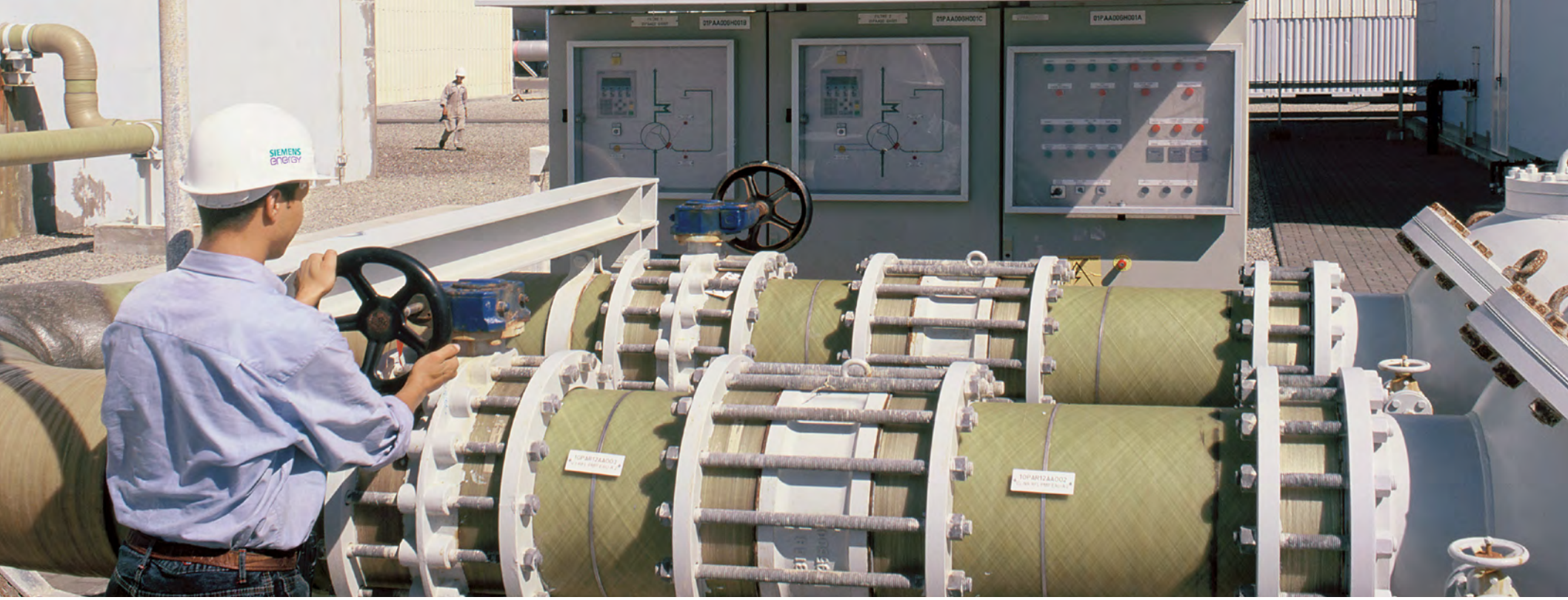

Benson® test rig

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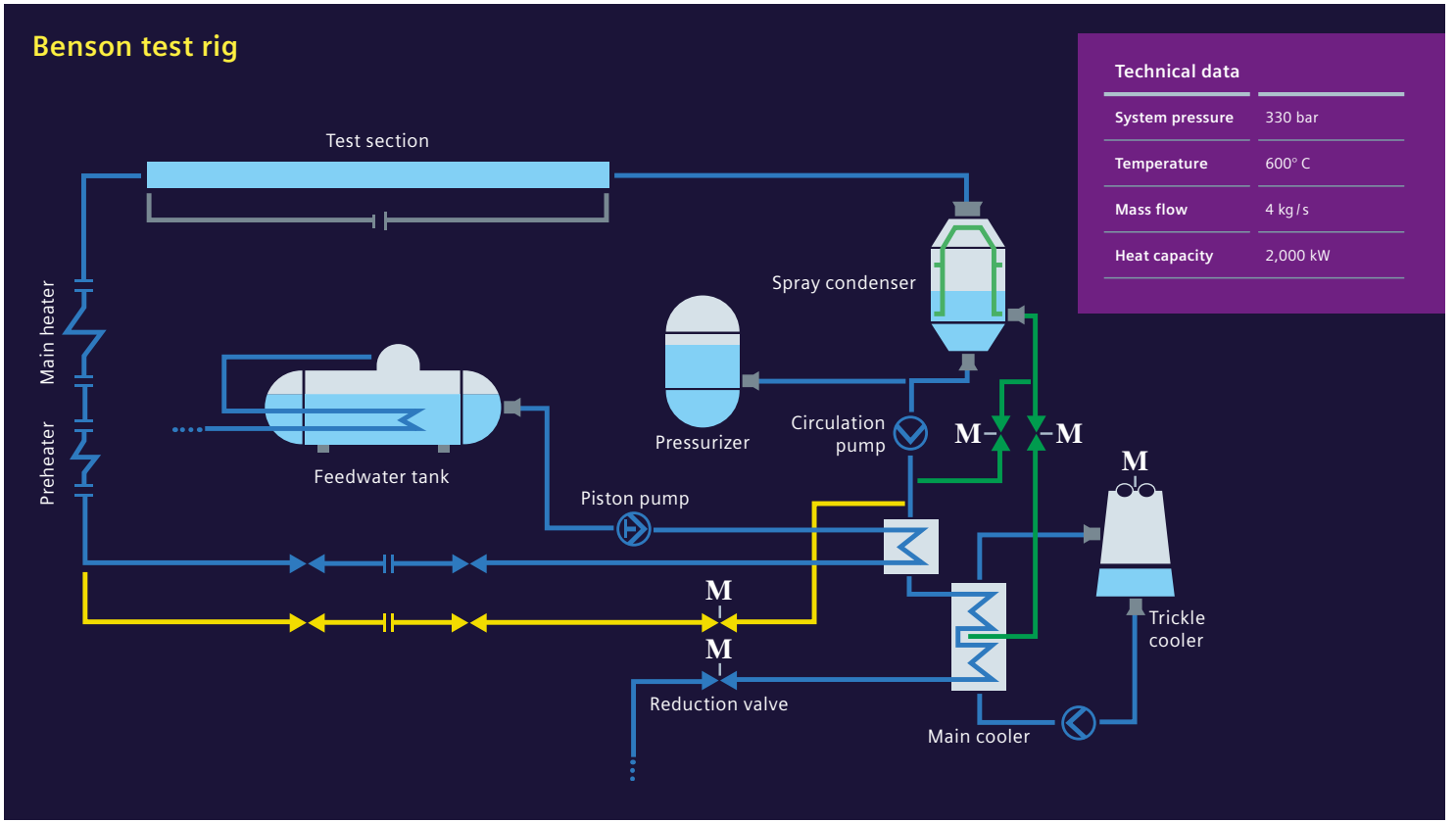
Tried, tested and trusted

