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# A Novel Method to Avoid Pilferage from Overhead Distribution System

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**Abstract**: This paper presents a novel method to use the current transformers with a comparator and communication systems to serve against the pilferage of electricity from the overhead transmission lines. The block diagram representation has been used for the lucid demonstration of the complete process. Also, a practical example has been discussed to substantiate and validate the research.

**Keywords:** Pilferage, Current Transformers (CT's)

## Introduction

Recent increase in demand for power far outpaces the investment in the new transmission and distribution infrastructure. Optimal operation of the aging electrical infrastructure is thus a priority. In a deregulated environment, optimal operation is about maximizing profits while minimizing business risks. This implies that electrical equipment, such as generators, transformers, transmission lines, etc. could be treated as consumables, thereby enabling operation in a planned manner that allows the maximization of profits [1].

The utilities have been grappling with issues such as astronomically high aggregated technical & commercial losses which result from inefficient metering, billing and pilferage of electricity and due to inefficient use of electricity in several sectors such as agriculture. Improving the financial health of utilities requires urgent measures at the user-end (demand side) i.e. in the power distribution. The demand also needs to be managed efficiently to bridge the huge gap between demand and supply. Reducing demand and consumption can reduce the stress on the generation and T&D systems at a fractional cost compared to the investment required to augment capacity [2]. This problem can be solved to an extent if the novel method of using current transformers along with communication systems and comparator, (as proposed by the paper) is used.

Current transformers (CT's) [3] are used in electrical grids for measurement and protective applications to provide signals to equipment such as meters and protective relays by stepping down the current of that system to measurable values. Their role in electrical systems is of primary importance because the data sent by current transformers represent the heartbeat of the entire system [4]-[6]. CT's are needed for supplying the comparator with the specific value of current flowing in the transmission line which is compared with the reference value of the current and the communication system issues a signal to the substation as soon as the value of non-concordance crosses the marginal limit.

## Mechanism

### A. Construction & Mechanism

As the electricity pilferage has been one of the major curses for the overhead transmission systems, it has been costing heavily since last many decades; this method provides a novel method to tackle this very problem.

A current transformer (CT) is placed on either side of the pole of 11kV transmission line. The CT will be assisted with a comparator and communication systems. Each pole supplies a definite number of loads. CTs will also be mounted on every load supplying wire. By this the total value of current drawn from a particular phase ($I_{PT}$) is determined; this value can be subtracted from the value of current coming from behind ($I_{B1}$) to get the value of current in the transmission line ahead ($I_R$). This calculation process will be done by a subtractor circuit and will be continuous. This will serve as the reference input to the comparator. Further the CT of the succeeding pole will persistently communicate the value of current received ($I_{B2}$) by it to the adder. A marginal drop in the value of current can be considered on account of stray losses or external disturbances. Let its value be $I_M$ (marginal current). The value of $I_{B2}$ and $I_M$ is added using an adder circuit. This added value is communicated back to the previous pole with the help of communication system (3) and (1). The comparator will be operated in a mode such that it will give a '0' in output until the reference value of current is equal to the value of current in the line ahead and will give '1' in the output when the reference value will be greater than the value of current in the line ahead.

i.e. Comparator output $= 0, when\ I_R \leq (I_{B2} + I_M)$ &
$= 1, when\ I_R > (I_{B2} + I_M)$

As soon as $I_R > (I_{B2} + I_M)$ the comparator produces '1'as output which sets the D-flip-flop and hence activates the communication system (2) to respond. The communication system (2) will communicate to the communication system (4) installed over the transformer, which will further acknowledge this to the substation. Also, it will be quite easy to figure out the particular location where this activity of pilferage is being practiced.

## B. Block Diagram Representation

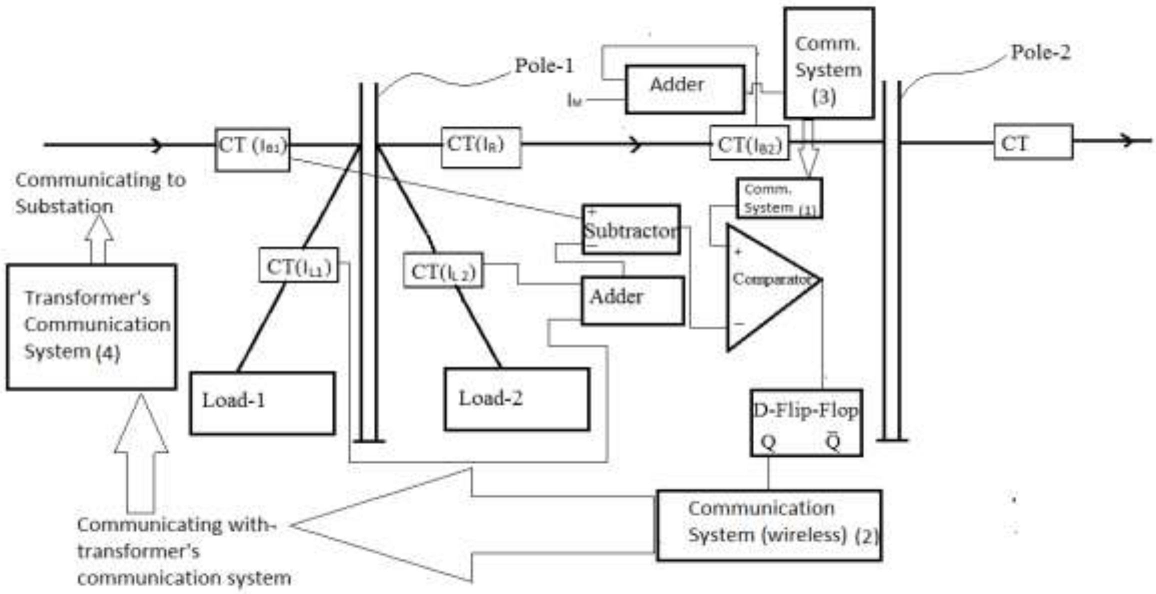


Fig.: Block diagram representation of the protective system for one phase

### Communication Systems

The communication system (1) & (2) can be radio frequency communication; as the distance between the two poles is not much. The communication system (3) must be a system which must cover a long distance as the location of pilferage is not known. It can be close to the transformer and even very far away from the same. The communication system (4) must be able to communicate for very long distances as the substation would naturally be much far away from the distribution transformer.

### Analysis and Verification

If a 250kVA transformer supplies an area at 250V, then

$$I_{B1} = \frac{250 \times 10^3}{250} = 1kA$$

If there are two loads; of 1kW and 2kW of 0.8 p.f. at 250V, both on the considered pole, we have

$$I_{L1} = \frac{1000}{0.8 \times 250} = 5A$$

$$I_{L2} = \frac{2000}{0.8 \times 250} = 10A$$

So, $I_{B2} = I_{B1} - (I_{L1} + I_{L2})$

$$I_{B2} = 1000 - (5 + 10) = 985A$$

This value serves as the reference. The actual value of IB2 is sensed by the CT at the next pole and value equal to (IB2 + IM) is communicated back by the communication system installed over the same. This value is compared with the reference value by a comparator which sets the flip-flop as soon as the reference shoots above the level of the communicated value. This flip-flop in turn activates the communication system (2) which reports the transformer about the discrepancy which further communicates the same to the substation.

### Conclusion/Results

This novel method will surely be a landmark against the pilferage activities, if implemented. This would save both life and property as the probability of fault occurrence as well as destruction of electrical equipments; both would reduce by a great extent.

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