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Energized CO_2 Dry Ice Blast Cleaning Firmly Grounded in the Canadian Electrical Industry

By Kristen Lindsay

Electrical distribution system components require regular maintenance to ensure optimum levels of safety and service reliability. The expense of many maintenance practices has always stimulated the search for newer, innovative maintenance procedures and materials to reduce costs and improve safety.

After two and a half years of research, development and testing, cleaning energized - up to and including 29 kV - using CO_2 dry ice blast cleaning technology is now a proven and innovative process.

Murray McClung of Wickens Industrial Limited, Martin Malinowski, Director Electrical Distribution at Oakville Hydro and Richard Murray, Superintendent Operations and Engineering at Milton Hydro worked together throughout this period of research, development and energized testing to guarantee the successful use of this technology.

Inspection & Maintenance of Air Insulated Units

In addition to a program already in place for substations, both Oakville Hydro and Milton Hydro established regularly scheduled inspection programs for major components of their overhead and underground systems in the late 1980s. Vault rooms, and in particular, switchgear are two of the most expensive components to maintain. The majority of switchgear is air-insulated padmounted/ metal enclosed.

25 kV and 14.4 kV Class Units

Both utilities experienced problems with the 14.4 kV class units, energized up to 29 kV, and Oakville Hydro experienced a small number of eventful failures with the 25 kV class units, energized up to 29 kV. It appeared that the fundamental cause of the problems/failures was an eventual dielectric breakdown caused by phase to phase and phase to ground tracking. The tracking was sustained through a combination of dust mixed with road salt and condensation deposited on live and grounded parts.

Oakville Hydro and Milton Hydro recognized that proactive maintenance would be necessary to avoid eventual failure. "Unchecked, tracking eventually will lead to a dielectric breakdown and a short circuit will occur, generally causing permanent damage that must be isolated and repaired before electricity supply can be restored," Malinowski explains. "From the linemen's perspective, they may be extremely hesitant to operate a device where tracking is occurring."

Only two cleaning and maintenance methods existed prior to the successful introduction of energized CO_2 dry ice blast cleaning technology. However, both methods required de-energization of the units so the units could be hand wiped or high-pressure potable water washed and then dried prior to restoration of power.

Almost all of the gear was tied into the system via looped express and local cables however, it was still necessary to arrange a number of interruptions where a radial supply existed. The loop supply arrangement is not always the majority case for some utilities.

"As time progresses, power interruptions have become less and less tolerable to our residential, industrial and commercial customers," Murray says. "With time being so important to personal lives and in such a competitive business environment, reliability is of the utmost importance, so much so, that some large customers are beginning to take power system reliability into account before deciding to locate within a certain municipality."

By 1994, the water wash process was well established, and depending on the location of switchgear, washing was found to be necessary every three to six years.

There was a relatively high cost associated with the maintenance of insulated switchgear over the lifetime of the units, particularly for units that were radially supplied. This prompted a serious review of the continued use of air insulated switchgear by both Oakville Hydro and Milton Hydro.

History of the Tool

In April 1994, an American magazine ran an article which reviewed a process being used by Puget Power in Washington, to clean live 15 kV gear, using air blown dry ice pellets. CAE Alpheus* of California and Puget Sound Power and Light jointly developed this cleaning process after a two-year study that commenced in 1991. Malinowski brought this article to the attention of McClung and Colin Saunders of the Electrical and Utility Safety Association (EUSA). Wickens Industrial Limited, as the Canadian distributor of this product, was able to supply the products and expertise necessary to introduce the technology to the Canadian electrical industry.

"After an initial discussion with

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Murray McClung, prompted by this magazine article, Wickens seized the ball and ran with it," Malinowski says. "By doing R&D over a significant length of time, combined with plain hard work, they have introduced a new useful tool into the industry market place where one had been lacking."

