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GROUP REF. : A3
PREF. SUBJECT :3
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?

Extension of Periodic Inspection Interval of Existing Switchgear by Installation of IoT Technology

Introduction

The maintenance interval of switchgear has been extended from once every six years to once every 24 years by applying condition-based approach. Monitoring systems have been installed to many substation switchgears, and condition-based approach has successfully improved equipment reliability and reduced maintenance labor, based on the automatic and remote constant diagnosis with non-outage which can detect the sign of the failure as shown in Fig.1.

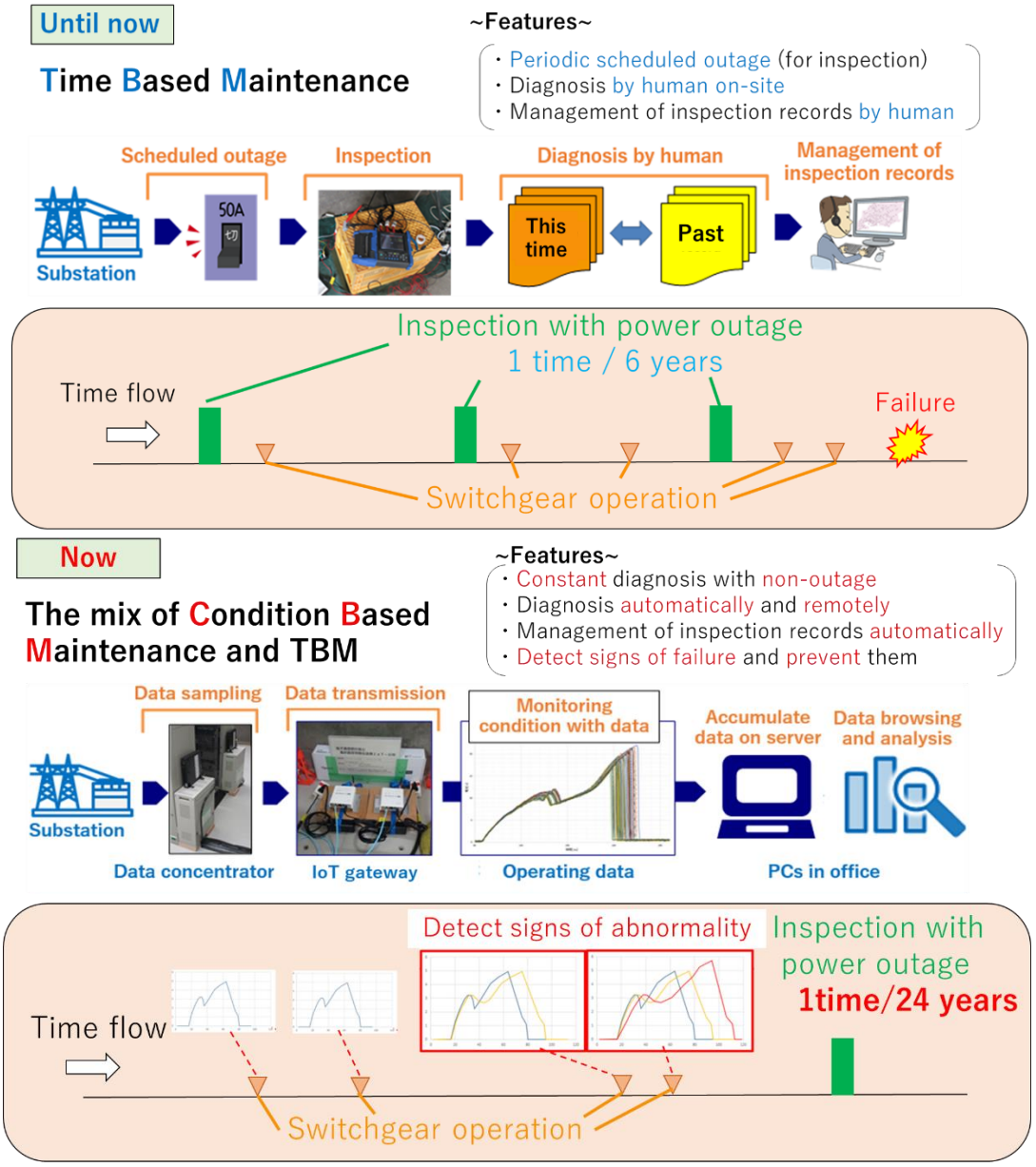


Fig.1. Image of extension maintenance interval

Overview of Monitoring Device for control circuit

In order to diagnose the condition of switchgear, monitoring device for control circuit was developed and installed into existing switchgear as shown in Fig.2. The DC current waveform of the control circuit is acquired by the sensor and collected by data concentrator. It also analyzes each circuit breaker condition and diagnosis results can be browsed in desktop PC by end user very easily.

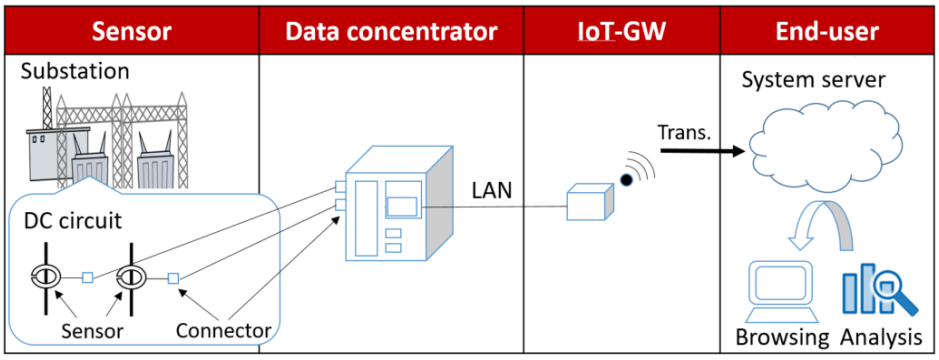
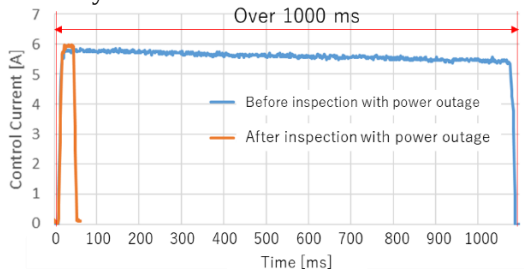


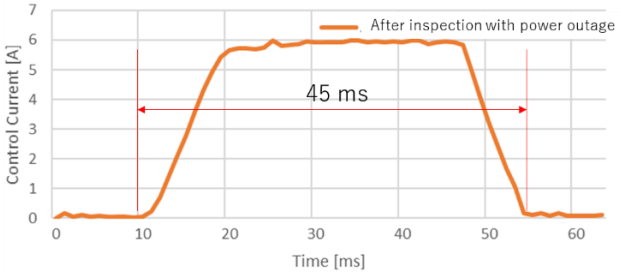
Fig.2. Configuration of monitoring device

Example Failure Prevention of Gas Circuit Breaker (GCB)

DC current waveform of the control circuit is a good index to diagnose condition of GCB. The duration of the DC current waveform of the control circuit will be longer than the normal condition if the lubricant of GCB mechanism is deteriorated. Fig.3(a) illustrates the tendency of the abnormal condition of the DC current waveform of the control circuit. The duration of control current before the inspection is longer than 1000 ms which indicates a GCB abnormality. As a result of inspection and maintenance on GCB conducted with power outage according to the diagnosis, duration of the DC current waveform of the control circuit was recovered drastically to 45 ms.



(a) DC current waveform of the control circuit before/after inspection with power outage



(b) DC current waveform of the control circuit after inspection with power outage

Fig.3. DC current waveform of the control circuit waveform of GCB

Extension of Inspection Interval with Power Outage for Switchgear

Inspection interval with power outage has been extended drastically with the benefits of IoT technology although maintenance method has not completely migrated into CBM. Since the benefits of both TBM and CBM are incorporated, replacement of electrical component remains to be conducted every 24 years based on our experience.

Future Policies

Monitoring device for other substation equipment such as transformers is under development in order to accomplish extending the inspection interval of entire substation equipment in the future.