University of Victoria | Graduate Studies

Notice of the Final Oral Examination
for the Degree of Master of Applied Science

of

ANAISSIA FRANCA

BEng (University of Victoria, 2015)

"Electricity Consumption and Battery Lifespan Estimation for Transit Electric Buses: Drivetrain Simulation and Electrochemical Modeling"

Department of Mechanical Engineering

Friday, March 9, 2018
10:00 A.M.
Engineering Office Wing
Room 106

Supervisory Committee:
Dr. Curran Crawford, Department of Mechanical Engineering, University of Victoria (Co-Supervisor)
Dr. Ned Djilali, Department of Mechanical Engineering, UVic (Co-Supervisor)

External Examiner:
Dr. Ralph Evins, Department of Civil Engineering, UVic

Chair of Oral Examination:
Dr. Leslie Saxon, Department of Linguistics, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

This thesis presents a battery electric bus energy consumption model (ECONS-M) coupled with an electrochemical battery capacity fade model (CFM). The underlying goals of the project were to develop analytical tools to support the integration of battery electric buses. ECONS-M projects the operating costs of electric bus and the potential emission reductions compared to diesel vehicles for a chosen transit route. CFM aims to predict the battery pack lifetime expected under the specific driving conditions of the route. A case study was run for a transit route in Victoria, BC chosen as a candidate to deploy a 2013 BYD electric bus. The novelty of this work mainly lays in its application to battery electric buses, as well as in the coupling of the ECONS-M and the electrochemical model to predict how long the batteries can last if the electric bus is deployed on a specific transit route everyday. An in-depot charging strategy is the only strategy examined in this thesis due to the charging rate limitations of the electrochemical model. The ECONS-M is currently being utilized in industry for the preparations of Phase I and II of the Pan-Canadian Electric Bus Demonstration & Integration Trial led by the Canadian Urban Transit Research and Innovation Consortium (CUTRIC). This project aims to deploy up to 20 battery electric buses for phase I and 60 electric buses for phase II across Canada to support the standardization of overhead fast chargers and in-depot chargers, which in a first in the world. At this time, the developed CFM can not support any final claims due to the lack of electrochemical data in the literature for the high capacity lithium-ion cells used in electric buses. This opens the door to more research in the ageing testing of batteries for heavy-duty applications.