



# Steam Turbine Generator Maintenance Programs

## ■ ESSENTIAL STEAM TURBINE MAINTENANCE

A properly maintained Elliott steam turbine generator (STG) can operate reliably and efficiently for decades. The best way to ensure the long-term performance of your Elliott STG is through a collaborative maintenance agreement with Elliott Field Service. Downtime can be expensive and unplanned downtime can be extremely disruptive. Following a regular maintenance program is the only sure way to maximize system uptime and to detect potential problems before they occur.

An effective STG maintenance program begins with specified preventive maintenance on a periodic basis – daily, weekly, monthly, and annually. Facility operations and maintenance personnel can perform many of these routine tasks. Regular inspections, necessary repairs and overhauls should be performed by Elliott’s expert and experienced service engineers.

Elliott Field Service will tailor an ongoing maintenance agreement specifically to your system and operating requirements to help you to achieve the STG operating performance you require.



## ■ TYPICAL MAINTENANCE SERVICES

Elliott Field Service offers a variety of maintenance services to keep your STG operating reliably and efficiently for years.

### *Remote Monitoring*

Remote condition monitoring allows Elliott to see what you see. Elliott personnel can monitor the operating conditions of the unit, trend operating data, set automatic alarm and trends limits, and receive notifications through text and email when alarms or trips occur.

### *Monthly and Semi-Annual Inspections*

Many STG operators elect to have an Elliott service engineer onsite regularly to manage less frequent preventive maintenance activities.

### *Annual Inspections*

Annual inspections give Elliott service engineers the opportunity to observe and evaluate STG performance onsite, discuss operating problems with operators, troubleshoot problems, review parts inventory, and discuss training. An Elliott service engineer should inspect an STG at least once a year.

### *Bearing Inspections & Minor Overhauls*

Steam turbine bearings and seals should be physically inspected every two to three years. This entails opening the bearing housings; removing and inspecting the bearings and seals; and replacing any components as needed. The work is generally done during a planned shutdown.

### *Major Overhauls*

A major overhaul is a detailed inspection and overhaul of the entire steam turbine generator set including the turbine casing, rotor, seals, and bearings; the generator; and auxiliaries such as the gear, couplings, lubrication system and controls. An STG should be overhauled every 5 years.

### *Service Visits*

Elliott service engineers can be available for onsite repairs and maintenance in as little as 24 hours.

### *Training*

Elliott offers a variety of STG training programs including online tutorials; onsite, hands-on training for operators; and formal classroom training at customer facilities and Elliott's training center.



## Recommended STG Maintenance

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### ■ DAILY MAINTENANCE

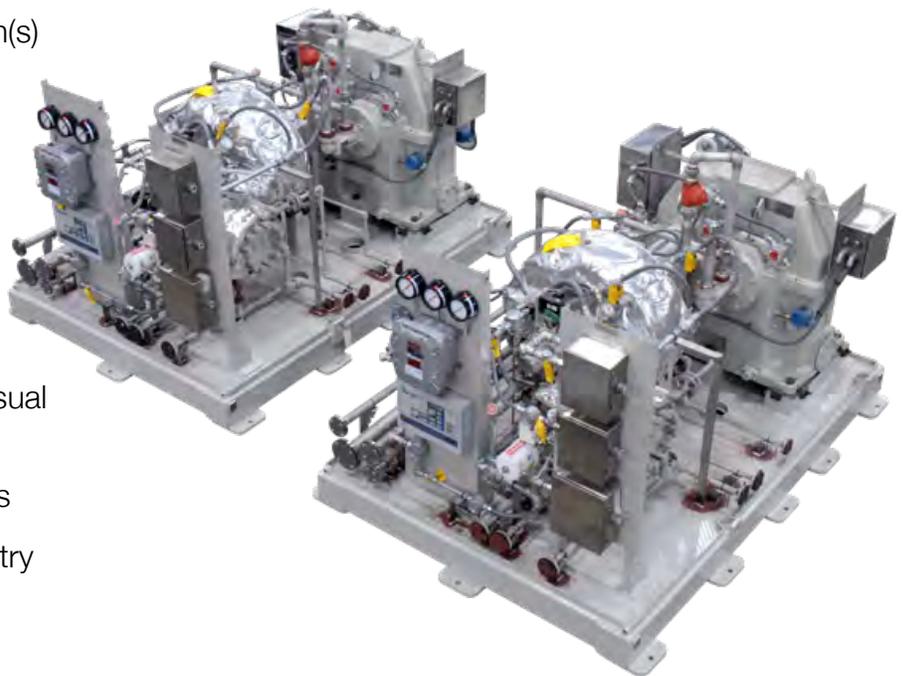
- Monitor bearing housing oil levels (on ring oiled setups); refill as needed
- Monitor and record:
  - Lube, seal, and control oil pressures and temperatures
  - Bearing metal temperatures
  - Bearing case or bearing oil throw off temperatures
  - Cooling water conditions
  - Bearing housing vibration levels: vertical & horizontal
  - 1st stage pressure (if applicable)
  - Inlet steam pressure and temperature at flanges
  - Steam flow rates
  - Exhaust steam pressure and temperature at flanges
  - Governor valve/servo position(s)
  - Speed
  - Load
  - Voltage
  - Output kW
  - Current
- Walk-around inspection for unusual noises and leaks
- Review operating data for trends
- Check boiler feed-water chemistry

