Simulation of 12-pulse Rectifier and H –bridge inverter used for Induction Melting Furnace

R.D.PATEL,

M.E.[Power System] Student, Department Of Electrical Engineering, S.K.Patel College Of Engineering Visnagar, Gujrat.

rakshit.p11@gmail.com

Abstract

Obtaining for variable dc voltage in industries 3-phase thyristor is used. 3-phase thyristor involve large lower level harmonics in the input currents. 6-phase thyristor produce comparatively less harmonics to 3-phase thyristor. For high power grid source application used 12-pulse thyristor rectifier involves two 6-pulse rectifier. These 12-pulse rectifier reducing harmonics content comparatively more to 3-phase and 6-phase. But 12-pulse rectifier include the (12m $\pm$ 1)th (m: integer) harmonics. This paper proposes to medium frequency induction melting furnace as a load on the power system.

Index terms:- induction melting furnace, 12 – pulse rectifier, H – bridge inerter.

1 INTRODUCTION

Different rectifier connect with system than it include lower – order harmonics in source current. In case of high power application more harmonics problem include. One of the solutions for this harmonics problem reduction is the utilization of active power filter, but this solution is more expensive. Another solution for harmonics reduction is installation of passive filter, than passive filter is mandatory to reduce source current harmonics problem introduced by the different rectifier to the power system. This solution creates expensive rectifier system and overall rectifier system is bulky[1].

Diode rectifier used passive component and switching devices for reduce harmonic problem, but they are create more complicated system include in high power grid application. The 6-pulse rectifier is involving most AC drive because of its low cost and simplest structure. The input current THD can exceed 100% with no harmonics filter with 5^{th}, 7^{th} and 11^{th} harmonics at full load condition. Harmonics filter with 5^{th}, 7^{th} and 11^{th} harmonics being dominant harmonics component. A 12-pulse rectifier involves two sets of 6-pulse rectifier is very popular for different types high power grid application. The multi-phase transformer can be an autotransformer or an isolated transformer with some phase displacement to provide two three-phase voltage sources that cancel the 5th and 7th harmonics. 12-pulse rectifier with a delta-delta-wye isolation transformer and the resulting input current waveform where 11th and 13th harmonics are the dominant harmonic components[1].

In this paper use a series connected 12-pulse thyristor rectifier connect with the H – bridge inverter and represented the coreless induction melting furnace circuit diagram. This diagram represented the time varying parallel RLC circuit model. In

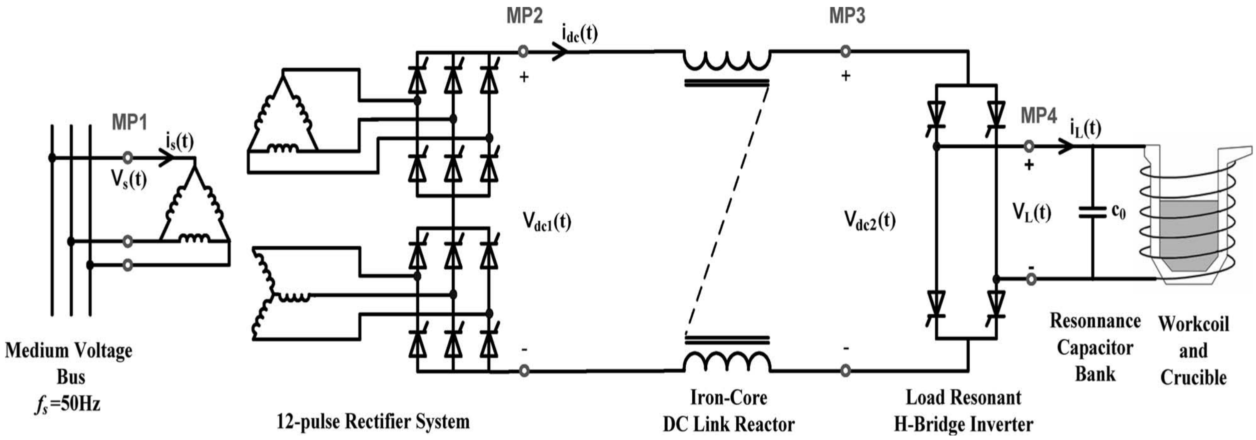


Figure 1. Simplified power circuit diagram of a IMF [2]

particularly in this addition investigate of the input, output voltage and current of the system.

2 SYSTEM DESCRIPTION

Simple power circuit diagram of induction melting furnace show in figure 1. During the melting period variable frequency supplied by load resonant single phase H – bridge inverter circuit for maximize the power transferred to the work coil. Resonant capacitor bank is connected across the work coil for maintain the resonant situation. 12 – Pulse rectifier is connect with the H – bridge inverter circuit via dc link reactor. It is one types of dc choke. It also serves as a current limiting reactor against fault on the inerter side. 12 – Pulse rectifier system is formed by using a three phase Δ–Δ/Y transformer bank and two six pulse rectifier connected in series. Operation of the induction melting furnace system shown in figure 1 and discussed their input, output voltage and current result in next section.

