FEE MODEL FOR THE TRANSMISSION SERVICE IN THE COMPETITIVE POWER MARKET

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ABSTRACT

The competitive structure in the power industry implies in a new electric flow model to become effective the power market. The technological incompatibility between the competitive market and transmission service, such as monopoly, makes ineffective the dynamics operating between these markets and inhibit its management. For example: the two activities that have arisen with the restructuring of the energy sector, the system operator and the spot market have their actions constrained by the incompatibility. That means that the single node model for the flow ($f_{u,v}$) presents in the objective function $0 \le f_{u,v} \le f_{u,v}^{\max}$ does not apply to the competitive structure (full nodal) in face of the inability to manage the flow, and hence the stocks of energy in the short term. The inconvenience [1] identified as a result of the Second Law of Kirchhoff (SLK), becomes the spot market futile in its mission to "store" the electricity at the lowest nodal price criterion, because SKL blocks the energy cheaper. And with that, focus on more expensive energy to be more forthcoming of the consumer; in addition to render the ancillary network. Such limitations of the model imply a flow insufficient to pay the system operator or lines owners, which to depend on the “subsidies” to cover its demand for long-term. Perceiving in front of the problem, that in order to spot market effective is necessary for greater integration between the information generated in that market and the actions of the system operator. And among these actions, allowing a greater flexibility for managing the flow so that the operator enjoys the dynamics of the market on prices and quantities to build the optimum dispatch. This work includes an algorithm of polynomial complexity that promises to make the competitiveness between companies of signal generation and a surplus for the system operator. With the method allowing the choice of the generator, spatially dispersed, and outline the flow of generating up to the consumer markets depending on the efficiency of the line. The flow model purpose has its viability in the restrictions $0 < f_{u,v} < f_{u,v}^{\max}$, managed from a weight matrix ***P***. With the power grid in its steady-state, represented in a graph $G(\Phi, \pi, \mathrm{P})$, mixed, with flow directed from generator to adjacent vertices. Φ and π are supply/demand information in $\{u, v\} \in V$ de G; $p_{uv} \in \mathrm{P}$ parameters set out in arcs $\{(u, v)\} \in A$ of G. And the security constraint in the maximum flow of lines ($f_{u,v}^{\max}$), and work with the "stock" nodal electric power. In the ***P*** matrix takes into account the qualitative and quantitative aspects of the consumer in terms of safety and reliability, and / or efficiency of project by the side of the operator system. With the efficiency tied to the performance of the line η ($0 \le \eta \le 1$); with calculated using the formula: $\eta_{uv} = \mathbf{1} - \Phi_v / \Phi_u$ where: (Φ_u) is the nodal injection (source) in unit power W, and (Φ_v) is the nodal withdrawal (sink), in unit flow *Wh*. With the parameters η staggered elements of the matrix P ($p_{uv} \ge 0$, $p_{uv} \in P$) is the array of network connectivity. It is understood the economic efficiency in the transport when the method chooses

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performance better paths for the "flow" of energy, or minus losses in the transport [2]. The remuneration of the operator follows the dynamics of the spot market by "buying" a regional power, cheaper, and resells it at a premium region. This scheme allows an assessment of pay in the transaction cost, so clear: Let π_u be the nodal price for the sale of energy in the region *u*, and π_v retail price in premium region *v*, the difference $\pi_v - \pi_u$ signals a surplus [3] between regions and that, in principle, should a enough revenue in the short and long term for the "operator of the system". The mathematical model of the electric flow considers the nodal stock of the power plant in *W* and the nodal demand in *Wh.* To become more easy the exposure and understanding of the analysis takes itself as the true security constraints $\sum_u g_u \leq min\ \{ f_{uv}^{\max} \},\ g_u \leq g_u^{\max}$ with g_u corresponding with the stocks of electric power available on the network, with the constraint of nonnegative to the flow ($\phi_{uv} \geq 0$). Under the constraints of nodal flow, or flow conservation $\sum_{\{v:(u,v)\in A\}} \phi_{uv} - \sum_{\{v:(v,u)\in A\}} \phi_{uv} = \Phi(u)$: $\Phi(u)$ takes to be a region exporting or importing electrical power. In the condition $\mathit{\Phi(u)} > \mathbf{0}$, the region is characterized as exporter of energy; while $\mathit{\Phi(u)} < \mathbf{0}$, it is characterized as importer of energy. In the condition $\Phi(u) = 0$ the region presents a time neutrality or in balance supply/demand, or is border crossing point. The statement for the problem that incorporates the actions of the operator and the energy market information being:

$$OSIST = \min\{ \sum_{\{(u,v)\}\in A} p_{u,v}\phi_{u,v}(1) : \sum_{\{u,v\}\in V}(-\pi_u + \pi_v)(-\phi'_{u,v})(2); \text{s.t:} \exists \phi'_{u,v}(2.a); \phi'_{\acute{u},v} \geq 0(2.b) \}$$

s. t:

$$\sum_{\{v:(u,v)\in A\}} \phi_{uv} - \sum_{\{v:(v,u)\in A\}} \phi_{uv} = \Phi(u) \qquad (1.\ a)$$

$$\sum_u \Phi_u = \sum_v \Phi_v \qquad (1.\ b)$$

$$\phi_{uv} \geq 0 \qquad (1.\ c)$$

The first installment of the objective function (1) deals with the optimization of the electrical flow on the grid. The constraint (1.b) counting the loss of electric power in the line to optimal dispatch. The second part of the objective function (2) deals with to "maximize" the surplus, according to the existence of flow $\phi'_{u,v}$ of current generator, in the consumer’s network.

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