



# TURBO GENERATOR SERVICE

TO EXTEND YOUR ASSETS LIFETIME

**ANDRTZ**

ENGINEERED SUCCESS



# Fit for the future with ANDRITZ engineered solutions

The ANDRITZ GROUP is a globally leading supplier of plants, equipment, and services for hydro- and thermal power stations, the pulp and paper industry, the metal-working and steel industries, and solid/liquid separation in the municipal and industrial sectors. ANDRITZ is always close to its customers, with more than 250 production locations and service and sales companies around the world.

ANDRITZ Hydro is part of the ANDRITZ GROUP and is a global supplier of electro-mechanical equipment and services for hydro- and thermal power plants. As one of the world's largest suppliers and with 120 years of experience in electrical engineering we are offering a comprehensive product and service portfolio.

Already in the 1950ies the development, design and manufacturing of turbo generators started in our workshop in Weiz, Austria. Since then, our product range developed and covers currently the range from 8 MVA to 350 MVA.

More than 1,200 turbo generators with a total output of over 137.000 MVA were manufactured by ANDRITZ to date, providing flexibility to changing grid conditions and delivering highest possible efficiency.

We develop engineered service and retrofit solutions to achieve maximum customer benefit and return on investment based upon energy market development, customer goals, and plant conditions.

Close cooperation and permanent information exchange between the Center of Competence for turbo generators and all other research facilities of ANDRITZ guarantee the utilization of the newest technological developments, constant technical enhancement and state-of-the-art design of our products.



# Facing the changes of market environment

Global energy consumption is rising dramatically and the demand for reliable and flexible energy is growing. Because of the increasing amount of intermittent energy production through wind and solar, turbo generators are able to take over the task of grid regulation.

Consequently, the operating conditions are changing dramatically, moving towards a more cyclic operation. These new operating regimes have a major impact on the mechanical structures as well as on the electrical systems, leading to greater stress and shortening of the lifetime.

Turbo generators are able to play a major role for grid stability and for providing sustainable electricity production. All strategies are based on the use of modern technologies and implementation of optimized processes. No matter how different the individual customer requirements are, a proper combination of individual solutions meeting the technical, economical, and legal requirements of their markets is the key.

Additionally, about 50% of the installed turbo generators in power plants all over the world are more than 30 years old. Therefore, the market is increasingly being driven by modernization and upgrading of existing equipment.

Each thermal power plant owner has different reasons for modernizing its existing assets. In some cases, the equipment is reaching the end of its lifetime and plant safety can no longer be guaranteed. Nowadays, the environmental impact of energy production and sustainability is becoming more and more important. As the reliability and performance of a plant deteriorates the operation and maintenance costs increase.

## HIGHLIGHTS

- More than 1,200 turbo generators manufactured
- Over 120 years of experience of electrical engineering
- Engineered service solutions for maximum customer benefit
- Modern, advanced technology

# Service portfolio for long life-time and best performance

ANDRITZ has reached remarkable milestones on implementing latest developments and technologies of the turbo generator design, enabling our customers to cope with the new market demands and conditions.

## LIFE-CYCLE SERVICES

### INSPECTION AND OVERHAUL

To preserve best availability and to minimize risk of unwanted standstills and maintenance, ANDRITZ with its long term experience provides inspections of turbo generators, its electric and mechanical auxiliaries, diagnosis and analysis, as well as planned maintenance. With the direct contact to the design and research departments, the provided engineered service solutions always incorporate state-of-the-art technology for serviced generators while increasing reliability and prolonging the life-cycle.

We perform turnkey inspections and overhauls of turbo generators from outage preparations, dismantling and reassembly to diagnosis and execution of the necessary repairs.

Our portfolio for turbo generator inspections and overhauls includes:

- Inspections (generator, auxiliaries, excitation, protection systems)
- Robotic Air Gap Inspection
- Diagnosis and analysis
- Turnkey overhauls
- Delivery of spare parts
- Refurbishment
- Trouble shooting

Our extensive know-how enables us to support our customers in optimizing their earnings over the lifetime of the generating unit and contributes to:

- Reducing the risk of unscheduled outages
- Optimizing outage planning maintaining sustainable high availability and reliability
- Monitoring of trends and analyzing the changes in the different operation parameters.

### MAINTENANCE

We offer numerous services for scheduled and unscheduled maintenance activities. We offer planning, management and execution of minor and major revisions and overhauls including condition assessment, repairs and spare part management. Long-term service agreements with customized services complement our portfolio.

