

Unearthed power supply and insulation monitoring ensure electrical safety

High availability for reliable operation in waste water treatment facilities

A waste water treatment facility has an important task in treating waste water from several municipalities. The Annacis Island Waste Water Treatment Plant in British Columbia is the second largest treatment plant in Canada and has one of the highest levels of process treatment automation in the industry. This waste water treatment facility, maintained by MetroVancouver, treats approximately 175 billion liters of wastewater every year. The plant provides secondary treatment to wastewater for over 1 million residents in 14 municipalities.





HIGH AVAILABILITY

FOR RELIABLE OPERATION IN
WASTE WATER TREATMENT FACILITIES



FP200 display and operator unit for devices of the iso685 series without display



1200 hp influent pump motors

▶▶▶ Recently, the waste water treatment facility underwent substantial upgrades to ensure it stays online and operational 24/7 for years to come. With an ever-increasing demand of waste water to treat, high operational availability is paramount both to the plant and the surrounding municipalities that rely on the waste water treatment services provided.

The focus of MetroVancouver is to maximize the economic efficiency of their pumps and filters that play a key role in water treatment while maintaining a strict standard of electrical safety throughout the facility. For them to achieve this, MetroVancouver needs to implement a technology that enables them to monitor the safety level of their electrical systems associated with the plant's pumps and filters.

MetroVancouver specified that they did not want to experience a drive failure in the coming 15 years of operation at this treatment facility. As part of this requirement, it was determined that an unearthed system with insulation monitoring has to be installed. In an unearthed system, there is no connection from source to ground and a single insulation fault from one of the phases to ground would still allow the system to operate. An insulation fault can result from humidity, moisture, mechanical and electrical stresses and exposure to gases, all of which are present in a waste water treatment facility. If the single insulation fault is recognized and corrected in time, the system

can remain online until the next issue arises. This feature is advantageous for applications that demand continuous operation, such as this waste water treatment facility.

A closer look at the electrical system shows that the pumps and filters are fed by variable frequency drives (VFDs) that allow for the plant personnel to control the motor speed and torque by adjusting the input frequency. The difficulty with VFDs is that there are rectifiers, filters and inverters in the circuitry, which can cause AC or DC faults to appear if there is an insulation fault. Additionally, VFDs can inadvertently create harmonics or low-frequency signals which can negatively influence the insulation measurements.

To mitigate the effect of harmonics in the system, the plant had implemented 12-pulse input and 18-pulse input VFDs to operate their pumps and filters. Technically, a 12-pulse input VFD is fed by 2 secondary transformers and an 18-pulse input VFD is fed by 3 secondary transformers. The purpose of having multiple transformers feeding the VFD is to get phase shifted outputs which allow for more pulses to be created. Theoretically, the increased pulses reduce the total harmonic distortion from input to output but realistically, there are still some harmonics present despite this.



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▶▶▶ The selected solution (an unearthed system) that can reliably detect AC and DC faults while being immune to the harmonics from VFDs was necessary to monitor the system in both offline and online instances. This ground fault monitoring device in this ungrounded system would allow maintenance personnel to find and correct insulation deterioration in the early stages, which reduces further damage and avoids expensive and unscheduled stoppages of the VFDs.

The specification for offline and online monitoring of the VFDs meant that all input secondary transformers and the output filter to the motor has to be monitored with an insulation monitoring device (IMD). The main problem with having more than one IMD in a circuit is that, because of their connection to earth potential and their internal resistance, they see each other as an insulation fault and possible influence.



