VECTOR GROUP TESTING OF THREE TRANSFORMERS AND SIMULATION OF RESULTS ON SUMILINK

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Abstract: - Vector group testing is done to ensure the parallel operation of three phase transformer connected in the power system. There are various ways of connecting three phase transformers with phase shift of 0^0,$\pm30^0$ and 180^0.This phase shift is due to different ways for connecting the primary and secondary windings of the transformer. To connect the various transformer, the secondary waveform should be same for all the transformer otherwise a large circulating current will flow in system that may cause short circuit. To simulate the results, the Simulink from MATLAB software is used.

INTRODUCTION

As the need of good quality power is increasing exponentially in vast country like India, we need to produce a huge amount of energy to meet the need of the consumers. To have the output power in synchronism with all the other system we shall connect the transformers in parallel to avoid circulating current. Circulating current causes instability in the system. When three phase transformers shares a common load, connected to more than one transformer and the phase shift between the secondary of both the transformers have zero phase shift, then it is said paralleling. In three phase transformers, phase bushing are marked as ABC, UVW or RYB

SELECTION OF VECTOR GROUP

1. Harmonic Mitigation: Vector group of transformers depends upon removal of harmonics present in it. 3rd harmonics can be nullified by y-connection in Dy connection so as to prevent it from reflecting on the delta side.

2. Parallel operations: For parallel operations the transformers should have same vector group & same polarity of the winding.

3. Earth fault Relay: The use of inter connected star wound transformer to create a neutral along with the earth fault relay. Earth fault can't be restricted by delta-delta transformer.

4. Type of Non-Liner Load: We can use Dyn11, configurations for systems having different types of harmonics or for nonlinear types of loads, for example VFD's, furnace heaters, etc. Also the 3rd harmonics in the supply system are nullified by the 30 deg. phase shifts of voltages.

5. Transformer Application: The generating side of power transformer is generally connected in delta whereas star connection is made on load side. Star-star is commonly used, as it saves neutral insulation and eliminates grounding transformer, in transmission purpose transformers. This configuration is used in most of the systems. For all unit connected generators, Yd or Dy connection is considered as standard connections.

Factors useful in designing a system, are many in number, that are associated with the transformer connections. And so the best selection of the transformer connections are determined by the application of these factors.

CIRCUIT DESCRIPTION-(Dyn11)

The Dyn11 signifies various things: -
1.The H.V. side is connected in Delta.

2.The L.V. side is connected in Star with neutral.

3. 11 signifies that the L.V. leads H.V. by 30^0.

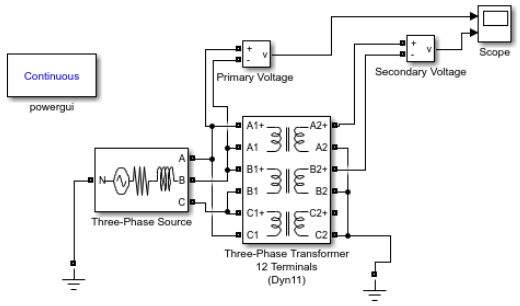

Fig: -Circuit diagram for Dyn11

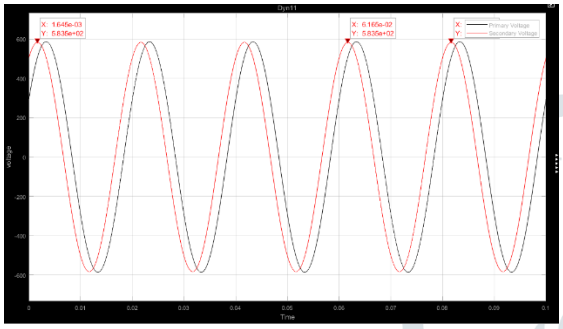

Fig: -Graph to show L.V. leading from H.V. by 30^0

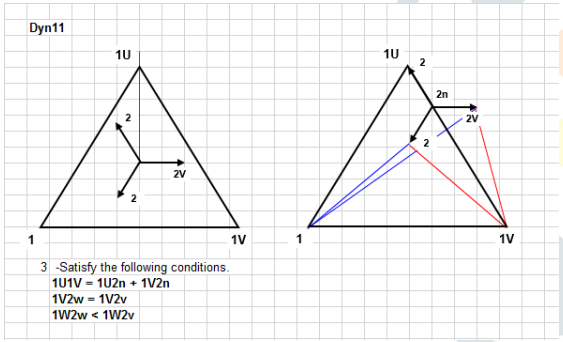

Fig: -Phasor diagram to determine the vector group

PROCEDURE

1.Apply maximum LV voltage available from power supply on HV side of transformer. Voltage should in the range of 430V to 450V. Higher the voltage, higher is the measurement accuracy.

2.The voltages should be balanced. For calculation purposes, the average of three phase or line voltages as measured is used. It is very important that the phase sequence of applied voltage is confirmed to be positive sequence using phase sequence meter.

