



1. Project Data

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|------------------------------|---|
| Project ID P159807 | Project Name Dispatch Improvement Project |
| Country Bangladesh | Practice Area(Lead) Energy & Extractives |

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|--------------------------------------|---|--|
| L/C/TF Number(s) IDA-60100 | Closing Date (Original) 31-Dec-2021 | Total Project Cost (USD) 15,727,388.36 |
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|--|---|
| Bank Approval Date 26-Apr-2017 | Closing Date (Actual) 30-Jun-2025 |
|--|---|

| | IBRD/IDA (USD) | Grants (USD) |
|---------------------|-----------------------|---------------------|
| Original Commitment | 59,000,000.00 | 0.00 |
| Revised Commitment | 20,510,420.00 | 0.00 |
| Actual | 15,727,388.36 | 0.00 |

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2. Project Objectives and Components

a. Objectives

The Original Project Development Objective (PDO) was to “improve the reliability and efficiency of the power system in Bangladesh through optimization of dispatch operation.” (Financing Agreement, page 5). The PDO was phrased identically in the Project Appraisal Document (PAD) (PAD, page ii).

The PDO was not revised during implementation.



For the purposes of this Implementation Completion and Results Report (ICR) review, the PDO is assessed as a whole rather than separating reliability and efficiency outcomes. Although the Project pursued both outcomes, there is an overlap in the intermediate results indicators (IRIs) in the Results Framework (RF) across the outcomes (as reflected in the ICR's Theory of Change), and parsing the PDO would not add value. Nonetheless, the reliability and efficiency outcomes are covered separately in the efficacy section.

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

Yes

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

No

c. Will a split evaluation be undertaken?

No

d. Components

1. Original components

The Project supported Phase 1 of Bangladesh's power system dispatch modernization. Phase 0, implemented in 2015, included limited-duration Free Governor Mode Operation (FGMO) trials to assess the feasibility of narrowing the frequency bandwidth and plant willingness to participate. Phase 1 (the Project) aimed to establish continuous FGMO with at least 30 participating generation plants, supported by physical investments, contractual arrangements, and grid code amendments. Phase 2 was expected to achieve a fully automated system dispatch.

Component 1: Technical Assistance (cost at appraisal: US\$8.0 million; actual cost: US\$1.6 million) consisted of two sub-components:

- **Sub-component 1.1 Primary Frequency Control Trials and Training** aimed to finance expert assessments of existing frequency control and dispatch systems, modeling studies, primary frequency control trials at 30 or more plants, and training for Power Grid Company of Bangladesh (PGCB) and National Load Dispatch Centre (NLDC) engineers and operators on frequency controls and dispatch protocols.
- **Sub-component 1.2 Capacity Building and Institutional Review** would include training on modern control theory and operational frequency regulation through governor response and secondary control, as well as building capacity on power system dynamic modeling using Power System Simulation for Engineers (PSSE). The institutional review aimed to identify pathways for implementing merit-order dispatch and make recommendations for transitioning to Automatic Generator Control (AGC) and fully modernized dispatch (possibly supported by a follow up Bank operation). Awareness raising on modern dispatch would target key institutional stakeholders.

Component 2: Operational Enhancements (cost at appraisal: US\$47.0 million; actual cost: US\$14.0 million) consisted of three sub-components:

- **Sub-component 2.1 Integration of Generators in the NLDC's Supervisory Control and Data Acquisition (SCADA) System/Energy Management System (EMS)** aimed to finance hardware for



generation plants to be fully effective in implementing controls, including Remote Terminal Units, SCADA systems, generator controls, Automatic Voltage Regulators, and power system stabilizers.

- **Sub-component 2.2: Modernization of the NLDC's SCADA/EMS Software** would finance software for real-time economic dispatch control, operator load flow, and Automatic Generation Control (AGC) and modeling power system dynamics.
- **Sub-component 2.3: Optimization Software for Dispatch** would support fuel- and transmission-constrained dispatch optimization simulations, including integrated with the SCADA/EMS system.

Component 3: Removal of Transmission Bottlenecks and Improvement of Voltage Quality (cost at appraisal: US\$22.0 million; actual cost: US\$3.5 million) consisted of two sub-components:

- **Sub-component 3.1 Line Upgrade** would address transmission capacity bottlenecks and enhance system transfer capability.
- **Sub-component 3.2 Dynamic Line Rating (DLR)** would improve transmission capacity on six critical transmission lines identified by PGCB.

2. Revised Components:

- **Sub-component 3.2 (DLR)** was dropped at Restructuring 3, as its objectives had already been met by sub-component 3.1 and by PGCB.
- **Sub-component 2.3 (dispatch optimization)** was merged into sub-component 2.2 at Restructuring 3, as it was logically part of the EMS.
- **Financing for PGCB's telecommunication system (under sub-component 2.2)** was canceled at Restructuring 4 due to procurement delays.

