Future-proofing high voltage test systems

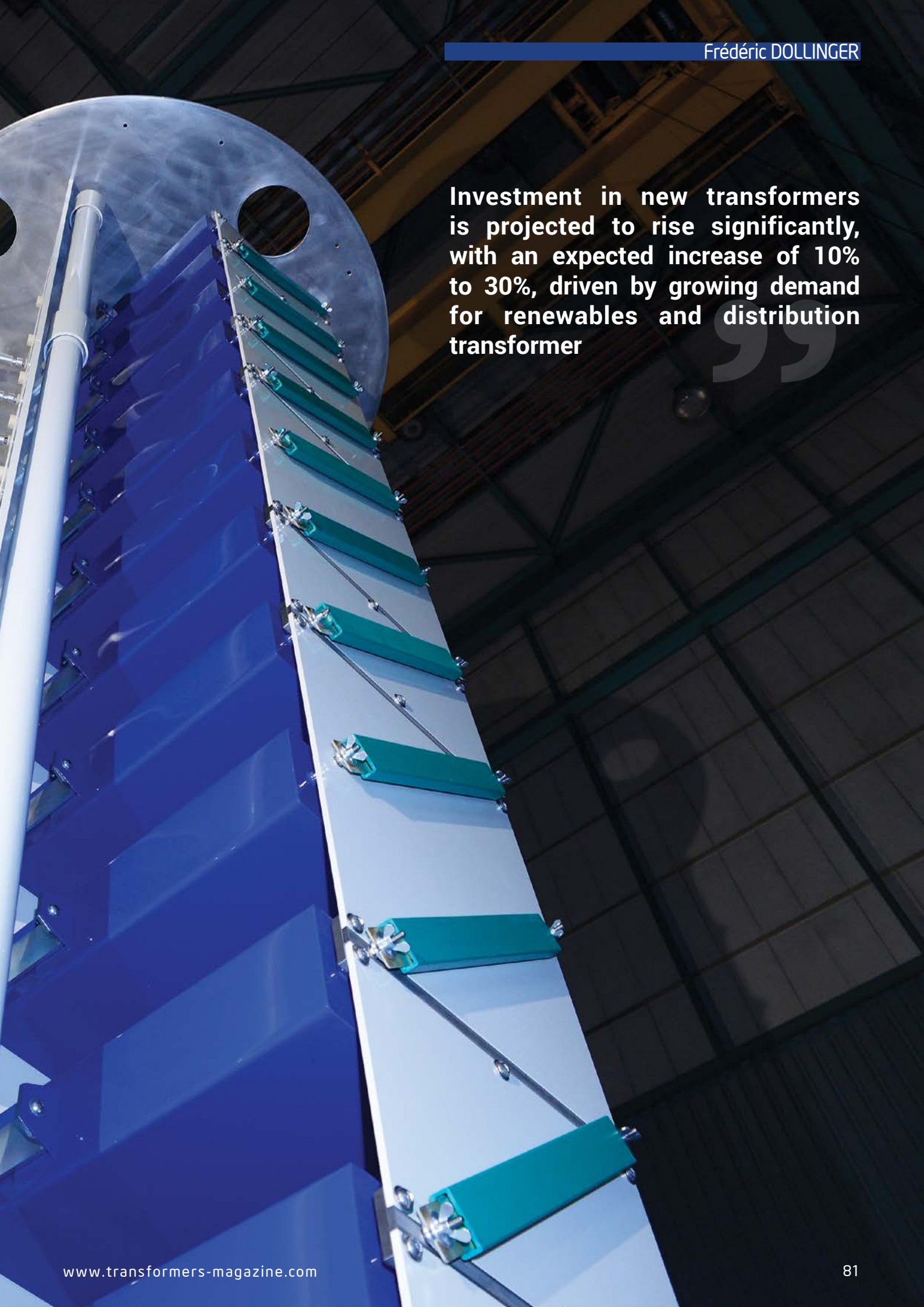
The human-centric investment strategy

ABSTRACT

The high voltage testing industry is undergoing significant transformation driven by increasing investments in new transformers, especially for renewable energy applications. Haefely, a leading supplier of transformer test systems, highlights the importance of future-proofing investments to ensure long-term reliability and efficiency. This article discusses strategic approaches for upgrading high voltage test systems, breaking away from conservative industry mindsets, and planning for long lead times. It also emphasizes the importance of proactive maintenance, robust backup plans, and comprehensive operator training to enhance system performance and safety, ultimately ensuring resilient and adaptable infrastructure for the future.

KEYWORDS:

future-proofing, high voltage, testing, proactive maintenance, operator training, supply chain planning



Investment in new transformers is projected to rise significantly, with an expected increase of 10% to 30%, driven by growing demand for renewables and distribution transformer

Proactively addressing the need for system upgrades not only enhances reliability and efficiency but also provides peace of mind, knowing that your operations are well-prepared for the future

Setting the stage for future-proof investments

According to the recent report "Investments 2024: Outlook to 2033" by Transformers Magazine, investment in new transformers is projected to rise significantly, with an expected increase of 10% to 30%. Manufacturing capacity is anticipated to grow by 10% by 2026 and by 30% by 2030, before stabilizing at a 10% growth rate by 2033. These plans align with the anticipated lead times for acquiring new transformers. Notably, applications related to renewables and distribution transformers are forecasted to experience the most significant growth over the next five years.

