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Preventive Maintenance of the Electrical Equipment of HANARO

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1. Introduction

Electrical equipment deterioration is normal, but equipment failure is not inevitable. As soon as new equipment is installed, a process of a normal deterioration begins. Unchecked, the deterioration process can cause a malfunction or an electrical failure [1]. Preventive maintenance is defined as an activity undertaken regularly at preselected intervals while a system is operating satisfactorily, to reduce or eliminate an accumulated deterioration, while a repair is an activity to bring a system to as a good as new status after a failure has occurred [2]. Electric equipments of HANARO such as high and low voltage switchgear and motor control centers, etc., have been operated since they were installed in 1993. We have conducted a periodic and surveillance test on these equipments. And the equipments go through an inspection by the Korea Electrical Safety Corporation (KESCO) every two or three years.

We planned to overhaul the major components, such as the protective device (vacuum circuit breaker, air circuit breaker and protective relay), transformer and high and low voltage switchgear bus as a preventive maintenance (PM) and conducted the overhaul in 2007. The overhaul was conducted in two ways. One was an inspection and maintenance of the major components, and the other was an electric system analysis. This paper describes the overhaul activities and their results.

2. Inspection and Maintenance of Electrical Equipments

In this section inspection and maintenance which were the conducted activities are described. We achieved the inspection using two methods. One is carried out at a de-energized condition. In this stage we overhauled not only the vacuum circuit breaker and air circuit breaker but also the protective relays. The other method is using an infrared camera at an energized condition [3], [4].

2.1 Inspection at an De-energized Condition

The inspection at the de-energized condition was carried out mainly on the vacuum circuit breaker and the air circuit breaker. The principle difference between the vacuum circuit breaker and the air circuit breaker is in the main contact and interrupter equipment. In the vacuum circuit breaker, these components are in a vacuum bottle and are not available for a cleaning or adjustment.

A. Contact Resistance

The resistance at the contacts is used to determine the amount of heating that can occur at the contacts as a result of the current flow through this connection. The resistance was measured using a low digital resistance ohmmeter which is a direct reading 100 Amp, 4 wire digital ohmmeter and is used to measure the DC resistance of contacts in a conducting path. All of the measured values were below the maximum allowable value.

B. Vacuum Integrity

Vacuum integrity is checked by an application of a test voltage across the open contacts of the bottle. The integrity of the vacuum is judged by the leak current when a test voltage is applied. The acceptance criterion is below 0.3mA when applied test voltage is 20kV. The vacuum integrity of all vacuum circuit breakers was satisfied with the acceptance criterion. Fig. 1 shows the vacuum integrity tester.

Fig. 1. Picture of vacuum integrity tester

C. Operating Mechanism

The closing and opening action should be quick and positive. We checked the closing and opening time. The results satisfied the acceptance criterion. Fig. 2 shows the test result of one vacuum circuit breaker.

All moving parts are subjected to wear. We inspected the operating mechanism for loose or broken parts, missing nuts and bolts, and a binding or excessive wear.

2.2 Infrared Inspection

Infrared inspection of equipment has been widely used in the electric utility industry for many years. It has proven very beneficial for identifying a potential problem that, if gone unnoticed, would most likely lead to unanticipated outages of the equipment. With the help of infrared, we can repair electrical problems before they fail. This will ultimately reduce or eliminate the operational downtime.

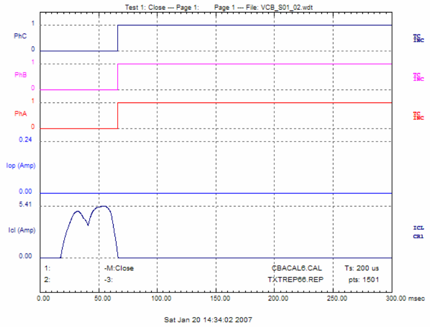

Fig. 2.(a) Test result of Vacuum circuit breaker (closing time)

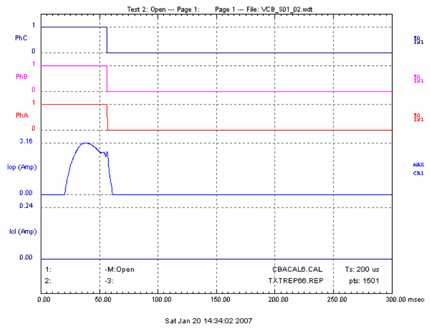

Fig. 2.(b) Test result of Vacuum circuit breaker (opening time)

Excessive heat relative to an entire system can be a sign of potential problems. These higher temperatures often indicated loose or faulty connections, the improper wiring installation, ground faults, short circuits and other common problems in electric equipment. Using an infrared inspection, we found and repaired five loose connections. Fig. 3 shows the picture and thermal image of a disconnecting switch.

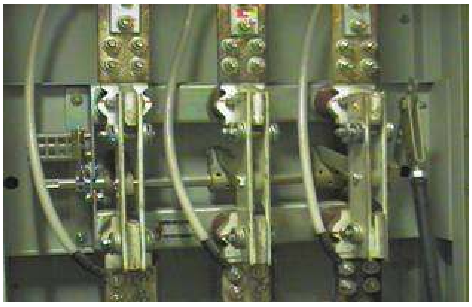

Fig. 3.(a) Picture of disconnecting switch

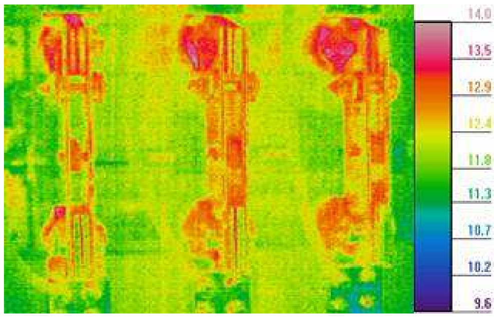

Fig. 3.(b) Thermal image of disconnecting switch

3. Electric System Analysis

The electric load has increased in recent years because of an installation of the Fuel Test Loop (FTL) and Cold Neutron Source (CNS). We did a short circuit analysis for a safety and a load flow analysis for a stability of the HANARO electric system in consideration of the load of not only the FTL and CNS but also the other facilities. The system analysis shows that HANARO has enough power supply to cover the increased load by the FTL and CNS. Using the results of the short circuit analysis and the load flow analysis we also carried out a protective device coordination. We performed an overhaul for the protective relays. The procedures of the overhaul were a physical inspection, cleaning, and a setting according to protective device coordination report and a test of the tripping circuit.

4. Conclusions

HANARO electrical equipments were overhauled as a preventive maintenance - inspecting, diagnosing and repairing of electrical equipment before a malfunction or failure. As a consequence of the preventive maintenance, safety, reliability and stability of HANARO electric system could be increased.

REFERENCES

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