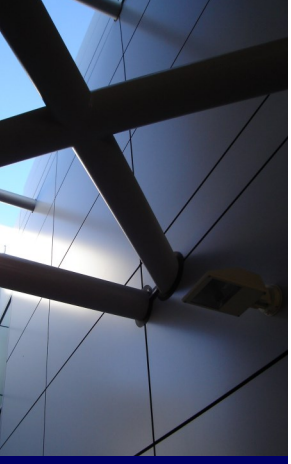

MECHANICAL ENGINEERING

*The Department of Mechanical Engineering presents:*

# *The Master's Dissertation Defense of:*

# *Eli Brewer*

## Tuesday, June 9, 2015
## 2PM, Bourns Hall A265

### Measurement of Fine Particles from Mobile and Stationary Sources, and Reducing the Air Conditioner Power Consumption in Hybrid Electric Vehicles

Master of Science, Graduate Program in Mechanical Engineering
University of California, Riverside, June 2015
Dr. Heejung Jung, Chairperson

We study the PM2.5 and ultrafine exhaust emissions from a new natural gas-fired turbine power facility to better understand air pollution in California. To characterize the emissions from new natural gas turbines, a series of tests were performed on a GE LMS100 gas turbine. These tests included particulate matter less than 2.5 µm in diameter (PM2.5) and wet chemical tests for SO2/SO3 and NH3, as well as ultrafine (less than 100 nm in diameter) particulate matter measurements. The turbine exhaust had an average particle number concentration that was 2.3x103 times higher than ambient air. The majority of these particles were nanoparticles; at the 100 nm size, stack particle concentrations were about 20 times higher than ambient, and increased to 3.9x104 times higher on average in the 2.5 - 3 nm particle size range. This study also found that ammonia emissions were higher than expected, but in compliance with permit conditions. This was possibly due to an ammonia imbalance entering the catalyst, some flue gas bypassing the catalyst, or not enough catalyst volume. SO3 accounted for an average of 23% of the total sulfur oxides emissions measured. While some of the SO3 is formed in the combustion process, it is likely that the majority formed as the SO2 in the combustion products passed across the oxidizing CO catalyst and SCR catalyst. The 100 MW turbine sampled in this study emitted particle loadings similar to those previously measured from turbines in the SCAQMD area, however, the turbine exhaust contained far more particles than ambient air.

The power consumed by an air conditioner accounts for a significant fraction of the total power used by hybrid and electric vehicles especially during summer. This study examined the effect of recirculation of cabin air on power consumption of mobile air conditioners both in-lab and on-road. Real time power consumption and vehicle mileage were recorded by an On Board Diagnostic (OBDII) monitor and carbon balance method. Vehicle mileage improved with increased cabin air recirculation. The recirculation of cabin air also significantly reduced in-cabin particle concentrations. Recirculation of cabin air is an excellent and immediate solution to increase vehicle mileage and improve cabin air quality.