As a leading supplier of transformer test systems, Haefely has observed these trends firsthand. We are witnessing a substantial phase of investment from both large corporations and domestic companies. This investment wave includes renovating existing laboratories to boost power capacity, enhance loss measurement accuracy, and increase throughput. Additionally, projects focused on laboratory extensions are becoming increasingly common.

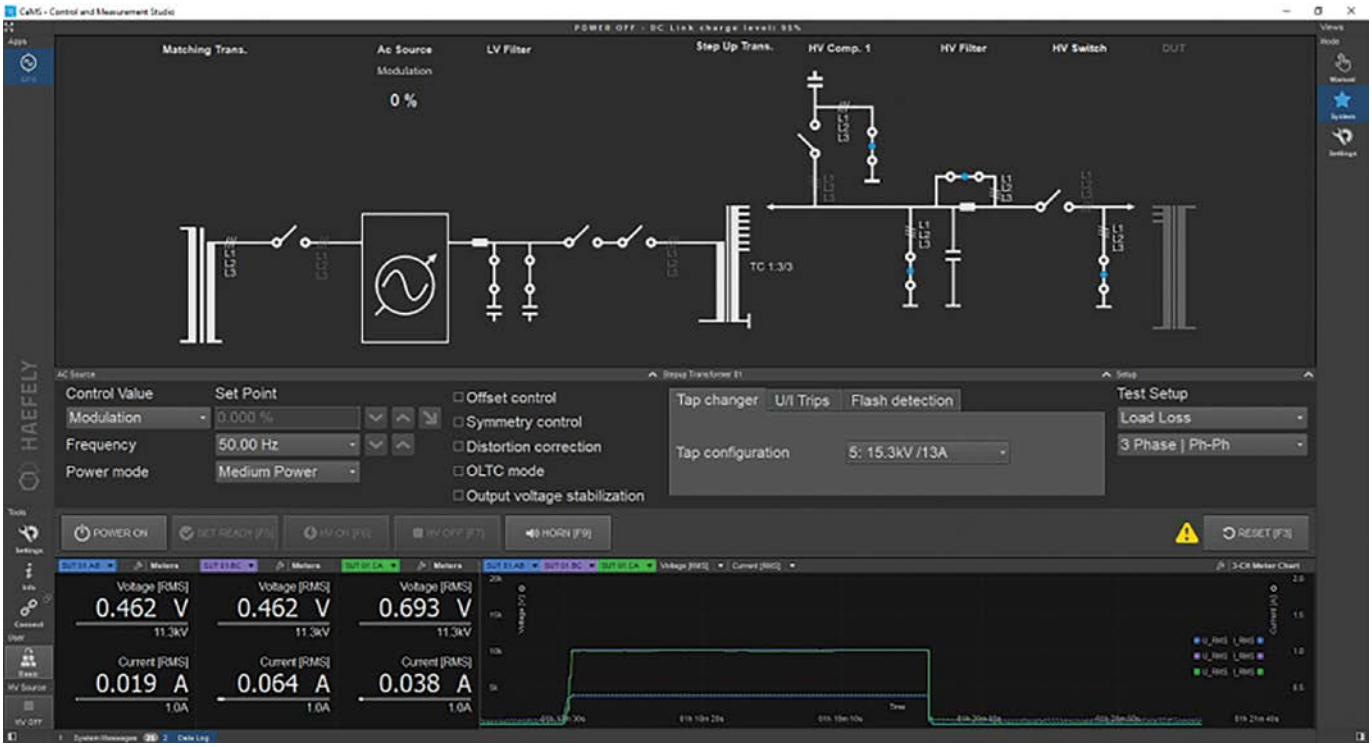
Staying ahead of these trends and technological advancements is crucial. Strategic investments in high voltage test systems ensure long-term reliability, efficiency, and safety. By anticipating future needs and preparing for them today, we can create a resilient and adaptable infrastructure. This report will explore the importance of moving beyond traditional industry mindsets, identifying key investment triggers, and making optimal decisions for managing critical components.

We will provide valuable insights on developing robust backup plans, investing in upgradeable systems, and the essential role of proactive maintenance and calibration. By focusing on human-centric strategies, including comprehensive operator training and stringent safety protocols, this report will equip industry professionals with the expertise to make informed, future-proof investments. Emphasizing practical approaches that align with current AI trends, we ensure that investments are prepared to stand the test of time.

1. Identifying investment triggers

Identifying investment triggers for high voltage test systems is critical for maintaining operational efficiency and staying ahead of potential issues and market demands. Here are some key factors that necessitate investment:

One of the most obvious triggers is the need to increase power or voltage capacity or throughput. This requirement is straightforward, but forecasting market growth and timing the investment correctly can be challenging. Waiting too long can result in late investments. In the current market, where simultaneous investments are common, this leads to long delivery times from machine suppliers and delays in project execution. A proactive approach, using market research to invest ahead of time, can mitigate these issues, ensuring quicker delivery and better market pricing.



