

ansaldo | energia

GENERATORS OPERATION & SERVICING



GENERATOR SHAFT LINE

Ansaldo Energia has focused on turbo-generators since the early 1920s, when we began the production of our first air-cooled turbine generator. Since then, Ansaldo Energia has continuously enhanced its OEM and non-OEM services portfolio.

Today Ansaldo Energia's Generator Shaft Line offers complete solutions for turbo and hydro generators over a range of applications, leveraging internal resources, proprietary know-how and technologies, and a global network of external suppliers. We can also offer complete maintenance, restoration and modification services on non-proprietary, third-party turbogenerators.

We Know Our Job

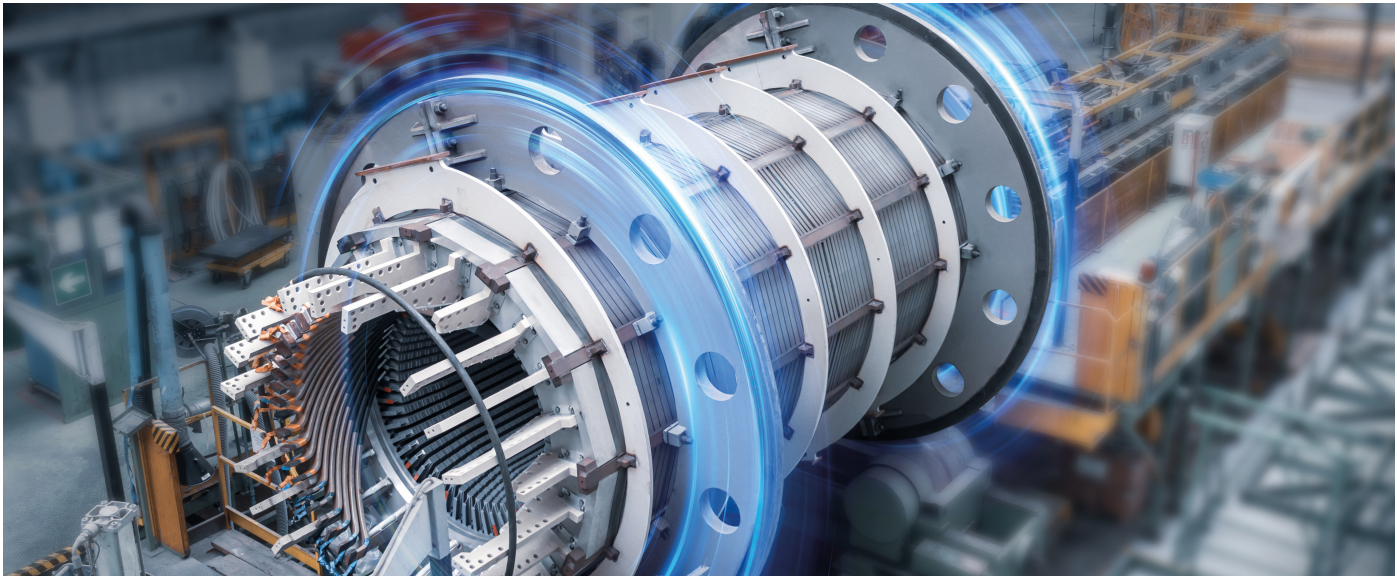
The Ansaldo Energia's know-how and experience as an OEM (Original Equipment Manufacturer) derives from the design and manufacturing of:

- About 500 air-cooled units in the 10-330 MVA range
- More than 200 units in the 40-1220 MVA range, cooled by hydrogen and hydrogen+water
- Approximately 40 years of technological agreements with GE and ABB
- More than 500 salient-pole generators, manufactured since 1950
- A present large product and services portfolio combining all types of turbogenerators, including different cooling mediums and plant types (fossil, gas, geothermal, nuclear), and hydro units with low-medium-high speed

Our team can provide Customers with the technological know-how of an OEM on every type of technology. By merging a flexible approach, a pro-active structure and highly specialized competencies over different technologies, we build upon our knowledge and leverage our organizational expertise, to achieve the know-how to work both on the OEM fleet and on non-OEM generators.

