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SYMMETRICAL AND UNSYMMETRICAL FAULT COMPENSATION USING STATIC VAR COMPENSATOR DEVICE

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Abstract - **Reactive power adjustment plays an essential role in maintaining luxuriant power system stability and ferocious power quality. STATCOM is a newly old-fashioned solution for reactive power rectification in power systems. The advantages of STATCOM for power systems are examined, as well as its guiding principles and methods of control. Harmonic mitigation, power factor control and voltage control are among the many control measures that are examined. STATCOM's ability to lower voltage fluctuations, maintain continuous control and react fast are highlighted as benefits over traditional reactive power compensation systems. Simulation findings are given to demonstrate how well STATCOM operates and functions under different power system situations.**

Index Terms **- STATCOM**

I. Introduction

Reactive power modification is required for the stability and dependability of contemporary power systems. Reactive power is needed when inductive loads like transmission lines, transformers, and motors are added to the system. Reduced system efficiency, higher line losses, and voltage instability can all be caused by insufficient reactive power modification. Reactive power control techniques must thus be offered in order to guarantee the power system's maximum possible performance. STATCOM is among the most promising developments for reactive power compensation. A solid-state device called a STATCOM, that additionally regulates voltage levels and raises power factor, allows reactive power to be added or withdrawn from the system quickly. Unlike conventional reactive power compensation systems like reactors and shunt capacitors, STATCOM offers continuous and dynamic reactive power compensation monitoring.

II. Literature Survey

1. A review of STATCOM control for stability enhancement of power systems with wind [1]

There has been a noticeable rise in the past few years in both the development of alternative forms of energy and their integration into the existing power grid. Because of the substantial advancements in electrical technology, it has become more difficult to operate and regulate the interlinked electrical network while preserving power system stability. Converter-based sources of renewable energy, such as solar and wind photovoltaic, have transformed the power grid. Because these sources of energy have different dynamic behaviour from traditional generation, power systems must cope with a variety of unique stability challenges. STATCOM, or a shunt related FACTS, is a crucial component in preserving the reliability of the electric power system.

2. Multilevel current source converter- based STATCOM suitable for medium-voltage applications [2]

The STATCOM of MCSC. It suggests an entirely unique modification method. The MCSC STATCOM terminals report that the new transmission method performs better than the commonly used Shifted in phase Carrier SPWM in terms of THD and di/dt. A technique for electrical current balancing is provided that ensures the inductive devices' currents remain balanced. The CBA does not require regulations. Its foundation is the real-time assignment of the best switching state to every CSC module. Additionally, this study offers two control strategies. The STATCOM is regarded as a SISO in the first. As a result, just one PI controller is needed. The controller's gains would need to be adjusted if the STATCOM switched from the capacitive to the induction approach, or the other way around.

3. Intelligent Parameter Design-based Impedance Optimization of STATCOM to Mitigate Resonance in Wind Farms [3]

Large-scale wind turbines in several areas and nations are required by the STATCOM in order to sustain reactive electricity. The STATCOM is a practical and reasonably cost substitute for impedance shaping in the reduction of resonance, given the shortcomings and intricacy of distributed wind

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generation systems. Nevertheless, a quantitative stability assessment and an optimization plan for the STATCOM resistance are now needed for actual massive windmills. This study consequently suggests a structured resistance network-based stable evaluation of real wind farms in order to accurately determine the windmill's stability and quantitatively evaluate the damping factors offered by the STATCOM. The order of resistance vector model that the WTG and STATCOM employ for network simulation is the foundation of this investigation. The suggested stability analysis is illustrated with a typical windmill found in Western China. After solving the STATCOM controlling settings using a heuristic intelligence approach, the windmill's ideal safety buffer is found within the bounds of intended performance. To achieve this, an intelligent parameter design-based technique is used to optimize the STATCOM impedance. Comparing the suggested resistance optimization approach to the proposed understanding-of-models-based improvement method demonstrates the methodology's efficacy.