User Interface for Transformer Test System with Complete Laboratory Monitoring and Control

The situation becomes more complex with aging transformer test systems. While it may be tempting to delay investment until a major failure occurs, this reactive approach can lead to significant challenges. When a system fails unexpectedly, the replacement process becomes urgent, leaving little time for a thoughtful investment strategy. This urgency often results in compromises due to delivery times, as the ideal solution may not be immediately available. Such scenarios should be avoided whenever possible, as they are certainly not pleasant experiences.

A much wiser approach is to proactively replace aging systems before they fail. This strategy offers two significant benefits. First, it allows ample time for reflection and the freedom to choose the best solution without the pressure of urgent delivery timelines. Second, if space permits, the existing system can be retained as a backup. This provides a safety net in case the new test system encounters issues or requires calibration, ensuring continuous operation in the test laboratory without interruption.

Proactively addressing the need for system upgrades not only enhances reliability and efficiency but also provides peace of mind, knowing that your operations are well-prepared for the future. By taking a forward-thinking approach, businesses can avoid the pitfalls of reactive investment and make strategic decisions that support long-term success.

Moving beyond the 'we've always done it this way' mentality is essential to adopting state-of-the-art technologies and practices

2. Breaking away from industry conservatism

The high voltage testing industry has long been characterized by a conservative mindset. While this focus on reliability has been beneficial, it can also hinder progress. Moving beyond the "we've always done it this way" mentality is essential to adopting state-of-the-art technologies and practices. Successful modernization efforts demonstrate the benefits of innovation, including improved efficiency, accuracy, and safety.

A prime example of this shift is the 2012 launch of Haefely's DTTS Distribution Transformer Test System featuring an EPS Electronic Power Supplier. At the time, the global EPS market was estimated at $19 billion, comparable to the $20 billion power transformer market. Major players such as ABB Ltd, Siemens Industry Inc, and Schneider Electric SA were already leveraging EPS technologies in various applications.

When we introduced EPS technology to transformer testing, the initial market reaction was cautious. Test engineers often responded with, "This technology is too new, and we don't want to risk it." Despite EPS technology being well-established and proven by the same big names in the power transformer world, its application in transformer testing was met with scepticism.

Promoting the advantages of EPS over traditional motor generators requires significant effort. However, since 2012, we have not lost a single project to these older technologies and are now proudly

EPS 1500 kVA Electronic Power Supply

Early planning for long lead items and prioritizing critical components is essential to navigating supply chain challenges and ensuring high-quality project execution

celebrating the installation of our 100th transformer test system with EPS technology. This milestone illustrates how conservative the mindset in our sector was back in 2012, despite other sectors benefiting from more advanced technologies.

EPS technology brings disruptive innovation with features such as real-time total harmonic distortion compensation, which allows for improved loss measurements, single-phase voltage control, freedom of frequency selection, and certified SIL 3 safety levels, just to name a few. These benefits, unimaginable with motor generator technology, have opened new possibilities in transformer testing. In short, EPS represents superior technology and is also more attractive from a financial perspective.

