Abstract: - This report is an update on the research project involving the implementation of a DSP based power electronics interface for alternate/renewable energy systems, that was funded by the Department of Energy under the Inventions and Innovations program.

Objective:

The objective of this research is to develop an utility interface (dc to ac converter) suitable to interconnect alternate/renewable energy sources to the utility system. The DSP based power electronics interface in comparison with existing methods will excel in terms of efficiency, reliability and cost. Moreover DSP-based control provides the flexibility to upgrade/modify control algorithms to meet specific system requirements. The proposed interface will be capable of maintaining stiffness of the ac voltages at the point of common coupling regardless of variation in the input dc bus voltage. This will be achieved without the addition of any extra components to the basic interface topology but by inherently controlling the inverter switching strategy in accordance to the input voltage variation.

Technical Progress:

The block diagram of the proposed DSP based interface is shown in Figure 1. Texas Instruments DSP TMS320F240 will be used in the implementation of the controller. The DSP(TMS320F240) which is chosen to implement the proposed algorithm not only provides the computational capability but also integrates all the power electronics peripherals necessary to implement any such system. These peripherals include PWM generators, timers, ADC etc.

Fig. 1 Block diagram of the proposed DSP based interface.

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Hardware setup:

The main controller setup (an Evaluation board for TMS320F240) for this project has been obtained from Texas Instruments under University Support program and is shown in Figure 2. Relevant software for the evaluation board has also been obtained. These software include –

- XDS510PP Emulator
- TMS320C2xx C source debugger/ Linker (software)

Figure 3 shows a voltage source inverter module which has been purchased from Spectrum Digital Inc. This module has all the necessary power devices (MOSFETs) and the necessary MOSFET driver circuits.

In addition to the two boards shown in Figures 2 and 3, a Lab drive Interface module is used to interface the DSP module with the three phase pulse width modulated (PWM) inverter module. The block diagram of the hardware setup is shown in Figure 4 and Figure 5. A 1/3 horse power ac induction motor is being used as the three phase load for the inverter.

Software Development:

The software development for implementing the proposed algorithm is underway. Software blocks that are independent of the algorithm to be used, have been developed. These include – PWM waveform generation, analog to digital conversion, digital to analog conversion.

Technical Difficulties:

A short circuited component was detected in the voltage source inverter module. Testing is underway to replace the faulted component and bring the hardware back into operation. The voltage source inverter being available in a module form makes testing and replacement of components within it complicated.

Activities for the coming period:

- Integrating the software modules.
- Testing the software in conjunction with the hardware.
- Start working on a technical paper to be submitted to the IEEE Power Engineering Society.

Figure 2 TMS320F240 evaluation board.

Figure 3 Three Phase Voltage source inverter .

Figure 4: DSP and Lab drive Interface Module

Figure 5 : Three-Phase Inverter Module Interface