Field data are collected on a 25-t 12-MVA IMF system for several melting cycles at measurement points MP1–MP4 in Fig. 1, by using a custom-designed power quality measurement system which is programmed to collect raw data. Each voltage and current quantity is sampled at a rate of 12.8 kS/s with time synchronization. At MP1, voltage and current signal are taken from secondaries of conventional current and voltage transformers. At MP2–MP4, voltage signals are taken by the use of high-voltage active differential probes, and current signals are taken by the use of coils. Some sample records of currents and voltages at measurement points MP1–MP4 are shown in Figs. 7–10, respectively [2].

3 12–PULSES RECTIFIER SIMULATION RESULT

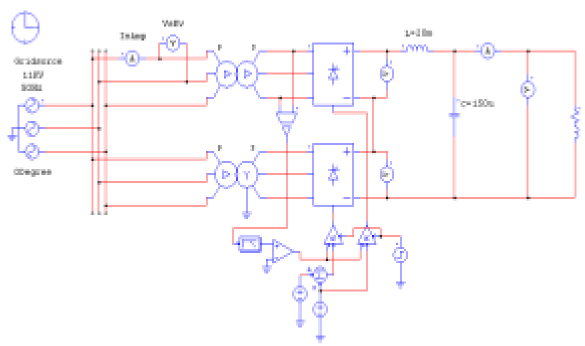


Figure 2 Simulation result of 12 – pulse rectifier current and voltage of input, output.

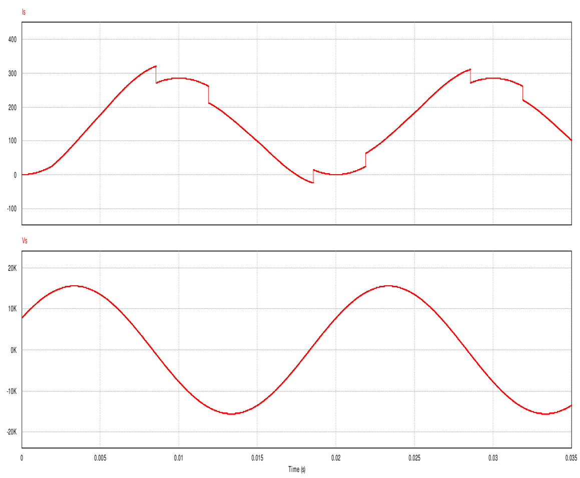
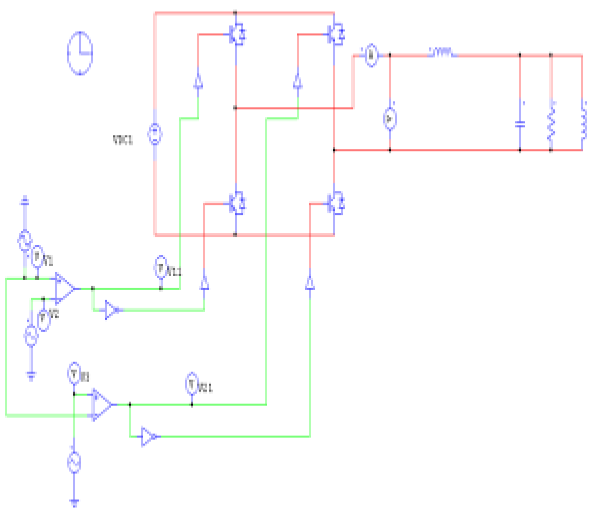


Figure 3 Source current, source voltage.



