

COMPOSITE ERROR, EFFECT OF PHASE DISPLACEMENT

2. HARMONICS ON C.T. RATIO

TRANSFORMER VOLTAGE EQUATION

$$E_1 = 4.44 f \phi_1 T_{P_1}$$

E_1 = PRIMARY VOLTAGE / ph

f = FREQUENCY

ϕ_1 = FLUX (PRIMARY)

T_{P_1} = PRIMARY TURN / ph

$$E_2 = 4.44 f \phi_2 T_{P_2}$$

$$\frac{E_1}{E_2} = \frac{I_{P1}}{I_{P2}} = \frac{I_2}{I_1} = \underline{\underline{P.T. RATIO}} \quad (\phi_1 = \phi_2)$$

for PT 2
POWER TRANSFORMER

$$\frac{\phi_1}{\phi_2} = \frac{I_{P1}}{I_{P2}} = \frac{I_2}{I_1} = \underline{\underline{CT RATIO}} \quad (\phi_1 \neq \phi_2)$$

for C.T

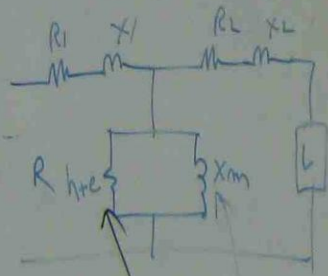
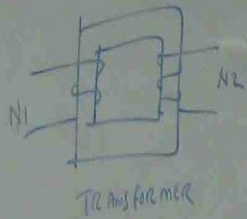
IN CT CHANGE IN
SECONDARY MAGNETIC FLUX \rightarrow COMPOSITE
CAN EFFECT C.T RATIO ERROR

BECAUSE OF COMPOSITE ERROR, CT RATIO
RATIO CAN BE CHANGED CAUSING WRONG
OPERATION OF RELAY SYSTEM.

SOLE FLUX SATURATION,
HARMONIC CAN
CAUSE COMPOSITE
ERROR

HARMONIC FILTER
TO AVOID HARMONIC

EFFECT OF MAGNETIZING AND HYSTERESIS LOSS ON CT RATIO

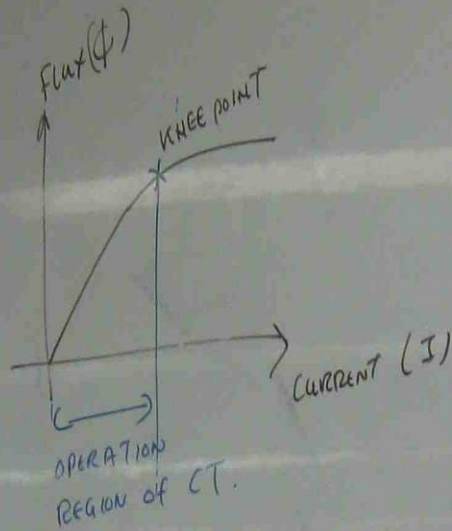


h-Hysteresis

e-EDDY CURRENT

MAGNETIZING

EDDY CURRENT & HYSTERESIS LOSS
IS NOT A PROBLEM FOR POWER TRANSFORMER
BUT IN CT, IT CAN CAUSE THE WRONG OPERATION.



FOR ACCURATE OPERATION, CT MUST
OPERATE WITHIN OPERATING REGION

THE CURRENT HIGHER & BEYOND THE
OPERATION REGION CAN CAUSE THE
WRONG OPERATION OF CT.

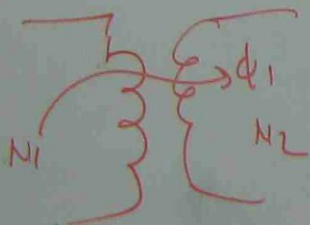
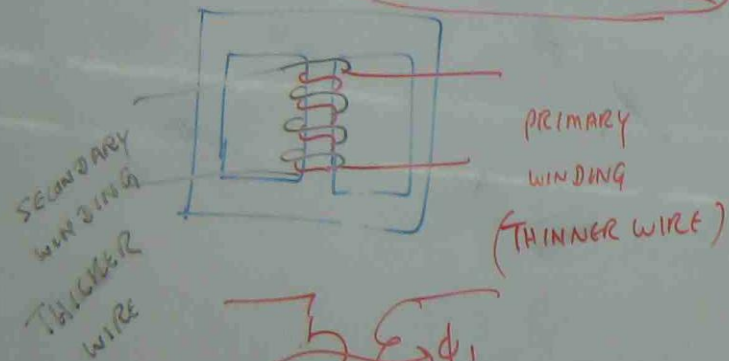
CT CORE MATERIAL

NICKLE IRON CORE CAN GIVE
THE ACCURACY UP TO 10 TO
15 TIME RATED CURRENT.

