INADVERTENT TRIPPING OF POWER SYSTEM DUE TO MAGNETIZING INRUSH CURRENTS

Manoj Kumar Khare, R.C. Agarawal, M. L. Jain
EMCO Limited, Thane, Maharastra

Effect of Design Parameters

No of phases and winding connection

Size of transformer

Core Material

Core Geometry

Design Induction

Type of Core Joint

NO OF PHASES & WINDING CONNECTION

nrush current in 3 phase transformer is equal to or less than 1 phase

ransformer depending upon winding connection -

Delta, Star, Grounded Star, Auto etc.

Winding connection combination of energised and secondary winding

TRANSFORMER SIZE

Generally Inrush to/rated current ratio is lower for large MVA

Time Constatnt for Inrush Curent is large for Large MVA

CORE STEEL MATERIAL

- **HiB material have lower remenance, but slightly higher saturation level compared to RGO Material.**
- **Thus HiB material are associated with lower peak inrush currents and higher minimum %2nd harmonic/peak ration**

CORE GEOMETRY

- **Affect core remenance**
- **Affects the magnetic field distribution in the core, which hence affect the core air inductance**

DESIGN INDUCTANCE

Peak inrush increases with with inductance

Min %2nd harmonic /peak decreases with inductance

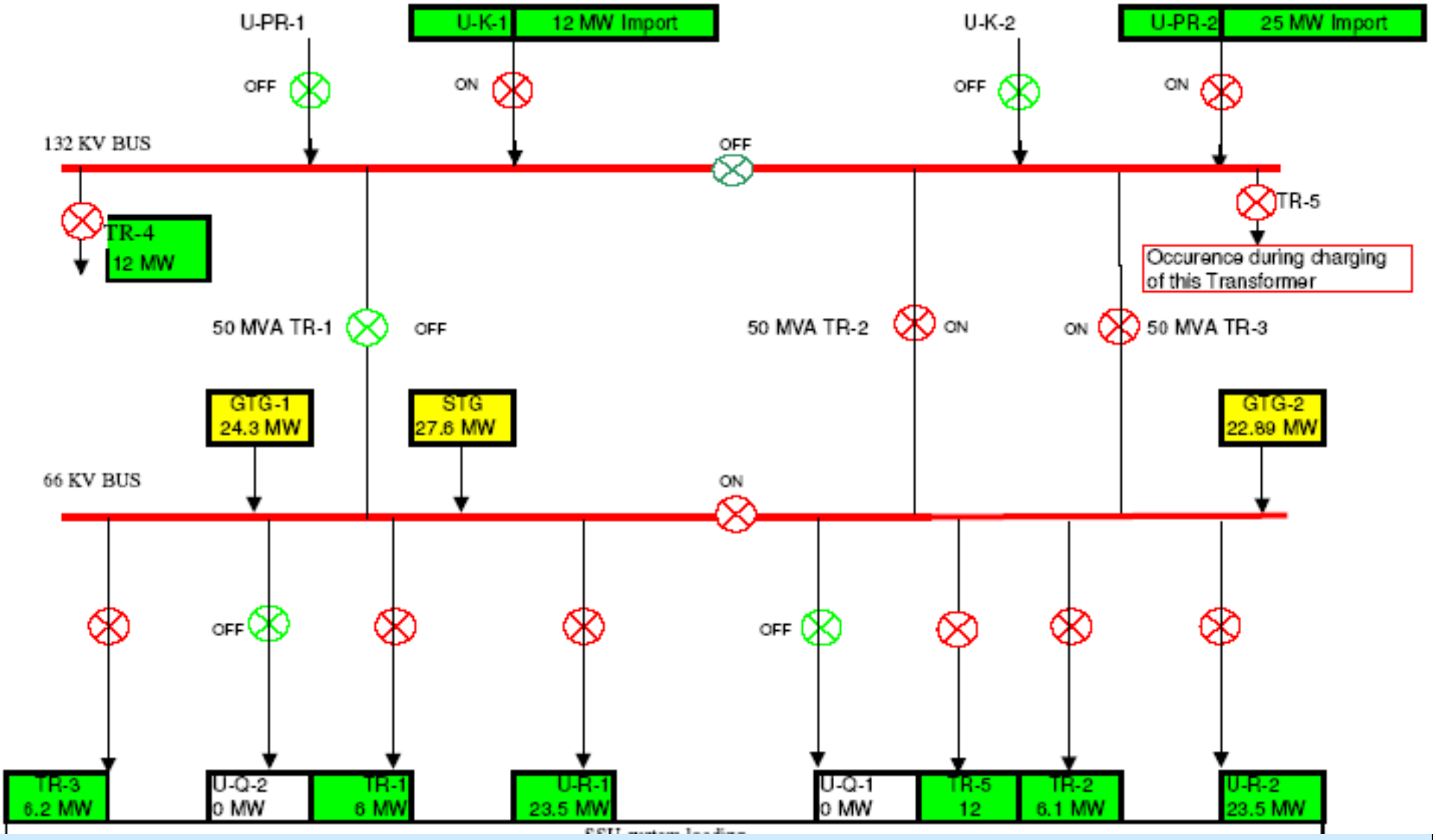
CORE JOINT TYPE

•Transformer Core has lower remenance than material of the core because of high reluctance of the joint.

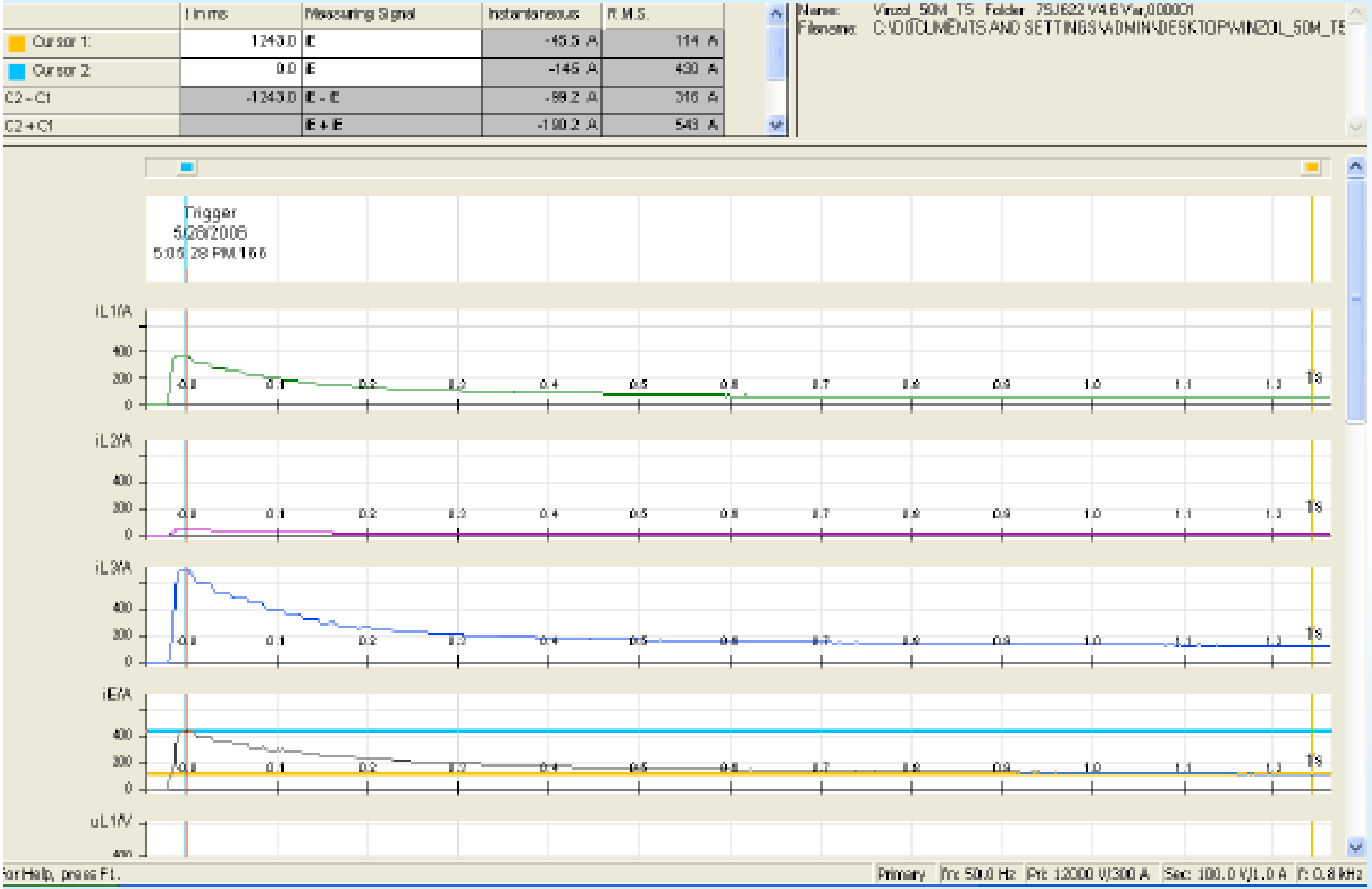
•Non step lap core has slightly lower peak inrush current than the step lap core

