
بسم الله الرحمن الرحيم
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POWER INTERCONNECTIONS

GENERAL POTENTIAL BENEFITS OF GRID INTERCONNECTIONS

- IMPROVING RELIABILITY AND POOLING RESERVES
- REDUCED INVESTMENT IN GENERATING CAPACITY
- IMPROVING LOAD FACTOR AND INCREASING LOAD DIVERSITY
- ECONOMIES OF SCALE IN NEW CONSTRUCTION
- DIVERSITY OF GENERATION MIX AND SUPPLY SECURITY
- ECONOMIC EXCHANGE
- ENVIRONMENTAL DISPATCH AND NEW PLANT SITING
- COORDINATION OF MAINTENANCE SCHEDULES

WHY USE HVDC?

The first commercial use of modern HVDC transmission was in Sweden in 1954. Since the 1980s, when high-voltage solid state converters were developed to replace mercury arc converters, the use of HVDC transmission in interconnection projects has taken off. While still expensive, costs of converter stations have been steadily falling, and HVDC must be considered as an option for many interconnection projects. Unlike long-distance AC transmission, HVDC transmission over long distances has no inherent stability limit. Also, even within AC stability limits (which can be extended through the use of FACTS or other reactive compensation), HVDC can overtake AC on cost grounds alone. This is because HVDC carries more power for a given conductor size and only requires two conductors while AC transmission requires three. Thus, even though converter stations are very expensive, the cost per kilometer of DC transmission lines is lower. Generally, for distances above about 600 km, HVDC transmission is less expensive to build and operate than AC.

AGREEMENTS

LEGAL ASPECTS

- **Power purchase and pricing agreements, including agreements on the currency of payment, the escalation and/or indexing of prices to prices of other energy commodities over time, and penalties if sales or purchase minimums are not met.**
- **Agreements on siting of power lines and related infrastructure, such as routes between generating plants and consuming grids, and placement of substations and interconvert (for AC-DC-AC systems) stations.**
- **Agreements on power line operation, including deciding upon or constituting a joint authority to operate the interconnection, and agreeing on how the power line operator will be governed or overseen by both parties.**
- **Agreements on power line operation will also include agreements on how the interconnection right-of-way is to be maintained.**

- **Agreements on power line security, including agreements on which parties will be liable in the event of different types of incidents resulting in power line damage;**
- **Agreements on the environmental performance of the interconnection, potentially including environmental standards to be met during construction of the line, and environmental and safety (including fire safety) standards to be met during line operation;**
- **Agreements on liability for power line failure, including damages to third parties caused by power line failure;**
- **Agreements for the orderly, fair, and open selection of contractors to build and/or finance and/or operate and maintain interconnection infrastructure, including agreements on how such contractors are to be overseen by parties to the project.**

POLITICAL ASPECTS

- **Agreements in principle as to sharing power resources — political agreement between the two governments that such sharing of resources would be mutually beneficial**
- **Agreements on moving forward with the interconnection project, including agreements on contractor selection, power line routing, and other major decisions**
- **Agreements as to how interconnection project contractors will be paid, and by whom;**
- **Agreements as to how the benefits and costs of the project will be shared between and within nations**
- **Agreements as to how the interconnection infrastructure will be operated and secured, including agreement on the governance of the interconnection operator**
- **Agreements as to the sharing of information necessary to plan, operate and protect the interconnection.**

ISSUES

- TECHNICAL
- ECONOMIC
- LEGAL
- POLITICAL
- SOCIAL
- ENVIRONMENTAL

SUMMARY OF KEY STRATEGIES FOR MAXIMIZING BENEFITS AND MINIMIZING THE COSTS OF GRID INTERCONNECTIONS

Given the potential benefits, costs, national attributes favoring agreements, and barriers to cooperation in each of the six main issue areas covered in this report, some of the key potential overall strategies for reaching the necessary agreements to implement an interconnection project include:

a. Ensure the *fair distribution of economic, social, and other benefits and costs* among the nations involved in an interconnection, as well as among the groups within nations that are “stakeholders” in the interconnection. This is an important element in ensuring that the net benefits of an interconnection are maximized, and that the political, social, and other costs are kept low;

b. Ensure that the *direct costs and avoided costs of an interconnection are specified as accurately as possible*, preferably within the context of comprehensive long-term power system (and overall energy sector) planning. This means that analyses of the economics of power trade across all of the nations involved in an interconnection project (or set of projects) need to be part of both short- and long-term electricity and overall energy sector planning by the project participants;

c. *Emphasize transparency* in all negotiations related to grid interconnections, including allowing all stakeholders access to all relevant materials;

d. Include *all* (or at least all major) *potentially affected parties in the early stages of project formulation*, and continue to solicit the input of all parties on key decisions throughout the project;

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d. Include *all* (or at least all major) *potentially affected parties in the early stages of project formulation*, and continue to solicit the input of all parties on key decisions throughout the project;

e. Establish clear needs and protocols *for collecting and distributing quantitative data and other information* needed for project design, as well as for the accurate estimation of project costs and benefits;

f. Establish *clear legal and administrative authorities* over all aspects of the design, construction, and operation of the grid interconnection. In some cases this may require building legal and regulatory capacity within the participating countries;

g. Work *with and through international and regional institutions*, including international financial institutions, to help smooth the path to political agreement, as well as to assist in providing the capacity for all groups to contribute meaningfully to decisions related to the interconnection;

h. Locate new power lines in *existing transmission or transport corridors* as much as possible;

i. Continue *planning and assessment studies even after the grid integration project is completed*, and avoid the temptation to cease assessment studies when the project is completed;project;

j. Implement *capacity building* to allow different social stakeholder groups to meaningfully participate in investigating and deciding upon grid interconnection options, and in planning for grid interconnection construction and operation;

k. Undertake a thorough *estimate of the significant environmental costs and benefits* that will flow from a grid interconnection. This will require a thorough and systematic study of all of the aspects of the interconnection, the electricity generation facilities feeding the interconnection, and the fuel chains feeding electricity generation, in all of the countries and areas within countries that may be affected by changes in energy sector activity or infrastructure brought about by the interconnection.

THANK YOU