III. BLOCK DIAGRAM

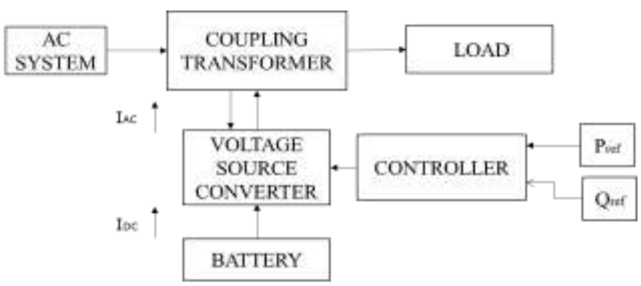

Fig 3 Simulation block diagram

Many problem qualities appear in this power system for example voltage sag, voltage swell, voltage dip. Power quality problems rectified by using STATCOM device. Controller part have three major equipment they are PWM, PI controller and IGBT.PWM used to compare reference signal and carry signal and it identify the error and transfer the signal to the PI controller. It compensates or identify the transient error in particular signal. IGBT triggers the pulses in exact angle. Rectified signal passed through the voltage source converter (VSC). It will convert DC into AC wave in exact and compensate voltage or current to the load by using coupling transformer.

IV. METHODOLOGY

In general, STATCOM functions as a voltage source conversion (VSC), converting input voltages from DC to three separate phases AC voltages at a fundamental frequency with regulated angle of phase and scale. The Voltage Source Conversion may deliver high-quality AC voltage at the output to the load or grid by utilizing PWM technology. The concept behind STATCOM's continuous functioning is to supply an AC voltage source beneath the transformer's leakage reactance through the connection of a VSC to a DC capacitor. This particular power source is grid-connected and is based on a VSC shunt. Enhancement of the quality of the electrical current carrying the load can be achieved by passing a controlled current. But by adding current where it connects to the grid, a STATCOM can likewise increase voltage dip. Stability of voltage and reactive power flow problems in the power grid are addressed methodically as part of the reactive power compensation process with a STATCOM. First, a thorough examination of the system is carried out, including load flow analyses and stability evaluations to pinpoint problem areas and reactive power needs. These results guide the strategic placement of STATCOMs, which maximizes their performance in reactive power supply and voltage regulation while reducing costs. The time period is shown on the X-axis in the simulation, while the voltage is shown on the Y-axis. If there is a single line to ground fault in power system without using STATCOM the non-linear load voltage value will be -0.6404v. After using STATCOM the voltage value will be 298.1v. During line to line fault, the non-linear load voltage will be -0.6408v after using STATCOM the load voltage will be -294.8v. If Symmetrical fault appears then the load voltage will be -0.6545v after using STATCOM the load voltage will be 201.5v. The input value will be similar to the output value without any interruption in the power system. There are 50 cycles total; in the event of a voltage dip, 25 cycles will be present and the remaining 25 cycles won't occur.

V. SIMULATION AND RESULT

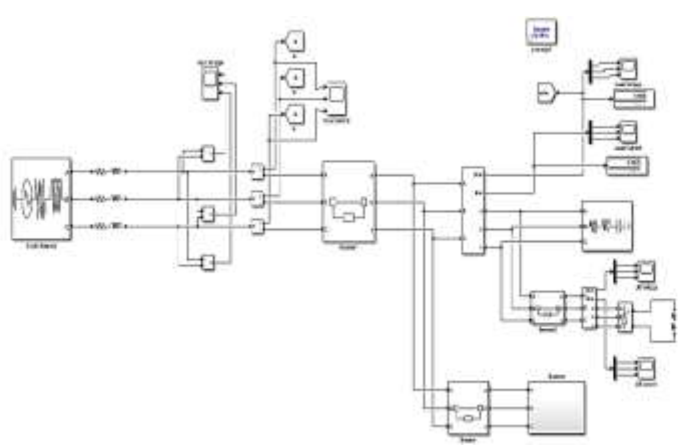

Fig 5 Simulation circuit

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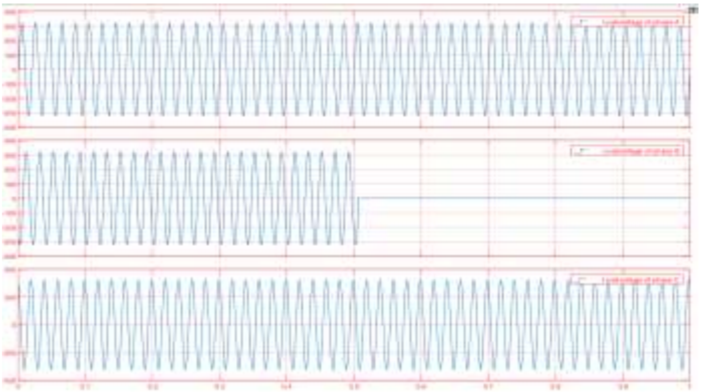