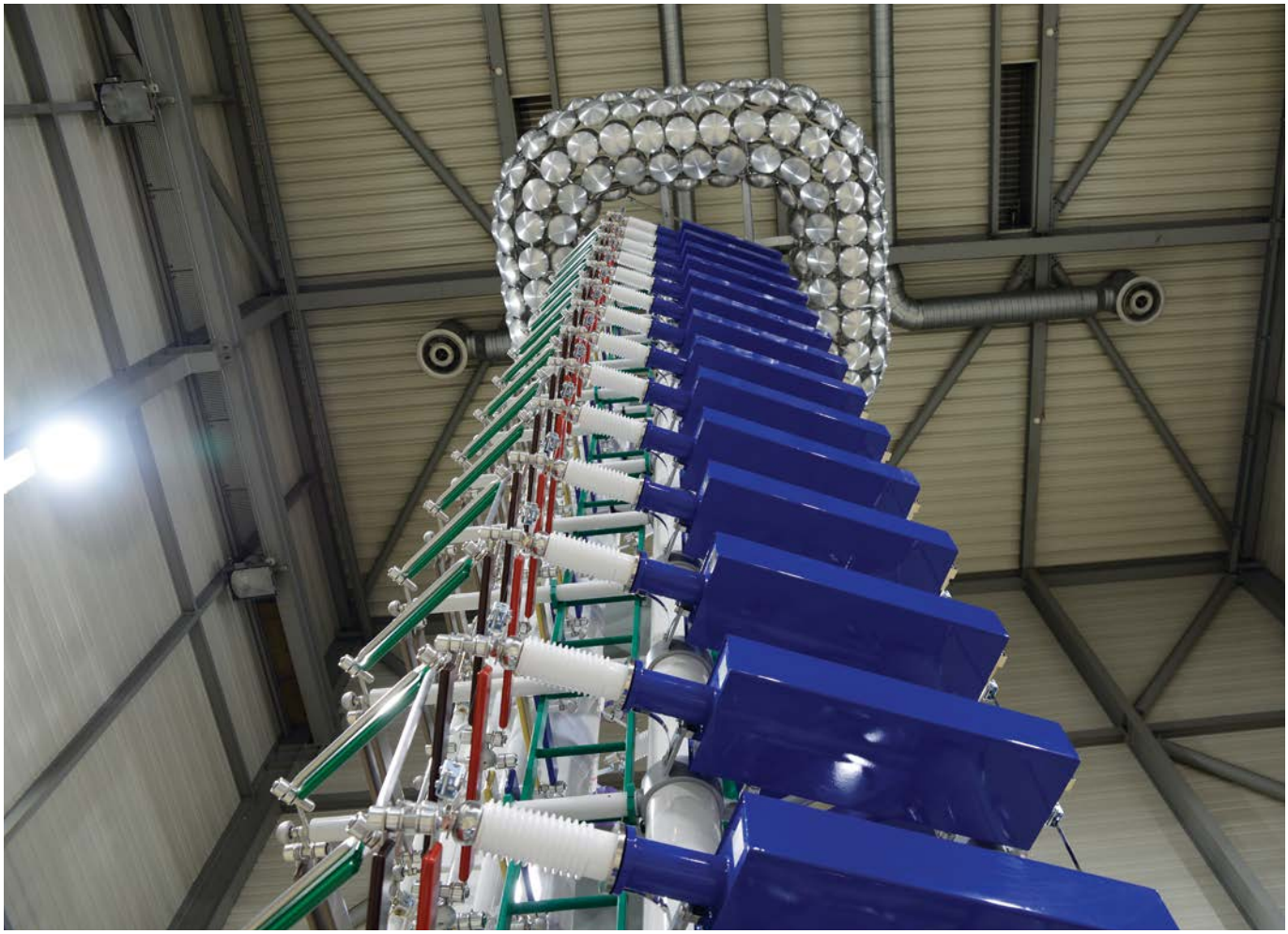
Encouraging innovation means moving away from the "we've always done it this way" mindset and exploring new ways of doing things. Embracing new technologies and practices not only enhances performance but also ensures that the industry remains competitive and forward-looking.

By adopting a proactive approach to innovation, we can leverage the best available technologies to drive progress and improve outcomes. This shift in mindset is crucial for the future success of the high voltage testing industry.

3. Planning for delivery times and long lead items

Managing the logistics of acquiring new systems is critical in today's rapidly evolving high voltage testing industry. According to the report "Investments 2024: Outlook to 2033" by Transformer Magazine, current investment trends highlight significant challenges related to long delivery times, not only for high voltage laboratory equipment but also for all types of machinery required to produce transformers. With everyone investing at the same time, supply chains are stretched thin.

To navigate these challenges, early planning for long lead items and prioritizing critical components is essential. Ensuring that strategic decisions are made well in advance allows businesses to avoid the pitfalls of reactive investments. Engaging in open discussions with suppliers as early as possible can help identify items with long delivery times and establish a priority list for investments.



SGVA 3600-540 Impulse Voltage Generator: HAEFELY's Flagship System

Consider a scenario where the delivery time for certain items or systems exceeds the construction time of a test laboratory or production hall. This situation, a shift from past practices where facilities were built before procuring the systems to be housed within them, necessitates a more integrated approach to planning and procurement.

Building strong and strategic relationships with suppliers is crucial. Early engagement with suppliers helps in understanding their production schedules, potential bottlenecks, and the lead times of critical components. This proactive approach ensures that businesses can secure essential equipment in a timely manner, avoiding costly delays and disruptions.

For instance, a company planning to upgrade its high voltage testing laboratory should engage with suppliers well before construction begins. By identifying long lead items early, the company can prioritize these components in the procurement process, ensuring they arrive on time for installation, thus avoiding any delays in the overall project timeline.

Planning for delivery times and long lead items is an essential aspect of modernizing or upgrading high voltage testing systems. By prioritizing early planning, engaging in proactive supplier discussions, and adapting to market dynamics, businesses can mitigate the risks associated with long delivery times. This strategic approach ensures that investments are executed smoothly, supporting continuous operational efficiency and readiness for future demands.

In conclusion, adopting a forward-thinking strategy in managing logistics and supply chains is key to staying ahead in the competitive landscape of high voltage testing. Through meticulous planning and strategic partnerships, companies can overcome the challenges posed by long lead times and ensure their operations remain efficient and future-proof.

4. Maintaining operational continuity with robust backup plans

Maintaining operational continuity requires robust backup plans, especially in the high voltage testing laboratory, where system failures can have significant consequences. Murphy's Law tells us that "anything that can go wrong will go wrong." This principle isn't just a pessimistic adage; it's a reality rooted in mathematical and statistical analysis. Every system, no matter how well-designed, is susceptible to failure at some point. Recognizing this inevitability is crucial when making investment decisions in high voltage testing systems.

Integrating redundancy into your test systems can be a game-changer, providing flexibility and enhancing production capacity while mitigating the risk of system failures

Failures aren't the only events that can disrupt operations. Regular maintenance jobs, service tasks, and measurement calibrations can also lead to downtime. Each of these necessary tasks, if not properly planned for, can halt production and lead to significant delays and financial losses.