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

Project Cost: The appraisal estimate was US\$77.0 million, and the actual disbursement was US\$19.1 million.

Project Financing: The Project was financed through an IDA credit of US\$59.0 million at appraisal, with US\$16.4 million disbursed at closure (ICR, page 5) – a reduction of US\$42.6 million. This reduction reflects cancellations of US\$33.5 million at Restructuring 3 (February 2024), US\$7.0 million at Restructuring 4 (November 2024), and US\$3.5 million at Restructuring 5 (May 2025). The remaining gap is due to exchange rate fluctuations - the loan was nominated in Euros, while expenditures were in Bangladeshi Taka and US dollars.

Borrower/Recipient contribution: The Borrower's contribution amounted to US\$18.0 million at appraisal, with US\$2.7 million disbursed at closure (ICR, page ii).

Project Dates: The Project was approved on April 26, 2017, and became effective on February 14, 2018, an almost 10-month delay. The mid-term review (MTR) was in July 2019. The Project was restructured five times: (i) on December 23, 2021; (ii) on November 9, 2023; (iii) on February 28, 2024; (iv) on November 27, 2024; and (v) on May 3, 2025. The original closing date of December 31, 2021, was extended three times,



totaling 42 months (three years and six months), to June 30, 2025, which was the Project's actual closure date.

Restructurings: Five restructurings were undertaken, with Restructurings 3-5 involving scope reductions. In total, US\$43.98 million of IDA commitment (75 percent of approval amount) was cancelled due to the cancellation of activities that either could not be completed prior to closure or were redundant by the time the Project was ready to implement them, the removal of contingencies, and reduced costs - including due to fewer participating plants under Component 2 and the shift of many expert-led trainings to home country-based delivery under Component 1.

Restructuring 1 (December 23, 2021) extended the closing date from December 31, 2021, to October 31, 2023 (22 months).

Restructuring 2 (November 9, 2023) extended the closing date from October 31, 2023, to January 31, 2024 (three months) to complete ongoing procurement for FGMO implementation, SCADA/EMS updates, and telecommunications equipment. Procurement not resulting in, or close to, contract award by January 31, 2024, was to be dropped.

Restructuring 3 (February 28, 2024):

- Canceled US\$33.51 million of uncommitted/unutilized IDA credit (57 percent of the appraisal total) and dropped activities that were no longer needed or could not be completed by closure, as decided during Restructuring 2.
- Removed sub-component 3.2 *Dynamic Line Rating (DLR)*, as redundant - its objective was already met through sub-component 3.1 *Line Upgrade* and other projects by PGCB.
- Merged sub-component 2.3 into sub-component 2.2, as it is part of the EMS.
- Made limited revisions to the Results Framework (RF):
 - Replaced the PDO indicator "Projected fuel saving (Mega Joules (MJ))" with "Generation merit order dispatch system implemented (Yes/No)", which directly reflects intended Project results and is easier to measure. This change did not constitute a reduced ambition.
 - Dropped the intermediate results indicator (IRI) "Number of DLR installed", following the cancellation of sub-component 3.2.
- Extended the closing date from January 31, 2024, to June 30, 2025 (17 months or one year and five months) to allow for the recent contracts to be completed.

Restructuring 4 (November 27, 2024):

- Canceled US\$6.97 million of IDA credit (12 percent of the appraisal total) and removed the telecommunications activity under sub-component 2.2, as it could not be completed within the Project timeframe due to procurement delays.
- Updated Project risk ratings in response to civil unrest and interim government inauguration.

Restructuring 5 (May 3, 2025 – two months prior to Project closure) canceled US\$3.5 million of IDA credit (six percent of the appraisal total), which could not be utilized before closure.



Split evaluation. Although the Project scope was reduced under Restructurings 3-5 with the cancellation of multiple activities, the RF targets were not revised. As a result, conducting a split evaluation is not feasible; the reduced scope is ultimately reflected in the level of target achievement.

