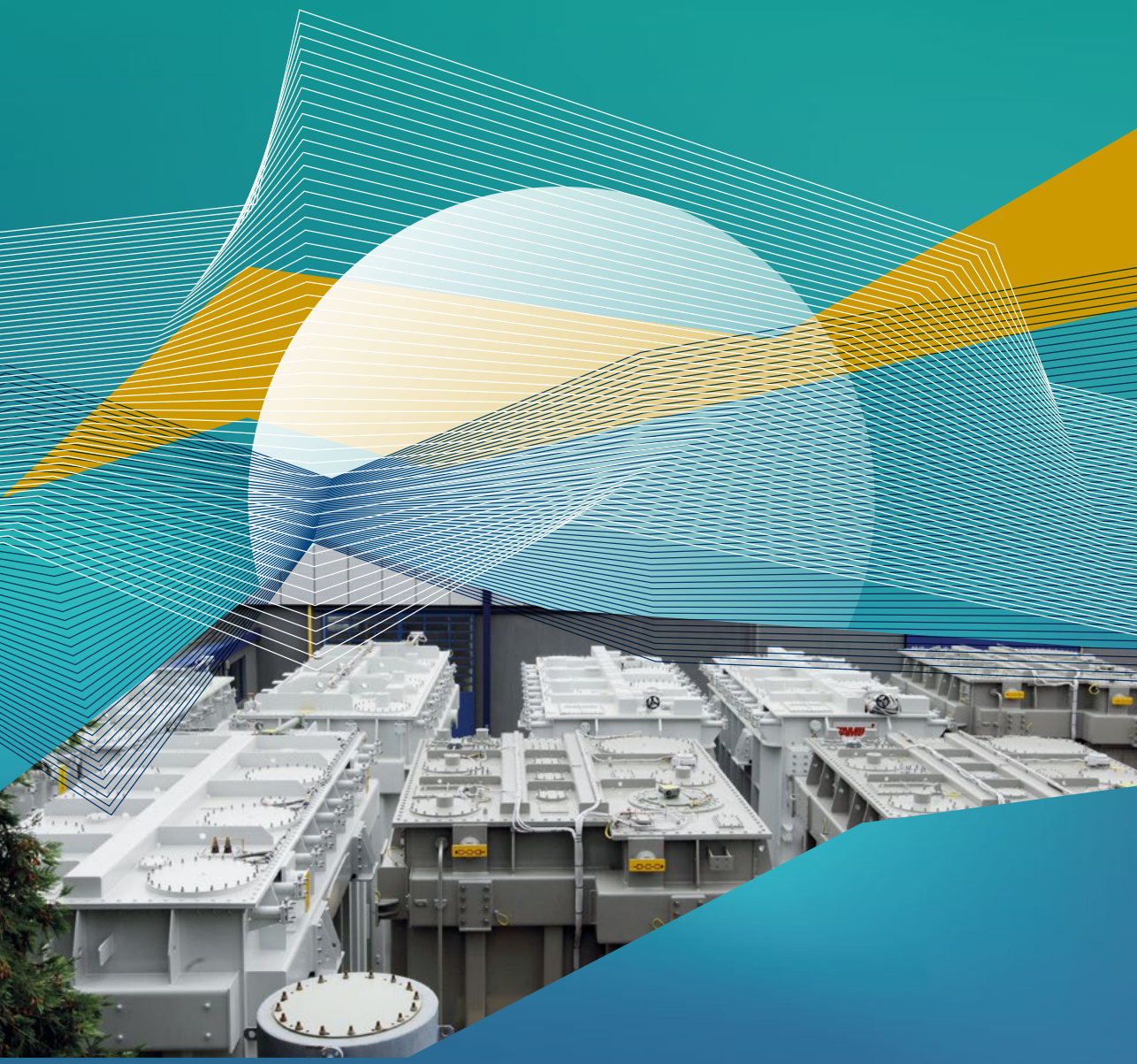
Tamini Power Applications

The Italian tailor made



TAMINI

ENERGY TRANSFORMERS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ENERGY TRANSFORMERS

Power Applications

Unique solutions, developed on customer needs.