APPLICATION OF BALANCING WINDING IN CT

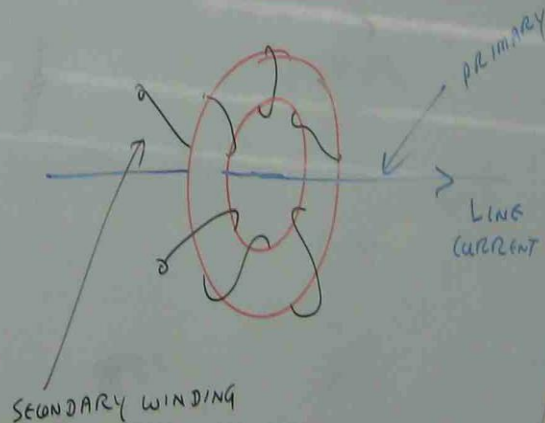
MAGNETIC COUPLING

POWER TRANSFORMER



Flux is closely
LINKED.

CURRENT TRANSFORMER

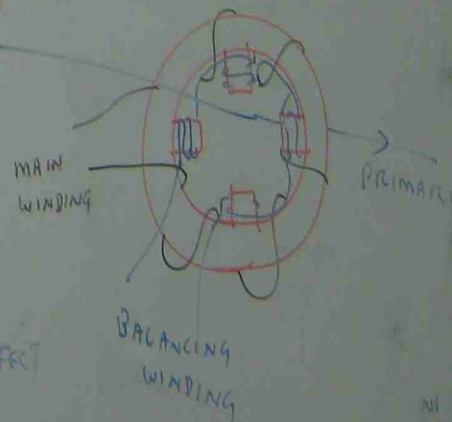


Flux is VERY loosely
LINKED

Flux LEAKAGE EFFECT
↓
ERROR

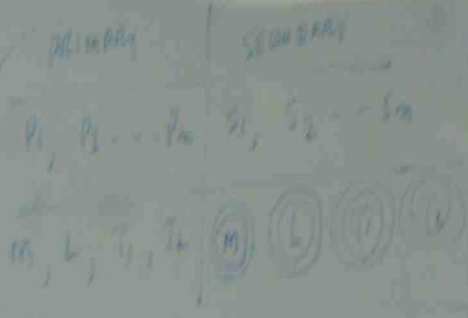
TO REDUCE THE ERROR, LEAKAGE
FLUX NEEDS TO BE REDUCED.

BALANCING WINDING IS
INTEGRATED IN CT TO
REDUCE THE LEAKAGE FLUX

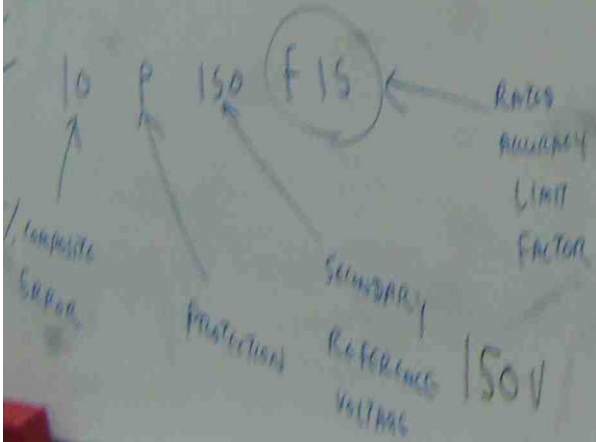


CLASSIFICATION OF CTS

TERMINAL MARKING



INTERPRETING CT



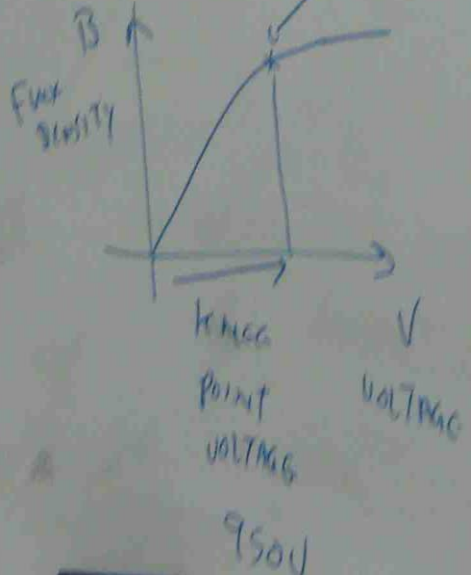
$$\% \text{ Composite Error} = \frac{I_e \times 100}{I_s \times K}$$