3. Relevance of Objectives

Rationale

Country and Sector Context. At the time of Project appraisal, Bangladesh's power infrastructure deficit was a major constraint on development, with frequent outages affecting both economic activity and households. Per capita annual electricity consumption was 407 kWh - among the lowest globally and in South Asia - while access to electricity reached 78 percent of population. The Government aimed to double installed generation capacity from 2016 levels by 2021, making expansion and modernization of the transmission system critical. The 2014 nationwide blackout underscored the urgency of strengthening power system reliability. In response, the Government launched a system reliability study, and the World Bank conducted analytics to identify technical solutions. The Power Grid Company of Bangladesh (PGCB) faced three core challenges: (i) absence of primary frequency control, risking cascading outages, while underfrequency triggered automatic feeder tripping and preemptive use of costly oil-fired units; (ii) inadequate reactive power support, causing unstable voltage and disrupting supply; and (iii) dispatch inefficiencies, as generation was not consistently scheduled according to merit order due to limited automation and optimization. Grid constraints and natural gas shortages forced dispatch of more expensive oil-fired plants versus gas-fired units, reducing efficiency. The Project aimed to upgrade the power system to enable optimized dispatch, enhancing system reliability and efficiency. (ICR, pages 1-2)

Relevance to Government Strategies at closure. At closure, the Project remained aligned with the Government's long-term strategy, the Eighth Five Year Plan (8FYP) 2021–25, which emphasized improving the quality of transmission and distribution to address inefficiency and constraint issues, alongside cleaner energy mix and rational demand projection. The Government planned to add significant transmission infrastructure to support uninterrupted and reliable power supply. The energy sector strategic document Integrated Energy and Power Master Plan (IEPMP) 2023 supports more reliable and efficient transmission by ensuring adequate transmission capacity, preventing bottlenecks, planning for system flexibility to handle changes in demand and supply, maintaining stable grid frequency, and enabling efficient dispatch of electricity.

Relevance to the WBG's Assistance Strategies at closure. The Project was aligned with the WBG Country Partnership Framework (CPF) FY2023-27, Objective 8 "Enhanced Sustainability and Productivity in the Use of Natural Capital for Climate-Smart Green Growth." A reliable power system with robust frequency control enables the operator to balance real-time fluctuations in renewable output, facilitating integration of variable energy. Optimized dispatch prioritizes least-cost generation, typically favoring renewables over costly oil and diesel. Improved system balancing lowers technical losses, further enhancing efficiency. Frequency stabilization is also critical for integrating the forthcoming Rooppur Nuclear Power Plant, which requires a tight frequency band for safe operation. (ICR, page 6)

Previous sector experience. The Project supported Phase 1 of Bangladesh's power system dispatch modernization, building on Phase 0 (2015) which included limited FGMO trials and laid the foundation for the Project's support to continuous FGMO operation. It also drew on lessons from prior World Bank projects



in Bangladesh and beyond, including the Bangladesh *Rural Electricity Transmission and Distribution Project* (P129920) and *India Fourth Power System Development Project* (P101657). The latter was a long-term Bank engagement with the India Central Transmission Utility, which transformed into a leading global transmission company. (PAD, pages 11-12)

The relevance of objectives is rated High. The PDO was aligned with Government and World Bank strategies in effect at Project closure, addressed the country's urgent development needs, and was set at the right level.

Rating

High

4. Achievement of Objectives (Efficacy)

OBJECTIVE 1

Objective

To improve the reliability and efficiency of the power system in Bangladesh through optimization of dispatch operation.

Rationale

The Project's theory of change (ToC) was not included in the PAD but was prepared for the ICR (ICR, page 2). It closely reflected the Project logic in the PAD, outlining activities, outputs, immediate outcomes, short-/medium-term outcomes, and long-term impacts. To achieve the PDO, the Project supported activities in three areas: (i) TA, (ii) operational enhancements, and (iii) removal of transmission bottlenecks. Expected outputs were, by activity area: (i) assessment of governor/SCADA/EMS/telecom, a dispatch improvement study, grid code amendments, primary frequency control studies, and training; (ii) upgrades of governors and excitation systems, and installation of SCADA/EMS and optimization software; and (iii) transmission line upgrades and installation of DLR. Expected immediate outcomes were: (i) improved NLDC control of generators and a narrower frequency band; (ii) an operational merit order dispatch system; and (iii) increased transmission transfer capacity. Expected short-/medium-term outcomes were: (i) improved reliability (reduced unserved energy and outages); and (ii) improved efficiency (fuel cost savings). Critical assumptions were: (i) generating plants cooperate with PGCB and NLDC in implementing frequency controls; and (ii) fuel supply - particularly natural gas - would be adequate.

The ToC captured the main expected outputs and outcomes, adequately reflecting the causal links, and the critical assumptions were meaningful.

At closure, the RF included two PDO indicators: (i) unserved energy due to underfrequency (GWh), and (ii) generation merit order dispatch system implemented. Fourteen IRIs tracked progress in: frequency band reduction and outages, upgrading generation units, establishing NLDC control over generators, assessing SCADA/EMS/telecom systems, amending the grid code, upgrading transmission lines, installing EMS and optimization software, and completing the dispatch study. The RF was aligned with the ToC and the PDO.



