



OPERATIONAL SERVICES BRANCH  
**ENGINEERING LABORATORY REPORT**

LP136/2013

LER Data Retrieval and Analysis

Montreal, Maine & Atlantic Railway, Train MMA-002

Date of Occurrence: 06-Jul-2013

ATTENTION:

CROWN COPYRIGHT. THIS REPORT IS RELEASED FOR SAFETY PURPOSES ONLY, AND MAY BE AMENDED PRIOR TO, OR SUBSEQUENT TO RELEASE OF THE FINAL TSB REPORT. REPRODUCTION OF THIS DOCUMENT, IN WHOLE OR IN PART, MAY BE PERMITTED ON REQUEST TO THE TSB.

OCCURRENCE NUMBER	OCCURRENCE CLASSIFICATION	NUMBER OF PAGES	NUMBER OF APPENDICES	RELEASE OUTSIDE THE TSB REQUIRES REVIEW BY THE ACCESS TO INFORMATION AND PRIVACY OFFICE.	YES	NO
R13D0054	2	16	3		<input checked="" type="checkbox"/>	<input type="checkbox"/>

PREPARED BY

*Daxing Chen*

D. Chen, Ph.D. (Senior Engineer Specialist - Rail Dynamics)

APPROVED BY

*T. Givins*

T. Givins, P.Eng. (Manager, Recorder and Vehicle Performance)

RELEASED BY

*Les Donati*

L. Donati, Ph.D. (Director of Operational Services)

RELEASED ON

29 NOV 2013

REVISION

## Table of Contents

1.0	INTRODUCTION .....	1
1.1	Description of Occurrence .....	1
1.2	Background.....	1
1.3	Engineering Services Requested.....	2
2.0	CALIBRATION .....	3
2.1	Wheel Size and Travel Distance References .....	3
2.2	Time Calibration References .....	3
2.3	Verification among LER, SBU and Crossing Signal Downloads.....	4
3.0	IDENTIFIED EVENTS OF INTEREST .....	4
3.1	Review of LER Records .....	4
3.2	Events of Interest .....	5
4.0	CALCULATION OF VEHICLE LOCATIONS .....	8
4.1	Rest Position before Runaway .....	8
4.2	Derailment/Separation Moment.....	8
4.3	Positions of Locomotives after Separation .....	9
5.0	CONCLUSIONS.....	9

## List of Tables

Table 1: Identified events of interest .....	6
Table 2: Corresponding events in SBU records.....	7

## List of Figures

Figure 1: Aerial view of derailment site .....	12
Figure 2: Connection point at Mile 117.14 Moosehead and Mile 0.0 Sherbrooke Subdivision .....	13
Figure 3: Compressed graphic of entire downloaded LER data .....	14
Figure 4: Graphic LER data between stop at Nantes and final stop after derailment.....	14
Figure 5: Graphic LER data from engine shutdown to first stop after derailment .....	15
Figure 6: Graphic LER data during the runaway.....	15
Figure 7: Graphic LER data during the last backward movement.....	16
Figure 8: Switch and curve where the derailment likely occurred .....	16

## List of Appendices

Appendix A: Edited SBU Download Data .....	A-1
Appendix B: Standard Report Crossing 117.11 .....	B-1
Appendix C: Calculated Locations of Vehicles in Train MMA-002 .....	C-1

## 1.0 INTRODUCTION

### 1.1 Description of Occurrence

1.1.1 On 6 July 2013, at approximately 0115 Eastern Daylight Time (EDT), Montreal, Maine & Atlantic (MMA) freight train MMA-002 rolled uncontrolled and derailed loaded tank cars of crude oil in the town of Lac-Mégantic, Quebec. Most of the derailed tank cars lost their contents as a result of the accident, which contributed to a large fire that burned for several days. There were 47 fatalities, and approximately 32 buildings were destroyed. The crude oil leaked into the river and caused serious environmental pollution.

