APEGM

Member in Training (MIT)/Supervisor/Mentor
PROGRESS REPORT FORM
Instructions to MIT, Supervisor and Mentor (If Applicable)

Note: All MITs are required to have a professional member take responsibility for their work. If the MIT is a GIT, he/she must have either a P.Geo or a P.Eng. with geological expertise take responsibility for his/her work. If the MIT is an EIT, he/she must have a professional engineer take responsibility for his/her work. If the direct supervisor is not a professional member then the MIT is required to find a professional member either from inside or outside the company to act as a mentor and to take professional responsibility for their work.

Note: This form is to be submitted by the MIT, their direct supervisor and their mentor (if applicable) for every six month employment period, or/and whenever there is a change in supervision / employment. The following procedure should be followed:

1. ***MIT completes his/her portion of this report including the Professional development and Volunteer service reports downloaded from the APEGM website.***
2. ***MIT submits the report to APEGM, keeps a copy and submits one copy each to supervisor and mentor (if applicable)***
3. ***Supervisor completes the Supervisor/Mentor declaration shown on the next page, completes his/her portion of the report and submits the entire report to APEGM.***
4. ***Mentor (if applicable) completes the Supervisor/Mentor declaration shown on the next page, completes his/her portion of the report and submits the entire report to APEGM.***

If supervisor and/ or mentor portions of the report can be completed at the same time as the MIT's report it would be acceptable for the report to be submitted as one (or two) document(s). If, however, the report cannot be submitted on time (within 8 months of the start of the reporting period), it is advisable that the MIT submit a copy to APEGM before sending it to his/her supervisor and his/her mentor (if applicable). Otherwise, the MIT will be penalized for late reporting.

APEGM encourages collaborative reporting between the MIT, supervisor and the mentor, however, should the supervisor or mentor prefer to have his or her reports remain confidential from the MIT we ask that it be so indicated in the supervisor or mentor declaration on the following page.
In the event that there are two or more consecutive supervisors (or two or more consecutive mentors) for one six month reporting period – e.g. one supervisor for 4 months and another supervisor for the next 2 months, more than one progress report will be required to cover the 6 month period in question.
***Note to Master's and PhD students**: Experience credit can be claimed for project and thesis work only. Normally, the candidate should submit his/her progress report for every six month period, and complete the **Post-graduate Student Experience Allocation table** near the end of this report.*

After January 1, 2004, APEGM is subject to PIPEDA. For details on APE GM's Privacy Policy in general and how it relates to this report in particular please see www.apegm.mb.ca after January 1, 2004.

Declarations of Supervisor or Mentor **PLEASE READ & SIGN**

Section A: to be completed by a professional member registered in the location of the MIT's place of employment

A1. I __________________ have been registered as a professional engineer ☐ geoscientist ☐ (check one) since
(Name)
___________ in _____________ with expertise in ________________.
(year) *(province)* *(discipline)*

A2. I have taken professional responsibility for the quality of the MIT's work as described in this report for the period from _______________ to ________________. See Note 1. **Signed:** _________________ **Date:** ________________
(d/m/y) *(d/m/y)*

Section B: to be completed by a supervisor if the supervisor is **not** a professional member registered in the location of the MIT's place of employment

B1. I __________________ am qualified to take responsibility for the quality of the MIT's work by reason of the following:
____.

B2. I have taken responsibility for the quality of the MIT's work as described in this report for the period from _______________ to
(d/m/y)
________________. See Note 1. **Signed:** __________________ **Date:** _____________________
(d/m/y)

Section C: THIS SECTION MUST BE COMPLETED BY THE SUPERVISOR & THE PROFESSIONAL MEMBER

C1. In an effort to ensure the timely assessment of this report, I will endeavor to complete my portion of this report no later than a month after receiving the report from the MIT.
☐ Yes ☐ No If the answer is No, please provide a reason: __________________________

C2. In my opinion, the MIT has completed ___________ months equivalent to full time experience in this report period. See Note 2.
It is important that you answer this question.

C3. I do ☐ or do not ☐ authorize APEGM to provide information contained in this report or a copy of this report to the MIT. See Note 3. **Signed:** __________________ **Date:** ______________________

Note 1: The reporting period should cover the same period as the MIT reporting period shown on item 1. If the reporting period for which you have taken professional responsibility does not correspond to the MIT reporting period shown on item 1 of the progress report please explain why: ____.

Note 2: normal vacation, bank time, family leave, for which the employee is entitled. is not discounted. Overtime is not counted extra. If, however, the MIT has been absent for a significant amount of time due to special circumstances - disability leave for example, this time should be discounted from the full time number of months of experience. If the MIT has made sub-standard progress in this time frame, the number of months given may also be discounted, if you feel it is warranted. If the number of months is discounted for any reason, please provide an explanation in section 10. If the time is discounted for any reason, APEGM reserves the right to indicate the fact that the time was discounted to the MIT and to indicate that the time was discounted at the request of the supervisor/mentor. ***Note to supervisors of Master's and PhD students****: Experience credit can be claimed for certain work only. Generally, the candidate should submit his/her progress report for every six month period, and have the supervisor indicate the number of months of equivalent to full time thesis work that was done during these six months. See* ***: Post-graduate Experience Allocation*** *table on page 9.*

Note 3: If authorization is not granted, for our information purposes only and recognizing that you are not obligated to do so, please provide a reason for withholding this authorization: ____.

Note 4: Each supervisor and mentor should complete a separate declaration page.

1. MIT to complete all portions of this report except for areas <u>specifically</u> marked "to be completed by supervisor/mentor".

Note: Before completing this form, please familiarize yourself with APEGM's document entitled "Nature of Acceptable Work Experience". An important aspect of this program is progression in responsibility and complexity of work therefore the answers to question #4 and #5 are of particular interest. You are encouraged to use this report as a guide for both yourself and your supervisor in order to indicate the kind of progress you are making as a member-in-training.

I, ____

Surname Given Name Middle Name(s)

(FULL LEGAL NAME)

Employed ☐ Enrolled in post-grad study (see <u>post-grad exp. alloc. table</u>)☐ Or Unemployed ☐

By ____

Company Name Address Postal Code Phone Number

____

Company Email Home Address (See Note 1) Home Postal Code Home Phone Number

hereby submit the following report on my Pre-Registration Program participation from

____________________ to ____________________

(d/m/y) (d/m/y)

During this period, I was employed by:

____

Company Name Address Postal Code Phone Number

____

Company Email

as ______________________________ under the immediate supervision

Description of position held

of ____

Supervisor's Name (see Note 2) Present Address Postal Code

____

Supervisor's Phone No. Supervisor's Email

If your supervisor was not a P.Eng. or P.Geo. registered in Manitoba please provide the name of the professional member who is taking responsibility for your work during this period (mentor):

____

Mentor's Name (See Note 2) Present Address Postal Code

____

Mentor's Phone No. Mentor's Email

Note 1: Provision of home information is voluntary. See see Privacy Policy at www.apegm.mb.ca for further details.
Note 2: Under PIPEDA, you may not give any information other than the name, title, business address and business phone number of an individual without the consent of that individual. Please see Privacy Policy at www.apegm.mb.ca for further details.

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2. Work Experience:

2.1 Please give a description of your Engineering/Geoscientific Work Experience for the period noted in question #1, **including** information in support of your responses to questions **2.2, 2.3, 2.4** and **2.6**. Append additional sheets as necessary:

Note: This report documents 8 years of engineering experience, which is based on my notes, weekly reports, progress reports, test and validation reports and other electronic documents (i.e. emails). It will also include courses I took for my professional development during this time period. I would like to claim the 48 months of engineering experience based on this MIT report.

August to December of 2000

Position Held: Electrical Control Technician, Research and Development (R&D)

As a new employee of the Research and Development (R&D) Department at New Flyer Industries Ltd, I was given the opportunity to review and study the Transit Bus electrical system. My previous experience with SLC 500 AB PLC software and hardware controls, Device-Net network protocol, mobile transport and drilling for the mining industry was beneficial in helping me understand my new role in the company. I had gained some background knowledge in Standby Power Generation, Manufacturing Processes, Six Sigma, MBTF, SPC and QS-9000 when I worked as a Facilities Engineer at Motorola Philippines.

I was involved in a project called "Invero". My responsibilities were to test, implement, design and program the Programmable Logic Controller (PLC) of a coach electrical system. The PLC system is an Invero coach called the Vehicle Control System or "VCOM". It is composed of the PLC system and the Human Machine Interface (HMI), which are both communicated under a network protocol known as "Device Net".

APPLICATION OF THEORY

a) Comparison between Flat-Media Trunk Cable and Round Media Trunk Cable

- I was tasked to analyze and evaluate the two different Device-Net communication cables (Flat Media vs. Round Media) to determine which cable is reliable and production friendly. We found out that the Flat Media trunk cable was not suitable for transit coach application because the Vampire connector was not a sealed type and it could be located at high condensation when adjacent to the AC area. The corrosion on vampire clamps caused it to lose its continuity as well as its communication link between the PC and the modules. If the vampire teeth were not properly installed, it would either bend or slice through the insulation due to the transit coach vibration, which would result in an intermittent short or loose connection.
- The Round Media trunk cable had a sealed in-between screw connector that minimized corrosion when exposed to high condensation and a corrosive environment. It could withstand vibration and could be twisted and flexed nicely on the bend corner of the bus. If there was a problem with the cable, the maintenance people could just remove the segment or a drop of the cable and replace it with a new one.

b) Device-Net Communication

- I was involved in evaluating the Device-Net network protocol to see the advantages over the current AB SLC Remote I/O system, which was used at that time on all New Flyer low floor coaches. There were several advantages of the Device-Net over the proprietary Allen Bradley system such as a higher network speed (i.e. Device-Net 500 Kbps versus Remote I/O 57 Kbps), an open CAN network, a robust communication system (design for high level of pollution, primarily due to Electromagnetic Interference), an efficient error detection mechanism and a non-destructive bit wise arbitration method.

c) Uninterruptible Power Supply (UPS) System

- I evaluated the "Always On" 24 VDC UPS system, which provided power for 5 minutes and protected the on-board computer system (AB 6181) from any sudden power interruption during starting of an engine. The UPS system could operate to a minimum input voltage of 19.5 VDC and to a maximum input voltage of 32 VDC. It used UPS batteries for back-up power for the UPS system and for the on-board computer. The UPS system was implemented on demo production coach SR708.

d) Research on Alternative AGM Battery

- We used Sonnenshein AGM batteries after extensive research due to the following reasons:
  1. Deep-cycle application
  2. It had a wide temperature range between –30C to 50C, which was suited for mobile or transit bus applications.
  3. Higher power density per cell compared to lead acid batteries
  4. It had an expected float life of 4 to 5 years.
  5. The Dryfit Battery utilized a sealed valve regulated system. There were no acid fumes or potential for electrolyte spillage under normal operating conditions. The AGM battery was installed inside the Secure Diagnostic Box (SDS) behind the driver's seat, which provided power to the UPS/Computer On-Board system.

e) In-house Passenger Control Simulation

- We simulated a passenger counter in the R & D department by using two Allen Bradley (AB) Photo Sensors to see if we could replace the supplier passenger counter. The goal was to provide an NF passenger counter system as an alternative to a supplier passenger counter system. We put each photo sensor on door A and door B and connected it to the Device-network, which communicated to an on-board computer. I created the graphics for the Human Interface Machine (HMI) program showing the two doors with a sensor, total number of people entering/leaving the room and number of people who left the room. We found out after several days of testing there was an error margin of +/-10%. There were several questions at that time, such as how to mount the sensor on the door inside the coach. There was also a concern over a situation where two or more people are trying to enter at the same time or two or more people are trying to enter and leave the coach simultaneously. The project was later abandoned due to lack of in-house experience, as well as lack of time and resources to continue.

f) Human Machine Interface Project

- I was assigned to learn and create a Human Interface Program (HMI) using Rockwell Software RSView32 Developer Package. The design concept was to provide the maintenance group with the quick graphic snapshot of the status of the coach, a data log as well as error codes stored in an Access Database. The HMI program illustrated the coach graphics and each device (e.g. turn signals flashing on the screen whenever turn signals are activated). The project was carried-on until the better half of 2001.

g) Pico Controller Implementation

- Pico Controller is an electronic control relay with built-in logic, timer, counter, and real-timer function. Pico is a control and input device rolled into one, which can perform many different tasks such as a Master Run System. You can also program the logic without using a laptop or programming software as there is an already built-in screen that will allow you to program right into the controller. With the use of the Pico Controller, we solved the following issues below:
  - Transfer power of the UPS from auxiliary to main power if the back-up batteries are already low in power.
  - Set the time to be synchronized with the Transit Property Schedule (i.e. different time zones).
  - Reduce the cost per unit if we install additional controllers like the Leo.
  - Program the logic according to what we desired to operate without any difficulty.
  - Reduce the amount of current consumption running at 24 volts due to limited battery resources.
  - Due to the smaller footprint of the controller, it can be installed with its limited real estate inside the PC panel.
  - Reduce the start up time of 1 minute and 40 seconds boot time of the onboard computer to less than 6 seconds and at the same time bypass the timer once the master run switch is in day night run position.

PRACTICAL EXPERIENCE

- I helped to install the harnesses of the Demo coach SR616 and performed the Electrical Checkout procedure to ensure all Electrical components and devices were working properly.

- I studied the Rockwell Software called ControlLogix to help me understand how to install, debug and test the software on Allen Bradley (AB) Industrial Computer 6181. The AB 6181 computer had 250 Mhz Pentium II MMX, 256MB RAM and 2GB of Hard Disk Space which ran on Windows NT operating system. The AB 6181 computer would be the brain of the transit bus electrical system, which controlled the coach doors, interior lights, kneeling and ramp system, turn signal lights, tail and clearance lights and more.

- I attended an Employee Orientation training given by the Human Resources Department, which provided me with materials for employee benefits, rules and regulation and company policies.

- I worked with the supplier "Always On" and I received the new FB3001TB Uninterruptible Power Supply (UPS) design specs revision 5. I reviewed the specifications and requested a change to the main-cutoff voltage from 22.25 VDC to 22.50 VDC, a detailed block diagram and change to the power led indicator on the UPS drawing specification. We also discussed the 15 amps charging current from the UPS because the Power Sonic (PS) batteries were designed only to take 5.2 amps for the initial charge. According to the UPS specification of PS batteries, it should not be overcharged because the AGM batteries would overheat. According to "Always On", if the design of the UPS is changed, the casing will also be changed and the current limiter will be larger. The current limiter will dissipate at least 40 Watts, which would be a waste of power. As a result, we decided to look for an alternative vendor for the back-up batteries.

- I provided a brief explanation of the on-board computer system to the two personnel from New Flyer St. Cloud facilities on SR616. I explained that the on-board computer could provide quick diagnostic status of each of the PLC I/O modules and the information shown on the computer could be used for troubleshooting purposes.

- I assisted an R and D designer in providing AutoCAD drawings with schematics, runsheets and Harness Bill of Materials for production Demo Coach SR708.

- We went to Vansco Electronics to attend the proposed presentation regarding the instrument panel. The instrument panel would be device-net compatible, hooked-up with J1939 and would have a separate auxiliary power for the dimmer. Also Vansco Electronics would create an Electronic Data Sheet (EDS) file in order to be read by either Rockwell SoftLogix or Rsnetworx as node 14.

- We solved the 1784-PCIDS card problem due to an unclean power supply and incompatible firmware revision. It was a team effort that composed of a group of people from Electrical Group R&D, Westburne and Rockwell Automation. The effort we made had helped to create a more reliable system because we had a better understanding of what we were doing.

- I met with the Production Engineering Electrical Group Leader to show me how the code generator worked to generate a consistent PLC ladder program for Production coaches. The code generator was not completed and required a lot of work in coding, which used VB scripts to beef-up the library of the Ladder program functions. The PLC code generator was built in an MS-Access 97 database and used Visual Basic for Application (VBA) for customized routine functions.

- I learned more about the Data-Link wireless modem for the remote diagnostic of an Invero Coach. The wireless modem could transmit and receive messages from the on-board computer to the PC workstation and vice-versa. The operator could remotely diagnose the coach on the PC workstation and confirm the status of the Electrical System.

- I learned about the AB 1792-88HC Device-Net Module specification and its capabilities. This Device-Net Module could provide high current outputs (i.e. 5 Amps and 10 Amps), had Device Logix, which used an embedded program that could program a function block using Boolean Algebra, and could operate in a stand-alone system.

ENGINEERING MANAGEMENT

- I was assigned to manage a project to create and complete a VCOM mock-board to be used for testing and validation as well as a show and tell for Customer Service, Production, Sales and Marketing.

- I was assigned to research and evaluate an off the shelf controller to be used on the UPS system and on-board computer. As an end result, I chose the Pico Controller due to its versatility, small footprint and reduced cost. It also no longer required an extra 1792-88HC device-net module.

- I was involved in the replacement of Flat-Media Cables with Round Media Trunk cables to mitigate the risk of having loose connections in a Production Invero Coach due to exposure to corrosive elements and vibrations inside the coach.

January to December 2001

Position Held: Technical Lead (Programming), Engineering Department

I was promoted to Technical Lead of a newly formed Programming Group under the Production Engineering Department due to my knowledge of Device-Net, PLC programming, HMI programming and the Invero Coach Project. I supervised two Electrical Designers with 40 man-years electrical experience in automotive and agricultural application. Also I was responsible for the management of different PLC programs for production, supporting Customer Service requests, and supporting R & D. In addition, I managed the PLC code generator.

APPLICATION OF THEORY

a) **Battery Test for 8D batteries and Auxiliary Batteries with Uninterruptible Power Supply (UPS) system**
   - The battery test was started in December 2000 to early January 2001 and it was the last project that I had completed as a part of the R & D department. The main goal of the test was to validate whether or not the main battery had enough cranking Amps after the coach was idle for four days while the on-board computer was on. The test bench was a mock-up board with main batteries, UPS system, an electrical load and auxiliary batteries. We set the main battery current draw at 2.5 amps to simulate when an on-board computer is on for four-days. At the start of the test, the main batteries were 100% charged at 26.47 VDC and the UPS auxiliary batteries were at 25.79 VDC. After four days of testing, the main batteries were at 47% charged at 11.31 VDC and the UPS auxiliary batteries were at 22.47 VDC. We installed the main batteries to the coach and tried to crank the engine but it failed. The conclusion was that a sustained > 2Amp load was sufficient enough to discharge both main and auxiliary batteries. So we came up with a solution that would turn-off the on-board computer and wake-up early Monday morning without the intervention of the operator. This project was called the **PCOM system**.

b) **PCOM System Concept and Implementation**
   - Created a state flow-chart and block diagram of the P-COM system prior to implementation. It utilized the brain of a micro-controller called "Pico Controller". The conceptual idea was to provide a reliable control of power for the computer, uninterruptible Power Supply (UPS) and Device-Net modules within the NFI Transit Bus. The P-COM was designed to have an automatic start-up and shutdown operation of the CPU, UPS and the Device-Net Modules at any given day and time. The P-COM could also manually energize the CPU and Device-Net Modules by switching ON the Master Run Switch. The most important concept of the P-COM system was that the driver would not have to wait long to run the NFI transit bus. The operator would wait for at least 5 to 6 seconds after the operator switched ON the Master Run Switch, provided he or she was within the window between start-up and shutdown time. In addition, the P-COM system conserved the battery power by switching OFF the Device-Net Modules after 2 minutes of start-up initiation, provided that no one switched ON the Master Run Switch. The P-COM system also shutdown the main power for the CPU at a preset time if no one was using the NF Transit Bus.

c) **Daytime Running Lights using Pulse Width Modulation (PWM) Application**
   - The AB 1792-88HC block had PWM square wave output capability that could be used for day-time running lights application. I calculated the duty cycle with the equation of Duty Cycle = Ton / Tperiod X VDC required for the headlights to be at 10.2 volts during DRL. The AB 1792-88HC had a built-in embedded program called Device Logix and could be programmed using function blocks and timers. The Device-Logix program for DRL was activated when the PLC or on-board computer sent an output message to activate the headlights. This methodology removed the extra DRL module (unit cost of $180) and extra installation and was implemented on every Invero coach produced by New Flyer. It changed the duty cycle of the DRL by changing the time in the Device-Logix program.

d) **Continuation of Human Machine Interface (HMI) Program Implementation**
   - I continued working on the HMI program that would be used for SR702, 708 and 537 (For Winnipeg Transit). The HMI program had Visual Basic programming and I utilized its power to control Window API to shutdown the computer whenever the ladder program activated the shutdown sequence. I had set up different security levels depending on the authorization access of the users. The HMI program was also set-up to call different diagnostic programs such as DDEC and Allison Doc click on windows buttons. It had a capability to send out an email whenever certain I/O module outputs were shorted or open circuit through a cellular wireless modem installed inside the coach. The wireless modem was not implemented due to level infrastructure and

resources required at that time. It was implemented on several production SR versions that were provided to the customer.

e) **PLC Test Program Loaded in PLC Controller For EMI and EMC Testing.**

- I discussed the modifications with team members in regards to SR636 PLC program designed for EMI and EMC testing. I assisted the Technologist to create a program that would handle and trap the error bits and stored it in an integer file. During the testing, the technologist monitored the PLC program and looked for trap bits at a certain level of V/m field intensity. It was suggested to him to create a folder for 30 V/m, 60 V/m and 100 V/m to save the PLC program after they tested the bus to a certain level. By saving the program to a corresponding V/m level folder, it would create documentation for us, in which signals from the PLC triggered during EMC testing. Also I helped research on how the AVL rung worked which would trigger the PLC AVL output and AVL Block fault bit. The test was done at Elite EMC in Chicago, IL.

f) **Kneeling The Bus using Ramp Deploy Switch Analysis and Testing**

- The customer requested that New Flyer create the ramp switch so that it could be used to kneel the coach and deploy the wheelchair ramp. This was a challenge for us because it had never been done before. We set-up a program for SR616 proto-coach and made an assumption on how much time it would take to kneel the coach before deploying the ramp. We set the timer for 3 seconds but the coach only knelt a few inches from the ride height and it was too high. We then set the timer for 4 seconds and this time it worked to the proper kneeling distance from the ground. Since the kneeling function was based on time, there were no height sensors to tell the controller the exact height of the coach. We made an assumption that the mechanical leveling valve would provide the proper ride height when the coach was raised from the kneeling position. The test we did on SR616 satisfied the customer request and was implemented on the PLC program for future contracts.

