TOSHIBA is one of North America’s leading turbine/generator service providers. Our unique high-speed balance and overspeed facility assures that proper balance is achieved prior to returning your equipment to service. Precision balancing of steam turbine and generator rotors also provides a comprehensive understanding of equipment operating characteristics.

Need a high-speed balance? No problem.
Toshiba’s high-speed balancing facility enables multi-plane balancing of flexible rotors by means of influence coefficients and modal balancing techniques. High-speed balancing of flexible rotors results in minimal deflection of the rotor’s axis during operation and a reduction of forces transmitted to the foundation though the full speed range of the unit. Minimal residual unbalance also improves the life of fluid film bearings, thus reducing maintenance costs and downtime. For generator rotors, our balancing facility also permits overspeed, flux probe, impedance and heat run tests to be performed as part of any balancing jobs. Toshiba’s facility includes:

- 150-ton balancing capacity for steam turbine and generator rotors
- Overspeed up to 110% of operating speed
- Generator rotor electrical testing—at rated speed—including:
  - Impedance tests (0 to 3,600 rpm to 0)
  - Flux probe test at 3,600 rpm
  - Running Megger testing
- Optimization of balance weight placement and consolidation
- Collection and evaluation of indicator run-out readings
- Precision monitoring and supervisory control equipment
- Electronic data acquisition to record critical parameters
TOSHIBA is one of North America’s leading turbine/generator service providers. Qualified and reliable engineering analysis of equipment and operational dynamics helps deliver quality and add value to any project. Extensive in-house engineering capabilities include turbine and generator condition assessments, failure analysis and material evaluation, fatigue and fracture testing, positive material identification and non-destructive examination (NDE).

**When you need the right answers.**
Toshiba’s highly-skilled and experienced engineering team has the analytical tools to provide:

- **Equipment condition assessment**
  - Bored rotors, shrunk-on disks, blade attachment dovetails, steam path components, unit life extension studies

- **Failure analysis**
  - Fatigue, brittle fractures, corrosion, stress corrosion, wear, deformation, embrittlement, creep/stress rupture

- **Modeling and vibration analysis**

- **Fracture toughness testing**—$K_{IC}$ and $J_{IC}$

- **Positive material identification**

**Turbine/Generator Materials Analysis**

- **Finite element analysis** (thermal and mechanical)
- **Fatigue and fracture mechanics analysis**
- **Cumulative damage analysis**
- **Mechanical and chemical testing per ASTM standards**
- **Non-destructive examination (NDE)**
Extending Equipment Life Options

- Reducing rotor preheating requirements
- Designing new generator rotor windings
- Retaining ring and forging modification to mitigate tooth top cracking
- Reverse engineering turbine and generator components
- Engineering permanent turbine casing weld repairs

Non-Destructive Examination (NDE)

Utilizing an array of testing and inspection techniques, Toshiba’s level I, II and III-certified inspectors evaluate various properties of materials, components and systems. Tests include:

- Positive material identification
- Ultrasonic inspection
- Eddy current testing
- Magnetic particle inspection
- Liquid penetrants testing
- Visual (borescope) inspection

Toshiba’s engineers use their years of experience to craft the correct solution for your equipment needs and take into account specific unit configurations and mechanical properties.
Toshiba America Energy Systems’ experience with F-Class generators reflects the uniqueness of this specific class of equipment. While workscopes for these machines include repairs for known technical issues, it is equally important to provide in-depth inspections and assessments in order to uncover other systemic problems. This careful analysis, conducted by our experienced staff of generator engineers, helps ensure worry-free operation once the equipment is put back into service.

