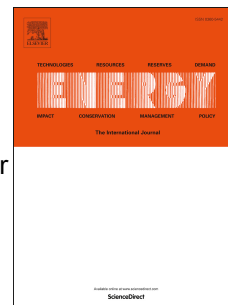


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Closed-loop Optimization Control on Fan Speed of Air-cooled Steam Condenser Units for Energy Saving and Rapid Load Regulation

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Abstract:

In order to save more energy and quicken the load change speed of air-cooled steam condenser units, the closed-loop optimized control on the fan speed is proposed and its realization is worth making intensive study. In this regard, the study presents the static and dynamic models of air-cooled steam condenser, and the characteristics of turbine power output affected by fan speed. Then, the structure of closed-loop control on fan speed is designed. Furthermore, two optimized methods on condenser pressure based on fan speed control are separately discussed: the optimum condenser pressure is solved by the genetic algorithm to save more energy, and the condenser pressure regulation is combined with traditional boiler-turbine coordinated control to accelerate the load response. Case study in our paper proves that the fan speed optimization can significantly improve the unit load-following capability, and furthermore unit coal consumption has been significantly reduced when the unit operating in a stable load condition.

Keywords:

Air-cooled units; Closed-loop control; Fan speed; Condenser pressure; Load change

Nomenclature

Q_r	heat rejection of exhausted steam	$\Delta p_{s,0}$	fan resistance caused by the invariable factors
D_c	mass flow of exhaust steam	n	number of operating fans
h_c	exhausted steam enthalpy	$P_{s,0}$	initial condenser pressure
C_{pw}	specific heat capacity of condensed water	$P_{s,\infty}$	final condenser pressure
t_s	condenser saturation temperature	T_1, T_2	time constants
Q_a	heat absorption of cooling air	$\mathcal{L}(\cdot)$	Laplace transformation
D_a	mass flow of cooling air	γ	turbine power relative deviation
$LMTD_{cd}$	log mean temperature difference at the condenser	k	slope of condenser pressure-turbine power relative deviation curve
t_{a1}	inlet air temperature	P_{s0}	rated condenser pressure
t_{a2}	outlet air temperature	β	turbine steam load ratio
ρ_a	air density	N_T	actual turbine power output
V_a	volume flow of cooling air	N_{T0}	rated turbine power
A	total heat transfer area	ΔN	net power income

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