PRACTICAL EXPERIENCE

- Learned the VCOM system when I was in R & D. I shared and transferred the knowledge and experience to Production Engineering. The main goal was to facilitate the transfer of information and experience from R & D to Production Engineering prior to producing the first production demo SR708 Invero Coach. My job also involved supporting any production issues that arose during the production stages.

- Learned and updated the PLC code generator. Also discussed amongst our group how to make the PLC Code generator more function based rather than output based. The code generator generated a ladder program based on selectable features, I/O's and Bill of Materials. Also created documentation for theory of operation for Interior Lights (IL) for 30 LF, 40LF and 60LF coach.

- We attended the Air System Training at the Technical Publishing and Service Part Building on April 12, 2001. The training provided us with an understanding of how air systems were essential to the operation of the air brakes and doors of a transit bus.

- Assisted R & D to set-up an HMI page for SR615 and also modified the set of conditions in the PLC program to match the HMI. Commissioned the computer for SR615 and conducted testing on it. Also set-up the mock-up board for presentation to the New Jersey Transit employees.

- Attended the Winnipeg Conversion Meeting and demonstrated how the computer system worked to the Winnipeg Transit officials. They were impressed with the system but they asked for data recordings i.e. how many times the front door opened and closed in one day. They also looked for a preventive maintenance page such as if the battery must be replaced after one year.

- Attended a meeting in the R & D department to discuss the Electrical System of an Invero Coach. The discussion focused on completed packages of schematics, harnesses, as well as parts and suppliers of the components that were to be used for production.

- We contacted Rockwell Automation to help us burn a new program to the flash prom. We decided to set-up test PLC equipment to simulate the same scenario and discovered that the S:2/9 was the culprit. The Rockwell technical support advised us to change S:2/9 from 1 to 0 and applied the procedure on our test PLC equipment. After we applied the procedure, we were able to overwrite the previous program with a new revised PLC program to the flash-prom.

- Met with a PDM specialist regarding the Data Manager program. He showed me how the program worked and how one of the main goals was to obtain the information from IMAN and create technical summary lists, BOM, customer information and MRL under the same database. While the PLC code generator acquired particular information (for Electrical), it will drive those options to produce a PLC program. This would cut the time in half for the entire process of paperwork. It would eliminate printing and checking of the technical summary and MRL. It would be faster to extract information from the PDM and from sales and marketing. The entire concept was to obtain the same kind of information through checkout options from the customer. This same information would be handed down to PDM and to Engineering. This would eliminate duplication of work and at the same time it would reduce the errors coming from the extracted information. My question was how valid and accurate was the information being fed to us? It was not easy but it was feasible. It would take an entire organization to join together in order to achieve this kind of feat.

- I was involved in one of the first production Hybrid Project SR721 Portland Metro. This coach had Series Allison Hybrid (Series Hybrid had an Engine-Generator combination and a Traction Motor without direct mechanical coupling to the engine) and had an Inverter Module and Energy Storage using Nickel-Metal Hydrid Batteries. I created a ladder program based on the information from the Hybrid System I/O specification and operations, as well as from Engineers and Designers who had knowledge of the system.

- I was sent to Missisauga, Ontario to support the SR708 Invero Demo coach at the Canadian Urban Transit Authority (CUTA) show. During the CUTA show, there were several minor problems on the Demo coach which prevented it from operating properly. One of the issues that arose was the Pico Controller preventing the multiplexing system from starting the engine. We bypassed the controller to allow the engine to start and charge the batteries. We also fixed the door from slamming closed by adjusting the valve opening and changing the timer in the PLC system. I followed the Invero bus while driving to St. Catherine and London, in case the bus shutdown or problems arose during that time.

- Assisted the R & D department on the Remote Access Project. Completed the first phase of the project by proving the theory using Cellular Modem with an MTS connection and a laptop with internet access. The second phase of the project was how to locate the GPS transmitter using off-shelf software with mapping capabilities. The Remote Access Project was not implemented due to level infrastructure and limited resources at that time.

- Redesigned the VCOM system by removing the on-board computer from the critical control of the bus and replaced it with Micrologix 1500 for controls. We also eliminated the use of the UPS system and Pico Controller, which saved the company thousand of dollars per coach. The on-board computer would only be added as a special feature if the customers were willing to pay an extra five thousand dollars to receive the advanced system.

ENGINEERING MANAGEMENT

- Managed a **PLC code generator** with up to date information based on customer requirements and specifications in regards to functionality of a transit coach (i.e. how long the rear door opened in x amount of seconds). The PLC code generator was a relational database output driven program that generated ladder program codes as well as selectable features based on customer requirements and specifications. The PLC code generator reduced the time required to create programs because the block of ladder code could be reused on different Transit properties. We also changed the code to be a more functionally driven program to generate codes to run efficiently and to group the ladder program together based on function.

- When I was promoted to Technical Lead (Programming Group), I was given the opportunity to supervise two Electrical Designers with the main goals of providing initial release PLC programs for the production and support of Customer Service Field Service Request (FSAR). In order to maintain consistent programs and to keep track of the property specific PLC programs, we improved the PLC code generator by keeping up to date with the latest information, improving PLCPROGS spreadsheets by providing the type of power plants, city and transit information and creating theory of operation for each function of the ladder program. I also implemented revision changes and change requests for new or updated programs to keep track of the changes before writing the code into the code generator. We also created a priority list from customer service field requests depending on a priority code provided by the Technical Service Administrator (i.e. code 1 means Safety Issues, code 2 means Acceptance issue).

- The newly formed programming group eliminated overhead costs due to the removal of Engineering Contractors (high dollar value per hour), who were in-charge of the PLC program release for production, supported Customer Service and maintained the PLC code generator.

- I assigned tasks to one of my designers to create a PLC symbol library, dictionary and a written procedure for PLC program standardization. We discussed the affected I/O symbols, schematic pages and created a written procedure to be followed by the Electrical Designers. We standardized the PLC symbol dictionary, library, and written procedures as well as eliminated ambiguous I/O symbols, which allowed for consistency in creating new I/O symbols and was consequently used on Invero and Winnipeg D-Net buses.

- Mentored a new student trainee to be familiar with ECO procedures, and PLC program creation for production. I also showed him the HMI programming, which helped me debug and clean up the Visual Basic codes.

- Met with our Electrical Engineering Manager at that time and discussed the potential risk of having an on-board computer system to control critical functions of the bus. Based on the specifications of the computer and an incident that happened to the SR616 proto-coach, we suggested replacing the central controller with the Micrologix 1500 controller, which would be better suited for wide temperature ranges. The on-board computer would be an add-on feature for diagnostic and troubleshooting purposes as per customer requirement. We also added a temperature switch to the on-board computer, which would only operate above 5 degrees Celsius to protect the LCD screen and the hard disk from damage due to cold weather conditions. It was a drastic change of concept from an on-board computer to the PLC controller (Micrologix 1500) controlling the critical functions of the bus.

January to December 2002

Position Held: Technical Lead (Programming), Engineering Department

APPLICATION OF THEORY

a) RSEmulator Program Implementation

- The Electrical Engineering group purchased the software, which could emulate the RSLogix 500 ladder program. RSLogix Emulate is a troubleshooting and debugging tool, which emulates most operations of the Allen-Bradley PLC-5 and SLC-500 family processors. It executes the ladder logic programs in the computer, updates the programs' data tables, and allows us to approximate what is going to happen when it downloads the programs to the physical PLC processors. RSLogix Emulator uses the computer's CPU to scan the rungs in the ladder program. The rungs of the program read inputs from and write outputs to the data table stored offline in the ladder logic project. The offline data table is also active during emulation. Emulator reads the ladder program and the data table into the computer's memory before executing the ladder logic. The basic order of events during emulation is no different from when a processor runs a project. Emulator scans the rungs, pauses to update the output and input image tables, and scans the rungs again. (During normal operation, Emulator repeats the program scan until the users tell it to stop.) Since there is no real I/O, the emulated ladder logic takes cues only from the state of the data table. To generate responses in the ladder program, it will need to change the value of the desired I/O bits, storage bits, or storage words acting as inputs to the ladder program. The Electrical Designer used the software tool for debugging the ladder program before it was released to the New Flyer Production Facilities.

b) Hazard Flasher using Device Logix Embedded Programming

- Developed a program for AB 1792-88HC module which can flash the four-way flasher in an event that there is a communication error from the master Micrologix 1500 controller. The program was designed to handle both a regular turn signal and flasher from the output command on the Master controller as well as network errors in case of no communication from the master. The Device Logix program was in the form of Boolean logic with timers to activate the flasher once per second. The program was loaded in the built-in EEProm in the 1792-88HC module and would not be erased in an event of a power shutdown. However, the state of the timers and counters would be reset on a power cycle. The 1792-88HC module pin 22 and 26 (output 0 and 4) were capable of carrying 10 amps therefore, the outputs were suited for higher current applications such as headlights and flasher. The device-logix program was implemented on all Transit coaches with VCOM and VCOM plus systems.

c) Designed Modification of the Kneeling Program

- Reported a kneeling issue on SR832 D60LF articulated coach from St. Cloud Facilities. The Production Engineer described the issue when they tested the coach for kneeling operation. After three tries, it depleted the compressed air from a reservoir tank (wet tank) and the coach could not be raised with the suspension air bags. The operator had to wait a couple of minutes for the air compressor to fill-up the reservoir tank. The articulated coach was sent to NPD for testing to find out why the compressed air depleted so quickly. During the test, the NPD technician knelt the coach for several seconds and found that even the suspension air bag was empty. The coach can only be knelt a few inches from the ground hitting the leveling limit of the bag. The original PLC program was programmed to exhaust air as long as the kneeling switch is activated. Therefore, the air from the reservoir tank would eventually be depleted. The new PLC program limits the kneeling to 4.75 seconds regardless if the switch is activated or not. The original program also exhausted most of the air from the bag whereas the new program exhausted air half of its content, which reduced the time to fill up and conserve compressed air from the reservoir tank. The new PLC program was implemented on all New Flyer coaches.

d) Computer Temperature Controlled Operation

- This project was started in 2001 and continued into early 2002 when installed in on-board computer systems for the Transit Authority. We designed a temperature control on-board computer system within the limit of operational range of the specification. The theory of operation of the computer temperature controls were as follows: when the temperature was within $5 < T < 51$ ºC, the on-board computer would boot-up for a minute until it displayed the log-on screen. If the temperature was out of range, the PLC controller would start the timer up to 3 minutes and would send a signal to the computer to shut itself off. If the temperature was within range, the PLC output would cycle the relay for 500 ms to reset the power to the computer and restart again.

PRACTICAL EXPERIENCE

- Wrote computer specifications and software requirements for different departments including production due to different needs and user access. The computer specifications and requirements were passed to MIS for deployment to support the VCOM (Vehicle Communication) system used in Transit coaches.

- Reviewed the I/O definition of Allison Parallel-Hybrid System for the SR826 Seattle Property. This was a prototype coach to be tested by the King County Transit Authority. The hybrid coach incorporated a VCOM plus system, which included an on-board computer for central diagnostics and a Human Machine Interface for the PLC I/O troubleshooting guide.

- The newer version of RSLogix 500 version 5.00 had a different object model compared to RSLogix 500 version 3.01. It caused the code generator to not be able to generate a ladder program in the newer version 5.00. I asked a technical support from Rockwell software to resolve the issue. The Rockwell Software Engineer provided me with visual basic programming and object model documentation. I rewrote the program based on the documentation they had provided and resolved the issue.

- Troubleshot the SR759 WMATA coach after a Technologist from Customer Service reported that the PLC program disappeared from the SLC 500 controller, which caused the coach's electrical system to shutdown. The Technologist also reported that when they re-downloaded the program to SLC 500, the coach came alive, was driven around then shutdown again. Advised the Technologist to check the ground wires of the SLC 500 at the rear panel. It was discovered that there were loose ground wires causing the SLC 500 to shutdown, log a fault and erase the program. The wiring connection was tightened and I burned a UVProm to be installed in the SLC 500. The UVProm memory stored the PLC program, which would prevent the SLC500 from losing its program.

- Acquired RSEmulator program from Rockwell Software, which was used to emulate the PLC program prior to downloading to the SLC 500 controller. The Electrical Designers had tools to test the ladder program and debug it as it was in the SLC 500 controller before the Production Technician will test the Transit coach.

- Completed the Electrical Checking for SR820 San Francisco. I compared the I/O mapping of the schematics to the PLC ladder program and found out that there was a missing low oil pressure switch that was utilized for the engine starter lockout and low oil indicator. The schematics were sent back to the Electrical Designer for correction.

- Assisted a production Electrical Technician to set-up the RSNetwork Program in his Bench Electric computer. Also set-up the KFD card in his computer to be used to communicate with Device-Net modules or the VCOM system.

- Assisted RPSM for Eastern Canada in downloading a new program for London Transit SR739. We worked through the steps to download the program using the RSView32 HMI program. The RPSM also reported that there were fault codes appearing on the SDN display. Advised the RPSM to reset the module by switching-off the power and turning-on the power. The fault codes disappeared but advised RPSM to check any loose connections to the network cable between modules.

- Provided Technical support to Marketing personnel on how to deal with SR708 Demo coach. Walked him through the steps on how to access the HMI program and provided him with a temporary username and password to use the HMI diagnostic tool.

- Received a contact report from the RPSM in regards to losing power to the Engine ECU. It was reported that the throttle deactivated intermittently when driving the coach. Sometimes the Engine would shutdown and the coach would start to coast. When the RPSM recycled the power through the Master Run Switch, the RPSM restarted the engine. Advised the RPSM to double check the wiring from the PLC output signal all the way through the Engine ECU, as it could be a loose connection.

- Met with the Account Manager from Iconic Inc. to discuss the possibility of having a ruggedized laptop for the VCOM plus application to replace the current AB 6181 on-board computer. The laptop would survive a 4G drop test and it had a flash memory instead of a hard disk drive. We also discussed the possibility of having wireless LAN, wireless PDA and HMI capabilities.

- Helped out a Clever Devices software engineer by providing information on the Remote I/O modules dip switch setting to set the different addresses for 4 remote I/O module blocks. Clever Devices were setting up a mock-board to test the IVN (Intelligent Vehicle Network) to communicate with the SLC controller system. This project was used on the WMATA (Washington Metropolitan Area Transit Authority) bus contract.

- I had learned a great deal from the EMI/EMC testing for SEPTA hybrid coaches. The test plan was created by a New Flyer Technologist and the actual test was conducted in the Elite Testing facilities outside Chicago, Illinois. The test references were based on SAE J551/2-Test Limits and Methods of Measurement of Radio Disturbance Characteristics of Vehicles, Motorboats and Spark-Ignited Engine-driven devices, SAE J551/4-Test Limits and Methods of Measurement of Radio Disturbances Characteristics of Vehicles and Devices Broadband and Narrowband and SAE J551/11-Vehicle Electromagnetic Immunity --Off Vehicle source. The EMI/EMC test was part of the SEPTA requirement to qualify the coach for acceptance prior to production.

ENGINEERING MANAGEMENT

- Managed the computer resources (e.g. laptops and software) in the Electrical Engineering group by keeping track of the serial numbers, software versions, laptop model numbers and number of licenses to support VCOM and the PLC system. All of the information was supplied to MIS in order to support the cost of maintenance of the software every year. MIS gave us the authority to manage and provide technical support to all Rockwell Software products because the Electrical Engineering group were familiar with and knowledgeable about the software product.

- As Technical Lead for the Programming Group, we provided Technical Support to Customer Service and managed programming revisions and documentation. I also assigned Electrical Designers to deal with different programming issues and program creation as well as supporting New Flyer Production. It was a continuation of my responsibility from 2001.

- Completed the cost analysis of different laptop specifications with software installed that were provided to New Flyer production facilities to be used for downloading the software and diagnostic tools. We chose Panasonic Touch notebook for its ruggedness and also decided on trade-offs between hardware performances and cost.

January to December 2003

Position Held: Technical Lead (Programming), Engineering Department

APPLICATION OF THEORY

a) Vansco Multiplexing Module Validation Test on SR878 Hoquiam Prototype Coach

- I was involved in the early stages of this project to convert the coach SR529 from Allen Bradley SLC system to Vansco Multiplexing System. The SR529 conversion was evaluated by Engineering, NPD and customer service. The reason behind moving to the Vansco Multiplexing system was cost overruns of the VCOM system. We wanted to integrate more items into a common network that would reduce the amount of multiplexing modules required and subsequently reduce cost. The Vansco system also had more features offered compared to Allen Bradley SLC system. It was also a design for automotive application. We developed a test plan for SR878 first production coach, reviewed the I/O mapping, integrated it into the existing foot print of the AB SLC system and identified discrete I/O's that utilized the J1939 communication. We performed a test by verifying multiplexing signals through the diagnostic software and electrical checkouts. We also did a road test to verify any potential issues that may arise. The end result was that we delivered a new multiplexing system, which became a standard for all New Flyer coaches.

b) Implementation of Suppression Diode on the Dash Fan

- Technical Service personnel reported that instrument indicators were flashing when the dash switch was flicked on and off. We investigated the problem and found that the issue was due to an inductive load from the DC brush type fan causing the indicator to flicker. Every time we flicked the switch on/off, it had a negative spike of –27 VDC, which was enough to notice flickering on the indicator. We added two diodes on the dash fans to accommodate two fan speeds and measured the negative spike during switching and then reduced it to almost zero volts. The diodes became a standard install for dash fans.

c) SR925 Rear Door Operation Validation and Testing

- Our Purchasing Department had changed suppliers to Hoerbiger-Origa to supply a drop-in replacement for the Invero Coach. However, there were technical challenges on the said door, the original wiring was not able to work to the new connector style and there were programming changes. We worked with Hoerbiger-Origa to obtain the design specifications and theory of operation on the magnetic valves and how the reed switches were supposed to work. We had designed harnesses and provided a 24 VDC power supply to the magnetic valves. We made the rear door open and close on several cycles but there were hiccups in the system if the "rear door closed reed switch" was not properly set-up then the rear door would reopen itself. The airwave pressure switch was activated when passed by the rear door closed reed switch therefore it activated the rear door open mag valves. This was not a good indication that the rear door could be used for Production Coaches. Another challenge arose at that time when New Flyer had changed to a new Multiplexing System and the program was not exactly the same as previous. I had to rewrite the program and use different ladder functions to be able to operate the rear door. We tested again the rear door and observed how it closed then looked at the VMM diagnostic software when the rear door closed reed switch input triggered. After observing the rear door several times, we proposed to the manufacturer of the rear door to add a third switch to prevent the door from re-opening. We also provided a timing diagram when the rear door open-mag valve deactivated. The third reed switch was called a rear door obstruction switch. The function of the switch was to disable the sensitivity/auto-retract circuitry, which allowed the doors to re-open. Achieving maximum sensitivity of the sensitive edge and obstruction detection pressure switch (based on back pressure), this switch was placed 1" from the end of the stroke on the cylinder. In this condition, the door opening is closed off which means that there is virtually no gap between the door and the bus frame. Therefore, the auto-retract circuitry can now be turned off. We also added a time delay of 250 ms for obstruction detection to prevent the door from reopening when it is about to close. The test was successful and it was installed in production late December of 2003 and well into early 2004.

d) Test and Validated Voith Transmission J1939 CAN messages

- Worked with a Voith Application Engineer to determine all discrete I/O to be replaced with J1939 CAN Messages. Some of the functions were replaced such as Transmission Neutral Status, Over 2 MPH Status, Retarder Active status and more. It was validated on the SR878 Hoquiam prototype coach and we also added redundancy in the program for added protection such as SPN 523 (Current Gear) and SPN 524 (Selected Gear). These two messages had to be synchronized before the engine could be started.

PRACTICAL EXPERIENCE

- Attended a Vansco Training Course for the VMM ladder program and VMM modules. This training provided me with a brief overview of the VMM multiplexing system capabilities and its limitations. The new Multiplexing system had significant advantages in terms of cost and functionality.

- I helped the Regional Product Service Manager walk through the process of the RS Network to solve a network issue. The Logic Status light on the new node 16 did not come on however, we assumed it would just be a defective LED. Node 25 was also a problem on this bus. It kept intermittently dropping out, which could have been a bad device net cable. Advised the RPSM to investigate the next day.