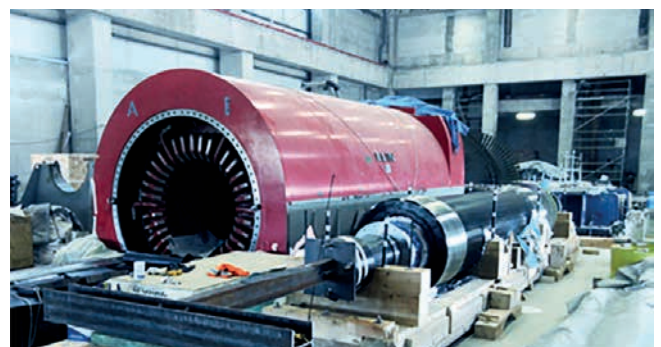
### ONLINE MONITORING - DiOMera

Supply, installation, and commissioning of online monitoring packages are important when safeguarding the overall functionality of generating units, ensuring sustainable operation of electric power plants. We are supporting our clients in identifying the most economical solution for their turbo generators.

The tailor-made solution is a combination of dedicated modules developed by ANDRITZ integrating third-party packages available on the global market.

## HIGHLIGHTS

- Turnkey inspections and overhauls
- Robotic Air Gap Inspection
- Repair of third party generators
- Reduced risk of standstills and unplanned maintenance





# The systematic "Three-Phase Approach" ensures tailor-made solutions guaranteeing the maximum benefit for the customer.

## REPAIRS AND UPGRADES

Our in-house component manufacturing and services are supplied from a single, reliable source achieving best cost efficiency and optimized cycle time. Quick response and flexibility to all challenges especially concerning unexpected findings or emergent work are keeping the downtime of our customers' equipment to a minimum. To accomplish this, we have developed a structured three-phase process to support repairs and upgrades.

### 1 ASSESSMENT AND DIAGNOSIS

Our approach is based on profound understanding of our customers' machinery with individual inspection and repair needs. All required data, parameters and measurement results are registered, assessed, and evaluated during this phase. This forms the basis for the design evaluations.

### 2 ANALYSIS AND DESIGN EVALUATION

During this phase our engineers with their comprehensive generator design knowledge focus on the root cause analysis using state-of-the-art in-house calculation tools for electromagnetic, thermal and mechanic design of the turbo generator. The calculation results are validated with measurements and operational data. Knowing the root cause is the basis for designing unique solutions matching the specific generator and avoiding the same issue again.

### 3 DESIGN OPTIMIZATION

We develop suitable scenarios to fix the root cause of the machine failure. The scenarios are evaluated and finally the most feasible and economic solution is selected by the customer. The selected solution can include temporary repairs to keep the generator in operation until a planned outage for the final repair. This reduces the downtime and the related costs to a minimum for optimized life-cycle costs.

Upgrades can increase both the reliability of the existing turbo generator and the power output. Following our systematic "Three-Phase Approach" a feasibility study shows the potentials of an upgrade enabling customers to identify suitable solutions for their specific generator. Upgrade solutions include rewinds, replacement of components or replacement of generators, stators, rotors, excitors or auxiliary systems.



## HIGHLIGHTS

- Focus on "root cause" fixes
- In-house manufacturing saving cost and time
- Temporary repairs to allow emergency operation until final repair
- Delivery of spare components