The Benson test rig was set up in an accredited laboratory in Erlangen, Germany, operating from 1975 to 2003. Its primary goal was to study aspects of Benson steam generators and heat recovery steam generators, focusing mainly on heat transfer, pressure drop, and flow stability in two-phase flows within evaporator tubes. This extensive research led to a rich database covering heat transfer and pressure drop data for evaporator tubes, also supporting and validating the Benson design software.

Ministry of Electricity and Energy, Egypt

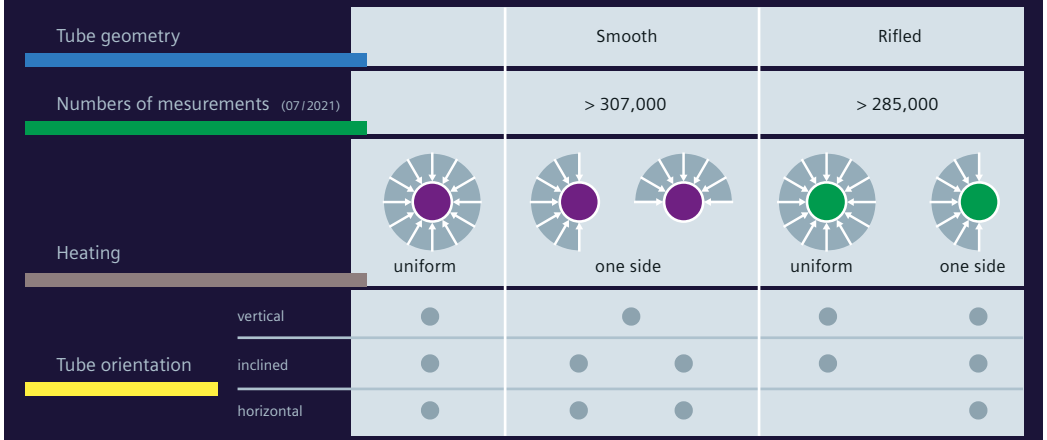
- Equipment of three combined cycle power plants
- 24 vertical triple-pressure Benson heat-recovery steam generators
- Part of the megaproject designed to increase electricity generation in Egypt by 50 percent
- Highly efficient and flexible combined cycle operation



The facility included a water supply, the test subject, a thermal pressurizer, and a cooling system. For experiments needing high mass flow rates, the rig could run in recirculation mode. The Benson rig's thermal pressurizer was a distinctive component, providing extremely stable system pressure – a critical requirement for accurate, steady-state heat transfer measurements near the critical pressure range.

Research into the physical phenomena and theory behind the dynamic stability of two-phase flows was conducted under the Benson license, resulting in documented findings. In 2014, a parallel tube test stand was added to the Erlangen lab to further examine these phenomena. This configuration allowed for controlled observation and reproduction of dynamic instabilities in vertically arranged heated tubes shaped like typical Benson evaporators under laboratory conditions. The results were analyzed to further validate Siemens Energy's dynamic stability simulation programs.

Database for heat transfer and pressure drop in evaporator tubes



Typical test parameters:

Pressure	$25 \leq p \leq 280$ bar	**Heat flux**	$0 \leq q \leq 950$ kW/m²
Mass flux	$30 \leq m \leq 2{,}500$ kg/(sm²)	**Tube inner diameter**	$8 \leq d \leq 50$ mm

Benson software

Software	Application	
KRAWAL	HRSG	Thermodynamic & thermohydraulic analysis
DYNAPLANT		Dynamic flow stability
DYNAPLANT	HRSG & Fired steam generator	Benson-specific control concepts
WATSEF		Water/steam separator efficiency

Software	Application	
DEFOS	Fired steam generator	Thermodynamic performance
STADE		Pressure drop in single tubes
STADENET		Flow distribution in thermohydraulic networks
WATHUN		Detailed heat transfer analysis
DYNASTAB		Dynamic flow stability
WATHAN		Membrane wall strength

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