Extend the Life of Existing Switchgear

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by Hal Theobald, Product Manager
Schneider Electric USA, Inc.

Summary

Introduction

In an industrial facility, nothing operates without a reliable flow of electricity. Therefore, it is critical to properly maintain the switchgear and switchboards that distribute electricity through the power system. Switchboards are more commonly used in commercial and light industrial applications, while switchgear is usually specified in heavy industrial applications, where the demands on the equipment require more robust construction.

Electrical switchgear has two types of components that make up the system, which can be referred to as passive and active. The passive components include such things as the steel framing channels, cover plates, barriers, horizontal and vertical bus structures, as well as components that make up the mechanical structure of the equipment. The critical active components are the power circuit breakers or fused devices that comprise the overcurrent protective system.

Maintenance Requirements

Major electrical equipment manufacturers generally require annual maintenance for power circuit breakers to ensure proper operation and maintain equipment warranties. This maintenance consists of cleaning and lubrication of the primary and secondary disconnects, racking mechanisms, and cell interlocks. A thorough onsite maintenance workscope for low-voltage power circuit breakers includes:

- Inspection
- Cleaning and lubrication
- Adjustments
- Overcurrent protective device testing
- Insulation testing
- Charge/close/trip circuit testing

The use of new or refurbished parts or subassemblies may be required to return a circuit breaker to good operating condition.

A more intensive maintenance option for circuit breakers is in-shop reconditioning. With this option, the breaker is initially tested against ANSI standards and then completely disassembled, cleaned and inspected. Damaged parts are refurbished or replaced, and pivot points are relubricated before the circuit breaker is reassembled. The reconditioned breaker is retested against ANSI standards, including primary injection or timing testing.

Even with annual maintenance, however, power circuit breakers may need additional upkeep or upgrades. Factors to consider include the operating environment, availability of spare parts, reliability and the cost of ongoing maintenance. There may also be the need to increase the switchgear's fault or continuous current rating, or the desire to upgrade technology. As a result, facility managers are often faced with the choice of maintaining aging (or obsolete) equipment or replacing it with a new switchgear line-up to take advantage of current technology.

Replace or (Continue to) Repair?

When considering whether to maintain equipment or replace it, facility managers must take into account the initial capital cost, along with potential disruption to the facility's processes and workflow during the course of changing out the equipment. Unless process loads can be rerouted temporarily during the demolition of old equipment and installation of the new switchgear, the cost of lost production can be substantial.

Another consideration that is often overlooked is conduit placement. Installing new switchgear (which is usually smaller than the older/obsolete equipment it is designed to replace) requires that existing conduit above and below the equipment be moved. Cabling may need to be replaced or spliced, as well. This is an expensive and time-consuming process, often costing more in labor and material than the cost of the new equipment.

Facility managers now have another option to consider for the repair vs. replace dilemma. New design capabilities exist to modernize and extend the life of the active components, i.e., circuit breakers, while leaving the existing switchgear structure intact.

Modernize and Upgrade LV and MV Switchgear

Modern power circuit breakers are designed using space-age materials in very compact formats, with digital trip units. They also offer very high fault current withstand capability without the use of limiter fuses. Since power circuit breakers provide such a vital function in protecting the electrical system, as well as reducing the risk to electrical workers from arcing faults, these design improvements are a quantum leap forward in equipment and personnel protection. In addition, they have lower maintenance requirements than the older, open iron frame circuit breaker designs.

Retrofitting is a general term that is used to define any process which allows for modernization and life extension of electrical equipment. Several different retrofit strategies exist for adapting modern circuit breakers into existing low-voltage and medium-voltage switchgear structures.

The switchgear structure, conduits, cabling and footprint are left intact, which saves time and money (above).

Aging or obsolete circuit breakers (left) are replaced with state-of-the-art circuit breakers, which brings the existing line-up to current technology (right).

Direct Replacement and Retrofill Solutions

Direct replacement circuit breakers and circuit breaker retrofill solutions fall under the general category definition of retrofits. Though different processes, both have the same end result: improved power system reliability and lower life-cycle costs.

- **Direct replacement:** A new circuit breaker designed to fit into the existing cubicle with little-to-no modification to the switchgear cell.

  A low-voltage direct replacement breaker uses a standard circuit breaker that is interchangeable with new and old switchgear of various manufacturers. This is accomplished via the use of an adapter cradle to fit the new circuit breaker into the existing switchgear. A medium-voltage replacement circuit breaker is designed to fit directly into the existing OEM switchgear. An adapter cradle is not utilized. The direct replacement solutions reduce downtime since there is minimal (if any) outage on the equipment bus.

