Commissioning of Electrical Equipment

Commissioning of Electrical Equipment (on photo OKKEN Low Voltage Switchgear - Schneider Electric)

1. Objective

To verify *system condition* after has been energized with rated system (service) voltage for which it is designed. Also to ensure the protection, metering system for correct directionality.

2. Test Instruments Required

1. Multimeter
2. Phase angle meter
3. Phase sequence meter
4. Communication software (if required)

3. Test Procedure

3.1 Pre – Energisation Checks

The following items shall be check without fail prior to energise the system:

1. All pre commissioning tests are conducted for all equipments
2. A visual check at CT (current transformer)circuits, not to be kept open.
3. A visual check at VT (voltage transformer) circuits, all the links to be closed.
4. VT primary is connected to line.
5. Restoration of all isolation links and connections.
6. Restoration of remote alarm and indication links.
7. Adaptation of relay settings.
8. CB trip test at test position from protection relay by shoring contacts to ensure protection trip.
9. Power cable / conductor terminated with proper tightness.
10. Visual check at power transformer for power cable termination, cable box cover, oil level and cooler fan setting.
11. Visual check for insulation medium level SF6 if applicable.
12. Cancellation of PTW (permit to work), other authorised documents for relevant system prior to energization.
13. No admission for unauthorised personnel in the concern vicinity.
14. A study of switching programme or the sequence to be executed.
15. All the panel covers are closed.
16. All safety action taken, like keeping fire extinguisher and first aid items.

3.2 Post – Energisation Checks

The following points shall be checked during and after commissioning:

1. No abnormality in the system after energization.
2. Voltage measurement shall be done for all points and found normal.
3. Phase sequence check for correct rotation.
4. Phasing check before paralleling two circuits by either hot stick or VT secondary side.
5. If the circuit is loaded, CT secondary current of all cores and phases shall be measured with angle with respect to any one of the phase voltages.
6. Directional test shall be done for directional protection, like directional O/C, E/F, and distance protection. This test has been explained later.
7. Stability test shall be done for differential protection.
8. If applicable, on load test for automatic voltage controller shall be done for transformer.
9. Check for correct readings on indicating meters.
10. Live test for auto-changer over scheme, auto-reclosing scheme shall be done.

3.3 Synhronising / Phasing Checks

Phasing checks:

Before making two live feeders parallel, the phasing must be checked though the source is same. This could be done in two methods. One method is hot phasings, most reliable method, since the check is done on the primary. The voltage difference between feeders shall be monitored by connecting hot stick (Voltage detector equipment, rated for system voltage, that will indicate presence of voltage) between *Rph-Rph*, *Yph-Yph*, *Bph-Bph* of two feeders respectively.

Another method is phasing between VT secondaries, and a caution be taken for this method, that there is no mistake on secondary wiring.

To ensure correct connection of primary and secondary, energise both the VTs by any one supply and do phasing between secondaries. For correct connection no voltage difference shall be observed during phasing. Now the VTs could be energised with respective feeder's supply and repeat the phasing between VT secondaries. If there is no considerable voltage difference between the feeders voltage, they are ready to parallel.

Synchronising Check:

Before making to different source of same voltage level, in addition to phasing check, synchronisation must be done. The following steps shall be followed.

1. Adopt proper setting for synchro-check relay.

2. Check the secondary grounding for all VTs are at same point (star point or Y phase).
3. Energise both the VTs with same source.
4. Do phasing between VT secondaries, check synchro-check relay picks up continuously and synchroscope is staying at 12'o clock position. This ensures that the primary and secondary connections of VTs are correct.
5. Now energise the VTs with respective sources.
6. Check the synchroscope the pointer continues to rotate. This rotation (incoming voltage vector is rotating with respect to running voltage) is due to slip frequency between the sources, i.e., phase angle between the voltages varying time to time due to frequency difference of supplies.
7. If the observed rotation is fast, try to make it slow by increasing or decreasing speed of the machines.
8. Once the rotation is slow, when the incoming voltage phase angle difference falling with in the setting value the synchronising relay will pick up and it will drop off as soon as the phase angle difference exceeds.
9. It is allowed to parallel the sources with in this period.

3.4 Directional Test

This test to verify the directional protection / distance relay is looking in desired direction (trip direction). This could be confirmed by on load test. The principle of the test is that the load current and voltage shall be simulated in trip direction and observe the relay operation. The VT or CT input to the relay shall be reversed and observe the relay is reset.

The procedural method could be difference with different type of relays. The relay manufacturer's procedure shall be followed for directional check.

The following precautions shall be taken during directional test:

- Protection shall be put out of service, i.e. all out put contacts are isolated.
- Never open circuit CT circuit.
- At the end of the test all the connections shall be restored back.

3.5 OnLoad Stability Test

This is the test to confirm the stability of a *differential protection* for through fault with load current. The following precautions shall be taken during test.