1.1.2 Preliminary examination of the derailment site determined that buffer box car CIBX 172032, immediately behind the locomotive consist, and the following 63 loaded tank cars derailed on the main track of a 4° 7' right-hand curve in the direction of travel (eastward), covering a No. 11 turnout. The locomotive consist separated from the derailed cars and split into 2 portions, with each travelling different distances before they came to a stop. After a significant time, the front portion of the locomotive consist moved backward (westward) and collided with the second portion, both moving a short distance further (westward) and coming to a final stop together.

1.1.3 The derailed buffer box car struck a stationary cut of cars on the siding track. The following 8 tank cars were scattered in separated jackknifed positions. The next 2 tank cars lay in the direction of the turnout siding, ahead of the main jackknifed pile-up of the rest of the derailed tank cars among which the fire and explosions occurred. The last 9 tank cars in the train did not derail. They were disconnected and removed back and away from the derailment and fire by the locomotive engineer and emergency responders. An aerial-view photograph of the accident site is shown in Figure 1.

### 1.2 Background

1.2.1 Train MMA-002 consisted of 5 locomotives, 1 operation control car VB-1, 1 loaded buffer box car, and 72 tank cars loaded with petroleum crude oil. The train weighed 10 287 tons and was 4701 feet long.

1.2.2 The train was operated by a 1-person crew. Before midnight, it came to a stop on the main track of Station Nantes with an automatic application of the air brakes. The locomotive engineer applied hand brakes on the locomotive consist and the buffer car, and then released the automatic brake, but kept the independent brake (IND) of the locomotive consist in the applied position. The engine of the lead locomotive, MMA 5017, was kept running at idle to maintain the air brake supply. The locomotive engineer left the train and went to a hotel for rest, as indicated in his schedule.

1.2.3 A fire was detected on the lead locomotive sometime after the locomotive engineer left (LP181/2013). Local firefighters came and put out the fire. A local MMA engineering employee was called to attend to the fire site. The engine of the locomotive was shut down, and the train was left unattended again.

Approximately 59 minutes later, the train started to move down the descending grades, and accelerated all the way until it reached the town of Lac-Mégantic, where it derailed.

- 1.2.4 The lead locomotive, MMA 5017, was equipped with a Quantum Engineering Incorporated (QEI) locomotive event recorder (LER) version no. S45E, serial no. 0204100033. The recorded data in the “extend log” was downloaded from MMA 5017 by a MMA staff member soon after the accident. The Sureté du Québec (SQ, Quebec police) then seized the locomotive consist for their criminal investigation. When the SQ released the locomotives to the Transportation Safety Board (TSB), the LER records in the locomotives from before and during the accident had been overwritten by later recordings, so no meaningful data could be obtained from the other locomotives. The LER download from MMA 5017 was the only recorded data available for TSB analysis.
  - 1.2.5 The train was also equipped with an end-of-train (EOT) sense and brake unit (SBU). The SBU was sent to the TSB Engineering Laboratory for examination (LP 132/2013). The records in the DataFlash were extracted and converted into Excel spreadsheets. The EOT SBU download data were provided to this LP officer (Appendix A) for a comprehensive analysis of LER and SBU data together.
  - 1.2.6 The TSB investigation team also obtained a copy of the standard report of the public crossing at Mile 117.11, Moosehead Subdivision, that indicated the activation of the crossing signal and protection. The time record was calibrated by an independent crossing company. This record (Appendix B) was used as a reference in the synchronization and calibration of the downloaded LER time records.
- 1.3 Engineering Services Requested
    - 1.3.1 The preliminary investigation found that the train experienced a number of events, including unattended parking, fire, engine shutdown, runaway, derailment, and explosion. There were several broken knuckles, including those between the second and third locomotives, indicating that the locomotive consist had separated and rejoined. The derailed cars scattered in several small, jackknifed groups as well as in a main pile-up. The downloaded raw LER data file was sent to the TSB Engineering Laboratory, and a complete analysis was requested to assist the investigation in determination of the times, locations, and related parameters of the sequence of events leading to the derailment. A laboratory project was opened for this LER data-analysis work.
    - 1.3.2 The QEI Quantum Desktop Playback software was installed, and the raw download file was uploaded successfully. When first reviewed, the data was found to be not calibrated. In order to calibrate the data, measurements were taken for a number of reference locations, wheel sizes, travel distances, and times. The SBU and crossing records were reviewed, and an attempt was made to synchronize and analyze these data with the LER data. These data were further correlated with those of the on-site examinations and other investigation findings. A number of events of interest were identified with precise parameters. The sequence of events leading to the derailment was provided to help determine the

most likely derailment scenario as well as potential causes and contributing factors.