At our Milwaukee Service Center, we offer:

- Complete or partial rotor rewinds
- J-Strap and main lead replacement/reconditioning
- Spacer block repairs
- Amortissuer assembly repairs
- Collector ring machining and replacement
- High-speed balancing

On-site stator services include:

- Complete stator rewinds
- Stator rewedges, with modified ripple spring designs
- Addressing loose end winding hardware and blocking issues
- Stator electrical testing
- Clean, inspect and test hydrogen seal assemblies
TOSHIBA is one of North America’s leading turbine/generator service providers. Through our sales, engineering and scheduling professionals and an experienced workforce, we ensure quality and value in rewinding, refurbishing, repairing and testing large generator rotors and stators. In addition to extensive in-house generator modernization capabilities, our comprehensive outage management and field services enable single-point contract responsibility.

We understand the critical nature of outages.

Toshiba’s high-bay facilities at our Milwaukee Service Center, with a 300-ton lifting capacity and wide-ranging machining capabilities, make us unique in the power generation service industry. Generator services include:

- **Rotor and stator rewinding**
- **Stator core restacking**
- **Inspection, diagnostics, testing and other engineering services**
- **Large inventory of retaining ring forgings**
- **Design and manufacturing of parts**
- **High-speed balancing**
- **Field services**

**Rotor Modernization Services**

- **Complete rewinds – new or refurbished copper winding**
- **Retaining ring machining and replacement**
- **Inspect, repair and manufacture**
  - Main leads
  - Collector rings
  - Hydrogen seals
- **Diagnostic inspection and evaluation**
- **Bearing journal machining and repairs**

Toshiba’s large inventory of retaining ring forgings fit most rotor sizes.
Stator Modernization Services

- Complete rewinds, including water-cooled stators
- Winding and insulation inspection and repairs
- Core inspections, repairs and evaluation
- Diagnostic inspection and evaluation
- Core restacking
- Frame and mechanical inspection and repairs
- Re-wedging

Balance and Overspeed Facility

- Collection and evaluation of indicator run-out readings
- Balance rotor at rated speed and overspeed
- Electrical testing, including:
  - Running impedance tests (0 to 3,600 rpm to 0)
  - Running flux probe test at 3,600 rpm
  - Running Megger testing

Electro/Mechanical Testing Service

(All testing performed in accordance with IEEE standards.)

- DC controlled overvoltage
- Insulation resistance
- EL-CID testing
- Shorted turn diagnostics
- Stator wedge tightness
- Mechanical resonance (bump testing)
- Water-cooled stator winding dry-out testing
Toshiba America Energy Systems recognizes that there is a large population of aging fossil-fueled steam turbines whose operators are considering upgrading last stage blade rows with more modern designs. Upgraded designs now available from Toshiba can help improve reliability, maintainability and operating performance over earlier generation blades.

Key technical advantages of Toshiba’s last stage blades:

- Demonstrated performance enhancements
- Multiple shielding arrangements
- High-efficiency airfoil design
- Detuned against blade/rotor torsional vibration
- Improved root finger design
- Advanced testing and qualification
- Increased backpressure operational limits

Available L-0 standard sizes of 26, 30 and 33.5 inches, with respective L-1 and L-2 blades also offered.

On-site “Long Shank” retrofits:

- Advanced long shank LP turbine blade designs
- Optimized dovetail design reduces stresses (up to 15% reduction)
- Customized blade shank design uses original rotor without impacting performance
- Abundant experience in installation, including the specialized NDT and machining necessary
- No performance or efficiency impact as a result of the modified shank
Toshiba America Energy Systems has formed its Measurement Inspection Services (MIS) organization within the company’s Engineering Department. For more than 20 years, this talented and experienced team of professionals have earned the trust of all major turbine and generator OEMs for their retrofit measurements. Previous customers have included manufacturers and service providers in gas, hydro, nuclear, aerospace and military industries worldwide. Utilizing advanced measuring, analysis and reporting software (Verisurf®), MIS travels to customer sites, both domestic and international, performing advanced measurement inspections as part of this new service offering.

