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This document verifies the validity of our SimPower model against the exisiting UWM simulation results. We compare our simulation results with the results in Test_Results_082508W97.doc provided by UWM, which we will simply denote as the UWM report. Our SimPower simulation considers a three-bus network example which operates in island mode, and an additional load is added to bus 2 at time $t = 10s$. The example is shown in figure 1. The network consists of three generators with power set point $0.4, 0.8, 0.6$ (pu) respectively. There are three active loads which request $0.96, 0.72, 0.48$ (pu) active power, respectively. Transmission lines are assumed to have zero resistance and all have impedances of $z = 0.0039j$. Each generator has generating limits between 0pu and 1pu. Each transmission line has power flow limits between -0.4pu to 0.4pu. The cost functions of the three generators are: $2.0 + 0.1p + 0.1p^2$, $3.0 + 1.8p + 0.1p^2$, $1.0 + 0.5p + 0.1p^2$. All generators come online at $t = 0$s with their initial fixed power set points. At $t = 3$s, we switch from the fixed power set point scheme to our event-triggered set point scheme. At $t = 10$s, the third load is added to bus 2.

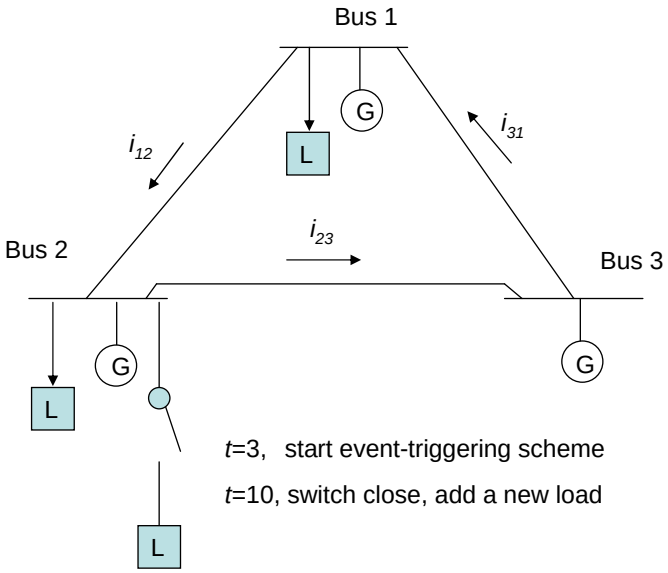

Figure 1: Three generator simulation model

For comparison purposes, we only plot the transient behavior of the system before and after we add an additional load at time $t = 10s$ in the following figures. We consider two different test scenarios, one of which only uses the fixed power set point (0.4,0.8,0.6 (pu)) strategy. The simulation result in this case shows that the bus voltage, current, generator power, load power, generator frequency exhibit similar transient behavavior as shown in the UWM report. The time-

scale of the transient behavior also matches. This shows that our SimPower simulation does capture the transient behavior of the system. The second simulation tests the case when we adjust the power setpoint using our event-triggered strategy. In this case, the generator's active power approaches a new steady state that is the system's economic optimal point. Transients are also observed in the system. We can also see that in this case, we have much better power quality (frequency very close to $60Hz$) compared to the fixed setpoint case.

Figure 2 and 3 plot the phase a voltage and current of the three generators. The voltages are well kept at the desirable value, and the current slightly increases with the addition of an extra load. The behavior matches what happens in the UWM report (Figure 6.1.4, first two plots). The other two phases exhibit similar behavior and are not plotted here.