Integrating redundancy into your test systems can be a game-changer. Consider the scenario where you're investing in a 3000 kVA EPS for transformer testing. You have two configuration options: a single 3000 kVA test bay or two parallel test bays of 1500 kVA each. While the latter setup might seem more complex, it provides several critical advantages. With a dual-bay setup, you can test two medium-sized transformers simultaneously or combine both bays to test a larger transformer. This flexibility enhances production capacity and can significantly boost your operational efficiency.

The difference in investment between a single bay and a dual-bay system is minor compared to the potential losses incurred from a system failure in a single bay configuration.

Investing in redundant systems and proactive maintenance strategies is essential for maintaining operational continuity in high voltage testing. By planning for potential failures and ensuring that backup systems are in place, businesses can mitigate risks and ensure smooth, uninterrupted operations. This proactive mindset fosters stability and safety, ultimately contributing to the long-term success of the facility.

5. The importance of proactive maintenance plans

Regular maintenance is crucial for ensuring the longevity and efficiency of high voltage test systems. Proactive maintenance plans, supported by maintenance contracts, not only prevent costly failures but also extend the life of the equipment. Early repairs are typically less expensive and less disruptive than dealing with major breakdowns.

High voltage test systems, while generally reliable, require a nuanced approach to maintenance. They may not demand constant attention to operate at peak performance, but any failure can lead to prolonged downtime due to the custom-made nature of many components. Regular maintenance helps in identifying potential issues before they escalate into significant problems. By addressing minor wear and tear early, companies can prevent unexpected and often expensive failures. This proactive approach minimizes downtime and ensures that systems remain reliable and efficient.

Maintenance contracts often include scheduled inspections and can be ideally combined with the calibration of the measurement systems by the same

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Being prepared for unexpected system failures involves identifying and stocking critical spare parts, streamlining the procurement process for quick repairs, and understanding logistics

engineering team. This combination is financially attractive, as it allows for two critical tasks to be completed in a single service visit.

Scheduled maintenance can be planned during off-peak hours or integrated into the production schedule to minimize disruptions. This strategic planning ensures that maintenance activities do not interfere with the critical operations of the high voltage testing facility. In contrast, unexpected failures can halt production, causing delays and financial losses.

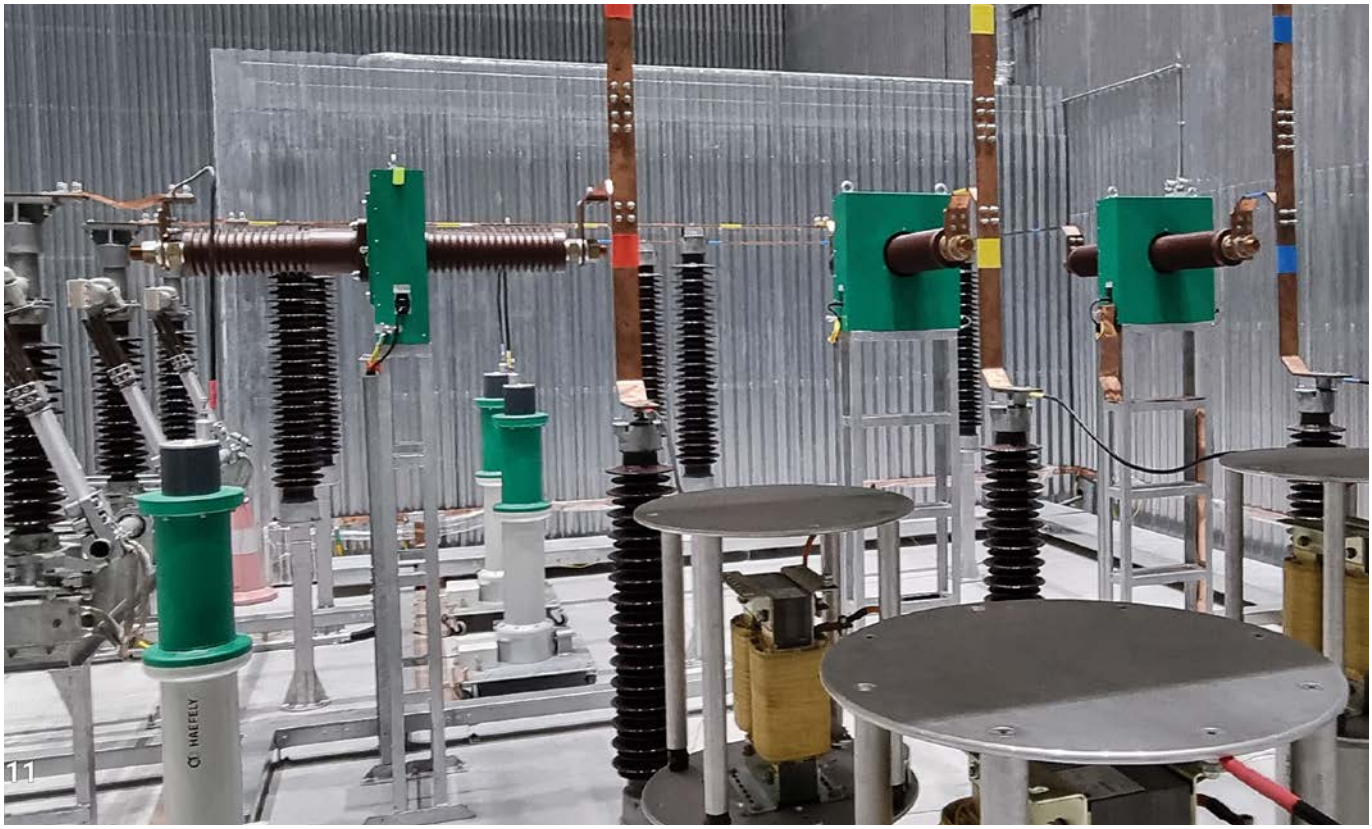
Regular maintenance also plays a crucial role in ensuring the safety of high voltage test systems. These systems operate under high stress and extreme conditions, making it essential to maintain all safety protocols. Routine checks and maintenance tasks help in identifying and rectifying potential safety hazards, thereby protecting both the equipment and the personnel operating it.

