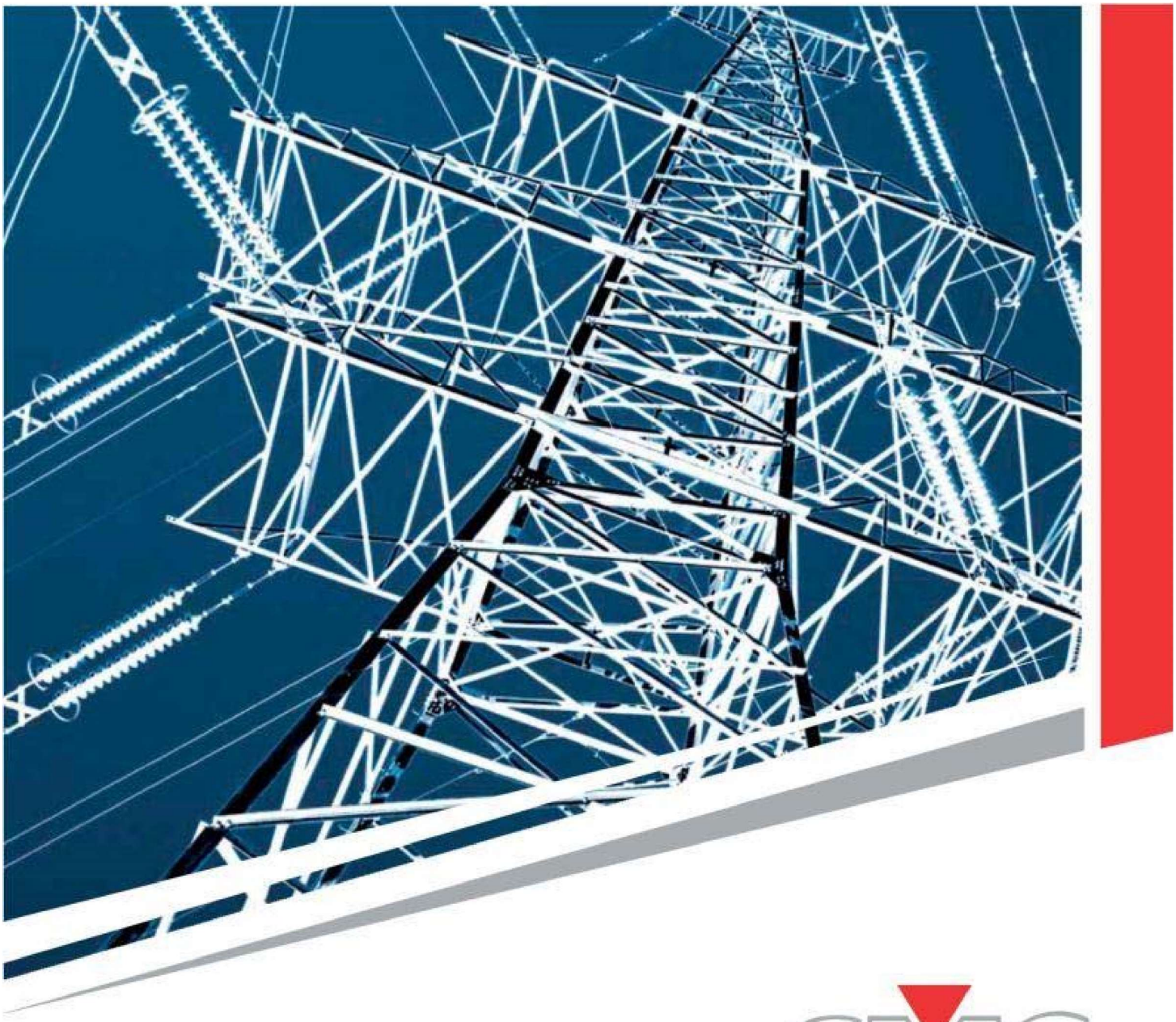
RAPTOR: Passing current through an 84 MVA transformer