- Assigned work to an Electrical Designer to fix an issue on the SR863 Seattle and SR870 Hamilton Build. The issues were as follows: the stop request lamp did not work when the front entrance door was closed, the turn signal clicker did not activate when the turn signal switch was on and the rear door open indicator stayed on all the time. The PLC program was fixed and sent the updated program to production.

- Advised the Customer Service Trainer to not release the test program to the customer because some of the functions had potential effect on the performance of the coach. The customer only received an official version of the program because it was properly tested and verified.

- Attended a meeting to discuss the SR878 Hoquiam, WA pilot production coach. It was scheduled to be on-line on June 27, 2003 and in the Crookston Facilities on July 18, 2003. Vansco supplied the multiplexing modules and supported the pilot production run. We also discussed the connectors and terminals for the VMM modules to ensure we received the information in time due to the long lead-time to order the parts.

- Discussed the VMM software product key generator with a Software Engineer from Vansco Electronics. The key generator generated keys to control the access rights of all users, and imposes a time limit on them i.e. "limited functional time limited version" of the VMM Software described in the VMM Product keys document. A New Flyer requirement was to control the product key so that it would prevent the customer from writing the ladder program as well as prevent unauthorized access of the program without the consent of New Flyer Industries.

- Met with a Vansco Software Engineer and Product Application Manager to discuss software enhancement for the VMM ladder program. New Flyer wanted to see improvements in the software such as enhancing printing capability, additional character space on the rung descriptions, subroutines, formatting of the pages, program code generator and others. We created a spreadsheet to keep track of the action items to be completed by Vansco.

- Received a FSAR from the Customer Service Department in regards to the shutting down issue on the WMATA CNG coach. We discovered that the low oil pressure switch, which acted as an engine starter lockout was always closed instead of being opened. As a result, the CNG mag valve remained closed and starved the engine for fuel for 30 seconds. After an investigation by RPSM, they found that due to the location of the oil pressure inside the engine compartment, it was subjected to corrosion. In addition, the two wires connected to the switch were shorted. The RPSM replaced the oil pressure switch with a different brand, which had a higher tolerance to salt spray, mud or other corrosive contaminants.

- I was involved with discussions with Sales/Marketing, Engineering, and PDM regarding an agreement on New Flyer's position on deceleration lamp systems while maintaining NF's compliance with FMVSS (US regulations) and CMVSS (Cdn regulations). Regardless of the configuration or lamp color, flashing deceleration lamp systems were not permitted on production coaches as it drove New Flyer out of compliance with FMVSS 108 S5.5.10(d) and CMVSS 108 S5.5.10(d). New Flyer's standard was to use amber steady-burn lamps as a deceleration warning system. Red steady-burn lamps were offered as an option (red steady burn is OK with FMVSS and CMVSS), but it was agreed that this lended itself to a less than ideal situation of following drivers who had multiple sets of stead-burning red lamps operating in different sequences. From this point forward, the electrical group only offered solid-burning deceleration lamp outputs in their programs for both new and repeat contracts. In the interest of future bus sales, New Flyer engineering offered part installation suggestions to make solid burning lamps flash, but these parts were required to be purchased and installed only by the vehicle owner or their employees without New Flyer involvement.

- Worked with MCC in regards to SR925 warm wall system "Electrical Concepts". The discussion involved the Lower section (Zone 1), which would consist of 2 convectors, one on the street side & one on the curb side. Each convector would have 2 blowers. The street side convector would have a temperature sensor. MCC's control module would no longer be required. Thermoking accepted this temperature sensor signal then, at Thermoking's desired set point, used our PLC system to open the water mag valve & turn on the zone 1 blowers. Blower speed was controlled using Pulse Width Modulation (PWM), but details must be given to MCC before warranty approval is provided. A single water mag valve (located in the engine compartment) controlled water flow to all the convectors on the coach. The Electrical interface consisted of a 4-cct square WeatherPack connector for blower power at each convector. A second 2-cct or 3-cct WeatherPack connector on the street side convector was required for the temperature sensor. The Upper section (Zone 2) HVAC Engineer indicated that the same concept would apply to the upper (rear) section i.e. the two convectors with 1 blower each, temperature sensor in the street side convector, Thermoking accepting the temperature signal, then indirectly controlling the mag valve & zone 2 blowers. We did not implement the PWM output concept because Vansco could only pulse the output at 1KHz while MCC required us to pulse PWM at 10 to 20 KHz, which was beyond what the VMM module could provide. Also, the PWM motor generated an EMI, which affected the sensitive visual/audio equipment in the coach.

- Assisted an Engineer-In-Training to create an Electrical Checkout Procedure for new Cummins Engine ISL 03. The Electrical Checkout procedure was approved by the Cummins supplier and was used in both Production Facilities in Crookston and St. Cloud, Minnesota.

- Updated numerous programs for service brake application. These were a part of a field campaign to update the program in order for the ATC (Automatic Traction Control) from the WABCO ABS system to function properly. The issues were that the ABS ECU thought the brakes were applied when they were not, and vice versa. Therefore, ABS ECU did not shut off the ATC when the brakes were applied, and likewise, the ATC never worked when the brakes were not applied. If the ATC was working while the brakes were applied, there was a potential for the ATC to use the modulator valves and service air to prevent wheel lock-up and 'pulse' the air pressure. The bus 'lurching' would then be caused from the brakes not being applied when expected rather than an unexpected throttle input.

ENGINEERING MANAGEMENT

a) SR878 Prototype Coach Project

- I was involved in this project in terms of the technical aspect of the Electrical System. I coordinated with several suppliers for technical support and validation. I was also involved procuring parts such as the VMM modules to create a mock-board for test and simulation.

b) Hoerbiger-Origa Rear Door Project

- This project was a huge undertaking in regards to its technical aspects. The Program Manager at that time expected Engineering to make the new door operate within a short time frame. We had time constraints due to the fact that the coach SR925 was required to be delivered to the customer on a certain deadline. We had managed to pull all available resources to do testing and validation, acquired technical information as well as worked out technical issues that arose during the course of the project. It involved a few groups in Engineering as well as several people from production to help make the rear door operational. A Hoerbiger-Origa Electrical Engineer also set-up their own mock-up for simulating a several thousand door cycle test and worked out any technical issues that were found during the course of testing.

January to December 2004

Position Held: Technical Lead (Programming), Engineering Department

APPLICATION OF THEORY

a) Design and Implement J1939 CAN Retarder Application And Removal of Retarder Application Modules

- The project J1939 CAN Retarder Application was started in late December 2003 and we used the SR925 Invero as a test coach. The project continued well into spring of 2004. The design goal was to reduce the cost of removing the retarder resistance module, relays and wiring associated with the Transmission Electronic Control Module (ECM). One of the challenges with this project was that there was no standard industry practice for developing a Controller Area Network (CAN) retarder application, which could resolve the uncertainties without designing, building and testing the system.

- We started the project by gathering all of the technical requirements and specifications provided by the Allison Transmission supplier, Vansco Electronics as well as referring to the SAE J1939 guidelines. We also realized that there were limitations to the current ladder programming and software calibration, and that we did not have the proper software tool to do testing and verification. We had asked the Allison Transmission Engineer to change the software calibration of the Transmission ECM to V9C software. Along with the Transmission ECM software being changed, it also included an option for a service brake signal to achieve shift enable through J1939 and to remove the actual discrete input to transmission. We had also asked Vansco to modify the Vansco application code for the Pocket Gateway Module (PGM). Vansco also provided a Sim Engine for CAN simulation and CAN sniff for CAN verification.

- The final test began in February 2004 with a group of Engineers and Technicians from Allison Transmission and Vansco Electronics. We drove the test coach SR925 and tried several new programs. The test and validation were successful during that time. The project was implemented and the original design concept was achieved by reducing cost (>$200) and adding flexibility to the retarder operation by changing retarder values in the program.

b) GE Hybrid Electrical and CAN Interface Implementation

- The GE hybrid project started in October 2004 and ended in March 2005 when the very first coach was successfully commissioned. Since we chose the Vansco Multiplexing System as a primary coach controller, its J1939 CAN capabilities allowed us to exchange data between Gas-Electric Hybrid propulsion and New Flyer Vansco Multiplexing System. We were able to explore a number of possibilities, which could be achieved by using CAN communication instead of a digital inputs/outputs and analog signals. We were able to reduce the number of VMM modules to five, removed the pocket gateway and a number of propulsion harnesses such as accelerator pedal harness, shift selector harness, fuel pump control, brake air pressure transducer, high voltage interlocks and indicator lamps. Below are the lists of items achieved during the Gas-Electric Hybrid Electrical Interface Project:

<u>Removal of one VMM 2820 and a Pocket Gateway Module</u>

- As a standard of practice, a Pocket Gateway Module separated chassis CAN communication and power train CAN communication. It also required additional VMM 2820 modules to communicate to various input/output signals between the GE Hybrid and Vansco Multiplexing system. In collaboration with ISE Corp, we created proprietary CAN messages that allowed for the exchange of data through J1939 CAN communication directly without the use of pocket gateway. We were able to remove one VMM 2820 module that was required for Input/Output between GE Hybrid propulsion and Vansco Multiplexing System.

<u>Removal of Accelerator Pedal Harness</u>

- In an original design of the GE Hybrid Coaches, the accelerator pedal harness was wired up from the driver's area to the back of the coach. Since New Flyer Industries and ISE Corp created proprietary CAN messages, it allowed us to include various digital and analog messages. One of the technical challenges that we encountered was that the Vansco VMM modules had a digital filtering which contributed to the delay of the accelerator pedal actuation. After we realized that Vansco did not have a software feature to reduce the sampling rate of the filter, we asked Vansco to add this feature and to try it as a mock-up board. Vansco provided us with a beta version that had not been fully tested yet and it was downloaded to a Vansco mock-up board so that we could see the accelerator response time when a pedal was quickly depressed. The original firmware version had a delay of 0.5 second when the pedal depressed instantaneously, which is unacceptable for the overall response of the coach. Also, we assumed that the driver would feel that the coach was not responsive enough when depressing the pedal. The new firmware and VMM software were able to reduce the delay time from 0.5 seconds to 75 ms, which is an improvement in terms of response time. Other technical challenges were the scaling factor and resolution of steps when the accelerator pedal decreased or increased when stepped on. Since an analog input measured voltages and converted it into digital data, it had an inherent digital filter. As observed in a CANalyzer plot graph, the digital message resolution was not as smooth when decreasing or increasing the accelerator pedal actuation. In order to solve this problem, the Vansco software had a feature, which selected raw data analog input and was able to make smoother steps when broadcasting accelerator pedal messages to the GE Hybrid system. The analog input was a 10-bit resolution that allowed up to 1024 steps at a maximum accelerator depression.

<u>Removal of Transmission Shift Selector Harness</u>

- In an original design of the GE Hybrid Coaches, the shift selector harness was wired up from the driver's instrument panel to the back of the coach. Using the CAN messages, we were able to broadcast messages for Drive, Neutral or Reverse to the GE Hybrid System. It gave us more control on how or when the driver can shift the coach into gear. For example in startup, the GE-Hybrid system would charge the capacitor for 30 seconds before it could drive the coach. The Vansco multiplexing system would receive a CAN message from the GE Hybrid System that driving was not allowed. It would flash the indicator light in the shift selector, and even if the driver pressed the drive button it would not allow the coach to shift into gear or to drive.

<u>Removal of Hard Wires to Tell Tale Indicators</u>

- In a regular coach and in hybrid coaches, some of the critical indications were hardwires from the ECM to the indicator lamps at the instrument panel. Using CAN communication, we were able to receive fault codes and to send messages to the indicator lamps without using output signals from the VMM modules.

Brake Air Pressure Transducer Controls

- ISE corp. provided two air pressure transducers as a part of a kit: one for system air pressure and the other for brake pedal application. The system air transducer monitored the amount of air at the rear air tanks and broadcasted the information to the Hybrid system through CAN communication. The brake pedal air pressure transducer measured the amount of air pressure applied when the brake pedal was depressed. It also broadcasted the information to the Hybrid system through CAN communication. The regenerative braking kicks in when the driver released his foot from the accelerator pedal. When the driver pressed the brake pedal to a maximum, the regenerative force increased smoothly to 100% of regenerative torque. We did some calculations to ensure the regenerative braking was smooth (e.g. 0 to 8 psi is equal to 25 to 100% regeneration braking). We also added a brake pedal switch as an added feature, so that the hybrid system would know that the brake pedal is depressed and was not a false analog reading from a transducer.

c) Design The Alternator Indicator Alternative Solution

- Discussed an alternative solution for alternator or battery indicator using VBat+ of VMM 2820, day night select status and engine rpm (substitute for engine starter lockout). The design concept was to replace the R terminal as the primary input status of an alternator fault indicator. The reason why we wanted to use the new set-up was because the Vansco Multiplexing system only monitored 1/3 of the winding plus square wave pulses, which gave us an input that varied between 8 to 14 volts in less than 2 seconds (observed).

d) Vancouver Trolley Project

- I was involved in the project started in March 2004 until the end of 2006. I will highlight some of the applications of theory that I had done for 2004 and will continue to do in 2005 and 2006.

- Created a truth table and timing diagram of the proposed Electric Air Compressor operation.
- Calculated the total electric power required for heating inside the trolley coach.
- Assisted in creating electrical load analysis calculation and provided it to a Professional Engineer.

e) Low Fuel Sender Feedback Using Analog Input of the VMM Input

- Computed the proper size of resistor for a low fuel sender. A full tank at 112 Gal had 25 ohms of resistance and an empty tank at 3.7 gal had 225 ohms of resistance. The supply voltage was 13.8 volts and the reference voltage was at 27.6 volts. K = 140 and slope m = -2.7. As per specs, ≤ 25 gal should alarm and indicate the low fuel. The empty tank had a voltage of 7 VDC, a full tank had 1.4 VDC and a low fuel warning had 5.9 VDC (25 gal).

PRACTICAL EXPERIENCE

- Attended a five day training course on Allison EP 40/50 System Service & TroubleShooting Electric Drives (Service Training) in Indianapolis, Indiana, USA. I was exposed to hands-on training of an Electric Drive Unit, how to check the High Voltage Energy Storage prior to installation and the engineering principles of the Hybrid Diesel-Electric propulsion system for commercial and transit coach application. We also learned to troubleshoot the coach with an Electric Drive using Allison Doc software and were able to identify types of diagnostic fault codes, which caused the Traction Control Module (TCM) to not switch into gear. I met several Allison Engineers who gave us an overview of their R and D facilities in regards to the development and testing that had gone on over the last 10 years. Allison personnel gave us a plant tour of an Electric Drive Unit in one of the facilities in Indianapolis. The tour gave us a brief overview of the manufacturing process, tools, automation and quality control. Before the end of the training, we had discussed the production of the first coach SR953 and were provided with manufacturing guidelines on how to install, test, validate and commission the hybrid propulsion system.

- Helped a customer from Capital Metro Transit in regards to the PLC program. The customer asked NFIL if it was okay to make some programming changes. The customer added a momentary switch, which acted as a ground input and was connected to input I2.0/0. The switch would be depressed for 3 seconds and the program would send a signal to the HMI in order to command the shutdown sequence. The customer discussed the leakage current on the output of the Node 08X and Node 36X. Node 8x was supposed to be the ground output and was able to get a positive reading. The customer asked about the source code for shutdown, log-on and HMI update.

- Provided some information about the Vansco Multiplexing module to an Allison Hybrid Engineer in Indiana, Indianapolis. New Flyer lended the Vansco Training Board to Allison Hybrid for CAN simulation of Traction Control Module (CAN).

- Assisted Vansco in providing some info about the New York Center Axle issue and created a program utilizing Wabco Axle speed sensors through J1939 communication. The Center Axle drag on brake was resolved by activating an indicator signal on the driver dashboard to alert the operator.

- Received a phone call from our Regional Product Service Manager in regards to Node 10 shutting down or the Network light going solid red every time the operator picked the handset and transmitted something through its antenna. The code on 1769-DNET was 72-10, which meant Node 10 stopped communicating with the scanner. I recommended replacing Node 10 with a high current module and to also check the connection or shield of Node 10 with a metal casing to protect itself from radio frequency.

- Discussed with Electrical Designers the J1939 issue on SR826 Hybrid Bus. It was suggested that the CAN was flooded with information, which could have caused the Caterpillar Engine not to start in the first place. They found out that whenever they removed the ABS system from the CAN, the Cat Engine started and worked fine.

- Discussed the possibility of having network loss monitoring during cranking for the Vansco system. This feature would prevent the operator from starting the coach if the batteries were low to start the engine. This would protect the starter from deteriorating. The indicator strips would flash and the buzzer would beep. The warning indicator could be reset by using a combination of switching off a master run switch and depressing the starter button. For normal application, if the engine was running and one or more networks dropped out or there was a permanent loss of communication, it would flash the indicators and buzzer would buzz.

- Spoke with a Vansco Engineer about the memory flag. I learned that the memory flag value only stayed whenever there was power because the value only stored in RAM. While the Generic log value was saved on EEPROM, it activated during master input number one signal. The generic log can only be used on that module and cannot be used to a rung related to another module. The only way to store the information with a last known state was to use the memory flag as an output for the generic log. The last known value of the generic log will be transferred to memory flag. The memory flag could be used anywhere in the program in relation to different modules. The only thing to consider was that when the generic log was used for the first time, the initial value was the maximum single floating point numeric value. If the value was out of range, to be considered a usable value, we have to put a condition that it was either 1 or 2 to be a logical value in the generic log.

- Received a message from a Thermoking (TK) Application Engineer as they could not start the engine even though the master run switch, front start select switch, park brake switch, and indicator strip and gauges were all on. In addition, there was no speedo message and the Allison shift selector was off. He tried to start the engine from the rear and he still could not get the engine to turn on. We started troubleshooting the coach by doing a process of elimination. We opened the rear panel and looked at output 3 of Node 9, and found that it was on. We looked at the fuse for the ignition relay (F7PS 30A), which was located at the engine fuse box near the main batteries. We looked at the drawing 160618C WD-FUSEBOX FB for reference. The TK Application Engineer discovered that the breaker was tripped. We reset the breaker and the engine ECM and Transmission ECU started working. As a result, we were able to start the coach.

- Sent a program to Ottawa Transit for SR925 D version of the program. We found out that when the power inside the coach was shutoff and turned on again, the rear door obstruction detection limit switch was not true, therefore the flag with a latch for rear door obstruction detection also becomes not true. I created a program so that every time the modules powered up it would latch the rear door obstruction detection with an assumption that the exit door was closed.

- Supported the first production SR953 Diesel-Electric Hybrid Coach at the manufacturing facilities in Crookston, Minnesota. We observed and assisted with the electrical installation of the coach. We also assisted the electrical checkouts, validation and start-up of the coach. We drove the coach around the Crookston vicinity in diesel-electric mode and verified the Hush-Mode (Electric-Mode) for two miles.

- Solved the remote throttle erratic behavior of the SR953 Diesel-Electric Hybrid Coach. Before the program was fixed, we started the engine either from the front or rear select. The engine rpm only went up to 1100 rpm for less than a second and after that it stayed between 950 and 1000 rpm. The engine shut down after 30 seconds. The NF engineer from NPD told us that they had a similar problem and the solution was to delay the engine remote throttle signal to CAT for several seconds and let Allison command the engine to a desired RPM. We modified the program to delay turning on the engine remote throttle signal for 10 seconds. On start-up, the engine rpm reached 1166 RPM then 2 seconds later, it decreased to 750-800 rpm on idle. An

Interstate Application Engineer recorded the operation on his Allison doc diagnostic software before and after the fix. The record was later sent to Allison Headquarters in Indianapolis.

- Coordinated with a Caterpillar Engine Supplier to provide the correct engine program for SR953 Diesel-Electric Hybrid, which was to be downloaded by a local Caterpillar Dealership in Crookston, Minnesota. The issue was that the engine override shutdown was not working properly due to wrong engine calibration.

- Discussed the shutdown override operation with the supplier Allison Hybrid as it was different from a standard diesel coach. Based on an Allison Application Engineer explanation, if the engine entered the "Engine Protection System", the CAT would send a bit through CAN confirming that the engine was about to shutdown. Allison Hybrid would see it and it would allow for 30 seconds before the propulsion system disengaged from the engine. If the override switch was triggered, it reset the timer for the shutdown but the bit that was supposed to reset, did not. Allison thought that the engine was about to shutdown. Because they did not interfere with the engine shutdown, it would automatically disengage from the engine. The Allison hybrid supplier had agreed to submit a theory of operation to New Flyer.

- Provided a flash GUI to the New Flyer Customer Service to update the Pocket Gateway Module (PGM) already in service. Coordinated with Vansco to change the PN of the PGM due to the changes for the engine hour meter. Engine ECM required only 3 bytes of messaging and Vansco sent 8 bytes of messaging. Vansco changed the PGM messaging to 3 bytes to correct the problem.

- Attended the meeting on the upcoming Vancouver Trolley Project to discuss the requirements and specifications to start the design of the Trolley coach electrical system. Reviewed preliminary schematic drawings from Vosshol-Kiepe and also reviewed the previous electrical schematics of the Trolley built for Athens, Greece.