By preventing costly failures, extending equipment life, enhancing safety, and ensuring cost-efficiency, regular maintenance plays a pivotal role in the operational success of high voltage testing facilities. Investing in proactive maintenance strategies is not just a best practice but a necessity for maintaining continuous operational efficiency and readiness for future demands.

6. Preparing for potential failures: Spare parts and repairs

Even with a proactive maintenance plan and thorough system investigations, entirely eliminating the risk of failure is nearly impossible. Any system can fail, and operators can make mistakes due to stress, time pressure, or fatigue. Being prepared for unexpected system failures involves identifying and stocking critical spare parts. Streamlining the procurement process for quick repairs and understanding the logistics of spare parts delivery can significantly reduce downtime and maintain operational efficiency.

Understanding the Criticality of Spare Parts: Take the example of an impulse voltage generator. For each test, the operator eventually needs to exchange the front and parallel resistors to adjust the waveform. Climbing up and down the tall generator introduces a risk of dropping and damaging the resistors. These resistors, especially if they have custom resistance values, often have long lead times. Therefore, it is wise to stock a few spare units on-site to avoid lengthy downtimes. In contrast, other components, such as charging capacitors, may be less critical. These capacitors are often standardized across different generator sizes and are typically available from the manufacturer's stock. They can be quickly shipped for repairs, making it less urgent to stockpile these items. In this situation, a strong relation-



TMS 580 100 kV 3000 A: Transformer Loss Measuring System

Accurate and reliable test results depend on proper calibration, and choosing between different calibration approaches and methods is crucial for maintaining high standards

ship with suppliers ensures quick access to replacement parts, including agreements for priority service or expedited shipping for critical components.

Imagine the scenario of a Factory Acceptance Test (FAT) for a 300 MVA 550 kV power transformer. The test engineer is under significant stress, pressured by the critical nature of the situation and the need to perform flawlessly. Amidst this pressure, a connection error occurs, resulting in a flashover that burns out the measuring input of the impulse voltage digitizer. With the digitizer failing, completing the FAT on time becomes impossible. Even if the digitizer is available from stock, sourcing a spare unit from the manufacturer could take one week, factoring in shipping and customs clearance times, which can vary significantly depending on the country. The cost of a spare digitizer is minimal compared to the overall system cost and the financial and reputational impact of a delayed FAT. This situation underscores the importance of proactively managing spare parts.

To ensure smooth and trouble-free operations at the test laboratory, it is crucial to understand the critical aspects of each part and identify those with high failure risks and long lead times. Proactively stocking critical spare parts is essential for maintaining operational continuity.

7. Calibration considerations: Standards and needs

Accurate and reliable test results depend on proper calibration. Choosing between different calibration approaches, such as HAEFELY calibration certificate or SCS ISO 17025, and methods, such as on-site or laboratory calibration, is crucial. Each option has its benefits and must be selected based on specific needs and circumstances.

On-site calibrations, while generally more costly, offer significant advantages. They can be integrated with proactive maintenance plans and scheduled during off-peak hours or alongside other planned maintenance activities. This approach ensures that calibration activities do not interfere with the critical operations of the high voltage testing facility, minimizing disruptions and maintaining productivity.

Laboratory calibrations, on the other hand, are typically less expensive and can be a viable option for smaller systems that are easy to ship. However, this method usually requires more time, meaning the test system will be unavailable for a longer period. This scenario is particularly feasible if the facility has redundant test systems, allowing operations to continue while one system is being calibrated.

The critical aspect of calibration is having a well-defined strategy set ahead of time. Each calibration approach needs careful planning and scheduling. Calibration laboratories are often booked well in advance, especially for on-site services, which are in high demand. Therefore, it is essential to plan and secure appointments early to avoid long waiting times and ensure timely calibrations.

Another important consideration is the layout of the test laboratory. The physical location of measurement systems, such as the loss measurement setup, should be easily accessible to calibration engineers and their equipment. Ensuring accessibility can streamline the calibration process and prevent delays. For instance, if the loss measurement system is placed in a location that is difficult to reach or requires disassembling parts of the setup, it can significantly slow down the calibration process. Planning for easy access during the initial investment and design phase can save time and reduce complications later.