Unique in Quality

Our transformers are the result of a unique mix: the artisan excellence of Made in Italy combined with the best available technology.

Unique in Technology

We have unique research and development methodologies to ensure the highest standards of products and services for our customers.

Unique in Customization

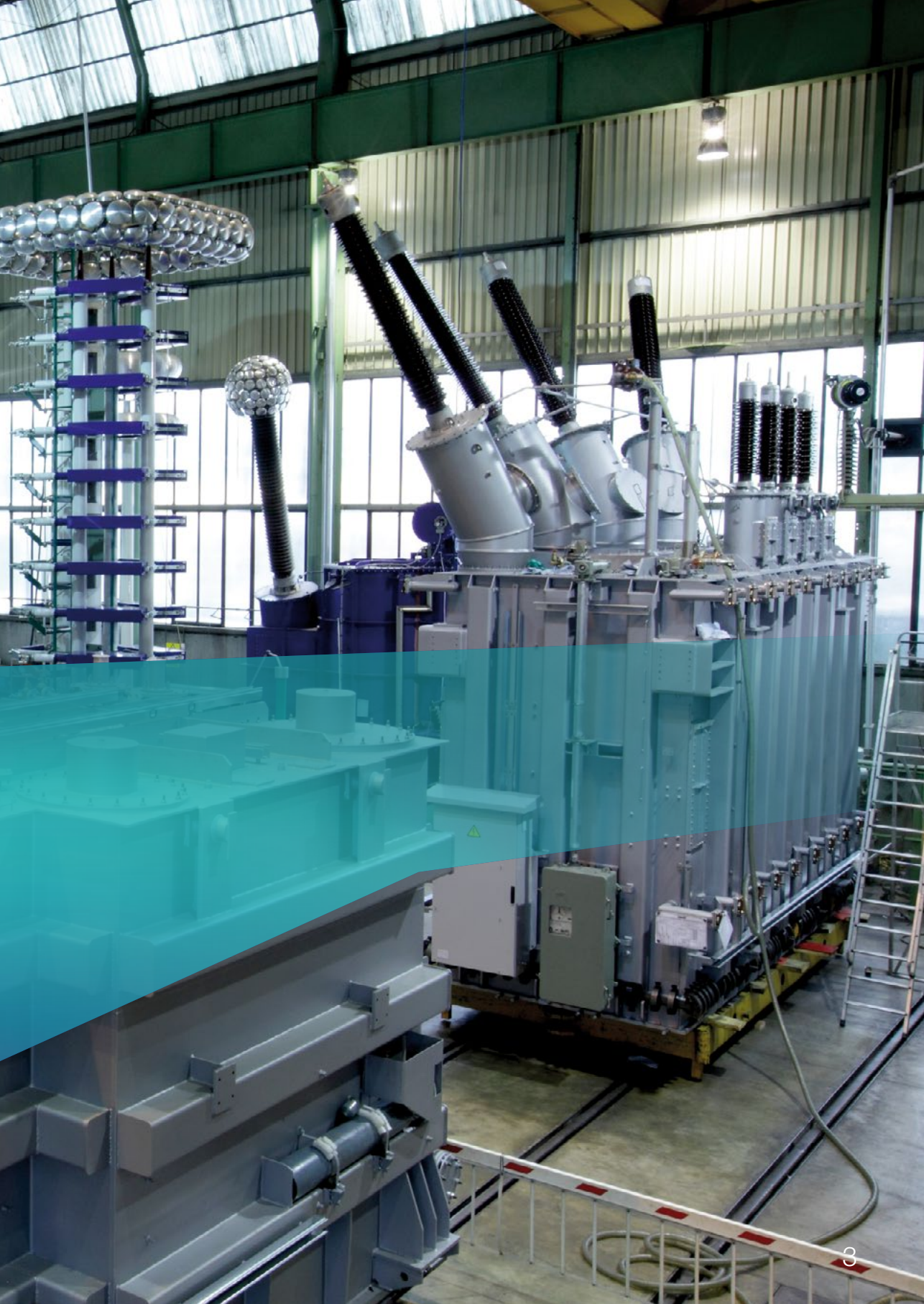
We meet the specific needs of each client through our ability to customize each solution, backed by more than a century of experience in the industry.

