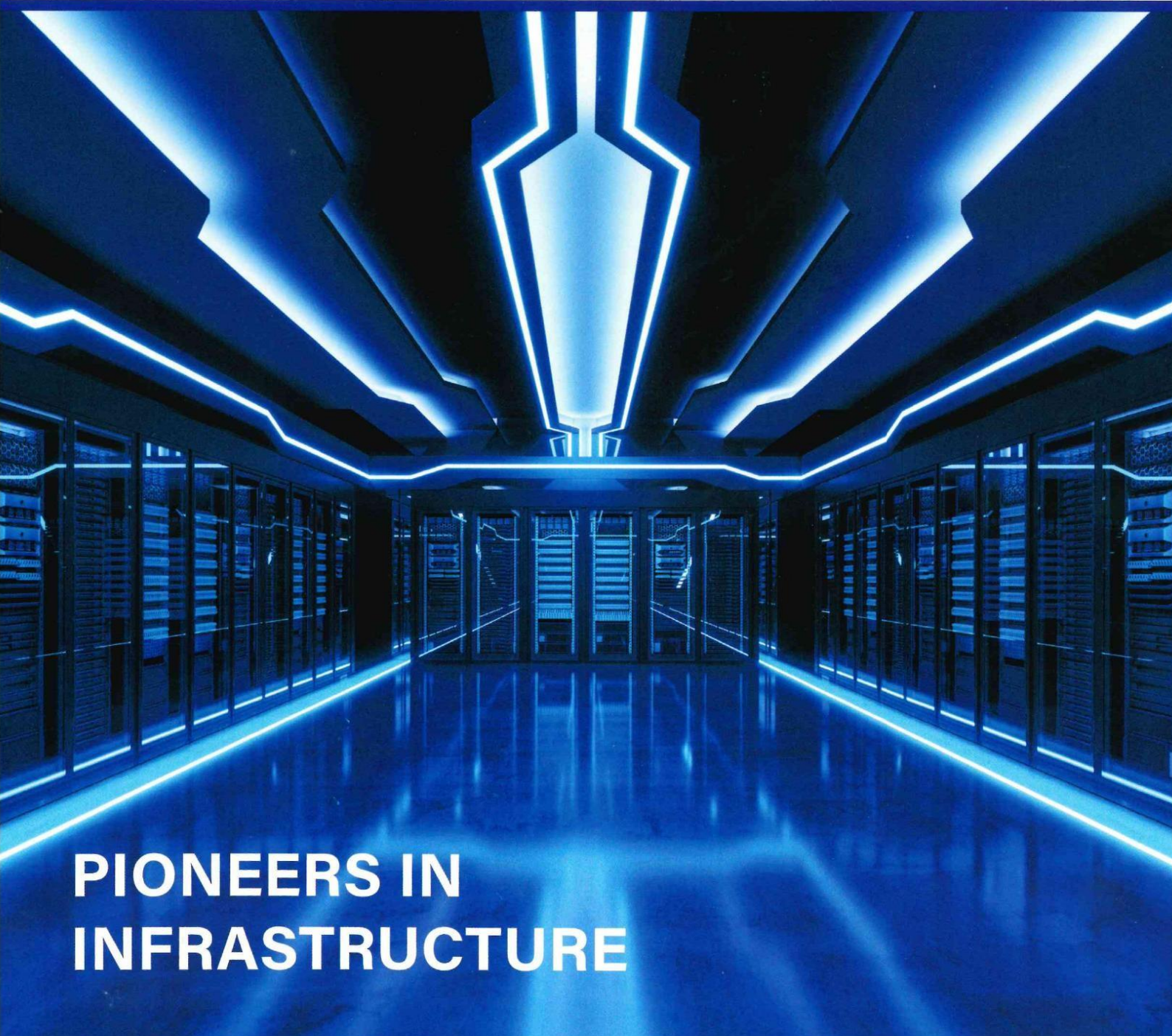


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Pipes

Piping and Liquid Transport: The Achilles Heel of Data Centers

Flexible - Safe - Efficient



**PIONEERS IN
INFRASTRUCTURE**

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Introduction

Our world has become increasingly dependent on data centers and their mission-critical digital services. Reliance on these services has led to the proliferation of data centers to keep our digital society functioning. This white paper explores the common materials of carbon steel and plastics used for data center piping infrastructure in emergency power generation and liquid cooling systems. Deficiencies of both materials along with threats from pipe joints and fires are examined, and solutions from Brugg Pipes are proposed.