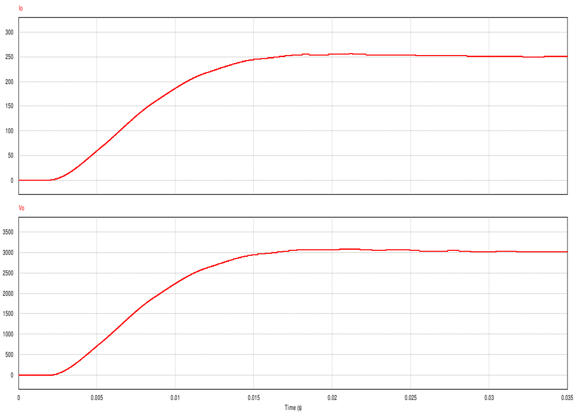


Figure 4 output current and output voltage

4 H–BRIDGE INVERTER SIMULATION RESULT

Figure 5 Open loop H – bridge inverter circuit

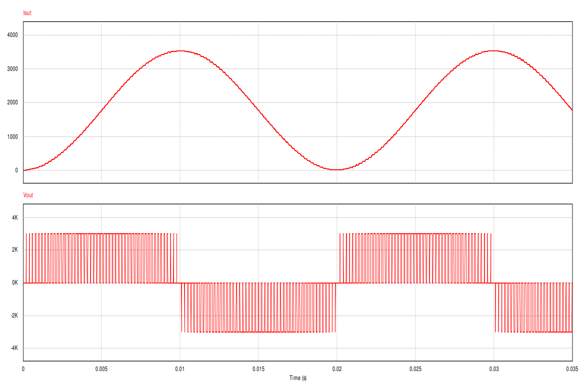
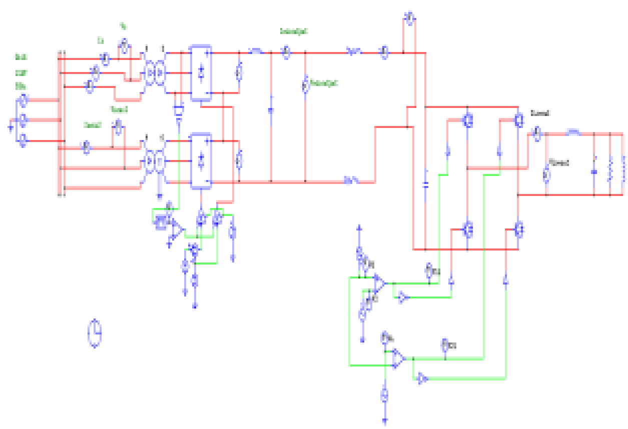


Figure 6 Iout and Vout for H – bridge inverter

5 12 - PULSES RECTIFIER CONECT WITH H – BRIDGE INVERTER



At MP 1

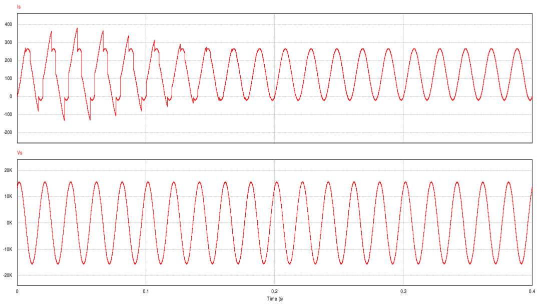


Figure 7 Supply voltage and current wave form at MP 1

At MP 2

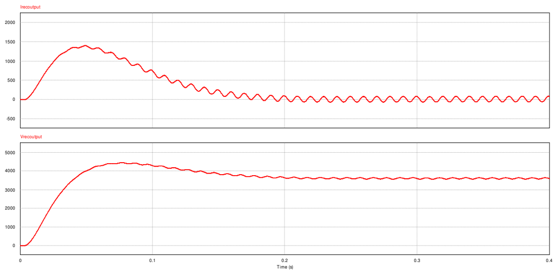


Figure 8 DC – link voltage and current wave form at MP 2

At MP 3

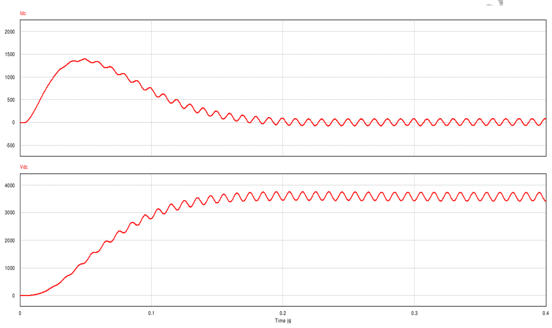


Figure 9 Inverter output voltage and current wave form at MP 4

CONCLUSION

Simulation of the 12 – pulse rectifier system and H – bridge inverter circuit input, output

At MP 4

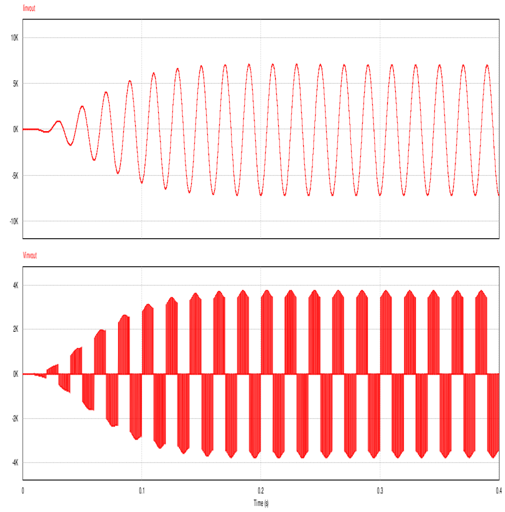


Figure 10 DC – link voltage and current wave form At MP 4

voltage and current waveform. Than after combine both

circuit and make induction melting system and measure voltage and current.

REFERENCE

[1] Shoji Fukuda, Senior Member, IEEE, and Issei Hiei, “Auxiliary Supply-Assisted 12-Pulse Phase-Controlled Rectifiers With Reduced Input Current Harmonics.” IEEE transaction on industry application, vol. 44, NO.1, January/February 2008.

[2] Ilker Yılmaz, Muammer Ermi¸s, and IssikÇadırcı, “Medium-Frequency Induction Melting Furnaces as a Load on The Power System” IEEE Trans. On industry application, vol. 48, No. 4, july/august 2012.