Fig 5.1 Phase B fault without STATCOM

The above picture shows that a single line to ground fault because there is no voltage wave at a particular time in phase B.

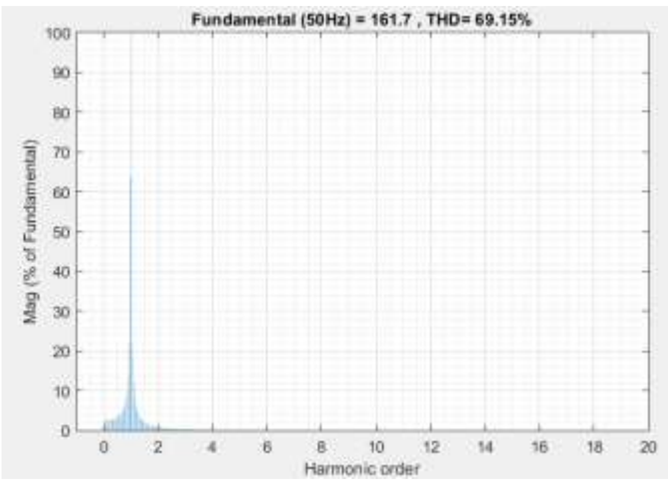

Fig 5.2 FET analysis for phase B fault without STATCOM

If sing line to ground fault appears then the THD value for non-linear load voltage is 0.69 without using STATCOM. Fundamental frequency becomes 161.7 Hz.

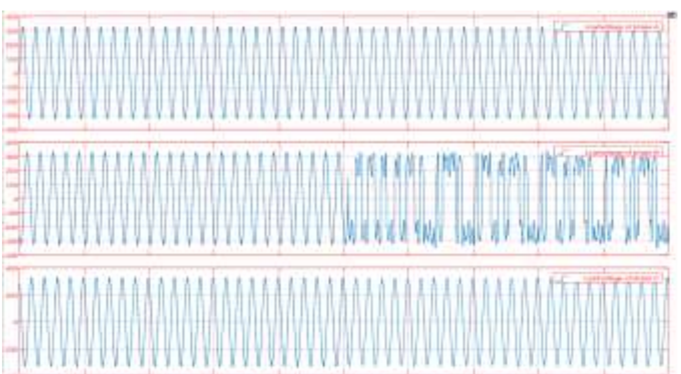

Fig 5.3 Phase B fault with STATCOM

Using STATCOM to rectify the single line to ground fault causes the voltage wave to grow at the single line to ground fault location in phase B of the system.

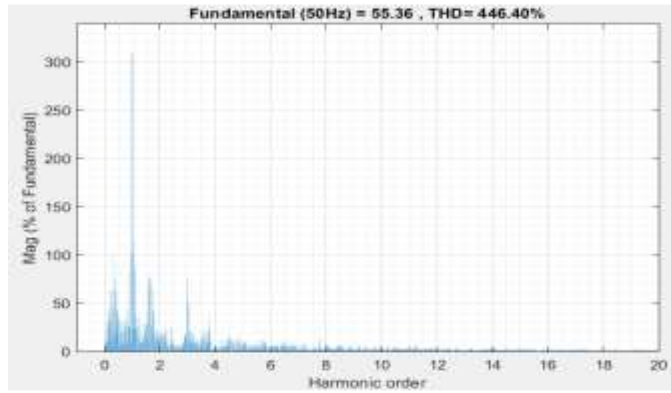

Fig 5.4 FET analysis for phase B fault with STATCOM

After using STATCOM in single line to ground fault the THD value reduces and becomes 4.46. The value of fundamental frequency is 55.36Hz.