- Conducted a conference call with the supplier Forster in regards to the J1939-11 compliance. New Flyer required all vendors to be J1939 compliant. The supplier suggested that they did not have to put the shield to their Speedo Cluster Unit (SCU) due to the possibility of receiving noise from the CAN network. I explained to the supplier that we grounded the shields at one point so that it carried the noise to chassis and prevented any ground loops. The supplier eventually added an RC network in the SCU to accommodate the shield. I sent the SAE J1939-11 specs to the vendor for further reference.

- Assisted an Allison service engineer to troubleshoot the Dual Power Inverter Module (DPIM) unit due to a J1939 CAN issue. At first, the Allison service engineer suspected that there was a J1939 CAN backbone quality issue. After several tests, we confirmed that the J1939 cables were all good. The ground loop was assumed to also be a possibility due to the J1939 shield grounded into the DPIM chassis and the shield grounded at the center of the coach. We used the CANalyzer and found out that there were some error frame messages datalog from the J1939 CAN network. An Allison Service Engineer replaced the old DPIM with a new one but we still had a CAN issue. We did a process of elimination to find the source of the error messages and found out that the noise detected on the network was coming from the Three-phase AC cable shield, which was not connected to the metallic strain relief on the Electric Drive unit. The Allison Service Engineer reinstalled the old DPIM and connected it to the CAN network. The CANalyzer was still detecting an error frame and the bus load spiked to 70 percent. When the new DPIM was reinstalled, there were no error frames and the network bus load decreased to 50 percent. We used an oscilloscope to see the waveform at the CAN network. The new DPIM had a differential voltage while the old DPIM had both voltages above the X-axis. It was determined that the DPIM had CAN problems and the Allison Service Engineer wrote a report to be sent to the main Engineering Department at Indianapolis, Indiana.

- Contacted the multiplexing supplier in regards to high temperature problems in output 19 and 20 of the multiplexing module. It was discovered by the supplier's engineer that the resistor was heating up during normal operation due to ambient heat absorbed by the module. If the coach sat outside under the sun, the internal temperature inside the coach would become very hot. Therefore, it was a contributing the factor when heating up the resistor and eventually turning off the opto-isolator.

- Resolved a beeper noise issue based on a report from an Electrical Engineer after he did an analysis on the DRL PWM for headlamps. The Electrical noise was generated from PWM outputs, which caused the beeper to pulse quickly in day run. All of the output from multiplexing module node 3 was tainted with noise generated by PWM on O3-1 and O3-2. I changed the ladder program so that the low beam became full on when the ramp was deployed and the beeper was activated.

- Attended a meeting with Vosshol-Kiepe in regards to an upcoming project of the Vancouver Trolley Coach. We discussed and reviewed the scope of supply, technical specs of the Inverter and Hot coach detection, location of the components and equipments on the coach, and installation and testing requirements of the propulsion system. I also reviewed the power requirements of the heating element to heat-up the passenger cabin of the coach.

- Sourced out different magnetic contactors to be used for High Voltage switching for a three-phase power for Air compressor motor and defroster/floor heaters. Rating of the contactor, reliability and cost were criteria for choosing a magnetic contactor.

- Created a draft Electrical Schematics and Wiring Diagram for the SR983 Vancouver Trolley Project to be reviewed by a Professional Engineer and the Transit Authority. This was a requirement that the Transit Authority required to review the initial design and specifications of the prototype trolley coach.

- Spoke to a Hoerbiger-Origa System Engineer in regards to the Transit Coach exit door controls. There were two issues that had been raised during the mock test for the exit door system. The first issue was that the pilot mag valve had to be delayed shutting-off after all door open conditions became false. The delay on break should be around 500 ms to ensure that the pilot mag valve allowed the pressurized air for the door to be closed tightly. The second issue had been raised in regards to the rear door dump pressure after the system was in normal condition. Even when the door was closed and low in air, the centering magvalve was activated. When the system pressure was up and running, the centering magvalve was deactivated and the door was not fully closed. Even with an 80 psi of air in the cylinder, the door sensor was sensing that the door was closed. One suggestion from the supplier was to initiate a closing pulse signal from a PLC output when above zero speed signal or the bus started moving.

- Provided information to a Technical Service Administrator on how an engine shutdown override operated on a Detroit Diesel Series 40 engine using the PLC system. I created a program that would allow the operator to activate the shutdown override switch four times before deactivating it. The counter would log the number of times the switch was activated.

- We visited the ISE manufacturing facilities in San Diego, California. The intent of the visit was to become familiar with the ISE Engineering and Manufacturing capabilities of providing a hybrid propulsion system for the Transit Bus Application. Like New Flyer, ISE was a system integrator company by buying Hybrid packages from Siemens and re-engineering it depending on the Transit Bus Manufacturer requirements. We visited a Transit Bus retrofit shop, Custom Coach Works (CCW), in San Bernandino, California, which was where they had used ISE hybrid propulsion packages.

ENGINEERING MANAGEMENT

- Managed a project called **"Design and Implement J1939 CAN Retarder Application And Removal of Retarder Application Modules"**. This project required a lot of coordination from the suppliers and internal resources to provide help to do the testing. I also planned and scheduled testing several times. It also involved risks due to technical uncertainties that could be overlooked during the project life cycle. Cost of the project was minimal because it is part of New Flyer overhead cost and the tools were developed and supplied by the vendor created in-house by their engineering staff. The end result was that we were able to achieve an approximated (> 200USD) cost reduction due to removal of parts such as the retarder module, wiring harnesses, and relays from the rear PLC panel.

- Managed a project called **"GE Hybrid Electrical and CAN Interface Implementation".** I was assigned to this project due to my experience and knowledge of the Multiplexing and J1939 CAN system. Our goal was to develop a vehicle CAN interface system with Gas Electric (GE) Hybrid system. I created an initial requirement for the New Flyer electrical system and coordinated with our supplier to ensure that they complied with the requirement. Our supplier created proprietary CAN specs and different network architecture for us to review and to approve types of CAN messages and network architecture to be used. We discussed strategy to mitigate any risk of using CAN messages instead of PLC I/O hardwires. We also attended weekly meetings to discuss updates and action items to be closed prior to production. The project was continued until the end of March 2005.

- The **Vancouver Trolley Project** was the most challenging project I had ever handled during that time due to the lack of exposure to Electric Trolleys and the fact that only a few cities in North America operated Trolley buses. The Electric Trolleys had been around for at least a century and most of the trolley buses operating in

North America were 20 or more years old. It was a challenge that I accepted because it applied similar engineering principles to the Electric trolley and I had experience working on Hybrid coaches. We did a lot of research and development with Vosshol-Kiepe on how to adapt the technologies on New Flyer Buses based on their expertise and industry guidelines set in Europe. The original Vancouver Trolley propulsion used a 600 V DC motors and the antiquated motor controllers whereas the new Trolley propulsion used IGBT inverters, induction three-phase 600 VAC motor, microprocessor controllers and CAN-based communication. I had learned scheduling, scope of supply and resources from the Program Manager who was in charge of the project. The project continued until late 2006.

January to December 2005

Position Held: Technical Lead (Programming), Engineering Department

APPLICATION OF THEORY

a) **Vancouver Trolley Test and Validation**

Vancouver Trolley Specific Speedo Cluster Unit

- Provided a requirement to Forster Instrument to show the air compressor warning on the SCU display. The display would display as COMP COLD i.e. compressor is cold. It would then scroll "WAIT", COMP WARM i.e. compressor reached warning temp. It would scroll "MAIN REQD" and COMP OVRHEAT i.e. compressor reached critical temp and then shutdown would occur. Advised to use CAN messaged propriety PGN 65469 with repetition rate of 1000 ms with 2 bits for each message. Since the SCU display accommodated seven characters only including space, we decided to use the Maintenance Indicator Light to flash it to a different rate for different air compressor fault messages.

J1939 Wheel Speed Signal Convert To Speed Signal Pulse

- Previous Vancouver diesel coach utilized the PWM square wave signal from the transmission output and was used as a speed signal for the VIU (Vehicle Interface Unit) and APC (Automatic Passenger Counter) system. The PWM signal pulsed 16 times per revolution of the output shaft speed, had 50% duty cycle and the voltage ranged from 0 to Vbatt (12 VDC or 24 VDC). Since the Electric Trolley could not provide a PWM signal, it had an option to broadcast the wheel speed through the J1939 CAN network. We came up with a technical requirement of an electronic control module (ECU), which converted the wheel speed messages (KPH) into PWM output of 1000 pulses per 100 KPH. The supplier of the VIU and APC system recalibrated the input to read the PWM from the customized wheel speed ECU converter. The ECU was implemented and tested by New Flyer and the APC and VIU supplier.

Designed the Ladder Program For Different Driving Condition

- Under normal driving conditions, the operator could press the drive or reverse button with the following conditions: the 600 VDC or Emergency Propulsion Unit (EPU) were available, compressed air was above 75 PSI, front and rear door were closed, kneeling was not activated and the wheelchair ramp was not deployed. If one of these condition were not met, the Vansco Multiplexing system would not send the "Driving Allowed" message to the Kiepe Central Controller Unit and the shift selector Drive and Reverse Mode would be flashing.

- When the coach stopped at the bus stop on an inclined surface and the coach rolled backwards, the Kiepe Central Controller Unit would detect the pulses from the magnetic pick-up on the gears of the output shaft to the axle. It would send a "Roll Back" message through the CAN network. After receiving the "Roll Back" message, the Vansco Multiplexing system would activate the pneumatic brake valve to prevent the coach from rolling backwards. This operation was called the "Anti Roll-Back" feature. A pneumatic brake valve could be activated in manual mode by the operator using a "Hill-Holder" switch. After several tests in Vancouver, the lock roll back did not work because the condition was tied in with the zero-speed flag. The program had changed to replace the zero-speed and to add <5 kph in series with the roll-back flag.

- During wheel chair deployment, the Vansco Multiplexing system would send the CAN messages to the Kiepe Central Controller Unit and it would disengage the 600 VDC contactor and separate the overhead line electrical connection and the trolley coach. The design intent was to prevent the coach from becoming hot when the wheel chair ramp was deployed and touching the ground. This was part of the customer requirement to prevent the passengers from getting shocked when stepping in or out of the trolley coach.

Power Steering Motor Operation

- Earlier in the development of the power steering motor, we had used a 3 KW Bosch DC motor to provide power steering assist to the operator. The DC motor had a high in-rush current that caused the voltage to dip from 25.5 VDC to 11.5 VDC for 25 to 50 ms. This then caused some electronic equipment to reset including the Kiepe Central Controller Unit and the Farebox system. It became critical to supplement an energy storage device that was quick enough to provide an instantaneous burst of energy. We came up with a short-term solution of adding a 70 KJ ultracapacitor near the power steering motor. The voltage dips were reduced from 25.5 VDC to 20.5 VDC during the power steering motor start-up. In the original program that I created, the operation of the power steering motor was activated when the forward or reverse mode was selected and the accelerator pedal was depressed. The power steering motor deactivated when the speed was below 3 KPH, the accelerator pedal was not depressed and the timer delayed for 3 seconds. It met the customer requirement that the motor be off when the trolley coach was stopped.

- We created the new configuration that would connect the positive side to the diode and the battery, and the output side would be connected to the contact 86 of the power steering pump solenoid. With this type of configuration, it prevented the capacitor from blowing up the fuse at the battery and power steering pump. It wired up the new configuration for the ultracapacitor connected after the main battery disconnect switch. The power steering motor circuit motor protection was changed from a fuse to a slow-tripping circuit breaker that would not trip during start-up.

- The 3 KW Bosch DC motor was tested in Vancouver and passed the satisfactory steering performance. The solution was not carried through production due to the high cost of the ultracapacitor and the manufacturer of the ultracapacitor was not ready for production at that time. The DC motor also had its limitations due to the brush type with brushes life of 5000 hours and when it heated up to a critical level it would require as much as 10 times the amount of time to cool it down (based on the temperature curve of the manufacturer specification).

Air Compressor Operation

- Created a VMM ladder program to create different states of air compressor operation. As soon as there was a demand for air pressure, the VMM multiplexing module would send a message to Kiepe Central Controller Unit (CCU) to turn off the 400 VAC. Kiepe CCU turned off the 400 VAC and sent the message back to the VMM Multiplexing system. The VMM multiplexing system closed the contactor and sent the message back to Kiepe CCU to activate the 400 VAC. Kiepe CCU received the message and softstarted the 400 VAC supply.

- We encountered a problem when the air compressor turned off and turned back on again after sometime. The motor did not turn or tried to turn. The Quincy manufacturer recommended that the motor be wired as a **Wye-Delta** starter. As Quincy stated, when the motor was wired as **Direct-Online (DOL)** starter, it reduced the life of the motor due to a high starting current. In order to combat this problem, the motor was wired as a Wye-Delta starter. The principle behind the Wye-Delta starter was that the motor windings were connected as Wye during start-up in order to reduce the amount of voltage across phases, therefore reducing the full-lock torque to a third. Once the motor was at 80% full rpm, the contactor switched from Wye to delta connections in impressed full voltage across phases. It was better than DOL but the problem remained. The contactor and motor were susceptible to frequent start/stop many times in a day, which may lead to a high maintenance cost for the entire system. Another disadvantage of Wye delta start was that it switched from Wye to delta and caused transient and high current in-rush in Delta configuration because of the sudden drop of motor speed during transition at 1/5 second if the motor had a light load. The best alternative for frequent switching start/stop was using an electronic soft-start feature that allowed it to ramp-up the voltage and frequency during start-up. This would prevent sudden in-rush current and allow the motor speed to increase smoothly to its peak. The voltage and the frequency rose from 0 to maximum (50Hz/400V) in approximately 2.5 seconds. The Kiepe CCU loaded a new program with new parameters to extend the soft-start time to 4 seconds.

Regenerative Braking Test and Validation

- Attended a conference call with Kiepe and discussed the remaining trolley issues. We conferred about the renegerative braking being too aggressive as per GVTA. Kiepe suggested trying a potentiometer for the brake pedal similar to the accelerator pedal that monitored the brake threadle travel. I suggested to use an air pressure transducer that would monitor the amount of brake pressure applied when the brake pedal is depressed. I explained to Kiepe that we installed the air pressure transducer in our hybrid coaches and it worked perfectly in controlling the regenerative braking. For the Gas Electric hybrid, we sent the maximum braking force at 8 psi at 100% and 0 psi at 0%. The voltage output signal from the air pressure transducer was between 1 to 5 psi. Kiepe was willing to try out the air pressure transducer. We forwarded the information to a Professional Engineer regarding the brake pressure transducer that replaced three brake pressure switches for controlling regenerative braking of the Kiepe system. We chose the brake transducer with pigtails as it was suited for the Kiepe wiring application. The test was done in late 2005.

b) New Multiplexing Controller For Instrument Gauge Cluster and Indicator

- Discussed concept of a new multiplexing controller for the instrument gauge cluster, which had a capability to accept inputs and provide output for test lamps. The multiplexing controller had the capability to send out CAN messages to the Vansco multiplexing system and was able to flash fault codes from the engine, transmission and ABS. The estimated time to develop the prototype was 6 months and it was tested on the test board prior to production.

c) Center Air Gauge Validation

- Assisted two Electrical Designers with testing of the center air brake gauge with a new voltage regulator and a new program.

Analysis

- We found out that in a D60LF coach, the center air brake gauge moved randomly due to the following reasons: Inconsistent voltage input to the resistor, inconsistent reference voltage and changes in resistance value of the transducer.
  - With the voltage regulator, it eliminated voltage fluctuation to the resistor pack and the transducer. There was a needle fluctuation reading of the center air brake gauge due to the change in voltage calculation from 0.2 to 0.1 V and it resulted in a 3 PSI jump in the gauge. The fluctuation was still noticeable.
  - We came up with a solution by changing the analog value to raw data instead of a voltage. This eliminated the voltage calculation error. With a raw analog input, it increased the division of scaling to 1024 bit on whatever the high voltage limit. We used a 3.33V/1024 bit resolution in order to give a smooth reading from the analog input.
  - Calculated the actual resistance based from data provided by Forster and found out that it was off by 12 lbs. The actual measured resistance was 155 ohms at 125 psi. Recalculated the value and we came up with a slope of 0.1438902. Since it did not have a decimal value of greater than 1, we multiplied by 143.8 and divided by 1000 to obtain smoother steps on the center air brake gauge.

Interim/Alternative Solution:

- For SR994, we created a jumper harness that included the 8 VDC voltage regulator and a raw analog input with a calculated PSI value.

d) Fuel Level Gauge Recalculation

- Recalculated the value for the fuel level using raw analog data. The production Engineer added an 8 VDC voltage regulator to provide a stable voltage supply to the resistor pack. The fuel level calculation was based on 39.7 ohms for full (112 gallons) and 246 ohms for 0 gallons. The slope was –0.1572107 and K was 150.80. The production engineer tested the program on the SR1041 and it worked.

e) Fan Control through Pocket Gateway Module Implementation

- We tested the fan control and found out that it was not working. We analyzed the CAN messages with CANsniff and it was found that the fan request was not passing through the PGM. We asked Vansco to change the firmware to allow the PGN 57344 Cab controller message 1 to pass. It was eventually loaded into the PGM and the Vansco Multiplexing system was able to receive PGN 57344, which adjusted the PWM output to the hydraulic proportional valve that controlled the radiator fan speed.

f) Speed Cluster Unit (SCU) Prototype Test and Validation

- I tested the SCU and noticed that there was a significant improvement in response time in activating the tell-tales indicators when flipping the switch back and forth with minimal delay. Informed the supplier that there were two things to be corrected. Firstly, the response time for the buzzer was still slow. I tried sending as low as a 50 mS repetition rate but it was still not responsive to the message. Secondly, when I programmed the tell-tale 100mS On and 100 mS Off, the response was quick but there was skipping intermittently (once every 10 to 15 flashes interval) and it was noticeable on observation. When we programmed the tell-tales to flash 250 mS On and 250 mS Off, the skip was negligible. The testing was carried out through early 2007.

g) Baltimore Battery Issue Test

- We had supplied AGM batteries to the Baltimore Transit Authority. It was reported that they had experienced a brown out situation when the battery charger was removed from the AGM batteries. The Baltimore Transit Authority insisted that the AGM battery was not suited for the transit coach application. We advised the Baltimore Transit Authority that we were going to conduct a MODAC study in St. Cloud. I created a test plan and submitted it to Delco-Remy Application Engineering. Below is the summary of the test conducted in St. Cloud:

  - We measured different Electrical parasitic loads on different transit coaches. Each coach showed different loads due to the type of equipment that was installed on each coach. We checked voltages across the batteries in random prior to delivery to the customer. The average voltages across the batteries were 25VDC, which meant the batteries were in good shape prior to customer acceptance of the coach.

  - We conducted a pull down test for the AGM batteries. A Professional Engineer from Delco-Remy drained the batteries to about 10 V with a consistent current discharge of 300 to 500 A. We tried to start the coach but the starter chattered which was not expected. We started it again and this time the engine started. The battery pulled a current from the alternator as much as 280-290 amps when the engine was at fast idle and the climate control was off. During that time, the alternator gave as much as 301 to 302 amps and stayed at that range for at least 15 to 20 minutes to meet the battery demand. We thought that the battery would have a thermal runaway because of the high charging current (because the batteries were assembled as parallel and series, each bank receiving at least half of the total current demand) but it did not happen. The battery temp rose from 27 C to 34 C at the top and 30 C at the side of the batteries. The engine compartment temp wass at around 42 to 50 C. The test was inconclusive before it was never proved that discharged AGM batteries could cause a brown out situation.

  - We conducted a 16 hour test for the coach to see how the AGM batteries behaved in different temperature variances. Test showed that the battery temp was around 56 C at top and 55 C on the side of the battery. The engine compartment temp was around 72 C and the ambient temp was between 30 to 34 C. It was recommended that the regulator should be temperature compensated to adjust for the charging voltage to varying degrees in temperature.

  - We also conducted a 72 hour parasitic load test by adding 12/24V lamp load immediately after the 16 hour operation test. The intent of the test was to see if the AGM batteries had enough cranking amps to start the batteries in the following week.

  The test was concluded after three weeks and we were not able to prove that the AGM batteries could cause a brown out situation when it was fully discharged.

PRACTICAL EXPERIENCE

- Attended a meeting with Allison in regards to J1939 messages. We looked at St. Catharines as a prototype coach to implement the Gen 4 Allison TCM. The lead-time was 33 weeks before production. FMEA would be part of the documentation.

- Verified the PGN 65467 or FFBA that was sent by PGM PN 261075 using CANsniff and a DLA. We found out that the J1939 PGN 65466 and 65467 was not checked off on the J1939 table. Rechecked the message and sent a program to Crookston Production.

- Met an Application Engineer and the Manager of Allison Hybrid to discuss the diagnostic connector. The issue was that we saw a voltage spike of 35.5 volts that was enough to fry the 12 VDC power of the TCM and VCM when the CAT diagnostic tool plug was linked to our diagnostic connector. One of the solutions was to add a voltage clamp suppression along the J1939 network.

- Spoke to a Production Engineering Technician in regards to the SWAT issue 35 kneeling, which was activated or the ramp was deployed when the coach was in gear. I found out that production turned off the selector switch at the engine switch box, and the Vansco neutral flag stayed true (last known state). In the typical PLC coach, when the ignition was off, the transmission neutral status was off as well, therefore the ramp could not be deployed.