Unique in Design

Our experienced and qualified team designs unique products, thanks to the incomparable know-how gained Worldwide.

Power Applications

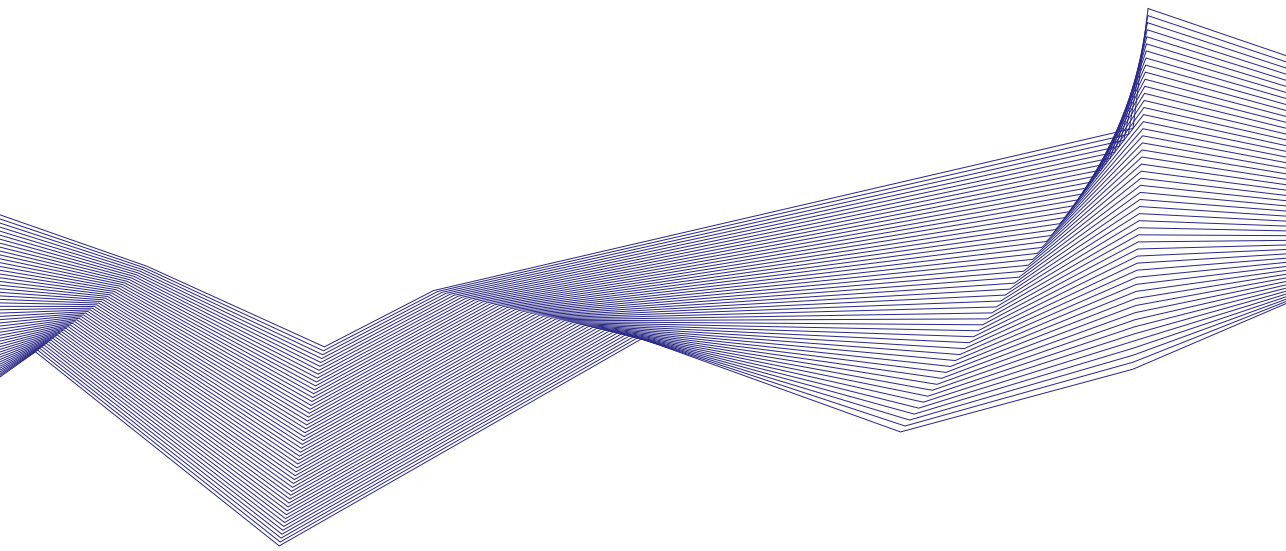
We produce customized transformers for electric systems, designed for both conventional and renewable energy sources



Transformers for Power Applications

Tamini designs and manufactures Power Transformers, PST, Autotransformers and Reactors for production, from both conventional and renewable sources, transmission and distribution of electricity.

The Company's products are designed to provide custom solutions for specific customer needs, effectively responding to ongoing technological progress in electricity generation, distribution and transmission systems, meeting the increasing demand for the interconnection of different national networks.



Research & Development

The goal of the research and development activity is to achieve the best possible life cycle cost of the Tamini products by a continuous improving of design criteria and manufacturing and testing facilities.

Investigation on power transformers includes the following activities:

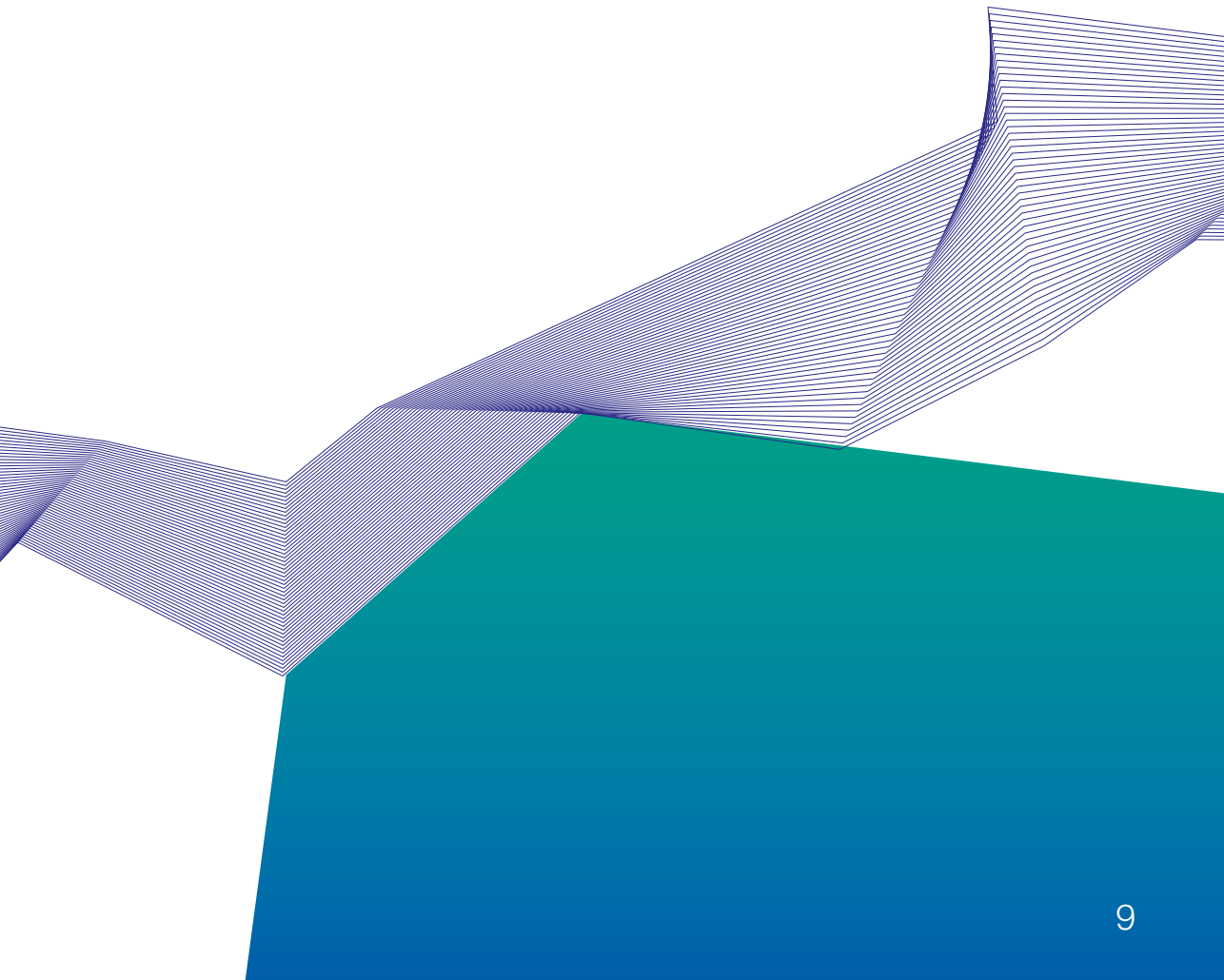
- Losses and noise level reduction;
- Analysis of electromechanical stresses due to short circuits;
- Analysis of mechanical stresses due to seismic and transportation shocks;
- Materials and components with improved characteristics and performance;
- Diagnostic systems;
- Analysis of electrical stress due to fast-transient over-voltages;
- Fluid dynamics.

Quality Assurance, Quality Control and Safety

Quality Assurance procedures are carried out and certified according to ISO 9001-2008 Standards. Quality Control is performed at every step: engineering, production cycles, procurement, testing and on site installation.

All Tamini's factories have their own testing facilities suitable for the routine, type and special tests in accordance with IEC or IEEE (ANSI) and other worldwide recognized Standards (ASA, CSA, BSS, SEV etc.).

