

Current Transformers of Releases and the User's Expectations

Introduction

Generating stations are provided with battery banks of auxiliary DC supply. This auxiliary supply is used for circuit breaker close/trip/spring charging operations, protection, indication, control, emergency lighting and for operating critical electrical equipments during power failure. Whenever aux DC is not available or even if it is available, release are preferred for LV auxiliaries in new installations and in upgrading and modernization of existing installations.

The generation station LV auxiliaries are fed from unit auxiliary boards and station aux. boards. Typical unit aux. feeders are for boiler auxiliaries, turbine auxiliaries, battery chargers, GR fans, cooling water pumps, drain pumps, instrument air compressors, coal feeders, belt conveyors, water lancing system, DG set, emergency bus etc. Typical station auxiliary feeders are for station lighting, service air compressors, battery chargers, package boilers, ventilation and air conditioning etc. In addition, LV auxiliaries are also available for peripherals like lignite handling system, ash handling system, circulating water pump house fire water pump house, DG set, De-mineralization plant etc.

The authors are associated with the testing and commissioning of release of different makes for LV auxiliaries. They wish to share their experiences and their expectations from user point of view.

Types of Releases

The various types of releases available for LV breakers are,

- Thermo-magnetic
- Solid state
- Micro-processor based
- Communication capable.

All release are associated with dedicated trip coils-which are different from shunt trip coils, if any, provided along with.

Features

- Over-load protection with or without thermal memory, phase failure protection, earth-fault protection with definite time or inverse characteristics, instantaneous and/or short time delay short-circuit protections available in single unit.
- Under-voltage release with or without time delay and shunt release with or without power storage, available as optional accessories.
- Aux supply is not required for tripping.
- No moving parts except the final trip mechanism.
- Maximum flexibility of characteristics, which enable them to have full discrimination with upstream and downstream protective devices with inverse/ very inverse / extremely inverse characteristics.
- Close pick-up/ drop-off ratio.
- All the three phase protections are adjusted simultaneously with one control.
- Characteristics remain unaffected by temperature variations, except in the case of thermo-magnetic releases.
- Accurate, reliable and stable.
- Less maintenance.
- Less frequency of testing.
- Superior versions have in-built watch-dog circuits, measured value acquisition and indications.

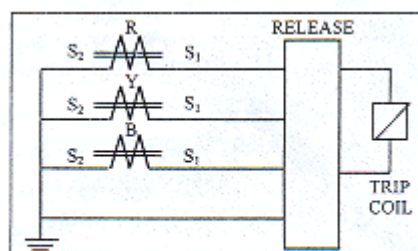


Fig 1 CT and release connections for three phase, three wire system

Construction

The release system consists of:

Three breaker mounted multi-tap current transformers (CTs) for three phase, three wire system. The CTs are connected in CT star, over-load elements of releases in star with E/F element in the residual connection (Fig 1).

- Three breaker mounted multi-tap current transformers and a fourth neutral current transformer for three phase, four wire systems. The neutral current transformer is also mounted on the breaker for four pole circuit breakers or on the neutral conductor on the panel rear side for three pole circuit breakers. The four CTs are connected in CT star, with E/F element of the release in the residual connection formed with four CTs. The fourth current transformer is effective only for the earth fault protection, but not for the over-current protection of neutral conductor (Fig 2).

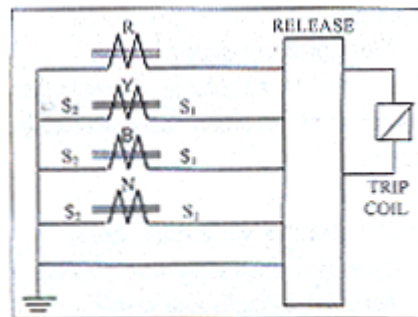


Fig-2 CT and release connections for three phase, four wire system

- The release.
- The tripping solenoid.
- Re-close lock-out.
- Signaling contact.
- Signaling unit for remote signaling for superior versions

The CTs provide the power supply for the releases, tripping solenoid, re-close lock-out and signaling contact. They have special ratio. The releases also do measured value acquisition in superior versions.

Difficulties Encountered During Commissioning and the User's Expectations

The releases are manufactured and tested separately at works located in one place. Then they are sent to the manufacturer's breaker assembly shop located in geographically distant place. In some cases, the releases are imported. In the breaker assembly shop, the release is assembled with other components like breaker mounted CTs and neutral CT.