Condition - 1

Measure Voltage between

1. 1U and 2n (V1U2n)

2. 2n and 1V (V2n1V)

3. 1U and 1V (V1U1V)

V1U2n + V2n1V = V1U1

On Site results: -

V2n1V **=99.6V,** V1U2n **=0.4V,** V1U1 **=100V**

99.6V+0.4V =100V

Condition - 2

Measure Voltage between

1. 1W and 2v (V1W2v)

2. 1W and 2w (V1W2w)

V1W2v > V1W2w

On Site results: -

V1W2v =**100.4V**, V1W2w =**100V**

100.4V > 100V

CIRCUIT DESCRIPTION-(YNd1)

The YNd1 signifies various things: -

1.The H.V. side is connected in Star with neutral.

2.The L.V. side is connected in delta

3. 1 signifies that the H.V. leads L.V. by 30^0.

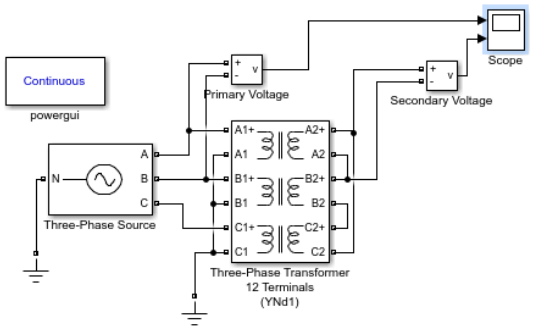

Fig: - Circuit diagram for YNd1

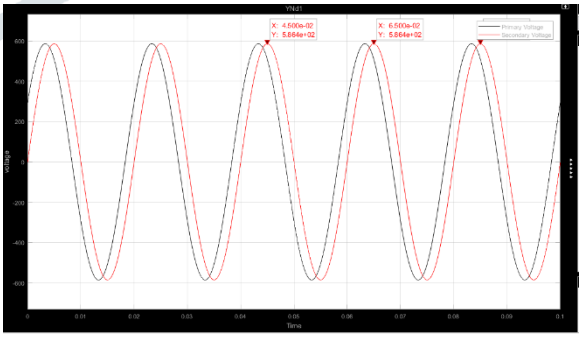

Fig:- Graph to show H.V. leading from L.V. by 30^0

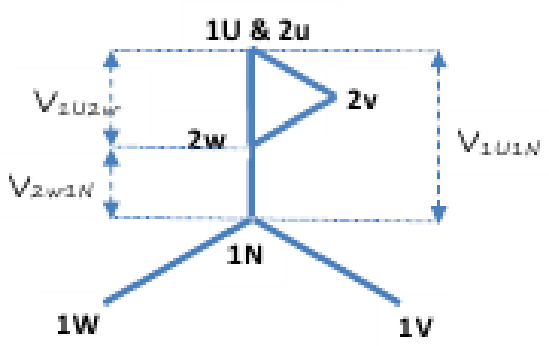

Fig:- Phasor diagram to determine the vector group

Condition - 1

Measure Voltage between

1. 1U and 2w (V1U2w)
2. 2w and 1N (V2w1N)
3. 1U and 1N (V1U1N)

V1U2w + V2w1N = V1U1N

On Site results

V1U2w =**59.6V**, V2w1N =**25.6V**, V1U1N =**82.5V**

5906V+25.6V=~82.5V

Condition - 2

Measure Voltage between

1. 1W and 2v (V1W2v)
2. 1V and 2v (V1V2v)

V1W2v > V1V2v

On Site results

V1W2v =**112V ,** V1V2v =**31V**

1102V>31V

PARALLEL OPERATION OF THREE PHASE TRANSFORMER(Dyn11)

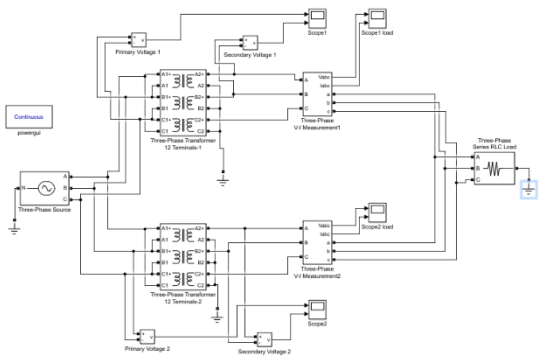

Fig: Circuit diagram for load sharing of Dyn11

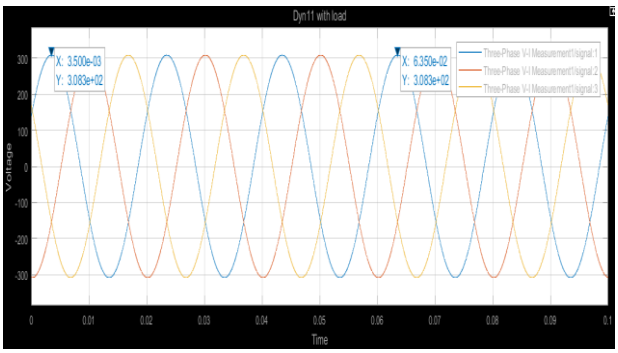

Fig:- Voltage level of load sharing (Dyn11)

