

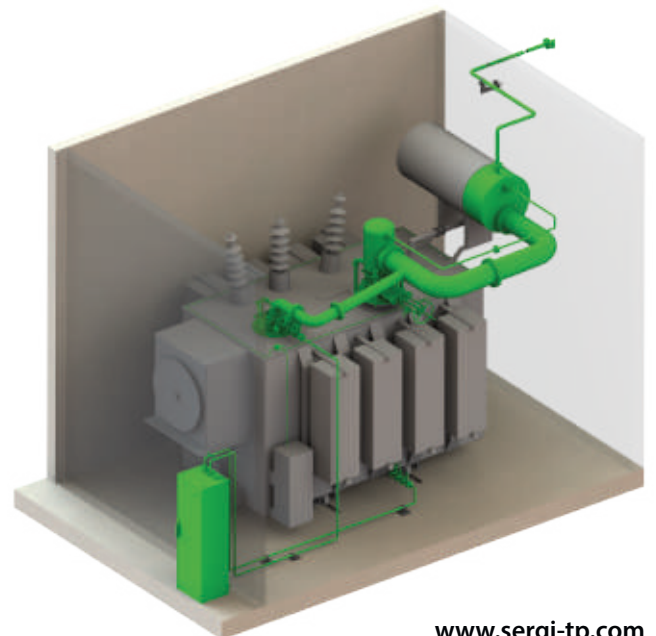


SERGI
TRANSFORMER PROTECTOR

TRANSFORMER PROTECTOR™

Transformer Explosion and Fire Prevention

Increase critical infrastructure resilience
Improve prevention of industrial risks
Prevent environment pollution



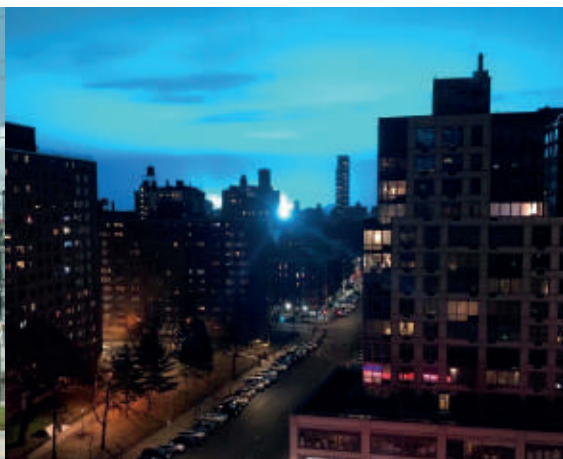


Transformers: Key assets for power supply

Transformers have a long supply lead time, making this equipment a **critical asset**.

Transformers explode during **normal operation** (through loss of oil dielectric properties, insulation failure, lack of maintenance), or for external reasons such as **cyberattacks**, age, design errors, **weather conditions**, etc.

"A coordinated attack on just 9 of the United States' 55,000 electric-transmission substations on the right day could cause a blackout from Los Angeles to New York City," according to a study conducted by FERC.¹



TRANSFORMERS

Critical assets in a critical infrastructure

In energy grids, transformers represent a key asset due to their functions, their supply lead times and their cost. The failure of such equipment can have severe impacts on the operation of power grids.

Transformers are present throughout the grid from power generation to distribution, for water supply, transportation, industries and residential areas, etc.



Most transformers are filled with oil. Such asset explodes during normal operation (insulation failure), or for external reasons such as cyberattacks, age, design errors, weather conditions, etc.

A transformer explosion with its associated fire creates human and environmental risks. In addition to the risk for the power supply, a transformer located next to a sensitive area (e.g., explosive plants, hospitals, parks, residential or working zones) can generate significant consequences and damages.

Transformers can be subject to cyberattacks; if substations are hacked, a transformer overload could occur within 48 hours without local or regional operators noticing. This would lead to an insulation failure within the transformer, resulting in a transformer explosion.

At a large scale, any successful cyberattack could trigger physical damage to transformers and widespread service disruption. *"In addition to the impacts on critical services, households and businesses that rely on electricity, an attack could result in millions or even billions of dollars in damages for electric utilities and its consequences."*² (IEA)



TRANSFORMER PROTECTOR™

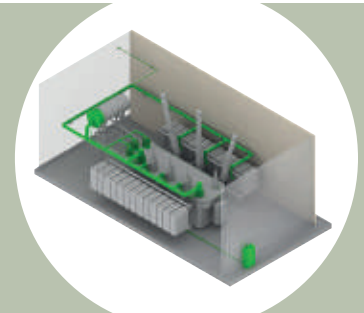
The TP is a Fast Depressurization System defined by the National Fire Protection Association (NFPA) in its Code 850.