The operation of the releases with special kits assembled the purpose is done. In many cases, it is learned that, the checking of the CT current circuit and operation of the releases, before dispatch to site performing primary/secondary injection is not carried out. If primary injection testing is not carried out at site, the reliable operation of the releases, under actual fault conditions is not ensured. During primary or secondary injection tests at site, some of the releases were not operating and they were replaced.

Many manufacturers consider the release with CTs as a matched pair and the rating plate details like ratio, protection class etc. are not mentioned. The manufacturer's drawings contain all information, except the information of the CTs on which protection is dependent. As a result the suitability of the CTs is not known to the end-user. Even in cases where protection class is mentioned as PS class the details like knee-point voltage (Vk), magnetizing current at $V_k/2$ or $V_k/4$, secondary resistance etc. are not mentioned in the rating plate of the CTs. As per IS-2705, the rating plate of PS class CTs shall contain all such information. Even if the CTs are not of PS class, some minimum details like accuracy class accuracy limit factor, VA etc., are to be mentioned.

In cases, where it is mentioned, the CTs during testing at site found to be not meeting the specifications mentioned by the manufacturer and were placed. 'PS' class CTs were found to be saturating before VK; magnetizing current was found to be high. Further, the rating plate particulars of CTs mounted on the neutral bus are different from the ones mounted on the breaker.

As multi-tap CTs are used and the available ratios and the adopted ratio are not mentioned in the drawings, the end-user experiences some surprise during site testing. CTs of incorrect ratios were found mounted. In one case, the rating plate for 'PS' class CTs contained magnetizing current

measured during factory testing and not the maximum required magnetizing current. As the site results of magnetizing current were different, the manufacturer was called and his explanation was sought.

As CT particulars are not mentioned in the drawings and primary injection on the breaker mounted CTs of releases is not carried out by the manufacturer at factory, the problems like improper CT ratio selection, mismatch of line CT and neutral CT ratio etc. are found out at site during testing resulting into replacement of components, avoidable time and cost over-run. In one case, the ratio of the neutral CTs were found to be half of the line CT ratio; the neutral and line CT ratios shall be identical. All such neutral CTs were replaced afterwards.

The orientation of the breaker mounted and neutral CTs are not mentioned in the drawings. While carrying primary injection at site, we noticed the improper relative orientation of line and neutral CTs, which in-turn results into false E/F pick-up during unbalanced/single phase loading or blocking of E/F protection during actual fault conditions.

For three phase, three wire systems, the neutral CT is mounted on the neutral conductor on the panel rear side for three pole circuit breakers. The neutral CT secondary wires are brought to the release via sliding contacts mounted on the breaker top or bottom. Sometimes due to improper contact at the sliding contacts, the neutral CT secondary remains open.

For site testing of the releases, specially assembled kits are used by the manufacturer. They serve the purpose of 'Go-No go' arrangement. Many versions of these kits do not check the CT connection correctness, but only the operation of the releases. The checking of the characteristics of the releases at-least at few points of the characteristic curves is not done by many of the kits.

Some of the MCCBs are provided with 'Earth fault modules'. For three phase-four wire system, earth fault protection is available with externally mounted multi-tap core balance current transformers (CBCT). These CTs do not have any rating plate details. None of the CT details including the adopted ratio are mentioned in the drawings. The method of site testing, to ensure reliable operations is also not indicated.

As a normal convention, the CT secondary circuits are wired with 2.5 or 4.0 sq.mm wires. But this convention is not followed in the case of these CTs, even-though in some cases, the secondary current is mentioned to be more than 5A.

Except in superior versions, where additional signaling units are provided, the cause of tripping is not known. Separate indications are not provided for different types of faults.

Conclusion

In-built release are preferred over conventional breakers with trip coils and relays, because of their simplicity and non-dependence on aux. supply. However, if the manufacturers address the difficulties faced by the end-user and sort them out, it will be very much appreciated. The manufacturers shall furnish the complete details of line and neutral CTs and the available and adopted ratios in the bill of materials and drawings and in breaker rating plates. Primary injection testing of breaker mounted and neutral CT's at factory and checking the operation of releases shall be made mandatory. Necessary information for site testing shall also be provided.

References

1. IS-2705 Specification for current transformers.
2. Instruction manuals of releases of manufacturers

Reference Book

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