Case analysis: the early bird – electric power load despatching

Business, Industries

Case Analysis: The Early Bird – Electric Power Load Despatching The Early Bird – Electric Power Load Dispatching Electric utility firms have, for more than two decades, used marginal productmarginal cost concepts to generate and dispatch electric power in a more efficient, lowercost manner. Southern Company, the nation’s third largest utility, refers to its load dispatching method as the “ Early Bird” system. Southern’s Early Bird is designed to provide automatic, computerized control of all the company’s power production and transmission facilities.

The Early Bird continuously calculates the marginal cost of delivering additional kilowatts of electricity to Southern Company customers anywhere in the company’s service area; then, as electricity demand rises or falls at points throughout the system, Early Bird transmits “ raise” or “ lower” impulses to the company’s generating units and routes the correct amount of electricity along the most economical transmission path to the end user. Periodically, Southern Company engineers test the operating efficiency of every piece of power-generating equipment the company has in service.

The purpose of the test is to determine how much fuel, labor, and other variable inputs are required to produce electricity with that unit and, subsequently, to calculate a production function for that generating unit. Experience has shown that revised production function equations must be calculated from time to time because normal wear and tear, maintenance problems, and mechanical efficiency vary over time and from generator to generator, depending on who manufactured it, when it was purchased, how long it has been in service, and the reliability with which it has performed.

In other words, the production function for a given generating unit shifts by sufficiently large amounts over time to make it worthwhile to update the input-output equation. The equations for the production functions of each generating unit are then fed into Early Bird and combined with information as to fuel prices, wage rates, and other variable input prices to obtain marginal cost functions; from these, MC values can be calculated for a particular generating unit at whatever rate it is being operated.

In addition, because there is a loss of electricity in the course of “ shipping” it through the transmission wires, Southern engineers make studies to determine the transmission loss coefficients from generating units to distribution substations. These, too, have to be updated several times a year since the transmission loss depends not only on the distance factor but also on the varying load characteristics of the system and changes in the transmission grid.

The marginal cost equations, together with the transmission loss coefficients, are the nucleus for Early Bird’s control of power generation and transmission. When, during the course of a day, the demand for electricity picks up, the Early Bird system is programmed to compare the marginal costs of generation at each on-line unit and then to send impulses to raise the electricity output of the unit (or units) where MC is lowest.

Simultaneously, another Early Bird program analyzes the transmission loss coefficients to calculate how best to allocate the increased load on the transmission grid so as to minimize transmission loss to the many

substations and end-user locations. In similar fashion, when electricity demand falls off (as work shifts end and businesses close at the end of the day), the Early Bird system automatically sends impulses to reduce electricity generation at those power units where MC is highest and reroutes the remaining load to maintain maximum transmission economy and load-generation balance.

At periods of peak demand, when on-line generating units are already operating at or near their minimum cost points, and assuming that water levels in Southern’s dam reservoirs are ample, Early Bird sends impulses to Southern’s hydroelectric facilities to open the gates and generate enough power to get across the peak. Southern’s power system control center is also equipped to forecast short-term loads for the next hour, day, or week. For example, weather data from all round Southern’s four-state service area are fed into the Early Bird network several times a day to help forecast heating and air-conditioning loads.

The hourly, daily, and weekly Early Bird forecasts of upcoming load demands are used to preplan the mix of generating units to put on line and those to put on standby, to schedule maintenance, and to determine whether to exchange blocks of electricity with neighboring utilities. For instance, approximately 15 minutes prior to the beginning of an hour, Early Bird calculations as to the next hour’s generating and transmission costs are made; this information is then compared immediately with similar information obtained from adjoining utilities having interconnections with Southern’s transmission network.

If it is determined that it would be more economical for Southern to buy a “ block” of electricity from an adjacent company than to generate the electricity needed itself (because at the forecasted generating rates the other company will have lower MC than Southern), then an order is placed for that unit at a price set forth in the interchange agreement between the two companies. On the other hand, if Southern’s marginal costs are lower than those of its neighbors, then it may agree to sell a block.

The exchange of electricity among interconnected companies based upon marginal cost calculations is common throughout the electric utility industry. As bigger and faster computers have become available, the functions of the Early Bird system have been expanded to permit. 1. Reductions in unnecessary “ load-chasing,” with resultant savings on maintenance; 2. Monitoring the current operating status of generating units, line flows, voltages, station breakers, and switches as a basis for assessing the prevailing degree of security (reliability) within the system: . Altering the dispatch criteria to allow for reducing power output at a particular facility because of unexpected air or thermalpollution, yet doing so in a way which entails the least increased costs to the system; 4. Operating hydro, steam, combustion, and nuclear generating units in a mix which seeks to minimize fuel costs; and 5. Monitoring temperatures, oil pressures, stream flows, and so on at unattended hydro stations to give early notification of potential troubles.