Technical note

COMPACT SPLIT CORE CT

Abstract: Plant turnarounds or shutdowns, are one of the critical times in the operation of a plant. Shutdowns have an intense impact on the plant's financial future either in positive or negative ways. To avoid financial and production hampering in a plant during turnaround, compact split core current transformer is the best solution. These CTs provide openable cores which are easy to install with different bus bar mountings and cable tie provision.

Introduction

Current transformers (CT) are vitally important tools to aid in the measurement of Alternating Currents. They scale down a large primary current (input) to a reduced magnitude of current at secondary (output), for measurement and instrumentation.

A CT utilizes magnetic field strength around the conductor inducing current in its secondary winding. This indirect method provides a high level of isolation between the primary circuit and secondary measurement circuits and allow for easy installations.

CTs are available in various sizes, designs and input-output ranges. This technical note attempts to address one such innovative type of CT.

Compact Split Core CT:

Current transformers are generally located in the main breaker panels or in branch distribution panels where space is always a challenge.
Since CTs are to be installed 90° to the conductor. CT cores are solid core type or may have a split core. The construction of core, whether solid or split defies how the CT can be installed. Solid core CTs feature a closed loop, in which the primary conductor must be passed through.
Whereas, a split core CT can be temporarily made open for retrofit installations. During which the primary conductor need not be disconnected while the CT is being installed.

RISH Compact Split Core CT:

Current transformers are indispensable in areas of application like substation monitoring & control, Process industries, automation industries and for systems where SCADA has been implemented.

To cater the needs of such industries an innovative approach by Rishabh Instruments put forth a compact split core CT, reducing the system complexities regarding space, hard-wiring and installation.

The *RISH Compact Split Core CT* offers significant advantages to professionals during the power analysis, meter implementation and installation phase in electrical panels, mitigating the aforementioned complications.

General Specifications and Features:

- ✓ Applicable to International standard IEC 61869-1 & -2 : 2012
- ✓ Current ratios ranging from 60/1 to 500/5A
- ✓ Complies to accuracy class 1 & 3
- ✓ Hinged split core with swing open for ease of installation
- ✓ Cable tie provision for faster installation
- ✓ Safety plug-in shorting link

Fig.1. RISH Compact Split Core CT

In designing a split core CT instead of solid core CT, certain design complications arise. The first and most crucial difficulty is the reduction in accuracy due to split core (air-gap core).

The above figure 2. shows the B-H loop measured on a toroidal core made from grain-oriented electrical steel grade M4 and split core of the same material.

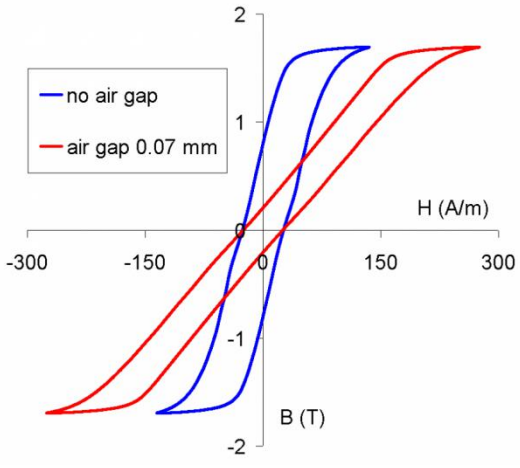

Fig.2. Comparing B-H loop of solid and split core CT*

The blue curve shows B-H loop for solid core having a larger slope whereas, the split core B-H curve in red has a comparatively lesser slope, changing the loop shape but having almost no effects on the power loss (W/kg). Air-gap due to split core leads to increase in magnetizing current inducing errors and thus degrading CT accuracy.

As well as the ampere turns affect the accuracy, increasing error at low ampere turns.
Error (e) increases by the relation:

$$e = k * \frac{1}{(AN)^2}$$

Where,
k = constant
AN = ampere turns
And also, the the core length increases the error by :

$$e = k * L_j$$

In order to redefine the accuracy as per IEC standards a better core material like ZDKH is used. This core

* by S.Zurek, Encyclopedia Magnetica, CC-BY-3.0

material offers hysteresis loop with smaller hysteresis area.

The ratio between accuracy class and burden is approximately constant.
Where burden is the resistance of the load which one can put on the secondary of the CT.
This constant may be called the "accuracy quality factor" K of the winding.

$$K = \frac{100 * A}{P}$$

Where,
A = accuracy class
P = rated burden in VA

Hence, maintaining a higher accuracy quality factor we provide CTs which have a small burden of 0.2VA.

Another challenge which we generally come across in handling current transformers is its secondary winding voltage during open circuit.
Due to the relatively large (5A) current requirement, CTs require a larger , heavier core and a larger cross section wire. This translates to a larger, heavier final product and high costs. Moreover, these CTs can be extremely dangerous because of large voltages induced when CT secondaries are not shorted. Causing large arcing across open secondary wires.
To mitigate this we engineer safety plug-in shorting links to ensure that the CT remain shorted, even if disconnected from the meter.

Fig.3. Safety plug-in shorting link.

Areas of Application:

The safe, low VA burden and click fit split core CT makes it very convenient to use in retrofit applications without disconnecting any cable.

This saves down-time period and revenue loss which would occur due to shut down of plant during installation of CT.

In modular panels, distribution boards, automation systems this type of CTs are ideally suited.

1). Power System Analysis:

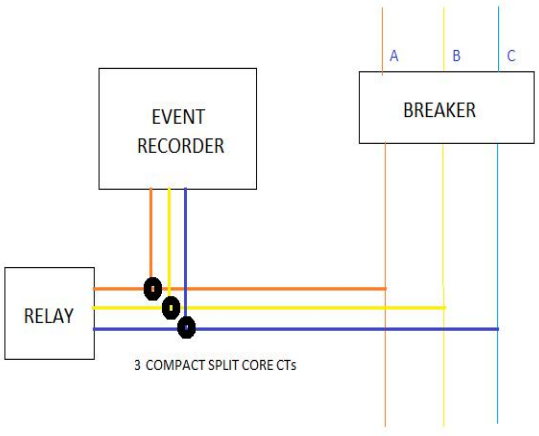

Fig.4. Power System Analysis

Power system analysis is an analytical method in which the electrical power system is studied in order to find the values of current on which depends the design of protection system.

It generally consists of Load flow analysis, stability studies and short circuit studies. These are generally achieved through software. After the implementation of the derived parameters for protection, the system parameter check can be done using event recorders which would measure current of relays and breakers via compact split core CTs.

This helps in verifying relay and breaker performance.

To mention, this CT is a metering CT and can be used only for measuring & monitoring and not for protection purpose.

2). Automating Electro-mechanical relays :

A low cost upgradation automation solution in substations for an electro-mechanical relay is using SCADA.

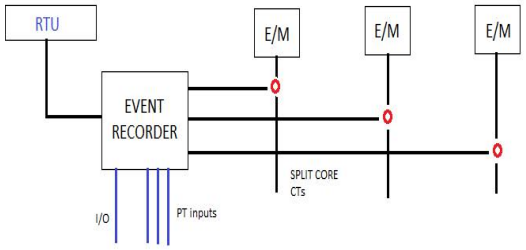

Fig.5. Automating E/M Relays

Measuring and reporting SCADA data to RTUs, includes measurement of parameters like RMS voltage, current, power factor, calculating peak fault currents and report to SCADA.

For such applications split core CTs are compatible eliminating outages and maintains high measurement accuracy.

Thus, RISH Compact Split Core CT has all the features required in a metering CT. Plus its compact size and openable core makes installation easier and haste-free, suitable for almost every application.