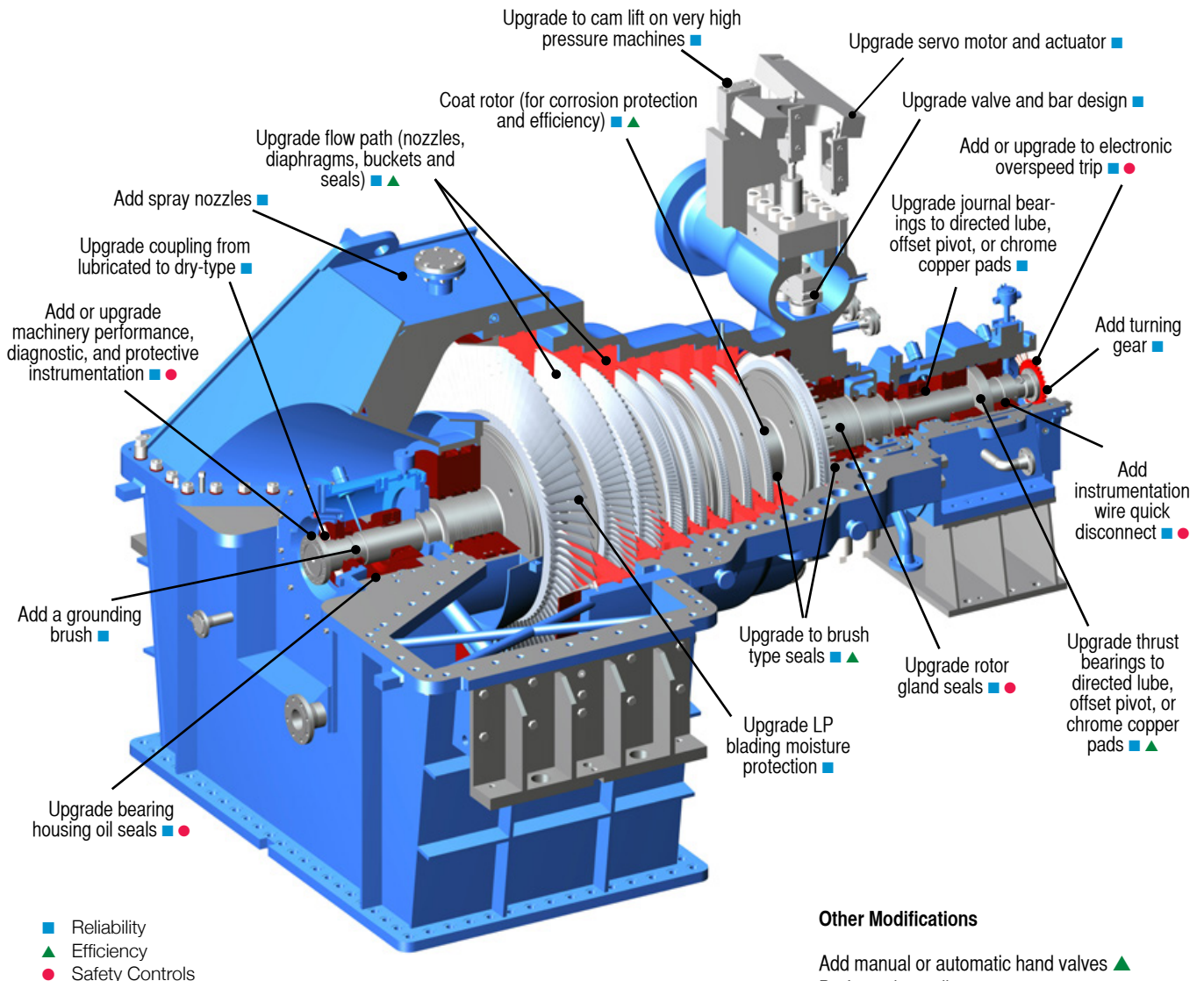


Steam Turbine Modifications and Rerates

Changes in a flow path or in a plant's overall steam balance can affect the performance of the steam turbine at the heart of many refinery, chemical, and industrial processes. Elliott Engineered Solutions can restore steam turbines and other critical rotating equipment to peak performance with modifications and rerates that increase efficiency, maintain safety and reliability, and improve control, regardless of the original equipment manufacturer (OEM.)

As process plants and turbomachinery mature, efficiency and reliability can decline. Steam turbine upgrades can significantly increase reliability and efficiency, extend time between plant shutdowns, abbreviate turnarounds, and reduce unplanned outages. Elliott Engineered Solutions redesigns steam turbine flow path aerodynamics to meet changing performance needs. Changing journal bearings to tilting-pad bearings can improve reliability. Upgrading diaphragms and resizing gland seal systems also offer reliability improvements. Updating the turbine controls with an overspeed trip system enhances safety. An equipment site audit by an experienced Elliott engineer will identify modifications that can keep your turbomachinery performance high and your maintenance costs low.

