SUMMARY OF PROJECT PERFORMANCE

A. Background

1. The Green Power Development Project was approved on 29 October 2008. The Asian Development Bank (ADB) has provided loans of $80 million for Dagachhu hydropower development (a 126 megawatt (MW) run-of-river type hydropower plant), aiming at exporting clean renewable energy from Bhutan to India through the exiting grid connection between the two countries. The project has another component on rural electrification, which targets at providing access to electricity to 8,886 households and public institutions (e.g., schools, clinics, and community facilities) in rural areas on an on-grid and off-grid basis, using renewable energy sources (i.e., hydropower and solar power).

2. For the Dagachhu hydropower component, the executing agency is the Druk Green Power Corporation (DGPC), and the implementing agency is the Dagachhu Hydro Power Corporation (DHPC). The rural electrification component is mainly the responsibility of the Bhutan Power Corporation (BPC). The overall project is to sustain the country’s inclusive economic growth, by promoting cross-border power trade and domestic electricity access in parallel. The power export revenue helps Bhutan sustain affordable electricity prices for domestic users and generate additional government financial resources to promote socioeconomic development for rural areas.

3. The overall project has been on track and will be physically completed by 31 December 2013 (i.e., loan closing date). However, Dagachhu has had to incur increased costs in civil works due to (i) bad rock conditions, and (ii) price inflation. Specifically, the Dagachhu civil works encountered far more fragile geological conditions, in contrast to the results of the feasibility study. Particularly, the tunnel excavation works required extra reinforcements on account of the unexpected poor geological conditions. As a result, the civil work costs were increased over time. The costs were also affected by the high price escalation of labor and materials. These two things combined raise Dagachhu’s overall cost estimates by 16.6%. In spite of these cost increases, the project remains technically sound and financially and economically viable.

B. Performance of the Project

4. The Dagachhu plant construction is near completion. The overall project has been performing well and satisfactory on ADB’s project performance rating system. The project meets the following standard performance criteria:

5. Expected delivery outputs. The Dagachhu hydropower component has been progressing well to deliver expected outputs: (i) constructed Dagachhu hydropower plant, and (ii) improved DGPC management systems. DHPC will complete all construction works of the Dagachhu plant by the loan closing date of 31 December 2013. There will be no loan extension. The DGPC managerial capacities have been enhanced over the past five years since the project planning, through ADB’s capacity development technical assistance. DGPC effectively set up its comprehensive business function covering corporate planning, procurement, internal control, human resources management, financial management, safeguard control, and management information systems.

6. The progress of the rural electrification component under the project has been satisfactory. BPC has already achieved a targeted number of households electrified within the planned cost and timeframe. It helps the government advance its goal of electricity for all from
2020 to 2013. The government has achieved almost 90% in a nation-wide electrification as of the end of 2012.

7. **Satisfactory implementation progress.** Both contract and disbursement records have been satisfactory. All the contracts have timely been awarded. More than 98% of the ADB finance has already been disbursed, except for residual interest during construction. About 95% of Dagachhu’s physical construction has been completed, and the remaining works are highly likely to be completed by the original loan closing date.¹

8. **Satisfactory compliance with safeguard policy requirements.** All the environmental and social safeguard loan covenants have been complied with. Before and during implementation, appropriate safeguard actions have been undertaken to ensure compensation for losses of partial land and crops for the affected people, fish ladder design, minimum ecological flows, air, soil, and water quality monitoring, waste management, health awareness activities, and, among others. The project has additionally been making significant contributions to the well-being of the communities, bringing about various positive impacts to the locality, such as employment opportunities, improved access to health services and education, and tree planting. The detail is described in the social safeguard compliance assessment and the environmental safeguard compliance assessment.²

9. **Successful risk management for implementation.** The project has well-managed the major risks identified during the project appraisal. DGPC and DHPC have established effective arrangements of the off-take, clean development mechanism (CDM), currency risk mitigation; overall risks to the project’s financial sustainability are deemed minimal. In spite of geological surprises and the resultant cost increase, DGPC and DHPC have technically managed the construction schedule; no loan extension is required. The public and private project sponsors effectively controlled all the project activities including procurement, disbursement, safeguards, contracts, construction, supervision, and coordination among the stakeholders throughout the project implementation.