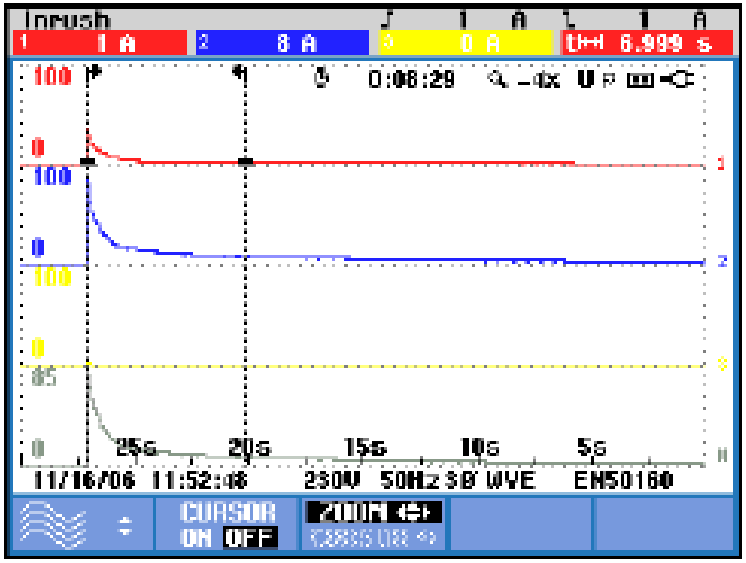
CASE STUDY

RATING	**:**	**50 MVA**
VOLTAGE	**:**	**132/33 kV**
TYPE	**:**	**SYSTEM TRANSFORMER**
TRIPING	**:**	**ON EARTH FAULT**

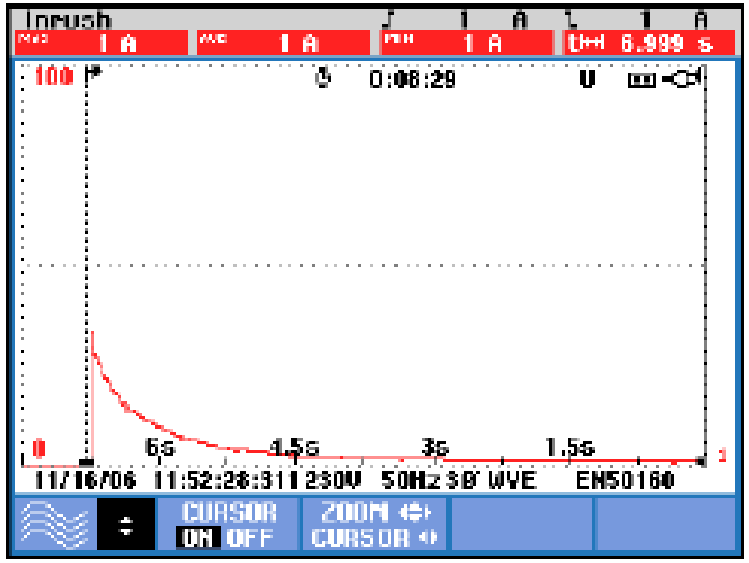

U-PR-1
U-K-1
12 MW Import
U-K-2
U-PR-2
25 MW Import
OFF
ON
OFF
ON
132 KV BUS
OFF
TR-5
TR-4
12 MW
Occurence during charging
of this Transformer
50 MVA TR-1
OFF
50 MVA TR-2
ON
ON
50 MVA TR-3
GTG-1
24.3 MW
STG
27.6 MW
GTG-2
22.89 MW
66 KV BUS
ON
OFF
OFF
TR-3
6.2 MW
U-Q-2
0 MW
TR-1
6 MW
U-R-1
23.5 MW
U-Q-1
0 MW
TR-5
12
TR-2
6.1 MW
U-R-2
23.5 MW