- Received a report from Crookston Production that the ISE coach had a stop engine light issue. They were able to drive the coach back to Crookston and reset the fault codes after resetting the master run switch. . ISE personnel were flown to Crookston to resolve the stop engine light issue.

- Assisted a Technologist with reviewing the J1939 layout for the Chicago property. Basically, we had discussed the technical aspect of each device to be connected into the J1939 network. The central diagnostic reporting and datalogging in the coach was the basis for future bus contracts.

- Received a report from Crookston Production in regards to the low air pressure indication on SR1021. According to the report, the low air did not trigger the low air indication. Advised a Production Engineer to check the PGM PN and SCU PN to see if they were correct. Also we checked the program and we did not see anything wrong with it. A Production Engineer found out that the J1587 cable was not connected to the SCU module. The issue was resolved.

- Created a J1939 CAN database for New Flyer Industries Ltd. The J1939 CAN database was used to store proprietary messages used by different suppliers.

- Attended a SR924 Gas-Electric Meeting, and discussed some of the major issues for high voltage interlocks and override shutdown feature. These features would protect the technician from accidental electric shock during maintenance check-up and it would prevent the coach from moving if the service panel was opened.

- Attended a Winnipeg meeting with a New Flyer Sales and Marketing representative in regards to the auxiliary heater bypass magvalve operation. I explained the operation of bypass magvalve to Winnipeg Transit. When the engine temp was below 148Fand the ThermoKing Unit and Floor heaters were off, the by pass valve was opened. If the climate control switch was in OFF or VENT, the bypass valve opened to minimize water flow to the driver's defroster area.

- Attended the SWAT meeting for the Vancouver Trolley. Discussed some of the items in regards to the exit door harness, fuse box installation and ground connection points. An interesting conversation came up when an issue was raised in regards to the ground connectors near ground point chassis. Since we were crimping 6 individual wires to a ring tongue terminal and wired to the 6-pin weather pack connector, it was better to remove the connector in between and crimp the 6 individual wires directly to a ring terminal. It reduced the potential point of failure and it saved money by not using the connector.

- Spoke to VP of Engineering from Vanner about the CAN initialization of the Vanner equalizer. Vanner loaded all of the features, some of which activated only if Vansco sent a word (2 bytes) once every second right after the Vansco wake-up and ignition switch was On. For example, the jumpstart override only activated if the Vansco multiplexing system sent the request to Vanner. The Vanner would be on all the time as long as it was connected to the battery system. The CAN initialization would only wake up when the ignition was switched on. -Sense A and Sense B was used if the wire was open or shorted. For example, if the fuse was connected between the Battery and the DGG, and the sense wire was hooked up after the fuse and it was open, it triggered an open fault from Vanner.

- Attended a meeting in regards to the harness reduction. We were looking for ways to increase the number of ground points so that the ground wire did not have to go to a single ground point location. The goal was to reduce the length of the ground wire and remove the ground connectors as well. Redesigned the wire duct with the U-channel to be able to fit all of the harness with less space. Replaced SXL with GXL to reduce the outside diameter of the wire. We discussed the wire duct at the engine compartment and where to route the engine harnesses. We discussed the possibility of redesigning the rear panel due to possible location of the radiator at the rear window area. Inside the engine compartment, it was suggested that instead of a stud, the production worker would drill a hole using self-tapping screws to allow him to clean the surface of the chassis after the coach is painted. It would be easier for production to clean the surface of the chassis instead of having a stud protruding from the chassis surface. Advised the Technologist to review the LH and RH crown for the ground point connections.

- Assisted MCC (Mobile Climate Control) personnel to work on the Vancouver Trolley heating system. We installed the controls for the MCC heating system and redefined the cable routing for the floor heaters. An Engineer-In-Training had requested to use a 6-pin Deustch connector in order to fit it into an inch of hole drill underneath the bus flooring. The high voltage cable had a strain relief on the top of the floor heater. We relocated the floor heater 24 VDC harness and connectors near the HV termination box. The original location was underneath the heater coil. It applied to both floor heaters. HV cable routing was routed on the top of the floor heater due to no space inside the floor heater itself. MCC created a channel to cover and protect the HV cables. Asked MCC if the 24 volts and high voltage could be routed side by side for easy installation but MCC suggested not to mix the two together due to the possibility of Electromagnetic interference. The harness for the 22-pin connector was tucked inside the wire duct at least 10 more inches before the actual 22 pin location of the MCC connector. The Engineer-In-Training opened an Engineer Deviation (EAD) for the XCC1 jumper to reach the MCC connectors.

- Met with MCC Engineers and discussed the floor heater high voltage cable routing. It was decided that they were to increase the height of the floor heater by 2 inches in order to accommodate the high voltage cable. The plan was to have a channel to fish through the wire without clamping it for support. A New Flyer NPD drafts person provided the new dimension for the floor heater and sent it to MCC. The MCC proposal for the new floor heaters was reviewed by a Project Manager and the Director of New Product Development.

- Discussed with the VP of Engineering from Vanner about the monitoring of the battery health through the Vanner equalizer. According to the VP of Engineering, there were two options of operation. The first option was to monitor the battery for 20 minutes before determining the health of the battery. The second option was that the battery monitoring would always be on, which would consume 200 mA from the battery. The VP of Engineering recommended to choose the second option due to the importance of battery health before the coach was in operation. In order to achieve the battery monitoring, it required a current transformer that would be supplied by Vanner. It increased the price to $100.00 to add the battery health monitoring system. It was not added to the Vancouver Trolley project because it was beyond the scope of the customer requirement.

- Attended a meeting at the New Flyer NPD department to discuss securing of the high voltage cable. The NPD personnel tie warped the high voltage cable and secured the cable by pulling it down. Discussed with an Electrical Technician from Kiepe to pre-assemble the cable attached to the DGG and ship it to New Flyer to minimize the amount of risk of installing the wires inside the DGG unit. When installing the DGG unit, the production time was reduced from 1.5 days to mere hours to complete and assemble the harnesses on-line.

- Tested the Forster SCU PN 263119 and found out that if both front and rear air pressures were low p<75psi, the low warning light turned off. If one of the pressure gauges was low and one was up, the low air warning was activated. Contacted Vansco Electronics to find out if the PGM programming was incorrect.

- Attended an MCC meeting to discuss the shipping of the new floor heaters. The MCC Engineering Manager explained the possibility of tripping the TCO due to the thermal momentum when the 400 V blowers were off for 15 seconds. The TCO reset when exposed to -30C. According to the NPD Professional Engineer, the drivers were trained to not expose the coach to odd situations where the coach sat in the middle of the intersection without 600 VDC power. Another situation that could be encountered was when the coach was in EPU mode, and the 600 VDC was removed. The heating unit could still be operating and trip the thermal cut-out switch due to the thermal momentum after the loss of the 400 V blower power. One solution was that when the driver pressed the EPU button, the Vansco Multiplexing system would send a signal to turn off the MCC heater coil and let the 400 VAC blower run for a short period of time before the coach moved without a 600 VDC overhead line. The output for the EPU mode would be O3-17 from the side console panel.

- Kiepe had a problem with the insulation on their 24volt system when they did an insulation test from 24 volts to chassis ground of the coach. During the test, the insulation only went up to 1 Megohms instead of 34 Megohms. I worked with Kiepe and we found out that the CAN shell between their system and the NF system CAN were partially touching each other. The NF CAN shield was grounded to the coach. The problem was solved and the CAN shell was reinstalled back into the ZLG and the hot coach detection to the SDS box.

- Contacted the Application Engineer from WABCO in regards to the ATC problem. We found out that the blink code 7-5 was due to the J1939 connections and the WABCO ECM was looking for certain type of messages from the engine and transmission. Advised a Kiepe System Engineer to change the program of the Kiepe

Central Controller Unit to broadcast the powertrain messages to the J1939 network. The problem was resolved after the programming change to the Kiepe CCU.

- Received a phone call from a New Flyer Customer Service Trainer in regards to the Vansco network error. According to the Trainer, the system power and network light were flashing and only node 3 had the continuous illuminated power and network light. Advised the Trainer to re-download the program and recheck the pin connections on each module. After completing all the steps, there was still a system error in each module and no progress in the status of the multiplexing system. Advised Trainer to go to the diagnostic mode to see which inputs and outputs were grayed out. He found out that node 3 was grayed out. He replaced Node 3 (2820) with a module from another coach and it started working again.

- Attended a meeting between Vansco and New Flyer to discuss the problem encountered in Community, Baltimore and San Bernandino Transit. There were a few issues that we discussed and provided some resolution. The first issue was when the transmission requested the "32 byte Engine Configuration Signal" and it was broadcasted globally on the J1939 network. The Vansco Multiplexing System responded by having the VMM's send an "Abort PGN" message 65251, and it caused the engine to stifle and shut down. As per SAE J1939, an Abort broadcast was not compliant and Vansco reprogrammed the PGM to not send the abort messages. The second issue was the VMM 1210 failure of output 9 and 10. Vansco explained that output 9 and 10 were not meant to drive an inductive load such as a relay and it could potentially damage the outputs. The third issue was that in the VMM 1210 there were 2 Micro controllers and one of them was called PIC, which included Proms with 2 Bytes. One of the bytes functions was to look for Active Hi and Active Low input status. The microchip had internal Prom corruption problems. The solution was that Vansco released a new logic change to check for any corruption of Proms or addresses at boot up, and protection would be included. The logic change to the program was to remove the power control from pin 1.

- Studied the data log from SR1000 Community and we found out that the bus loading increased to 34% due to PGN 256 and 512, which had priority 0 and transmitted every 0.6mS for 512. As per SAE document, PGN 512 was actually ISO 11992 for the truck and trailer application. In a newer log after the flash update, PGN 512 and 256 were nowhere to be found. It was found out later that the source of the increased bus loading was coming from the Caterpillar diagnostic tool.

- Attended a meeting about the Baltimore battery issues. We planned to conduct the MODAC study in St. Cloud for three consecutive weeks. A Delco-Remy Application Engineer conducted the MODAC study and we added a temperature probe to monitor the battery temperature. Three people from the Electrical Engineering Group were assigned (including myself) to assist the Application Engineer from Delco-Remy.

- Sent an email to Thermoking in regards to CAN messaging for temperature data. TK uses PGN 65535 as a proprietary PGN to send messages from the base module. CAN 20 to CAN 23 were being transmitted once every second under PGN 65535. Suggested to TK that each CAN identifier should have its own PGN number.

- Discussed the possibility of having a different PGN for tacholink. This would prevent the vendor from looking into the Vansco CAN messaging and we would be able to manage the proprietary PGN for each vendor component.

- Assisted a Technologist in solving the problem of the kneeling operation. The Production Engineer reported that when the kneeling was raised, the lower and raise kneeling magvalve toggled back and forth. After reviewing the program, the condition to unlatch the kneeling flag was 0, but the program never went to zero, which was why it kept counting back and forth. We added a condition less than 1 and less than –1 and forced the memory flag to zero. After downloading the program, it worked. Another issue was why the bus never raised when the air reserve was low. The wet tank was sitting at 90 psi, which was at the lower range of the spectrum.

ENGINEERING MANAGEMENT

- Created a product comparison matrix between Allen Bradley and Siemens contactors. The dimension of AB contactor was longer than the Siemens contactor. In the product comparison matrix, the Siemens Contactor had several advantages over the AB contactor.

- Advised Kiepe to provide pigtail harnesses for SGU as a plug and play feature. We did a time study, where a production worker could reduce the amount of time installing the SGU in production and reduce the risk of damaging the board during the wiring installation. We applied the same concept to other Kiepe components such as the Motor Module (MOM).

- Attended a meeting about improving the Kiepe Harnesses. The Manufacturing Engineering specified the requirements that the production worker should not create or assemble wiring harnesses. Assembled wire harnesses from the manufacturer would significantly improve the installation time and reduce the risk of damaging harnesses during installation. We also did a labor cost comparison when assembling Kiepe harness in-house versus assembling by Kiepe itself.

- Coordinated the effort to release the Bill Of Materials of Kiepe Harnesses. We discovered discrepancies between the NFIL runsheet and the Kiepe Kalipro document in terms of pins, connectors and lengths after BOM reconciliation. Still some PN for the power cables and remaining harness drawings were missing. Passed the marked up drawing to NPD for rechecking. Spoke with the Program Manager in regards to the Kiepe Harness and how to deal with the BOM. As it stands today, there were some mix Kiepe PN and manufacturer PN on the harness runsheet. We had to use the Kiepe PN instead of the manufacturer PN because Kiepe provided all the materials for harness assembly. Asked NPD to change all the vendor PN to Kiepe PN.

January to December 2006

Position Held: Technical Lead (Programming), Engineering Department

APPLICATION OF THEORY

a) **Vancouver Trolley Project**

<u>**Air Compressor Theory Of Operation**</u>

- The new Kiepe program allowed the air compressor to operate when the system air pressure was low. This satisfied the GVTA requirement for operating the air compressor in neutral mode. In the new VMM ladder program, when the air compressor starts (e.g. crossing the insulators), the blow down magvalve will deactivate for several seconds (not 23 seconds) to reduce the high in-rush current. Also, it discharges air pressure from the blow down magvalve prior to switching off the air compressor. The load current drops from 10.7 A to 6 A then opens the contactor. It was a significant improvement over the previous program. The old program opened the contactor under load somewhere between 10.5 to 11 Amps. It increased the life of the contacts when the motor contactor opened under no load conditions. The VMM ladder program also eliminated the sudden inrush current of a motor during start-up by providing a few seconds of not engaging the contactor. A high in-rush current could cause the Kiepe static converter to shutdown. The technician would have to do a manual reset of the Kiepe system.

<u>**MAR Operation Revised Program**</u>

- Verified that the 600 VDC contactor would be opened when the ramp was deployed in neutral mode. This satisfied the GVTA requirement for operating the MAR (Mobility Aid Ramp) in neutral mode. The new test program was loaded into the Vansco multiplexing system and used VMM software for diagnostic purposes. I also used Vector CANalyzer to monitor the timing sequence of each of the inputs and outputs of the MAR (Mobility Aid Ramp) system. We also tested different conditions such as when a ramp is deployed, and when one of the NFIL signals drops out. For example, when the front door was closed or park was not activated, the wheelchair ramp indicator would flash and the Kiepe main contactor would remain open until the ramp was stowed and the forward/reverse direction was depressed.

b) **Vapor Door Class System Rear Door Operation**

- Wrote a theory of operation in regards to our current rear door operation for Vapor doors. Created a test program for SR758 Ottawa for the rear door operation. Below is the basic operation that was incorporated into the program.

    - If the door controller was not authorized and somebody was trying to open the door, either in stationary or moving (above 2 MPH) mode, the driver buzzer would activate and the rear door open indicator would flash.
    - If the coach was stationary and if one of the rear doors was open without authorization, then the interlock would be activated.
    - If the door controller was authorized and the coach was stationary, the rear door would be enabled.
    - If the door controller was authorized and the coach was moving (above 2 MPH), the rear door would not open, the buzzer would activate and the rear door indicator would flash.

c) **Auxiliary Batteries**

- Designed a power supply control switch for auxiliary battery power. The concept of the design was to switch on and off the auxiliary power solenoid when the main battery disconnect switch was switched on and off. The technical problem to implement the concept was that the solenoid coil had to be "on" for a short duration of time.

d) **Boston Project**

The Operation Of Two Independent Measure Of Velocity As Per Customer Requirement

- The technical requirement from the customer was that the multiplexing system should be able to compare two independent measures of velocity and determine if the coach was stopped before the rear door can be opened. The Vansco multiplexing system can read the J1939 CAN messages from a different source address that broadcasted a calculated velocity. The commonly used calculated velocity was a wheel speed measurement coming from the engine source address 0, which broadcasted PGN 65265 Cruise Control Vehicle Speed (CCVS). The wheel speed implementation had 2 bytes of messages with a bit resolution of 0.0039 KPH/bit. The wheel speed was a calculated value based on an output shaft speed of the transmission, gear ratio and tire size. The second reference of velocity was the front axle speed that broadcasted from the ABS ECU. The broadcast message from ABS ECU was Electronic Brake Controller 2 (EBC 2) PGN 65215 SPN 904. The two independent velocities operated when the coach sped below 3.2 KPH and then the operator could enable the rear door.

- If one of the wheel speed messages was not below 2 MPH when the coach was stopped, the rear door would not be enabled. The "Speed Switch" indicator would only activate if one of the wheel speed messages was not zero after 10 seconds.

- If one of the wheel speed messages was not equal to 0 MPH when the bus was stopped, 10 seconds later the "Speed Switch" indicator would be activated continuously and latched "On" until the master run switch was cycled. The rear door and the brake lock would not be enabled.

- If one or both wheel speed messages lose communication, the "Speed Switch" indicator would flash and the "J1939 Com" indicator would also be activated. Since the wheel speed messages were coming from the Power Train network, the "J1939 Com" indicator flashed. The rear door would not be enabled.

- If one of the wheel speed sensors failed, the speed message became zero. If one of the wheel speed messages was above 2 MPH, the brake interlock would not be enabled when the coach was moving. This prevented inadvertently activating the brake interlock when the coach was moving. The only time the brake interlock activated was if the emergency rear door switch was activated.

Proposed Operation of J1939 Communication Failure Indicator

- Vansco J1939 Multiplex System had a capability to detect chassis and the powertrain network fault. If one of the VMM nodes dropped out, 10 seconds later the "J1939 Com" indicator would be activated continuously and latched. In order to unlatch the "J1939 Com" indicator, the operator was required to cycle the master run switch. If one of the Power Train ECM or ECU loses communications from the Power Train network, the "J1939 com" indicator would flash.

Ultra-Capacitor Design Concept for Transit Bus Application

- The customer requirement was that the starter circuit have a 24volt 70kJ asymmetrical electrochemical capacitor and a high current carrying relay. A high current cabling consisted of 4/0 with a length that did not exceed 6ft. The controls brought the capacitor in parallel with the batteries just prior to a start attempt and isolated the capacitor from the batteries three minutes after the vehicle had been running, which insured that the capacitor was fully charged.

- The design concept that we implemented to the property was that the capacitor unit would be used for the sole purpose of starting an engine while the batteries would be used for the coach electrical system (e.g. Grid Heater at start-up, Multiplexing system, Lights and etc). The 20 Amp DC/DC converter allowed the capacitor to charge up when the voltage was below 20 VDC or after the engine started. It provided an electrical isolation that prevented voltage dips during starting, which affected sensitive electronic equipment such as the Engine ECU, farebox or camera system. Under abnormal operation such as when the system battery was discharged, the capacitor would wake-up the coach and start the engine. This was accomplished by using the dead battery and start push button switches, thus activating both simultaneously.

- Assisted a Professional Engineer on how to use the NI-DAQ for the MODAC study of the Boston Coach. A problem we encountered was during the setup of the current transformer and its power supply. We solved the problem by setting up the DAQ channels into a differential mode in order to read the output from the current transformer.

e) Electrical Test Bench Implementation

- I was assigned to set-up the Electrical Test Bench for Electrical Panel checks. Aside from myself, there was a Manufacturing Technologist and an Engineer-In-Training who helped me to complete the Electrical Test Bench. It involved three phases of the project to fully complete the test of the Electrical Panels.

- Phase 1 of the project was to identify the I/O references between the Vansco Multiplexing system and harnesses that connected the Test Bench and Electrical Panels. Some of the harnesses could not be used because it was damaged during the move. We made-up harnesses specific to each panel such as a side console panel and a rear PLC panel. It was a manual test and required WD, schematics for references and the program to complete a single panel checkout. From the time we obtained the Run sheet information, created a cross-reference manually and a basic test program, it took at least 8 hours to set-up a new SR to be tested. The learning curve was tremendous because we had to be familiar with the equipment in a short period of time.

- In Phase 2 of the project, I created an automated program called "SpreadSheet_Generator_IO" that generated a cross-reference between test bench and panel assemblies **in seconds**. This automated program cut the time of test set-up by 3/4. The remaining quarter was to create a test program for the panel assembly test and for double-checking the cross-reference information documentation of SC and Rear Panel Harnesses. Test time for each panel, depending on the amount of error in the panel assembly and complexity of the panel, was reduced from 2 hours (first time) to 20 - 45 minutes.