Type	Range (MVA)	Applications	Installed Units	Total Power MVA
HYDROGEN/WATER-COOLED TURBOGENERATORS	Up to 1,200	Gas turbines, Steam turbines	>60	>31,000
HYDROGEN-COOLED TURBOGENERATORS	Up to 740		>160	>29,500
AIR-COOLED TURBOGENERATORS	Up to 450	Gas turbines, Steam turbines, Geothermal turbines	>590	>68,000
HYDROGENERATORS	Up to 420	Hydroelectric plants	>530	>26,500
			>1,400	>155,000

All Generators can operate as **SYNCHRONOUS CONDENSERS**



Ansaldo Energia's Service Portfolio for Generators

Ansaldo Energia's Service organization provides worldwide, overall and life-cycle technical assistance in the fields of generators maintenance and operation, by adopting ad-hoc and high technology solutions and repairs. We are able to service a wide range of generator technologies for planned and unplanned service outages:

- Air-cooled turbogenerator
- Indirectly H₂- cooled turbogenerator
- H₂- H₂O cooled turbogenerator
- Hydrogenerator

Ansaldo Energia's Service can also provide Clients with in-house or remote personnel training, supported by tailored digital materials.

Generator Shaft Line offers services in the following areas:

Shaft Line Solutions

- Generator capacity enhancement (upgrades)
- Maintenance and operation optimization
- Entire unit replacement
- Generator rehabilitation
- Auxiliaries renovation
- Excitation system improvement (from analog to digital, from rotating to static)

Repair

The majority of repair and field activities are completed on-site at the Customer's location. Necessary repairs and/or improvements are performed at our Genoa (Italy) Repair and Manufacturing Facility. If required, our Abu Dhabi Repair Workshop and Middle East Service Hub (MESH) in Dubai (UAE) can support repair activities with a network of qualified local suppliers.

On Site

We offer the following on-site capabilities:

- Machining repairs
- Low Speed Balancing and alignment assessment
- Partial or total stator re-winding including RR (Resin Rich), VPI (Vacuum Pressure Impregnation) and GVPI (Global Vacuum Pressure Impregnation) technologies
- Turbogenerator rotor re-insulation
- Hydrogenerator salient-pole replacement
- Magnetic core repair, including partial restacking

Machining, such as rotor journals lathing, including metal spray to recreate original diameters, slip rings rectifying, and coupling holes honing, is possible due to fully skilled mechanics/operators and a wide set of portable equipment, such as: Drilling Machine, Lathe, Vertical Turning Lathe, Line boring, Horizontal boring and milling.

A special tool, designed and developed by Ansaldo Energia, permits in addition a fast and reliable dismantling of stator bars insulated as per the GVPI technology.

Maintenance

We provides every type of maintenance: from a Short Inspection to a Major Overhaul, covering the machine, its auxiliaries (seal oil system, gas system, demi-water system, braking system on hydro) and the excitation/starting systems, regardless of the technology and the manufacturer.

Pre-outage activities:

- Elaboration of Scope of Works (SOW)
- Elaboration of Inspection and Test Plan (ITP)
- Planning Elaboration
- Pre-outage meetings
- Method Statement
- Risk assessment
- Tools preparation
- Spares definition



On-site activities:

- On-site mobilization
- Mechanical dismantling
- Fact Finding / Non-Destructive Tests (NDT)
- Non-Compliance (NC) report and resolution
- Failure analysis / Troubleshooting
- Remedials implementation
- Generator re-boxing
- Start-up assistance and balancing
- On-site demobilization

Post-outage activities:

- Final Report issue
- Data base fertilization
- Engineering feedbacks
- Technical Information Letter (TIL)

In case of fault, fast intervention to diagnose the extent of the issue, a troubleshooting RCA (Root Cause Analysis) and repair are included in the offered services.

