



**King County**

Department of Transportation

Metro Transit Division

Transit Safety Unit

2016AM009

## **PRELIMINARY REPORT**

**DATE of REPORT:**

May 26, 2016

**REPORT TYPE:**

Electrical Shock Injury

Ln1

Complaint #209476493

**RESPONDING SAFETY OFFICER:**

James Wells

### **ELECTRICAL SHOCK EVENT:**

**Shock injury:** May 9, 2016 Atlantic Base

**Employee:** Mechanic, Mr. Bill Marion ID 40829

**Time:** 12:30 PM

Mr. Bill Marion ID 40829 was inspecting coach 4369 from underneath in the pit and received a shock. He reported the shock to Lead Mechanic Ken Peterson ID 45291 and then left work and did not go to the ER as instructed in his Electrical Safety Training March 2015. Mr. Marion drove himself to Group Health but they were slow and in frustration he left – it is unclear what information they received from him. He did show up briefly at the start of work May 10 but did not remain on site. He filled out an incident report, but did not request the Self-Insurer Accident Report (SIF2) before leaving to go on vacation.

Lead Mechanic Ken Peterson directed Electronic Technician Lead Tom O'Bannon ID 46732 to do an investigation concerning the hot coach, reported by Mechanic, Marion had received a shock from coach 4369 when he grounded himself by leaning against the hand railing down inside the pit and touching the pet cock valve to drain moisture from the coach, to see if there was voltage to the coach. O'Bannon reported that the X60 connector in the Roof Top Compartment (RTC) on the roof was disconnected so that the hot coach detector did not function. This condition also allowed voltage on the coach skin and chassis to climb to 270-280 V (volts as measured by O'Bannon). Instead, Marion's hand touching the coach body provided the ground.

The Intermediate Potential Panels inside the passenger compartment were opened by O'Bannon and he determine that the voltages were reverse from expected and it appears (This was never proven to be the case, it was disconnected on per VK during their investigation) that the wires hooking up the hot coach detector were reversed: The voltage was positive on the negative pole side do to the missing connection which gives the reference for the check perform. This means the whole system had no ground to measure against.

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The X60 connector inside the RTC container on top of the coach is not something that a VM employee works with/ touches. (See photos at end) This work is currently being performed by the Vossloh Kiepe factory representative (Raimund Wagener) working on site and the Electronic Technician employees have been observing this work for training purposes. This person, according to Tom, was asked to investigate this shock situation and had no knowledge or information or ideas on how/why the connector was loose or undone and how the hot body detector did not work.

Mr. Wagener checked another coach and with the connector removed the body 'Floats' up. According to Mr. Wagener this is like a 'Static' charge, similar to rubbing stocking feet on a carpet and touching a door knob. [It was] high voltage with very low current, it is unclear if Mr. Wagener did an actual measure of the voltage to the skin of coach 4369. Mr. Wagener also checked the fault log and found no faults indicating this problem. However, according to Kim Martin from Fleet Engineering the "HOT COACH" was induced from the high voltage overhead. It should be noted that injury can occur at very low current. Heart fibrillation will occur at 100 – 200mA.

Moreover, Mr. Martin states, "We need a measurement here. If Mr. Wagener did not measure than it is speculation and should be omitted. Mr. Martin states, [I] can make a case for static electricity being deadly, as in the case of lightning. The potential and the resistance determine the amperage (Ohm's Law). Mr. Wagener is confused, I think, by the feed being a small current but the actual discharge current after the voltage has "floated up" can be much higher (as in the case with lightning.)"

### LEAD MECHANIC KEN PETERSON STATEMENT:

While Mr. Marion was inspecting Coach #4369, he was leaning against the rail in the pit, when he grabbed the pet cock for the "Wet Tank" (to drain moisture out); he received voltage in the form of a small shock. Lead Mechanic Ken Peterson immediately directed Electronic Technician Tom O'Bannon to check to see if it was in fact a Hot Coach. O'Bannon found roughly 270-280 volts to the body/skin of the coach. This all happened while the poles were down in the racked position. Everyone at Atlantic base is aware of this situation, and all standard precautions are being followed, at this time.

### ELECTRONIC TECHNICIAN TOM O'BANNON STATEMENT:

WO# 2267513 - 56-C5-485

300V present on coach body with NO HOT COACH ALARM. IPs has -285V to -300V to chassis. Reseated X60 on the CPM A1, tested insulation and body voltage, all OK.

Found loose connector X60 on rooftop insulation check board CPMA1 (in RAC). X60 is the connection from the CPM 202 to the chassis through the A1 board. Without proper reference

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to chassis the CPM 202 will not detect a hot coach, and stray voltages will cause damage to the CPM 202. [It] looks like we fried 2 CPMs (hot coach detectors) during troubleshooting.

### MECHANIC BILL MARION INCIDENT REPORT:

While [doing an] inspection of coach 4369, I got zapped with 300 volts. [Because there was voltage that created the] Hot Coach [it was placed] on hold. I reported to Lead Mechanic Ken Peterson and Electronic Technician Tom O'Bannon to check coach. I went to Group Health for blood pressure check.

