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Determination of Short Circuit Fault Current Ratings in Wind Turbine System Connected To Utility Using ETAP Software

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Abstract- Calculation of short circuit fault current ratings are more important in power systems to design the ratings of relays. In this paper about wind turbine system connected to the utility grid through load bus and utility bus is discussed and in this system the Short circuit fault current ratings can be calclated using electrical power system analysis software (ETAP). This software is intilligent and it can perform, monitoring, simulation, optimization, and control of electrical power systems. Here the short circuit current ratings calculated for wind generating system is connected to the utility grid using ETAP software and faults are characterized by LG faults only. It can analyses the with different frequencies in ETAP and also faults are applied every bus like load bus, generator bus and combination of load bus and generator bus using ETAP simulation results.

***Keywords*— ETAP, short circuit faults, wind turbine, utility grid**

I. INTRODUCTION

Manipulation about to short circuit currents are more difficult in any power system consider effective major issue in high currents and reliability [1]. Short-circuit current ratings are compulsory because of exact design of relays. Here short circuit's current rating calculations are two type's first one static type short circuit current rating calculations and dynamic type short circuit current rating calculations [2-7].

In static estimation just distinguishes the underlying estimations of short circuit current rating , then the dynamic count decides the present time waveforms during along with short circuit current ratings[8-13].

This work approaches to calculate to wind turbine is connected to grid like stand-alone system to short circuit fault current ratings are to simulated in ETAP software different kinds of frequencies and short circuit current ratings as shown in below theory.

II. PROPOSED SYSTEM DESIGN

Short circuit currents ratings of the power system is to calclted by using ETAP software is shown in figure 1, in operation by using the method of newton raphson power flow method. In this diagram utility grid is connected to bus number 1 then it connected transformer and it is connected wind generating station through load bus no 2. Here the system short circuit current ratings can measured using the software where it can apply the faults with different frequncies with respective number of cycles.

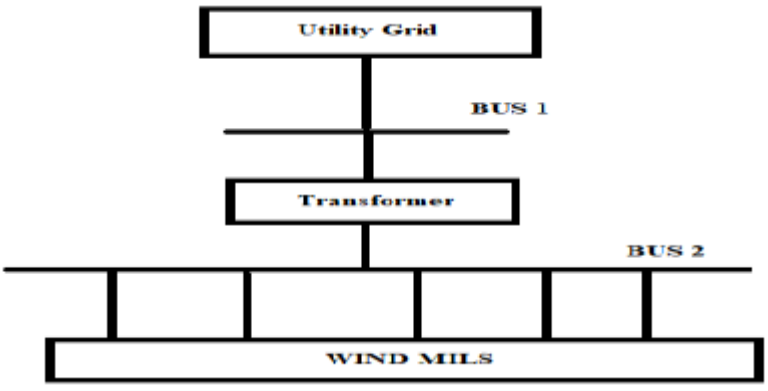


Fig. 1 wind generation system is connected to utility grid

A. Wind turbine generation system

Wind turbine generation system presnted in ETAP software seen in figure 2,in wind tubine system inducton generator is selected for generating power. In this power curve and power coefficient typical graps in presented in wind turbine model and ratings of the wind turbine aero dyanmics are selected in sample data in ETAP softwere.