The TRANSFORMER PROTECTOR™ (TP) is the sole proven solution to prevent transformer explosion and fire. **The TP is a passive mechanical system that cannot be hacked.** With 20 years in operations, the TP has saved USD hundreds of millions to transformer owners.

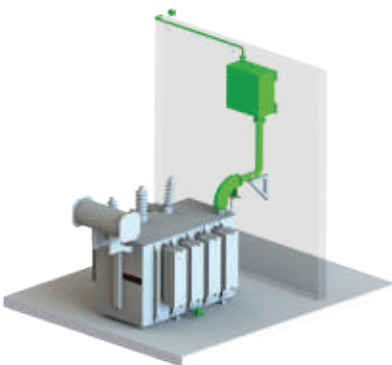
As per NFPA Code 850, the TP protects the Tank, OLTC, Bushing Turrets and Oil Cable Boxes and it is activated by Dynamic Pressure following transformer short-circuit, which ensures its effectiveness. The TP can be installed on new or existing oil-filled transformers from 0.1 to 1,000 MVA and above.

“ A EUR 15 million Product Liability Insurance is provided with TRANSFORMER PROTECTOR™, never claimed for 20 years thanks to its high efficiency and reliability.

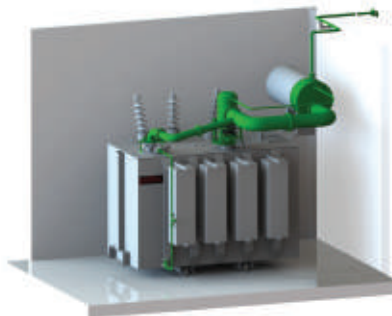


Different TP models according to transformer design and customers' requirements

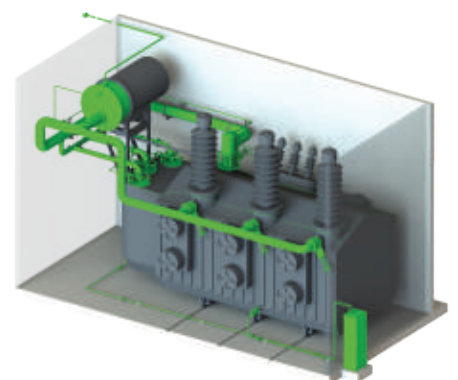
Request more information to your account manager.



Model TPS, tank protection with mobile cabinet



Model TPE, tank and OLTC protection with mobile cabinet



Model TP, tank, 3 OLTC and 3 bushing turrets with fixed cabinet

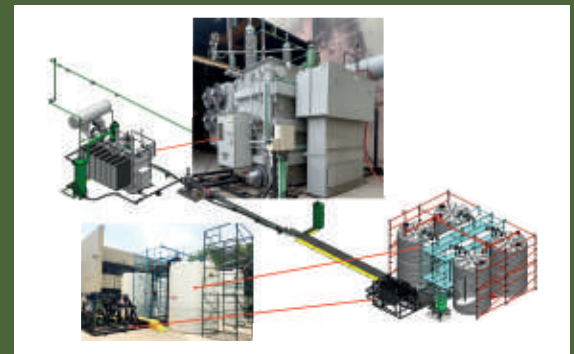
Research, simulations and live tests are mandatory for avoiding transformer explosions

Despite investments in transformer design, monitoring systems, extensive maintenance, etc. transformers continue to explode:

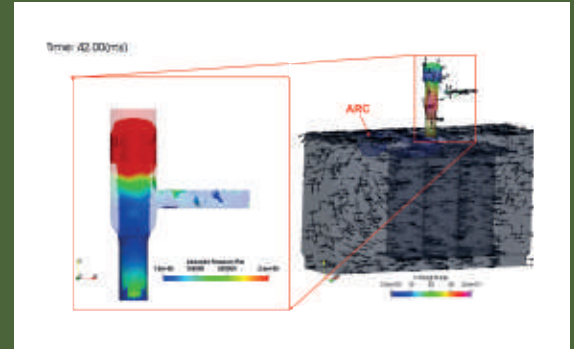
- ❑ "A one-year research study led to the discovery of 730 transformer explosions in the US alone."³
- ❑ "The consequences are nearly always total loss of the transformer and often with collateral damage to other adjacent assets, as well as environmental pollution and loss of supply for a long period of time."⁴
- ❑ "Many experts anticipate that the number of failures per year will increase significantly in the near future."³

66 Live tests performed by two independent High Voltage Laboratories⁵

In addition to CFD and FSI simulations, the SERGI Transformer Protector Research Department uses live tests, creating internal arcs inside oil-filled transformers to demonstrate the TP is an effective Fast Depressurization System.