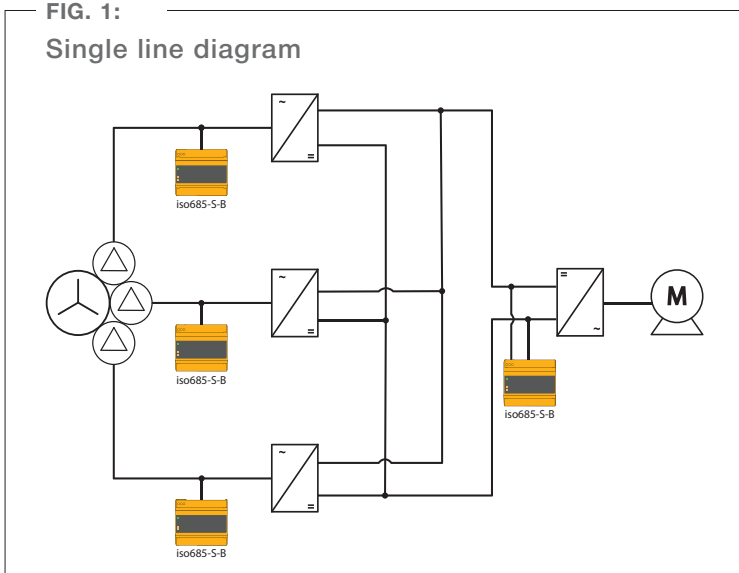
Insulation monitoring devices iso685-S-B

Fortunately for MetroVancouver, there was one device on the market that could handle all these difficult tasks with functionality, reliability and affordability. The ISOMETER® iso685-S-B, a high-end IMD from Bender, was chosen as the perfect solution to monitor the entire electrical system, which includes the transformers, the VFD and the motor. This IMD is suitable for this application due to its proprietary ability to detect AC and DC faults while being immune to harmonics and its ISONet ability, which allows it to couple with other IMDs in the same circuit. This ISONet feature allows internal separation between the IT system and the installed iso685s so that when the system is energized, only one iso685 remains active to monitor the entire system while the others remain on standby but are separated from the system being monitored. When the system is de-energized, 3 IMDs are required for the 12-pulse input and 4 IMDs are required for the 18-pulse input systems. The increase in IMDs is due to the presence of the diodes in the rectifier circuit which do not allow for the flow of current when the system is de-energized.



With the growing popularity of communication technology in modern industrial infrastructures, such as waste water treatment facilities, the integration of IMDs into a communication network is essentially seamless.

FIG. 1:
Single line diagram



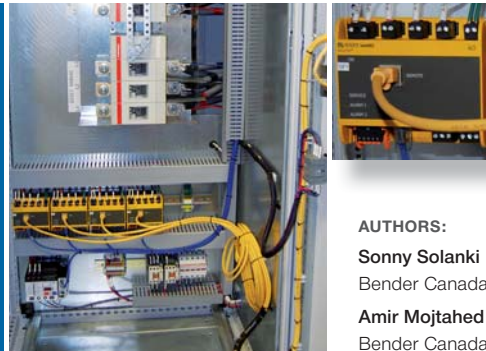
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▶▶▶ Bender IMDs feature an Ethernet interface which can be used for communication with Modbus, an integrated web server and BCOM (which enables communication between Bender devices). With an integrated web server, IMD data, i.e. measured data and device parameters, can be conveniently displayed on remote PCs via a web browser, providing crucial information necessary for decision-making. In this application, the iso685's ethernet capability was used to access information which allowed maintenance personnel to get the most up-to-date information on the status of their electrical systems being monitored by Bender devices.



Thanks to Bender's iso685 ground fault monitoring device, the Annacis Island waste water treatment facility increases their economic efficiency by improving operational availability through optimized maintenance while ensuring the safety of plant personnel and equipment. This is a story of great success for Bender and shows the versatility and functionality of a powerful ground fault monitoring device in an ungrounded system. ■



AUTHORS:

Sonny Solanki
Bender Canada Inc.

Amir Mojtabeh
Bender Canada Inc.



Bender GmbH & Co. KG

Postfach 1161 • 35301 Gruenberg • Germany
Londorfer Straße 65 • 35305 Gruenberg • Germany
Tel.: +49 6401 807-0 • Fax: +49 6401 807-259
E-Mail: info@bender.de • www.bender.de

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BENDER Group