Short inspection

- Inspection of components outside generator frame (make-up filter, slip ring, brushless check)
- Electrical checks on rotor and bearing NDE insulation

Minor inspection

- Dismantling of frontal end covers in order to allow visual inspection on end-windings
- Dismantling and inspection of the bearings
- Air gap robotic inspection ("Magic Inspection") in the stator core with rotor inside

Major inspection

- In addition to activities performed during a Minor Inspection, rotor is pulled out from the generator to allow a detailed visual inspection and electrical tests
- Every component of the generator is checked and restored

Diagnostics

Diagnostic tools are available to continuously monitor turbogenerator parameters and behavior, in order to detect aging trends and to address maintenance activities. We offer a preventive maintenance program, ensuring that Customers are in the best position to achieve optimum operation and to reduce costs.

Ansaldo Energia is leader in developing tools and methods to check the operation of turbogenerators and to assess the state of mechanical components. Our portfolio includes different tests aimed to minimize maintenance cost and increase availability of the plant, avoiding the risk of unplanned outages.

GT [MW]	ST [MW]	GT [MW]	ST [MW]	GT [MW]	ST [MW]
149	93	0	0	206	99
148	91	-1	0	0	0
164	72	240	112	265	239
269	106	262	119	264	
262	98	0		291	
0	-1	209		308	
265	90	0	0	257	
161	41	0	0	257	
256	73	253		0	0
260	55	261	242	0	0
262	97	260	64	0	0
285	105	253	65	97	
0	0	247	69	0	63
0	0			128	

Non-Destructive Testing:

Ansaldo Energia continuously develops specifically tailored non-destructive testing of the generator components. We offer high reliability and repeatability of the tests, as well as reduced testing time by avoiding long and expensive dismantling of components.

Life Assessment:

We provide different procedures to analyze the expected remaining life of capital and strategic generator components, as well as the characterization of material exposed to high temperature and thermal cycles.

Remote Monitoring:

Ansaldo Energia monitors the health of generator cycles 24/7 by the remote acquisition of vital parameters (typically temperature and vibrations). The acquired data and specific feedback are returned to the Operator to provide for planning and predictive intervention and optimize the list of necessary spare parts.

In particular, DIAGEN® is an integrated diagnostic proprietary system, designed and developed by Ansaldo Energia: it can be installed on existing units, regardless of the size, model and OEM.

Integrated Plant Support

Integrated Plant Support (IPS) increases reliability and availability of your generator, while improving plant efficiency and flexibility. Our Remote Monitoring & Diagnostics centres of Genoa (I) and Abu Dhabi (UAE) offer:

- 24/7 experts support for data analysis and supervision of plant parameters
- Troubleshooting, event analysis, recommendations through ADA (Advanced Diagnostic Analysis) system for vibrations analysis and Distributed Control System (DCS) connection

DIAGEN

DIAGEN® allows real-time measurements, evaluation of trends and Fast Fourier Transform (FFT) analysis, which can be connected to our monitoring centres in Genoa and Abu Dhabi.

Several benefits can be achieved by the Customer:

- Easy data reading and assessment with only one instrument
- Support by Ansaldo Energia generator specialists
- Predictive diagnostics to reduce fault risks
- Easy implementation to connect with already installed probes by Ansaldo Energia or other OEMs
- Cost saving



Long Term Service Agreements

Ansaldo Energia provides Long Term Service Agreements (LTSA) that incorporates optimized outages planning, state-of-the-art technologies, skilled permanent monitoring and best-in-class expertise in a customizable format, which allows:

- Anticipation of technical issues
- Optimization of scheduled and unscheduled interventions and inspections.
- Optimization of spare parts management
- Supply, installation and commissioning of upgrades
- Maintenance and operation day-by-day



Parts

As a generator OEM, and based on our extensive experience in the Servicing and Maintenance of our own fleet, Generator Shaft Line manufactures and continually develops capital parts and all other spares for turbogenerators and hydrogenerators.

Leveraging today's capacities with a history of knowledge and technological agreements with different manufacturers, Ansaldo Energia is able to supply a wide spectrum of parts for third parties' machines.

As needed, Generator Shaft Line is able to rapidly implement a Reverse Engineering process, based on a team of well-proven experts in the design of generator parts, equipped with up-to-date digital tools for 3D scanning and prototyping.



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