TRANSPOWER

QUALITY ALERT!

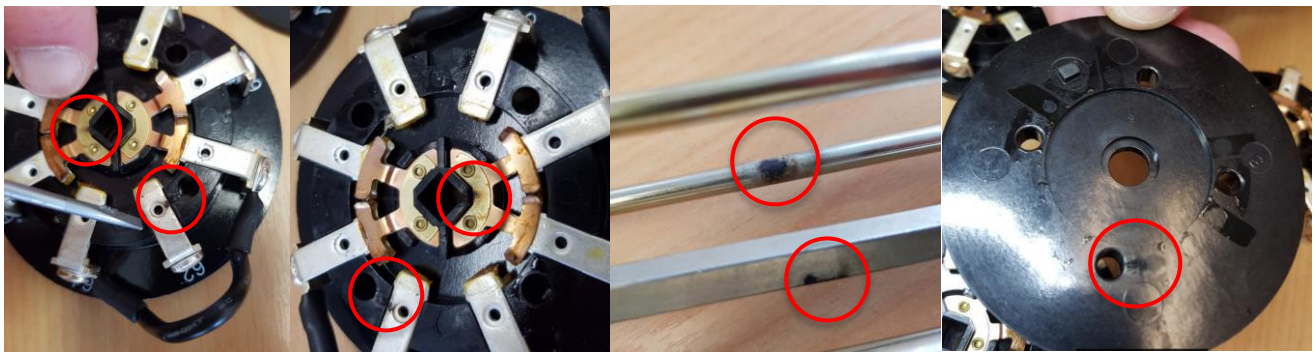
11th June 2019
Maximo REF No. n/a

Electroswitch Damage Found During Precommissioning Testing

ISSUES IDENTIFIED:

During recent acceptance and pre-commissioning tests at Kinleith Substation, a low insulation resistance (IR) reading was returned on an NCT secondary circuit. Subsequent investigation found that the IR fault was inside the protection test switch (Electroswitch) requiring switch replacement before commissioning could proceed.

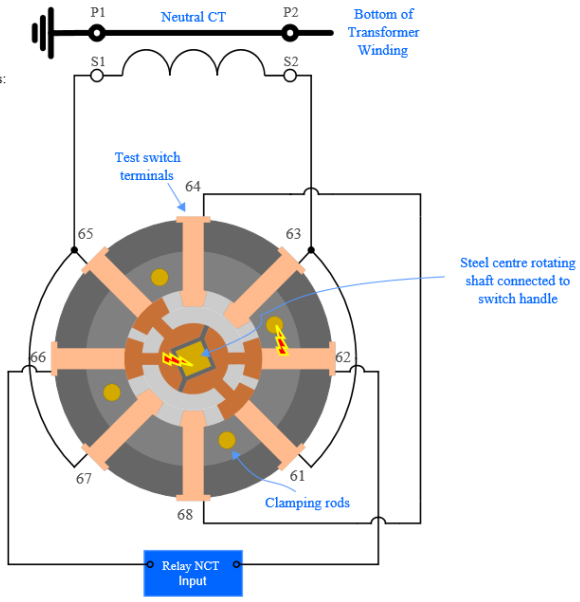
An internal examination of the switch found that sustained arcing had occurred between the Electroswitch moving contact and earthed shaft, and between an Electroswitch fixed contact and earthed through-bolt.



PROBLEM DIAGNOSIS:

Electroswitch Function on terminals:

61-62 = 65-66 = Service
62-63 = 66-67 = Trip Off
63-64 = 67-68 = Test



There are several ways that a high voltage can appear across an Electroswitch CT wafer. One is primary current flowing in the CT with the switch in "Test" position and the TP installed shorting link missing.

Another possibility is primary current flowing through the CT with the switch in "Service" or "Trip Isolate" positions and the relay missing or its CT input disconnected.

Examination of the circuit showed that the arcing occurred between the contacts connected to the relay NCT current input. The relay NCT input must therefore have been open circuited with the switch in "Service" position while primary NCT current was flowing.

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CONTRIBUTING FACTORS:

Panels are shipped without relays and the relays are generally not installed until relay acceptance testing is completed. This can take some time and if gaps are left in the CT secondary circuit there is a risk of very high voltages (>3000V) being imposed on the CT secondary, secondary wiring and test switch wafers if current is able to flow in the CT primary.

The primary current required to generate high secondary voltages at an open-circuited CT secondary is surprisingly small (a few A at high CT ratios).

This primary current flow can occur while performing CT ratio checks on other cores or primary resistance testing. It can also occur during faults on other equipment as earth fault current can flow through the CT primary if there are local or remote earths on both sides of the CT.

ACTIONS TAKEN TO PREVENT RECURRENCE:

On-site checks carried out to ensure that suitable measures are implemented to maintain the integrity of CT secondary circuits during acceptance and pre-commissioning stages, including confirmation that:

- Relays are installed
- Secondary wiring is completed
- All CT switch wafer links are installed
- CT circuits are proven to be continuous in all switch positions.

LEARNINGS FROM THIS:

1. When undertaking acceptance and pre-commissioning testing it is essential to confirm the integrity of all CT secondary circuits prior to injecting primary current, e.g.:
   - Are protection relays installed and have the associated CT secondary circuits been connected ?
   - Have test switches been acceptance tested and are all required links installed ?
   - Has end-to-end continuity of the CT secondary circuit been proven ?
   - Where appropriate, have shorting links been applied to ensure that CT secondary circuits are not open-circuited ?

2. All work must be managed using an appropriate work control procedure such as a Work Authority and/or Work Method Statement. This includes management of isolation points and other temporary safety measures such as application and removal of CT secondary shorting links.

3. Care is required when working on neutral CTs, DCBs, CSAs and indoor 33 kV switchgear with integral earth switches on the bus side of the CT. There is a risk of exposure to high secondary voltages from external earth fault currents flowing in the CT primary if the primary circuit is earthed on both sides of the CT. For more information see TP.SS 07.24, Appendix D and E.

Quality Assurance

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