

# **Retrofit Technical Review**

## **Abstract**

Legacy circuit breakers (CB) commissioned during the 1950 to 1960s are still under operation in many utilities today. The majority are past due their expected lifetime and will soon be decommissioned or salvaged. Distribution Network Operators (DNO) and switchgear operators (SO), in anticipation of this dilemma, must consider the available options concerning the replacement of these circuit breakers, while also assessing fiscal management and regulatory policies.

## **Introduction**

Over the last two decades, the retrofit concept has become recognized worldwide as a solution for the rehabilitation of switchgear containing antiquated or obsolete equipment. The inability to replace components with original replacements parts has led most Distribution Network Operators (DNOs) and switchgear operators (SOs) to seek an alternative method. The driving force behind the high demand for retrofit solutions stems from several causes including: (1) original replacement parts or updated parts are no longer being manufactured, (2) outdated technology (3) prohibitive cost, (4) poor quality, and (5) extensive lead times.

## **The Retrofit Solution**

Retrofit solutions offer significant benefits for the replacement of outdated switchgear. These factors include:

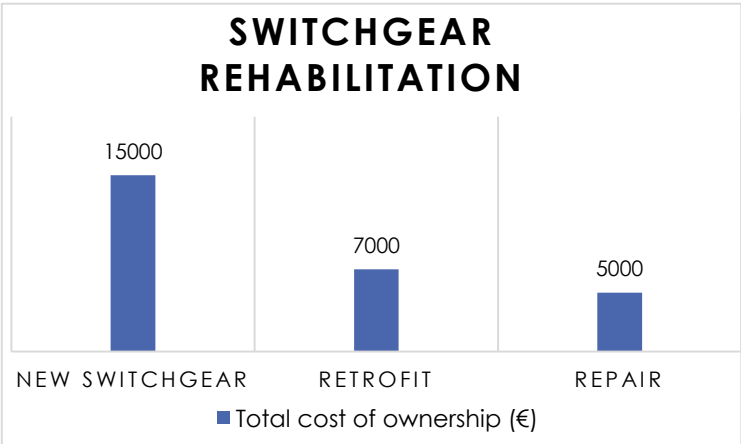
- A. Cost effectiveness
- B. Technical specifications
- C. Personnel safety
- D. Regulatory policies

### **A. Cost Effectiveness**

Several factors contribute to the cost effectiveness of the retrofit solution. By taking into consideration the downtime, project lead-time, and the endurance of the retrofit, the rate of return on investment is significantly higher than if repaired.

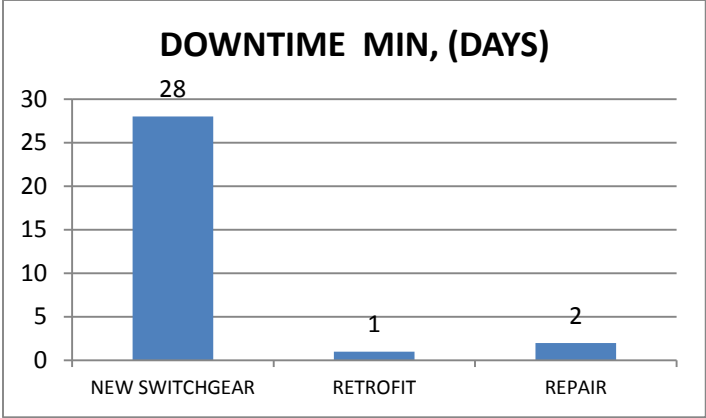
**Retrofit vs Repair**

When faced with the decision on how to best solve the problem of outdated or obsolete equipment, switchgear operators are typically limited by investment plans, time constraints, and budget. Retrofit offers the best value for the money when compared with other available options. The following graph illustrates the comparison of possible solutions for D4X rehabilitation.

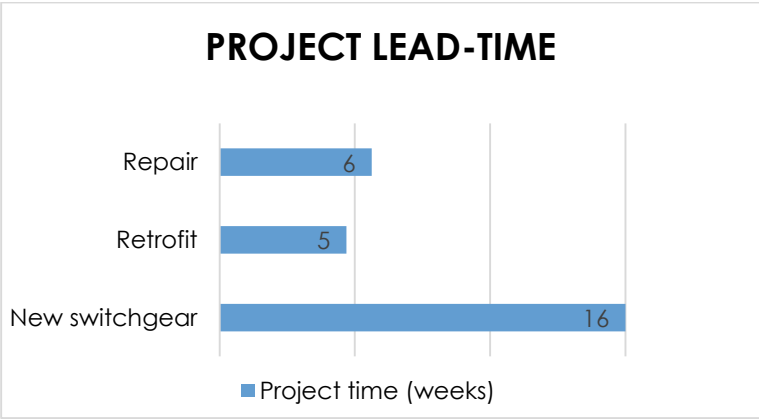


**Minimizing Downtime**

Downtime is simply not an option for certain work sites. For example, hospitals, fire brigade stations, and other emergency centers would experience critical situations if a shutdown were to occur. Additionally, large industries or heavily populated areas are limited to just a few hours between shutdown and energizing during the replacement of a single feeder. Below is a graph comparing the projected downtime for the options available.