Some IRIs supported specific PDO indicators (e.g., IRIs on frequency band supported PDO indicator 1 on unserved energy, while the IRI on dispatch study supported PDO indicator 2 on dispatch), others supported both PDO indicators (e.g., the IRI on transmission line upgrades), and others monitored outcomes (e.g., IRIs on outages).

IRI results:

I. Technical Assistance:

1. “Minimum frequency (Hertz (Hz))” (baseline: 48.7 Hz; target: 49.5 Hz). Achievement at closure was 49.3 Hz; the target was 75 percent (substantially) achieved. This reflects the highest minimum frequency during the three months after FGMO operationalization in June 2025. It is reasonable to expect the target to be reached soon, as system-wide frequency stability remained in the targeted band 99.6 percent of the time during the five months after full operationalization of the FMGO, with the Project contributing significantly to this outcome (ICR, pages 6-7).
2. “Maximum frequency (Hz)” (baseline: 51.4 Hz; target: 50.5 Hz). Achievement at closure was 50.95 Hz; the target was 50 percent (partially) achieved. See comment on IRI1.
3. “Number of staff trained” (baseline: zero; target: 45 staff). Training covered SCADA and EMS systems and relevant applications (ICR, page 18). Achievement at closure was 40 staff; the target was 88.9 percent (substantially) achieved, with gender-specific target (share of female staff trained) only 25 percent (barely) achieved. However, many of the originally planned international expert-led trainings were replaced by locally-based ones due to issues with hiring consulting firm Monenco (ICR, pages 4–5; see details under 2.e).
4. “Dispatch Improvement Study completed (Yes/No)”. Target was met by Project closure.
5. “Grid Code amended (Yes/No)”. Target was not met by closure. However, consultant’s recommendations for Grid Code revisions were submitted to the Grid Code Review Committee; and approval is expected by early 2026 (ICR, pages 11, 18).

II. Operational Enhancements:

1. “Number of generation units with governor and excitation system upgraded/replaced (baseline: zero; target: 15 units). Achievement at closure was 30 units, as all Project-supported 30 plants were upgraded as planned; the target was met.
2. “EMS & Optimization software installed (Yes/No)”. Target was met by Project closure.
3. “NLDC control on generators (Number)” (baseline: zero; target: 15 generators). Achievement at closure was 30, as all Project-supported 30 plants were fully capable of running in FGMO by Project closure, as planned; the target was met.
4. “Assessment of governor, SCADA, EMS, and telecom systems completed (Yes/No)”. Target was met by Project closure.

III. Removal of Transmission Bottlenecks and Improvement of Voltage Quality:



1. “Number of DLR installed (Yes/No)”. Achievement at closure is unknown; the indicator was dropped during Restructuring 3, as this outcome had already been achieved through line upgrades by the Project and other PGCB investments.
2. “Transmission line constructed or rehabilitated under the Project (km)” (baseline: zero; target: 40). The achievement at closure was 34.3 km; the target was 85.8 percent (substantially) met.
3. “Number of outages per year due to underfrequency (Yes/No)”. Achievement is unknown; post-closure data were unavailable due to data recording errors (ICR, page 6).
4. “Cumulative duration of power outages per year due to underfrequency (hours)” (baseline: 407; target: 166). Achievement is unknown; post-closure data were unavailable due to data retrieval challenges (ICR, page 6).
5. “Number of citizen engagement events on power supply quality” (target: 3). Fifteen events were conducted; the target was exceeded.

PDO results:

PDO indicator 1. “Unserviced energy due to underfrequency (GWh)” (baseline: 5.08 GWh; target: 2.08 GWh). FMGO became operational shortly before Project closure, so data were not yet available at closure. Limited post-closure data indicate 9.63 MWh, negligible compared with the target. However, it is reasonable to expect the target will be met soon, as system-wide frequency stability remained within the targeted band 99.6 percent of the time following full FMGO operationalization, with significant Project contribution (ICR, pages 6-7).

PDO indicator 2 (original). “Projected fuel saving (MJ)”. Result at closure is unknown; the indicator was replaced at Restructuring 3, as measuring it proved difficult - the appropriate methodology was not available to PGCB.

PDO indicator 2 (at closure). “Generation merit order dispatch system implemented (Yes/No)”. Introduced at Restructuring 3 as directly reflecting intended result and easy to measure (Restructuring Paper, page 7). Target was not met at closure: although EMS was upgraded, the merit-order dispatch functionality had not been utilized (ICR, page 17).

