Upgrades & Retrofits
Advanced Steam Path (ASP)

Steam path upgrades

Environment
Reduced specific emissions

Output
Increased capacity

Efficiency
Reduced specific fuel consumption

With a wealth of experience on both impulse and reaction technologies, GE offers a range of upgrades for parts of the steam path where lifetime or efficiency may be lacking.

Background
As with all machines, steam turbines suffer degradation with age. Although minor refurbishment and modification can return performance to near original levels, this may not be enough for the turbine to compete with modern units. This is especially true for blading, where developments in both aerodynamic and mechanical analysis, along with better manufacturing and materials, have increased the performance of modern machines.

A further concern for today’s operators is that grid systems are demanding operation beyond the original design intent. This introduces additional cyclic stresses to steam path components. Operating conditions may also be affected by alterations to related equipment such as the boiler.

Solution
The design of aerodynamic components, such as blades, is continually evolving by the use of advanced Computational Fluid Dynamics (CFD) techniques, backed up by the testing of real models.

The use of three-dimensional (3D) blading has allowed many of the traditional stage efficiency limitations to be overcome. With modern blading, both the blade profile and its shape are designed to limit the growth of the boundary layer, and reduce secondary flow losses at the hub and tip. Modelling also allows the prediction of blade vibration and operating stresses, resulting in more resilient designs with greater operational flexibility.

Modern manufacturing capabilities allow for cost-effective reproduction of high-performance geometry, including integral features such as shrouds and snubbers.

The application of modern gland seals significantly reduces leakage. This is particularly important on the shorter High Pressure (HP) and Intermediate Pressure (IP) blades.

GE has a portfolio of advanced sealing technologies to reduce leakage in all interfacing areas.
Steam path upgrades can be applied to every section of the turbine. However, HP and LP cylinders usually have the greatest potential for cost-effective improvements.

**HP Cylinder**
Historically the design of HP cylinders was often compromised by mechanical design constraints arising from the high operating temperatures experienced by an HP cylinder. Modern materials with high strength at elevated temperatures enable improved designs and improve life and reliability.

The extent of an upgrade is not simply limited to changes of aerofoil. The number of stages can be optimised to current operating requirements and it is sometimes possible to make radical changes to the steampath, such as replacing a double flow steampath with a more efficient single flow steampath within the same HP outer shell. Turbine flow capacities can also be adapted to take advantage of any spare or increased capacity of the steam boiler.

**LP Cylinder**
Significant performance gains are often possible by retrofitting LP cylinders. Gains are realized from advanced 3D blade profiles at the front of the LP and particularly from the application of the most appropriate modern high efficiency last stage blade (LSB). Increases in exhaust area by application of a longer, modern LSB are often possible within the existing LP hood, and this has a direct effect on reducing the leaving loss in the LP turbine. GE has an extensive family of high efficiency LSBs, of different sizes, allowing the best blade to be chosen for the new steam conditions. 3D CFD models of LSB, diffuser and hood are used to attain best possible exhaust performance even when existing LP hoods are retained.

The wet steam environment of an LP exhaust is a challenging operating regime; old LSBs are often corroded or highly eroded by water droplets, particularly at the leading edge. This results in performance losses and, in some cases, mechanical integrity concerns. Today, the mechanisms of erosion and corrosion are better understood and GE’s LSBs utilize a range of hardening, shielding and material technologies for protection.

**Benefits**
- Output improvement
- Efficiency improvement
- Lifetime extension
- Process adaptation
- Reduced O&M costs

**Applicability**
Our steam path upgrades can be applied to all types of steam turbine, whether of GE or non-GE manufacture.

**References**
GE has an extensive list of steam path upgrade references from around the world.

To learn more about this offering, contact your GE sales representative or visit powergen.gepower.com.