I_e = SECONDARY EXCITING CURRENT (RMS)

I_s = RATED SECONDARY CURRENT

K = RATED ACCURACY LIMIT FACTOR

0.05
PL 950
PRECISE
KNEE POINT VOLTAGE
KNEE POINT VOLTAGE
SECONDARY WINDING RESISTANCE
3% AT 75°C
 R_{35}



PL - PRECISE

PS - SPECIFIC PURPOSE

TUTORIAL (7)

WHAT IS PROTECTIVE TRANSFORMER?

PROTECTIVE TRANSFORMERS ARE PT- POTENTIAL TRANSFORMER AND CT- CURRENT TRANSFORMERS. THEY ARE UTILIZED TO REDUCE THE SYSTEM LEVEL HIGH VOLTAGE AND CURRENT TO RELAY AND INSTRUMENT LEVEL LOW VOLTAGE AND CURRENT.

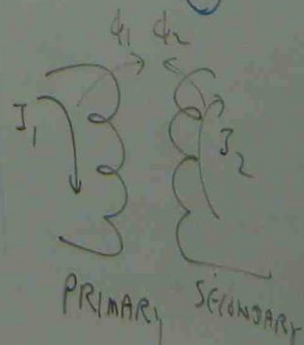
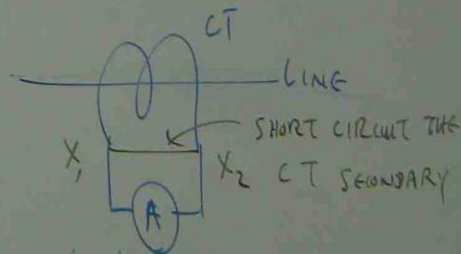
TUTORIAL (8)

Q1. FOR WHAT REASON THE BALANCING WINDING IS INSERTED TO CT SECONDARY WINDING?

IN C.T PRIMARY AND SECONDARY WINDINGS ARE LOOSELY COUPLED CAUSING HIGH FLUX LEAKAGE. HIGH FLUX LEAKAGE CAN CAUSE THE ERROR THAT THE SECONDARY CURRENT IS NOT PROPORTIONAL TO PRIMARY CURRENT. THE RELAY OPERATION BASED ON C.T RATIO CAN BE WRONG.

TO COMPENSATE THE LEAKAGE FLUX, THE BALANCING WINDING IS INSERTED IN CT.

Q2 IF YOU ARE REQUIRED TO REPAIR THE MEASURING INSTRUMENT WHICH IS CONNECTED TO SECONDARY SIDE OF A CURRENT TRANSFORMER, WHAT WILL YOU DO AFTER HAVING DONE SWITCHING OFF / TAGGING AND LOCKING?



WINDING
AFTER HAVING DONE SWITCHING OFF AND LOCKING, THE

CT SECONDARY MUST BE FIRSTLY SHORT CIRCUITED
BEFORE REMOVAL OF ANY INSTRUMENT CONNECTED
TO C-T SECONDARY.

TO
R,
NG
IF C.T SECONDARY TERMINALS ARE NOT SHORT
CIRCUITED, THERE IS NO FLUX IN SECONDARY OF
CT TO OPPOSE THE C-T PRIMARY FLUX
AND HIGH VOLTAGE CAN OCCUR AT C-T SECONDARY

TUTORIAL (9)

Q1. FIND THE FOLLOWING VALUES FOR GIVEN TWO CTS.

CT1 -- 20 P 250 F 30

RATED ACCURACY LIMITING FACTOR? — 30

SECONDARY REFERENCE VOLTAGE? — 250V

WHAT KIND OF CT? — P — PROTECTION

% COMPOSITE FACTOR — 20%

CT2 --- 0.07 PL 850 RS

SECONDARY EXCITING AMPERE? — 0.07 AMP.

WHAT KIND OF CT? — PL — PRECISION

KNEE POINT VOLTAGE — 850V

WHAT DOES RS MEAN? — SECONDARY WINDING
RESISTANCE 5% AT
75°C

