

# Discussion of Economics of a Transformer Designed with a Low Current LTC and Series Transformer Verses a High Current LTC and No Series Transformer

By Steve Moore, SPX Transformer Solutions, Inc.

## EXECUTIVE SUMMARY: ECONOMICS & BENEFITS OF LOW CURRENT LTC

It has been demonstrated that Low Current Load Tap Changer technology can yield significant benefit over high Current Load Tap Changer Technology. A transformer designed with a low current LTC and a series transformer can yield a total lower cost design while enhancing performance. Following are the key finding of the Study performed on a 600 Amps Low Current LTC vs. 2500 Amps high current LTC:

KEY FINDING	600 AMPS RESISTANCE BRIDGING	2500 AMPS REACTANCE BRIDGING
Energy Switched: $I^2T$ ( $A^2sec$ )	375 $A^2sec$	37,500 $A^2sec$
Contact Erosion	Lower	Higher (Minimized if Vacuum Interrupter is used)
Carbon Particles Produced	Low	High (Low if Vacuum Interrupter is used)
Technology Application	Arcing in Oil	Arcing in Vacuum
Bridging Impedance Device used to limit the circulating current	Resistor	Reactor (Preventative Auto)
MVA Rating of Series Transformer	10% of Max Name plate MVA of Transformer	10% of Max Name plate MVA of Transformer
Bridging Impedance-Resistor or PA	Resistor=step voltage / through current	0.625 % of Max Name plate MVA of Transformer
Rating of the Cable connecting Tap changer to Regulating/Tap winding	600 Amps Max	2500 Amps
Total Current passing through these Cable	250 A x 16 loops = 4,000 Amps	2,500 A x 8 loops = 20,000 amps
Size & Length of the Cable Run	Smaller Diameter & shorter run (LTC in seg. 1)	Larger Diameter & Longer run (LTC in seg. 2 or 4)
Resultant Flux Field, Induced Eddy Current, Heat & Load Losses in the core clamps & Tank wall based on the Cable Current	Low	High
Production/Assembly	Much easier	Cumbersome
Cost of cable	Say \$ 5000.00	Up to 10X higher depending on transformer Current
Weight of total Cable	Say 2000 LBS	Up to 10X higher depending on transformer Current
Support Structure needed for Cables	Say 500 LBS	Up to 5,000 LBS
Time consumed for Cutting, Routing, Crimping & wrapping Cables to & from LTC Terminal Board	Say 36 hours	360 hours
Labor Cost to install on unit	\$ 10,000.00	\$ 100,000.00
Regulating winding Diameter	Smaller (due to 600 Amps max)	Larger (4.17 times larger Cross sectional Area due to 2500A)
Resultant HV & LV winding diameter	smaller	Larger
Radial Real Estate cost	Say \$ 1000/mm	\$ 1,000/mm x 10 mm = \$ 10,000.00 more
RV Winding turns can be optimized by	Changing Series Transformer Turns ratio	Are function of Main Core & Coil Volts/Turn
Step Voltage	Can achieve even step voltage at all tap positions	One or more steps could be uneven Step Voltages
Contact Life Improvement	Adjusting the Turns Ration of Series Transformer can reduce the line current & increase the Contact Life.	Adjusting the Turns Ration of Series Transformer can reduce the line current & increase the Contact Life.
Sound Level	Lowest at Neutral, increasing to highest at tap extremes due to energization of series transformer core.	High on odd taps with little chance to reduce due to gapped core design of preventative Auto. Higher if series transformer is also used