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INSTRUCTIONS TO PREPARE A PAPER FOR THE ERCOFTAC DESIGN OPTIMIZATION 2004 INTERNATIONAL CONFERENCE

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Abstract. *This document provides instructions for the preparation of the two–page abstract, to be included in the* **Book of Abstracts** *of the ERCOFTAC DESIGN OPTIMIZATION 2004 INTERNATIONAL CONFERENCE (Athens, March, 31–April, 2 2004). The abstract can be written in Tex, Latex or MS–Word; if MS-Word is to be used, the authors are kindly requested to use a similar template. Before submission, the abstract should be translated to Portable Document Format (PDF).* **Please do not excess the maximum size of two pages!**

1 INTRODUCTION - DESCRIPTION OF THE PROBLEM

Electric power generation using both gas and steam turbines, operating in combined cycle, is nowadays in widespread use. The main reason is that combined–cycle gas turbine power plants have short erection time, low investment cost and higher efficiency compared to conventional steam power plants. This paper presents a design method for optimal combined–cycle power plants with supplementary firing, such as the one shown in fig. 1. Supplementary firing is employed at the gas turbine exit (position 0) in order to increase the temperature of exhaust gases entering the heat–recovery steam–generator, in the expense of additional fuel consumption. As already mentioned, the goal is to design power plants with maximum efficiency, maximum power output and minimum investment cost.

The design variables are listed below:

- high–pressure steam pressure,
- low–pressure steam pressure,
- superheated steam temperature at the exit of the high–pressure branch of the steam generator,
- feedwater temperature at the inlet to the high–pressure evaporator,
- feedwater temperature at the exit from the first high–pressure economizer,

- feedwater temperature at the inlet to the low–pressure evaporator, etc.

Twelve inequality constraints were imposed to ensure feasible heat exchanger design.

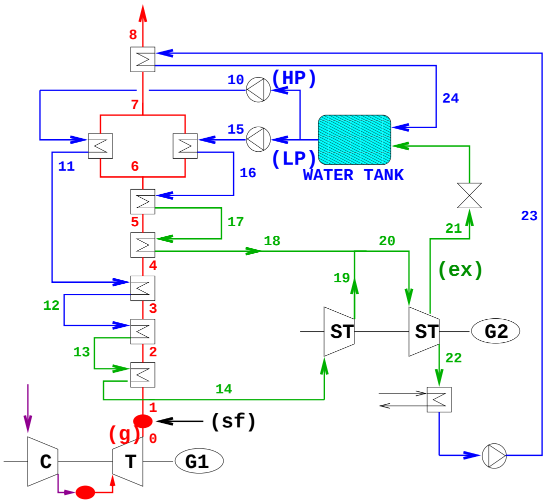

Figure 1: Combined Cycle Gas Turbine Power Plant with Supplementary Firing.

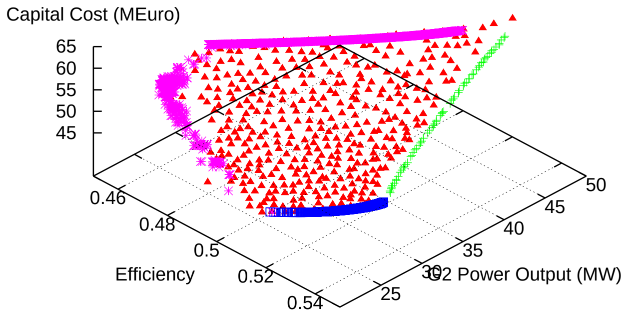

Figure 2: The computed Pareto front.

2 OPTIMIZATION AND ANALYSIS TOOLS

The optimization of the combined–cycle power plant is carried out using evolutionary algorithms, [1], [2]. The population size is 100 and binary coding is used. All inequality constraints are taken into account by penalizing the cost value of all the objectives. Practically, for any inequality constraint of the form $T_a \geq T_b$, the penalty factor $p_i = e^{\Delta T / T_b}$ ($\Delta T = T_a - T_b < 0$) is first computed. The total penalty factor p_{tot} is the product of all p_i's and the penalized cost value is the $y_k = y_k / p_{tot}$.

3 RESULTS

Some indicative results are given below. So, in fig. 2, the Pareto fronts computed through four optimization runs are shown. This $3D$ plot includes one Pareto front (surface, formed by a cloud of points) from a three-objective optimization and three Pareto fronts ($3D$ curves) resulted from three two–objective optimizations. For the latter, the objectives were (a) max.efficiency–max.power, (b) max.efficiency–min.cost and (c) max.power–min.cost.

REFERENCES

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