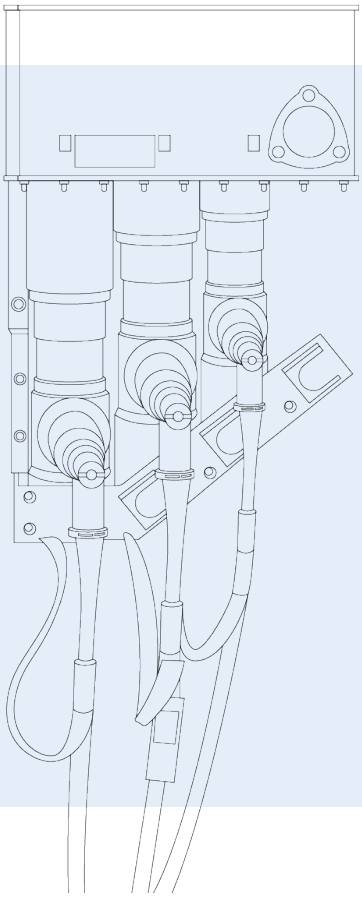
PUBLISHED ARTICLE

The Case for Upgrading Electric Utility Infrastructure

BACKGROUND

Switchgear has been a vital part of electrical power distribution systems for over a century. Its evolution reflects advancements in cable technology, grid requirements, and safety standards. While oil-filled switches once dominated the industry, they have proven to be problematic due to their high maintenance demands, environmental risks, and safety concerns.



Today, electric utilities must prioritize upgrading their infrastructure, and replacing outdated oil-filled switches with safer, more efficient alternatives. G&W Electric offers a comprehensive solution to this problem with its Cable Transition Modules (CTM) and modern switchgear like the Trident® and gas-insulated switchgear (GIS). This article highlights why utilities should eliminate oil-filled switches and how G&W Electric provides a pathway for modernization.

The Decline of Oil-Filled Switches

Oil-filled switches were introduced in the early 20th century and served as a reliable means of interrupting electrical loads in power distribution systems. Over time, however, the disadvantages of these switches became clear. Oil-filled switches require regular inspection and testing to determine dielectric strength., along with regular maintenance to ensure dielectric strength and performance are within acceptable ranges. More importantly, oil-filled switches pose significant environmental and safety risks.

G&W Electric began recommending to utilities in the early 1980s that they replace all “RA” style oil switches with modern alternatives due to safety concerns. The manual operation of these switches introduced the potential for human error. Improperly maintained oil switches could lead to catastrophic failures, releasing oil into the environment, risking fire hazards, and putting operators in danger. G&W Electric urged replacement with SF6 gas-insulated switches, which were both safer and more environmentally friendly than oil switches.

G&W Electric

The Advantages of Modern Switchgear

The introduction of SF6 switches in the 1950s provided a much-needed alternative to oil-filled switches. SF6 gas is an excellent dielectric and arc-quenching medium, which allowed for switches with higher ratings, reduced maintenance needs, and fewer environmental risks. As a result of the industry-wide push for reduced maintenance and increased safety, the 1990s saw the emergence of the next generation of switchgear insulation technology — solid dielectric switchgear. This innovation further enhanced safety and minimized environmental impact.

G&W Electric's Trident solid dielectric switchgear and gas-insulated switchgear (GIS) are prime examples of modern solutions that outperform oil-filled alternatives. These systems require minimal maintenance, offer superior reliability, and eliminate the need for oil or other hazardous materials. Utilities looking to improve operator safety, reduce downtime, and protect the environment should prioritize upgrading to these modern technologies.

Types of Cables and Their Implications

Underground cables play a crucial role in the functionality of switchgear, and the types of cables used can impact the ease of making upgrades. The evolution of cable technology has introduced various insulation materials and designs to improve performance. Most distribution cable systems in service today use one of four types of cables:

- Paper Insulated Lead Covered (PILC): PILC cables were widely used in the 20th century, but they have largely been replaced due to their susceptibility to moisture and degradation.
- Low-Pressure Gas-Filled (LPGF) and Medium-Pressure Gas-Filled (MPGF): These cables were developed to address moisture ingress problems with PILC by maintaining pressurized nitrogen or other gases. While effective, they require constant monitoring to ensure the gas pressure remains stable, making them difficult to integrate with modern switchgear.
- Cross-Linked Polyethylene (XLPE): Introduced in the 1960s, XLPE cables provide excellent thermal resistance and electrical properties. They are now a standard in modern electrical systems.
- Ethylene Propylene Rubber (EPR): Introduced in the 1960s, EPR cables offer similar benefits and reliability to XLPE cables. However, they provide additional advantages, including greater resilience against water treeing and increased flexibility.

