



Kahn Industries' Gerhard Merkle (left) discussing the dynamometer installation with a senior level engineer for the China Gas Turbine Establishment.

High-speed Dynamometer for Chinese Turbine Research Facility

Kahn Industries recently commissioned a 9500 kW Model 108-130 high-speed hydraulic dynamometer at the China Gas Turbine Establishment in Jiangyou, Sichuan, China. Founded in the 1960s, the China Gas Turbine Establishment (CGTE) is one of China's leading institutes for gas turbine research and development.

Among its many research and test facilities for gas turbines and their components, the CGTE operates an altitude test facility for simulating the pressure and temperature conditions of aero engines at varying flight altitudes, as well as a cold turbine test facility for testing and optimizing the flow characteristics of gas turbine engines. The cold turbine test facility utilizes a universal turbine housing and drive train that contains the test article.

Real time, continuous monitoring of hundreds of data points is provided by CGTE's modern data acquisition and

control system, which determines the required air and water flow rates, and provides a simultaneous display of overall turbine efficiency. A high capacity air compressor system provides the air necessary to operate the turbine.

The Kahn Model 108-130 hydraulic dynamometer system is installed in their cold turbine test facility for development of commercial gas turbines. The dynamometer system consists of the dynamometer; a Series 545 digital closed-loop automatic dynamometer control system; a Series 535 data monitoring/alarm system; hydraulic/lubrication; and other ancillary equipment.

According to the company, Kahn's advanced dynamometer technology and attention to design details provide a number of real, tangible benefits to the CGTE. Rated 9500 kW and 12 500 r/min, the Model 108-130 dynamometer is equipped with highly efficient perforated disc power elements. Power is absorbed and converted into heat through vortices generated in the perforated disc rotors and stators. Continuous

water flow through the dynamometer removes the heat. While operating at its maximum power level of 9500 kW, the unit requires a water supply of 295 m³/h. Water to operate the dynamometer in the CGTE facility is supplied by a large water reservoir located 50 m uphill from the test facility. A water accumulator located near the test cell dampens the pressure fluctuations of the water and eliminates the pressure spikes associated with this type of water system.

Like all Kahn dynamometers, the Model 108-130 is designed to absorb full power in both directions of rotation. Thus, changing the direction of rotation, which may be required for testing particular turbine configurations, is accomplished without repositioning the dynamometer. In addition, the water and bearing compartments are separated by mechanical carbon seals allowing the user to start the dynamometer under load and to perform a full emergency shutdown (to zero speed) under maximum load. Unlike dynamometers with labyrinth seals, there is no need to unload the Kahn dynamometer during shutdowns to prevent water from entering the bearings, the company said. Thus, quick and safe emergency shutdowns to zero speed are possible without risking dynamometer damage.

Experimental testing of gas turbines requires mapping a large number of data points over a wide power and speed range. During this process, rotational speed is controlled by the dynamometer, while the power level is increased or decreased by modulating the air flow through the turbine. The Kahn Series 545 digital dynamometer control system provides the precise, steady-state speed control necessary to ensure reliable data mapping.

This Series 545 features a digital PID controller with a control loop time of 10 milliseconds and is equipped with fast-response 100 mm electrohydraulic inlet and outlet control valves, providing a small amplitude frequency response of 45 Hz and a full stroking time of less than 150 milliseconds. For best control response, the Series 545 also provides simultaneous coordinated inlet and outlet valve dynamic control. This fea-

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China Gas Turbine Establishment control room with the Kahn Series 545 control console installed.

ture provides far better control response and stability than older technology single valve or primary/secondary valve control systems, the company stated.

During the commissioning process, the turbine was used to test the dynamometer verifying that the dyna-

nometer met specifications. Based on the operating range of the turbine configuration installed on the test stand, the dynamometer was operated at power levels up to 1050 kW and at rotational speeds up to 6000 r/min. With steady speed fluctuations of 1

r/min (less than 0.01% F.S.), the dynamometer speed control accuracy was well within customer requirements. Additionally, Kahn provided training to customer personnel in the basic operation and maintenance of the dynamometer.

Located in Wethersfield, Connecticut, U.S.A., Kahn Industries has long been closely associated with gas turbine testing. Following the early success of its flange-mounted dynamometers for aero engine testing, Kahn developed the Series 100 high-power, high-speed dynamometers for industrial and marine gas turbine applications in the 1970s. Since then, significant improvements have been continuously incorporated. Kahn also developed the Series 400 smooth disc high-speed dynamometers, which provide high-speed direct-drive capabilities with cavitation-free operation, resulting in extremely long life.

With a sales history in China dating back to 1985, Kahn has many repeat customers in China using these dynamometers. 