- Protection shall be put out of service, i.e. all out put contacts are isolated.
- Never open circuit CT circuit.
- At the end of the test all the connections shall be restored back.

3.5.1 Transformer Differential protection:

The current inputs to the relay from all the windings of the transformer shall be measured with angle WRT any phase voltage of VT. The differential current also is measured externally or internally by relay. There should be no differential current (practically not zero) during this test. If sufficient load is not available on the transformer, this test could be done by making two transformers parallel and keeping at different taps (A circulating current will be flowing between them).

3.5.2 Pilot wire differential protection:

The CT currents at both the ends shall be measured with phase angle. The pilot current shall be measured between the relays at normal load condition. The following steps are followed.

1. Isolate trip and alarm.
2. Enable the pilot wire relay with O/C check input energised (if applicable).
3. Measure the relay CT input current at both ends in all phases.
4. Measure the pilot current with normal pilot connection.
5. Connect only 'R' phase CT to the relay and other phase's CT short and isolate at both the ends fig 4.1.
6. Now check the pilot current and observe the relay is stable.
7. Reverse the pilot connection and measure the pilot current. Should pilot current reduce and relay operates for correct function.
8. It shall be repeated for 'Y','B','RY','YB','BR',"RYB' combinations.

3.5.3 Busbar differential protection:

The entire feeder's current shall be measured with phase angle. The differential current at main relay and voltage across CT bus shall be measured. At normal load condition there should be no differential current and voltage.

Fig 1 - Pilot wire protection on load test

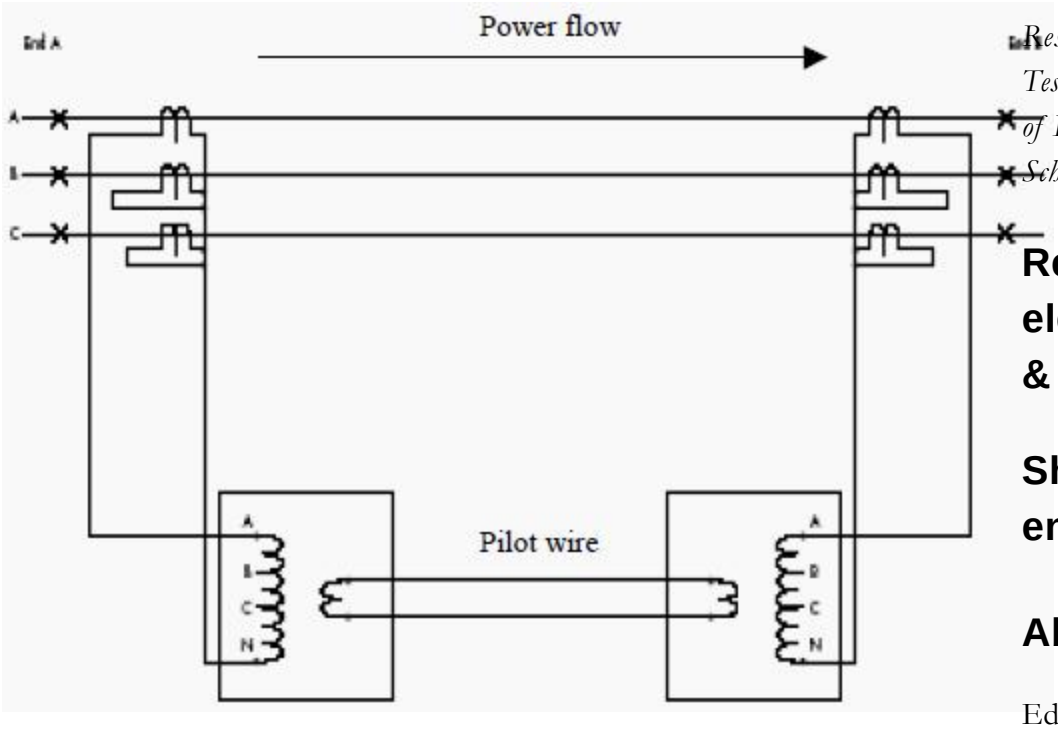
3.6 Metering Verification

All the meters show the primary quantity with secondary input quantities. Sometime it is impart to check the meter reading with actual inputs for correct polarity, particularly in power, energy measurement.

For power meter the input current and voltage shall be measured with angle.

The meter reading could be validated as shown in *fig 2*.