XLPE and EPR cables connect to modern switchgear using ANSI/IEEE386 interface connectors. These connectors provide a secure, insulated interface, making it easy to install, remove, and maintain the connection between the cable and the switchgear. The process involves preparing the cable by stripping the outer layers of the cable to expose the conductor. The ANSI/IEEE386 interface connector is attached to the prepared cable end which ensures a tight electrical and mechanical connection. The ANSI/IEEE386 interface connector is then attached to the equipment's bushing, creating a seal with the switchgear. This method is efficient and reliable, allowing for easy installation, removal, and maintenance, while ensuring the safety and integrity of the electrical connection.

However, LPGF and MPGF cables present a unique challenge: They cannot use current ANSI/IEEE386 interface connectors due to the need to maintain gas pressure at the cable ends. Maintaining the correct gas pressure at the connection points is critical in ensuring the dielectric properties of the cables. The design of current ANSI/IEEE386 interface connectors does not accommodate the need for a continuous gas environment, making it impractical to use them with LPGF and MPGF cables. Instead, gas-filled cables require specially designed terminations and fittings that can maintain the gas pressure and ensure a secure, leak-proof connection.

MODERNIZING SWITCHGEAR: A COST COMPARISON

We've described how G&W Electric's Cable Transition Module and Trident or gas insulated switchgear provide a seamless solution for utilities with gas-filled cables, allowing them to upgrade their systems without the prohibitive cost of replacing their entire cable infrastructure. But how much can this process save a utility?

Here's a side-by-side estimate scenario where one mile of LPGF circuit with oil switches on each side is having all oil switches replaced with solid dielectric switchgear, specifically the G&W Electric Trident. (The cost of the Trident switch is not included in this estimate.)

USING G&W ELECTRIC'S CABLE TRANSITION MODULE

Labor and equipment • Installation of transition joint • Pulling of EPR jumpers to station • Installation of accessories	$230,000
EPR Cable	$30,000
CTMs and T-body Connectors	$75,000
Total	**$335,000**

REPLACING THE FULL CIRCUIT WITH EPR CABLES

Labor and equipment • Removal of LPGF cables • Installation of new EPR	$3,330,000
EPR Cable	$1,250,000
Splices and T-body Connectorss	$55,000
Total	**$4,635,000**

G&W Electric's Cable Transition Module (CTM): A Seamless Solution

One of the main obstacles to upgrading from oil-filled switches to modern switchgear is the incompatibility between gas-filled cables (LPGF and MPGF) and ANSI/IEEE386 interface connectors. To solve this, G&W Electric developed an addition to the Cable Transition Module (CTM) product line, creating a proprietary solution that enables the seamless integration of older gas-filled cables with modern switchgear systems.

The CTM11B-35LG enables utilities to make a cost-efficient transition from gas-filled cables to newer XLPE or EPR cables, which can then be connected to switchgear using ANSI/IEEE386 interface connectors. This is particularly beneficial for utilities that have not upgraded their infrastructure due to the high cost and complexity of replacing gas-filled cables entirely. The CTM11B-35LG preserves the gas pressure required at the ends of LPGF and HPGF cables, ensuring their dielectric properties remain intact. From the CTM11B-35LG, an ANSI/IEEE386 interface connector is used to connect to an XLPE cable, which in turn links to modern switchgear like G&W Electric's Trident or GIS switchgear.

This solution is a game-changer for utilities and industrial owners with legacy systems. It allows them to phase out oil-filled switches without the financial burden of replacing all their gas-filled cables. By upgrading their switchgear to modern alternatives, utilities can enhance reliability, reduce maintenance, and improve safety for operators and the environment.

CONCLUSION

A Path Forward for Utilities

As utilities face increasing pressure to modernize their infrastructure and meet contemporary safety and environmental standards, eliminating oil-filled switches should be a top priority. G&W Electric's Cable Transition Module and Trident or gas insulated switchgear provide a seamless solution for utilities with gas-filled cables, allowing them to upgrade their systems without the prohibitive cost of replacing their entire cable infrastructure. By embracing these technologies, utilities can ensure the longevity, safety, and efficiency of their power distribution systems while protecting both their operators and the environment.

For more information on how G&W Electric's solutions can help you modernize your switchgear and eliminate oil-filled switches, contact us today.

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