Elliott offers complete drop-in replacement turbines for situations where operational needs have changed significantly, and modifications to piping and foundations must be minimized. Elliott Engineered Solutions has years of experience in quickly re-engineering and reapplying out-of-service turbines for critical processes.



Elliott Engineered Solutions

Elliott Engineered Solutions has one focus – to help turbomachinery operators obtain the highest value from their critical rotating equipment. Elliott has more than 100 years of experience in engineering, manufacturing, repairing, and modifying all types of turbomachinery. Elliott Engineered Solutions specializes in the following areas:

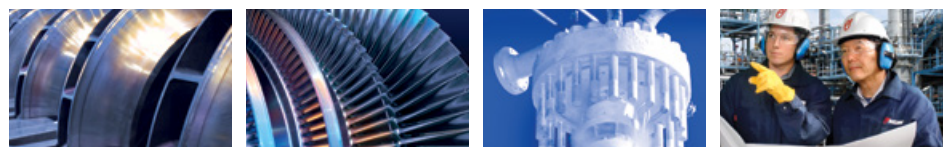
- ♦ Modifications and rerates of turbomachinery to increase the operational life and value of your investment by optimizing performance and reducing downtime.
- ♦ Reverse engineering and comprehensive analytical studies such as lateral and torsional rotor analysis, root-cause failure analysis, mechanical evaluation analysis, finite element analysis (FEA), and aerodynamic analysis.
- ♦ Onsite audits to evaluate turbomachinery efficiency and determine potential reliability improvements to maximize your return on existing equipment.
- ♦ Reapplication of previously owned equipment for emergency installation or cost-effective replacement.
- ♦ Equipment configuration designs to precisely fit existing footprints..

Enhancement	Category	Benefit
Add a grounding brush	Reliability	Eliminate bearing deterioration due to static electricity arcing
Add instrumentation wire quick disconnect	Reliability, Safety	Reduce chance of oil leak; Reduce maintenance time
Add manual or automatic hand valves	Efficiency	Improve steam consumption at reduced loads
Add spray nozzles	Reliability	Cool windage heating to prevent damaging exhaust end blading and condenser
Add or upgrade machinery performance, diagnostic, and protective instrumentation	Reliability, Safety	Improve machinery performance, health monitoring, and protective control
Add or upgrade to electronic overspeed trip	Reliability, Safety	Increase trip speed accuracy and dependability
Add turning gear	Reliability	Reduce the possibility of rotor bows
Coat rotor (for corrosion protection and efficiency)	Reliability, Efficiency	Reduce internal fouling and corrosion effects
Perform site audit	Reliability, Safety, Efficiency	Identify areas to upgrade for peak performance
Upgrade bearing housing oil seals	Reliability, Safety	Reduce oil leaks to atmosphere/Buffered design eliminate leakage
Upgrade control system	Reliability, Safety	Keep turbine operating within a safe range
Upgrade coupling from lubricated to dry-type	Reliability	Eliminate oil requirements and reduce maintenance; Improve rotor dynamics and coupling reliability
Upgrade flow path (nozzles, diaphragms, buckets and seals)	Efficiency, Reliability	Increase performance or capacity; improve reliability with improved materials
Upgrade LP blading moisture protection	Reliability	Reduce blade moisture erosion using plasma Stelling
Upgrade governor (mechanical or electrical)	Reliability	More precise and reliable speed control
Upgrade journal bearings to directed lube, offset pivot, or chrome copper pads	Reliability	Improve rotor stability at running speeds; Reduce oil requirements, bearing temperature, and bearing heat generation
Upgrade servo motor and actuator	Reliability	Eliminate mechanical wear and improve governor valve position stability
Upgrade rotor gland seals	Reliability, Safety	Reduce steam leakage, increase output, and increase reliability
Upgrade thrust bearings to directed lube, offset pivot, or chrome copper pads	Reliability, Efficiency	Reduce oil requirements, bearing temperature, and bearing heat generation
Upgrade to brush type seals	Reliability, Efficiency	Reduce seal leakage to improve efficiency
Upgrade to cam lift on very high pressure machines	Reliability	Eliminate wear on lift bar
Upgrade to voting logic trip block	Reliability, Safety	Improve reliability; Add redundancy
Upgrade valve and bar design	Reliability	Minimize lift rod, lift bar, and valve wear



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