10. **On track rating.** The overall project has been rated on track in the project performance rating since the system started. The project performance is satisfactory in terms of technical performance, contract awards, disbursements, financial management, and safeguard compliance.³

C. **Cost Overruns**

11. The cost overrun is a function of unexpected geological conditions found during underground excavation of civil works. The original civil work cost of the Dagachhu hydropower component was estimated at $80.5 million. After an international competitive bidding, the contract price fell within this original estimate. During implementation, it has been increased by $33.6 million. As a result, the revised total cost of civil works will be $112.1 million. The major factors of the cost increase are (i) bad rock conditions in underground works, and (ii) price inflation of labor and materials. The increased costs breakdown is evaluated in Table 1.

¹ The main works outstanding are (i) 0.3 km of tunnel excavation (out of 11 km in total), and (ii) overall aligning. The remaining rock conditions in the tunnel are in good order. The electromechanical equipment has been installed in an underground powerhouse. The transmission line is ready to evacuate power.

² Social Safeguard Compliance Assessment and Environmental Safeguard Compliance Assessment (accessible from the list of linked documents in the report and recommendation of the President, Appendix 2).

³ Includes timely submission of audited financial statements and safeguard monitoring reports.
Table 1: Increased Costs and Factors

<table>
<thead>
<tr>
<th>Factors</th>
<th>Increased Cost ($ million)</th>
<th>Share of total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Bad rock conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Price variation</td>
<td>8.3</td>
<td>25</td>
</tr>
<tr>
<td>b. Additional Works</td>
<td>10.7</td>
<td>32</td>
</tr>
<tr>
<td>Subtotal (i)</td>
<td>19.0</td>
<td>57</td>
</tr>
<tr>
<td>(ii) Price inflation</td>
<td>14.6</td>
<td>43</td>
</tr>
<tr>
<td>Total (i + ii)</td>
<td>33.6</td>
<td>100</td>
</tr>
</tbody>
</table>


12. **(i) Bad rock conditions.** This factor accounts for 57% of the total cost overrun. Increase in the civil work cost was mainly due to various geological surprises in the excavation of underground tunnels and powerhouse. It is hard to perfectly investigate geological conditions in the entire excavation areas in advance during the feasibility and engineering studies.\(^4\) During implementation, the excavation works encountered poorer subsoil, such as mica-bearing rocks in extensive areas. Mica-bearing rocks were easily collapsed; the civil works required additional reinforcements to sustain the roofs of tunnels and powerhouse by installing more steels, cements, and labor. The unexpected geological conditions have resulted in (a) price variation within the original work contract, and (b) additional works which was newly added to the scope of the original contract (i.e., contract variations).

13. **(a) Price variation due to bad rock conditions.** In the civil work contract, excavation works are defined and categorized in five different rock classes,\(^5\) which have different unit rates based on geological conditions. The higher unit rates are applicable to the worse rock conditions because of the additional reinforcing materials and time of the works. To date, a wide range of worse rock conditions has significantly increased the excavation cost of the civil works. Through in-depth analysis of contractual and disbursement data, it was found that the price variation within the contract amounted to $8.3 million in the additional civil work cost.

14. **(b) Additional works due to bad rock conditions.** Besides the above price variation within the contract, bad rock conditions have resulted in 22 additional works such as replacement of concrete column by steel one, strengthening of tunnel structure with pipe roofing, extra cavity treatment etc. They were required to maintain the permanent stability of the underground tunnels and powerhouse. Additional works due to these contract variations was $10.7 million.

