Freedom from the Grid

Distributed power generation can forgo elaborate transmission

World over, the traditional means of providing reliable and affordable power has been to build large sized central power plants, lay extensive transmission and distribution lines and finally deliver power to the end-user.

This may soon change. Power generation and technology companies across the world are working on the concept of distributed generation, which calls for generation of electricity on site by means of highly reliable, almost maintenance-free power generators.

Distributed generation refers to small-scale electricity-generating technologies such as microturbines, internal combustion engines, wind turbines, photovoltaics and fuel cells. Power marketers are interested in promoting distributed generation because it appeals to customers as a backup power source and provides generation independent of the grid.

This model of generation enables use of cleaner technologies. In an increasingly environment-conscious society, this is an important benefit. Distributed generation also reduces the need for extensive and often intrusive transmission and distribution systems. In countries like India, where T&D losses are high, this model yields even greater benefits.

Consumers are asking for enhanced power quality and reliability, as well as independence from the grid. But perhaps the most important factor behind the increasing popularity of distributed generation is the progress of the so-called “dispersed generation” technologies. Equipment manufacturers have significantly improved the performance and economics of small-scale dispersed power generation and management systems. For example, microturbines are now available that promise sufficiently low capital and operations and maintenance costs to make self-generation feasible for many more customers with much smaller loads than in the past. Fuel cells are also being commercialised, with additional power quality, environmental and other advantages that may offset potentially higher costs.

Solar and other renewable technologies will also be suitable for location at parti-cular customer sites. Meanwhile, technological “miniaturisation” is likely to continue to keep driving down the unit costs of small generation equipment to keep pace with the falling costs of larger machines.

Distributed power frequently offers additional, site-specific benefits like:

- Power quality for sensitive loads (a particular advantage of fuel cells).
- Savings from cogeneration, now called CHP (combined heat and power).
- Opportunities to despatch on-site generation and load management to reflect local power and gas prices and local needs.
- Avoided costs to the T&D system, reflected in avoided T&D charges. With these benefits, distributed power competes increasingly economically with the market prices of power supplied from the grid.

The new distributed resources have an-other characteristic that makes them quite different from existing central station plants: In most instances, electric power will flow to as well as from the customer. Depending on the relative economics of available supplies (and the rate consequences of different operating decision), the distributed generators may be used either as baseload units, with third-party, grid-based sources supplying the “swing” power, or as peak-shaving units, with the grid supplying the base, off-peak load.

In this interactive world, no generation plant need be an island. This dynamic interconnection of on-site generators with the grid poses real and significant issues such as synchronisation with the grid, routing and accounting for power flows, and assurance of frequency harmonisation. But significant benefits are made possible as well, including the coordinated use of dispersed generation to help compensate for supply outages from central station facilities, or to overcome transmission limitations to serve constrained load " pockets".

Under the old, "cost-plus" paradigm, the assumption was that the retail price of electricity service would equal the sum of the cost of producing transmitting and distributing power to the customer. The new, open-access paradigm shares this basic assumption, while assuming that the electricity production component of the equation would be set by a newly competitive wholesale market.

The economics of distributed generation, however, appear to promise a long-term, unpleasant margin squeeze quite at odds with the traditional equation. The arithmetic is simple. Today, the average cost of production from the generation plant is in the order of 4 cents per kilowatt hour. The average cost of T&D is around 3 cents per kilowatt-hour. In the old, cost-plus world, the retail price was determined by the sum of production, transmission and distribution, yielding average retail prices of around 7 cents per kilowatt-hour.

However, the cost of power from distributed sources is expected to approach, say, 6 cents per kilowatt-hour in many applications and locations. Sometimes this 6 cents may be the cost remaining after charging some costs to products other than commodity power (e.g., power quality or thermal energy). When costs such as these are achieved, the fundamental equation for the next decade is that production, transmission and distribution cannot materially exceed the otherwise available retail price. To put the matter a bit simplistically, 4 cents plus 3 cents must find some way to equal less than 6 cents.

Reference book:
Power Line Volume 4 No. 4
January 2000