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Comparison between Wound Rotor Induction Motor and Doubly Fed Induction Motor Under Different Fault Condition

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***Abstract*— This paper present the comparison of of Doubly fed induction motor and wound rotor induction motor using sensor less scheme and the whole analysis reveals the better dynamic performance of Sensor less speed over conventional method of speed and current measurement which reduces the error in the measurement of parameters, better noise immune, more efficient and reliable system**

Index Terms— Doubly fed induction machine, current sensor,speed sensor, wound rotor induction motor

1.INTRODUCTION

Doubly fed Induction motors are generalized wound rotor induction motor in which rotor resistance is replaced by two different convertors which is further fed back to the same grid In conventional wound rotor induction motor the majaor drawaback was associated with slip power loss which covers almost 20% of the total power flow which aid in decreases the efficiency of induction motor and reliability also.so to overcome the above problem DFIM is proposed in which the wasted energy is further utlised by giving it back to same source which increases the efficiency ,In this machine, stator and rotor both are fed from same source that why it is called doubly fed induction machine, Depend upon the need DFIM works in either motoring or generating mode, so in DFIM stator is directly connected to the source but the rotor is connected through two convertors to the same source , rotor side convertor and grid side convertor ,If DFIM works in generating mode then it will deliver both reactive and active power to the grid while converting the mechanical energy to electrical energy in this mechanical energy is driven by the prime mover , under the generating mode rotor side convertor acts as rectifier which converts the enduced ac to dc now this dc voltage is stored in the dc link after this dc volage converts to ac by using grid side convertor which further acts as invertor ,now the converted ac can some harmonics which can be removed by high value of inductance used as choke coil connected between grid side convertor and grid, if the voltage in the grid decreases then dc link will produce more reactive power to fulfill the decreases in voltage , voltage in the grid increases then dc lik will starts absorbing reactive power to compensate the increase in voltage.

If DFIM works in motoring mode then it will absorbed both active power and reactive power from the grid while converting the electrical energy to mechanical energy , under the motoring mode rotor side convertor acts as invertor which converts the dc to ac and grid side convertor is used to convert ac to dc now this dc will store in dc link which further act as source for invertor .The whole simulation model for 50MW as shown in figure 1

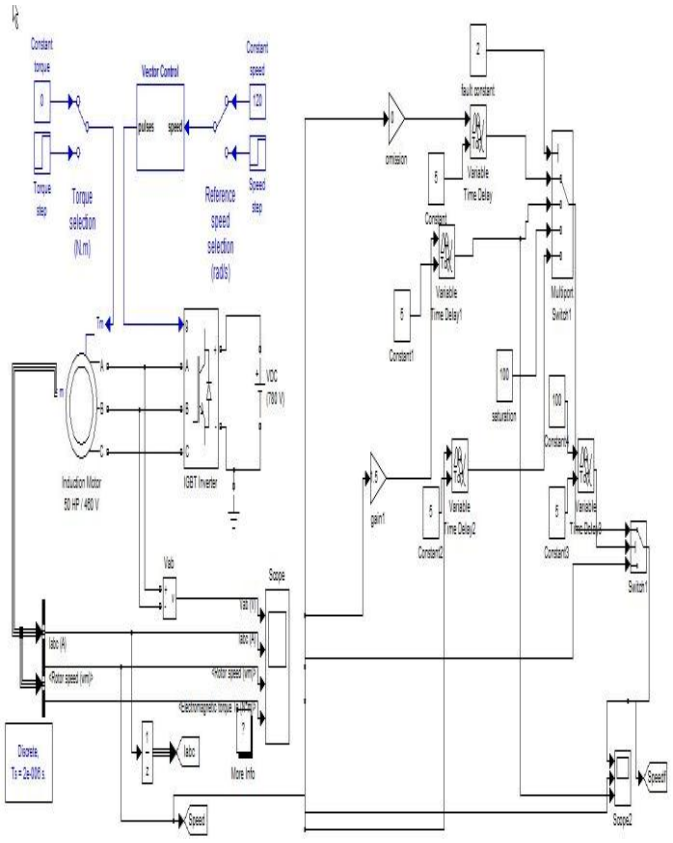

Fig.1 Doubly fed Induction motor(DFIM)

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II. SYSTEM OVERVIEW

An induction motor drive requires measurements of the three-phase currents torque and speed .We will see how the system performance is changing under different load conditions before and after fault injection for both Doubly fed and wound rotor induction motor. Before fault occurrence, we can see that how starting torque is improving in case of wound rotor induction motor and starting current is reducing, further addition of rotor resistance make the induction motor to draw lesser amount of current from source. Basicallyfollowing of the machine can allow certain type of fault

1) Induction machine
2) Inverter
3) Speed encoder
4) Control and estimation platform

