Design Confirmation: Capability of Ritz Standard Design Voltage Transformers for Steep-Front Very Fast Transient Over-Voltages (VFTO)

Ritz standard design Voltage Transformers successfully withstand the negative impacts of very fast steep wave transient overvoltages on the transformer caused by typical vacuum recloser operations in DER (Distributed Energy Resources) and DA (Distribution Automation) applications.

Utilities are developing renewable and distributed generation sources as a larger percentage of their total electric generation portfolio. Wind energy, solar energy and battery-storage are part of this developing portfolio. Additionaly, electronic controlled vaccum switching reclosers are increasingly utilized for targeted reliability improvements as part of utilities' distribution system automation progams.

For the interconnection of these renewable sources to the local distribution system, the host utility typically utilizes standard circuit protection devices and revenue metering components (medium voltage rated current and voltage transformers). In recent years, medium voltage distribution circuit protection devices (reclosers) have shifted from oil-insulated hydraulic operated reclosers to solid dielectric vacuum switching electronic controlled reclosers. Benefits of vacuum switching technology in these reclosers are their capability to handle frequent operations, to perform opening-reclosing operations in milli-seconds, and for improved circuit-fuse coordination (using programmable electronic relay devices).

Switching overvoltages generated by vacuum based switching device used in reclosers.
The operation of vacuum switches and disconnect switches, introduces very-fast transient over-voltage (VFTO) onto the connected system. The severity of these transients are magnified by characteristics from the vacuum contacts switching 1) current chopping on contact opening, and 2) pre-strike or re-ignition on contact closing.

Ritz standard voltage transformers withstand these very-fast transient over-voltage (VFTO) conditions.
Outdoor medium-voltage transformers designed, produced and tested (in accordance to IEEE C57.13) for utility distribution voltages passed VFTO type transients as referenced from Clause 6, CAN/CSA-411.1, and exceeded these testing parameters by completing 50% more cycles with respect to the number of positive and negative steep-front VFTO impulse applications, with no internal failures or external flashovers.

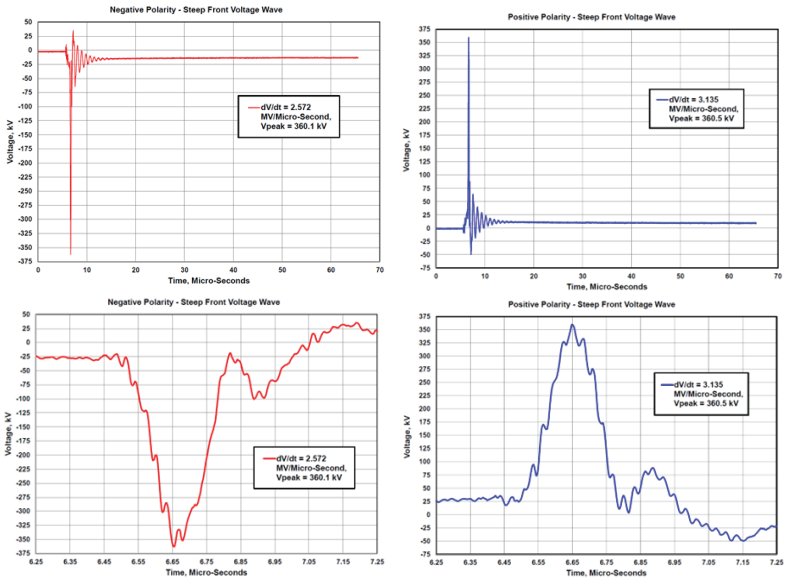
Test Sequence for Confirmation of Design Capability

1) standard design and manufacture processes for unit types VEF15-09, VEF25-10 and VEF36-10
2) routine dielectric and accuracy testing according to IEEE C57.13-2016
3) VFTO withstand capability testing for verification to CAN/CSA 411.1 standard [2], clause 6.6
4) routine dielectric and accuracy testing according to IEEE C57.13-2016

- Ritz factory location in Lavonia GA USA for sequence 1, 2 and 4
- JMX High Voltage Lab in Atlanta GA USA for sequence 3

Test Parameters accordance to IEEE C57.13-2016 and CAN/CSA 411.1

Ritz - voltage transformer rating and design per IEEE C57.13-2016						VFTO Test Voltage 1		VFTO Test Voltage 2	
Unit Type	Voltage Class	PFWV	BIL	Accuracy Burden	Thermal Burden	Peak	Waveshape	Peak	Waveshape
VEF15-09	15.5kV	34kV	110kV	0.3WXY	1000VA	85kV	1.2µs X 50 µs	190kV	≥ 2.5MV / µs
VEF25-10	25.5kV	50kV	150kV	0.3WXYZ	2000VA	85kV	1.2µs X 50 µs	270kV	≥ 2.5MV / µs
VEF36-10	36.5kV	70kV	200kV	0.3WXY	1300VA	100kV	1.2µs X 50 µs	360kV	≥ 2.5MV / µs



Typical Negative and Positive Wave Shape for VFTO Test Voltage 2

Tests Required	Number of Impulses Applied	Peak Voltage	Polarity	Tests Completed & Passed
10 Negative & Positive Impulses	1	Test 1	Negative	15 Negative & Positive Impulses
	5	Test 2	Negative	
	1	Test 1	Positive	
	5	Test 2	Positive	
	1	Test 1	Negative	
	5	Test 2	Negative	
	1	Test 1	Positive	
	5	Test 2	Positive	
	1	Test 1	Negative	
	5	Test 2	Negative	
	1	Test 1	Positive	
	5	Test 2	Positive	