This proactive mindset ensures that all necessary preparations are made, such as securing early bookings with calibration laboratories and ensuring that all equipment is readily accessible. With this approach, facilities can maintain high standards of accuracy and reliability in their testing processes.

8. Investing in upgradeable and scalable systems

Choosing systems that can grow and evolve with business needs is a key aspect of future-proofing. Upgradeable and scalable systems provide flexibility, allowing businesses to adapt to changing requirements without significant additional investments. This modular approach ensures long-term viability.

HAEFELY is celebrating its 120th Anniversary, showcasing its commitment to remaining a stable and long-term partner in the industry for at least the next century. This milestone is a testament to the company's enduring reliability and innovation.

As an example, our world-famous impulse voltage generator, the SGVA, celebrates its 50th Anniversary design, while its smaller counterpart, the SGDA, marks its 25th Anniversary design. Over the years, the mechanical structure and core design of these generators have remained unchanged, highlighting their near-perfect engineering. This consistency brings numerous benefits, such as a proven design with decades of reliability and long-term accessibility to spare parts.

The only part of the generator that has evolved over the years is the control and

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measurement systems, primarily due to the rapid advancements in electronics and software capabilities. HAEFELY regularly upgrades the control units and measurement components of installations that are 20 or 30 years old, bringing these systems up to state-of-the-art standards at a reasonable cost. This commitment to continual improvement ensures that our customers can rely on their investments for many years, adapting to new technological advancements without the need for significant additional expenditure.

At the same time, the SGVA and SGDA generators can evolve to meet your business needs. This means that the voltage rating of the generator can be increased after installation by adding further capacitor stacks on top of the generator. This upgradeable design brings flexibility in the investment for later transformer voltage increases in production.

Another example is the modular approach of the EPS for transformer testing. The standard HAEFELY EPS has a 540 kVA rating. To increase the power, additional EPS modules can be stacked accordingly, and this can be easily done on-site for later power upgrades.

By investing in upgradeable and scalable systems, businesses can ensure they are well-equipped to handle future demands and technological changes. This approach not only supports long-term operational efficiency but also enhances the overall value and performance of the testing systems. HAEFELY's long history and dedication to innovation make it a trustworthy partner for those looking to secure their technological future in the high voltage testing industry.

9. The crucial role of operator training

Comprehensive training programs for operators are essential for maximizing system performance and safety. State-of-the-art systems often come equipped with advanced software modes and user-friendly graphical interfaces designed for intuitive operation. However, achieving optimal performance requires a deep and thorough understanding of the system's full capabilities. Without this knowledge, operators might not fully leverage

Proactive Maintenance for HAEFELY Systems

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the technology, potentially compromising system efficiency and longevity or even worse, creating unsafe conditions for themselves.

In order to ensure transformer quality, system longevity, and operator safety, it is critical to invest in operator training—not just at the time of system installation but continuously through regular maintenance training sessions. Over time, applications and needs may evolve, and personnel may change, necessitating ongoing education to keep up with advancements and changes in operations.

Regular refresher courses and advanced training help prevent accidents and ensure that equipment is used to its full potential. These training programs should cover system operation, application knowledge, safety protocols, troubleshooting and maintenance.

Investing in comprehensive operator training is a recommended proactive approach, supporting a culture of safety and excellence, ultimately contributing to the long-term success of the facility.

10. Locate the real bottlenecks

When the goal is to increase throughput in a transformer factory, it is essential to understand the testing workflow and identify the true bottlenecks. For distribution transformers, the winding resistance and turn ratio measurements are often the most time-consuming parts of the testing process due to the need for multiple tap measurements. One practical solution to alleviate this bottleneck is to duplicate the test bays for these measurements. By having multiple test bays dedicated to winding resistance and turn ratio measurements, tests can be conducted simultaneously, greatly reducing the overall time required for testing.

While fully automated test systems might seem like a logical solution to increase throughput, they often perform tests sequentially. This approach is slower compared to the multiple test bays strategy. Moreover, fully automated systems tend to be extremely expensive, complicated, and require more maintenance, adding substantial financial burden without necessarily providing the desired increase in throughput.

Another typical bottleneck is the heat run test, especially when performed on a sample from a batch of distribution transformers. This trend is increasing in the distribution transformer industry, particularly as end-users in the renewable power generation sector tend to require transformers to include heat run tests. To address this, having a dedicated heat run test bay specifically for type tests can streamline the process. This dedicated setup ensures that routine production testing is not disrupted, thereby increasing the overall throughput of the factory.

Additionally, end-users in the renewable power generation sector often require lightning impulse tests for distribution transformers, which further complicates the bottleneck challenge. Since this test is usually only a type test, and most distribution transformer factories do not own an impulse voltage generator, it typically necessitates sending the transformer to an external test laboratory. This process is both time-consuming and costly. While using external laboratories is the most cost-effective solution for occasional type testing, it becomes a logistical nightmare for regular testing. It requires precise synchronization between production, shipping, and the external laboratory.