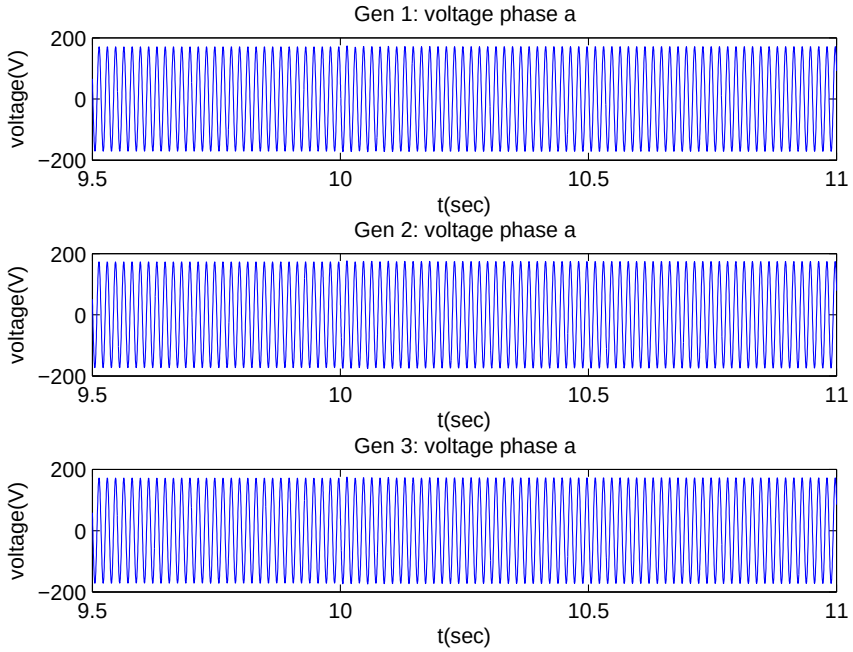

Figure 2: Fixed setpoint: Phase a voltage of three generators

Figure 4 plots the frequency of the three generators. Similar to figure 6.1.4 (the third plot) in the UWM report, it took about $0.2s$ before the frequency is stablized after the addition of a load.

Figure 5 plots the active power of the three generators. Similar to figure 6.1.4 (the fourth plot) in the UWM report, it took about $0.2s$ before the active power is stablized after the addition of a load.

Figure 6 plots the power of three loads. Again, we see a very obvious transient behavior which lasts about $0.3s$.

To summarize, the transient behavior of the system is indeed captured in our SimPower simula-

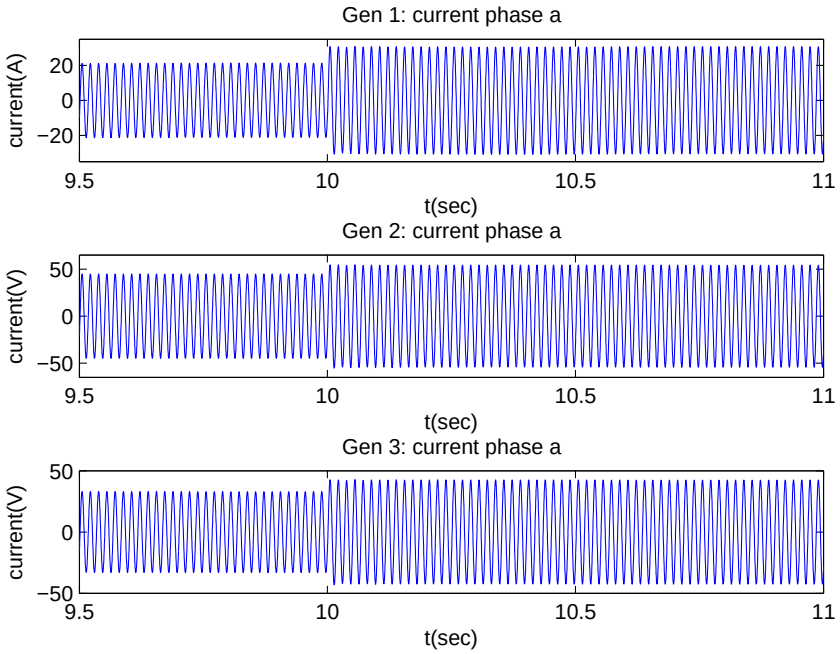

Figure 3: Fixed setpoint: Phase a current of three generators

tion.