CASE STUDY

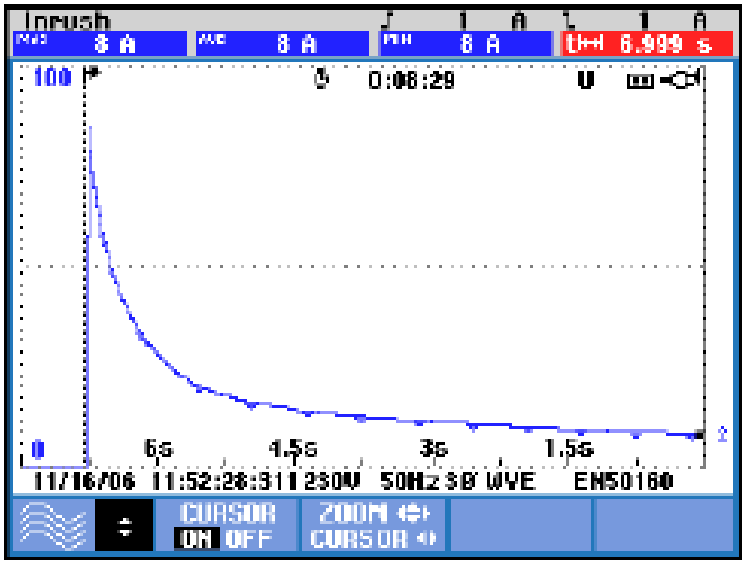

t in ms
Measuring Signal
Instantaneous
R.M.S.
Cursor 1:
1243.0
iE
-45.5 A
114 A
Cursor 2:
0.0
iE
-145 A
430 A
C2 - C1
-1243.0
iE - iE
-99.2 A
316 A
C2 + C1
iE + iE
-190.2 A
543 A
Name:
Filename:
Trigger
5/26/2006
iL1/A
iL2/A
iL3/A
iE/A
uL1/V
Primary
fn: 50.0 Hz
Pri: 12000 V/300 A
Sec: 100.0 V/1.0 A
fs: 0.8 kHz



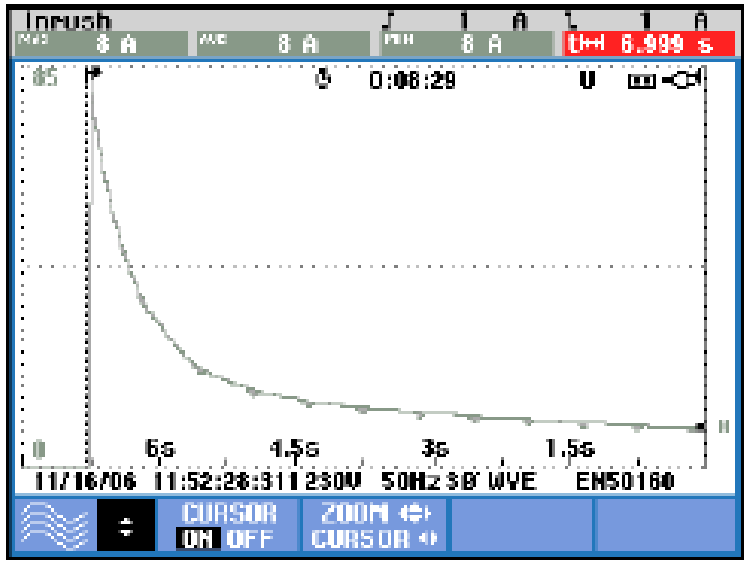
phase and neutral current



r-phase current



b-phase current



neutral current

ANLYSIS

Description	Inrush (Calculated)	Recorded while tripping of CCPP	Recorded while testing
Magnitude I_L(Peak)	2233.9 A	700 A	575 A
Magnitude IN(Peak)Less than	2233.9A	430A	1175A
Max Time duration	--	1.2 sec	14.4 sec

ANLYSIS

Two autotransformers were also connected next to the transformer under investigation. Whenever the transformer was switched on, the major portion of dc transient current of this transformer would tend to return through the other two auto transformers, rather than going through the high resistance path of supply lines. This would cause saturation of the core of the nearest autotransformers. Under this condition, the duration of inrush current was increasing manifold due to combined effect of transformer & system on time constant.


Thank You