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The Four Borders Project: Reliability Improvement and Power Transfer in South Asia

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List of Acronyms

AC	Alternating Current
BOOT	Build-Own-Operate Transfer
BPDB	Bangladesh Power Development Board
CERC	Central Electricity Regulatory Commission
CIER	Commission of Regional Power Integration (South America)
DC	Direct Current
DPR	Detailed Project Report
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
GOI	Government of India
GWh	Gigawatt hours
HEP	Hydroelectric Power Plant
HVDC	High Voltage Direct Current
IPP	Independent Power Producers
IRR	Internal Rate of Return
MOU	Memorandum of Understanding
NEA	Nepal Electricity Authority (Nepal)
NPV	Net Present Value
NTPC	National Thermal Power Corporation of India
PGCB	Power Grid Corporation of Bangladesh
PGC IL	Power Grid Corporation of India, Ltd.
PDB	Power Development Board
PPA	Power Purchase Agreement
PTC	Power Trading Corporation of India
Rs.	Rupees (India)
SAARC	South Asian Association for Regional Cooperation
SADC	Southern African Development Community
SARI/Energy	South Asia Regional Initiative in Energy
SAPP	Southern Africa Power Pool
SAPTA	South Asia Preferential Treaty Agreement
SEB	State Energy Board (India)
TSO	Transmission System Operator
USAID	United States Agency for International Development
USEA	United States Energy Association

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Executive Summary

PURPOSE OF THIS STUDY

The purpose of this pre-feasibility study is to provide guidance to regional power sector stakeholders as well as governmental policy-makers as to the possibilities for interconnecting transmission systems of Bangladesh, Bhutan, India, and Nepal in what is referred to in the report as the "Four Borders Region."

This regional interconnection (the "Four Borders Project") could provide significant benefits to regional economies through closer cooperation on regional power transfer, enhanced system reliability, improved security and diversity of supply, increased economic efficiency in system operation, reduced environmental impacts, and lower costs to consumers. It also could help attract private sector investment to the regional power sector.

This study is intended to be the first step in bringing this project concept to reality. It is expected to serve as the basis for further discussion and analysis, which will result in the identification of additional issues and questions that need to be addressed if this project is to move from concept to actuality. Accordingly, this report identifies additional technical assistance that may be required to move the project to the next stage in the development process. The results of this pre-feasibility study could eventually form the basis for design and development of a specific cross-border project upon completion of a more detailed project feasibility report.

ASSESSMENT OF PROJECT OPTIONS

Three technically viable options for the interconnection that would provide for multilateral power exchange were analyzed. These would locate the interconnection in India at either the Siliguri (West Bengal) or Purnea (Bihar) substations without using land in the constrained "chicken-neck" region of northeastern India. These options are:

- **Option A:** Limited Power Transfer – based on a 132 kV system;
- **Option B:** Moderate Power Transfer with Accelerated Development – based on developing a 220 kV system in advance of the system developments in Nepal and Bangladesh; and
- **Option C:** Moderate Power Transfer with Phased Development – based on developing a 132 kV system initially, which would be upgraded to a 220 kV system in conjunction with power sector developments in Bangladesh and Nepal.

PRINCIPAL RESULTS

The results of this analysis include:

- **Option C,** which incorporates a phased approach to developing the proposed Four Borders Project, best serves as the basis for establishing regional power transfer and trade and is the preferred option.

- Transfer of surplus power available from hydropower plants in Nepal and Bhutan through this interconnection can help reduce power deficits in India and Bangladesh.

- Preliminary power flow analysis indicates that the proposed interconnection would improve system stability and reduce transmission system losses in the region by about 90 MW.
- The options assessed would permit the transfer of power from 50 MW up to approximately 500 MW.
- Investment requirements for these options would be minimal, ranging from approximately $9 million to $52 million.
- Estimated levelized transmission costs for the options range from 2.6 cents per kWh for power transfers of 50 MW to 0.2 cents per kWh for transfers of 500 MW.
- All of the options analyzed have positive rates of return, which increase significantly with the level of power transfer.
- The options reviewed in this report could be easily implemented within the 2005-2010 time period.
- All of the options have minimal environmental impacts, as they rely extensively on existing facilities.

RECOMMENDATIONS AND NEXT STEPS

To achieve these benefits and to make the proposed Four Borders Project a reality, it is recommended that a Working Group be established consisting of regional stakeholders representing India, Bangladesh, Bhutan, and Nepal to review the proposed project, serve as a liaison with energy ministries and other sector stakeholders, and develop and oversee an implementation strategy. Major elements of this strategy should include:

- Develop and execute an Inter-Governmental Memorandum of Understanding, which would establish principles for power trade and transfer among the countries to promote an integrated regional transmission system for the benefit of all parties.
- Develop and execute an Inter-Utility Memorandum of Understanding for regional transmission system operators that establishes the operating principles and rights and obligations of participants and the procedures for ensuring full cost recovery and equitable sharing of benefits;
- Prepare a detailed project report for the World Bank and the Asian Development Bank that meets all of the requirements for developing, financing, and implementing the proposed regional interconnection; and
- Establish an Environmental Assessment Team with representatives from Bangladesh, Bhutan, India and Nepal to address environmental and social issues associated with this project and coordinate with the Working Group.

This implementation strategy could be supported by technical assistance provided by USAID under the SARI/Energy Project. Activities that could be provided under the SARI/Energy Project include:

- Review the regional energy supply/demand balance and confirm the amount and cost of power available for regional power transfer and trade under the recommended option;
- Validate the recommended interconnection option and perform a detailed integrated resource assessment to further quantify the costs and benefits;
- Identify and select favored options for establishing open transmission access, fair pricing and conditions of service for inclusion in a regional transmission services agreement;
- Review legal and regulatory requirements to support development of the proposed interconnection and provide assistance to draft any necessary changes/additions in rules, regulations, and laws;
- Provide assistance to establish a regulatory regime that would support development of the proposed regional interconnection by coordinating existing or proposed independent regulatory entities in each country; and
- Support development of an initial environmental impact assessment to collect data, assess impacts, and develop mitigation measures that would be implemented through an environmental management plan.

The details of the analysis, including technical and economic evaluations of options and basic data and assumptions are provided in the body of this report. A conceptual configuration for the proposed Four Borders Project is provided in the map below.

Geographic Configuration of the Interconnections