15. **(ii) Price inflation.** This secondary factor represents 43% of the total cost overrun. As shown in Table 2, the compounded inflation in Bhutan is 46.13% from the project preparation to implementation periods (2008-2012). The annual domestic inflation was projected at 5% at appraisal for the implementation period. However, higher inflation has been recorded in all the years during project construction period besides 2009. While inflation has slowed down from 13.53% to 8.37% over 2012 to 2013, the inflationary factor remains higher (Figure 1). The current trends indicate that Bhutan’s inflation may be slowing but it is forecast that more than 7% will continue for the next years.

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\(^4\) The feasibility studies were conducted by an experienced international consulting/engineering firm under the financial assistance from the government of Austria.

\(^5\) There are five rock classes including class 1: good, class 2: slightly good, class 3: slightly bad, class 4: bad, and class 5: loose.
16. The civil work contract includes a price variation clause (PVC) in respect of labor, cement, fuel, and steel. These items cover an 85% weight of the total civil works, and their PVC is based on each of their price indices of August 2008. For example, the consumer price index of labor has increased by 57.2% from August 2008 to May 2013. Higher inflation rates have directly impacted these unit prices. This has significantly increased the PVC base payments to the civil contractors. Their price variation formulas are in Table 3.

### Table 3: Price Variation Formulas

<table>
<thead>
<tr>
<th>Components</th>
<th>Formula</th>
<th>Weight (P)</th>
<th>Base Price Index (ib)</th>
<th>Current Price Index (ic)</th>
<th>Increased Percentage (2008-2013)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor(^a)</td>
<td></td>
<td>30.0%</td>
<td>145.0</td>
<td>228.0a</td>
<td>57.2%</td>
</tr>
<tr>
<td>Cement(^b)</td>
<td>(V = 0.85 \times P / 100 \times R \times (ic-ib) / ib)</td>
<td>15.0%</td>
<td>137.7</td>
<td>169.8b</td>
<td>23.3%</td>
</tr>
<tr>
<td>Fuel(^c)</td>
<td></td>
<td>15.0%</td>
<td>33.2</td>
<td>48.3c</td>
<td>45.8%</td>
</tr>
<tr>
<td>Steel(^d)</td>
<td></td>
<td>10.0%</td>
<td>150.4</td>
<td>166.4d</td>
<td>10.6%</td>
</tr>
</tbody>
</table>

\(R = \) Total value of the works done during the period concerned, \(V = \) variation (increase or decrease in the cost of work).

\(^a\) Source: All-India Average Consumer Price Index Numbers for Industrial Workers as of May 2013 issued by Labor Bureau, Government of India.

\(^b\) Source: Price indices for Cement & Lime as of May 2013 issued by Economic Advisor, Ministry of Industry, Government of India.

\(^c\) Source: The official retail price of High Speed Diesel (HSD) oil for Phuentsholing outlet as of May 2013 issued by Ministry of Economic Affairs, Royal Government of Bhutan.

\(^d\) Source: Price indices for Steel (Long) as of May 2013 issued by Economic Advisor, Ministry of Industry, Government of India.
C. Conclusion

17. The overall project has been performing well in terms of (i) delivery outputs, (ii) implementation progress, (iii) compliance with safeguard policy requirements, (iv) risk management for implementation, and (v) on track record of the project performance rating system throughout the project implementation. The cost increase was majorly caused by some exogenous factors. Despite the cost overrun, the project remains technically sound, economically feasible, and financially viable.

18. The outstanding major excavation works have been progressed. They are very short distance in tunneling. The excavation works are being conducted in both points from upstream and downstream of the tunnel in parallel. The rock conditions in both points are found identical and manageable. The excavation works are highly likely to be completed earlier than the end of December 2013 (i.e., loan closing date of the original loans).

19. The government accords the highest priority to completion of the project, which is in line with the national development priorities in boosting export revenue through cross-border power trade and increasing domestic electricity access. The project is consistent with the development objectives and the country partnership strategy. Thus, the project fully meets eligibility criteria for additional financing.