Overall Results: Outcomes on Reliability, Efficiency, and Training (cross-cutting):

I. Power System Reliability

The Project contributed to improvements in power system reliability, and while PDO indicator 1 (unserved energy) was unmet by closure, it is reasonable to expect it will be met in the near future, as FMGO became operational shortly before closure, and system-wide frequency stability (directly supporting PDO indicator 1) was within the targeted 49.5-50.5 Hz band 99.6 percent of the time during the five months after full FGMO operationalization, compared with 55.8 percent in the preceding nine months. While exact attribution to the Project is unknown given parallel investments, it is notable: Project plants accounted for 30 of 67 FGMO-capable plants (3.6 GW of 18.5 GW), representing 20 percent of capacity and 45 percent of plants. However,



data for other outcome-level IRIs on reliability – outage frequency and duration – could not be used due to recording errors. (ICR, pages 6-7, 12)

Other reliability-related IRIs performed well: generation unit upgrades and governor assessments exceeded targets; transmission line upgrade target (both a reliability and efficiency indicator) was substantially met; and Grid Code amendments are expected to be approved by the Grid Code Review Committee in early 2026. Also, the Project played a catalytic role by creating capacity for the nationwide FGMO rollout (ICR, page 7).

II. Power System Efficiency

The Project contributed to efficiency improvements; however, PDO indicator 2 on full merit order dispatch was not met, and dispatch operationalization remains uncertain (ICR, page 8) and unlikely to be achieved soon. Specific results were delivered: SCADA and EMS systems were upgraded and integrated with dispatch engines capable of running optimization algorithms, and five Area Load Dispatch Centers were established. However, EMS applications were only partially functional, and automated merit order dispatch was not in regular use. Key constraints included incomplete data inputs, system tuning needs, coordination issues with the Bangladesh Power Development Board (BPDB), cancellation of the telecom upgrade, and gas supply limitations. Transmission lines' congestion was reduced, but PGCB was unable to quantify resulting efficiency gains (ICR, pages 7-8).

Performance on primarily efficiency related IRIs was as follows: the dispatch study was delivered, EMS and optimization software installed, and transmission line upgrades - relevant for both reliability and efficiency - were substantially achieved.

III. Training

The target number of staff trained was substantially met, but training was not fully delivered as expected; many originally planned programs were cancelled; and international expert-led activities were replaced with locally-based ones.

Rating. The efficacy rating is Modest. Neither PDO indicator was fully met by closure. Reliability outcome – unserved energy reduction - is expected to be met in the near future, but efficiency outcome - operationalized merit-order dispatch, remains uncertain. Nevertheless, multiple intermediate results supporting PDO outcomes were met.

Rating
Modest

OVERALL EFFICACY

Rationale

The Project's efficacy is Modest. While the Project contributed to improved frequency control and efficient dispatch by delivering multiple intermediate outcomes that supported the achievement of PDO outcomes, neither of the two PDO indicator targets were reached by closure. The outcome on improved reliability



(reduction in unserved energy) is expected to be reached soon, as the FMGO in the participating plants was operational by Project closure. However, the outcome on improved efficiency (merit order dispatch system) is less likely to be achieved soon, as its operationalization is being delayed.

Overall Efficacy Rating
Modest

Primary Reason
Low achievement

5. Efficiency

a. Economic Analysis (PAD, pages 53-60); ICR, pages 27-31):

Approach. A cost-benefit analysis (CBA) was conducted at both appraisal and closure using comparable methodologies, with a 12-percent discount rate and a 5-year Project life, focusing on economic benefits from improved frequency control (enhanced reliability). Component 1 was not included, as CBA is generally not conducted for TA. Other investments were excluded for different reasons at appraisal and closure. At appraisal, benefits from improved dispatch and transmission were estimated as substantial but excluded due to high uncertainties (PAD, page 59). At closure, benefits from improved dispatch were not estimated because it was not yet operational and expected gains had not materialized, and input data for transmission improvements were not available.

Results. At appraisal, CBA yielded a positive net present value (NPV) of US\$41.1 million and an economic internal rate of return of 46.0 percent (PAD, page 60). At closure, NPV declined to a negative -US\$1.94 million, and EIRR fell to six percent (ICR, page 30).

Conclusion. The Project did not generate sufficient economic returns to justify the investment. Both NPV and EIRR were notably lower at closure than at appraisal, reflecting cost inefficiencies in implementation. The Project was economically viable at appraisal, with a positive NPV and an EIRR exceeding the opportunity cost of capital (i.e., the discount rate), but not at closure, as NPV was negative and EIRR fell below the discount rate.

b. Administrative Efficiency:

The ICR noted that the Project's design was characterized by a clear structure, strong implementation logic, and technically feasible activities. It was informed by prior assessments, successful frequency control trials, and Bank analytical work. Risk analysis at appraisal identified macroeconomic, political, sector strategies, technical design, institutional capacity, fiduciary, environmental, and stakeholder risks, with an overall risk rating of substantial, and mitigation measures were designed. The Bank team included experts with strong knowledge of the country and the implementing agency. Bank supervision was consistent and proactive, issues were addressed proactively, and financial management (FM) was adequate. (ICR, pages 10-11, 14-15)

However, the Project faced significant inefficiencies, including the cancellation of 75 percent of IDA funds, a 3.5-year implementation delay, and weaknesses in progress tracking. Specifically:

- **Fund cancellations.** Overall, US\$43.98 million of the IDA commitment (75.0 percent of the appraisal cost) was cancelled, and multiple activities were dropped.



