Electrical Transmission

For the most part, electricity is generated in a central location and transmitted to the end user. Transmission occurs over the electrical power grid. The grid consists of three basic levels: local delivery lines, regional distribution lines, and major long-distance transmission lines. To deliver electricity to end users requires miles and miles of branching, relatively small wires, together with transformers, circuit breakers, and other equipment. Major transmission lines are large wires that carry huge amounts of electricity, but do not branch so much.[i]

Wire creates friction for the electrical current, which we call *resistance*. The higher the current, the longer the wire, and the thinner the wire, the more the resistance. Resistance uses up energy and creates heat. Use up too much energy, and none is left at the far end. Make too much heat, and the wire sags or even melts. When an electrical transmission line melts or sags, it runs the risk of coming too close to another line, or to a building, a tree, somebody or something passing underneath, or even the ground. The electricity can jump, possibly injuring someone, wrecking equipment, and stopping the delivery of electrical power.

As demand for electricity has soared, in many regions electrical generating capacity has not kept up. There might be enough capacity to handle, for instance, cities on average days, but not during peak demand. During peak demand, they must import electricity from elsewhere. Grid operators have to have sufficient capacity to transmit this imported electricity over their transmission lines without melting or too much sagging. And they have to have sophisticated systems to balance the load when, perhaps, clouds cover one city but not another, or when a cool front passes through one but has not yet reached the other.

When demand or an imbalance reaches the point at which it threatens a major transmission line or generating station, the line or station must disconnect from the grid to save itself. This then increases strain on the rest of the system, and a cascade of lines and stations coming under threat and disconnecting can occur. This is precisely what occurred during the Northeast Blackout of 1965.[ii] That one occurred when a circuit breaker at the Niagara Falls Generating Station tripped, and a cascade followed. Lest anyone think that blackouts are a thing of the unsophisticated past, however, an even larger blackout occurred in 2003. This one, affecting the entire U.S. north and east of Michigan and Ohio, plus the Province of Ontario, originated when a generating station in Eastlake, Ohio, went off-line.[iii] Missouri has never had a regional transmission system blackout like these, but the widespread storm-related power outages of 2006 and 2007 have been reminders that our own grid is not invulnerable.[iv]

Large-scale alternative energy resources are located far from Missouri, posing transmission challenges. In addition, solar and wind power fluctuate with the sunshine or the wind. We will have to invest in our grid if we want it to be able to handle these kinds of resources in the future.

In addition, the electrical grid is perhaps the part of our essential infrastructure that is most vulnerable to terrorism. As historical blackouts have shown, terrorists wouldn't have to destroy a significant part of it, only an essential link at just the right time. Grid security will be an important issue going forward.

[i] *Electrical transmission*. Wikipedia. Viewed online 11/28/2007 at http://en.wikipedia.org/wiki/Electric_power_transmission.

[ii] Many of us remember this from our childhoods. For an interesting article on it, see *Northeast blackout of 1965,* Wikipedia. Viewed online 11/28/2007 at http://en.wikipedia.org/wiki/Northeast_Blackout_of_1965.

[iii] *Northeast blackout of 2003*. Wikipedia. Viewed online 11/28/2007 at http://en.wikipedia.org/wiki/Northeast_Blackout_of_2003.

[iv] These different power outages illustrate the different levels of the power grid. The blackouts in the Northeast affected the power generating stations and the large transmission lines. The ones that affected Missouri involved primarily the distribution system, the myriad small, branching electrical lines that run from substations to homes.