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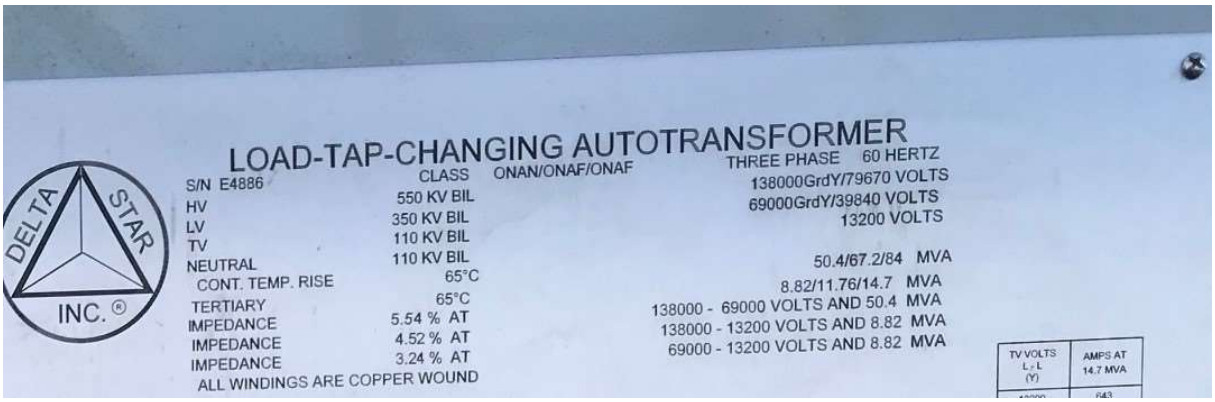
Raptor – Passing current through an 84 MVA transformer

This document describes how to utilize the flexibility of the Raptor System to pass enough current through a large transformer that secondary currents can be read from the relays monitoring the system. It is desirable to do this when the substation is commissioned or anytime the transformer is serviced. The test checks polarity and ratio of the CTs in the circuit. KAMO Power, of Vinita, OK, does this test now using a phantom load box to generate the current. This method limits the amount of current and the length of time they can apply the current because of the limitations of the load box. KAMO Power came to us with the challenge of being able to pass at least 20 amps single phase through the transformer. A test like this can be done single or three phase with each method having pros and cons. Since KAMO's chosen method of test is single phase and there was no desire to change, a single phase C-15 was chosen for this challenge over a three phase TriRaptor. Either test set would be able to accomplish this with adjustments to the wiring harness used for this test.

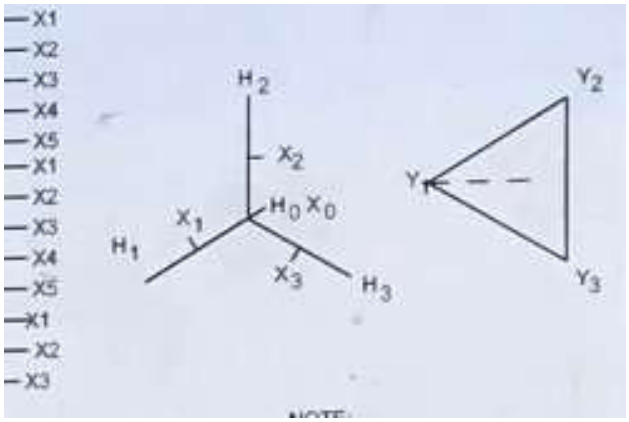


Transformer Nameplate

The set up:

KAMO's connection for their test was the following:

H1, H2 and H3 tied together.
X0 and H0 tied together
Raptor current (Io) passing from H3 to X3.



The Raptor setup above consisted of five wire harnesses of 5-10gauge wires wrapped 4 times through the Raptors for a total of 100 turns. Because the HH would not allow an entry of 100 turns I disconnected one turn to get a total of 99 turns. The white wire hanging loose is the disconnected turn.
Voltage measurement leads connected to V2 were used to measure the voltage drop across the windings of the transformer. A separate ammeter was used to measure the secondary current from the transformer CT. Impedance was calculated using Io, V2 and the phase angle between them.

The Test:

The output leads (Io) from the from the Raptor were connected to X3 and H3. V2 leads were connected to the same place. 20 amps was applied to the transformer. The HH picture below shows the test in progress.

V2 = 75.2 volts
Io = 20 amps
Deg = 84.9
Z = 3.76 ohms

I temporarily increased the current to 50amps without a problem as far as the Raptor was concerned but I did not want to stress the wires.

By calculation this test at 20 amps could have been done with a Raptor MS only. It would also be possible to get even more current with smaller gauge wire and more turns.
A TriRaptor would also work for a three phase test with these connections.

