

Next level reliability and resilience for distribution transformers

Discover the Transient Voltage Protection (TVP®) Technology by Hitachi Energy



Transient voltage can cause damage to transformers and, over time, lead to failure, resulting in reduced lifetime, downtime, and costly repairs or replacement. Hitachi Energy's Transient Voltage Protection (TVP®) technology is now available for liquid filled and dry type distribution transformers to protect them against switching transients, securing reliability, a long lifetime of service operations, and mitigating the risk of costly outages.

In a world that thrives on connectivity and innovation, reliable and efficient power distribution is non-negotiable. As industries evolve and technology advances, the demand for transformers that can keep pace with the changing landscape has never been higher.

In this evolving landscape of power distribution, reliability and resilience are paramount. Hitachi Energy, a pioneer in transformer technology, has now made available the Transient Voltage Protection (TVP®) Technology for both liquid filled and Dry type distribution transformers. TVP® is an innovative solution that establishes a new standard for safeguarding their reliability and life expectancy. Hi-

tachi Energy has spent over a decade researching and perfecting protective solutions for network switching, and its TVP® technology is the successful culmination of these years of effort. The TVP® technology is an already proven protection solution for Hitachi Energy's dry-type transformers, and now its application has been expanded to Hitachi Energy's liquid-filled transformers.

Understanding the importance and advantage of Transient Voltage Protection (TVP®)

Why is transient voltage protection crucial? If your processes involve frequent electrical network switching or if nuisance

tripping is a concern, your transformers may be at risk of premature failure due to switching transients. Vacuum Circuit Breakers (VCBs) do provide increased safety and efficiency, to electrical systems, but in certain system configurations and procedural operations, VCB (and SF6) switching can produce fast transient over-voltages inside the windings, that must be avoided as they may lead to failures and costly downtime.

Transformers with TVP® Technology offer complete protection at every switching instance

Transformers with TVP® Technology provide comprehensive protection for



Hitachi Energy's success with TVP technology in dry-type transformers spurred the company onto another groundbreaker – its launch of Liquid-filled Transformers with Transient Voltage Protection (TVP®) Technology

electrical systems during every switching instance. Their network-agnostic design makes them a perfect fit for diverse network configurations, offering optimal solutions without the need for complex and time-consuming system studies.

Strategic integration of varistors

Equipped with varistors strategically integrated into the transformer windings, TVP® provides protection against both reignitions and resonance amplification during switching events. Their strategic placement across the windings eliminates the risk of any damage from sudden transient peaks, mitigating subsequent costs of downtime and repair or replacement.

Proven field record

The effectiveness of TVP® is underscored by the successful operation of ~2,500 units of Hitachi Energy Dry-type transformers equipped with TVP® technology for over seven years in the field across various applications. No field failures have been reported, attesting to the reliability and robustness of this solution.

The new solution for liquid-filled transformers was presented in November during the inauguration of the company's cutting-edge Transformers Factory in Bac Ninh, Vietnam.

This event was also considered the perfect occasion to unveil this pioneering technology for the industry.

More than 200 attendees, including customers, partners, and employees, enjoyed the product launch ceremony at the new company facility with a display of a life-size demo unit. This memorable event marked another milestone for the company's commitment to developing innovative solutions for the energy industry, as the Bac Ninh factory will produce distribution transformers with TVP® Technology. The solution sets new heights of reliability and resilience for transformers.

TVP explained

Hitachi Energy's transformers equipped with TVP® have varistors strategically integrated into the transformer windings to protect them from fast acting transients.

The waveforms in Figures 1 and 2 below represent actual laboratory testing, representing worst-case switching scenarios for 20 kV Dry type and liquid-filled transformers. These charts show how TVP® limits transient voltage peaks to a controlled, predictable level that is safe for the transformer.

Hitachi Energy's TVP technology is the only solution that can control voltage rises internally and externally to transformer windings. TVP technology does not increase design complexity as opposed to other solutions like RC snubber circuits.

Transformers with TVP compared to other solutions A decade of proven performance

For the past decade, Hitachi Energy has been at the forefront of innovation, first introducing Dry-type Transformers with TVP® technology. With over 2500 units operating globally, the TVP® technology has demonstrated unparalleled reliability, boasting zero reported failures. This proven field record extends across diverse applications, including data centers, industries, rail infrastructure, and more.

Extended expertise

Backed by over a century of experience in transformer technology, Hitachi Energy's legacy of innovation and commitment to excellence ensures that customers receive not just a product but a reliable solution supported by a trusted industry expert.