The second set of simulation results which uses our event-triggered setpoint strategy is also shown below, from figure 7 to figure 11. If we look at the simulation results, the major difference we notice is that in the generator current in figure 8 and generator active power in figure 10, we notice a very obvious linear trend. We should emphasize that this is a result of the event-triggering scheme we used. Although there is a nice linear trend, we also see obvious transient after $t = 10s$, which is expected. In figure 10, the new steady state the generator power goes to is the new economic optimal point. If we compare figure 9 and figure 4, it is not difficult to see that the generator frequency in the event-triggered case is much closer to $60Hz$, which results in better power quality.

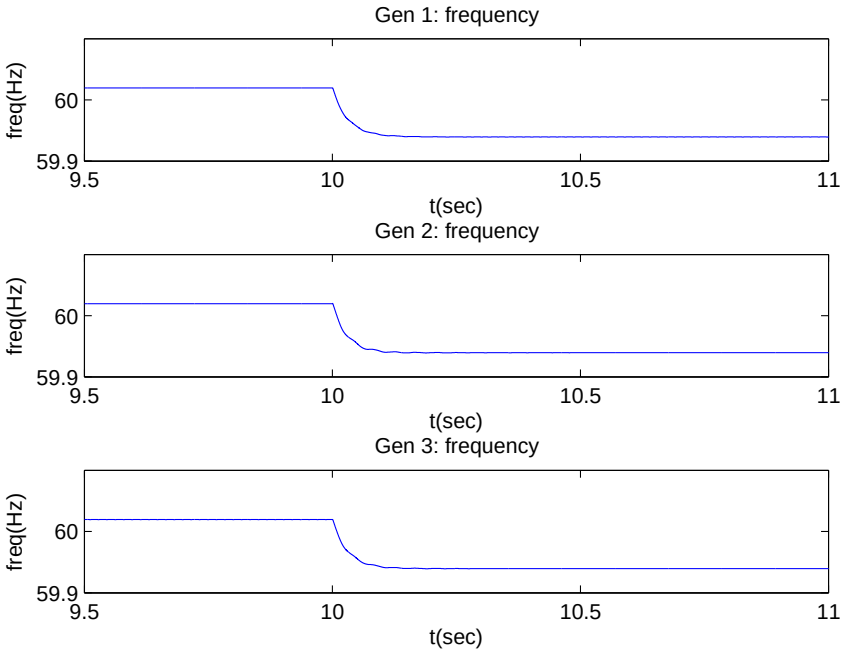