KAMO personnel verified all readings by measuring the secondary current and confirming the correct values for the 1200:5 ratio of the CTs.

The same test was done again with the following connections:

Current passed through H3 to X3 with no other jumpers on the windings. This is the highest impedance combination.

The test results were as follows:

V2 = 236.4 volts
Io = 6 amps
Deg = 86.5
Z = 39.4 ohms

Six amps was the max I could apply with 99 turns. I could pass more with smaller gauge wire and more turns.

By calculation this test at 6 amps could have been done with a Raptor MS only. It would have required ~200 turns with the same setup and smaller gauge wire. That means that a TriRaptor would also work for a three phase test with these connections.

Conclusion:

The enormous flexibility of the through hole technology of the Raptor system makes it very feasible to pass current through a large transformer with either the single phase Raptor system or the TriRaptor. The way this test has to be done is with wiring harnesses that make it possible to create very long single cable multiturn configurations. The harness system allows a varying number of turns in a very short period of time vs the very tedious method of turning a very long single cable 200 times or more.

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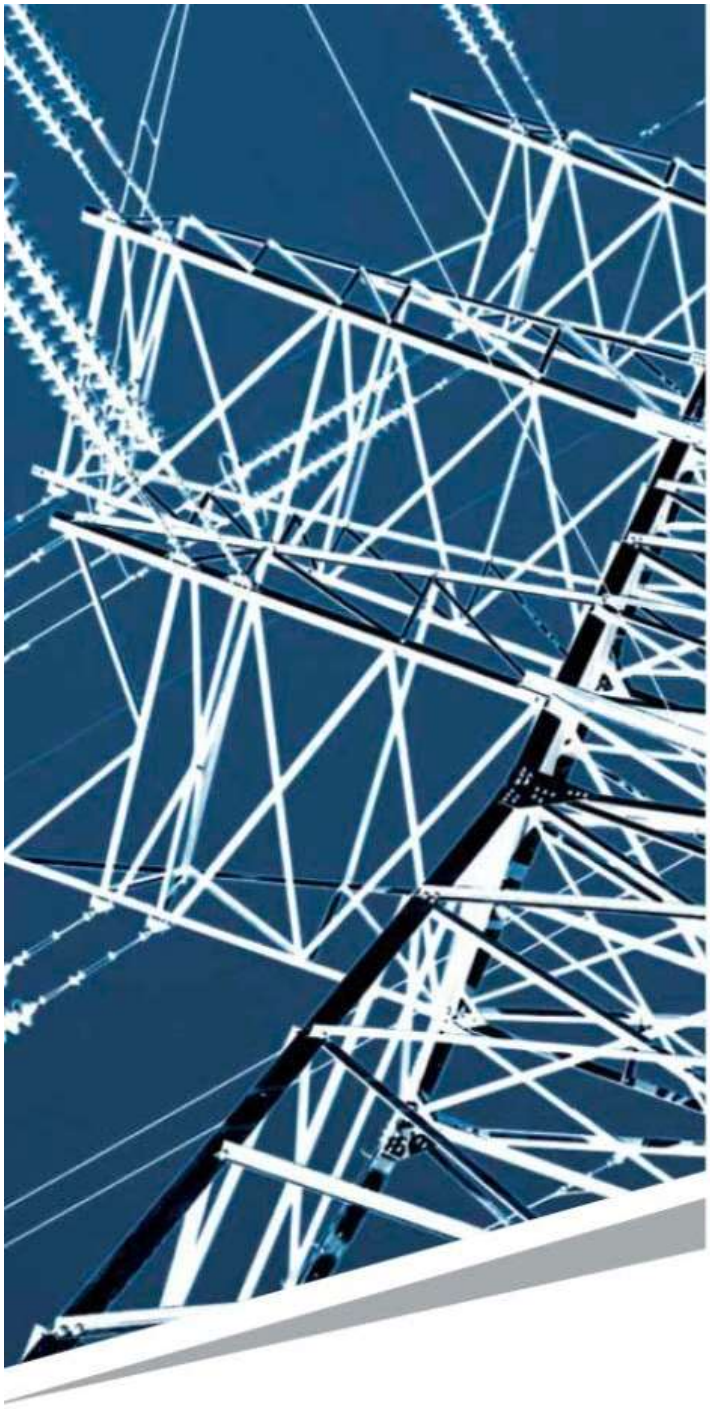

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