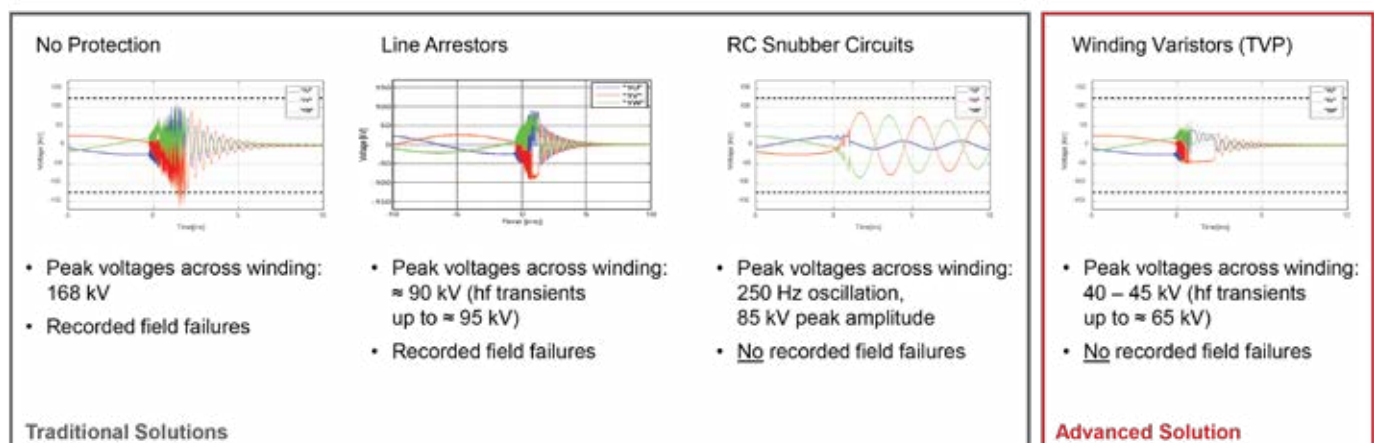
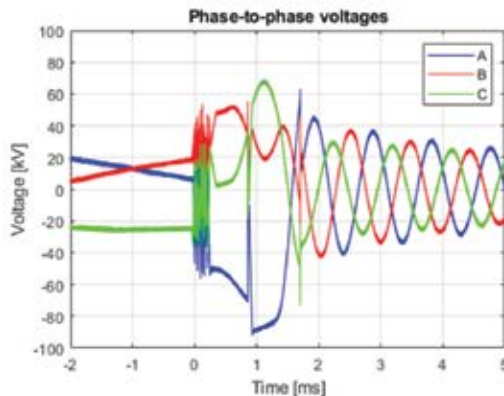


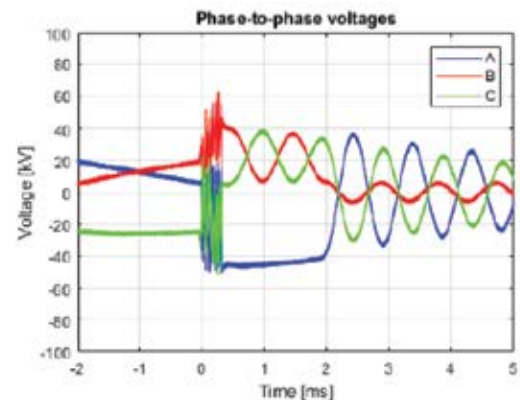
Figure 1. Worst-case switching scenario of a 20 kV Dry-type transformer

Phase-Ground Surge Arrestors (only)



- Delta primary, Liquid immersed
- 90 kV peak voltages
- Clipping from phase-to-ground surge arrestors

Winding Varistors (TVP)



- Delta primary, Liquid immersed
- 40 – 45 kV (hf transients up to ≈ 65 kV)

Figure 2. Worst-case switching scenario of a 20 kV liquid-filled transformer

Hitachi Energy's transformers equipped with TVP® have varistors strategically integrated into the transformer windings to protect them from fast acting transients

What sets TVP® apart from other solutions?

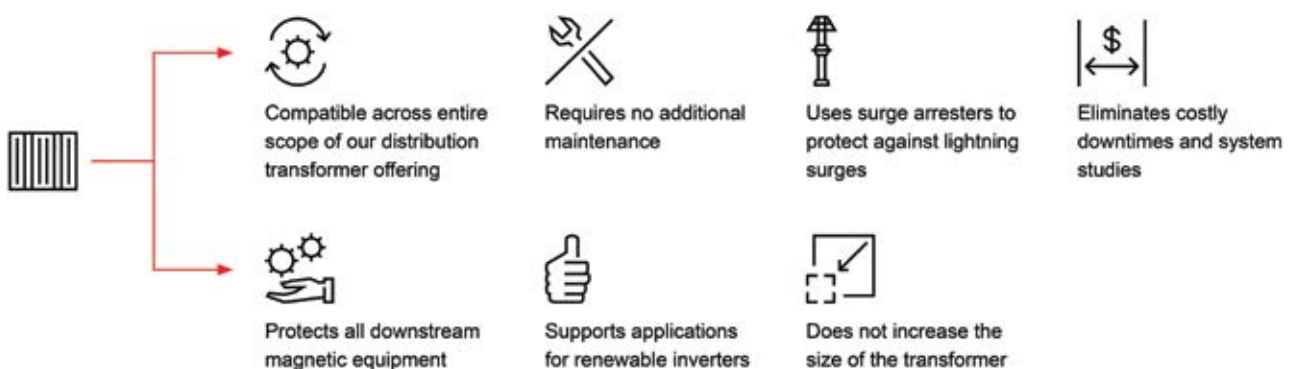
▪ Optimal solution with minimal complexity