While rigid carbon steel and plastic pipes are common, both exhibit weaknesses and unnecessary risks that threaten IT infrastructure, uptime percentages, and operational expenditures, thereby increasing the total cost of ownership. To counter these threats, Brugg Pipes presents the FLEXWELL® Safety Pipe (FSR), and SECON-X pipe products. Manufactured using stainless steel, both showcase flexibility, cut-to-length pipe runs, perpetual leak monitoring, weld-free connection fittings, and typical one-day installations. Brugg Pipes' certified installation experts ensure that all projects are completed at the highest standards, to provide a secure and resilient data center facility.

Key Findings

Issues related to piping infrastructure seldom present immediate cause for concern, however, replacement and maintenance procedures are threatening to data center security and operation. Data center owners and operators must prioritize safeguarding their IT and physical infrastructure against critical threats to emergency power generation and liquid cooling pipe systems. It is essential for data center infrastructure management teams to implement long-term preventative alternatives that eliminate these sources of risk.

Downtime Costs

The Uptime Institute's 2022 data center resilience survey found 80% of data center managers and operators have experienced some type of power outage over the last three years. [1]

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With downtime costs averaging \$5,600 per minute and between \$140,000 and \$540,000 per hour, the need for resilient piping infrastructure used in emergency power generation and liquid cooling pipe systems is critical.[2]

Carbon Steel & Plastic Pipes

Standard carbon steel and plastic materials fail to provide the highest resilient piping infrastructure. Commonly selected due to their high worldwide availability, low upfront cost, and familiarity with fuel transportation systems, both exhibit adverse effects that threaten data center operations.

Carbon steel pipe systems' greatest risk is the threat of corrosion. Internally the deterioration of carbon steel occurs due to trace amounts of water in diesel fuel and other types of liquid medium. External factors, notably humidity, also take a toll on the physical integrity of the pipes. The accumulation of rust leads to contamination of the medium, system damage, and failure. Perpetual protection measures, inspections, and repairs are necessary to ensure the carbon steel pipes remain in proper working order.

Common external prevention methods include cathodic protection and the application of corrosion-resistant coatings in the form of metallic sprays or epoxy. Internal solutions include monitoring the water content of diesel fuel and using inhibitors in the medium to form a protective layer on the inner surface of the pipe walls. Installing stainless-steel piping products from Brugg Pipes eliminates the complications of rust and fuel contamination from carbon steel pipes.

High-Density Polyethylene (HDPE) piping alternatives present their own unique risks. Careful considerations for the transport medium chemical structure, temperature limitations and subsection to UV radiation must be accounted for. While HDPE pipes pose durability, they are subject to forms of disfigurement over time. In diesel fuel saturation tests, the change of HDPE under both wet and dry conditions displays a swelling increase of 2.3% and 7.2% over

168 and 1584-hour time frames respectively. Brugg Pipes' use of nonpermeable stainless steel eliminates this risk of material disfigurement due to saturation. [3]

Installation and Pipe Connections

Brugg Pipes provides an innovative solution to these common vulnerabilities of conventional rigid pipe systems. In addition, these systems require connection joints on relatively short sections of pipe, which prove to be costly, time-consuming, and failure-prone, in addition to continuous maintenance and inspection requirements. Brugg Pipes eliminates these issues requiring zero connecting joints along the pipe run.

The advantages of a continuous pipe run without intermediate joints are demonstrated below in a data center fuel systems project utilizing a 2-inch FSR pipe. Covering 40 meters, a single pipe was installed at a rate of 2 minutes per meter. When compared to a 2-inch double-walled rigid pipe system, the welded joints required extensive preparation, welding time for the inner and outer pipe, and necessary tests and inspections. As a result, the construction schedule was 20 orders of magnitude longer, estimated at 27 man-hours to complete.



