DESIGN AND FAULT ANALYSIS OF PMSG WIND TURBINE FOR STABILITY ENRICHMENT

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Abstract: This paper presents the stability Enrichment and fault analysis of a Permanent Magnet Synchronous Generator based wind turbine fed to a multi-machine system through a Line commutated converter-High Voltage Direct Transmission link. The inverter current regulator circuit of the High Voltage Direct Link is independently designed using Proportional-Integral-Derivative Controller and Adaptive-Network based Fuzzy Interference system Controllers. It can also be concluded from the simulation results that the proposed controller joined with the designed damping controller exhibits the best damping characteristics to develop the performance of the PMSG based Wind Turbines.

Keywords: - Permanent Magnet Synchronous Generator (PMSG), LCC-HVDC (Line commutated converter-High Voltage Direct Transmission) link, PID (Proportional-Integral-Derivative) Controller, ANFIS (Adaptive-Network based Fuzzy Interference system)

I.INTRODUCTION

The increasing energy consumption pattern of the world is shown in the Fig.1. The consumption of energy has been increasing and it will triple in a period of 50 years by 2020. Data on fossil fuel consumption by the same fuel type. The fossil fuel use as energy source has many restrictions. There are a number of pollutants that have been identified as coming out of the use of fossil fuels and they are serious health hazards.

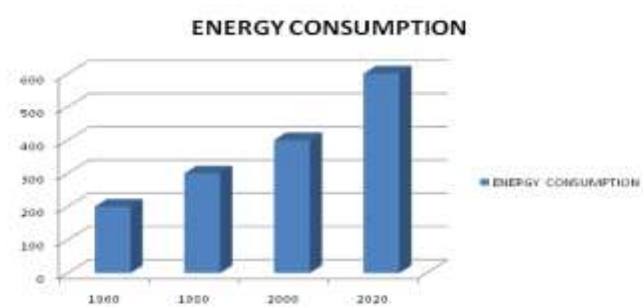

Fig 1. Energy consumption variations

II.PROPOSED SYSTEM

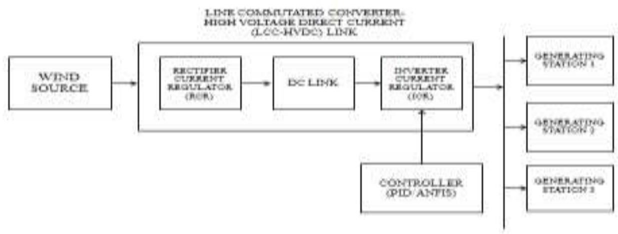

Fig.2. Block Diagram of Proposed System

The configuration of proposed system block diagram as shown in Fig.2. The DC link connects between rectifier current regulator and inverted current regulator. In this block is called as LCC-HVDC Link. In this link is connected between the wind turbine and generating stations. The configuration diagram of the proposed system also has shown infig.3

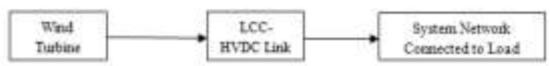

Fig.3. Configuration of the proposed system

III. OPREATION OF PERMANENT MAGNET SYNCHRONOUS GENERATOR

The wind turbine is connected with Permanent Magnet Synchronous Generator as shown in Fig.4. When the wind is present, the turbine starts rotates which in turn gives the alternating current supply. Using the diode rectifier the AC supply is converted into direct current supply then, the DC is stored in the battery source using boost converter circuit. The DC voltage is given to the load side through the inverter circuit.

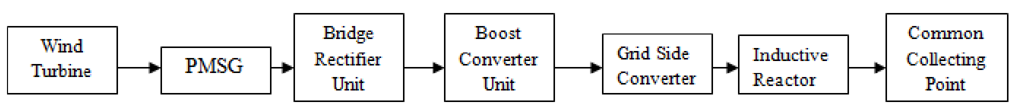

Fig 4. Circuit topology of the proposed system

The proposed system of configurations explained with four modes of operations.