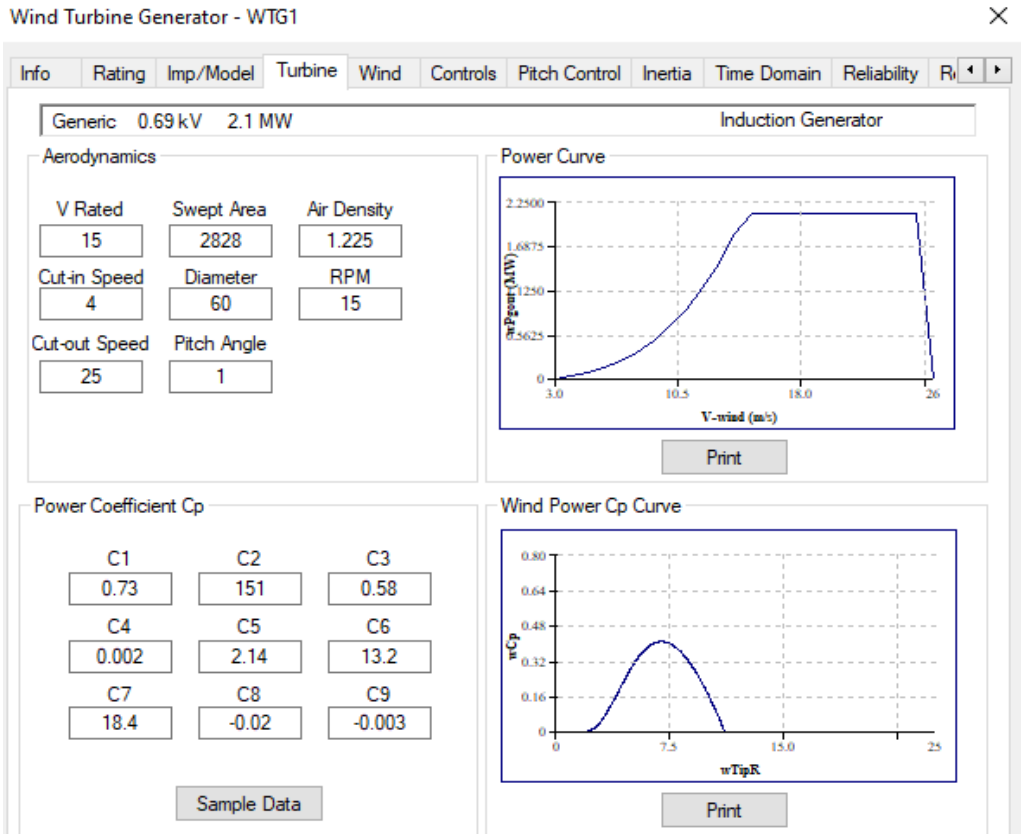


Fig.2 Wind generator system in ETAP

B. Utility grid

In the power grid editor can edit or design own model and typical values can give in ETAP. This utility grid is equality to Thevenin's circuit, a short circuit impedances can be presented in a unique voltage a constant voltage. The default mode of operating for a power grid is swing type. The power grid mode is swing type considered. Same as wind turbine the typical values are considered in utility grid with short circuit ratings as shown in figure 3.transformer also taken in account typical values presented in ETAP has taken in the design system.

