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COUNTRY :	Japan	PREF. SUBJECT :3
REGISTRATION NUMBER : 7300		QUESTION N° : 16

Q16: A general question to utilities: Which is the expected maintenance interval extension by applying condition-based approach in comparison to a time-based one?

Effort for automatic acquisition of open/close time of circuit breaker

1. Introduction

Measurement of the open/close time of a circuit breaker main contact is a common method of checking to ensure the required interrupting performance during periodic inspections. The need arises since as the open/close time changes, interrupting performance may decrease due to wear and tear of mechanical parts caused by open/close operations and deterioration of lubricants over time.
The inspection of circuit breakers is usually carried out during the daytime on weekdays when the circuit breaker may be taken out of service. However, some circuit breakers should only be removed from service during the night or on holidays due to power system restrictions. Consequently, it may be difficult to arrange service personnel. In response, unique stationary measuring equipment was developed to eliminate the need for routine field work related to circuit breaker inspection.
Figure 1 is an overview of the key components for remote measurement of the open/close time of a circuit breaker. The auxiliary contact is mechanically connected to the operating mechanism and main contact in order to transmit the state of open/close with regard to periodic inspections of circuit breakers. In addition, this approach serves as a case study of a stationary digital sensor and data transmission system for automatic data acquisition.

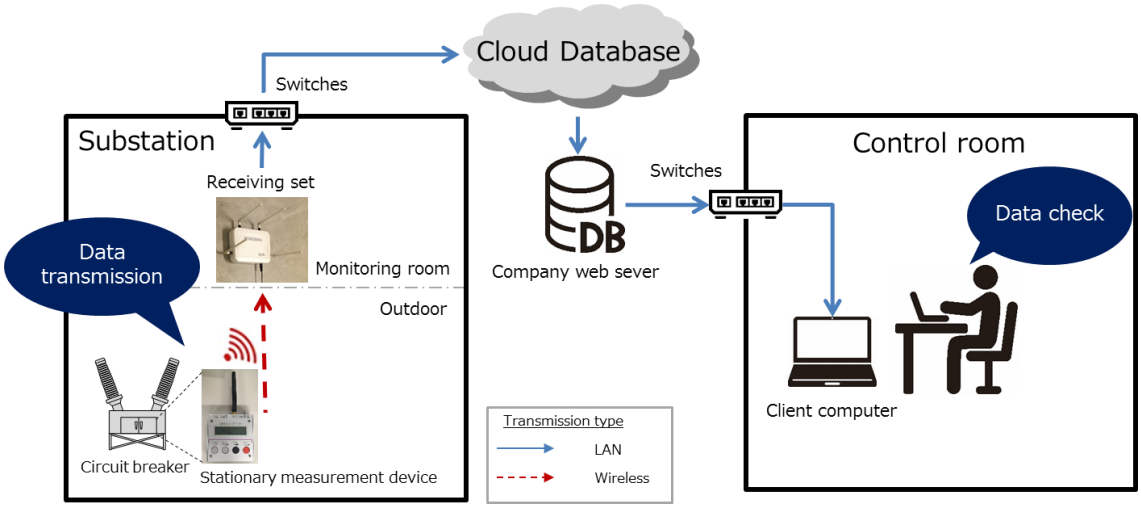
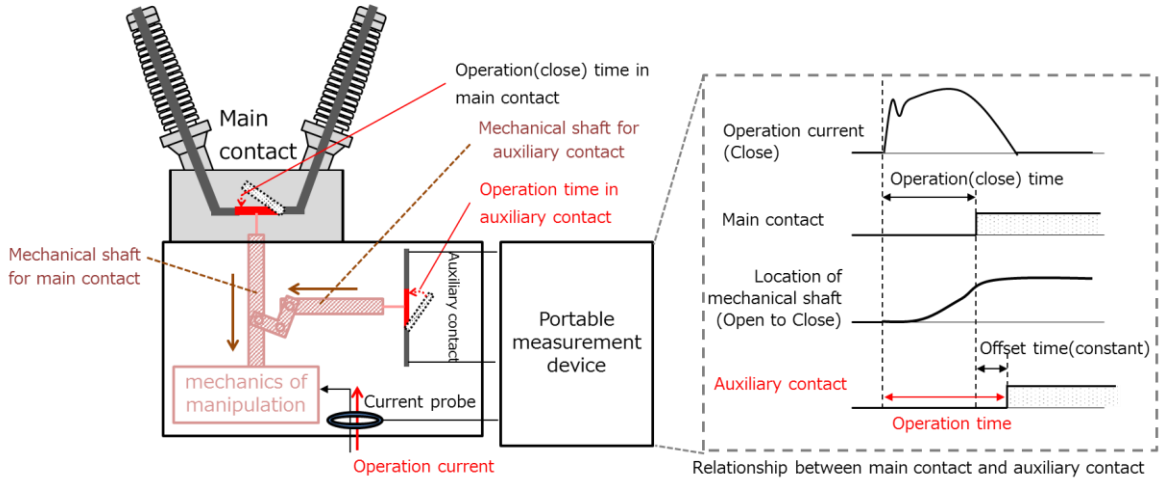