**Key services offered:**

- First article inspection to blueprints or CAD Models
- Portable CMM/Laser Tracker inspection at any location
- 2D and 3D measurement for reverse engineering of complex parts/structures
- Scanning service for small or large parts and equipment
- Basic inspection training

**Industries served:**

- Power Generation
- Aerospace
- Military
- Petroleum
- Automotive
- General Manufacturing

**Expert use with these advanced measuring devices:**

- FaroArm
- Faro® Focus 3D Scanner
- Faro® Laser Tracker
- Verisurf® Software

**Mission:**

“Measurement Inspection Services is committed to quality and progress through the use of, and training in, the latest dimensional measuring tools, software and technologies to support our customers’ critical measuring needs.”
TOSHIBA’s MSV Bypass Valve Upgrade offers a unique main stop valve bypass configuration that addresses commonly experienced solid particle erosion (SPE) issues. It’s the answer to time and resource-consuming inspections and maintenance of conventional design bypass valves. The multi-hole MSV bypass valve greatly reduces O&M costs, while increasing steam turbine availability. The design dramatically extends bypass valve service life and requires only minor modifications to install.

Upgrades are available for valve sizes from 8 to 13 inches.

The Challenge
Conventional MSV bypass valves are configured in such a way that steam is forced to change direction via a solid-surface impact. This makes these valves highly susceptible to SPE and steam cutting. Increased frequency of unit starts and total runtime on bypass further accelerate this deterioration. Severe erosion can lead to bypass valve failure and solid object damage to the turbine, resulting in costly forced outages.

The Solution
TOSHIBA’s improved design redirects the steam path to prevent solid-surface impact, thereby eliminating erosion problems. Stellite coatings in high-wear areas, as well as upgraded valve stem and bushing materials, also ensure worry-free performance.

Proven Toshiba-patented Technology
• Installations range from recent replacements to many dating back more than 20 years
• Hundreds of multi-hole valves serving Toshiba OEM fleet and others
• Fleet average starts on bypass are in excess of 350 times
• Greatest number of starts on bypass—over 1,200
Cost-reduction benefits of TOSHIBA’s Multi-hole Bypass Valve Upgrade

- Reduces planned outages to replace or repair parts
- Reduces forced outages due to valve failure
- Eliminates annual bypass valve and stem replacement
- Minimizes valve stem blue blush and scale
- Extends seal head bushing replacement
- Inspection outage intervals are increased
TOSHIBA is one of North America’s leading turbine/generator service providers. Through our sales, engineering and scheduling professionals and an experienced workforce, we ensure quality and value. Extensive in-house steam turbine modernization capabilities include condition assessment, steam path and casing repairs, replacement parts and valve retrofit upgrades. Complete vertical integration at our Milwaukee Service Center enables single-point contract responsibility for outage management and field services.

**We understand the critical nature of outages.**

Toshiba's high-bay facilities, with a 300-ton lifting capacity and wide-ranging machining capabilities, make us unique in the power generation service industry. Turbine services include:

- **Steam path assessment and repairs**
- **Blade and replacement parts manufacturing**
- **Casing repairs**
- **Valve inspections and repairs**
- **Valve upgrades**
- **High- and low-speed balancing**

**Turbine Modernization Services**

- **Steam path components**
- **Steam path repairs**
  - Blade inspection/analysis
  - Blade repairs
  - Blade manufacturing
  - Erosion shield replacement
  - Seal repairs and replacement
  - Diaphragm repairs
- **Casing repairs and re-rounding**
- **Bearing repairs**
- **Valve inspection and repairs**
- **Governor inspection and repairs**
- **NDE and condition assessment**
High- and Low-Speed Balancing

Toshiba maintains both stationary and portable balancing equipment to fit your job requirements. Our experienced dynamics engineers provide comprehensive vibration evaluation, analysis and reporting, assuring that proper balance is achieved before your equipment is returned to service.

New Component Manufacturing

- **Parts manufacturing**
  - Stationary and rotating blades
  - Valve stems and seats
  - Steam seals
  - Bushings
  - Studs and nuts
- **Specialty welding services**
  - Stellite overlays
  - Parent material repairs