50-Hz Low Pressure Steam Turbine Upgrades

Scope of supply
Siemens upgrade packages for low pressure (LP) turbines in fossil-fueled and nuclear power plants consist of a single-piece (two halves) inner cylinder, a double-flow rotor with a fully integral no-bore design and high-efficiency stationary and moving blades. The last-stage blades have individually optimized profiles and are made of high-grade steel.

To reduce the exhaust losses of the LP turbines the exhaust areas of the low pressure turbines can be favorably adapted to the present backpressure, for example by increasing the last stage.

Siemens offers the following products/last stages:
- LP upgrade 5 m²
- LP upgrade 6.3 m²
- LP upgrade 8 m²
- LP upgrade 10 m²
- LP upgrade 12.5 m²

Customer benefits
LP upgrades may help to improve the competitive position of your power plant through:
- Improvement of thermal performance
- Increasing the lifetime, especially if the old LP turbine suffers from wear and tear (e.g. stress corrosion cracking)
- Extended inspection intervals
- Simplified installation since the outer casing and the connection piping are unchanged.

Fig. 1: LP rotor with twisted free-standing and shrouded blades.
Fig. 2: Cross-section of the 12.5 m² LP turbine.
Features

The Siemens LP turbine upgrade packages are designed for optimized steam flow, through high-efficiency blading profiles, minimized clearance losses and reduced exhaust losses through increased exhaust cross sections.

The main features are:
- Fully integral, no-bore, double-flow rotor
- Upstream moving blades are integrally shrouded reaction-type blades with t-root design
- L-0 moving blades are freestanding or interlocked integrally shrouded blade design with side-entry root design*
- L-1 moving blades are interlocked integrally shrouded blade design, with side-entry root design*
- L-2 moving blades are integrally shrouded taper-twisted t-root design
- Hollow last-stage stationary blades with either suction slots or a heating system to prevent large water-droplet formation and therefore to reduce water droplet erosion
- All new replacement inner cylinder and stationary blade path components
- Blade rings with support and alignment hardware
- Optimized exhaust flow guides
- Sealings on shrouded blades are tip-to-tip seal design for reduced tip clearance losses
- Inlet flow guide
- Erosion protection features such as flamehardened L-0 moving blades, moisture removal features, improved materials and coating as needed
- New coupling bolts, keys, and assembly hardware.

References

50-Hz LP turbine upgrades have been performed in many nuclear and fossil-fired power plants.

Here are three examples:
- Gösgen, 1000 MW PWR nuclear power plant, Switzerland: By replacing the three old 10 m² LP turbines with new state-of-the-art 10 m² LP turbines output was increased by 28 MW (Fig. 3).
- Enstedvaerket, 630 MW coal-fired Power plant, Denmark, turbine-generator upgrade: The final stage of a 50-Hz low-pressure turbine was enlarged to permit an exhaust cross section of 12.5 m² (Fig. 4).
- Mehrum, coal-fired power plant, Germany: An upgrade of the turbine was carried out in May and June 2003. The improvement of the two LP turbine sections greatly contributed to the power increase of approximately 38 MW resulting in the new output of 750 MW. CO₂ emissions were reduced by 135,000 tons per year.

* design dependent

For more information please contact your local Siemens sales representative.