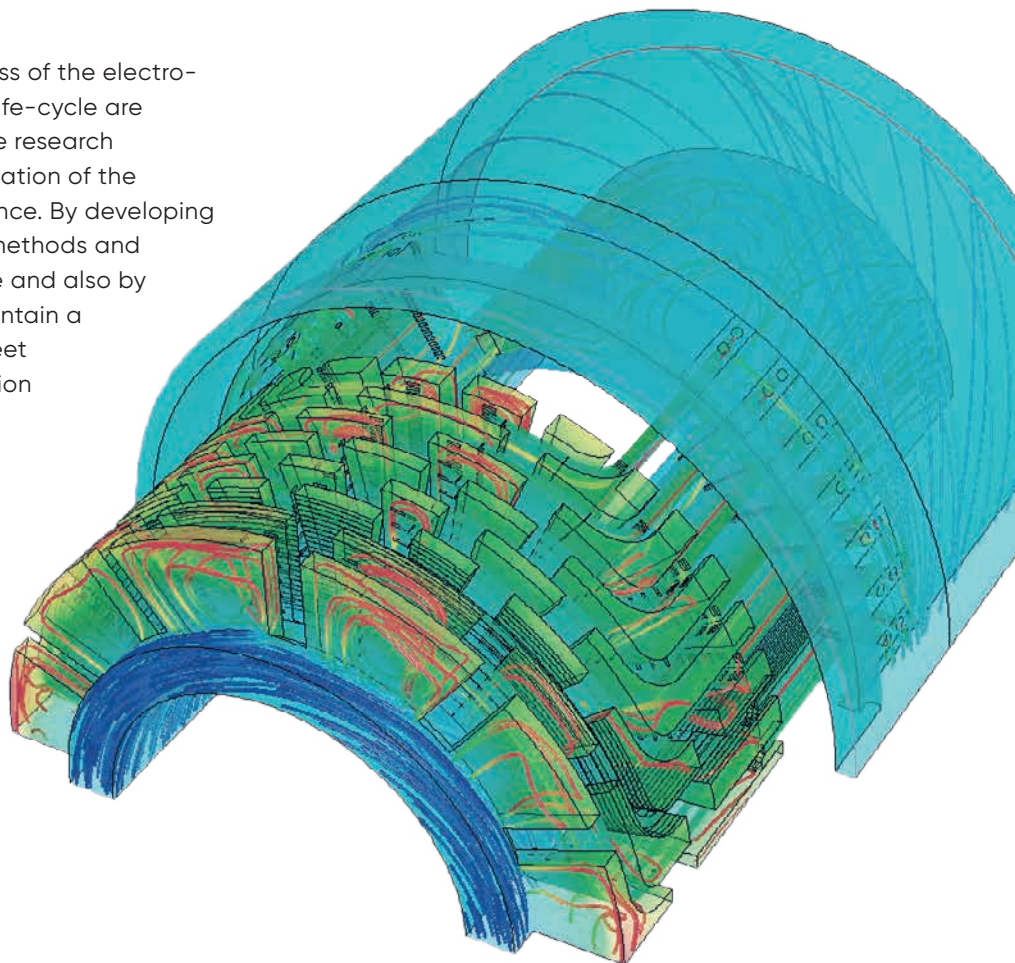
# Research and development to improve leading generator technology

ANDRITZ has more than 120 years of experience with the design and development of electrical equipment. Due to the changing market conditions, customer requirements, and technological developments, there are continuous challenges for research and development (R&D) regarding generator technology, automation, auxiliaries and grid compliance.

Finite Element Analysis methods are the standard tools in all fields of development and optimization processes of generators such as static and dynamic stress analysis, computation of 3D electromagnetic field- and frequency analysis. Computational fluid dynamics (CFD) is used for applications like optimization of cooling airflow and investigations of heat transfer in the rotor endwinding areas.

Flexibility of operation and robustness of the electro-mechanical equipment over a long life-cycle are today's major challenges. Hence, the research activities are focused on the optimization of the mechanical and electrical performance. By developing and applying numerical simulation methods and verification by measurements on site and also by cooperation with universities we maintain a steady technological progress to meet the requirements and high expectation of our customers.

**ANDRITZ global research and development activities focus on achieving improvements in processes, materials and design methods.**



# Our generator control panel as best fitting expedient automation solution

The generator control panel (GCP) is a solution for excitation, electrical protection, and synchronization for turbo generators and is characterized by space saving installation, a modular concept, standardized design, short delivery times, and competitive prices.

## HIPASE – PLATFORM

ANDRITZ has extensive and long-term experience in the fields of excitation, electrical protection, synchronization, and automation of power plants. Based on this experience the HIPASE platform for digital controllers has been developed. A highly performing and perfectly adapted platform integrating the specific requirements of the different fields in one single engineering and operating tool.

## EXCITATION

We deliver complete THYNE excitation systems for static and brushless exciters, including field current regulator (FCR) and automatic voltage controller (AVR) as well as two channel systems, integrated power system stabilizer (PSS) functionality and excitation systems for a static frequency converter (SFC) start for brushless excitations, depending on the requirements.

## PROTECTION

The electrical protection consists of all standardized functions needed for turbo generator sets. We offer a wide range of self-developed protective relays including required functionality.

## CONTROL AND SYNCHRONIZATION

We provide automation systems including control functions, such as brush control or changing synchronization areas. Furthermore, the automation system is used for interfacing the dispatch centers.

An independent synchronization device will conclude the integrated solution GCP. For operation and displaying all corresponding data from one turbo generator set, a local unit control touch display will be assembled directly in the generator bay. With the long-term experience and a wide installed base for generator control panels, we ensure sustainable solutions for station automation in thermal power plants.





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