Steam Turbine Retrofit

Why choose a Steam Turbine Retrofit?

Energy market deregulation, power trading, newly introduced environmental emission standards and the ageing of generating fleets, are pushing steam-turbine power plant owners to look for solutions to optimize their existing assets by improving generation availability and reducing operating costs. Steam turbines’ availability naturally decreases as they age. Problems affecting major components tend to occur with increased frequency, and often require time-consuming repair and/or replacement activities in order to be solved.

Old turbine technology may not be able to match continuously changing fast-paced market requirements

The high operating costs of old-generation power plants pose yet another challenge to plant owners. Modernization of their facilities or repowering through conversion into combined cycles will achieve a substantial improvement of efficiency, thus also enabling cost cutting. Steam turbine retrofits provide an attractive option in that they help Customers accomplish both goals.

Ansaldo Energia Steam Turbine solutions cover non-reheat and reheat cycles, in back pressure or condensing configuration, for a wide range of applications:

- Thermal Fossil-fired Steam Cycle Power Plants
- Combined Cycle Power Plants
- Cogeneration Heat and Power Plants
- Solar Power Plants
- Geothermal Cycle Power Plants
With over 100 years of experience in the design, manufacture and installation of steam turbines, more than 700 units worldwide and a total capacity of nearly 100 GW, Ansaldo Energia has the knowledge and expertise to enable Customers reap improvements in all the key areas of power plant operation.

**Capacity and Efficiency**

Power generation is an inherently competitive sector, and market competition among different power sources and among individual power companies is getting stronger and faster. Increased capacity and improved efficiency are vital goals for companies wishing to stay afloat, and ahead, in fast-changing, increasingly open energy markets. Ansaldo Energia Steam Turbine retrofits boost power production and improve heat rate while also reducing emissions.

**Lifetime Extension, O&M Cost Reduction and Availability**

Operating steam turbines beyond their design life for prolonged time means reducing reliability, which leads to greater risks of major failures and subsequent unplanned outages. Retrofitting with our technology will extend equipment life as well as maintenance intervals, meaning less O&M costs, stronger reliability and availability.

**Flexibility**

Energy production from renewable sources such as wind and solar is poorly predictable, thus requiring existing thermal power plants to handle different operating profiles. Flexibility is, therefore, the new watchword for power systems. The shift from base-load to high cycling is now a key requirement for any power plant, not only in Combined Cycle configuration.

Ansaldo Energia offers tailored solutions employing the latest technologies developed for our new units, as well as modernization of the ST control system to suit the requested flexibility in terms of reduced stress, increased automatic operation, better integration with the plant, capability to support grid frequency and low load operation in combined cycle.

**Quicker Resumption of Profitable Operation**

Building a new plant from scratch entails huge investments and is a lengthy, costly, and cumbersome process that brings all profit-generating operations to a halt. On the contrary, steam turbine retrofitting is a smart and cost-efficient solution to bring improvement in plant operation with lower investments, and without long-term interruptions in power production.
Leveraging the knowledge of different OEM technologies embracing both reaction and impulse designs, Ansaldo Energia retrofit solutions can achieve all the aforelisted goals by means of:

**High-efficiency blading.**  
We use the latest Three-Dimensional (3D) blading design tools for HP, IP and LP sections to reduce profile and secondary losses. A continuous development of profiles and shapes using state of art Computational Fluid Dynamics (CFD) techniques allows to overcome old blades’ efficiency limitations.

**Upgraded sealing to reduce leakages.**  
Improved gland seal arrangements considerably reduce leakages on blade tips and shaft glands, with possible application of “brush” tip seals or abradable material. A considerable improvement in turbine efficiency can be achieved through clearance reduction.

**Use of advanced materials.**  
The use of leading-edge high and low temperature materials for blading, rotors and casings retrofits allows for improved performance when linked to modified turbine inlet steam conditions; plus, it contributes to extending lifetime and improving operational flexibility. Well proven welded rotor solutions combining materials with different properties for different parts of the rotor are also available.