Tamini definitely complies with the most updated international legislation for safety and environmental protection.



Transformers for electrical energy production

Since the generation is usually located away from the load distribution area, for the optimization of the transmission process it is necessary to adjust the output current and voltage of the generator; for this reason in most of the power stations, the generator output is directly connected to a step-up transformer.

Besides the step-up ones, in a power generation plant there are other transformers to supply the power station auxiliary system for starting up the boiler/turbine generator unit or gas turbine/generator and for supplying those loads which are not specifically associated with the generating unit.

Generator Step-Up (GSU) Transformers

GSU transformer is an essential component of a power plant since it links the generation system to the transmission grid.

Product scope:

- System voltage up to 550 kV;
- Power rating up to 900 MVA;
- Three-phase and Single-phase units;
- Customized design for spare GSU transformers that can be used in different power plants;
- Customized interface transformer/grid: oil/air, oil/oil, oil/SF_6.

Auxiliary Transformers

The Auxiliary Transformer supplies loads which are essential to the operation of the power generation plants.

Product scope:

- System voltage up to 72.5 kV;
- Power rating up to 100 MVA.

Transformers and Reactors for electrical energy transmission

Transmission transformers and Autotransformers are used to interconnect the separate high voltage transmission systems.

To ensure security of supply, transmission transformers are installed in two, three or four transformer substations, such that, in the event of one transformer being unavailable for whatever reason, the load can be carried by the remaining transformers. To control the power flow in an interconnected network it is sometimes necessary to use a phase shifting transformer. Long power transmission lines often require shunt reactors to compensate the line capacitance to earth.

Transmission Transformers

Transmission transformers are used to interconnect high voltage transmission systems.

Product scope:

- System voltage up to 550 kV;
- Power rating up to 900 MVA.

Shunt Reactors

Shunt Reactors are used in a power system to compensate the capacitive reactive power required by the large HV grids.

Product scope:

- System voltage up to 550 kV;
- Power rating up to 300 MVAr;
- Three-phase and Single-phase units.

Autotransformers

These are particular units where primary and secondary windings are not separated but with a portion in common.

Product scope:

- System voltage up to 550 kV;
- Power rating up to 900 MVA.

Phase Shifting Transformers (PST)

Following the deregulation of the energy sector, modern power grids have an articulated structure covering large areas, often in different countries.

Energy is no longer produced and consumed in the same country, in the same area, but it is traded on a large scale between different countries and areas. Therefore, it is necessary to manage the energy flow according to the supply contracts and not to the natural path determined by the physical parameters of the interconnected networks.

A Phase-Shifting Transformer (PST) is a special unit, specifically used for managing the power flow through complex interconnection lines. This goal is achieved by controlling the phase displacement between the input and the output voltages of the transmission lines interconnected through the PST. Both the magnitude and the direction of the power flow can be controlled by varying the phase shift.

Similar considerations can be made about the reactive power flow, but based on the in-phase regulation of the voltages.

In order to satisfy these requirements, several design solutions of PST are available. The most common types are**:**

- Two-core design in symmetric and asymmetric configuration;
- Single-core design in symmetric and asymmetric configuration.

Both of them allow a possible addition of an in-phase voltage regulation, to compensate the net voltage fluctuation or to combine in-phase and quadrature regulation.

Product scope:

- System voltage up to 550 kV with in-phase regulation if required;
- Through-put rating up to 1800 MVA.

Phase Shifting Transformers (PST)

Some examples of PSTs

Here below a short description of the most important PSTs manufactured by Tamini over the years.

a) One core design with both in-phase and shifting regulation, 75 MVA:

- Primary side: 154.5 kV +18/-10 x 1.97 kV with on load tap changer for in-phase regulation;
- Secondary side: 138 kV ± j16 x 3.84 kV allowing a no load shifting capability of ±24° with on load tap changer.

b) One core design with both in-phase and shifting regulation, 62.5 MVA:

- Primary side: 236 kV +18/-10 x 2.95 kV with on load tap changer for in-phase regulation;
- Secondary side: 160 kV ± j16 x 4.045 kV allowing a no load shifting capability of +29° -14.1° with on load tap changer for the symmetrical range of regulation, plus an off circuit tap changer to extend or reduce furthermore the angle regulation range.