In such cases, the amortization for investing in an in-house impulse voltage generator can be fast and significantly relieve the bottleneck. Owning the equipment allows for more flexible scheduling and reduces dependencies on external laboratories.

These examples illustrate the importance of understanding and addressing bottlenecks to enhance productivity and maintain cost-effectiveness. Implementing solutions like duplicating test bays and setting up dedicated testing facilities can lead to significant improvements in efficiency. These targeted approaches ensure that the testing process remains manageable and economically viable, ultimately boosting the overall throughput and reliability of the transformer factory.

Robust cybersecurity measures are essential to safeguard against cyber threats, implementing best practices for data protection and conducting regular security audits

11. Care about cybersecurity

Traditional technologies for transformer testing were typically offline systems. In contrast, state-of-the-art test stations now feature PLC and computerized control units integrated with Windows environments. These systems are connected to the factory's ERP system, network printers, and other test bays within the laboratory. Even if these control units are not connected to the internet, they are part of the local network, making them potential targets for cyberattacks.

Once hackers penetrate the factory's network, they theoretically gain access to all connected computers, with the potential to lock down the entire test laboratory. This scenario, while extreme, is becoming increasingly plausible. Cybercrime is skyrocketing, and hackers are no longer just teenagers in their bedrooms. The industry is facing organized hacker groups, sometimes comprising hundreds of individuals, operating with the efficiency and structure of a business. This phenomenon, known as cyberwarfare, is highlighted by

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a staggering 72% increase in data breaches between 2021 and 2023.

The threat is real and demands serious consideration as part of investment strategies. An attack can potentially paralyze an entire company with a single click, with the resolution often hinging on negotiations with the hackers.

Robust cybersecurity measures are essential. Implementing best practices for data protection and conducting regular security audits are critical steps to safeguard against cyber threats. These measures require a strong IT team and include not only firewalls and antivirus software but also network segmentation, access controls, regular security audits, and employee training.

This proactive approach to cybersecurity is essential for safeguarding the future of the industry and maintaining trust with clients and partners. By being vigilant and prepared, transformer testing facilities can protect their systems, data, and operations from the growing threat of cyberattacks.

12. Care about safety

The final point in our discussion on investment strategies is safety. Regardless of the investment strategy you choose, safety must remain the core and principal focus. This is especially true for high voltage test systems, where the safety aspect is paramount. Any mistake can lead to dramatic and potentially catastrophic outcomes, and there can be no compromises when it comes to safety.

The good news is that with technological advancements, robust safety measures are now integrated into these systems. For example, computerized control units connected to high voltage systems via fibre optic cables provide excellent galvanic isolation, ensuring safety even in the event of a flashover. HAEFELY test systems are equipped with Safety Integrity Level (SIL 3) certification according to IEC 61508, which is the highest level recommended for this industry.

While SIL 3 certification covers the mandatory safety aspects, advanced functionalities offer additional safety benefits that go beyond regulatory requirements. Let's illustrate this with an example. HAEFELY's Electronic Power Supplier (EPS) systems are equipped with comprehensive software known as CAMS. Even if only the EPS is installed on-site, the system includes a family of sensors and interfaces.

The CAMS software monitors every current and voltage at every stage of the entire transformer test system, from the capacitive compensation bank to the test step-up transformer. Each current or voltage measurement is equipped with a trip level and flash detection. The software can also control the tap changer of the step-up transformer and all circuit switches. It has full access to monitor and control every component of the system.

The beauty of this approach lies in the software's global overview. Knowing which test is being performed on which type of transformer allows it to detect malfunctions early. For example, if a capacitor breakdown occurs, the system can immediately switch off to prevent damage. The software can also prevent operator mistakes, such as activating an induced voltage test while the capacitor bank is still connected to the circuit. Without such a comprehensive software patch, this scenario could lead to a fire in the factory, risking both the loss of equipment and the lives of operators.

This example illustrates that investing in mandatory safety measures is crucial, but proactively investing in state-of-the-art technology provides a whole new level of benefits. It transforms the entire test laboratory into a space with no room for mistakes, ensuring both operational efficiency and the utmost safety for all personnel involved.

Conclusion

Albert Einstein once said, "Out of complexity, find simplicity." This quote perfectly captures the essence of future-proofing high voltage test systems through a human-centric investment strategy in an AI-driven world. While the various aspects of strategic investment may initially seem complex, a deeper understanding reveals a clear and logical approach that ultimately simplifies the process. By embracing state-of-the-art technologies, such as those used by HAEFELY systems, we distil complexity into straightforward, effective solutions.

Investing in high voltage testing systems involves a multifaceted approach encompassing numerous factors. Understanding the importance of a proactive mindset justifies the investment today to ensure a safer, more efficient, and technologically advanced tomorrow in the transformer testing industry. This human-centric investment strategy in an AI-driven world ensures that our technology not only meets current demands but is also prepared to evolve with future advancements.

Author

Frédéric Dollinger has over a decade of experience in the transformer industry, he is passionate about pioneering cutting-edge solutions that revolutionize the efficiency and accuracy of transformer testing. A frequent speaker at industry events, he actively travels the globe, sharing his expertise with customers and collaborating on projects.