But, we have to deal the case of fault injection at speed sensor in both wound rotor induction motor and Doubly fed Induction motor as given in above fig.1 After creating a fault at speed sensor we have to compare the both cases, and analyse the effect of fault in torque, speed, current measurements

III. SIMULATION

Simulation of DFIM and induction motor were simulated for 50Hp machine which involved different convertor for its conversion and IGBT conversion . in this different set of fault will be injected at both stator and rotor end after that performance analysis will be done.the following sets of faults of fault injected at different current sensor
:

1) omission,
2) gain,
3) constant,

Omission is designed by substituting the output to be zero. Gain is further modelled by considering a suitable gain applied to the output of any system, where the sensor output is adjusted due to the internal fault occur in the system. Constant output will be given as constant value to the output signal it is comparable to stuck the core value. Or similar to the transformer core to saturate .

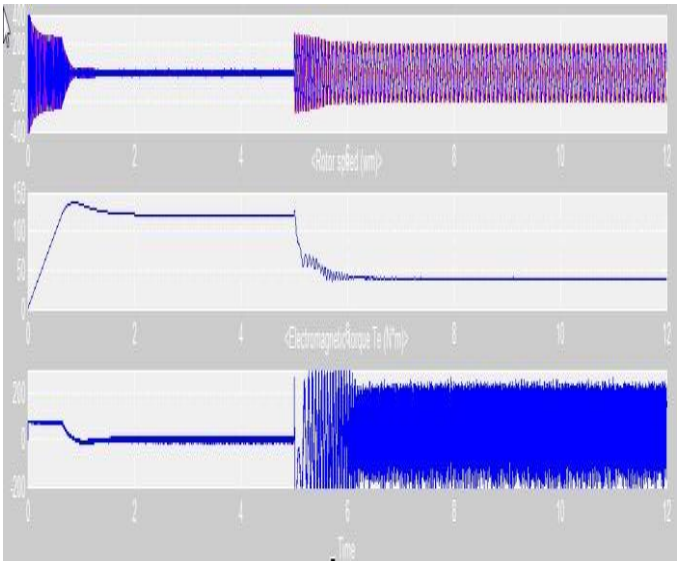

Fig. 2: No load performance of Doubly fed induction motor under Omission Fault Injection at t=5sec

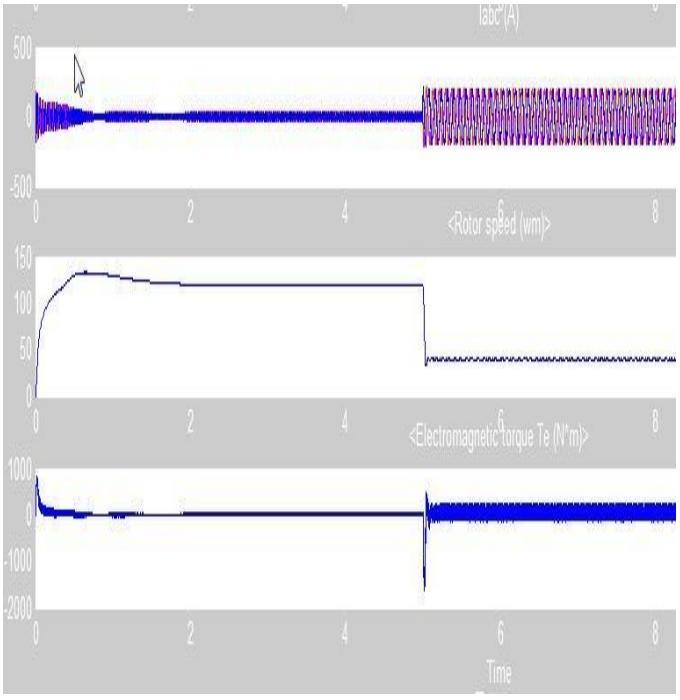

Fig.3 No load performance of wound rotor induction under Omission Fault Injection at t=5sec

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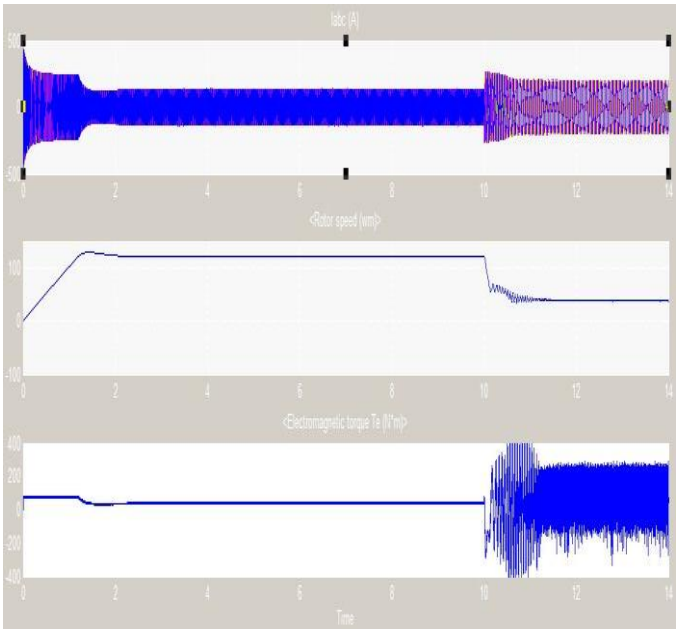