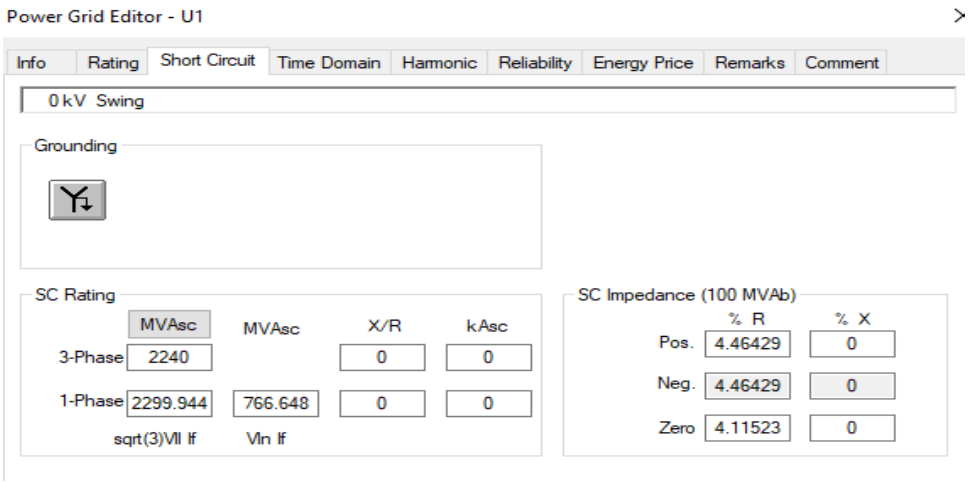


Fig.3 utility grid system in ETAP

III. ETAP SIMULATION RESULTS

In schamatic diagram praposes the grid is connected to wind turbine system wth the buses is used calaclete short circuit current ratings of the hyabrid energy system in ETAP. Here first wind is connected to bus number 1 next 5 wind turbines ratings of 2.1 MW is connected to load bus number2 as shown in figure 4, both buses are conneted to through a 3 MVA transformer. In this system four cases are considred first apply the fault at the bus 1 with different cycles, and then fualt applied by the bus number 2 with no diffrent cycles and finally tha fault occures in both buses with different cycles considered, and it confirm the short curcuit ratings of the hybrid energy system in power flow studies.

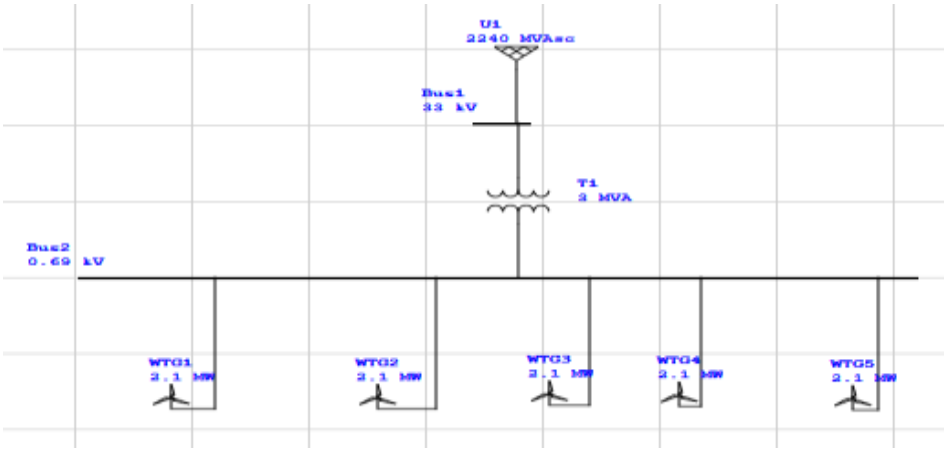


Fig.4. Schematic diagram of wind turbines are connected to grid

Case1

A. L-G fault on bus 1 with one cycle

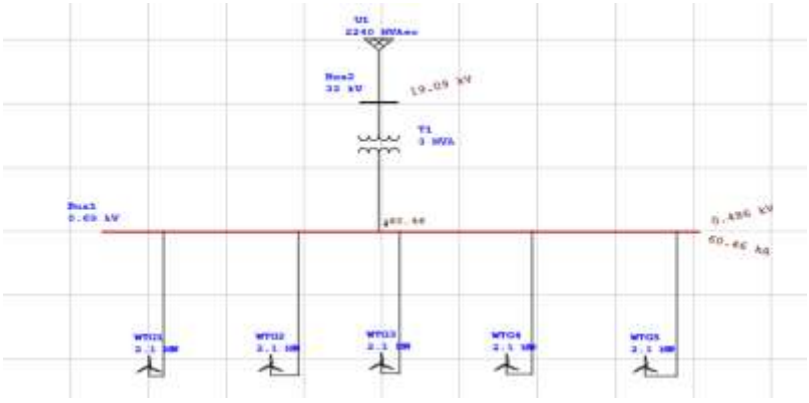


Fig.5 Short circuit current ratings fault applied bus 1 with 1 cycle (maximum rating)

So as simulations are done in etap and is studied about this, first case LG type of fault is applied at bus number 1that is called load bus, when the fault occurs then high currents are flows to the bus number 1 with the combination of grid and wind turbine system as shown in figure 5 and it has consider only one cycle frequency. The short circuit current and voltage ratings are 60.46 kA and 0.486 kv passes to bus number1 and it can confirm the short circuit current ratings are calculated of this present hybrid energy system using ETAP.

