Let's Build a Superhighway

MOVING TO A BETTER POWER GRID

BY STEINAR DALE AND R.H. MEEKER JR.

THE NATION'S TRANSMISSION system is the critical link between the power generators and the power consumers. The traditional role of a transmission system is to provide the most cost-effective generators with access to the loads and to enable an efficient electric power supply market, where the price of electricity varies little over a large geographical region. Though the value of the transmission system is recognized, there is significant under-investment in the transmission infrastructure continues. Mostly, existing regulations and opposition to new lines cause under-investment, not a lack of technologies. Continued under-investment will lead to more congestion, blackouts, volatile prices to the consumers, large profits for the well-placed generators, dominance of local market power, and increased reliability problems.

What is needed is an overarching transmission grid, a national superhighway grid, superimposed on the present interconnected bulk power transmission system to serve as a superhighway for delivering electric power throughout the United States and facilitate competitive regional wholesale electric power markets. The scope of such a grid is a unified national backbone network using 500-kilovolt and even higher-voltage high-capacity transmission lines, including coast-to-coast interconnections. This super grid would connect to utility grids and to unconstrained regional transmission networks operated by regional transmission organizations. Thus, major interstate and intrastate bottlenecks could be removed, including interconnections between adjacent regions as well as the international grids of Canada and Mexico.

This unified national backbone network would serve as a nationwide high-capacity electric power transmission network that would allow economical power delivery from remote low-cost production bases to demand-intensive areas, such as from energy-rich coal fields, river basins, large wind farms and nuclear generation parks. Such a national backbone grid would also allow bulk electric power transfers between adjacent regional transmission systems. Bulk electric power transfers between the Western and Eastern Interconnections would be achieved, as well as bulk power transfers between the United States and Canada and Mexico.

Inevitably, the development of nationwide interconnected power systems will require strategic system interconnections to and between adjacent regional transmission grids. The new high-capacity, long-distance transmission lines must be built to meet the needs of anticipated interregional bulk power transfers for the good of system efficiency and reliability. This super grid backbone system is most likely to be a direct current system, consisting of a combination of overhead lines and underground cables, including high-temperature superconducting direct current cables. It would also involve significant capacity improvement of tie lines at multiple locations in the existing grid of the RTOs and large, vertically integrated utilities. In either case, both high-voltage direct current and flexible alternating current transmission systems could be used for effective controls over the import and export.

A benefit of such an overarching super grid is the creation of a nonmonopolistic and competitive electric energy market. The operation of interconnected power systems would eventually unify electricity prices across the country and significantly reduce the electric energy prices in some high-demand areas. The interconnected power systems would improve the overall system reliability performance. At the given level of capacity reserve margin, the interconnected power systems could provide adequate emergency power from interconnected adjacent regions to the region that is experiencing catastrophic multiple outages, such as the simultaneous loss of several generation units and transmission lines. The super grid would also alleviate the problem of thermal constraints associated with parallel path flow or loop flow problems and facilitate large scale energy storage.

The operation of the interconnected power systems enables the assistance among neighboring systems to cope with incidental load growth, unforeseen delay of new generation or fuel supply transportation projects and extended maintenance outages of major genera-

NewsFlash

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Google would like the United States to consider installing 390,000 megawatts of wind generation and slashing fossil fuel generation 88 percent by 2030, according to *Wind Energy Weekly*.

The proposal, advanced by Eric Schmidt, Google CEO, would cost $4.4 trillion in 2008 dollars, but save an estimated $5.4 trillion.

tion and transmission facilities, thus reducing the possibility of regional energy price spikes. The operation of the interconnected power systems has the significant potential advantage of using the regional load shape diversity that may result from weather condition differences and time zone differences. This would allow the interconnected power systems to reduce the need for expensive peak generation capacity and share system operating capacity reserves.

From an environmental impact point of view, the interconnected transmission systems would provide opportunities for the use of generation with lower emissions. This would help to avoid the effect of greenhouse gases that cause global warming and to avoid other emissions that affect the environment and public health. Interconnected transmission systems also would allow greater use of renewable energy sources that are remote from major population centers. Baseload nuclear plants could be better used if such a national unconstrained grid existed. An interconnection of nonconstrained regional transmission grids would also help to keep a balanced regional generation resource mix so that a temporary shortfall of one type of resource would not cause significant problems. Intermittent renewable energy resources, such as wind, can be treated as "must-run generation," because in the example of wind, a much larger load base balances the resource over different time zones. Wind resources cannot be scheduled as other types of generation, but must be used when the wind is available. Wind resources are often remote and dependent on long-distance transmission. Interconnected transmissions systems would allow taking the full advantage of this renewable, nonpolluting energy resource.

The establishment of such a national grid – a unified national backbone network – would be beneficial to the efficiency and competition of the nation's wholesale electricity markets and would be in the best interest of the consumer. Major questions remain on how to achieve such a grid. It would certainly require significant transmission investments and long-term implementation efforts. Thus, who should pay for the building of the grid and who should operate the grid needs to be debated and resolved.

This idea of a national superhighway grid is not new, but now may be the time to re-examine the need for such an approach under the rubric of a nuclear renaissance and the growth of renewable energy resources needed to meet a carbon-constrained energy delivery.

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Electric Transmission Voltages

HV [HIGH VOLTAGE]
100–230 kilovolts

EHV [EXTRA HIGH VOLTAGE]
230– 800 kilovolts

UHV [ULTRA HIGH VOLTAGE]
800–2,000 kilovolts