The above mentioned units have been the first ones installed in the world with a special winding arrangements to obtain in-phase and angle regulation with only two three-phase tap changers and with several working possibilities.

c) Tamini one core design record is a 160 MVA PST 230 kV +24/-4 x 2.726 kV primary side (with OLTC for in-phase regulation) and secondary side 132 kV + ± j17 x 5.426 kV to obtain ±35° of shifting capability with on load tap changer. The transformer is OFAF type. The unit is also equipped with a tertiary winding for feeding auxiliary equipment.
The weight of the unit is approximately 240 Tons.

d) Another special application developed by Tamini is an autotransformer 150/200 MVA with primary voltage 330 kV and secondary voltage 161 kV ± 8 x 1.25% (with on load tap changer for in-phase regulation). This is also equipped with additional off circuit tap changer ±2 x 12 kV which allows shifting capability of ±6°. This autotransformer is the only installation in the world with this capability.

e) Two core design with both in-phase and shifting regulation, 160 MVA, obtained by coupling a main unit with a booster unit

- Primary side: 230 kV +16/-8 x 1.24% with on load tap changer for in-phase regulation;
- Secondary side: 155 kV ± j16 x 2.54% allowing a no load shifting capability of ±22° with on load tap changer.

Total weight of the two assembled unit is 366 tons.

f) The biggest units manufactured by Tamini (Two-core symmetric design among the largest in the world) have a throughput power of 1800 MVA with maximum shift angle of ±17,5°. Each unit is composed by two transformers, connected together with inlet and outlet voltage of 400 kV and angle shift adjustable by a 33 positions OLTC. Moreover, in order to invert the phase angle, an “advanced-retard” switch (ARS) is installed.

Transformers and Reactors for electrical energy distribution

Distribution Transformers

Distribution Transformers are used wherever it is necessary to connect systems for distribution and utilization of electrical energy.

They are nowadays used as well in mobile substations, needed to feed energy where a standard substation is not or cannot be built.

Tamini's experience has allowed the company to become a leading brand both nationally and abroad in the HV/MV and MV/MV distribution transformers market. The company's products are used across a wide spectrum of applications by a plethora of major clients.

Distribution transformers for energy distributions are usually three or single phase, fluid immersed, with different cooling methods, with conservator technology or sealed construction (with or without nitrogen/ air filling), with either off-circuit tap changer or on-load tap changer.

Furthermore, transformers for railway application with various loading cycles can be manufactured.

HV/MV Transformers

Product scope:

- System voltage up to 550 kV;
- Power rating up to 900 MVA.

MV/MV Transformers

Product scope:

- System voltage up to 52 kV;
- Power rating up to 100 MVA.

Special Applications in electrical energy distribution

Short-Circuit Test Room Transformers

Short-circuit test room transformers are used in test laboratories to check the short-circuit withstand capability of electric devices such as circuit-breakers, switches, transformers, etc. An extremely solid design is required for this type of transformers, for which the short-circuit is their operating condition.