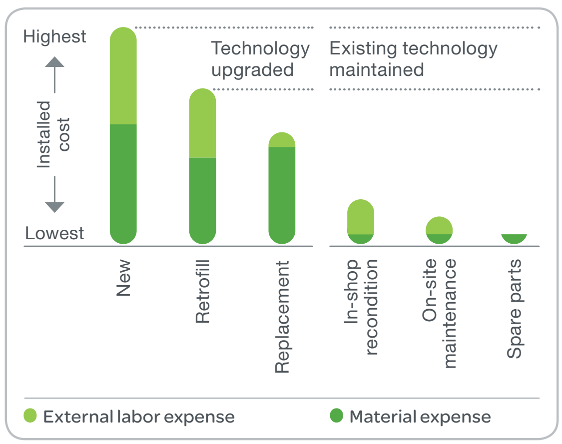
- **Retrofill:** The existing switchgear cell and bus are modified to accept the new circuit breaker.

  This process usually requires a longer bus outage, during which time the internal circuit breaker cell is modified to accept the new circuit breaker. A retrofill solution is often used in lieu of the direct replacement option for larger devices, such as main breakers and tie breakers. In these cases, because of the size of the replacement device, there may not be adequate room in the existing circuit breaker cell to allow for the intermediate cradle that is used in the direct replacement option.

It is important to note that in both retrofill and direct replacement options, new cubicle doors are provided to match the existing equipment and new circuit breaker face.

Choosing the Right Switchgear Solution

The state of the equipment and cost to do the work, including labor to complete the job, should be the determining factors in deciding which solution is best. Another consideration is the need for integrating new technologies to improve the performance of the circuit breaker and overall electrical system, such as a new solid state trip unit to replace an existing trip relay. The graph below compares the total installed cost, from the customer's perspective, for a range of solutions available to extend equipment life for low-voltage switchgear installations. The graph also shows when an upgrade in technology is included in the solution.



Bar chart compares the total installed costs for low-voltage switchgear installations. Costs are representative of price differences. Actual cost differences depend on the content and circumstances of each project.

Why Upgrade?

Improved Reliability

- Dash-pot style or air break interrupting devices on existing circuit breakers may have reliability issues
  - Many do not trip at all
  - Those that trip are not repeatable and may be well outside the time-current coordination parameters
- Aging materials reduce equipment reliability
  - Dielectric breakdown of insulating components
  - Degradation of aging mechanical parts

Reduced Maintenance Costs

- Older power circuit breakers require extensive periodic maintenance and overhaul, which is expensive and time consuming
  - Lengthens outages
  - May require outside support
- Many components for existing circuit breakers are no longer supported
  - New parts may no longer be available
  - The quantity and quality of used or reconditioned parts is decreasing
  - Prices of parts are increasing

Increased Capabilities

- Fault current interruption
  - New circuit breakers are available with higher ratings
  - In most cases the interruption capacity of the entire switchgear can be increased with an engineering study and a circuit breaker upgrade or replacement
- Arc flash limiting circuit breaker availability
- Trip unit accuracy and repeatability with new circuit breakers
- Power metering, monitoring and communication

Conclusion

The most obvious benefit of upgrading existing electrical switchgear is the significant savings on costs that would have been dedicated to buying new equipment — and not just the physical equipment, but the time and labor involved in specification, procurement, installation, testing and commissioning. A direct replacement or retrofill solution is a viable, cost-effective alternative to purchasing new equipment. In addition, the upgrade can be performed without major downtime and possible loss of production.

Appendix

Circuit Breaker Terminology

ANSI: American National Standards Institute.

Direct replacement: Retrofit process where a new circuit breaker (and adapter cradle for low voltage applications) fit into an existing switchgear cubicle.

Interrupting rating: The highest current at rated voltage available at the incoming terminals of the circuit breaker. When the circuit breaker can be used at more than one voltage, the interrupting rating will be shown on the circuit breaker for each voltage level. The interrupting rating of a circuit breaker must be equal to or greater than the available short-circuit current at the point at which the circuit breaker is applied to the system.

OEM: Original equipment manufacturer.

Overcurrent: Any current in excess of the rated continuous current of equipment or the ampacity of a conductor.

Primary disconnect contacts: An electrical plug-on connector in the main current path between the drawout components and the cradle mounted in the switchboard or switchgear.

Racking interlock: An interlock to prevent racking of a drawout circuit breaker when the enclosure door is open by not allowing the racking crank to be inserted into the circuit breaker.

Retrofill: Retrofit process where an existing switchgear cell and bus are modified to accept a new circuit breaker.

Secondary disconnect contacts: An electrical plug-on connector in the secondary (control) circuit between a drawout circuit breaker and its cradle in the switchboard or switchgear.

Trip unit: A programmable device that measures and times current flowing through the circuit breaker and initiates a trip signal when appropriate.

UL: Underwriters Laboratories Inc.

Schneider Electric USA, Inc.

9870 Crescent Park Drive
West Chester, OH 45069
Tel: 513-777-4445
Fax: 513-755-5028