The SMART Sustainable Grid Choice
White Paper

Eaton's XIRIA – The SMART Medium Voltage Switchgear Choice for Smart Grids, Sustainability, and the Circular Economy

Powering Business Worldwide

Eaton's XIRIA – The SMART Medium Voltage Switchgear Choice for Smart Grids, Sustainability, and the Circular Economy

1. Introduction

The world of power management has changed. Companies and governments must now consider and balance their economic, social and environmental goals and challenges. A key requirement for businesses of all types has become a future-oriented mentality so that actions of today contribute toward a sustainable environment for future generations.

Eaton's vision is to improve the quality of life and the environment through continuous development and the use of power management technologies and services. The Xiria medium voltage switchgear products, with over 100,000 panels shipped, eliminate the use of environmentally damaging SF_6 gas, and exemplify how smart design and technology excellence can address such values.

As a business and technology power management leader, Eaton has positioned itself globally through capabilities to answer tomorrow's most critical challenges today. In particular, Xiria technology provides modern, sustainable medium voltage systems – that enable smart grids and buildings.

2. Overview

We live in a diverse and complex ecosystem where humans and nature co-exist. As we are reliant on one another for our survival, our interdependency forms a part of the Earth's closed system. Our challenges need to be solved here on Earth, and by us.

The Earth's population is expected to reach more than nine billion by 2050. Future cities will require smart grids to efficiently manage power distribution that is becoming increasingly dynamic with the advancements of decentralized energy and smart, sustainable devices. Economies need reliable energy for economic growth, to enable manufacturing and to provide opportunities for entrepreneurs. Distribution Network Operators (DNOs) are already under continuous and increasing pressure to provide stable and uninterrupted power supplies. Smart grids require smart decisions at all levels to minimize the investment and maintenance costs.

Eaton is recognized as an energy management leader and as one of the most admired companies in the world (according to Fortune magazine's February 2018 list). In part, this is because for Eaton, responsibility to the planet and its people is a core value. Products must be designed to help meet these values. This is exemplified by the Xiria medium voltage switchgear product family which offers a sustainable answer to important modern-day and future energy challenges.

3. Eaton Innovation

Power plants, utilities, commercial buildings and the construction industry in general present opportunities for development in power systems. Economies can only grow when reliable sources of power and electricity are available. Medium voltage (MV) distribution networks and systems make use of switchgear, a combination of electrical switches, fuses and/or circuit breakers that control the flow of electricity. Such electrical systems are used to control, isolate and/or protect electrical equipment and people from downstream faults and damage in cases of current overloads or short circuits.

Xiria, with its associated unique systems technology, is Eaton's innovative solution for sustainable MV systems. Using vacuum technology instead of SF_6 not only makes Xiria the best for the environment, but also minimizes maintenance. It enhances operational safety, greatly increases the number of safe switching operations, and eliminates expensive end-of-life disposal procedures.

The Xiria system is fully insulated in enclosed housing and the design offers minimal space for installation and required maintenance. The system is designed with few moving parts for reliable switching even after a long period of inactivity. The reduced maintenance translates into significantly lower inspection and maintenance costs while still ensuring the operational safety of the distribution network.

Engineers, consultants, and asset managers must now consider the environmental impact of every part of their power network. Xiria's vacuum technology for insulation and switching offers the lowest environmental impact of all for medium voltage switchgear over the entire product life cycle. When considering medium voltage units, the switching and how insulation is done are both critical factors. Vacuum switching, pioneered by Eaton, has become standard in advanced, modern medium voltage switchgear. This ensures a long life and excellence in switching performance, plus improved safety as opposed to old, simple systems that switch in an SF_6 environment. Vacuum technology is reliable; its Mean Time to Failure (MTTF) is higher than 100,000 years. It can handle more than 30,000 mechanical operations and more than 100 short-circuit switching operations.

4. Xiria is SF_6-Free for Optimized Sustainability and Safety

A bit of background: MV Switchgear is generally enclosed in a metal–clad structure. Early in the 20th century, MV switchgears used oil and air as a medium in the circuit breakers. Technological advancements led to the introduction of gas (Sulphur Hexafluoride or SF_6) as an interruption medium and insulator in the late 1950's, along with vacuum circuit breakers shortly after that. As a gas-insulator, SF_6 was superior in performance, supposed at the time to be cheaper and more environmentally friendly than the previously used oil. Importantly, it allowed far more compact designs than only air options.