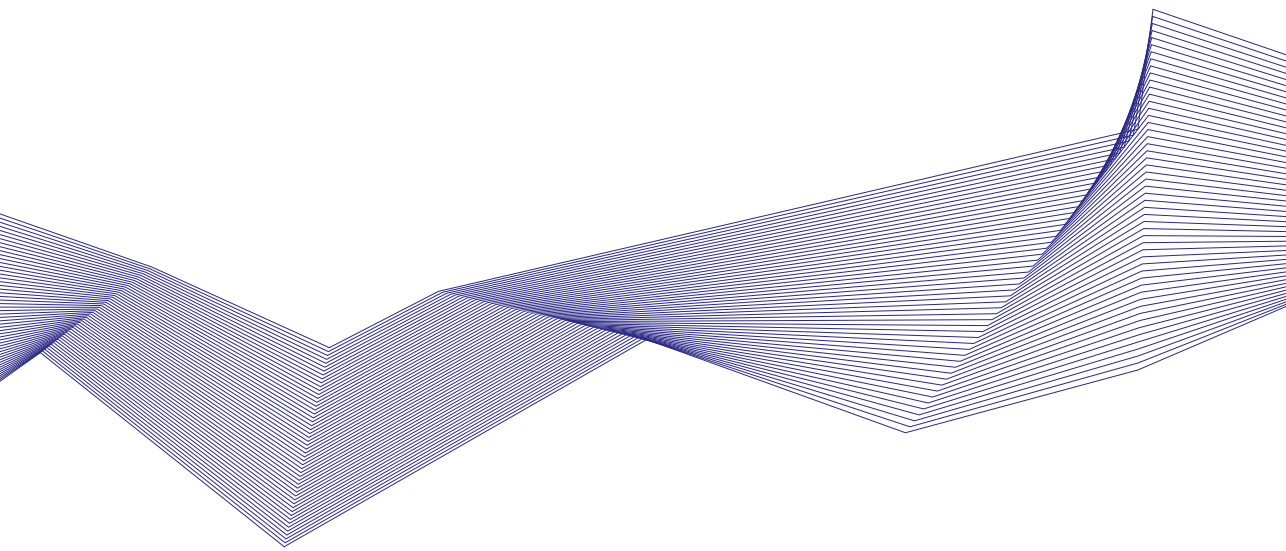
Mobile Substation Transformers

Mobile transformers are used when power needs to be temporarily supplied in a particular place and situation, like in cases of a system failure, system maintenance or civil construction. A typical mobile substation is electrical fully equipped and installed on one or more trailers, to be transported by road according to customer requirement.

An optimum solution in terms of design is always a path to be walked side by side by the end-user and the manufacturer.

Product scope:

- System voltage up to 245 kV;
- Customized power rating related to trailer dimensions, maximum transportable weight, cooling system and thermal class.



Main Accessories

Bushings

The bushings can be either of the oil/air type or oil/oil, in case of connections to cables in oil filled terminal boxes, or also oil/SF_6 for connection to SF_6 filled bus-bar ducts. HV bushings are usually of the condenser type with oil impregnated or with resin impregnated paper.

Cooling System

The transformers can be designed for any applicable cooling system following the requirements of the end user. The most used cooling systems for power transformers are ONAN and ONAF. These systems are achieved by radiator banks, mounted on the sides of the transformer tank, or in separate banks, with or without cooling fans. The cooling can also be OFAF (or ODAF) and OFWF (or ODWF) with coolers assembled on the transformer tank or in a separate bank.

Tap-Changers

The transformers can be equipped either with on-load or no-load tap changer fitted on the HV side.

The on-load tap-changers are suitable for local and remote operation and are fitted with all the accessories and with a marshalling cabinet mounted on the transformer tank.

They can feature a device for parallel operation.

Main Accessories

Tank and Oil Expansion Tank

The tank is made by welded steel streets creating a strong and stiffened structure to support full vacuum and over-pressure. The internal walls of the tank are painted with a hot oil resistant coating while externally the tank is painted according to Tamini Quality Assurance procedure. Specific painting requirements can be adopted on request.

The tank is equipped with an oil conservator divided in two sections for transformers oil and OLTC switch oil. Suitable manholes for internal inspection and maintenance are provided on the tank.

Ancillaries

The transformers are equipped with the following main fittings and accessories:

- Air silica gel breathers for the conservator sections;
- Oil level indicators with electric contacts for the conservator sections;
- Buchholz relay with alarm and trip contacts;
- Oil drain, filling and filtering valves;
- Oil thermometer complete with alarm and trip contacts and, on request, a device for remote temperature monitoring;
- Current transformers;
- Over-pressure protection;
- Lifting lugs for core and winding;
- Lifting lugs for the complete transformer;
- Marshalling box for signaling and protection auxiliary circuits;
- Earthing terminals;
- Oil sample valve.

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