Mode 1	PID Controller without Fault
Mode 2	PID Controller with Fault
Mode 3	Model for ANFIS Controller without Fault
Mode 4	Model for ANFIS Controller with Fault

<u>Mode 1: (PID Controller without Fault)</u>

In this mode of operation the PID controller is connected between the wind turbine and common collecting point. In this mode the fault is not injected in system. The simulation circuit and output results are shown in the Fig. 5 and 6.

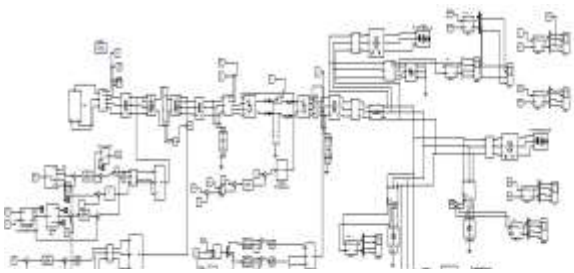

Fig.5. MATLAB Model for PID controller without fault

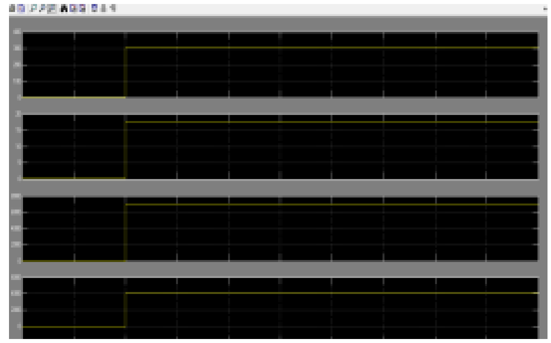

Fig.6. Voltage, Current, Real and Reactive Power output of PID controller without fault

Mode 2: (PID Controller with Fault)

In this mode of operation the PID controller is connected between the wind turbine and common collecting point. In this mode the fault is injected in system. The simulation circuit and voltage, current, real and reactive power output results are shown in Fig. 7 and 8.

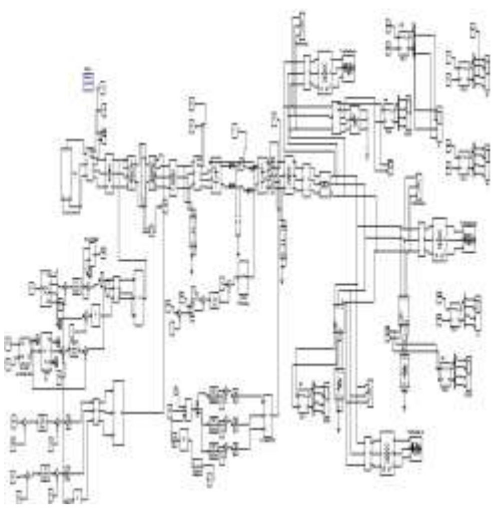

Fig.7. Model for PID controller with fault

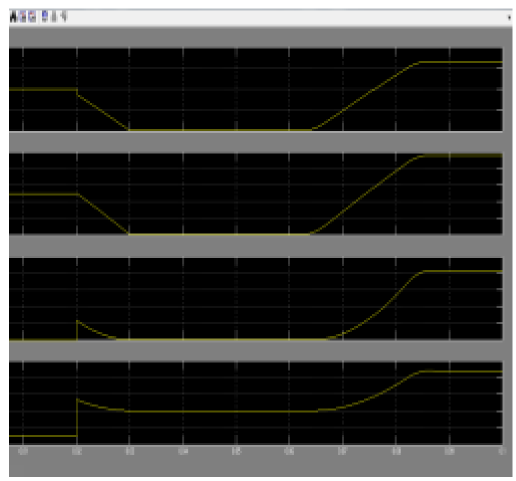

Fig.8. Voltage, Current, Real and Reactive Power output of PID controller with fault

Mode 3: (Model for ANFIS Controller without Fault)

In this mode of operation the ANFIS controller is connected between the wind turbine and common collecting point. In this mode the fault is not injected in system. The simulation circuit and the waveforms of voltage, current, real and reactive power output results are shown in Fig. 9 and 10.

