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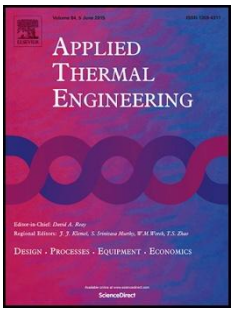

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Thermal balance of wet-steam turbines in nuclear power plants. A case study

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Highlights

- Steam turbine efficiency and power are estimated at a particular NPP.
- The model estimates the cycle parameters from various performance tests.
- Areas where the results of the simulation may be improved are identified.

Abstract

Conventional methodology is applied in this study to estimate the efficiency of nuclear power generation and the electrical power that is generated at a nuclear plant built in the nineteen-sixties. A simulation of the whole power plant is conducted with this methodology. The characteristic parameters from the study are compared with those estimated by the manufacturer for its on-design operation mode. Furthermore, the model calculates the anticipated pressures, temperatures, mass flows and electrical power on the basis of the data from various performance tests. These estimated parameters are then compared with real values measured in the plant. The objective of the present paper is to study whether the conventional approach is acceptable for the simulation of the parameters of the power station, and to identify areas where the results of the simulation may be improved, in order to minimize the deviations between the simulated parameters and the actual measurements.

Keywords: Nuclear Power Plant, Wet-Steam Turbine, Balance of Plant

1. Introduction

The first technical papers on the thermodynamic behavior of steam turbines were published at the beginning of the 20th c. In this period, the publication of Aurel Stodola [1]**Error! Reference source not found.**, a professor at the Polytechnic University of Zurich, the first edition of which dates back to 1903, is remarkable, because of its scientific rigor, depth, and validation through testing. The book remains a basic reference work on the study of steam turbines.

At the start of his paper, professor Stodola proves the validity of considering that steam (also in a wet condition) acts as a polytropic gas, using the equation $pv\gamma = C$, in order to simplify the relationship between pressure and specific volume in expansion processes at constant entropy. From this hypothesis, a complete development of a simplified formulation can be introduced, including what was later known as the Stodola Ellipse, which was studied by Cook in the nineteen-eighties **Error! Reference source not found.**[2].

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