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Analysis of Gas Turbine Boost to appear in International Journal

Sunoba Pty Ltd today announces that the *Journal of Engineering for Gas Turbines and Power* has accepted for publication a 16-page paper entitled "The Expansion-Cycle Evaporation Turbine". The author is Noel Barton, Managing Director of Sunoba Pty Ltd.

(The abstract is given below.)

The Expansion-Cycle Evaporation Turbine (ECET) is based on evaporative cooling of hot air at reduced pressure. This is a new concept.

An important application is to boost the power output of open-cycle gas turbines by about 20%, without any extra fuel consumption or CO₂ emissions. This is particularly applicable at peak demand in the electricity grid.

Barton comments:

This paper develops a theoretical model for the ECET and analyses the main losses. Also included is a coarse economic analysis, which shows that, at peak times in the electricity grid, the ECET will reduce the Levelised Electricity Cost by 6-10% and marginal CO₂ emissions by 17%. That's why I think this is an important paper."

The ECET is a spin-off from an invention for power generation from passive solar heat collection under a transparent insulated canopy. Work continues on that application, for which a piston-in-cylinder version of the evaporation engine is appropriate.

The new engine is completely original, worldwide, and is protected by patent applications. The technology is available under licence to manufacturers.

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About Sunoba Pty Ltd and Noel Barton

Noel Barton, founder of Sunoba Pty Ltd, was educated at the University of Western Australia, finishing in 1973 with a PhD in applied mathematics. Prior to becoming a full-time inventor in 2004, he held appointments at the University of New South Wales (1975-81) and CSIRO Australia (1973-74, 1981-2003). Dr Barton's passion is the use of renewable energy for power generation, mineral processing and transport fuels. His work within Sunoba Pty Ltd has concentrated on new heat engines and heat pumps, with a strong emphasis on renewable energy and energy conservation.

The Expansion-Cycle Evaporation Turbine

by N.G. Barton

(to appear in the *Journal of Engineering for Gas Turbines and Power*)

Abstract

This paper investigates a continuous-flow heat engine based on evaporative cooling of hot air at reduced pressure. In this device, hot air is expanded in an expansion turbine, spray-cooled to saturation and re-compressed to ambient pressure in several stages with evaporative cooling between each stage. More work is available in expansion than is required during re-compression, so the device is a heat engine. The device provides a relatively cheap way to boost the power output of open-cycle gas turbines.

The principal assumptions for the theoretical model developed herein are that air and water vapour are regarded as ideal gases with constant specific heat capacities. In the absence of losses associated with expansion and compression, the engine produces more power as the inlet temperature and the pressure ratio increase. The effects of irreversibilities are subsequently included in the expansion and compression stages, with realistic values used for the adiabatic efficiencies of turbine and fans. Purification and injection of water are also considered in the overall energy budget.

As a typical result for the new engine, if the inlet air is the exhaust of a 56 MW open-cycle gas turbine, the adiabatic efficiencies of turbine and fan are 0.9, the pressure ratio is 6.5 and there is four-stage re-compression, then the power output is 20.5% that of the gas turbine. The power output is sensitive to the adiabatic efficiencies of turbine and fans.