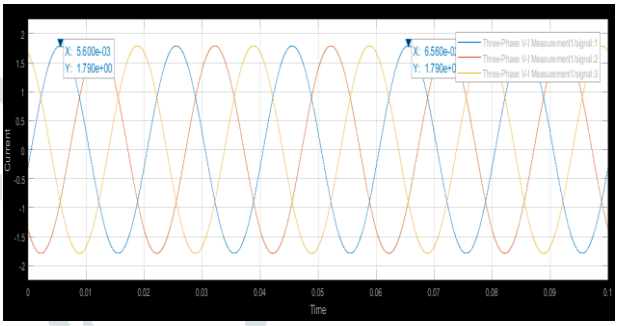

Fig:- Current level of load sharing(Dyn11)

Voltage level	Load shared(kWh)	Ammeter1(A)	Ammeter2(A)
230	0.6	1.6	1.7
300	1.1	2.1	2.2
415	0.6	1.8	1.95
415	1.1	2.8	2.7

Fig: - On site chart result

PARALLEL OPERATION OF THREE PHASE TRANSFORMER(YNd1)

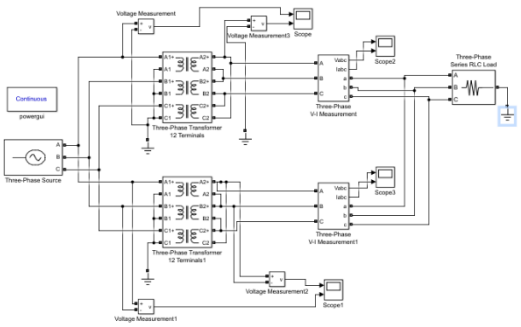

Fig:-Circuit diagram for parallel operation(Ynd1)

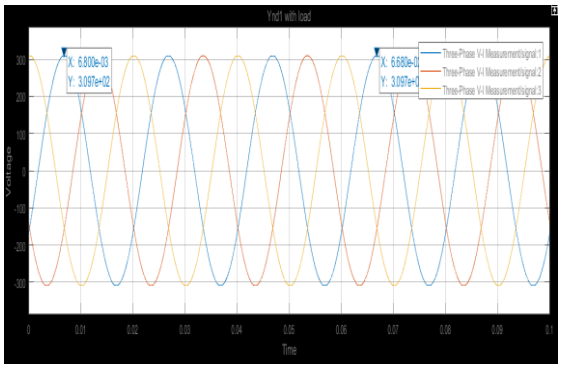

Fig:- Voltage phasor of load sharing(YNd1)

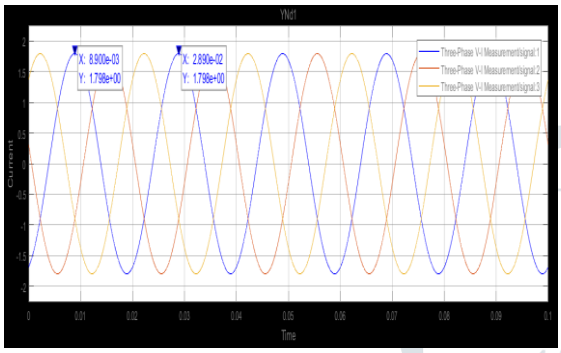

Fig:- Current phasor of load sharing(YNd1)

Voltage(V)	Load(kWh)	Ammeter(A)	Ammeter(A)
230	1.6	0.9	0.9
300	1.6	1.2	1.2
402	1.6	1.6	1.65

Fig:-On site results (YNd1)

LOAD SHARING WITH DIFFERENT VECTOR GROUP (Dyn11 &YNd1)

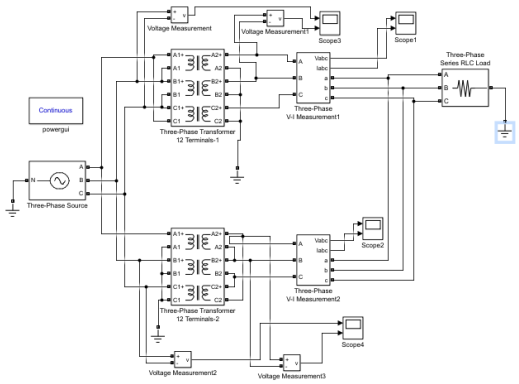

Fig:-Circuit diagram for different vector group

Since the circulating current in load sharing of different vector group is very much high and can cause a excess heating of transformers which can lead to short circuit or can damage to the transformers so on site results is not possible.

CONCLUSION

All the transformer should have same vector group, while connecting in parallel, otherwise large circulating currents will flow and can cause short circuit in the transformers. And also, most of the time, for distribution purpose the transformer with Dyn11 vector group is used, because it does not allow zero sequence currents to flow through the transformer. If transformers of equal rating and equal impedance is operated in parallel then they share equal load.

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