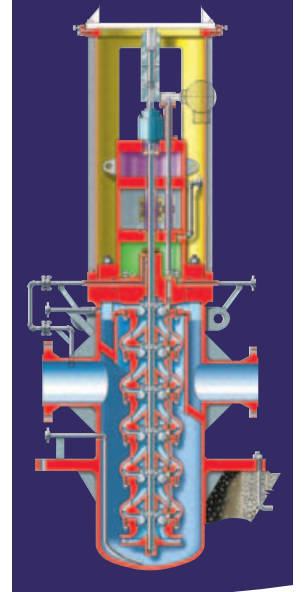




TKW Liquid Cryogenic Turbine-Generator Expanders

The incremental value of incorporating Flowserve model TKW turbines into a process stream is a 3%-4% increase of saleable LNG output.



A Leader in Cryogenic Liquid Expander Technology

Flowserve is the world leader in the design and manufacture of cryogenic liquid expanders. Since 1989, Flowserve has drawn upon its unmatched industry expertise and experience (in excess of 1 million operating hours) to develop a next generation design that provides considerable life cycle value to end users. Flowing liquid across the TKW eliminates the energy waste and reduced process efficiency associated with the use of a Joules-Thompson (JT) valve*. Furthermore, dropping pressure across the TKW results in a significant improvement in cryogenic liquid output along with additional electrical cogeneration.

The Economics of Retrofitting With Expanders

The incremental value of incorporating Flowserve TKW turbines into a process stream is a 3%-4% increase of saleable LNG output. Furthermore, the electrical power cogeneration adds approximately US \$1400 per day. The economic payback of installing two expanders, at a retrofit cost of US \$10 million, is 125 days.

Features and Benefits

Higher Isentropic Efficiency results in increased productivity for the same compressive power

Fewer Stages for a Given Pressure Drop results in increased shaft stiffness and increased reliability

Lower Runaway Speed during overload, underload or power grid connection loss

Pre-assembled Tandem Vaporizing Liquid Type Dry Gas Seals with nitrogen purge eliminates barrier fluid

Two-pole Generators for sizes to 3 megawatts

Additional Electrical Cogeneration increases available revenue stream

* Flowserve recommends that a JT valve be piped in parallel with the TKW to maintain production during TKW equipment maintenance.

The TKW Design

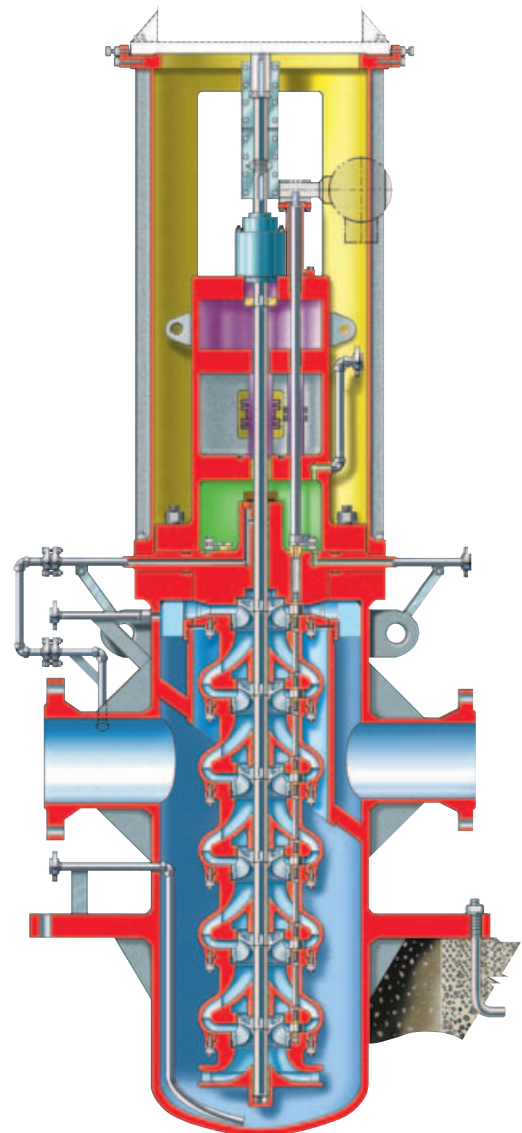
Available in configurations up to 10 stages and up to 3.5 MW generators, the TKW turbine expander provides increased process efficiency and improved mechanical performance over other designs. From its corrosion resistant stainless steel construction to its high efficiency induction generators, the TKW offers total life cycle value.

The TKW assembly is composed of four basic sub-assemblies – the intake and discharge barrel, the turbine, the generator stand and the seal housing.

The intake and discharge shell is a barrel within a barrel configuration. It is designed to direct the flow of liquid up by an annular assembly into a 360° guided inlet to the first stage turbine runner. After passing through all of the energy-absorbing stages, the flow is directed to the outlet and discharge flange. This design allows the complete turbine power and rotating assembly to be removed from the barrel while leaving the piping and insulation undisturbed.

Each turbine drives a high efficiency, vertical solid shaft induction generator. These units are designed for the high ambient temperature and humidity prevalent at the most extreme climates where LNG complexes are located. The tilting pad pivot shoe thrust and journal bearings are suitable for full runaway speed. They are capable of carrying the hydraulic thrust generated by the turbine over the entire operation range of the application and are lubricated by clean oil.

Generators and tandem mechanical gas seal assemblies are isolated from the cryogenic portion of the turbine by an engineered warm-up chamber.



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