Fig 2 - Nature of load



Resource: Procedures for Testing and Commissioning of Electrical Equipment by Schneider Electric

Related electrical guides & articles //

Share with engineers //

About Author //

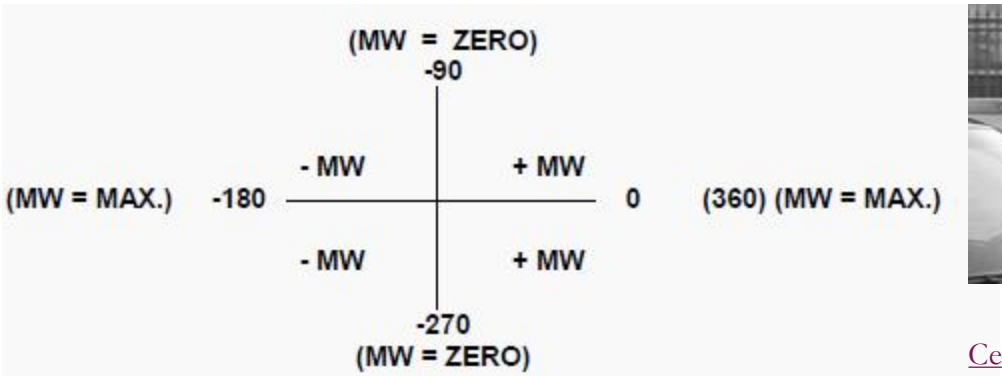
Edvard Csanyi

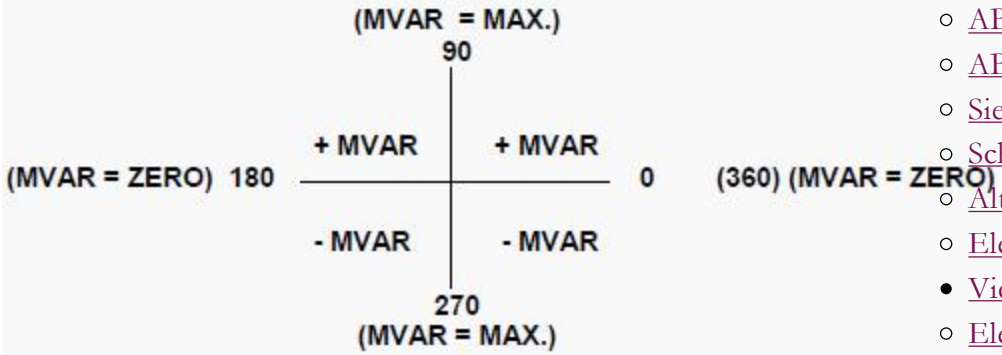
Edvard - Electrical engineer, programmer and founder of EEP. Highly specialized for design of LV high power busbar trunking (<6300A) in power substations, buildings and industry fascilities. Designing of LV/MV switchgears.Professional in AutoCAD programming and web-design.Present on Google+

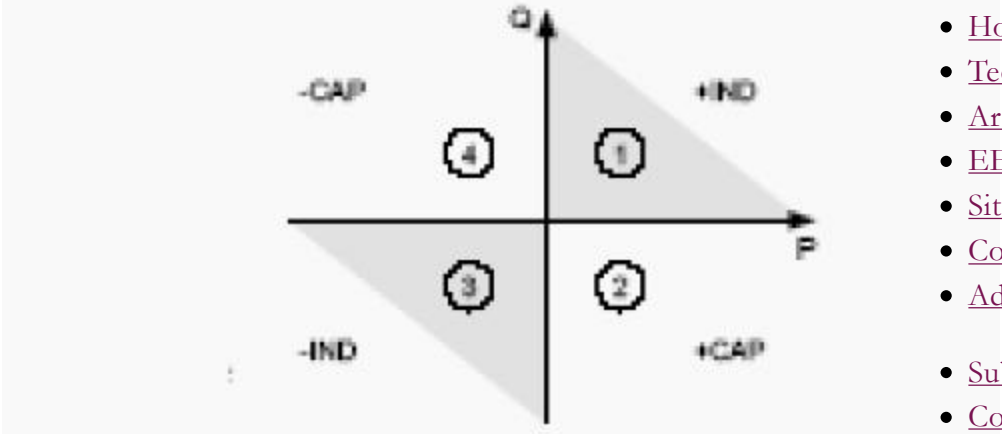
- SHARE
-
-
-
-
-

TOP
Get PDF

- Electrical Tools
  - Excel Spreadsheets
  - Windows Software
  - Android App
- Electrical Guides
  - Electrical Engineering
  - Power Substations
  - Generation T&D







- Data Center Guides
- Control & Protection
- Industry Automation
- ABB Drives Guides
- ABB Protection Books
- Siemens EE Basics
- Schneider Electric CTs
- Alternative Energy
- Electrical Design Docs
- Video Trainings
- Electrical Engineering
- PLC Programming
- Testing & Commiss.

- Home
- Technical Articles
- Article Categories (38)
- EE Resources
- Sitemap
- Contact
- Advertisement

- Subscriptions
- Complete Technical Articles
- Articles Alert

- Download Updates

Facebook Linkedin Google Plus Twitter