- In Phase 3 of the project, we set-up the Allen Bradley SLC test bench and expanded the spreadsheet generator IO to generate PLC programs. All of the test reports and documentation were turned over to Production personnel for information purposes and support for the Production Technician during the transition period.

f) Rear Door Operation from Hoerbiger-Origa Validation

- Worked out the theory of operation with an Electrical Engineer from Hoerbiger-Origa in regards to the new front door operation. I wrote the VMM ladder program and also provided basic operation of the new front door. When the front door controller was switched on, the output from the Vansco multiplexing system pulsed the front door open magvalve for 250 mS to open. If there was a door obstruction during opening, it activated the front door close magvalve to close the door. The operator would have to cycle the front door controller to reopen it. When the front door passed 85 degrees open, the door open limit switch opened. For door closing, when the front door controller was switched off, the output of the multiplexing system pulsed the front door close magvalve for 250 mS to close. If there was a door obstruction when closing, it activated the front door open magvalve to open the door. When the front door passed below 5 degrees when closing, the front door close limit switch opened. The power supply to the front door system was 12 VDC and it had a 6-pin weather pack connector so that the production worker installed the harnesses as a plug and play.

g) CAN Switches Test and Validation

- I tested and validated the EATON CAN switches. Since the CAN switches communicated through the J1939 network, it was easy to manipulate the messages and program the different sequences. The CAN set-up and the first byte was the master controller, and the last byte was the 7^{th} or the last set of switches. The connection between the master controllers and the switch was a daisy chain connection up to the last controller. Since the CAN switches were IP-67 or 68 rating, the switches would not be able to work in wet-environment conditions especially if the operator accidentally poured coffee on the top of the switches. Also provided some suggestions on how to operate two position maintain rocker switches. For example, if one position of the switch toggles to the next position, the messages should not change until the switch is closed.

h) VRLA AGM Batteries

- I researched about the VRLA tech manual. Charging guides stated: "Always use an automatic temperature sensing voltage regulator charger". Discussed the issue with the manufacturer that the trolley charger was not temperature compensated. We informed the manufacturer that the Vancouver ambient temp ranged from 35

C (max) in summer time to -15 C (min) in the winter. Calculated the estimated battery charge time from 0 to 90% to be 4 hours for 245 Amp-Hr batteries (8A8D) and matched the battery manufacturer graph of the "Charging Current vs. Charging Time" curve. Also calculated the estimated operating life of the AGM batteries. For normal operation, it would be 13778 hours for 75 discharged-charged cycles a day and 689 Operating hours in full EPU mode.

i) **Retarder Oil Temp and Transmission Oil Temp using CAN sniff**

- Provided information to a Crookston Production Engineering Technician on how to read Retarder Oil Temp and Transmission Oil Temp using CAN sniff. The CANsniff showed number of bytes, PGN numbers, priority numbers, sources address, destination address and 8 bytes of data file information. All of these numbers were shown in Hex format and guided the Production Engineering Technician on how to convert to decimals and binary format. An example of how to read Transmission Oil Temperature SPN 177 was as follows: The Transmission Oil Temperature had 2 bytes of information and it occupied byte 5 and 6 of the data file information. If the information showed DC hex in byte 5 and 2A hex in byte 6, since byte 5 was MSB and byte 6 was LSB, it would read as 2ADC which was equivalent to a 10972 raw value. Since the Transmission Oil Temperature had a bit resolution of 0.03125 °C/bit, multiply by the 10972 raw value and subtract the value by –273 °C. The result would be 69.875 °C. With this information, the Production Technician would be able to analyze data from Hex format and convert it into usable information to diagnose if the coach was performing correctly during retarder operation.

PRACTICAL EXPERIENCE

- Received a call from a Technical Service Representative in regards to the SR913's over voltage fault upon start-up of the engine. The technician saw 34 V at start-up and all ECM's were logging fault code. Every time the RPSM grounded the wire of the regulator directly to the GNDPEC PS12PC and the positive was connected to the F4PS 80 Amp fuse, the alternator worked properly. We suspected that the failure was probably due to loose wiring or one of the regulator sense wires being open. The RSPM tightened the loose sense wire and the voltage regulator started to work.

- Attended the EATON presentation meeting for the J1939 multiplexing switches. The Account Manager was committed to bringing samples in two weeks at a time. The EATON Account Manager spoke to the Engineer about how to protect the switches from dust and water exposure. The Account Manager was also committed to providing us with information on leakage current in an off state.

- Troubleshot the SR1054 Bakersfield due to the rear panel modules shutting off after 20 minutes. Checked the XBBPN3 and XRR50 and found that there was no power. However, there was power at XBBPN1 and XSC53 on the side console. When the TK technician opened the exit door panel and looked for XBBPN2, all of a sudden the power came up. There was a loose connection and it was fixed immediately.

- Conducted a conference call in regards to AVL, APC and Radio provisions. The discussion was about 15% of the CNG fleet installing cables provided by Dilax. SRCR was issued by marketing and would likely be approved to take a different SR. It was the same for the Trolley coach. The rest of the CNG would have a fish wire and conduit, while the trolleys would have the same harness installation provided in the SR983 prototype. For the APC location inside the trolley, we considered installing it at the top of the front curbside wheel well. The Tech Lead reviewed the design of it. We also discussed the possibility of New Flyer providing a double decker holder for the ODI keypad and radio MDT.

- Attended a conference call with Sure Power in regards to the wiring configuration and different types of Ultra Capacitors. Discussed the three different capacitor manufacturers: the KBI, Mallory and Delco-Remy, who could supply product for the upcoming built Boston Property. The KBI unit was a hybrid design that had a combination of battery and Ultra Capacitor. As per Sure Power, the Ultra Capacitor could provide 6 full starts at full charge. The main disadvantage of the KBI hybrid capacitors was that for the voltage to be maintained above 16 V for 24 volt application and the voltage drops below 16 V for a long period of time, the hybrid capacitor would be severely damaged. The Mallory capacitor was a Russian built capacitor and was designed for a cold cranking start. It had the highest energy density and the lowest resistance among the three competing capacitor manufacturers. It was built in a steel case, was robustly designed and could be discharged to zero volts. Also, Mallory could provide a full cranking power using a 40KJ compared to 70 to 80 KJ for KBI and Delco. As per Sure Power, this capacitor discharged itself after 4 to 5 hours and it needed to be charged again by a battery or a converter. Therefore it was not suited for long off-duration if the operator needed to crank the engine. The Delco Ultra Capacitor was a mesh design, composed of several capacitors in series and in parallel to attain the current and voltage requirement. It needed a balancing circuit to provide an equal charge for each capacitor during charging. It had the highest resistance among the three competing Ultra Capacitors and the least experience in terms of application. It was susceptible to vibration due to the mesh design. The only advantage of this capacitor was that it was readily available if requested by New Flyer.

- Attended a meeting about the E60LF trolley coach. We discussed making the DGG unit in the same location as the E40LF coaches. The wiring harnesses and power cables would be longer due to the length of the articulated coach. Another concern was how to secure the cable across the joint. The length of the cable was a concern due to the increase in resistance. We could have increased the diameter of the conductor to compensate for the voltage drop especially when a huge amount of current was required by the power steering motor.

- Spoke with an Allison Application Engineer in regards to the hot coach detector. As per Allison, they had internal protection in case of an isolation fault. If there was a fault, the TCM turned off the propulsion system and opened the contactor to the battery. The Allison TCM would send a stop system indication to indicate a fault. The Technician would then connect the laptop to diagnose the problem by looking at the fault codes. Asked the Allison Application Engineer if the TCM can send a different indication for the hot coach detection and if Allison would allow us to provide a CAN database for the proprietary messages.

- Met with the Account Manager and Director of Engineering of Delco-Remy to discuss the Ultra Capacitor availability. As per Delco, they did not have a production type of capacitor available until the following year because it had to be molded and tested as per industry standard. If New Flyer dropped this project from Delco, then Delco would not continue this project until there was a demand for it. Another interim solution from Delco was to provide prototype capacitors and install it in production Boston buses. The prototype capacitor was not environmentally sealed and could deteriorate over a period of time due to water intrusion, and salt and dust that could cause the capacitor connections to corrode. Delco did not want to guarantee the product because it was a prototype and it would be expensive to change it. After the meeting, we organized another meeting with KBI to see if they had a production type capacitor.

- Discussed with a Technical Service Manager (TSM) of Customer Service about the fuel sender gauge calculation for the SR924 GE coach. As per TSM, when moving the fuel level sender, it accurately showed on the fuel level gauge, but once the arm of the fuel sender was in the empty position, the fuel level still read 1/8 full. Asked TSM to provide us with an actual resistance reading at maximum and minimum deflection. Once we received the information, we were committed to sending out the new test program before the end of the week.

- Conducted another meeting with Sure Power in regards to the Ultra-Capacitor set-up. As per discussion, Sure Power was leaning towards the symmetric design capacitors such as Maxwell, Epcos and Ness Delco-Remy design. At the start of the meeting, they intended to use the Mallory capacitor as a prototype as it was asymmetric in design and could dissipate the charge to a minimum after 4 to 5 hours. One of the disadvantages of the Mallory capacitor was that it had to charge for the first 190 seconds after it had been discharged overnight using a 30-amp converter. Sure Power also provided a provision to have a bypass relay just in case the operator charged the capacitor quickly by bypassing the converter. Since it would be subject to a voltage dip when relay is closed and could weld the contacts, this type of system would be suitable for daily operation. Before the end of the meeting, Sure Power went back to a ness design capacitor for discussion because it could hold the charge for a long time. As per calculation, it could discharge 1.4% of its energy per day for the Ness Ultra Capacitor. Action items were provided to Sure Power to provide a discharge curve for Epcos, Maxwell and the Ness Capacitor in order to know when to start the engine or not to start it when the capacitor voltage was low. The control of the starting system would be taken care of by the multiplexing system. Sure Power provided a quote for the Epcos capacitor and it was the only manufacturer that was production ready at that time. The dimension of Epcos capacitor was 267 mm x 396 mm x 163 mm and Sure Power provided a proposal for submittal to the Boston Transit Authority (MBTA).

- Attended a Kiepe and New Flyer conference call and created action items for myself such as creating a theory of operation for the air compressor and creating a new program for the air compressor to coincide with Kiepe's new program for running the air compressor in neutral. Discussed the cable length of the 24 LVPS for the AETB project. The power cable diameter was larger due to the additional length of the AETB to reduce the voltage drop from the battery to the fusebox.

- Attended a Vancouver Trolley meeting with the Customers and the Sales/Marketing Team to discuss the SDS Box to have an additional VMM module, Radio System (Init) and APC Dilax system. We also discussed installing the fish wire conduit that New Flyer would be supplying to all coaches. The TSP (Traffic Signal Priority) would not be discussed on this property due to no advance information from the vendor.

- Attended another weekly conference call between Kiepe and New Flyer. We discussed the cable drawings and BOM from Kiepe. We explained to Kiepe that the drawings must have a BOM and be exported as DXF for NFIL to release it. Discussed the inner grommet of the DGG strain relief for the 24 V power cable. Asked Kiepe to find a thicker grommet that would fit the ring terminal and at the same time hold the 4/0 cable. We tried to avoid adding up a heat shrink or electrical tape that would increase the OD of the 4/0 cable. Also discussed the safety concern of MAR enabled in neutral. One of the concerns was if the switch was defective and it was manually deployed, it may not turn off the 400 VAC BNU side.

- Attended a Boston Meeting for Electrical requirements. The Professional Engineer from Vansco showed the wireless capability of the PDA. A question was raised about the following: If the coaches were sitting side by side, how would the PDA distinguish between the coaches? The wireless standard was based on 802.11b. One of the solutions was to provide dip switches to be set on each coach before it was released from production. The wireless PGM had a new PN and it provided a time-stamp. For data collection, Vansco could provide up to 8 Kbytes of information per module and could record duration, generic and counter log. Vansco had been asked if they could export the logs on an excel spreadsheet and what system anomalies Boston had required to be logged. Below were other discussion points during the meeting:
    - Discussed Vansco providing a discrete output to wake the multiplexing system
    - Determined whether or not Surepower could provide a quote, package design drawing and date of production.
    - Calculated the number of spares for I/O if the customer requirement met 20% spares for input and 20% spares for output for each panel.
    - The 9 pin diagnostic connector was relocated to the radio box from the B-post behind the driver's area panel. All diagnostic connectors for all devices would be found inside the radio box.
    - Battery specifications to be provided by the Electrical Engineering Group

- Spoke to a Technical Service Manager (TSM) from Cummins Engine in regards to wrong J1939 CAN messages. As per discussion, New Flyer found some discrepancies in messages broadcasted by Cummins ISM 02 ECM installed in SR1074 Chicago. As per the CAN data log, on a bad coach the accelerator pedal low idle switch SPN 558 was under byte 1. The first 2 bits were the ECM sending out 2 or 10 (binary) and in the other ECM known as good, it sent out a message SPN 558 1 or 01 (binary) when the accelerator pedal was not depressed and 00 when the accelerator pedal was depressed. This message was used to disable the Neutral Bus Stop feature when an accelerator pedal was depressed. The TSM gave us an explanation that the calibration program for the December and January version 8 was incorrect and advised us to download the calibration program version 9 that was released on Feb 2006.

- Attended a conference call with Kiepe in regards to the MAR activation in neutral to switch off the 400 VAC before deployment. The Vancouver customers wanted the main contactor open during MAR activation without pressing the neutral selector button. The new VMM ladder program was provided to the property and it was tested along with the new Kiepe Program.

- Helped a Professional Engineer to modify the program for the DRL logic. Explained to a P.Eng how the DRL logic worked during normal operation.

- Conducted an electrical installation checklist for Allison Generation IV transmission with the Allison Application Engineer.

- Received a memo from the Production Manager and was asked by the Director of Engineering to go to McGillivray Avenue to support the Bench Electric Test set-up with a Manufacturing Technologist. During that time, I assessed that the new bench electric group was not ready to do their own testing. We also encountered a problem that was related to miss wiring of the Night Park module power between pin 85 and pin 87. Other problems related to the SC SR1086 were programming errors, lack of basic understanding of the schematics and connections points and Input and Output signals, and lack of familiarity of WD pages. I trained the new people on bench electric and it took them awhile before they became familiar on how the electrical panel and bench test worked.

- Attended a conference call with NPD Professional Engineers and the Account Manager from NatPro to discuss the Air Compressor issue. As per data gathering, the PS7 125 psi was activated before the PS8 pressure switch at the governor side. It took 3 seconds between activation of PS7 and PS8. From 125 psi to

105 psi, it took an average of 5 minutes to activate the air compressor. From 105 psi to 125 psi, it took 48 seconds to reach the maximum pressure. The meeting concluded that I would download the program as discussed from the last meeting and sometime in the future, would add a pressure transducer and connect it to the VMM analog input.

- Discussed the dimmable and extinguishable ballast change to Pretoria. Dimmable and extinguishable ballast would have the same operation in dimming or extinguishing. 0 Volts for bright and 24 volts for dimming/extinguishing.

- Spoke to the Regional Product Service Manager (RPSM) in the California area about the accelerator pedal problem for the SR657 Long Beach transit. As per RPSM, every time the revision N program was loaded, it lost the TPS (Throttle Position Sensor) signal when depressed and the accelerator was active when released. Found out that the ITS 1560A was never implemented on any of the coaches in Long Beach Transit. The RPSM had to move the wire EN47J from pin B to C and reload the newest program to make it work.

- Attended a conference call with Sure Power to discuss concern over the pricing and handling of the capacitor. The Electrical Group Leader wanted to see the KBI capacitor included with the Sure Power Capacitor Unit rather than handling it separately because of convenience and cost. During a technical discussion, Sure power would provide a handle for the capacitor, move the charger to the output side of the relay and add a LED to indicate if the solenoid was energized. Also discussed the characteristic curve between KBI, Maxwell and EPCO's capacitors. When the voltage was stabilized, the KBI voltage was lower than Maxwell and EPCOS by 2 VDC.

- Attended a meeting with KBI in regards to the capacitor voltage drop after one week. As per actual data, it was 2 vdc below the supplied data from KBI. We asked KBI why the voltage did not match the supplied data. As per KBI, the reason was that the capacitor did not cycle between 13 to 26 V for 25 to 30 times before it was able to match the supplied data. The voltage monitoring was not enough to determine the amount of energy inside the capacitor. It should be current charge and the charger should stay for 15 minutes before turning off the ignition in order to provide a good charge to the capacitor.

- Conducted a test in NPD by cycling the KBI capacitor for 25 times to see if the charging and discharging would change in different times. We found out that when discharging the caps to 13 volts, it took 3 minutes and when charging to 27 volts it took 4 min 15 seconds. There was no significant difference in the amount of energy being discharged from the capacitor after cycling it 25 times.

- We experienced an issue when we switched on the air compressor and it did not run because Kiepe Central Controller Unit detected a fault to ground one of the three phases of the motor. We started to troubleshoot from the contactor up to the motor junction box. We found out that one of the motor leads connected to a terminal strip at the control box and was wired to the input of the VMM 1210 modules (Node 17). This caused a major damage to the VMM modules and killed it. Sent an email to a NatPro Account Manager to come to Durand facilities and fix the air compressor wiring. We showed the discrepancies between the supplied schematics by Quincy and the production SR1027 air compressor terminal strip to the Account Manager of NatPro. The wiring for the inputs/outputs were not the same. After fixing the wiring, we ran the air compressor, checked the rotation and it was correct.

- Another issue came up when the air compressor was running but not loading up to the air tanks. Found out that the VMM output to the blowdown magvalve was faulted. Asked Quincy if the solenoid had a diode across the coil, and I was told that it did not. Replaced the VMM modules with a new one and added a diode across the terminal strip inside the control box. Asked a Purchasing Officer to pressure Quincy to add the diode across the solenoid.

- Assisted a Kiepe System Engineer to conduct a final test of the trolley coach before driving it around the St. Boniface Industrial Park with a generator hitch behind the coach.

- Discussed the grounding of the defroster heater for the trolley. As per Kiepe, NFIL needed to add new ground due to a high resistance between the chassis of the heater and the chassis of the bus. The maximum resistance between two ground points was 50 mOhms. The ground wire connected between the defroster and DGG had a resistance of 157 mOhms. We added a wire between the defroster and GNDPSCBOX1.

ENGINEERING MANAGEMENT

a) **Electrical Test Bench Project**

- During the strike, I was assigned to rebuild the Electrical Test Bench with the Technologist and Engineer-In-Training from the Manufacturing Engineering. The management gave us a week to do a decent test for the side console and rear panel for both SR1110 and SR1086. The Electrical Panel test included rechecking the wire codes, testing input and outputs of the VMM module, and testing switches and indicator lights on the instrument panel. I also created a PLC harness documentation to be used by the Technician. Sorting out the Allen Bradley PLC harness was challenging because of the lack of documentation and expertise that was no longer in use. Completed the second phase of generator I_O by generating a cross-reference between test bench and Side/Rear Panel assemblies.

b) **Vancouver Trolley Project**

- Part of my responsibilities was to attend a weekly conference call and support the production coaches if any issues arose. I also organized a meeting with the Program Manager, the customer and the Vendor from East Penn to explain the advantages of the AGM batteries for the Electric Trolley Application. I also resolved some issues with BOM and drawings released by Kiepe such as wiring harnesses. The wiring harnesses were always in dispute due to different methodology used in creating the production version of wire harnesses.

c) **Boston Ultra-Capacitor Project**

- I was part of the Ultra-capacitor Project on the previous Boston Build. I was assigned to create a test plan and also coordinated the resources required to make the test and validation happen. The test plan and schematics were sent out to NPD to carry out the test. I met with a Sure Power Application Engineer, VP of Engineering and Account Manager to witness the test. The test and validation was conducted on SR1086 WMATA coach. The ultra-capacitor starting system was a concept developed by both New Flyer and Sure Power in order to meet the customer requirement and also provide improvement in starting capability compared to the customer's existing set-up. The advantages of the ultra-capacitor system were that it isolated the electrical system from the starter motor during engine cranking and also provided starter assist whenever the main battery system was discharged. However, the initial investment was high to have this kind of starting system on the bus. We projected it could offset the initial cost in the long run due to low maintenance cost as well as reduce coach downtime due to discharge batteries.

d) **Wireless Project**

- Worked on Vansco Wireless Gateway with Vansco Software Engineers. The information from wireless gateway could be accessed using Dell PDA. The wireless gateway was a part of the requirement for the Boston contract. The Technician could then troubleshoot the coach using a remote diagnostic handheld device.

January to December 2007

Position Held: Group Leader, Electrical Integration Group, Engineering Department
I was given an opportunity to become Group Leader of a newly formed Electrical Integration Group. I managed a group of 20 people, which was composed of Technologists and Engineering graduates. The Electrical Integration Group was divided into two groups: the Schematic/Programming Group and Harness Design Group. Each group was supervised by a Technical Lead, who reported to a Group Leader. As a Group Leader, I oversaw day-to-day operations, communicated to other Engineering groups, performed resource utilization (i.e. backlogs and capacity), performance appraisals, established short and long term goals for the group, selected new hires, managed special projects and made technical decisions.

APPLICATION OF THEORY

a) **Power Steering Test and Validation**

- Issues came-up from the Transit property that there were reports of momentary loss of steering when pulling out from the bus stop and crossing the dead spot at the intersection lines. The power steering motor was a 24 VDC Brushless DC motor and provided power steering assist during operation. The first batch of Engineering personnel was sent to Vancouver to investigate the issue and examine the suspected buses. They interviewed several transit drivers as well as maintenance electrical technicians to gather information about the issue. They found loose connections at the park brake, which activated the power steering. They asked me to provide a ladder program with delay in case the loose connection occurred. There was some improvement in the power steering operation but some trolley coaches still experienced a momentary loss of power steering. My employer decided to send another batch of engineering personnel including myself to Vancouver to further investigate the issue.

- We did a road test and static test to see if the power steering motor and the pump could provide enough flow and pressure to steer the coach. We also rented and installed SOMAT data acquisition and I was tasked to do the program and datalog the coach during the power steering cycle test. With the data on hand, there were several changes to the power steering design such as removal of the accumulator, increased size of the pump from 14 cc to 17 cc, as well as changes to the power steering motor program and ladder program. The data gathered during the power steering cycle test was also reviewed and validated by the Arteh Ltd Electrical Engineer, who was also the designer of the power steering electronics and the motor.