### UNSUBSTANTIATED:

The poles were either on the overhead wire or the shock came from the high voltage capacitors. Tom O'Bannon checked with both the poles up and down, finding voltage only when the poles were on the overhead wire. The poles were up at the time the shock occurred.

### UNCLEAR:

How did the hot coach detector work if the voltages were reversed? It didn't and could not work with the X60 switch disconnected. It did not warn that it was not working.

### FINDINGS:

1. Mr. Marion was allowed to transport himself to Group Health. Mr. Peterson did not provide transportation to an emergency room for a check-up after the electrical shock injury was reported. The mechanics who provide service on the 4300 and 4500 and BAE ESS system type coaches do not feel they are properly train. The Lockout/Tag out boxes shutting the power off is shared by the other bays in the shop, and creates a hazard because of bays not being able to independently lockout and tagout.
2. The Electrical Safety Program policy and procedures were not followed by Lead Mechanic Ken Peterson and Mechanic Bill Marion.
3. Inadequate and/or no training for the new fleet of coaches (4300).
4. There was no Work Order record of anyone (to include VK) performing any work on this coach. This includes Central Base.
5. Vissloh Kiepe/New Flyer (VK/NF) does not provide documentation of work performed.

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6. There was no record of who disconnected the X60 snap connector. The service manual for the new fleet is not available yet fully in English.
7. There are three redundant systems in place at the time. There is a fourth being test.
8. There was no immediate report to management by the Mechanic or Lead.
9. The hot coach did not provide any warning do to disconnected power supply at X60 in Roof Top Compartment (RTC).
10. The coach went into revenue service that morning before the incident.

### RECOMMENDATIONS:

1. Ensure Atlantic Vehicle Maintenance know, understand, and sign the signature page and follow the Electrical Safety Program policy and procedures.
2. Ensure the poles' are dropped from the overhead tracks when performing any service on 4300 series and 4500 series coaches making this a part of the new procedure.
3. Ensure formal training and recurring training for all mechanics who work on the new fleet of coaches (4300 - 4500) and including all BAE coaches equipped with an ESS system.
4. Ensure increased communication between VK/NF, Fleet Engineering, CSC and all mechanics who do service work on the 4300 series and 4500 series coaches and BAE coaches with an ESS systems.
5. Ensure Vissloh Kiepe/New Flyer (VK/NF) provide service records of all work Performed through the M5 Work Order Process.
6. Ensure whenever VK/NF perform any service to a coach or disconnect a switch on either a 4300 or 4500 to provide notification in the form of a placard placed on the dash or doors of coach as part of the lockout/tagout procedure.
7. Ensure the entire service manual for the new fleet (4300/4500) is in English.
8. Ensure a system of redundancies is created to back up the fail safety system crashes.
9. Ensure management takes ownership and give them a chance to demonstrate their willingness to correct the problem.

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10. Ensure the hot coach provide warning when there is a disconnected power supply at X60 in the Roof Top Compartment (RTC).
11. Ensure no coach ever enter into revenue service with the possibility of a "Hot Coach."
12. Ensure the lockout/tag out have the power source separated so that when a Mechanic is servicing a coach that bay is lockout/tag out and isolated from the other bays.

### CORRECTIVE ACTION TAKEN:

1. The fleet of 4300s and 4500s were checked for proper hot coach detector functioning. This was done by Atlantic Electronic Technician shop.
2. If the hot coach detector fails it will provide a warning light and buzzer to the dash, via the same light as the hot coach warning, if it is receiving power from the coach.
3. VK recognized that this is an issue and is working on a retro fit to the system so that if XT60, at CPM 11 has a power failure, or becomes disconnected the hot coach alarm and lights will activate.
4. VK Engineering will install new programing and will make hardware modification that will enhance the three fail safe systems for Hot Coach detection that will be monitor for one week by both King County Metro (KCM) and Vossloh Kiepe (VK).
5. Kim Martin from Fleet Engineering, Andrew Goudreau, SO South Base, and James Wells, SO Atlantic Base debrief the employees at CSC to demystify and stop rumors concerning this electrical shock event. Training is being planned and scheduled for refresher on High Voltage

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### CONCLUSION:

This office has determined Atlantic Vehicle Maintenance follow the Twelve recommendations and with the modification enhancing the three failed safe systems currently on the trolley coaches by adding a fourth and it allows notification by visual and audio if there is a faulty Hot Coach Detection System and following King County "Electrical Safety Program" for its employees working on "HIGH VOLTAGE" and WAC 296-45-015, 296-45-065(1), 296-45-25510(12), 296-45-115(2), 296-45-325(1) and NFPA 70E the risk matrix is ID. Without these recommendations and improvements to the Hot Coach Detection System a Hot Coach event can have a level of IA. See matrix and photos.