Fig.4. Half load performance of Doubly fed induction motor under omission fault Injection at t=10sec

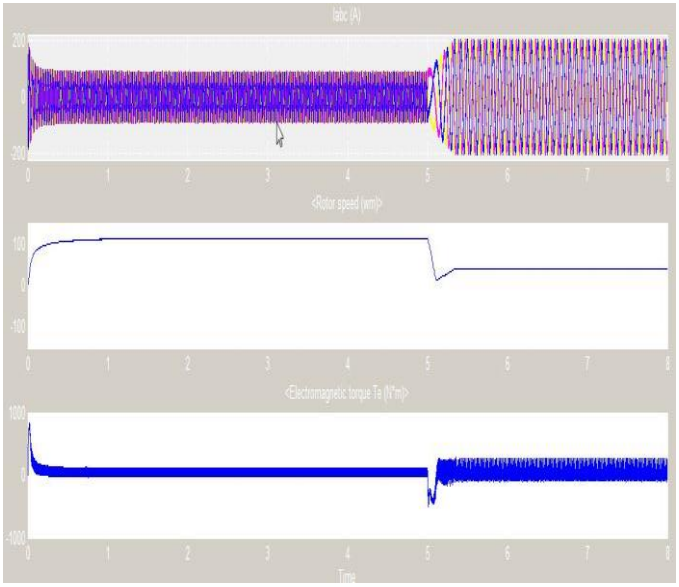

Fig.5. Half load performance of wound rotor induction motor under Omission Fault Injection at t=10sec

IV. PERFORMANCE EVALUATION:

Since the simulation model was validated under faults, all faults were injected into model and the system response were monitored .Based on fault injection ,we have to compare the Doubly fed induction motor and wound rotor induction motor . Before the fault were injected we can see that, wound rotor induction motor attains high starting torque and lesser starting current as compare to Doubly fed induction motor but DFIM gives more power as shown in fig.2 to fig.5 Let us discuss effect of above mentioned fault:

1) Omission: This type of fault is injected in both Doubly fed and wound rotor induction motor, before fault injection we can see that speed is set at 120 rad/sec. but as the fault is injected during no load condition speed reduces to 40 rad/sec and the current enhances up as shown in fig.2 and fig.3 ,similarly in case of half load condition, speed performance remain same as in no load condition but before fault injected current for squirrel cage is 135 ampere higher than that of wound rotor induction motor which is 90 ampere due to the some external resistance in rotor while after fault both attains value of 200ampere and corresponding torque increase up after fault injection from 40 to 250NM for Doubly induction motor and for wound rotor induction motor torque goes from 100 to 270NM as .shown in fig.4 and fig.5. Similarly we can analyse the same performance during full load condition as shown in fig.6 and fig.7.

2**) Gain(1.5):** This type of performance can be seen in fig.8 and fig.9, we can see that during half load condition speed was set at 120 rad/sec and after the gain fault injection it increases to 150 rad/sec and the current level increases up from 100 to 200 amperes and torque increases from 40 to 150 NM. in Doubly fed induction motor while in wound rotor induction motor current increased up tremendously from 80 to 400 ampere and torque increases from 10 to 4000 NM

MOTOR PARAMETER	VALUES
RATED POWER	50 HP
RATED SPEED	120 RAD/SEC
NO. OF POLES	2
STATOR RESISTANCE(Rs)	0.087
STATOR LEAKAGE INDUCTANCE(Ls)	0.8e-3
ROTOR LEAKAGE INDUCTANCE(Lr)	0.8e-3
MAGNETISING INDUCTANCE(Lm)	34.7e-3
ROTOR RESISTANCE(Rr)	0.228
INERTIA (J)	1.662
RATED VOLTAGE(L-L)	460V
External rotor resistance for wound rotor	3

V. CONCLUSION:

The proposed methodology for comparing DFIM and wound rotor induction motor by injecting fault at sensors using simulation modeling of induction motor drive shows that wound rotor induction motor attains comparable starting torque and starting current as compare to Doubly fed induction motor, but after the fault injection at the current sensors DFIM shows better performance as compare to wound rotor induction motor because all the measuring parameters speed , torque etc. attains steady state level quickly compare to woud rotor induction motor after the fault is removed by using different protective circuitry.

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VI. FUTURE SCOPE

The better comparsion between Doubly fed induction motor and wound rotor induction motor can be analyse if their comparison is measured by using intelligence technique

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