



## Why should I retrofit my old oil circuit breakers?

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### What are the drivers to change oil breakers?

Unless your old switchgear is dropping to bits and/or costing money in down time, a number of customers have difficulty justifying (especially to the Finance department) spending money on replacement switchgear by doing the traditional cost benefit analysis. It is difficult to show that spending money on switchgear will add anything to the bottom line but, conversely, not investing at the right time can certainly have a dramatic negative impact on it.

There are several drivers in the decision to replace or upgrade old oil filled switchgear. Sometimes, it can be more risk related than simply a matter of direct cost savings. The risk can be related to safety of operators and to plant, but another aspect is risk to the business, i.e. the impact on the production process, cost of lost production and cost of repairs in the event of failure of old oil switchgear. Any of these will outweigh by far the cost of replacement or retrofit switchgear.

### Reliability – risk of failure to operate

Maintenance costs are largely a function of the frequency of operation of the circuit breakers, with oil breakers needing to have contacts checked and changed depending on operation and wear. If they are not switched very often, or if they see faults infrequently, contacts and mechanisms will need little maintenance. However, if they are switched frequently maintenance costs, availability of skilled labour and, increasingly, availability of reliable and proven spare parts become significant factors.

On the other hand, when the switchgear is not operated often there is a distinct possibility that without the correct maintenance regime it is likely that the breaker might not reliably trip when called upon in the event of a fault. For example, when the lubricants have become dry, or parts have become corroded. Another issue is whether the operating springs have “set” over the years and there can be a real danger that the breaker will be unable to close satisfactorily or clear a fault.

Oil circuit breakers need to be carefully and properly maintained to ensure they will operate correctly. This is time consuming when done correctly (and it must be done correctly) and entails replacing worn parts inside the tank and outside, checking tank linings and oil condition, replacing with new moisture free oil, re-testing etc. Vacuum breakers need virtually no maintenance and by comparison the time to check periodically the condition of a vacuum circuit breaker is negligible with no replacement parts required for many years.

It is also worth considering that statistics show the majority of incidents of failure occur immediately after maintenance. This is often because of not following the correct practice, either due to lack of experience or expertise, or due to lack of care and attention. It is not unknown for breakers to be returned to service without oil, or with the incorrect level or quality of oil, resulting in immediate failure.

### Increased fault level – risk of failure to operate

Many sites have changed their electrical system over the years and fault levels have crept up to, or beyond, the original short circuit rating of the equipment. Clearly, any system with a fault level beyond the rating of the switchgear must be modified or have the switchgear replaced. However, even when the fault level is below the rating plate value there could be significant risk that an old breaker will not clear the current in the event of a fault. It is known that many old oil breakers, particularly, but not only, older designs without arc control devices, would not pass the making and breaking type tests of modern day standards.

Apart from the possibility of failure during switching a high fault current, we have seen total failure of isolating contacts to withstand currents far below the original fault level with horrendous results.

## Consequences – risk to people and business

There have been many of these types of failures recorded with oil breakers, unfortunately, often resulting in serious injury or even fatality. The result of inability to clear a fault in oil switchgear is **always** catastrophic failure. All old UK oil breakers are of the bulk oil type. Failure will inevitably lead to burning gas and oil, huge explosion and severe fire with high risk of serious injury or fatality to any operator in the vicinity. It would cause serious building damage and also wipe out part of the switchboard, meaning high financial costs for clean up and replacement and, probably more importantly, the process being fed by the circuit could be out of action for a period of months unless the circuit can be reconfigured.

There are many possible causes of internal failure of the breaker and, of course, any failure of the protection system, or the battery to operate the breaker under a fault condition would result in a similar catastrophic failure, with explosion and fire.

Operation of any oil filled circuit breakers by personnel at the front of the switchgear should always be avoided, even if PPE is worn. There are specifications which define levels of fire resistant PPE dependent upon short circuit fault level, distance from the switchgear etc., but the only really safe operation is remote from the gear.

Many older circuit breaker designs (including some previous vacuum breakers) are subject to safety notices and “modification packs” have been issued by manufacturers. In some cases the end user is not aware of these details and / or has not implemented the design modifications. Without the work being performed the equipment is at risk of failure and we are seeing that over time, some of the improvements are themselves time dependant.

## Summary

Basically, switchgear is like any other mechanical equipment in that it was designed for specific

requirements at the time. The design life was foreseen to be 25 years, so materials were chosen with that in mind. The mechanical endurance type test of circuit breakers up to the late 1970s was 1,000 operations and many breakers “just about” got through the tests. In service, parts have to be replaced during regular maintenance but there is a limit to how often this can be done before the breaker, i.e. the functioning unit, needs to be replaced.

Modern breakers are designed and type tested up to 10,000 operations and beyond, giving far higher reliability and much lower risk of failure.

The potential for an arc flash occurrence, or an internal arc in switchgear, is not confined to oil breaker switchgear. However, as described earlier, the consequences with oil switchgear are usually much more severe, due to the risk of fire in the event that the breaker is involved.

Almost all oil switchgear in the UK is well beyond its original 25 year design life. The Health and Safety Executive acknowledges and states that the risk of catastrophic failure of oil switchgear increases with age, so, it requires users to have an assessment process to ensure the condition of the switchgear is acceptable for use. HSE publications give guidance on how to assess the condition of switchgear and how to decide on the way forward depending on the results of the assessment.

In some cases retention of the equipment will be an acceptable decision. In many cases the condition of the fixed portion is fine and will last for many years. However, in many cases the part that does the work, the circuit breaker, needs to be replaced to reduce costs, or more importantly, to reduce the risk and potential consequences of failure.

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