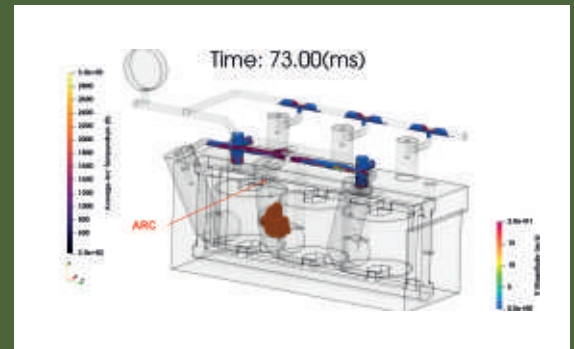


TRANSFORMER PROTECTOR™ Full-Scale Live Test on a 40/50/60MVA Transformer at LAPEM H.V. Lab.



The TRANSFORMER PROTECTOR™ with one Vertical Depressurization Set (VDS), is rapidly depressurizing a transformer subjected to an arc:

- The oil and gas jet outflow in the VDS is colored by velocity (top right) and pressure (bottom left).
- Oil velocity vectors are shown inside the transformer.



The TRANSFORMER PROTECTOR™ with 6 Depressurization Sets (DS) and 2 Tank Depressurizations Sets rapidly depressurizing a 750MVA transformer subjected to a 20MJ arc. The arc located in the central HV Bushing Turret is colored by temperature and oil-gas outflow from all DS are colored by velocity magnitude.

TRANSFORMER PROTECTOR™ Benefits

- ❑ Improve environmental protection, especially for offshore wind farms and plants near water points or vegetation, preventing water pollution or wildfires
- ❑ Optimize project requirements having a direct impact on CAPEX and OPEX
- ❑ Safeguard plant infrastructure and employees' life, preventing expensive lawsuits, fines, and penalties
- ❑ Reduce risk having a direct impact on insurance premium
- ❑ Comply with companies' policy to reach safety performance
- ❑ Increase power supply reliability by shortening plant outages to few hours after an internal transformer incident occurs
- ❑ Secure revenues to fulfill financial commitments and profitability
- ❑ Enhance community relations and preserve brand reputation
- ❑ Provide competitive advantage by selling trustworthiness
- ❑ Allow faster transformer repair and possibly onsite

³ Reliability of main transformers, H.P. Berg, N. Fritze, RT&A (Vol.2), March 2011

⁴ Guide for transformer Fire Safety Practices, CIGRE June 2013

⁵ G. Perigaud, S. Muller, G. de Bressy, R. Brady, An Answer to Prevent Transformer Explosion and Fire: Live Test and Simulations on Large Transformers, Power-Gen International, 2008

TRANSFORMER PROTECTOR™

Thousands of TP under operation worldwide

1 Namibia Power Corp. - Namibia

"Considering the increasing transformer lead times, insurance requirements and large capital investment required, NamPower's transmission management group made the decision that all indoor substations, strategic network transformers and reactors ≥ 40 MVA or with a high voltage of ≥ 220 kV should have a TP protection system."⁶

2 Nant de Drance - Switzerland

"Generator Transformers with their high fire capacities in the cavern deep in the mountain have high damage potential, our planner proposed the extremely fast reacting SERGI TP as additional safety is decisive for our purpose. I would **recommend** the TP to those operators who must reckon with extremely high consequential damages when their Transformers explodes."⁷

3 ORANO - France

"The insurance company mandated for this audit recommended in its report the installation on our transformers of a system of TP from SERGI, in order to prevent the risk of explosion and fire. I would **recommend** TP to any company for which a transformer explosion presents a significant industrial risk, especially if their insurance contract requires a high level of protection."⁸

4 ArcelorMittal - Germany

"We would recommend the TP particularly for applications of oil-filled transformers, in which personal injury cannot be ruled out in case of accident. We also recommend the TP where high demands are placed on the reliability of the power supply and in the case where a company lacks a replacement transformer and would be financially impacted following the loss of a transformer due to an electrical fault."⁹



⁶ Gerhard Myburgh, Namibian Power Corp (May 2015) Asset Security Strategy Addresses Fire Protection, T&D World