- The momentary loss of steering still persisted and this time we found the root cause of the issue. I created a test program that would switch-off the power steering motor momentarily. Then we would see if the driver could feel the loss of steering for 2 to 3 seconds. After several test runs, we were able to determine the issue due to the intermittent loss of connection that was enough for the motor to reset. The interim solution at that time was to replace the old relay with a bi-stable relay and attach the motor enable signal to the bus-bar inside the power steering motor compartment. The bi-stable worked and it prevented the 2 to 3 seconds momentary loss of steering during operation. While looking for an alternative final solution, the bi-stable relay never lasted long due to pitting of the contacts after numerous cycles, which led to another solution. We introduced a Solid State Sequencing Relay (SSSR), which was tested and revised well into early 2008.

b) Ultra-Capacitor Operation Test and Validation

- This is a continuation of the ultra-capacitor project for the Boston Built buses from 2006. We traveled to Dedham, Massachusetts to conduct an actual service test of the ultra-capacitor operation. The intent of the test was to gather actual data log from the service bus, improve the performance of the system and listen to the Transit Engineer and Technicians regarding their suggestions on the tell-tale functions of the ultra-capacitor operation. We set-up the equipment using Campbell Scientific, which was provided by a Delco-Remy Application Engineer. The part of the test was also to check the Delco Alternator and Regulator performance when the main batteries were fully discharged. The data logger recorded data every 1 second during the road testing and every 2 & 5 milliseconds for the cranking data. The voltage test-point was set-up to monitor capacitor voltage, starter voltage drop, alternator voltage output, batteries 12 and 24 V and side console panel for voltage drops. We added current sensors attached to the capacitor output, battery output and alternator output to see the level of current provided to the starter during cranking and to the batteries during charging.

- The test included eleven hours of road data (95 miles) which was collected from this application, traveling different routes in the Boston area. All electrical loads were turned on during this testing on the road and 99% of the time, the 24V electrical load would be below 171 amps. The new Delco Remy 50VR regulator performed well during this testing as there was a stable charge and voltage to the electrical system. The Delco Remy 42MT started very smooth because of the capacitor with the higher voltages. These were done with several cranking scenarios which included starting the bus by a capacitor with a dead set of batteries. The cranking circuit was monitored on Bus #0747. The cranking circuit resistance was .006 ohms based on a current draw of 1500 amps. This was calculated from the voltage drops from the battery to the starter. The Delco Remy recommendation for this was a maximum value of .002 ohms. The control circuit drop was .53 volts. The control circuit voltage drop, per Delco Remy recommendation was less than 2 volts.

- The test also proved that there were some deficiencies in the ladder program on different cranking scenarios and it was later improved and asked for approval from the MBTA transit. The improvement came with a new theory of operation of the capacitor starting and matrixes of tell-tales activation on different cranking scenarios. The end-result of the test satisfied customer requirements and eliminated gaps in cranking operation.

c) New SCU-II Programming and Validation

- Worked with Forster Instrument to create a written requirement for SCU-II unit. The SCU-II unit was smaller compared to SCU-I. The SCU-II had a faster microprocessor and it could broadcast J1939 messages. Unlike SCU-I, it could only broadcast messages through J1587/1708 communication such as a low air warning. The SCU-II also provided DM1 messaging capabilities if required and for this application we opted not to use it. I tested the unit for several months and came up with revisions of the written requirement and validation of the Vansco Mock-Board. The validation involved the response time within 100mS everytime the Vansco Multiplexing module broadcasted the tell-tales activation, chime activation with minimal delay at the time the switch is activated and fault display requirement on 7 character LCD display. Also took data log from CANalyzer and sent the file to Forster for review.

d) Stop Engine Indicator Functionality through the use of J1939 Multiplexing

Worked with a Cummins Application Engineer to understand how the Engine Protection works and activates the stop engine indicator when shutdown fault occurs. The torque derate and speed derate portions of the engine protection algorithm were turned on by Cummins heavy-duty engines. The ECM reduced engine torque due to high coolant temperature, high oil temperature or low oil pressure. If temperatures continued to rise or oil pressure continued to fall, the ECM would reduce engine speed.

The engine shutdown portion of the engine protection algorithm was turned off in heavy-duty engines as it is required to enable this feature. If coolant temperature or oil temperature rises above or the oil pressure falls below the set values, the ECM will remove fueling to the engine.

If oil or coolant temperatures rise to a specific value above the set value, the ECM will remove fueling to the engine. No fault code is logged but the ECM will flash the hardwired Red Stop Lamp for 30 seconds before shutdown. SPN 1109 (Engine Protection System Approaching Shutdown) will broadcast "Approaching" for the 30 seconds warning period. Once the ECM removes fuel from the engine SPN 1110 (Engine Protection System has Shutdown Engine) it will broadcast "Yes" for a few seconds while the engine is decelerating to zero rpm.

If oil pressure falls to a specific value below the set value, the ECM will remove fueling to the engine. No fault code is logged but the ECM will flash the hardwired Red Stop Lamp for 30 seconds before shutdown. SPN 1109 (Engine Protection System Approaching Shutdown) will broadcast "Approaching" for the 30 seconds warning period. Once the ECM removes fuel from the engine SPN 1110 (Engine Protection System has Shutdown Engine) it will broadcast "Yes" for a few seconds while the engine is decelerating to zero rpm. Created a ladder Vansco program for the stop engine indicator, which accomplished all of the operations as per Cummins engine requirement.

e) Multiplexing Module Output PWM Not matching Ladder Program PWM Input Percentage

- During a test, we found out that when programmed to 8.5% PWM, the actual output was at 10%. When programmed at 75% PWM, the actual output was at 80%. There were significant errors as we increased the PWM %. Also, we put the scope to see the waveform of the PWM at 1 KHz and it was not entirely a square wave. The rise time to maximum voltage was <50uS and set the Tektronix scan rate at 100 uS. The Infineon output driver used in the 1210 had a 100 us rise time max, therefore we potentially had a 10% error in PWM output. If the output driver on any one output or module happened to be 20 us, 30 us, or 40 us we could see a 2%, 3%, 4% error in PWM output. Therefore, the algorithm for fan speed would have to account for this worst case scenario with 10% error. It would have 95% PWM causing fan reversal, therefore the maximum PWM in the program must be less than 85%, perhaps 83% for another margin of safety. During the discussion of the result, one of the Professional Engineers asked me if Vansco or New Flyer had ever written a PID type algorithm routine to be used on a 1210. That is, if the rate of temp rise was relatively slow, apply a low PWM, and as we see the rate of temp increase, bump up the PWM. Vansco had already written a ladder program with PID in the past for proportional valves and did not recommend its use due to slow microprocessor response time of VMM 1210. The end result of the test was that we used a step program for different PWM levels, which varied with temperature and never allowed the program PWM percentage to pass 80%.

PRACTICAL EXPERIENCE

- I assigned a task to a new graduate from Engineering to provide a PID calculation for the Hydraulic Fan Control. It was proposed to have a 4.7 ohms resistor to lower the voltage of the hydraulic proportional valve for better modulation. I also assisted him to create a Vansco Ladder program to incorporate the PID logic when the current varied due to change of resistance because of the temperature. The program and the calculation were sent to NPD for evaluation.

- I have spoken with an RPSM trainer to see what information I could dig up because of a communication error when the diagnostic link adapter connected to the Vansco Multiplexing System. My findings were: the RPSM had a new Dell laptop, Win XP SP2, VMM 513 loaded and VAPI 1.1.0.19. The VAPI 1.1.0.19 was a problem but I could not confirm it until he loaded the newest version of VAPI on his machine and tried it on a vehicle. The Newest

VAPI was 2.0.4.51. The VAPI version 1.1.0.19 was 4 years old and was developed at the time of Win NT4. It was suggested that he obtain the latest VAPI and attempt downloading to the VMM.

- Discussed with Sure Power about the CSSM system, which had circuit breaker trips due to temperature extremes in Boston. The proposed solution to this was to move away from the circuit breaker and to insert a typical fuse holder in its place. This would lessen the nuisance trips but would continue to serve the purpose initially when there was a relay coil failure. Sure Power also showed a spec sheet for the fuse holder that could fit into the existing hole with little or no modification.

- Met the Voith Manager of Application Engineering Electronics and Account Manager at New Flyer to discuss and plan the upcoming Voith 0.5 DIWA for SR1186 Minneapolis build. The discussion involved converting most of the discrete signals to J1939 CAN messages and new harnesses specification. There was also a change on the Voith gear shift selector from the hardwired signals to CAN messages. The gear shift selector required a separate CAN from the Powertrain J1939 CAN network because of a potential network issue during operation. Voith provided schematics and user manuals for review and implementation of the new ECU.

- Reviewed the Generator Set quote from Kohler Rental Power Inc.. The rental company supplied the 200kW trailer generator set, 600VDC rectifier assembly and interconnection cables, for testing of the “traction” buses. Rate quoted was for a single shift operation up to 56 hours per week. The generator set would be used for trolley buses to be delivered to the Southeastern Pennsylvania Transportation Authority (SEPTA).

- Attended the APTA 2007 show in Nashville, Tennessee. It showcased the New Flyer BRT coach and Low Floor Restyle. I was part of the Engineering team that inspected and gathered info.

- We attended a two-day course of NX Wiring Routing. Our instructor taught us how NX Routing-Electrical worked and we went through step-by-step instructions based on the student guide training book. We asked several questions to the instructor such as: how to export the runsheet with wire lengths from NX Routing-Electrical and how to import the harness runsheet as in our current application, how to qualify parts, how to change default settings of NX Routing-Electrical, how the software would work in team-center and how to modify and write the design rule in NX Routing-Electrical. We also met a few people in the class from different companies such as Vermillion Inc, which built wiring harnesses for aircraft manufacturers. The engineer explained why he attended NX Routing-Electrical because one of the aircraft manufacturers named “Eclipse” designed the aircraft in UG including wiring harness assemblies. This is one good example of how a certain company already implemented NX Routing-Electrical.

- Vanner supplier provided the system diagram for all the components of the Vanner system. They gave a brief overview how 80-100 CAN and 90-60 CAN operated. The 80-100CAN kept the battery voltage of the main battery bank equalized, which would significantly increase battery life. The 80-100 CAN also monitored the main battery bank, while the 90-60CAN monitored the auxiliary battery bank. Both transmit the battery monitoring data over the CAN J1939. Based on the battery status transmitted over CAN, the vehicle controller (or other non-Vanner module) could make the decision to transfer charge from the main battery bank to the auxiliary battery bank via the 90-60CAN. The current sensors were needed to monitor the status of each battery bank. One current sensor was used by the 90-60CAN to monitor the auxiliary battery bank, while two current sensors were used with the 80-100CAN to monitor the main battery bank. The temperature sensors increased the accuracy of the battery monitoring significantly, as temperature affects the amount of charge one can pull from the battery drastically. This kind of system was installed on the Orange County built.

- Attended a Vansco Meeting to discuss the next generation of VMM modules. Vansco mentioned that they did some benchmarking compared to Siemens VDO, Actia, present generation VMM modules and I/O controls. There were several questions that were raised during the meeting in regards to the number of I/O count per module, Arc Detection, serviceability and cost comparison between Distributed I/O versus Centralized I/O. The meeting was meant to be a brainstorming session to gather all the information that would be a result of the next generation of VMM modules.

- Assisted a Technical Service Administrator with creating an ITS document for the Power Steering relay replacement procedure. After a few months of testing, we found an interim solution by replacing the power steering relay with a bi-stable relay. Also, in the ITS documents, it also mentioned how to test the power steering motor for any potential operational malfunctions prior to putting the Trolley in service.

- Attended a meeting with a System Specialist from Parker Canada to discuss the fan control hydraulic system and general fan drive system controller.

- Assisted a Mechanical Engineer from NPD with seting-up the SOMAT data acquisition for power steering testing. Also advised on which analog channel should be used and what test point required monitoring. The test was done in Vancouver on coach 2115 with a prototype Solid State Sequencing Relay (SSSR) to control the enable signal and power to the microprocessor, and the MOSFET driver of a DC brushless motor.

- Reviewed the data from SOMAT data acquisition installed on Trolley Coach 2115 to see if there were any anomalies with the power steering operation. The data did not reveal any instances of excessive steering stiffness or steering failure and there were no reports of steering inconsistencies during this data collection period. The one-week of data collection was uploaded on July 26, 2008.

- Traveled to Dedham, Massachusetts to meet with the New Flyer Regional Product Service Manager and Application Engineer from Delco-Remy to conduct a Mobile Data Acquisition (MODAC) analysis. The MODAC study was performed on a Massachusetts Bay Transportation Authority (New Flyer) Bus #0747. The transit bus ran service in Boston, Massachusetts. The charging system on the bus had a Delco Remy 50DN/270A/24V generator and the cranking motor was a 42MT Model #1990413. This transit bus also had a capacitor to aid in its starting. The CR9000 Campbell Scientific data logger was used to record data on the application. The datalogger recorded data every 1 second during the road testing and every 2 & 5 milliseconds for the cranking data. The MODAC study was also validated the capacitor engine start performance relative to the electrical system loads.

- Attended the meeting with MBTA and Cummins Representative in Boston, Massachusetts to discuss the ISL 07 After Treatment System concerns and how it would impact the next 155 coach orders. We also visited the MBTA training and testing facilities, and Cummins provided a demonstration on the ISL 07 engine and how the regenerative operation worked. Finally the meeting concluded on a high note and MBTA was happy that New Flyer and Cummins addressed most of their concerns in regards to the After Treatment system.

- Discussed with the Sure Power Account Manager about the year of production and field experience that they had put together and what they believed would be a better system for the next 155 buses to be built for the Boston Property. The design changes were minor and all addressed either technical issues encountered with the system during production or mechanical preferences of assembly line workers in Flyer or Sure Power factories. The basic premise and design had not changed. Sure Power provided a specification and mechanical pictures as a proposal for review. We also discussed a quote of the capacitor start system for the Ottawa property, which was identical to that of the Boston Property. New Flyer sales requested a quotation using another capacitor manufacturer other than KBI. Sure Power worked with two other manufacturers and suggested Maxwell as the alternative.

ENGINEERING MANAGEMENT

e) UG NX Schematics

- Re-opened the project UG schematics due to a need for automation within the Electrical Integration Group. One of my responsibilities as a Group Leader was to find out ways of minimizing or if possible, eliminating errors generated during schematic and harness design. I assigned two Electrical Designers to work on the project and their Technical Leads would supervise the progress of the project. We invested huge amounts of time to the concepts to implementation. First, we brainstormed the project requirements that would fit the Electrical Work Flow process. Second, we hashed out the design rules requirement. Third, we looked at the limitation of the program and fourth, we reviewed previous work and asked questions about who were involved in the last run of the project. Lastly, we met with the CAD support group and LTX people who developed the program. The primary design goal was to link the information from schematic to harnesses design and eliminate the manual extraction of data that was prone to errors during manual verification. It was also extremely important to review and rebuild the library for reusability of the devices and components in the schematic design. The project was continued well into late 2008 prior to production.

b) New Flyer Code Generator

- The project requirements were to provide a reusable ladder program for different bus orders and to reduce or eliminate errors during production when Electrical Technicians conducted Electrical checks or audits. Since New Flyer moved to the Vansco Multiplexing system, the previous code generator was never upgraded to a different software configuration. The previous code generator was programmed strictly to RSLogix 500 Rockwell software. I assigned a designer to this task, who was a graduate of Computer Engineering and had previous experience in software programming. The New Flyer code generator would be designed to extract information from a technical summary and schematic I/O pages. The library codes would also be based on previous property specific functions. The code generator would be programmed to use version 5.1.0.513 of

VMM ladder program in order to read and compile the program. The project was continued well into 2008 and is still in progress for completion.

c) **NX Wiring Routing**

- Harness routing errors in the coach were the highest on the Pareto Charts in terms of number of occurrences and time spent revising it. Harness design routing was strictly an autoCAD 2D isometric drawing and provided the rough estimate of where the harness should be routed. The issues were that each harness installer installed the harness differently from build to build and the mechanical parts were either away from the harness branch or it interfered with the harness install themselves. Since the harness installs were not part of the Virtual Bus, the mechanical designer could not verify if there were harnesses in the way when the mechanical parts were structured into the UG environment. The interim solution was to create a 3D harness install in Native UG to mitigate any interference or location issue with the mechanical parts. I assigned two designers to this project and found out that using present UG software was not as easy as it seemed when creating new harness installs. The CAD support group gave us the opportunity to use NX Wiring Routing and the designer evaluated the copy for a couple of months. They found out that this software provided the designer a tool to route harnesses easily. It also had automation capabilities that could transform a 3D harness into 2D form board for harness builders to build an actual harness. It could import runsheet information and apply design rule checks to validate connectors, terminals, lengths and wire codes. We created a business case and tried to obtain a license copy of the software in 2008.

January to October 2008

Position Held: Group Leader, Electrical Integration Group, Engineering Department

APPLICATION OF THEORY

a) **Power Steering Test and Validation Continuation**

- The bi-stable relay continued to be replaced every few months by the Coast Mountain Bus Company (CMBC) to keep the Trolley coaches in revenue service. The test for Solid State Sequencing Relay (SSSR) was not progressing as intended. By February 2008, the SSSR failed to restart the power steering motor and fueled the testing of SSSR at an accelerated pace. I created a test plan for the SSSR to simulate failure to restart the motor, a new test plan for the new Bi-Stable relay with hardened silver contacts and blow-out magnets, and a test for VMM 0604 as an intended replacement for SSSR. I also created a comparison chart including specifications between Bi-stable relay and SSSR. Coordinated with an NPD Professional Engineer to set-up a mock-up board of the power steering motor and sent it to the Industrial Technology Centre (ITC) to conduct the test. The SSSR test included 10,000 cycles On/Off test of the power steering from 0 to 150 to 0 amps. The test also included different scenarios such as low battery voltage, turning off power to the motor, increasing the load to the motor and so on. The same test was also applied to the VMM 0604 module, with minor rewiring for it to work. We also applied Failure Mode and Effect Analysis (FMEA) to the Vansco Engineers for implementing the VMM 0604 module for control of the power steering motor unit.

b) **VMM Ladder Program DM1 Test and Validation**

- Tested the new Diagnostic Trouble Code (DTC) feature and plug and play application in version 6.0.0.600 software. It was tested on two different properties: Orange County, Boston and Winnipeg Transit production coaches. In the previous VMM ladder program, the VMM J1939 table was not set-up to read variable length messages with data that did not have a specific location (e.g. DTC could be the first location at one time and could be in a different location the next time it became active). Issues came-up with the low oil indication using SPN 100. According to Cummins, a fixed low oil pressure set point was not recommended because the oil pressure was dependent on the Engine RPM. Also, there was an issue regarding the "Master Power Enabled" fault when the Vansco module reached up to 12 nodes or modules. The test set-up included a Vector CANalyzer software tool that sent messages to simulate DTC fault codes. The test program included DTC logic such as low oil and engine hot temperature. The test was successful and I wrote a theory of operation on how it operated and implemented the new program on all New Flyer Coaches.

c) **SCU-II Product Enhancement Specification Analysis**

- I wrote a specification document after the test was completed in 2007 and early 2008 and explained why it replaced the old SCU-1 unit. The Speedo Cluster Unit (SCU)-II had the capability to broadcast J1939 messages to the network. It could provide a maximum of 5 active low inputs and it could broadcast the activation on the J1939 PGN 65467 with a start byte of 4.1 to 5.1. The broadcast message from the SCU-II could be used to activate outputs in the Vansco Ladder Program. The turn signal clicker could be incorporated into the SCU-II and required hardwire inputs that were tied with wires currently running to the light bars for left hand and right hand activation. The turn signal clicker could be disabled/enabled by broadcasting the PGN messages 65466 SPN 50202 to SCU-II. The clicking sound would only activate if the SCU-II was powered by both battery and ignition power. If the SCU was not powered "On", the turn signal indicators would still function properly without the clicking sound.

PRACTICAL EXPERIENCE

- Supported the Project Engineer to conduct a Mobile Data Acquisition (MODAC) study and set-up a SOMAT Data Acquisition on SR1191 Albuquerque coach. The intent of the MODAC study was to gather baseline performance data of the three different alternator manufacturers to be installed on a Hybrid Coach. The three different alternator manufacturers were Delco-Remy rated at 270 Amps, Kirks Alternator rated at 300 Amps and Niehoff C803 rated at 500 Amps.

- Advised the Continuous Improvement Manager of the following SR trial run and cut-in for design improvement:
  - SR1263 Removal PWM DRL for headlamps. Replaced with 0.2 ohm resistor and Bridge Rectifier. Since PWM was no longer implemented on this upcoming build, the Capacitor -2200 MF 100 VDC was removed from the side console panel.

  - SR1251 Cut-In for the SCU-II turn signal clicker replaced the turn signal clicker relay installation. Updated the ELEC-STATUS spreadsheet to choose a SR, which would have a new SCU-II with turn signal clicker.

- Assisted a Professional Engineer in testing out the rear kneeling operation due to reports that the rear kneeling never recovered. Unfortunately, testing was inconclusive, as there appeared to be a pre-existing problem on that bus (suspected that the MV1 Skinner valve was shorted to ground causing the module output to show failure). However, we determined that with the ground wire disconnected, we were able to operate the system. It could have been the diode installed in reverse or the ground for the hold kneeling magvalve could have been partially short due to corrosion. More investigation was required. Note: The test coach was SR1227 60LF.