### ■ WEEKLY MAINTENANCE

- Check for steam leaks

### ■ MONTHLY MAINTENANCE

- Analyze turbine performance
- Exercise trip valve; does not require shutdown
- Sample lubricating oil; renew as necessary
- Check for hunting
- Drain water and dirt from reservoir/bearing housing; top off oil as needed
- Check instrument air & lube oil filters; replace as needed
- Check generator ventilation openings, air intake opening and its air filter (if applicable); clean or replace the filter if necessary



## Recommended STG Maintenance

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### ■ SEMI-ANNUAL INSPECTION

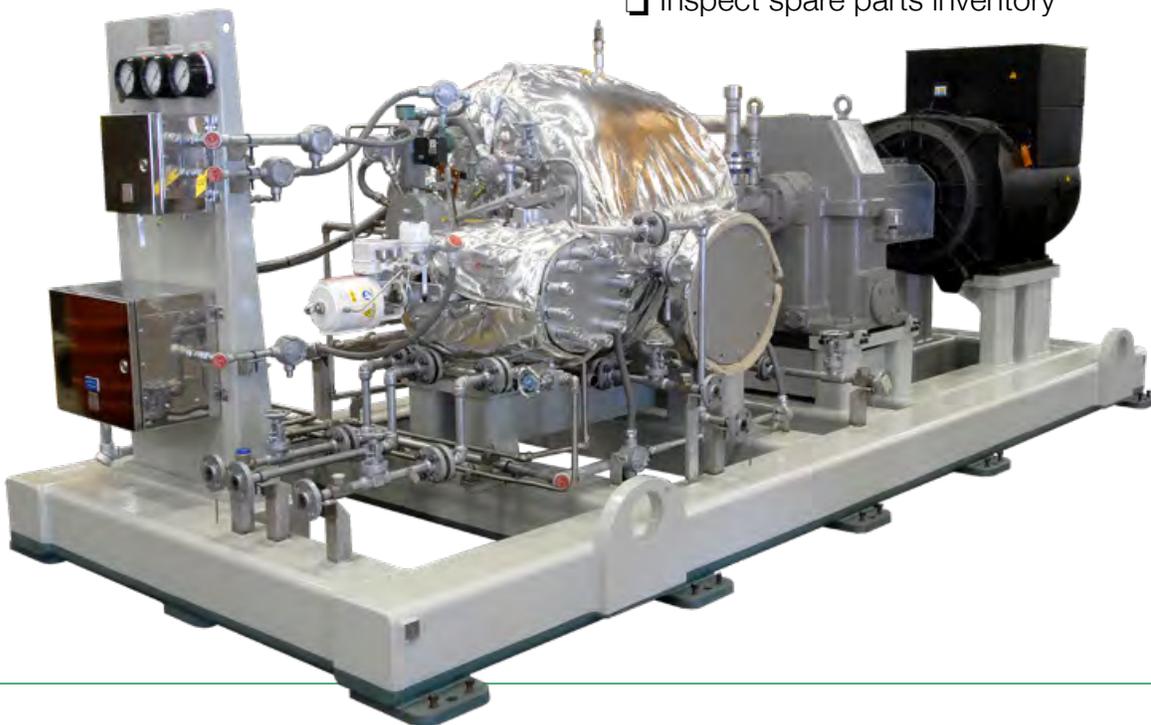
- ❑ Send oil sample to lab for analysis (if STG has gearbox)

### ■ ANNUAL INSPECTION

An annual inspection focuses on specific sections of the STG in order to avoid unplanned outages. The annual inspection is also helpful for planning of minor and major overhauls.

