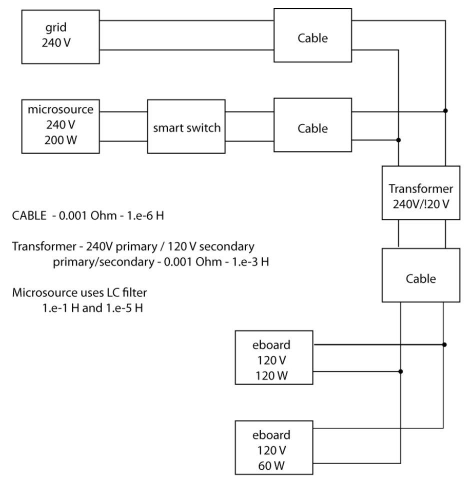
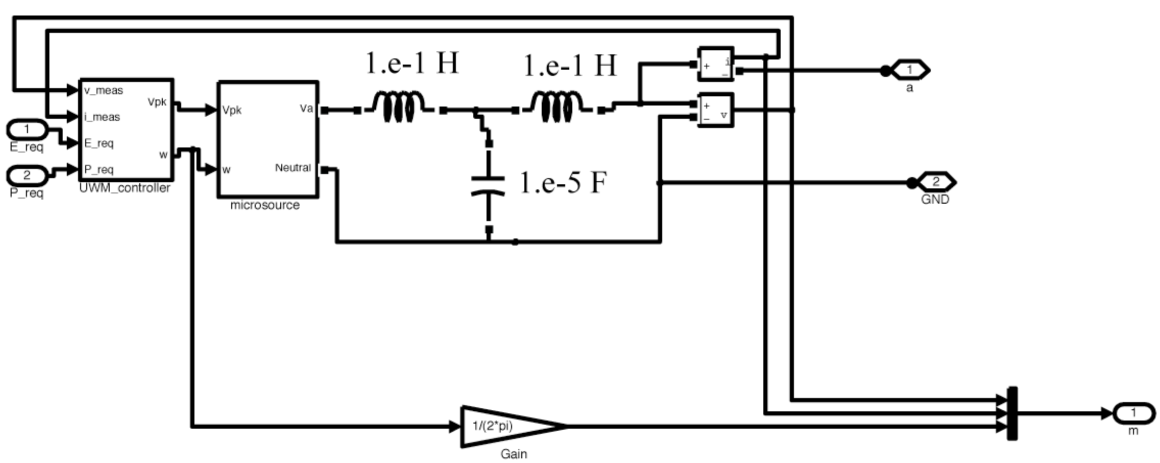
MONTHLY PROGRESS REPORT	
Contractor Name: University of Notre Dame (Michael Lemmon)	
Contractor Address: Office of Research, 940 Grace Hall, Notre Dame, IN 46556	
Contract/Purchase Order No. W9132T-10-C-0008 (prime contract no.)	Task Order No.
Project Title: Design and Simulation of Intelligent Control Architecture for Military Microgrids	
Period Covered: March 1 2011 – April 1, 2011	
POC/COR (Reference Paragraph 5 of the SOW):	
Achievements (Describe by task. Add additional tasks, if needed.): task numbers refer to tasks in Odyssian's original contract	
Task II: Model and Simulate Intelligent Microgrid Developed and tested single-phase microgrid using the 200 W – 240 V inverters being supplied by UIUC.	
Task III: Distributed Control Algorithm Development No activity	
Task VI: Develop Wireless Communication No activity	
Task VII: Develop Wireless Distributed Control No activity	
Problems Encountered (Describe by task. Add additional tasks, if needed):	
Task II: None	
Task III: None	
Task VI: None	
Task VII: None	
Open Items (List items that require action by the Contractor or the Government):s No open items	

Summary Assessment and Forecast (Provide an overall assessment of the work and a forecast of contract completion):

In February we received information from Odyssian concerning the single-phase demonstration that was to be conducted at the company. The main items we became aware of were 1) that the microsources would be 240V/200W sources and 2) that the Odyssian testbed would be single phase. We began developing a single-phase simulation of the testbed, making some modifications that were needed to ensure that the simulation was able to execute. The modified testbed block diagram is shown to the right. This system consists of the main grid, a single inverter connected through a "smart" switch, and step-down transformer (240V to 120V) and two eboard modules. One e-board module has a critical load of 120 W and the other has a non-critical load of 60 W.



The single-phase inverter models the system as a voltage source with an LC filter. To preserve system stability the inductor in this filter had to be chosen rather large (1.e-1). Subsequent discussions with P. Krein (UIUC) indicated that they were connecting their inverters as current sources, rather than voltage sources, to avoid such large components. A block diagram for the simPower voltage-source inverter is shown below.

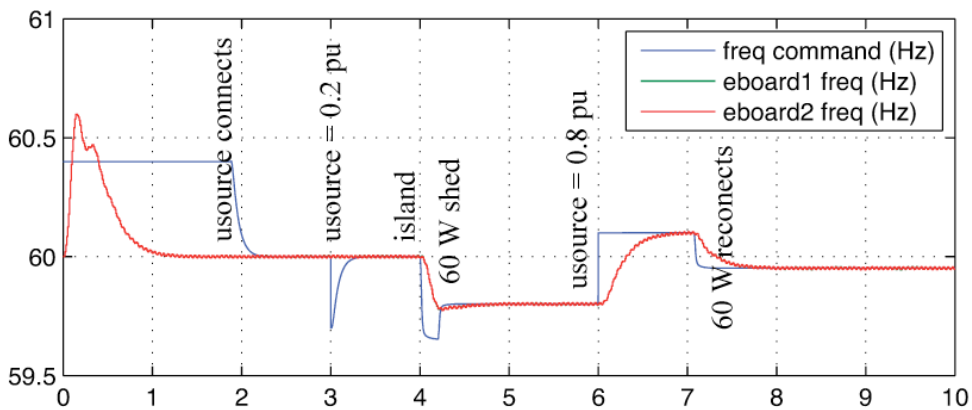


The preceding system was simulated with the following events.

Time seconds	Event
0.0	Simulation starts with main grid connected, e-boards disconnected, inverter disconnected (Preq= 0.8 pu)
0.1	e-board loads (180 W) connected.

2.0	Inverter (Preq=0.8 pu) connects.
3.0	Inverter setpoint reduced to Preq = 0.2 pu.
4.0	Microgrid islands.
4.3	e-board sheds non-critical (60W) load
6.0	Inverter setpoint increased to Preq = 0.8 pu.
7.1	e-board reconnects non-cirtial (60W) load.

The following plot shows the inverter's commanded frequency and the e-board's estimated frequency. At the beginning the commanded frequency and estimated frequency don't agree because the inverter is not connected to the microgrid. Once the inverter connects (2 seconds), the estimated and commanded frequency agree with each other. At 3 seconds into the simulation, the inverter's Preq is reduced to 0.2 pu. This results in a transient in the commanded frequency. Because the main grid is still connected to the grid, there is no drop in the estimated frequency. At 4 seconds into the simulation the main grid disconnects. We see a drop in the frequency which causes the e-board to shed 60W of non-critical load at 4.3 seconds. Upon shedding the load, the frequency stabilizes at about 59.8 Hz. When the inverter Preq is increased to 0.8 pu at 6 seconds, the frequency rises to 60.1 Hz and the e-board reconnects the non-critical load. This system works as expected.



Future work will begin integrating the dispatch logic into this simulation with at least three inverters in the system.