Figure 1 Uninterrupted Pipe Run

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Shorter construction schedules facilitate faster speed to market and simplified retrofit projects. Brugg Pipes can be immediately removed from the transport drum and placed above ground, inside the data center, or into an exterior trench. The accelerated installation process offers cost-effectiveness, minimizes site disruption, and allows for rapid integration with existing systems.

Brugg Pipes continues to choose stainless steel for connection fittings. These connections incorporate integrated surveillance spaces that enable uninterrupted monitoring throughout the system. Requiring only two end connections, data centers can be confident in the security of their system from Brugg Pipes, even under the threat of fire.

Fire Exposure

Data centers cannot afford to overlook this risk, as fires can cause significant damage to both infrastructure and reputation. Fire protection must be considered for the piping infrastructure from a data center's conception. To counter this threat, Brugg Pipes' FSR is the dependable choice due to its high level of fire resistance. Confirmed by its UL 1369 certification, FSR is capable of withstanding fire for up to two hours. This ensures that the piping infrastructure maintains its integrity and minimizes the risk of data loss or equipment damage.

After this examination of the deficiencies and vulnerabilities in piping infrastructure, it is evident that Brugg Pipes' flexible stainless steel pipes provide an evident solution. With the awareness of existing risks, it is imperative to implement piping infrastructure that prevents undesirable outcomes. Brugg Pipes provides a reliable and secure infrastructure solution.

Brugg Pipes Advantage

Brugg Pipes provides a standardized and predictable piping infrastructure. FSR and SECON-X pipes' use of stainless steel ensures a pipe system that can stand the test of time decreasing risk factors, improving longevity, and requiring less maintenance. With unparalleled features against conventional rigid systems, their installation and operation are streamlined and

efficient. Both products ensure the highest level of safety and leak detection before the possibility of contamination. Helically corrugated, flexible, and manufactured in lengths up to 1000 meters, these attributes facilitate installations that are typically finished in a single day, decreasing labor costs and shortening construction schedules. FSR and SECON-X set the benchmark for double containment monitorable pipe systems.

FSR & SECON-X

Brugg Pipes' manufacturing is far from that of their rigid alternatives. FSR and SECON-X are constructed utilizing Material No. 1.4404 stainless steel, equivalent to the US standard AISI TP 316 L, and require zero additional cathodic corrosion protection. The stainless steel is fusion welded and continuously monitored via an electrostatic sensor to ensure there are no defects along the weld seam. The interstitial monitoring space for FSR is made possible by an additional secondary pipe that is then encased with a protective polyethylene jacket. The interstitial monitoring space and double containment properties of SECON-X come from the design of vertical struts integrated into the polyethylene jacket that are offset from the corrugation of the inner pipe.



Figure 3: FSR



Figure 2: SECON-X



Testing & Monitoring

FSR and SECON-X are subject to factory testing to guarantee their quality prior to delivery. After manufacturing, sections from the ends of each completed pipe are removed and subjected to a burst test. To ensure a tight system along the entire length of pipe, the finished product is placed under a 72-hour nitrogen or 24-hour helium test, depending on the requirements of the customer. These tests strive to exceed industry standards and deliver safe, high-quality pipe solutions for the data center industry.

The continuous monitoring system of FSR and SECON-X operate under a positive pressure or vacuum principle. The helical design ensures an uninterrupted monitoring space even with the presence of bends along the pipe run. Always allowing for leaks to be detected, thereby minimizing the risk of damage to data center IT equipment, infrastructure, and the environment. With the monitoring capabilities of FSR and SECON-X, data centers can be assured that leaks will be contained and expeditiously addressed.

Final Analysis

Brugg Pipes offers a solution to the safety hazards, IT infrastructure threats, and environmental challenges that are associated with traditional piping infrastructure. By utilizing corrosion-resistant stainless steel, FSR and SECON-X pipes offer unparalleled durability and security to rigid piping alternatives. With Brugg Pipes' expertise in endless pipe construction, perpetual system monitoring, and swift installation techniques, both physical and IT infrastructure concerns are effectively diminished. Whether upgrading existing infrastructure or building a new facility from the ground up, Brugg Pipes can exceed the specifications for developing a reliable and hardened purpose data center facility. By implementing comprehensive manufacturing processes and attention to detail, Brugg Pipes is committed to delivering products that exceed customer expectations, providing the highest level of quality and reliability.

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