- Attended a conference call with EMP to discuss some items in regards to the power management implementation. The end result of the meeting was that NFI would provide a proprietary PGN to accept the broadcast messages from EMP, and NFI would determine which device was to be shut-off during high fan control demand. Also, the Engine Fan Fault indicator would not be required due to the intent to monitor the pressure of the hydraulic and radiator fan in our present system. The PGM would incorporate new proprietary PGN for the EMP.

- Spoke to the VP of Niehoff in regards to the thermal event that occurred on the Chicago coaches. The thermal event for the Niehoff alternator only occurred with the ISM engine. As the VP explained, their regulator had a thermal switch and if a thermal event occurred, the regulator would shut down. Therefore, the D+ output and alternator would shut-off as well. I explained to the VP about how the alternator operated when the D+ went below 24 VDC, and the battery indicator light on the dash would light On to warn the driver that the alternator was not charging. The VP of Niehoff contacted RPSM for Chicago to discuss the CTA procedure in an event that the battery indicator lit on. As for the future of Niehoff alternators, they were exploring the possibility of a temperature sensor near the bearing itself as well as using an intelligent bearing system that would predict if the bearing had a risk of having a catastrophic failure. For the battery temperature charging compensation, the VP provided us with information about the type of regulator used in Military Application, which could also be used for the transit application.

- Set-up the SOMAT data acquisition to conduct a test on two power steering motors from SEPTA trolley that were deemed defective. Tested to find out if one of the phases of the 3-phase induction motor were missing, which caused the power steering motor to run erratically. We found out that the missing phase was not the cause of the problem but that it was due to a loose enable wire to the connector of the micro-controller board. Advised Customer Service to check for loose enable wires in all motors of SEPTA trolley coaches.

- Reviewed the SR1224 Montebello program and Customer requirement in regards to CAN messages to be provided to Tacholink. This was part of the customer requirement to provide fault signals to the Electronic Data Recorder (EDC), which was a similar concept to a black box installed in aircraft passenger carriers.

- Traveled to ISE Corporation in San Diego, California to support the SR1223 Victoria Fuel Cell Project. I met the Director of New Product and discussed the remaining New Flyer Action items that were required actions. I also met with the Crookston Production Engineering Technician to work on action items such as the air system not being able to hold-up pressure and the service compartment lights.

- Attended the SAE Commercial Vehicle Conference 2008 in Rosemont Chicago, Ilinois. There were several oral presentations that I attended, which could be used for the Transit Application. Also met with several vendors such as Mentor Graphics, Delphi, C.E.Niehoff, MathWorks and others.

ENGINEERING MANAGEMENT

- **Developed Electrical Work Flow Chart**
  - Created an Electrical Work Flow chart in an attempt to capture the process of the Electrical Engineering groups, which comprised of an Electrical Integration Group and Electrical Components Group. The flow chart was comprised of a timeline of how long it would take for an Electrical Designer to do an SR project in each phase, as well as when to start and when to release the drawings and BOM. The work flow chart served as a guideline between two groups and it was approved and signed by two Group Leaders. The plan for the future was to incorporate the Electrical Work Flow Chart into the Team Center Engineering in collaboration with the CAD support group.

- **Ten Minutes Technical Presentation**
  - The intent was to encourage people to share their knowledge and experiences and enhance teamwork among group members. There was a 10 minutes time limit to make the presentation brief and efficient in regards to time management.

- **NPD Primo Support Resources**
  - Developed a resource management plan with an NPD Project Engineer to support the Primo project. The plan was to provide skilled resources and rotate any Electrical Designer who would be interested in taking part of the Electrical Design of the Primo coach. Also created a list of action items to be followed by the Electrical Designer. The resources plan was also intended to provide a progress of the project as well as resource mapping to ensure that it would not affect production related work.

- **Enrolled on Master Certificate of Program Management**
  - As part of my professional development and to become a better manager, I enrolled in a course offered by University of Winnipeg. I learned that Project Management was an application of knowledge, skills, tools and techniques to project activities to meet the project requirements. I also learned the different knowledge areas of Project Management. There were nine class modules that I attended, namely Program Introduction, Project Planning and Control, Personal and Team Communication in a Project Environment, Project Quality Management, Procurement and Contract Management, Effective Cost Management, Assessing and Managing Project Risk, Filling the Gaps and Final Exam and Project Simulation. The methodology that I learned was useful for on-going Projects such as UG NX schematics and the Electrical Group Resource Planning.

- **Time Study For Electrical Integration Group**
  - Conducted a time study the Schematic and Harness Group to find out how long it would take to complete a project in each phase. For example, in the Harness group there were several harnesses released for production and each designer provided their estimated time for completion on each harness. With the information on-hand, it would take an average of three weeks to complete a harness package per project, provided that there were no design changes from the customer.

PROFESSIONAL AND ETHICAL RESPONSIBILITIES

- **Deceleration Warning System**

  I learned through discussions with Sales/Marketing, Engineering, and PDM that the following had been agreed upon as being New Flyer's position on deceleration lamp systems while maintaining NF's compliance with the FMVSS (US regulations) and CMVSS (Cdn regulations).

  According to FMVSS guidelines, regardless of the configuration or lamp colour, flashing deceleration lamp systems were not permitted on production coaches as it would drive New Flyer out of compliance with FMVSS 108 S5.5.10(d) and CMVSS 108 S5.5.10(d).

  New Flyer's standard must use amber steady-burn lamps as a deceleration warning system. Red steady-burn lamps could be offered as an option (red steady burn is OK with FMVSS and CMVSS), but it was agreed that this lent itself to a less than ideal situation of following drivers seeing multiple sets of stead-burning red lamps operating in different sequences.

From this point forward, the electrical group would only be offering solid-burning deceleration lamp outputs in their programs for both new and repeat contracts. In the interest of future bus sales, New Flyer engineering offered part installation suggestions to make solid burning lamps flash, but these parts must be bought and installed only by the vehicle owner or their employees without any New Flyer involvement.

- **Responsibilities of the Group Leader**
  My responsibility does not end with managing people, managing projects and making technical decisions. It extends by providing opportunities for the professional development of the employees in regards to engineering professions. Since I represent my employer, I work hard to treat the employee fairly and be as honest as possible. I also keep in mind that by making difficult technical decisions, I always put the safety and welfare of the public first. I also consult with other engineering professionals for any technical related work beyond my capabilities and provide them with information that would help them to make a sound decision. I also inform my employer of my honest opinion in regards to work related issues. Also I strive to maintain the high standard of competence by seeking new technologies, knowledge and experience.

Note: Supervisor and Mentor assessments are to be shown by indicating either **Yes** or **No** in the space following the question:

Do you agree with the answer provided by the MIT?

If you are a professional member supervisor or a mentor, complete the Professional Member field. If you are a non-member supervisor, complete the non-member field. Comments should be made as applicable especially if the answer is No.

Supervisor/Mentor Assessment: Do you agree with the answer provided by the MIT?

Professional Member (Yes/No) YES Non-Professional Member (Yes/No) ______

Comments: ____________________

2.2 While undertaking the work experience indicated in 2.1, I have applied theory in:
i) Analysis/Interpretation_x__ ii) Project Design & Synthesis__x_ iii) Testing/Verification__x__
iv) Implementation_x__ v) Other(s)____________________
(please identify)

Supervisor/Mentor Assessment: Do you agree with the answer provided by the MIT?

Professional Member (Yes/No) YES Non-Professional Member (Yes/No) ______

Comments: ____________________

2.3 While undertaking the work experience indicated in 2.1, I obtained practical experience by:

i) Studying or being exposed to existing engineering/geoscience works________

ii) **For EITs:** Applying designs as parts of larger systems___X___

iii) **For GITs:** Integrating geoscience data analysis with larger projects/systems______

iv) Experiencing the limitations of engineering designs/geoscience projects______

v) Experiencing time as a factor in the engineering/geoscience process__________

vi) Other(s)____

(please identify)

Supervisor/Mentor Assessment: Do you agree with the answer provided by the MIT?

Professional Member (Yes/No) ___YES___ Non-Professional Member (Yes/No) ______

Comments: ____

2.4 While undertaking the work experience indicated in 2.1, I was exposed to the following areas of engineering/geoscientific management:

i) Planning___X___ ii) Scheduling ___X__ iii) Budgeting ___X__ iv) Supervision ___X___

v) Project Management ___X___ vi) Risk Assessment ___X___

Other(s)____

(please identify)

Supervisor/Mentor Assessment: Do you agree with the answer provided by the MIT?

Professional Member (Yes/No) ___YES___ Non-Professional Member (Yes/No) ______

Comments: ____

2.5 During this period, my communications skills improved, as follows:

(i) Oral presentations

In the past 8 years as an employee of New Flyer Industries, I gained a lot of experience by presenting numerous oral presentations in and out of the company. Below are the highlights of the presentations that I had done for the past 8 years.

- Presented on a PLC Code Generator to Product Data Management on how the tool helped the Electrical Group provide an accurate and correct program to Production. The code generator was developed to generate consistent, accurate and property specific features and design to reduce programming errors and reduce time to complete a program.

- Since I became a Technical Lead of the Programming Group, oral communication skills became an important part of my responsibilities through informal discussions (i.e. two-way face-to-face communication) and formal discussions (i.e. organized Monday morning meetings) with the group.

- Presented the proposed concept PCOM system to NPD (formerly known as R & D). The conceptual idea was to provide a reliable control of power for the computer, uninterruptible Power Supply (UPS) and Device-Net modules within the NFI Transit Bus. The P-COM was designed to have an automatic start-up and shutdown operation of the CPU, UPS and the Device-Net Modules at any given day and time. The P-COM could also manually energize the CPU and Device-Net Modules by switching ON the Master Run Switch.

- Presented with a group for our final Database Project, the Aunt Suzi video store. It was part of the Database Management Class that I took at Red River College.

- Chaired the Electrical Group weekly meetings to discuss projects, design concepts and key issues between groups. Also, the meeting was used for following up on action items on key issues.

- Presented the proposed Bi-Stable Latching Relay to the Translink and CMBC officials in Vancouver. The proposed Bi-Stable relay was a magnetically latching relay that would open or close the contact when a momentary signal was applied. The new configuration had increased the reliability the operation of the power steering motor and eliminated between 2 to 3 seconds momentary loss of steering.

- Presented a 10-minute Ultra-Capacitor presentation to the Electrical Integration Group. The presentation provided a general overview of the ultra-capacitor operation and how it would reduce coach downtime due to weak batteries.

- Oral communication has played an important role in dealing with Technical Service Administrators (Customer Service) and the Transit Authority in regards to listening to the issues, problem solving and relaying important technical information to the customer.

(ii) Written documents

- Wrote a theory of operation for the PCOM system. The P-COM system was designed to have an automatic start-up and shutdown operation of the CPU, UPS and the Device-Net Modules at any given day and time. The P-COM could also manually energize the CPU and Device-Net Modules by switching ON the Master Run Switch.

- Wrote a start-up and shutdown procedure for Invero Computer. This procedure was a guideline for Technicians when operating the on-board computer.

- Prepared an Engineering Test Report for the Master Run Switch using LEO Block. The test objective was to extend the life of the UPS battery without shutting-off the on-board computer for an entire night.

- Prepared Engineering Test Report for Master Run Switch Using P-Com system. The test objective was to see how long it would last the life of the Main and UPS batteries without interfering with the operation of the on-board computer system.

- Wrote an HMI Security Procedure for the on-board computer. The HMI Security Procedure provided the programmer with a guideline to set-up different user levels and passwords to access the on-board computer.

- Prepared weekly reports for my Supervisor.

- Provided a trip report to my Supervisor when I traveled to the Canadian Urban Transit Authority (CUTA) show in Missisauga, Ontario to support the SR708 Demo coach. I reported my activities and the accomplishments I had achieved during my trip.

- Prepared PLC Code Generator Document.

- Provided several technical documents such as theory of operations (i.e. Air Open Air Closed door, Interior Lights and more) to be used as guidelines to create PLC programs.

- Prepared a test plan for Ventura Door Operation. The test objective was to provide a procedure on how to set-up the Ventura door system, which included limit switching setting and cam adjustment.

- Prepared a written NPD request for Hoerbiger Touch bars and laid out a test plan for NPD personnel to follow.

- Completed the Vansco Multiplexing Project report which was submitted to New Product Development for 2003 Scientific Research and Exploration Development (SR&ED) taxation claims. The project report demonstrated the engineering challenges, the innovation, project management and cost reduction migrating into a new multiplexing system.

- Provided a trip report to my Supervisor when I traveled to the New Flyer Crookston Facilities in Minnesota to support the SR878, the first Vansco Multiplexing system production coach. I reported accomplishments and provided detailed information, which became a basis for future production coaches with a Vansco Multiplexing System.

- Prepared an ISE trip report when I traveled to ISE Corp, San Diego, California. The intent of the visit was to understand the company engineering and manufacturing capabilities of providing a hybrid propulsion system for the Transit Bus Application. I also learned the design of the gas-electric hybrid propulsion system.

- Prepared an SR&ED technical report for Gas-Electric Propulsion and CAN Interface.

- Wrote a Design Improvement Request for Removal of the Retarder Module And Use of J1939 Retarder Application.

- Provided a written theory of operation of a Hush Mode (Tunnel Mode) for the Allison Hybrid Coach operation in King County, Seattle, Washington to Sales and Marketing.

- Prepared a progress report of the Vancouver Trolley Project in 2005. The primary goal of the trip was to provide support to SR983 Vancouver Trolley coach project and assist Vosshol Kiepe personnel with any related technical issues.

- Prepared an engineering test plan for the Ultra-Capacitor Test. The test objective was to confirm the concept of the engine that would start and run in three modes of starting operation. The three modes of operations were capacitor start engine, battery start engine and wake-up the electrical system and start the engine.

- Prepared an NPD test request for the Life Cycle Test between Davidson and Deka AGM Batteries.

- Prepared an Engineering Test Plan for Boston Load Analysis. The test objective was to perform an Electrical System Load Analysis to meet the requirements for the SR1105 Master Resolution List document.

- Prepared a proposed Theory of Operation of the Ultra-Capacitor System for Boston Contract.

- Prepared a proposed Theory of Operation of the Two Independent Measure of Velocity and J1939 Communication Fault Indicator for Boston Contract.

- Wrote a Theory of Operation of the Air Compressor System for Vancouver Trolley Project.

- Wrote a Theory of Operation of the Mobility Aid Ramp (MAR) for Vancouver Trolley Project.

- Prepared the detailed written proposal for the Bi-Stable Relay for Power Steering Motor.

- Prepared trip report for NX Wiring Routing Training. The NX Wiring Routing Training was a two day course that taught us about connection list management, part creation with full associativity, design rules, wiring routing capabilities, and manufacturing instruction that delivered a complete system for design of the electrical harnesses.

- Wrote a Theory of Operation of the Ultra-Capacitor System for Transit Application.

- Prepared trip report of the MBTA Transit discussion in regards to the Cummins Engine Regeneration operation.

- Prepared Engineering Test Plan for Three Different Alternator Tests.

- Prepared a test plan for Vansco DM1 Test Procedure. The test objective was to validate the DTC messages being sent by the Vector CANalyzer.

- Prepared a proposed test plan for Bi-Stable Relay and Solid State Sequencing Test Plan. The test objective was to validate the new Bi-Stable Relay with hardened silver alloy contact and validate SSSR failure mode in test bench.

(iii) Interaction with others

- Conducted Electrical Group Leader Weekly meetings to discuss new designs, issues, cut-in SR's, process and procedures.

- Participated in the charitable institution such as Manitoba Marathon, Breast Cancer and a religious organization.

- Participated in New Flyer Golf Tournaments.

- Participated in meetings with the vendors to discuss contract requirements and technical discussions.

- Motivated and managed New Flyer employees by conducting weekly meetings, one-on-one collaboration, encouraging people to apply for courses as it may help their career as well as out of the office gatherings.

- Dealt with different suppliers to discuss design requirements, product specification, product applications, product pricing, technical support and practical experience of the products.

- Attended trade shows and seminars to meet different people from different areas of the transit industries.

- Participated in on-site meetings with the customers such as Winnipeg Transit, Coast Mountain Bus Company, Chicago Transit and Boston Transit.

- Participated in meetings with New Product Development in regards to design, timeline, resources and innovation for the Primo project (New Flyer Next Generation Coach).

- Participated in quarterly meetings with the Senior Executives in regards to the status of the company and its goals to achieve.

- Attended classes, courses and external training that enhanced technical, oral and written skills, managerial skills.

(iv) Other(s)

Supervisor Assessment: Do you agree with the answer provided by the MIT?

Professional Member (Yes/No) YES Non-Professional Member (Yes/No) ______

Comments: ____

2.6 During this period, I was required to make decisions based on an engineer's/geoscientist's professional and ethical responsibilities as follows, to:

i) The public__X___ ii) The profession__X___ iii) The client and/or employer __X____
iv) Co-workers__X___ v) The environment__X___

Supervisor/Mentor Assessment: Do you agree with the answer provided by the MIT?

Professional Member (Yes/No) ___Yes___ Non-Professional Member (Yes/No) ______

Comments: ______________________________

2.7 During this period, I had to consider the social implications of my work in the following areas:

- During the past 8 years working for my employer, I believe that I considered the social implication in nearly all aspects of my work. As a Group Leader of an Electrical Integration Group, I not only representing New Flyer, I also have an accountability and responsibility to the employee who work for me. Their work also has a social implication to the employer as well as to the public. Since New Flyer is an equal opportunity employer, caring for the environment by bringing new innovative technologies, promoting safety, customer response, quality of work, complying to federal and provincial regulations and continuous improvement, I as an employee practice engineering to maintain the same core principle of the company.

Supervisor/Mentor Assessment: Do you agree with the answer provided by the MIT?

Professional Member (Yes/No) ___Yes___ Non-Professional Member (Yes/No) ______

Comments: ______________________________

3. Personal Development

3.1 Examples of my ability to work effectively as part of a team, during this period, include:

- As a Group Leader, I managed and motivated people to do their job with vigor, as well as conducted weekly meetings to inform them of the group's progress and company direction. Promoted a team building exercise by sharing group responsibilities and encouraged employees to share ideas on how to do their job effectively and efficiently. Provided tools and training to employees in order to do their job properly.

- A daily communication to the Director of Engineering to provide status of the Sales Release projects was essential and carried out directive from the Executives to meet the goal dates.

- Worked with other Group Leaders to coordinate the timeline when to release the installs as well as exchanged technical information to make sure the release of install was correct.

- Coordinated with vendors to ensure they provided us with correct information and also provided technical information in order for them to meet Engineering requirements.

Supervisor/Mentor Assessment: Do you agree with the answer provided by the MIT?

Professional Member (Yes/No) ___Yes___ Non-Professional Member (Yes/No) ______

Comments: ____

____

____

3.2 Examples of my ability to assume responsibility during this period include:

- As a Group Leader, I assume responsibility of the implication of my team's work. I'm also responsible for ensuring the release of the bill of materials and drawings on time.
- In cases where any related technical decisions could not be decided amongst team members, I would assume responsibility to take over and make a sound decision based on information on hand.
- The special projects were part of the overall group plan for continuous improvement to make the job efficient and effective. I was responsible for creating project scope and charter, as well as creating a work breakdown structure and timeline of the project.

Supervisor/Mentor Assessment: **Do you agree with the answer provided by the MIT?**

Professional Member (Yes/No) YES Non-Professional Member (Yes/No) ______

Comments: ____

____

____

4. I have shown progress since the last report (where applicable) as follows:
   - Not Applicable.

Supervisor/Mentor Assessment: **Do you agree with the answer provided by the MIT?**

Professional Member (Yes/No) YES Non-Professional Member (Yes/No) ______

Comments: ____

____

____

5. I consider myself to be lacking in exposure to, or requiring improvement in, the following areas:
   - Since some of my projects were behind schedule, I would like to improve on my time management skills as well as my diplomatic skills to deal with some of the more difficult people with very unique personalities, who I encounter on a day-to-day basis.

Supervisor/Mentor Assessment: Do you agree with the answer provided by the MIT?

Professional Member (Yes/No) YES Non-Professional Member (Yes/No) ______

Comments: ____

____

____

6. During this period, I undertook the (additional) continuing education and professional development activities that are shown on the attached form.
7. During this period, I undertook the (additional) volunteer activities shown on the attached form.
8. I would like to provide the following additional, relevant information:

9. I understand that this progress report will be reviewed by my immediate supervisor and, where applicable, by the mentor who took responsibility for my work.
The MIT is responsible for submitting a copy of his or her report to the supervisor and mentor (as applicable) who will then forward their copies directly to APEGM. APEGM will no longer forward progress reports to supervisors or mentors.
Note: Your report will not be considered unless it is signed and dated.

21-NOV-2008
Date

Signature

To be completed by Supervisor/Mentor:

10. Supervisor/Mentor Comments:

I would like to provide the following additional relevant information about the MIT's progress and/or character (**Note: you must complete this portion**)

Paul has an excellent technical background and over the years has been able to complement this with a very good hands on and practical ability. He has grown rapidly within the organization and retains significant product knowledge that would be difficult to replace. His people skills have grown as well and he now manages a group of 20 plus engineers and designers.