

# ON SEARCH OF EQUILIBRIUM IN ORIRES MARKET MODEL

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This report is dedicated to the equilibrium search problem of ORIRES market model, which was considered in [1]. In general case a behavior of company  $l \in L$  could be written down as the following linear programming problem:

$$\sum_{i \in I} \sum_{s \in S} \sum_{t \in T} \tau_s^w (p - c_{li}) x_{list} + \sum_{i \in I} \sum_{s \in S} \sum_{t \in T} \tau_s^h (p - c_{li}) y_{list} - f \sum_{i \in I} k_{li} (z_{li} - z_{li}^0) - \sum_{i \in I} b_{li}^0 z_{li} \rightarrow \max, \quad (1)$$

$$\alpha_{lis} z_{li} \leq x_{list} \leq \beta_{lis} z_{li}, \quad i \in I, \quad s \in S, \quad t \in T, \quad (2)$$

$$\alpha_{lis} z_{li} \leq y_{list} \leq \beta_{lis} z_{li}, \quad i \in I, \quad s \in S, \quad t \in T, \quad (3)$$

$$z_{li}^0 \leq z_{li} \leq \bar{z}_{li}, \quad i \in I, \quad (4)$$

$$\tau_s^w \sum_{t \in T} x_{list} + \tau_s^h \sum_{t \in T} y_{list} \leq g_s z_{li}, \quad i = \text{"HPS"} , \quad s \in S, \quad (5)$$

$$\sum_{t \in T} x_{list} \leq \eta d z_{li}, \quad i = \text{"PSPP"} , \quad s \in S, \quad (6)$$

$$\sum_{t \in T} y_{list} \leq \eta d z_{li}, \quad i = \text{"PSPP"} , \quad s \in S, \quad (7)$$

where  $x_{list}$  and  $y_{list}$  — working capacity of  $i$  type station, belonging to the company  $l$ , in season  $s$  in hour  $t$  in working days and holidays correspondingly;  $z_{li}$ ,  $z_{li}^0$  and  $\bar{z}_{li}$  — installed, minimum and maximum allowed capacity of  $i$  type station, belonging to the company  $l$ , correspondingly;  $p$  — price per unit of electric power;  $c_{li}$  and  $b_{li}^0$  — unit costs for electricity generation and unit operating costs of  $i$  type station, belonging to the company  $l$ , correspondingly;  $\alpha_{lis}$  and  $\beta_{lis}$  — minimum and maximum allowed capacity coefficient of  $i$  type station, belonging to the company  $l$ ;  $\tau_s^w$  and  $\tau_s^h$  — number of working days and holidays in season  $s$  correspondingly;  $g_s$  и  $d$  — maximum number of hours of HPS (Hydro Power Plants) used in season  $s$  and PSPP (Pumped Storage Power Plants) installed capacity per day correspondingly;  $\eta$  — coefficient of efficiency of PSPP.

However, behavior of some companies is specific. There are companies, which don't plan to develop power in the years immediately ahead, and, by virtue of their geographical location, haven't HPS and PSPP. When modeling behavior of such companies, only working power constraints will be presented (2)-(3), using which one can develop a solution analytically. Use of this approach decrease computational complexity of the equilibrium search problem in the ORIRES market model, which is important in view of high dimensionality of the problem under consideration.

## REFERENCES

1. Khamisov O.V., Podkovalnikov S.V. Modeling and study of Russian oligopolistic electricity market considering generating capacity extension // Proceedings of the PowerTech 2011 Conference, Trondheim, Norway. – 2011. – p. 506-512