Current Experience with the Euler Turbine

Energent develops new energy technology, including new power cycles and new types of turbo machinery. One of the first new turbines developed was the patented Euler turbine. This turbine has several advantages including high efficiency, high reliability and tolerance to liquids and solids.

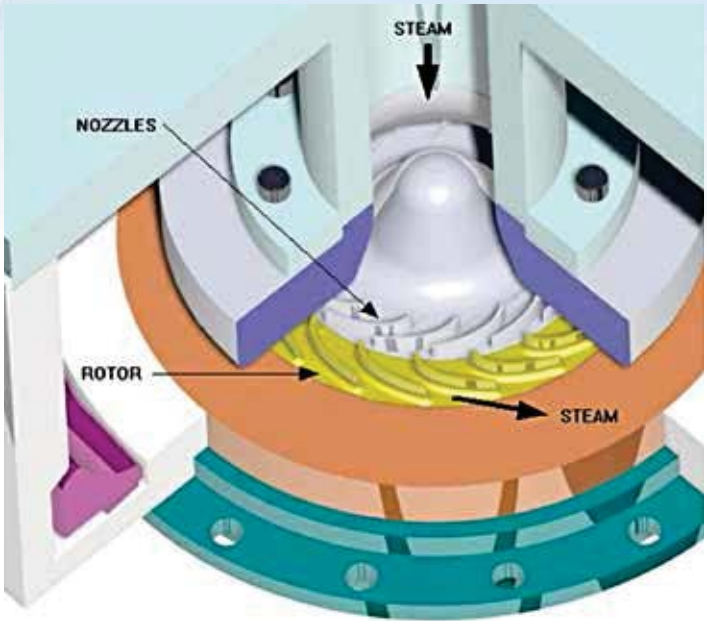

Figure 1 – Microsteam Turbine Operation

The basic principles of the Euler turbine are illustrated in Figure 1. The flow enters the center of the turbine and flows radially outward. The fluid is expanded through a nozzle row to a high velocity, driving a turbine rotor surrounding the nozzles, and subsequently exits through an annular diffuser. The use of two expansion stages results in high efficiency. Unlike radial inflow expanders, the radially outward flow enables the turbine to clear any solid debris or liquids from the interface between the nozzles and the rotor. Another advantage is that the blades are very rugged and not susceptible to vibrations or breakage as is a common problem in some radial inflow machinery.

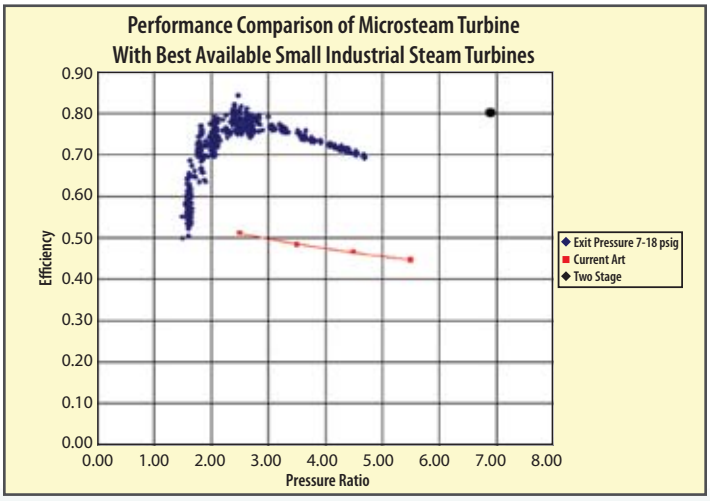

Figure 2 – Performance Comparison

The first application of the Euler turbine is known as the Microsteam® turbine. This power system has a rating of 275 kW. The application is to convert wasted steam pressure energy to useful power. Among industrial steam turbines, the Microsteam® turbine is unique in achieving a very high efficiency. Figure 2 shows measured test results of the efficiency versus the pressure ratio across the Microsteam® turbine for tests at the United Technologies Research Laboratory. As shown, efficiency peaks at 80% which can be compared to efficiencies in the 45-50% range for conventional industrial back-pressure steam turbines in this size range. Also shown is efficiency of a two-stage Microsteam® turbine which extends the high efficiency values to a higher pressure ratio.

Figure 3 – MIcrosteam Open Rotor

The rugged blades shown in Figure 3 are constructed from titanium alloy. The blades are very strong and are not susceptible to resonance-producing vibrations. An example of an installation at Con Edison in New York City is shown in Figure 4. The unit was designed with a vertical axis and a compact 34" width to enable installation through a standard doorway. The controls, electric switch gear and lube oil system are all mounted on one skid providing a complete factory built power system. This power system can operate unattended and has an automatic start and shut down.

Figure 4 – Microsteam Power System 275 kW installed at Con Edison Steam Station NYC

Currently the aggregated operating time for the several Microsteam® power systems that have been sold is 150,000 hours. They have produced more than 30,000 megawatt hours of useful power from previously wasted pressure energy. The successful application to steam led to other applications.