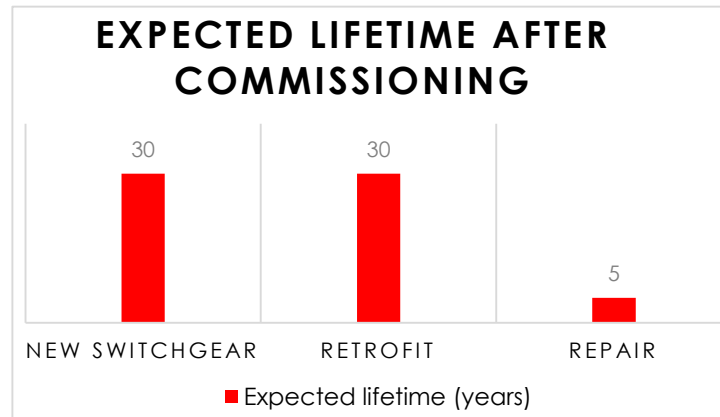


This illustration below demonstrates another crucial factor, project lead-time, which directly correlates to downtime. Economic and regulatory restrictions make it necessary to minimize this time. Downtime transforms into losses and additional expenditures to cover these losses.



**Return on Investment**

If properly maintained, metal enclosures and primary circuits are not subject to degradation during their lifetime. By replacing the circuit breaker and related recovering elements, retrofit offers the same expectancy as new replacements parts. The result is a much more cost-efficient solution than attempting to repair outdated switchgears.



## B. Technical Specifications

The final retrofit solution must be equipped with modern, high-end components capable of meeting the wide range of regional regulations, technical parameters, and service area environmental conditions. When making modernization assessments, DNOs and SOs evaluate their options at least ten years into the future taking into account load increase, network reinforcement, added generation, and paralleling of systems. To conform to these requirements, the retrofit solution must be equipped with modern, high-end circuit breakers.

Today's CBs provide superior technical capabilities compared to older Legacy switchgear (oil, water), in both ratings and functionality. Installation of a modern CB provides upgrades in substation ratings in terms of rated current and short-circuit current capabilities. Additionally, they require only minor modifications in the original switchgear. Other technically superior characteristics include:

- The ability to cover all existing Legacy switchgear available in service
- Improve general technical characteristics, reliability, and functionality
- Improve operation safety levels by implementation of reliable mechanical interlocks and indication
- Widen normal service condition far beyond the standard: -40°C-55°C ambient temperature range, 98% humidity

- Include the fastest, most reliable circuit breaker with competitive lifetime characteristics

Further applications of retrofit solutions include (a) ready for RTU, SCADA connection, (b) reclose functionality, (c) anti-pumping duty, and (d) high MTBF.

Modernization is an investment neither original nor updated parts of OEM can provide in relation to performance or value.

## **C. Personnel Safety**

### **Arc Protection**

A serious safety issue existing with old switchgear is the lack of IA classification, which was formally not implemented or required.

To guarantee the safety of personnel, there are two requirements: (1) arc-flash protection readiness and (2) safe manual close. Arc-flash protection is achieved by using the fast-switching CB joined with the fast-acting arc protection relay. A safe manual close is obtained with the use of a manual close generator and an extension cord that allows the operator to manually close the CB from a safe distance.

## **D. Regulations and Standards**

Modern circuit breakers are all type-tested in certified laboratories (CESI, KEMA) and therefore conform to all relevant international standards and regulations. This is especially essential for Legacy switchgear as standards of that time are no longer applicable and all modernization related work should conform to current standards.

## **Conclusion**

It is evident that circuit breaker retrofits are a cost effective method for modernization and life-extension for antiquated switchgear in an emergency state. Modern retrofits cater to the most crucial part of the switchgear, the circuit breaker, as it is the part under most stress and has a set operational resource. Routine maintenance is all that is required to keep other components in operation and compliance. Modern circuit breakers used in retrofits adhere to all required

international standards, provide a wide range of functionality, are technically superior, lightweight and maintenance free, and offer high flexibility in their operation and safety for personnel.

Certain DNOs and SOs may benefit from retrofits more greatly than others, for instance old power plants and industrial facilities. These sites, and others like them, with their need for constant output, and their lack of extra space, benefit the most from the minimal downtime and efficiency provided by retrofitting services.

Although certain DNOs and SOs might find it more critical to use the retrofit solution, it is evident that this solution provides the potential for great cost benefits for all users.