduct technology transfer concerning designing, construction management, procurement management, etc., and to contribute to effective power plant operation including providing technical guidance on operation and maintenance of the variable-speed type pumped storage power generators in the contractor contracts. In addition, it is decided that the personnel department of the executing agency will establish a training program tailored to the level of each hierarchy as an annual plan, and monitor the target number of participants and its achievement results.

According to the ex post evaluation results (Evaluation year: fiscal 2016) of Purulia Pumped Storage Project, which was conducted by the same executing agency as this Project, the fact that delay in obtaining forest clearance led to delay in construction schedule is reported. In this Project, however, there is no such problem, as forest clearance has already been obtained. In the above project, the contractors reported that there was a discrepancy concerning the method of price adjustment of the construction fee between the executing agency and the contractor, and a dispute concerning the payment occurred. Concerning price adjustment method of the construction fee, one of the factors for this is considered to be that the price adjustment method of the construction fee was ambiguous in the contract, as there were no standard bidding documents in those days. Today in international competitive biddings, the standard bidding documents formulated by JICA are obliged to be used, and JICA shall agree on the contract. In this way, efforts are made to eliminate unilateral or ambiguous conditions in the contract.

7. Evaluation Results

This Project, being consistent with the development issues and development policies of the country and cooperation policies and analysis results of Japan and JICA, will contribute to the economic development and improvement in living standard of the state through strengthening peak power supply capacity and power system

stabilization measures, and it is thought that it will contribute to Goal 7 of the SDGs, "Ensure access to affordable, reliable, sustainable and modern energy for all." Accordingly, there is highly necessary to support the implementation of this project.

8. Plan for Future Evaluation

(1) Indicators to be Used
Same as 4. (1) - (3)

(2) Timing of the Next Evaluation
Ex-post evaluation: 2 years after project completion.

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