B. L-G fault on bus 1 with 1.5 to 4 cycle

Here it can observe the fault created in bus number 1 with 1.5 cyles to 4cycles, when fault applied at bus1 the shor curcuit current and voltage ratings are to the bus is 57.197 ka, and 0.461 kv is shown in figure 5, when compared to the previous case the currents ratings are reduced due to because of no of cycles are incresed then these kind of ratings are called by the medium ratings.

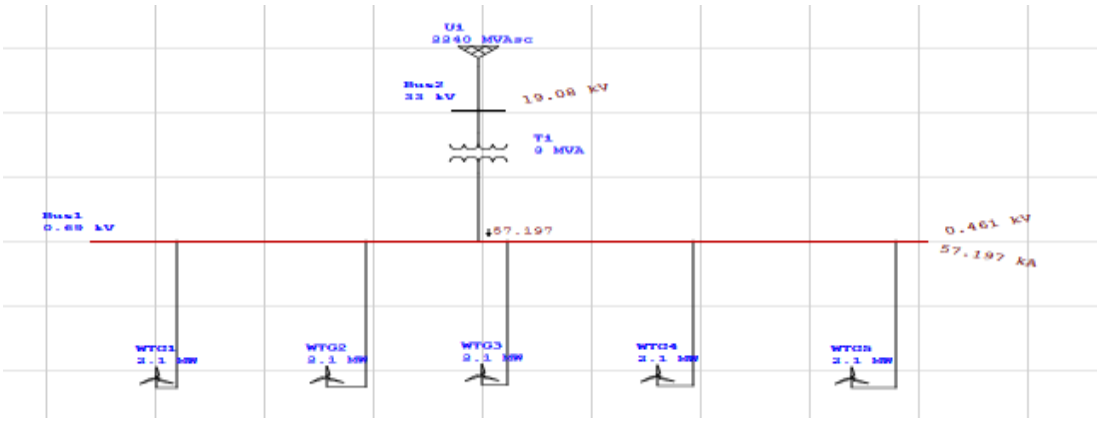


Fig.5 Short circuit current ratings fault applied bus 1 with 1.5 to 4 cycles (medium rating)

C. L-G fault on bus 1 with no of cycles is maximum

Here is fault is applied bus number 1 with maximum no of cycles incresed highest level as shown in figure 6, as same as when the fault currents are coming at bus 1, and the short curcuit currents and voltage ratings are in this case is 34.535ka and 0.4 kv among all the three maximum, medium and minumum ratings are calclated by the using of ETAP.