- **Delays.** Completion was delayed by 3.5 years, including a 10-month gap between Project approval and effectiveness, and an additional 2.5 years before the critical consultancy contract became effective. The main causes of delays included:
 - **Delays in contracting the Iranian consulting firm Monenco** affected the entire Project. Due to U.S. sanctions on Iran, the contract was signed only in February 2019. Government clearance took 20 months, making it effective in September 2021 – just three months before the original Project closure. Challenges in opening a foreign bank account and processing transactions added delays. This reflected an oversight, as the risks of contracting a firm from a sanctioned country -particularly for a core activity - were not adequately assessed during preparation.
 - **Limited mitigation of institutional and contractual risk at appraisal.** Stakeholder engagement focused on PGCB despite BPDB’s central role in operational decisions and dispatch practices. Unresolved institutional and contractual issues – including amendments to BPDB–generator contracts to compensate generators for costs they can incur through FMGO participation - led to prolonged coordination with BPDB and other stakeholders during implementation and delayed the operationalization of both FMGO and merit-order dispatch.
 - **Lengthy Government clearances** resulted in a 10-month lag between approval and effectiveness, including three months needed for approval by the National Economic Council and another five months to finalize the subsidiary loan agreement.

Overall, while the design was technically feasible and informed by prior assessments and trials, and supervision was hands-on, these strengths were substantially offset by negative economic returns (pointing to an unjustified investment), delays, the cancellation of 75 percent of funds and multiple activities, and weaknesses in result monitoring. Accordingly, the efficiency rating is Negligible.

Efficiency Rating

Negligible

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 | ✓ | 46.00 | 20.80 <input type="checkbox"/> Not Applicable |
| ICR Estimate | ✓ | 6.00 | 34.60 <input type="checkbox"/> Not Applicable |

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

6. Outcome

Relevance of objectives is rated as High, efficacy as Modest, and efficiency as Negligible. Thus, the overall outcome is rated as Unsatisfactory.



a. Outcome Rating

Unsatisfactory

7. Risk to Development Outcome

Institutional incentives. The Project built technical capability for FGMO, enabling all 30 supported plants and leading to its operationalization by June 2025, and contributed to developing technical capacity for merit-order dispatch, but operational use of these results has been delayed. Sustained functioning of FMGO depends on proper incentives, including contract-based remuneration, as FGMO can impose costs on generators. Currently, generators are compensated for such costs without formal contracts, risking discontinuation, which could lead to reduced FGMO participation. A similar risk applies to the merit-order dispatch system, where uncertainties – such as unclear division of responsibilities and coordination between PGCB and BPDB/IPPs - persist. Legacy take-or-pay PPAs may also conflict with merit-order dispatch, requiring regulatory and contractual changes. Aligning incentives, resolving contractual conflicts, and clarifying operational responsibilities is critical for sustainability of FGMO and merit-order dispatch Project results.

Natural gas availability. Adequate natural gas supply is essential for stable FGMO operation and merit-order dispatch, as roughly 40 percent of FGMO-capable plants are gas-based. Ongoing gas shortages limit the use of this cheaper fuel, constraining merit-order dispatch. Without a credible plan to expand domestic supply, secure liquefied natural gas (LNG) imports, or diversify the generation mix, the expected benefits from improved frequency response and optimized dispatch will remain limited.

Transmission capacity and system integration. The Project removed critical transmission bottlenecks, but rapid demand growth and the addition of large new power plants are increasing strain on the network. Without timely investments in transmission and telecommunications infrastructure, PGCB and NLDC may continue to face limitations in implementing real-time economic dispatch. Weaknesses in communications and control systems further increase these risks. Strengthening transmission and control infrastructure is essential to sustain the benefits of the Project's transmission upgrades.