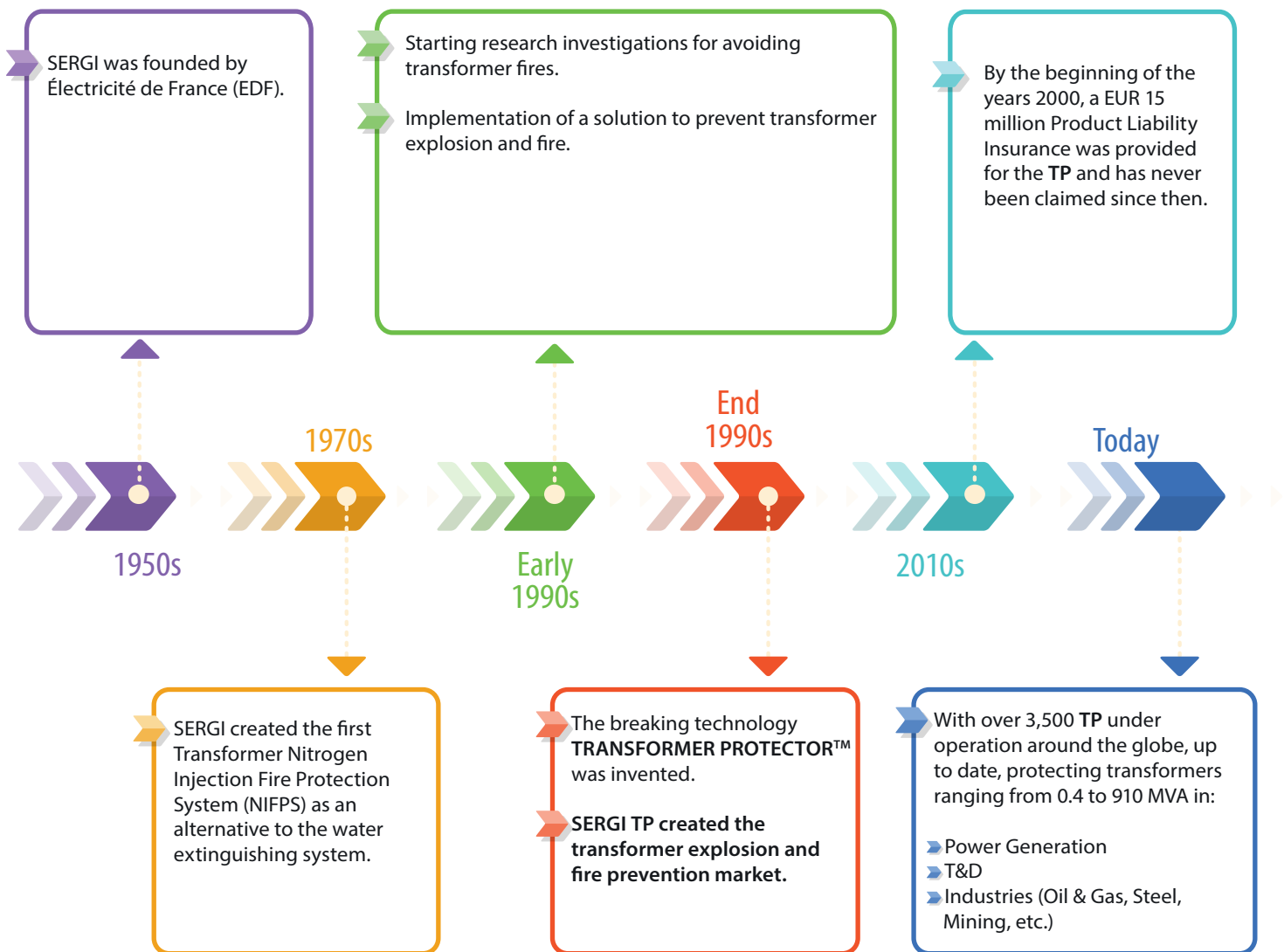
⁷ NDD interviews performed by SERGI Transformer Protector, 2020

⁸ ORANO Nuclear Team Interview performed by SERGI Transformer Protector, 2020

⁹ ArcelorMittal interview performed by SERGI Transformer Protector, 2021

TRANSFORMER PROTECTOR™

SERGI Transformer Protector Timeline



About us

SERGI Transformer Protector (SERGI TP) is specialized in transformer explosion and fire prevention, designs, manufactures and commissions TRANSFORMER PROTECTOR™ (TP) accordingly.

Since 1950, SERGI TP is at the origin of transformer fire and explosion protection. With more than 70 years' experience in transformer protection, SERGI TP is the world leader in the market.





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