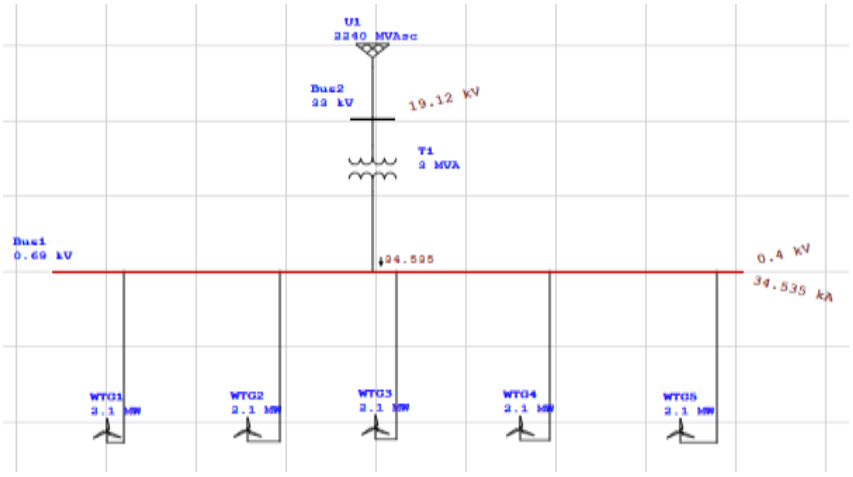
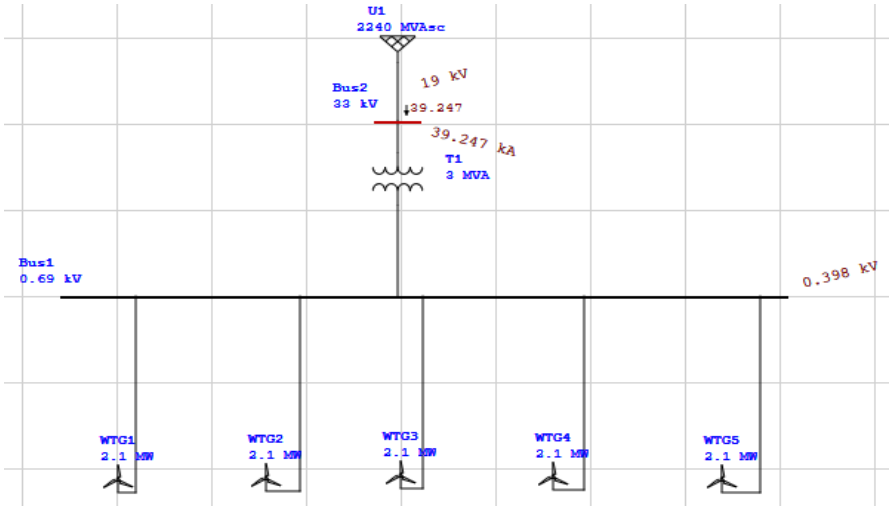


Fig.6 Short circuit current ratings fault applied bus 1 with no of cycle's maximum (minimum rating)