**Last Stage Blade (LSB).**  
In Combined Cycles LSBs are responsible for about 10% of the total power produced by the turbine and any improvement in the last stage significantly affects the performance of the unit as a whole. The last moving blades are often to be replaced because of the erosion caused by wet steam. Ansaldo Energia offers a broad portfolio of efficient LSBs, with proven features against water droplet erosion, to suit the project’s specific exhaust conditions. Our solutions include the possibility of installing a new inner block inside the existing outer casing to maximize performance improvement.

**Control System upgrade solution.**  
For ageing power plants, retrofitting the Steam Turbine Control System (STCS) can provide an opportunity to better exploit equipment capabilities while at the same time reducing O&M costs and improving the overall safety.

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Our retrofit solutions can be implemented with a stepwise approach:

- **Blading replacement:** the retrofit will be limited to replacing blades in the existing rotors and inner casings with newly designed blades of the same technology (i.e. impulse or reaction)
- **Fitting** of new, advanced inner blocks in the existing outer casings
- **Replacement of the entire module** with a new one adjusted to fit as much as possible within the existing foundations and turbine deck
BAHIA DE ALGECIRAS (Spain)

HP/IP module replacement

Bahia de Algeciras’ original 530 MW steam turbine, manufactured by Westinghouse in 1975, was retrofitted by Ansaldo Energia in 2011 in the frame of the conversion of the existing fossil fuel power plant into a 2+1 combined cycle system rated 800 MW. The retrofit works included a complete replacement of the HP/IP section with a new one featuring the latest reaction technology, installation of new HP and IP sections inlet valves and enhanced sealing system. A new microprocessor-based control system was also installed, and all the auxiliary systems already in place were modernized to be fully automated as required to ensure the plant’s flexible operation. After the retrofit, the ST was rated 270 MW in 2+1 combined cycle operation, achieving a significant internal efficiency improvement and extended maintenance intervals.
VADO LIGURE
(Italy)
HP/IP module replacement and LP inner block fitting

Vado Ligure power plant originally included four 320 MW coal units commissioned in the early ’70s. The Unit 1 was retrofitted in 2007 as part of the conversion of the existing fossil fuel conventional cycle plant into an 800 MW combined cycle in 2+1 configuration known as VL5. The retrofit followed a drop-in approach. It consisted in a complete replacement of the HP/IP section and the supply of a new LP section inner block, both based on the latest reaction technology, as well as new HP and IP sections admission valves.

The new LP inner block, fitting inside the original LP outer casing, featured a longer LSB (43” instead of the original 33.5”).

A new microprocessor-based control system was also installed as required to ensure the plant’s flexible operation.

After the retrofit, the steam turbine rating was 274 MW in 2+1 combined cycle operation, with a remarkable internal efficiency improvement and extended maintenance intervals.

PUENTE NUEVO
(Spain)
LP module replacement

Puente Nuevo’s original 313 MW Brown, Boveri & Cie (BBC) steam turbine was upgraded in the framework of a plant life extension project for the coal-fired power station, completed in 2009. Ansaldo Energia supplied a complete new LP section featuring the latest reaction technology, based on a 43” LSB replacing the original 34” one, in order to improve the plant’s power output and heat rate.

A new microprocessor-based control system was also installed to replace the original Mechanical Hydraulic Control (MHC) system. All of the turbine auxiliaries already in place were modernized to be fully automated.

The retrofit resulted in improved power output and heat rate.
EMBALSE NPP
(Argentina)
Rehabilitation activities for nuclear steam turbine

The 650 MW steam turbine manufactured by Ansaldo Energia and installed at the Embalse Nuclear Power Plant in the late '90s has recently been subject to significant renovation works. In 2015 the steam turbine control system - based on the analog technology used in the '70s - was replaced with a new, modern one, based on microprocessor technology. The activity was carried out during a planned partial overhaul of the turbine and therefore in a short time; it included the replacement of the original control cabinets and of a significant part of the supervisory instrumentation, the relevant checks and calibrations as well as loop checks and cold/hot commissioning.

More recently, in the frame of major activities carried out for repowering the nuclear reactor and improving the original thermal cycle, Ansaldo Energia was awarded an order for modifications to the HP section of the turbine to suit the new plant thermal cycle configuration, and for the supply of new monoblock rotors and diaphragms for the LP sections. The retrofit, foreseen to be completed within 2019, will result in a major increase in the power output of the unit, which is the workhorse of the national grid.