Figure 4: Fixed setpoint: Frequency of three generators

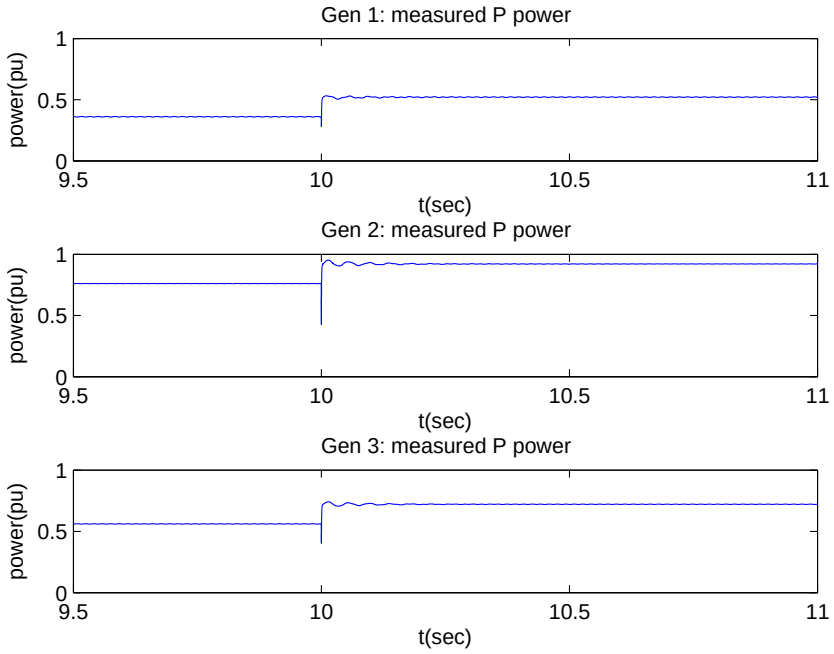

Figure 5: Fixed setpoint: Active power of three generators

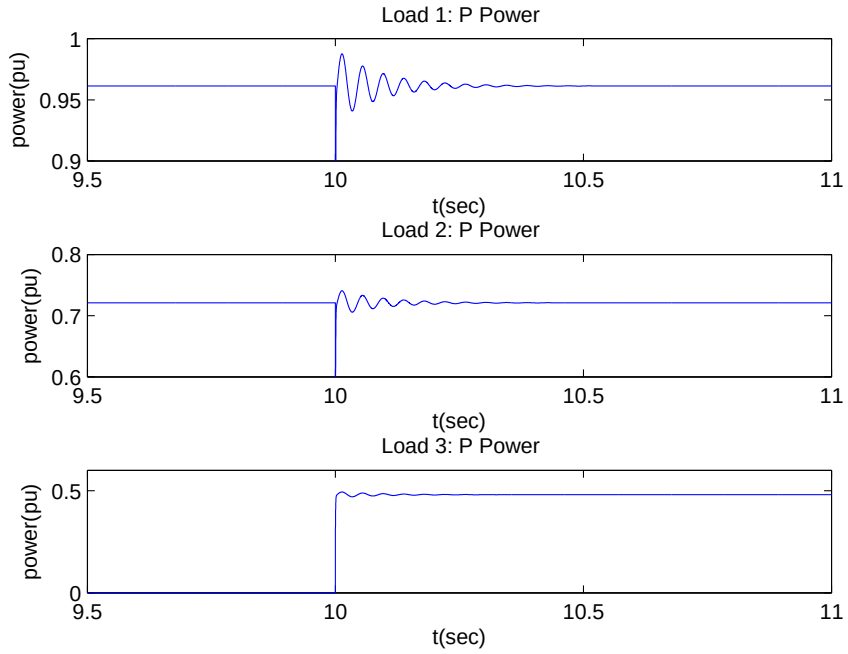

Figure 6: Fixed setpoint: Active power of three loads

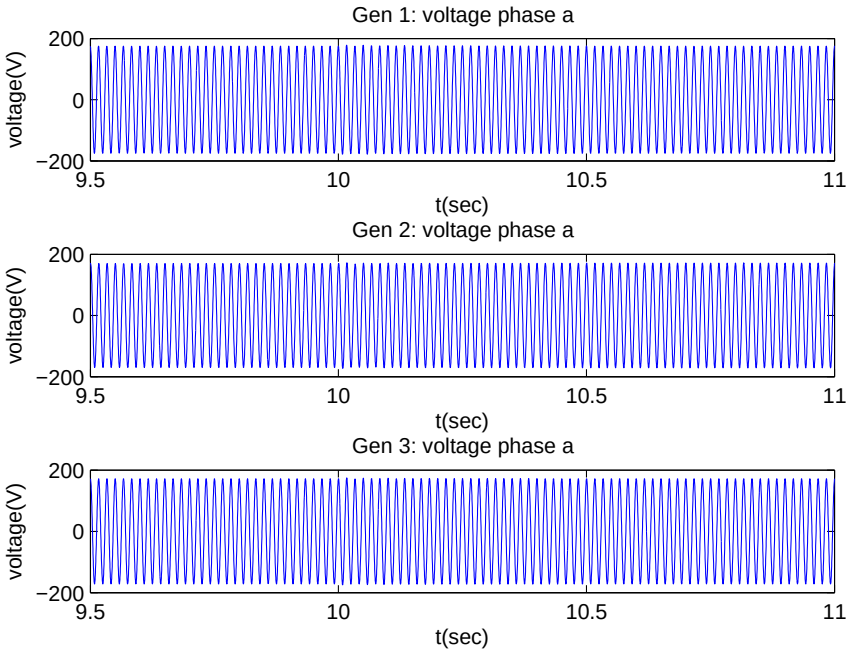

Figure 7: Event-triggered setpoint: Phase a voltage of three generators

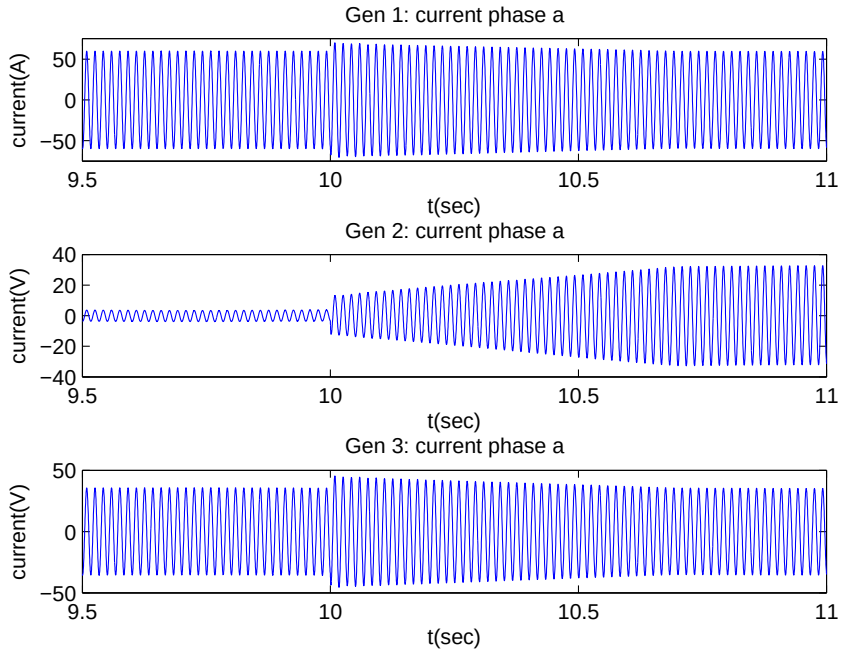