Figure 1 Acquisition and data transmission of open/close time of a circuit breaker

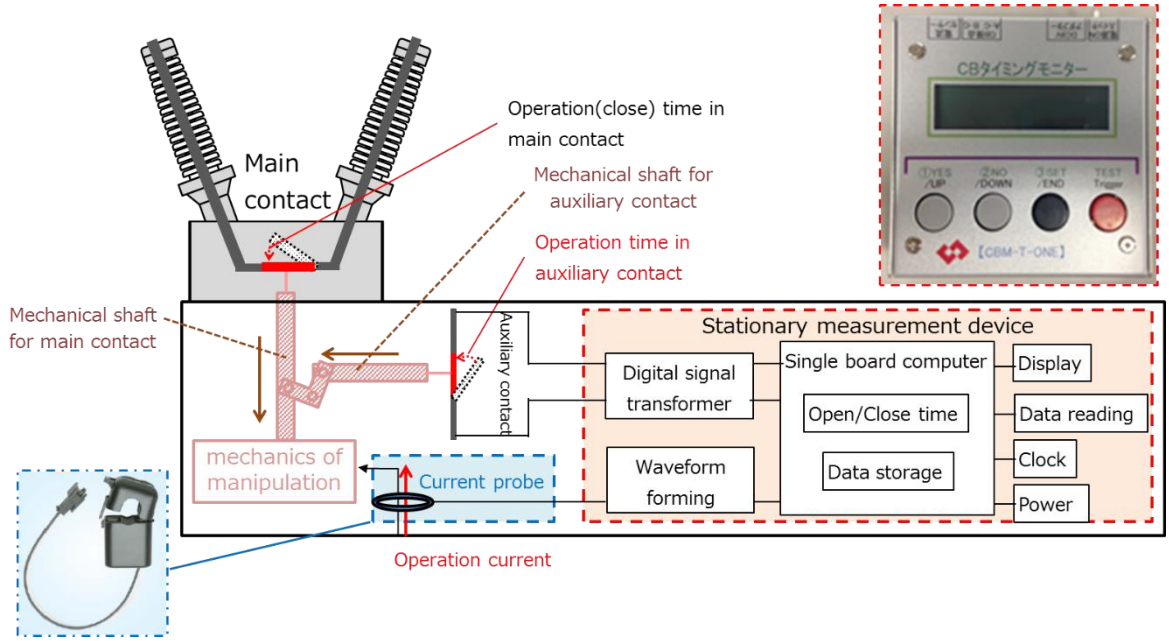
2. Comparison with conventional open/close operation time measurement

The open/close time measurement of auxiliary contacts is measured as the time from the start of current flow to the coil until the auxiliary contact finishes operating when the circuit breaker operates.
Previously, maintenance workers were required to travel to the substation, attach current sensors to the operating coil, connect instrumentation in the mechanism enclosure, connect a measurement wire to the auxiliary contact, input these measurement wires to the portable device and finally operate the circuit breaker.
Now, elements of the stationary type measuring device may be permanently installed inside the circuit breaker mechanism enclosure. For example, the current sensor for the operating coil and the measuring wire for the auxiliary contact are permanently installed in the system (Figure 2b). In addition, the stationary device has a wireless data transmission function that enables recording of the open/close time

during normal circuit breaker operations such as line switching. Consequently, the additional time and labor associated with an on-site visit is eliminated.



(a) Conventional method



(b) Current method

Figure 2 Comparison of open/close time measurement of a circuit breaker

3. Effect of the application of the stationary measurement device

Previously, the inspection of circuit breakers was carried out by visiting substations. With the introduction of the stationary measurement device, it is now possible to carry out the inspection remotely and thus to reduce the time and number of personnel required for site work.

Also, inspections were carried out only when the circuit breaker could be removed from service. Currently, it is no longer necessary to dispatch personnel since the open/close time can be obtained remotely by the stationary measurement device. This may occur when the circuit breaker is de-energized at night or on holidays due to system restrictions.

The application of the stationary measuring device is responsible for an improvement in work efficiency related to circuit breaker inspection of more than 70%. This is a significant improvement in efficiency.

4. Summary and future work

A wireless communication function is added to the stationary circuit breaker timing monitor to transmit measurement data to the maintenance base, further improving efficiency and saving labor in the measurement of open/close operation time (typically performed every six years).
The verification of wireless data transmission in outdoor substations has been completed. Practical field application is enabled by installing repeaters according to the distance between the measuring equipment and the receiver. Communication methods where the measurement devices are installed at different levels, such as indoor and underground substations, will be studied in the future.