Fig 5.5 Phase A, phase B fault without STATCOM

The above picture shows that a line-to-line ground fault because there is no voltage wave at a particular time in phase A and phase B.

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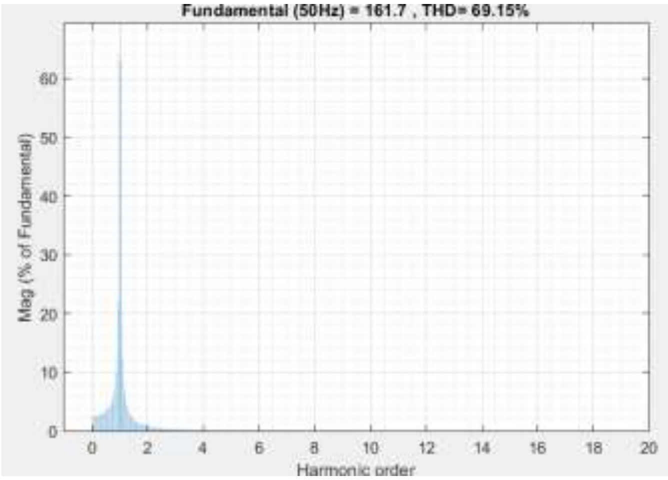

Fig 5.6 FET analysis for phase A, phase B fault without STATCOM

If line-to-line fault appears then the THD value for non-linear load voltage is 0.69 without using STATCOM. Fundamental frequency becomes 161.7 Hz.

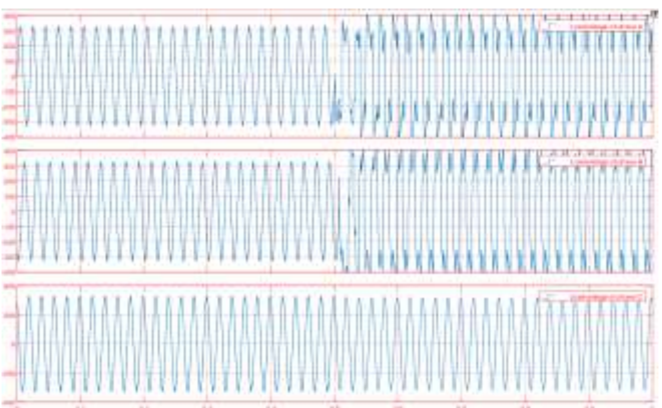

Fig 5.7 Phase A, phase B fault with STATCOM

The line-to-line ground fault is rectified by using STATCOM after using STATCOM the voltage wave raises at a Line-to-Line fault area in phase A and B.

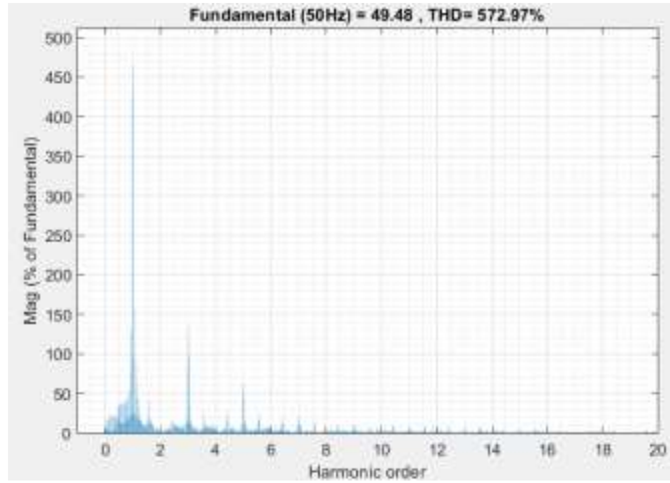

Fig 5.8 FET analysis for phase A, phase B fault with STATCOM

The THD value of line-to-line fault after using STATCOM is 5.72 and fundamental frequency value for load voltage is 49.48Hz.