SF_6 is now well known to pose significant risk to both human health and the environment based on possible operating conditions (extreme heat), possible leakage and the inappropriate disposal of the equipment at the end of its life cycle. Gas Insulated Switchgear (GIS), with SF_6, is unfortunately still used extensively around the world. SF_6 is one of the seven greenhouse gases listed in Kyoto Protocol [1] and in the Hazardous Substances Databank (HSDB). Releasing one kilogram of SF_6 into the atmosphere has the same emission effect as almost 24 tonnes of CO2 on global warming. It is also considered to be the most potent greenhouse gas with an expected atmospheric lifespan of more than 3,200 years. [2]

In addition, when SF_6 decomposes (mainly due to heat caused by arcing), it produces by-products such as HF, SOF2, SO2F10, SO2, all very hazardous to human and animal life. [3] The nature of being an insulator means that SF_6 containing medium voltage systems have arcs inside which generate tremendous heat and form these byproducts. For this reason, working on such equipment requires workers to wear specially designed safety gear with hazard material suits. The equipment must have good ventilation; instead special methods and safety requirements are needed to dispose of the equipment safely at end-of-life, or in the event that it fails whilst in use. If such equipment is not disposed of in a safe and responsible manner, humans and animals (and the environment) could suffer severe health consequences, with detrimental impact on the environment, from the released SF_6 gasses and its residual volatile material.

For the above reasons, regulations are becoming increasingly strict on the use of and especially disposal of SF_6 containing products. This adds considerable cost to operators of such gear and represents a severe potential financial impact on a product – often equal to the initial purchase price.

[1] https://ec.europa.eu/clima/policies/strategies/progress/kyoto_2_en)
[2] https://www.ghgprotocol.org/sites/default/files/ghgp/Global-Warming-Potential-Values%20%28Feb%2016%202016%29_1.pdf)
[3] https://www.epa.gov/sites/production/files/2016-02/documents/sf6_byproducts.pdf)

5. Xiria Switchgear - Advanced Technology Today for Tomorrow's Grid.

Xiria's design, features and options make the platform an ideal choice for utilities and other business segments alike. For example, circuit breakers (CB) in distribution ring main units (RMU) offer an advanced capability in conjunction with the necessary control and automation. Traditional Power Distribution Networks utilize load-break switches (LBS). These LBSs are acceptable for control, but unlike circuit breakers, they cannot interrupt a short circuit. With the addition of digitalization, the Xiria design can help determine a fault position and the faulty cable can be isolated. This reduces switching, interruptions are minimized and the distribution network operators (DNO) can minimize the impact of outages for customers during network faults. This is extremely important to DNOs, who often face hefty penalties for power outages, and certain customers such as hospitals, who require an uninterrupted supply of energy. Being part of a smart grid with self-healing characteristics, Xiria systems can be used to automate the fault restoration procedure, minimizing outages and the negative consequences when they do occur.

Xiria offers various options for remote signaling and remote control which are needed for fully automated networks. The options are modular and can be added quickly and easily at any stage. Thus, the Xiria design anticipates future needs and changing operational demands and developments.

Xiria's ability to switch up to 10,000 times enables it to be a market leader. This is increasingly important as switchgear has become a more active part of networks and other applications. Decentralized energy, such as wind and solar, is growing rapidly. These sources often require active switching on their own, but also because they are distributed, electricity may need to be "steered" around the grid. The existing Xiria systems in the field are already prepared for this new requirement.

6. Xiria's Role in Smart Grids

The goal of a smart city is to improve the quality of life. Technology can be used to improve the lives of residents in a sustainable manner. More and more cities, and even small villages around the world are becoming 'smart'.

Advancements in intelligent digital technologies with new terms such as Industry 4.0 and the Internet of Things (IoT) are rapidly changing our world. The IoT facilitates energy grids in generating data, data analysis, and insights that assist companies in making better decisions and design more efficient systems. Intelligent power solutions collect data, learn and provide actionable insights to optimize power usage and continuity. We are already seeing digital connectivity across the manufacturing floor, buildings, healthcare facilities and the electric grid.

In Xiria systems, equipment for remote or local communication between panels or automation systems can also be installed in the low voltage compartment. For instance, an Eaton Remote Terminal Unit (RTU) can be built with SCADA systems, making it useable for current and future smart grid applications. Again, the Xiria Medium Voltage Switchgear is ready for tomorrow's grid but available today.

