OPTIMIZATION OF COAL AND WATER CONSUMPTION IN HYDRO-THERMAL POWER SYSTEMS

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ABSTRACT

This research proposes a power market model for the hydrothermal-nuclear power system. The optimal utilization of energy is thought to be in nuclear, hydroelectric, and coal-fired power plants. Model-1 and Model-2 are two of the model's sub-models. While Model-2 use to address the issue of optimal power dispatch inside hydro units and coal-fired units, Model-1 is used to address the issue of assigning hydro loads and thermal loads. In the case study, a simulation has been performed. The findings demonstrate that the solution strategy is successful and the provided model is accurate.

Keywords: *Power market model, renewable energy, optimal power dispatch*

Nomenclature:

W_D – total water consumption of the system;
W_i – water consumption of every hydropower machine;
d – the maximum dispatch capacity of a reservoir of the system, const;
N_i – load of every generating set;
N_{DH} – predicted total load of water grid;
$N_{i\,min}$ – the maximum power of the water generating set,
$N_{i\,max}$ – the normal rated (the minimum) power of the water generating set
P_N – basic load taken by nuclear generating set,
N_{DH} – predicted total load of water grid,
P_{DT} – predicted total load of coal power grid.
F_D --total consumption of coal of system,
P_i -- load of every generating set,
P_D --total load of system,
$P_{i\,min}$-- the maximum power of the thermal generating set,
$P_{i\,max}$ -- the normal rated (the minimum) power of the thermal generating set,
d --the minimum spinning reserve capacity of system, const.

1. INTRODUCTION

The total connected size of India's power-systems till 31st March 2022 was 3,99,497 MW, which was primarily contributed by thermal-power (59%), Hydel power (12%) in addition to nuclear power (3%). Today, there is growing importance to the research of how to best distribute the electricity in our power systems. Power systems must be divided among themselves as effectively as practicable to guarantee the safe operation of all nuclear power reactors during their scheduled shipping cycles. The model attempts to optimize the usage of water power while minimize the use of coal while considering the outputs of coal and hydropower plants [1].

Because of the limitations, the traditional approaches to solve the OPF problem such as linear programming technique which reduce calculating accuracy and dynamic programming technique could not be widely adopted. Modern and sophisticated solutions to the issue, including the Generic Algorithm, the simulated annealing approach & the ANN method has been created in recent years. The simulated annealing method's parameter selection is challenging, and the GA is time-consuming to compute [2]. Therefore, the issue of optimizing the electric power system's short-term generation schedules requires further investigation. To avoid these limitations, we have applied the Chaotic Sine Cosine Algorithm (CSCA) which delivers greater efficiency over GA and ANN due to its superior global