James Wells  
Signature

06/12/2016  
Date

JWE: jwe

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### RISK MATRIX:

Probability Categories				
Description	Level	Specific Event		
Frequent	A	Electrical event will occur		
Probable	B	Expect electrical event to occur		
Occasional	C	Circumstances expected for an electrical event; it may or may not occur		
Remote	D	Possible electrical event but unlikely		
Improbable	E	Electrical event will not occur		

Severity Categories		
Category	Severity	Characteristics
I	Catastrophic	Disastrous event (death or system loss)
II	Critical	Survivable but costly (severe injury or major system damage)
III	Marginal	Relatively inconsequential (minor injury or minor system damage)
IV	Negligible	Limited or no impact (less than minor injury or system damage)

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### RISK MATRIX:

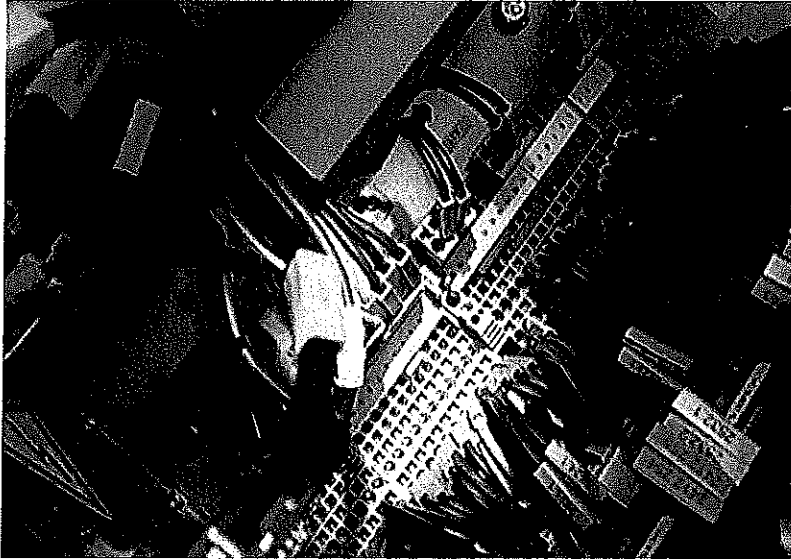
<b>Electrical Risk Matrix</b>				
<b>Probability Categories</b>	<b>Risk Severity Categories</b>			
	<b>Catastrophic (1)</b>	<b>Critical (2)</b>	<b>Marginal (3)</b>	<b>Neglible (3)</b>
<b>(A) Frequent</b>	<b>IA</b>	<b>IIA</b>	<b>IIIA</b>	<b>IVB</b>
<b>(B) Probable</b>	<b>IB</b>	<b>IIB</b>	<b>IIIB</b>	<b>IVB</b>
<b>(C) Occasional</b>	<b>IC</b>	<b>IIC</b>	<b>IIIC</b>	<b>IVC</b>
<b>(D) Remote</b>	<b>ID</b>	<b>IID</b>	<b>IIID</b>	<b>IVD</b>
<b>(E) Improbable</b>	<b>IE</b>	<b>IIIE</b>	<b>IIIE</b>	<b>IVE</b>

	<b>"HIGH" Risk must be mitigated</b>
	<b>"SERIOUS" Risk should be mitigated</b>
	<b>"MEDIUM" Risk is acceptable with review by management</b>
	<b>"LOW" Risk acceptable without review by management</b>

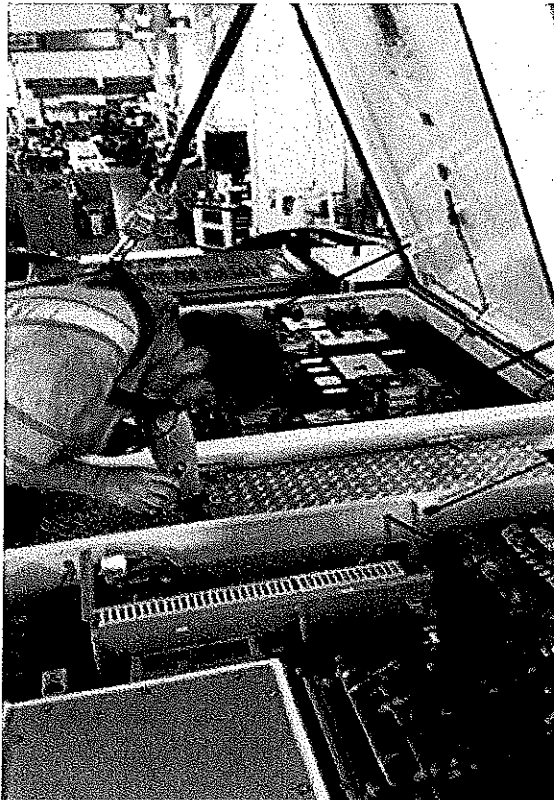


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### PHOTOS OF RTC:



X61 sticker – the X60 was not seen during this investigation.



The Electronic Technician looking at the location of the X60 connector that came loose or was disconnected.