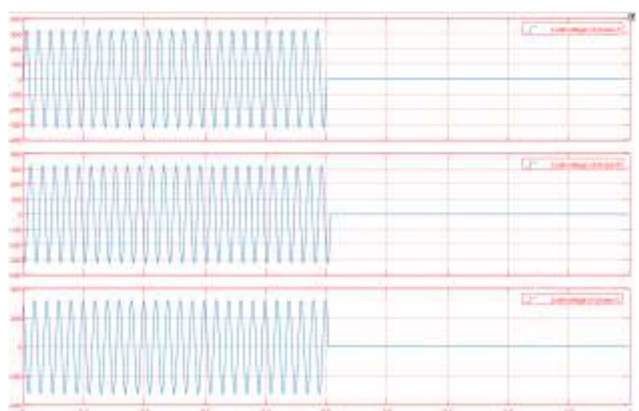

Fig 5.9 Phase A, Band C fault without STATCOM

The above picture shows that a symmetrical fault because there is no voltage wave at a particular time in phase A, B and C.

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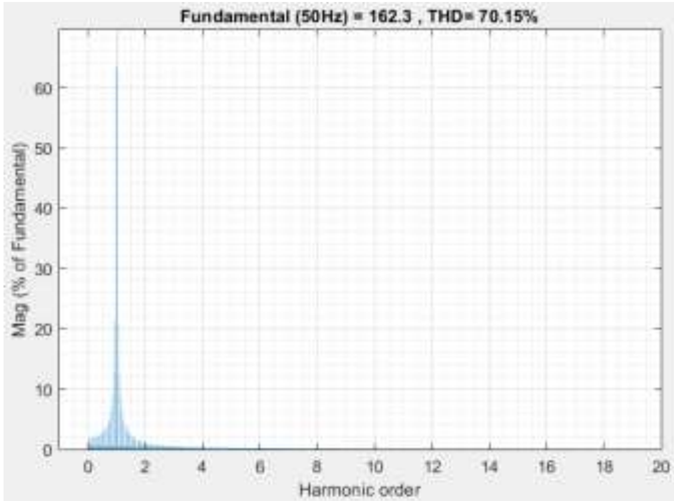

Fig 5.10 FET analysis for phase A, Band C fault without STATCOM

Without using STATCOM in symmetrical fault then its THD value for load voltage is 0.71 and its fundamental frequency value would be 162.3Hz.

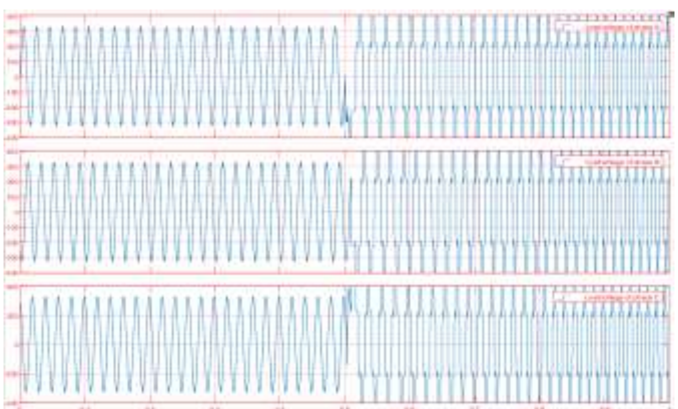

Fig 5.11 Phase A, B and C fault with STATCOM

The symmetrical fault is rectified by using STATCOM after using STATCOM the voltage wave rises at a symmetrical fault area in phase A, B and C.

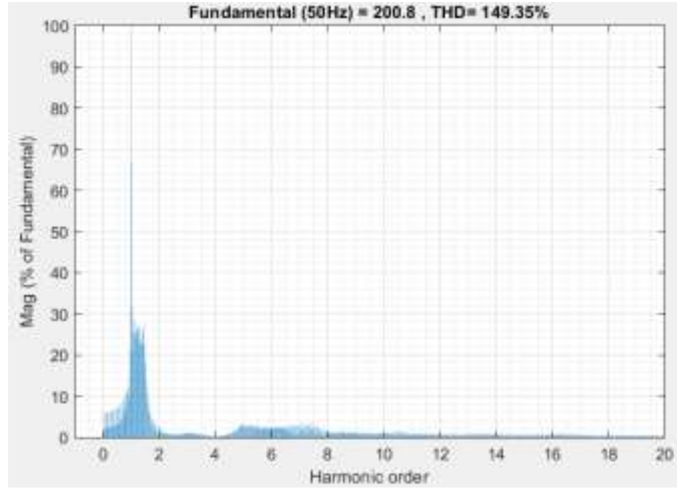

Fig 5.12 FET analysis for phase A, B and C fault with STATCOM

After using STATCOM in symmetrical fault the THD value of load voltage becomes 1.49 and the value of fundamental frequency becomes 200.8Hz.