Figure 5 – Microsteam Turbine installed in a Kalina Cycle Power Plant in Taiwan

Another application is in a Kalina cycle power system to produce power with an ammonia-steam mixture. Figure 5 shows a Microsteam® turbine installed in a Kalina cycle power plant in Qingshui geothermal field in Taiwan. The unit was successfully demonstrated, generating power from previously unused geothermal brine.

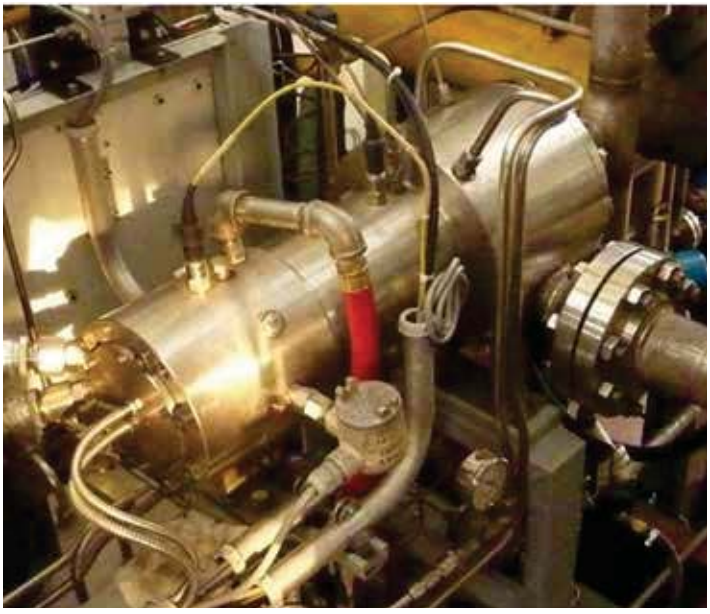

Figure 6 – Nanosteam Turbine Generator operating in Kalina Cycle Power Plant

In order to meet the needs of customers a 100 kW unit, the nanosteam® turbine was developed. Figure 6 shows that turbine operating in a Kalina cycle power plant with ammonia-steam fluid. This particular unit was operated in Shanghai, China. A twin unit is being operated in a geothermal hot springs power plant in Japan.

The nanosteam® turbine is currently being applied to generate power from wasted steam energy in New York City and also to generate power from biomass power plants in Italy.

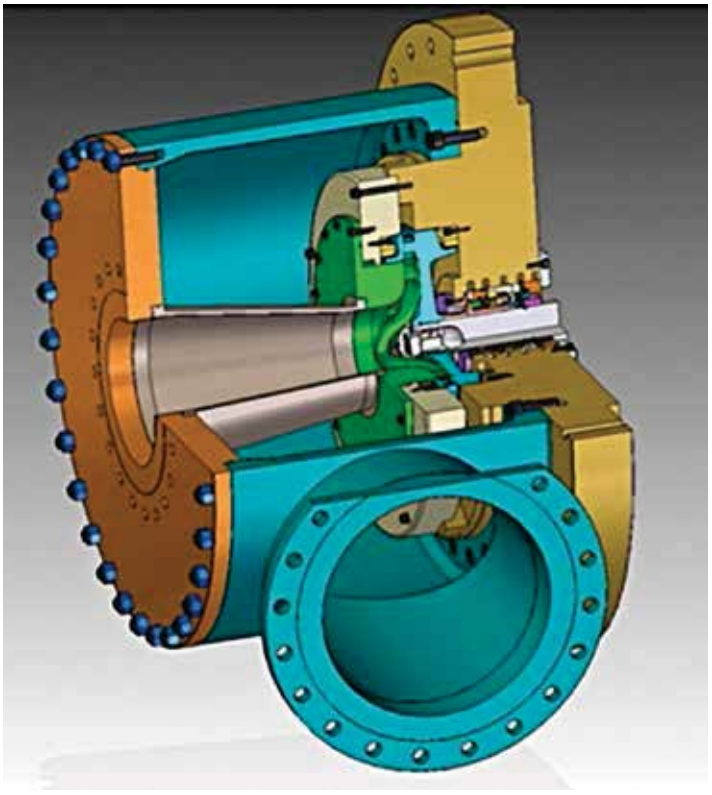

Figure 7 – SSNE SINOPEC 4MW Euler Turbine Generator Project

The successes at smaller scale led to interest in applying the Euler turbine to larger power systems. Figure 7 is a three-dimensional model of a 4 megawatt Euler turbine being constructed for a waste heat recovery system in Hainan China. This unit will operate in a power system which converts the energy in waste hot water to useful power.

The high efficiency and reliability of the Euler turbine in these applications has led to interest in others including organic Rankine cycle systems, gas dehydration, and refrigeration.

For further information, please visit www.energent.net.