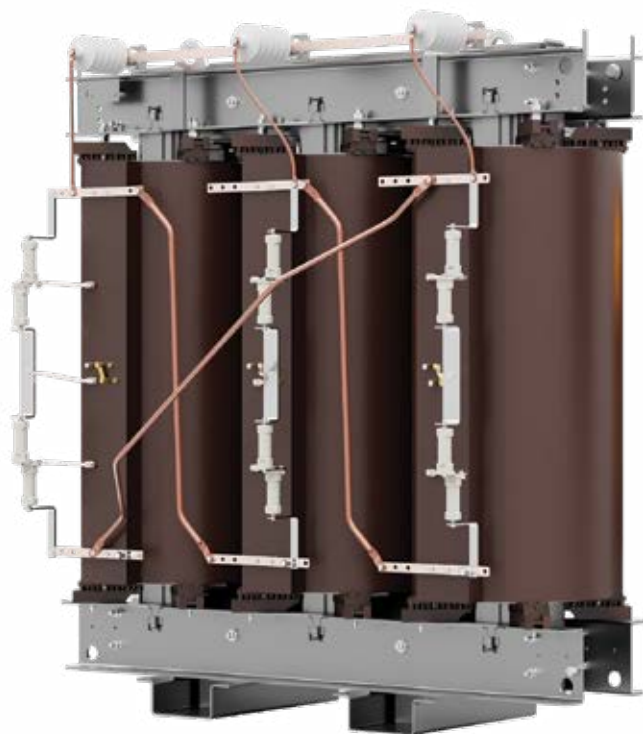
TVP® stands out as the optimal solution that works in all system configurations, eliminating the need for com-

plex and time-consuming systems. It outperforms alternatives like RC snubbers and does not alter the transformer footprint. Being an inbuilt feature of Hitachi Energy Transformers, TVP® requires no additional maintenance, eliminating site installation hassles for customers/end users.

▪ **Full protection with predictable control**
TVP® is the only solution that limits transient voltages to a controlled, predictable, safe level. It protects transformers and downstream equipment from both reignitions and resonance over-voltages, ensuring the utmost security for your electrical systems.

TVP technology — a simple solution for a complex problem





Hitachi Energy's TVP technology is the only solution that can control voltage rises internally and externally to transformer windings

Scope for TVP® Technology

TVP® for Dry-type transformers

Hitachi Energy's TVP® technology is available for Vacuum Cast Coil and Resibloc Dry-type transformers, providing reliable protection and performance.

TVP® for liquid-filled distribution transformers

TVP® liquid-filled transformers have

been launched, including pad-mounted, ground-mounted, and substation-type transformers, ensuring complete protection across a wide range of applications.

Mitigating risks in key applications

Certain applications are particularly at higher risk of damage due to switching transients. Transformers with TVP® are highly recommended for these critical areas to avoid potential failure and costly downtime:

- **Data centers:** Protect critical data center infrastructure from the risks of switching transients. The TVP allows for cost savings system design without fear of increased risk
- **Solar power:** TVP enables safe night-time/idle-time disconnection of solar transformer saving transformers' no-load losses
- **Rail and industry:** Safeguard transformers in rail infrastructure and industrial settings against transient voltage threats during 10,000's of switching operations
- **Wind power:** Enhance the resilience of transformers in wind power applications, where reliability is paramount.

Hitachi Energy's TVP® technology is available for Vacuum Cast Coil and Resibloc Dry-type transformers, providing reliable protection and performance

Why choose Hitachi Energy's transformers with TVP® Technology?

1. **Proven reliability:** Over 2500 units operating globally for over a decade with zero reported failures.
2. **Extended expertise:** Backed by a century of experience, Hitachi Energy offers a legacy of innovation and commitment to excellence.
3. **Unparalleled in the industry:** TVP® stands out as the most optimum solution, providing unmatched protection without altering the transformer footprint.

Elevate your distribution transformers to new heights of reliability and resilience with Hitachi Energy's Transformers with TVP® Technology. Contact Hitachi Energy today to explore how we can empower your power distribution needs.

Discover more about TVP® Technology



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With over two decades of experience in Distribution Transformers industry, Suhel has an in-depth understanding of the challenges being faced by the

industry in the energy transition journey.

He is driving the development of pioneering technologies for distribution transformer solutions at Hitachi Energy, solving the key challenges being faced by Utility, Industry, Infrastructure, and Transportation sectors, thereby enhancing reliability and operational efficiency, supporting sustainability, and creating value for customers and stakeholders, and positively contributing to society.



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