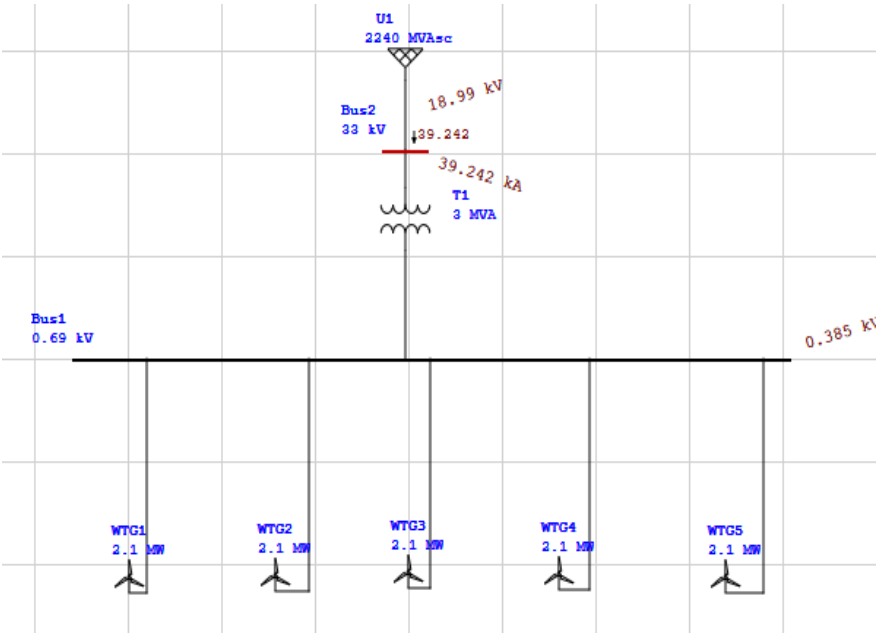
Case 2

D. *L-G fault on bus 2 with changes of number of cycles*

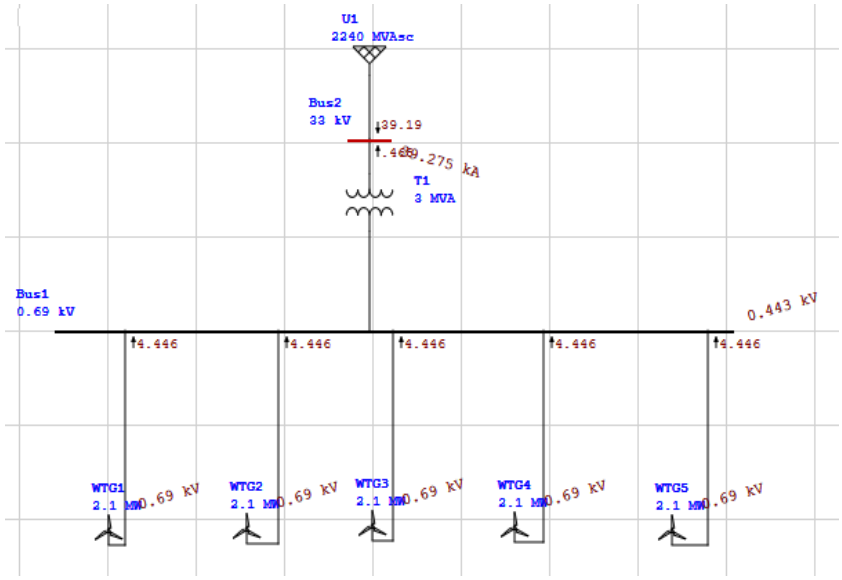
In this case L-G fault applied to bus number 2 that is utility bus with one cycle first,1.5 to 4 cycles and then maximum cycles. In these three cycles it is calclated short cuircuit current and voltage ratings same 39.247 ka and 1 kv becase of it near to generator or grid then if cycles is incresed also no change can be obtained as shown in figure 7.



(a)



(b)



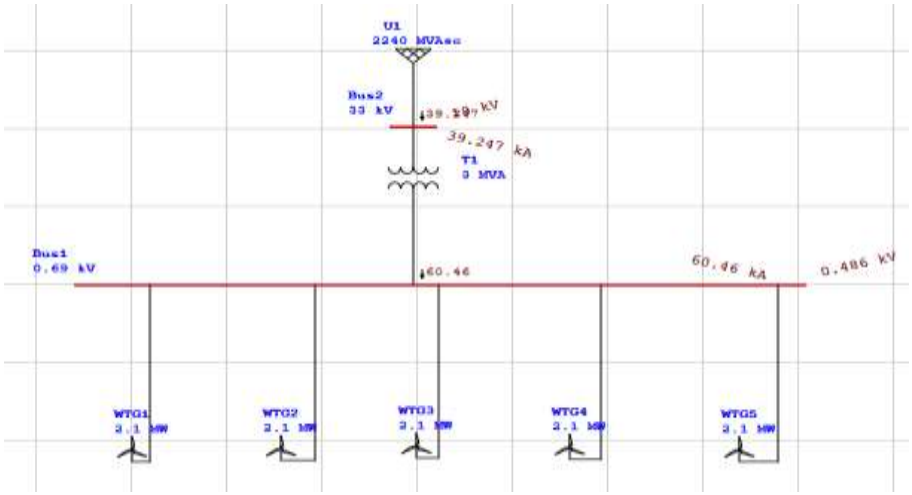
(c)

Fig.7. Short circuit current ratings fault applied bus 2 with no of cycle's (a) 1cycle (b) 1.5 cycles to 4 cycles (c) no of cycles maximum