S.NO	FAULT TYPE	LOAD CURRENT	LOAD VOLTAGE	STATCOM DEVICE	THD	
					LOAD CURRENT	LOAD VOLTAGE
1	Single Line to Ground fault	0.000234 A	-0.6404 V	Absence	69.15%	69.15%
		20.6 A	298.1 V	Presence	243.19%	446.40%
2	Line to Line fault	9.42e-05 A	-0.6408 V	Absence	69.15%	69.15%
		-20.62 A	-294.8 V	Presence	417.51%	572.97%
3	Symmetrical fault	-0.0004 A	-0.6545 V	Absence	69.15%	69.15%
		13.64 A	201.5 V	Presence	142.75%	149.35%

VI. CONCLUSION

The successful design, implementation, and testing of a symmetrical and unsymmetrical fault compensation using STATCOM. The simulation circuit was able to reduce the total harmonic distortion and it will raise power factor. In

conclusion, the project achieved its objective and contributed to the enhancement of power system. The third generation of dynamical VAR compensation device, after the FC, MCR and TCR types of static VAR compensators, is the Static Synchronous Compensator, a crucial component of the Flexible AC Transmission System. Its reactive current has flexible controllable reactive power compensation for the system. It resolves the issue of harmonic interference when switching banks of parallel capacitors. In many areas, including response time, power grid stability, system power losses and distortion reduction, transmission capacity and transient voltage limit, STATCOM performs better than other systems. Here, we can observe that STATCOM is reducing harmonics in addition to compensating for reactive power. The system's power factor is raised with the help of the

STATCOM. For an increase in power factor, the devised vector control approach produces superior outcomes and responds quickly.

REFERENCES

[1] Rehan Sadiq, Zhen Wang, C.Y. Chung. A review of STATCOM control for stability enhancement of power systems with wind. College of electrical engineering, Zhejiang university, Hangzhou, China, 2021.

[2] Faleh Alskran, Marcelo Godoy Simoes. Multilevel current source converter-based STATCOM suitable for medium-voltage applications. University of Exeter, England,2020.

[3] Yang Zhang, Yongheng Yang, Xin Chen. Intelligent parameter design-based impedance optimization of STATCOM to mitigate resonance in Wind farms. Carleton University, Ottawa, Canada,2020.

[4] Bhuvnesh Rathore, Om Prakash Mahela, Baseem Khan. Wavelet-alienation-neural based protection scheme for STATCOM compensated transmission line. University of Exeter, England,2020.

[5] Qi Wang, Bin Wang, Wanwan Xu, Jiapan Xu. STATCOM for Reactive Power Flow Control and Voltage Stability in Microgrid. Wuhan University of Science and Technology, China,2018.

[6] Stella Morris, P.K. Dash and K.P. Basu ‘’A fuzzy variable structure controller for STATCOM’’, Electric Power Systems Research 65 (2003)

[7] P. Rao, M.L. Crow and Z. Yang ‘’STATCOM control for voltage control application’’, IEEE Transaction power Delivery 15 (4) 2020.

[8] L. Zhou, A. Swain, and A. Ukil, “Reinforcement learning controllers for enhancement of low voltage ride through capability in hybrid power systems,” IEEE Transactions on Industrial Informatics, 2019.

[9] M. Ladinian, M. Allahbakhshi, S. Biswal, O. P. Malik, and D. Behi, “Study of the impact of switching transient over-voltages on ferro resonance of ccvt in series & shunt compensated power systems,” IEEE Transactions on Industrial Informatics, 2019.

[10] C. Li, R. Burgos, B. Wen, Y. Tang and D. Boroyevich, “Stability analysis of power systems with multiple STATCOMs in close proximity,” March 2020.