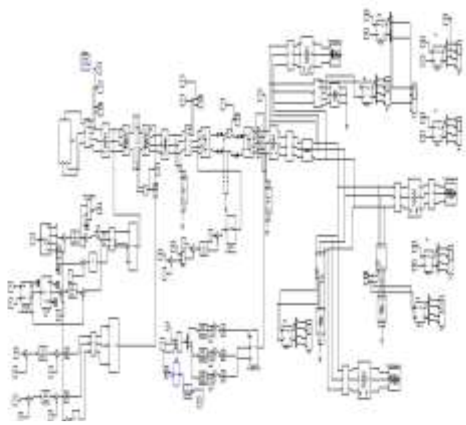

Fig.9. MATLAB Model for ANFIS Controller without Fault

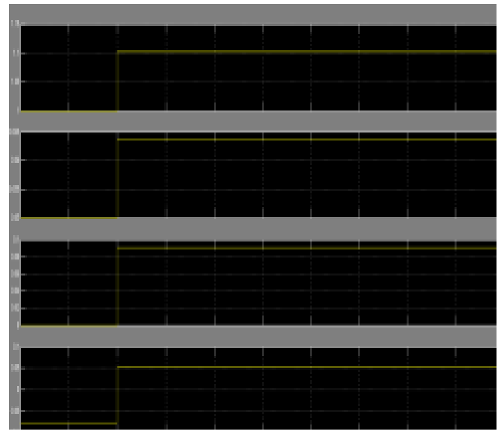

Fig.10. Voltage, Current, Real and Reactive Power output of ANFIS controller without fault

Mode 4: (Model for ANFIS Controller with Fault)

In this mode of operation the ANFIS controller is connected between the wind turbine and common collecting point. In this mode the fault is injected in system. The simulation circuit and the various Characteristics of voltage, current, real and reactive power output results are shown in Fig. 11 and 12.

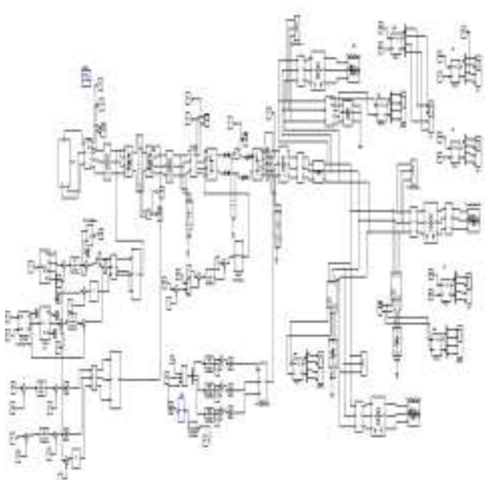

Fig.11. Model for ANFIS controller with fault

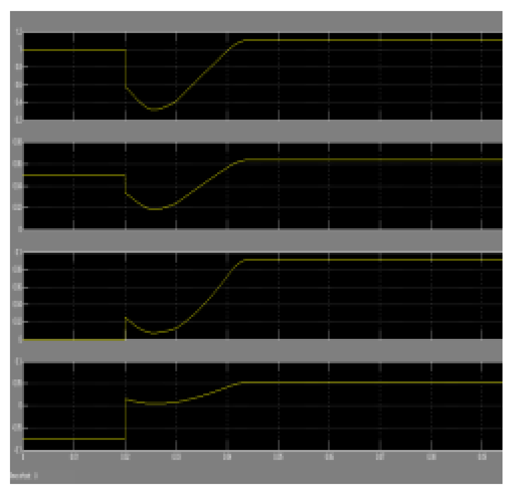

Fig.12. Voltage, Current, Real and Reactive Power output of ANFIS controller with fault

IV. CONCLUSION

This paper has presented the stability enrichment and fault analysis of wind turbine using Permanent Magnet Synchronous Generator fed to a multi-machine system through an LCC-HVDC link. The ICR of the high voltage direct link have been designed by using ANFIS and PID controllers. The proposed system subjected to a three-phase short-circuit fault at the connected bus have demonstrated the usefulness of the ICR joined with the two different designed damping controllers on suppressing inherent oscillations and improving the system stability of the multi-machine system under different operating conditions were discussed. It can also be concluded from the simulation results that the proposed controller exhibits the best damping characteristics to improve the performance characteristics of the PMSG based wind turbine fed to the multi-machine system through the LCC-HVDC link under different operating conditions.

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