- ❑ Visual inspection of seal and bearing housings, and drain piping for wear, leaks, vibration, and plugged filters. Housings are not opened unless a potential problem is detected.
- ❑ Visual, mechanical, and electrical inspection of all instrumentation, protection, and control systems, including trip assemblies
- ❑ Check safety devices
- ❑ Overspeed the turbine to check the overspeed trip

- ❑ Visually inspect the turbine generator string for:
  - Evidence of steam, oil or water leakage
  - Evidence of steam deposits
  - Proper position of all valves
  - Proper oil level
  - Condition of all control and trip linkages
  - Condition of instrumentation, conduit, wiring, insulation, etc.
- ❑ Review the recorded of number of normal starts and stops
- ❑ Review the record of unit trip outs and the reasons
- ❑ Review the record of oil samples and conditioning
- ❑ Review the record of operating data: pressure, temperatures, vibration, etc.
- ❑ Discuss operating problems experienced since last inspection or repair
- ❑ Grease generator earings (if applicable)
- ❑ Inspect spare parts inventory



### ■ BEARING INSPECTION & MINOR OVERHAUL

#### *Turbine Scope of Work*

- Shutdown equipment
- Lock Out Tag Out unit
- Visually inspect the turbine generator string for:
  - Evidence of steam, oil or water leakage
  - Evidence of steam deposits
  - Proper position of all valves
  - Condition of all control and trip linkages
  - Condition of instrumentation, conduit, wiring, insulation, etc.
- Measure and record turbine axial thrust float and radial lift
- Disassemble and inspect turbine bearings for:
  - Visual condition of shaft journals
  - Journal bearing clearance and condition
  - Oil seal clearances
  - Condition of carbon rings or labyrinth seals; replace if necessary
- Visually inspect governor and trip valve
- Inspect governor valve and valve seat for signs of leakage
  - Hand lap the valve if signs of uneven wear exist
  - Replace the governor valve stem packing, if necessary
  - Check governor valve setting; adjust open, closed and span, as necessary
  - Check trip valve setting and linkage; adjust as necessary
  - Check and clean water cooling chamber (if applicable)
  - Clean and inspect trip valve for signs of leakage
  - Replace worn parts and hand lap if necessary
  - Check shaft alignment
  - Remove and clean steam strainer. If strainer is exceptionally dirty, clean every six months

#### *Generator Scope of Work*

- Inspect winding and air filters for dirt, dust, oil, and salt vapor accumulation
- Check insulation resistance of stator (and rotor if synchronous generator); record and trend data

### ■ MAJOR OVERHAUL

#### *Turbine Scope of Work*

- Perform same scope as bearing inspection and minor overhaul
- Remove upper half casing and record “as found” internal clearances
- Remove rotor and perform visual inspection
- Check condition of labyrinth seals; replace if necessary
- Hand clean nozzle ring and visually inspect in position
- Visually inspect reversing buckets & diaphragms
- Disassemble, inspect, and reassemble main stop valve, if applicable
- Dimensional inspection of rotor journal bearings and seal areas
- Check shaft alignment
- Drain oil reservoir and lube oil coolers
  - Inspect oil coolers
  - Clean oil reservoir
  - Refill oil reservoir
- Install screens before bearing housings; flush oil using system pumps and filters
- Inspect bearing sleeves, oil seals, and all rotating components
- Inspect cage, laminations, stator core, slots, and all interior surfaces
- Supervise cleaning of stator, rotor, or frame, as required
- Perform generator electrical tests:
  - Ten-minute insulation resistance with polarization index, stator (and rotor for synchronous generator)
  - Winding copper resistance, stator and rotor
  - RTD resistance check, stator
  - AC impedance test, rotor
  - Megger, stator and rotor
  - Insulation resistance and PI tests
  - Current injection test with IR camera (if induction generator)
  - Inspect & test exciter at a qualified service shop; include the results in the final report
- Inspect generator coolers
- Install replacement bearings and other parts, as required

#### *Generator Scope of Work*

- Disassemble generator end bells and remove field
- Hand clean and inspect stator and field
- Inspect bearing journals for surface and dimensional properties
- Remove, inspect, clean, and re-install WP11 enclosure
- Replace hardware, gaskets, cables, lugs, and other consumables, as required
- Remove generator cooler ends and rod out cooler tubes



Elliott Group is a global leader in the design, manufacture, and service of technically advanced centrifugal compressors, steam turbines, power recovery expanders, cryogenic pumps and expanders, and axial compressors used in the petrochemical, refining, oil & gas, liquefied gas, and process industries, as well as in power applications.

Elliott Group is a wholly owned subsidiary of Ebara Corporation, a major industrial conglomerate headquartered in Tokyo, Japan.



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