8. Assessment of Bank Performance

a. Quality-at-Entry

The Project was prepared based on prior assessments, frequency control trials, and Bank analytical work. The activities were technically feasible, the design was logical, and preparation benefited from strong international and local expertise. Risk rating at appraisal was Substantial, and mitigation measures were identified. (ICR, pages 10-11, 14)

However, major preparation shortcomings led to delays, the cancellation of 75 percent of the original IDA financing and multiple activities, and constrained decision-making. First, an oversight led to hiring



Monenco, a consulting firm from a US-sanctioned country (Iran), for a core activity - the contract became effective only three months before the original Project closing date, and many activities were not implemented as planned or dropped. Second, critical institutional and contractual issues were overlooked: stakeholder engagement focused on PGCB despite BPDB's central role in dispatch and frequency response, and issues with contracts – including amending BPDB–generator contracts to compensate generators for costs they incur due to FMGO participation – were unresolved. These gaps led to prolonged coordination with BPDB and other stakeholders, delayed the operationalization of FMGO and merit-order dispatch, and posed risks to the sustainability of outcomes. Third, M&E processes, with unclear data sources and methodologies, and irregular, incomplete data collection, hindered progress tracking and decision-making. (ICR, pages 10-11, 14-15)

Overall, Bank performance at Entry is rated Moderately Unsatisfactory: the design was technically strong, but key risks were overlooked, and effective M&E was not established.

Quality-at-Entry Rating Moderately Unsatisfactory

b. Quality of supervision

The ICR noted that Bank supervision was consistent and proactive, with regular missions - at least two per year – and technical meetings, providing hands-on support, reviewing implementation, and addressing arising issues, including through restructurings. At least one co-task team leader (co-TTL) was based in the country. Although there were four TTLs overall, transition was smooth, and core fiduciary and safeguards specialists were retained throughout implementation. (ICR, page 14)

However, there were shortcomings. Issues stemming from the oversight at preparation were not fully addressed. Although PGCB considered terminating the contract with Monenco, the Bank decided to proceed with hiring, as cancellation would require significant time and effort considering procurement rules. Inadequate M&E arrangements were insufficiently addressed: data collection quality remained poor, and neither of the two PDO indicators was adequately tracked, limiting reporting and informed Project management. Opportunities to revise the RF during restructurings were missed. Also, implementation was impeded by prolonged coordination with BPDB and other stakeholders.

Overall, Bank performance at Supervision is rated Moderately Unsatisfactory. While supervision was consistent and hands-on, multiple issues – many rooted in preparation oversight - were insufficiently addressed, constraining implementation.

Quality of Supervision Rating Moderately Unsatisfactory

Overall Bank Performance Rating Moderately Unsatisfactory



9. M&E Design, Implementation, & Utilization

a. M&E Design

The RF at design reflected the logic of Project interventions, aligning with the PDO. The indicators measured objective and mostly specific results and included both quantitative and binary (Yes/No) indicators that were time-bound and attributable to the Project. Both PDO indicators at design were directly linked to the PDO and measured its achievement. Most IRIs were at the intermediate outcome or output level and supported the PDO indicators, although some tracked separate outcomes (i.e., the IRIs on outages).

However, M&E arrangements had significant shortcomings, including unclear or infeasible data sources and methodologies and insufficiently specific indicator definitions, which negatively affected M&E implementation. Notably, the methodology for measuring PDO Indicator 2 on fuel savings was not shared with PGCB, despite having been used at appraisal. The ICR further noted that the RF appears not to have been sufficiently discussed with or owned by the implementing agency during design. PGCB even reported that it was initially unaware of the RF (ICR, page 12, 16)

b. M&E Implementation

The ICR presented evidence of persistently inadequate M&E implementation. Data collection and reporting were irregular and sometimes inaccurate. PDO indicator 1 on unserved energy was never rated, and PDO indicator 2 on merit-order dispatch was consistently rated “not achieved”, with no data on progress. Even after Project closure and FGMO operationalization, PGCB was unable to provide all required disaggregated data (e.g., on underfrequency-related events). Concerns also remain regarding the validity and attribution of reported data, including on staff trained and on outage frequency and duration, which were recorded with errors. These weaknesses impeded monitoring necessary for efficient course correction. While restructuring provided opportunities to adequately revise M&E processes and the RF, they were not used. (ICR, page 12)

c. M&E Utilization

The ICR reported that, due to inadequate results reporting, M&E data were only partially utilized for Project management and decision-making. The M&E system did not support a comprehensive assessment of progress toward achieving the PDO, or decision making.

The M&E Quality is rated Negligible. M&E design, implementation, and utilization were inadequate, and necessary revisions were not made during restructurings.