7. Xiria and the Circular Economy

The global exploitation of resources mean that we reach Earth Overshoot day earlier each year. This is the day that we (individuals and businesses) have used our allocation of natural resources for the year. Ideally, we should reach this day on 31 December, but sadly we are far from this target. In 2018 for example, Earth Overshoot day was on 1 August. To combat the ever-increasing demand for more and more natural resources, the circular economy demands that products, services and systems have no negative net effect on the environment. Waste should be minimized during manufacturing, use and end-of-life, or ideally contribute to a second industry.

It has already been explained how Xiria's SF_6-free design makes it the most sustainable of all MV switchgear. However, for Eaton, that is not the end of the story. Eaton designs and manufactures according to the ISO 14001 environmental standard, with a strong focus on minimizing waste and the efficient use of materials. The Xiria product manufacturing follows these practices. The design uses a combination of air and solid insulation, in which the latter allows the switchgear to be compact. In addition, this material and others used to produce a Xiria are safe for people and the environment. As the system components are non-toxic, it is easy to reuse and has easy disposal with minimal environmental impact at end-of-life.

8. Conclusion

Access to affordable and reliable electrical energy has become an indispensable part of modern society. However, the requirements for such systems to be sustainable and enable smarter grids and power distribution are presenting new challenges; this is especially the case for utilities managing a rapidly changing grid. Distribution networks must meet ever more strict demands and offer sustainable solutions with minimal impact on the environment, while keeping costs down, now and in the future as business models change. At the same time, safety and operational reliability cannot be compromised.

As a leading power management expert, we understand the challenges faced by grid operators to acquire equipment today that is ready for both their current and future challenges. With smart grids on the horizon, they need systems that can adapt to changing needs. The Eaton Xiria family of medium voltage switchgear is designed and manufactured to meet the demands of smart, sustainable electric systems and serve customers who care about the circular economy. The unique design, which eliminates SF_6 gas for both switching and insulation, provides multiple benefits for customers. Not only does this technology have the lowest total cost of ownership, but it also enables switching up to 10,000 times, significantly reduces maintenance and can adapt to new, smart grids. At the end of its life, the equipment can be easily repurposed or recycled, avoiding risks to people and the environment.

With Xiria, we have been ahead of the curve when it comes to developing SF_6-free switchgear. Xiria is a state-of-the-art solution for sustainable medium voltage systems, based on our proven switchgear technology. Xiria uses vacuum technology instead of SF_6, which benefits the environment and reduces maintenance needs, as well as complying with the EU's new F-gas Regulation. This legislation foresees a full ban on 24 kV medium voltage switchgear relying on F-gases in 2026, with a phase-out by 2030 of switchgear with 36 kV,

Further to this the European Union is aiming to reduce their Co2 footprint so it will be very likely that an additional taxation will hit greenhouse gases and especially SF_6.

To protect primary components from ingress of moisture and dust, Xiria has a sealed-for-life compartment containing air under atmospheric pressure. Where products relying on SF_6 require a human-made, fluorinated gas (also known as F-gases) to prevent an internal arc, this solution is 100% F-gas free. Hence, our technology provides maximum safety for people and the planet.

With over 100,000 panels shipped, our Xiria range of medium voltage equipment responds to present and future needs in a fast-moving and growing world. Thanks to more than a century of innovation and experience, customers can count on us to continue developing the technologies that help them grow and adapt their business.

Notes

At Eaton, we're energized by the challenge of powering a world that demands more. With over 100 years experience in electrical power management, we have the expertise to see beyond today. From groundbreaking products to turnkey design and engineering services, critical industries around the globe count on Eaton.We power businesses with reliable, efficient and safe electrical power management solutions. Combined with our personal service, support and bold thinking, we are answering tomorrow's needs today. Follow the charge with Eaton. Visit eaton.eu.

For more information, visit **www.eaton.eu/electrical**

To contact an Eaton salesperson or local distributor/agent, please visit **www.eaton.eu/electrical/customersupport**

Eaton Industries (Netherlands) B.V.
Europalaan 202
7559 SC HENGELO
The Netherlands

Publication No. WP022009EN
November 2023

Follow us on social media to get the latest product and support information.

Powering Business Worldwide