CO_2 Dry Ice Blast Cleaning Technology

Since 1993, Wickens Industrial Limited has applied CO_2 dry ice blast cleaning technology to various industrial and non-energized electrical applications in the automotive, printing, food processing and many other manufacturing industries and hydro generating facilities.

The unique cleaning dynamics of this technology allow for the removal of contaminants that are much more stubborn than those encountered in padmounted switchgear and other electrical apparatus. As well, the dielectric strength of dry ice is superior to that of air. Dry ice pellets sublime upon impact, expanding to 400 times their solid state. This rapid expansion creates a flushing action that helps to remove contaminants.

This cleaning does not introduce any substance that requires reclamation like grit or solvents and the process is non-toxic. Commercial CO_2 is reclaimed from waste gases of industries such as refineries and fertilizer and chemical plants. The recycled by-product is used in the form of dry ice to perform maintenance blast cleaning.

Safety Standards

The maintenance crew consists of two certified power linemen and a CO_2 equipment technician. While the linemen perform the cleaning and inspection, the CO_2 technician regulates the ice/air flow as required and monitors the air drying equipment. In addition to basic personal protective equipment, workers wear fire retardant clothing, 40 kV-Class 4 rubber gloves and full-face shields. The insulated spray wands and directional nozzles are cleaned and inspected daily.

Dielectric tests are performed routinely to confirm the dielectric integrity of the spray wand components. This work is performed in compliance with EUSA's rules and other applicable regulations.

A two stage Inspection/Trouble Report is completed on every job. Part A is completed prior to commencing the cleaning to identify any suspect electrical and/or mechanical components that may pose a threat to worker safety. A hand-held thermal scan device is used to further assess suspect components. Part B is completed after all deficiencies are reported. The reports can be customized to provide required information for the customer's database.

Outcome and Realized Benefits

By early spring of 1997, production cleaning of energized 25 kV class switchgear took place in Oakville and Milton.

Both Oakville Hydro and Milton Hydro realized cost savings of at least 50 per cent per switchgear unit by using the previous conventional water wash method.

"Anytime you can provide a service for 50 per cent less as well as free up manpower for other tasks, it ultimately translates into savings for the customer. The CO_2 method has allowed us to address one large area in an efficient and cost effective manner," McClung says.

Since implementing the switchgear program in the late 1980s, both utilities improved switchgear to a level of excellence, boosted linemen confidence levels and increased systems reliability and customer satisfaction.

Cleaning energized equipment using this cleaning technology provides the electrical industry with the flexibility to schedule switchgear maintenance throughout the year, while decreasing maintenance costs and freeing up manpower.

The benefits this cleaning techno ogy has been shown to offer to elec tric utilities are extensive:

- Power interruptions to customers can be eliminated.
- Improved system reliability.
- Switching is not required, thereby removing the associated safety concerns.
- There is no necessity for reclamatic or grit or solvent containment.
- Cleaning time is reduced to a minimum.
- The method can be used throughou the year.

Future Developments

"I think there may be other potenti applications of the tool to solve problems that have not been taken into co sideration yet." Malinowski says.

In fact, R&D has already commenced to assess the effectiveness of the CO_2 dry ice blast cleaning process with other types of apparatus. "CO_2 cleaning/inspection programs have been completed on electrical apparatus other than padmounted metal enclosed switchgear," McClung explains. "These applications include both dead and live front transformers transformer rooms, electrical terminations on submersible equipment, elbows on dead-front switching units and "Poletrans" transformer units."

Larger utilities like Ontario Hydro and Manitoba Hydro have taken advantage of CO_2 dry ice blast clean ing technology by applying the clear ing process to generator windings and associated equipment. As well, now that energized CO_2 dry ice blas cleaning is firmly established as a viable technology within the Canadian electrical industry, the investiga tion of aerial applications is currentl underway.

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* PDF Document Note: CAE Inc. purchased Alphe Cleaning Technologies in June 1998. To avoid conf sion, text references in this article have been update to reflect our current name, CAE Alpheus Inc.