Figure 8: Event-triggered setpoint: Phase a current of three generators

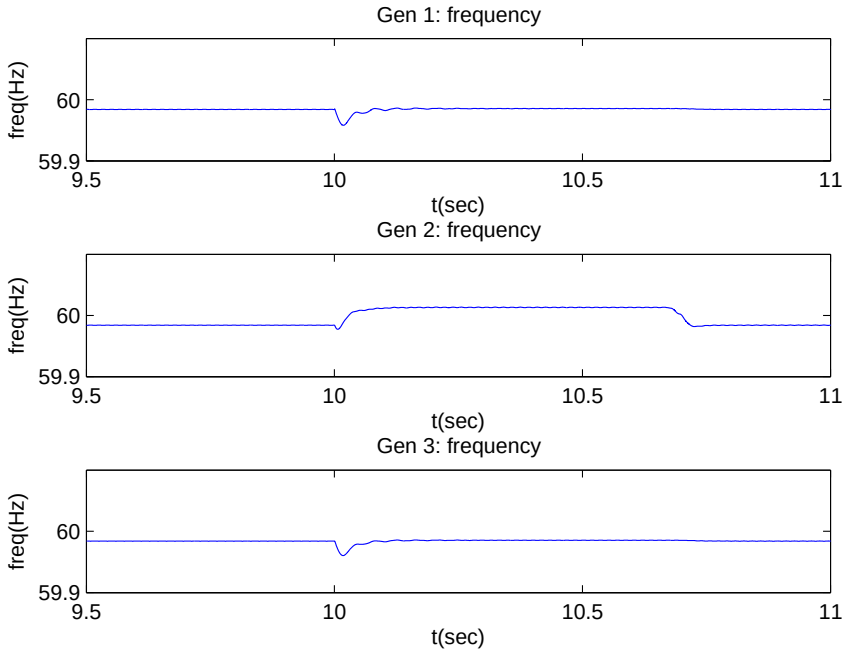

Figure 9: Event-triggered setpoint: Frequency of three generators

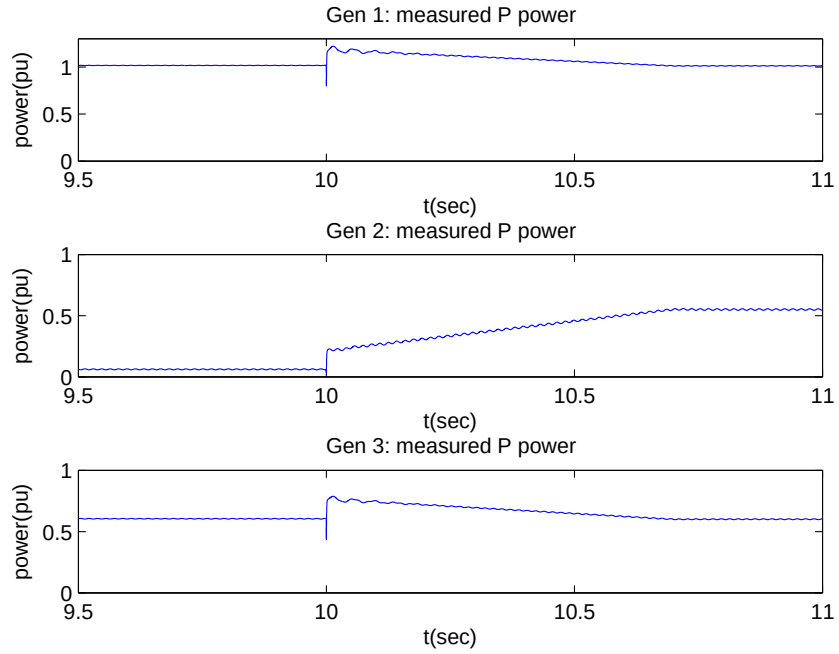

Figure 10: Event-triggered setpoint: Active power of three generators

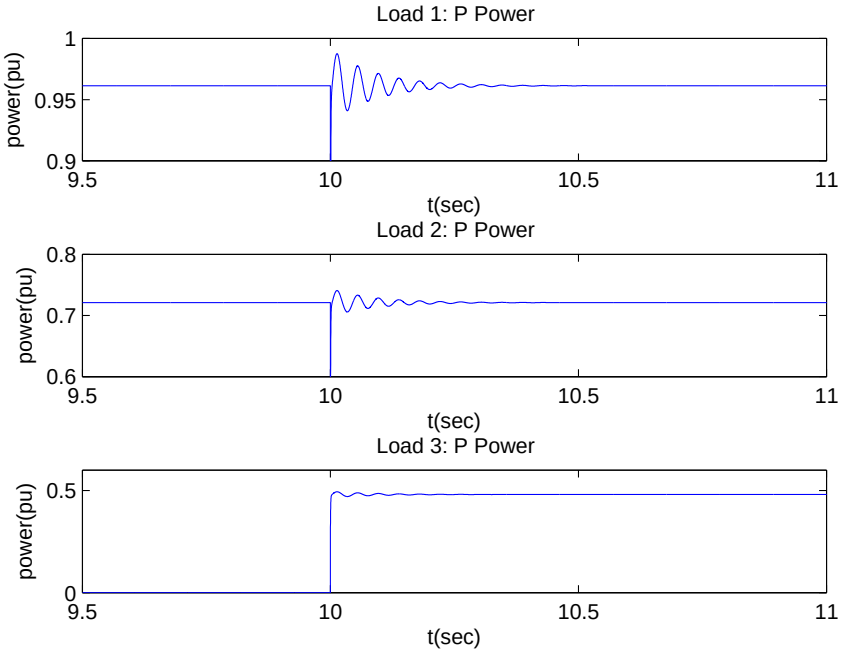

Figure 11: Event-triggered setpoint: Active power of three loads