M&E Quality Rating

Negligible

10. Other Issues



a. Safeguards

Environmental and Social (E&S) Safeguards. At appraisal, the Project was classified as Environmental Category B (Partial Assessment), triggering Environmental and Social Assessment (OP/BP 4.01) and Involuntary Resettlement (OP/BP 4.12), mainly due to transmission line upgrades. An Environmental and Social Management Framework (ESMF) and a Resettlement Policy Framework were prepared and disclosed prior to appraisal. The ICR reported that Project activities were implemented in accordance with the ESMF, with site-specific Environmental Codes of Practice, Environmental Management Plans, and Social Management Plans prepared once the lines were identified. No households were affected; therefore, a Social Impact Assessment or Resettlement Action Plan was not required, and no adverse impacts on livelihoods were observed. A Grievance Redress Mechanism (GRM) was put in place, and no grievances were recorded by Project closure. (ICR, page 13) Safeguards performance was rated as Satisfactory in the last six Implementation Status and Results Reports (ISRs).

b. Fiduciary Compliance

Financial management (FM). The ICR reported that FM performance was adequate throughout implementation. FM risks were rated Substantial at appraisal, and the implementing agency initially faced FM challenges - mainly related to unfamiliarity with the Special Commitment mechanism employed by the Project and some audit issues - but these were promptly resolved. PGCB’s FM team was competent, and quarterly Interim Unaudited Financial Reports (IUFRs) and annual audits of Project financial statements were submitted on time. All audit opinions were unqualified. FM performance was rated Satisfactory or Moderately Satisfactory in the last six ISRs, and Moderately Satisfactory in the final ISR. (ICR, pages 13-14)

Procurement. The ICR reported that the main procurement issue was the prolonged hiring of the Iranian consulting firm Monenco, with the contract becoming effective only three months before the original Project closing date due to the US sanctions on Iran. Additionally, a procurement complaint led to the cancellation of one package under Sub-component 2.2, reducing the scope of Project delivery. No other procurement issues were reported in the ICR. Procurement performance was rated Moderately Satisfactory in the last six ISRs. (ICR, pages 13-14)

c. Unintended impacts (Positive or Negative)

d. Other

11. Ratings

| Ratings | ICR | IEG | Reason for Disagreements/Comment |
|---------|----------------|----------------|----------------------------------|
| Outcome | Unsatisfactory | Unsatisfactory | |



| | | |
|------------------|---------------------------|---------------------------|
| Bank Performance | Moderately Unsatisfactory | Moderately Unsatisfactory |
| Quality of M&E | Negligible | Negligible |
| Quality of ICR | --- | Substantial |

12. Lessons

The following lessons were derived from the ICR (ICR, pages 15-16):

1. Accounting for stakeholder institutional roles and power dynamics during project preparation - and aligning design and implementation arrangements accordingly - is critical for energy sector projects. In this Project, achieving the intended outcomes required actions beyond the implementing agency’s (PGCB’s) mandate, particularly under BPDB’s political and contractual authority. However, the Project focused on engaging with PGCB and missed early coordination with BPDB, leading to a misalignment between Project objectives and BPDB practices. In hindsight, involving BPDB as a co-implementing agency and addressing contractual and incentive barriers to system-wide FMGO and merit-order dispatch with BPDB at preparation would have improved implementation. If this was not feasible, reducing Project ambition and adopting a narrower, more technical scope within PGCB’s control would have been preferable.

2. Full understanding and ownership of the RF and M&E processes by the implementing agency are essential, with accessible data and measurable indicators. The Project faced significant challenges in tracking progress and using M&E data for course corrections due to M&E deficiencies and limited ownership by PGCB, which even reported being initially unaware of the RF. Indicator definitions and measurement methods were unclear, and data availability was limited. Original PDO indicator 2 on fuel savings was dropped because the appraisal methodology used by a Bank expert was not shared with PGCB. Several indicators were not measurable at the intended granularity or required disaggregation that PGCB struggled to extract. Both PDO indicators and some IRIs were difficult to assess at closure, as outcomes would materialize only with a lag.

3. Proactive and anticipatory implementation support from the task team is critical to project performance. In this Project, significant delays arose when a core consultancy was awarded to a firm from a US-sanctioned country (Iran). Post-Project interviews noted that the Bank’s support was largely reactive rather than proactive. However, the Bank’s experience could have enabled it to advise the PMU prior to launching the procurement or at least during the evaluation stage. In addition, persistent weaknesses in the M&E system were also not fully addressed during implementation. Given PGCB’s consistent inability to report on indicators, the task team could have recognized M&E shortcomings and taken corrective actions, particularly during the Project’s multiple restructurings. More proactive engagement by the task team may have improved implementation and outcomes.

13. Assessment Recommended?



No

14. Comments on Quality of ICR

The ICR provides comprehensive technical information and strong analysis, and presents a well-justified assessment of the Project's results. It is logical and internally consistent, clearly linking evidence to findings and providing transparent discussion of Project weaknesses. The sections on lessons learned, risks, revisions and restructurings, key factors of implementation, context and approval, PDO relevance, and M&E implementation are informative, succinct, and exceptionally well written. Overall, the rating is Substantial.

a. Quality of ICR Rating
Substantial