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INTRASTATION OPTIMIZATION OF MODES OF THERMAL POWER STATIONS

For today the bulk of electric energy is produced at thermal power station (TPS). In this connection questions of optimization of regimes TPS are rather actual, demanding the further researches. Following groups of the equations should be switched on in composition of mathematical models of optimization of power installations criterion or an optimization; constraint equations; the restriction equations (type of equalities and inequalities). For reception of a condition of an optimality - the management equations, i.e. for the problem solution application of the matching algorithm based on a certain mathematical method is necessary.

In the presence of one optimization (scalar optimization) the matching algorithms of the solution based on methods of a variation calculus, linear or nonlinear programming, Lagrange multiplier method, gradient and others can be applied. However, the scalar model does not reflect all properties and parameters of difficult modelled installation and consequently, for reception of more effective solution, application multicriterion models and matching methods of their solution is necessary.

Let's present two-criteria mathematical model of optimization of a regime of the thermal power plant consisting from m of blocks by criteria of cost of a fuel rate and extent of irregularity of the schedule.

The first criterion function Z_1 - cost summary a fuel rate is formed of criteria of a fuel rate - criterion functions B_i of blocks TPS:

$$Z_1 = B = \sum^{m} \beta_i B_i(P_i) \rightarrow \min, \tag{1}$$

Where βi - fuel cost on i - m the block.

Decrease of start-up and disconnection involves an additional fuel economy. - criterion of decrease of starting charges it is possible to express the second criterion function by means of criterion of irregularity of load pattern TPS consisting of criteria of levelling of schedules of loadings of each of blocks Z_{2i}. For the separate block during T it is possible to write down such criterion in an aspect:

$$Z_{2i} = \sum^{T} \mu_i (P_i^{\max} - P_i^{\min}) \rightarrow \min; \tag{2}$$

Where μ_i - some factor of normalization of load patterns of the different blocks TPS, depending on the period of optimization, a parameter of reliability of the block, and others.;

$P_i^{\max}, P_i^{\min}$ - Between which ($P_i^{\max}$ - $P_i^{\min}$) = ΔPi, it is necessary to reduce the maximum and minimum values of power of load patterns of blocks, a difference.

Marking out economy of a fuel rate from levelling of the schedule of i th block TPS ΔBi, we present matching criterion functions on separate blocks in an aspect:

$$\Delta B_i(Z_{2i}) \rightarrow \max; \; i = (\overline{1,m}). \tag{3}$$

At an union of separate criteria (3) in the general on TPS it is necessary, that the fuel economy from load pattern levelling on one of blocks TPS did not occur at the expense of increase in irregularity of the schedule (and matching increase in a fuel rate) on other blocks.

The fuel economy maximum (fuel cost) from uniformity of schedules of all observed blocks will be a condition of an optimality of levelling

$$Z_2 = \beta, \Delta B_{\sum} = \sum_{i=1}^{m} \Delta B_i \rightarrow \max. \tag{4}$$

Recognizing that blocks have different dependences of change of a fuel rate on extent of irregularity of the schedule, this condition will be gained at equality relative changes of fuel rates ρi from extent of levelling of schedules on all blocks:

$$d\Delta B_i / dZ_{2i} = \rho_i = \text{idem}.. \tag{5}$$

Dependences of change of a fuel rate of each block on extent of irregularity of its schedule $\varphi_i = \Delta B_i\ (Z_{2i})$ can be gained on the basis of machining of the retrospective data or a settlement way.

The constraint equations connecting entrance and output characteristics of each block, characteristics are:

$$\Psi i = Bi\ (Pi) \text{ and } \varphi i = \Delta Bi\ (Z2i). \tag{6}$$

The equation restriction of type of equality is the balance between power P given out to users $P_{\sum}$ and the sum of powers of blocks P_i:

$$P_{\Sigma} = \sum^{m} P_i \tag{7}$$

And the equations restrictions of type of inequalities are restrictions on adjusting power of each block:

$$P_{i\min} \le P_i \le P_{i\max}. \tag{8}$$

Thus, the mathematical model multicriterion optimization of regimes TPS, including criterion functions (1), (4), constraint equations (6), the equations of restriction (7), (8) is built. For the solution of an optimizing problem scalar both criteria in one, i.e. we merge them by a change of sign of criterion (4) with (+) on (-), i.e.:

$$-Z_2 = \sum^{m} \Delta B_i \rightarrow \min. \qquad (9)$$

Considering that Z_2 - the criterion reflecting a fuel economy on TPS at the expense of levelling of schedules of all blocks, criteria (4) and (1) can be written down in the form of the general criterion function:

$$F_B = f(Z_1, Z_2) = \beta_i \sum^{m} (B_i(P_i) - \Delta B_i(\Delta P_i)) \rightarrow \min. \qquad (10)$$

Thus, it is carried out two-step scalar dual-purpose function: in the beginning block criteria B_i on a fuel rate in criterion Z_1, and criteria Z_{2i} on levelling of schedules of blocks in the general criterion Z_2 have been merged. Then criteria Z_1 on a minimum of expenses for a fuel rate on TPS and Z_2 on extent of levelling of a load pattern have been merged. Normalization of criteria has been carried out at the expense of reduction to uniform economic norm - fuel costs. Scalar, i.e. the problem led to the general criterion (10) it is possible to carry out the solution known methods of optimization, for example Lagrange multiplier method, a method of penal functions and others.

Comparison scalar and multicriterion models shows that at the account of several criteria efficiency of optimization of regime TPS increases.

The list of references

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