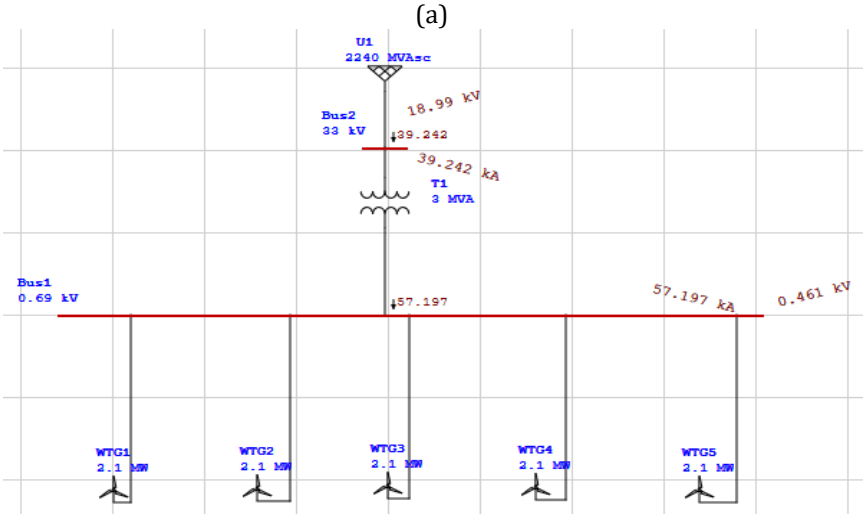
Case 3

E. L-G fault on bus 1 and bus 2 with changes of number of cycles

In the case 3 examine that the fault is created at bus 1 and bus 2 at a time, this can observe the same short circuit current and voltage ratings are in previous individual cases shown in figure 8.



(a)



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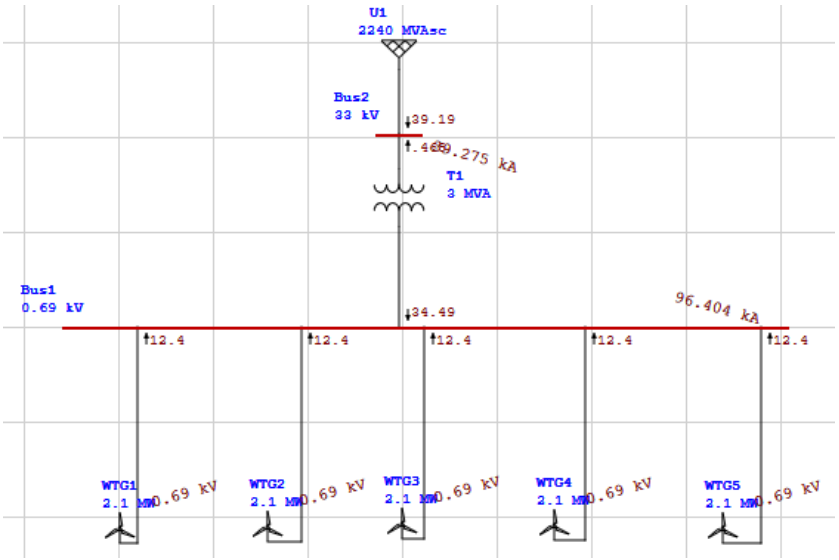

(c)

Fig.8. Short circuit current ratings fault applied bus 1 and bus 2 with no of cycle's (a) 1cycle (b) 1.5 cycles to 4 cycles (c) no of cycles maximum

IV. CONCLUSITON

Wind turbines is connected to power grid like hybrid energy system, in renewable energy systems is connected to grid calculates the short circuit current and voltage ratings in different cases. First case L-G fault created bus1, second case created bus 2 and third case fault is created both buses using ETAP software. Then ETAP results are satisfactory for easily calculated short circuit ratings when compared to conventional method. The ETAP software proved that intelligent software in load flow solutions, transient case and dynamic cases also. Then the future it can construct large size micro grids using this kind of software's. And finally using these calculations can be design relays and circuit breakers in any power systems.

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