- 1.3.3 This LP report describes the analysis of the downloaded LER data from the lead locomotive, MMA5017, including calibration of records, identified events of interest, calculation of the locations of vehicles in the train at the times of significance, and discussion of the likely derailment scenario.

## **2.0 CALIBRATION**

### **2.1 Wheel Size and Travel Distance References**

- 2.1.1 The wheels of the lead axle of locomotive 5017 were measured by the LP officer for the locomotive wheel examination project (LP182/2013). The circumference measurements were 126.75 inches for the left wheel and 126.25 inches for the right wheel. The average circumference for the 2 wheels of the lead axle was 126.50 inches, equivalent to a diameter of 40.266 inches, which was a little more than the labeled nominal value of 40 inches.
- 2.1.2 The site survey team (LP167/2013) determined that, before the runaway, the lead locomotive was located at Mile 6.718, Sherbrooke Subdivision, and that the final stop of the lead locomotive after the accident was at Mile 116.412, Moosehead Subdivision. The travel distance of the lead locomotive between these 2 locations included the return segment of the front portion of the locomotive consist during the last backward (westward) movement. The TSB engineering team also learned that the Moosehead Subdivision ends at Mile 117.14, where the Sherbrooke Subdivision begins at Mile 0.0 (Figure 2).
- 2.1.3 The measured average wheel size was entered into the LER data analysis software to adjust the mileage record channel and the speed channel accordingly. The resultant LER travel distance matched (within the resolution level of the LER mileage records) the measured distance between the stop location of the locomotive before the runaway and the final stop after the derailment. This finding confirmed that the mile and distance data could be considered to be properly calibrated.

### **2.2 Time Calibration References**

- 2.2.1 The data downloaded from the crossing at Mile 117.11 on the MMA Moosehead Subdivision (Appendix B) showed that the alternating current (AC) power was cut off at 01:19:29.45, and the event identified as gcp1 detected the train at 01:19:31.04. A calibration of the time was performed by an independent company (X Rail), and it was determined that the data needed a time correction of -4 minutes 1 second. In other words, gcp1 recorded its detection of the locomotive consist as 01:19:31.04, but it was actually 01:15:30.04.
- 2.2.2 The location mile of the sensor/detector gcp1 that detected the locomotive consist at 01:15:30.04 was the location of the West approach limit, located 650 feet plus half of the 130 feet island, or 715 feet west of the centre of the crossing located at Mile 117.11. Therefore, the detector/sensor was located at Mile 0.11 of the Sherbrooke Subdivision.

- 2.2.3 The time channel of the LER download from MMA 5017 was calibrated using the detection of the lead locomotive at Mile 0.11 Sherbrooke Subdivision at 01:15:30 as a reference point. An adjustment of +01:01:31 was applied to the raw LER time channel.
- 2.3 Verification among LER, SBU and crossing signal downloads
- 2.3.1 The SBU recorded the SBU status, EOT brake pipeline pressure (BP), and MOVE/STOP activities, but its GPS position channels were empty. All parameters except the EOT BP were sampled at 60-second time intervals. The MOVE/STOP parameter did not capture detailed speed data. The 60-second time interval made it difficult to synchronize the SBU data with the LER data.
- 2.3.2 The EOT BP was sampled at shorter intervals. However, changes in EOT BP lagged behind changes in lead locomotive BP by an uncertain time, as a result of the propagation time of the brake air along the train pipe from the locomotive to the end of the train. Therefore, the EOT BP could not be synchronized with the LER BP events.
- 2.3.3 The SBU data did, however, provide a record of the EOT BP that linked the brake air state along the train brake pipe, so the automatic brake application and release could be confirmed. The MOVE/STOP channel also provided a simplified overview of the train's motion. These 2 channels were used to complement the LER data analysis, as presented in the analysis below.
- 2.3.4 The downloaded crossing signal data recorded mainly the crossing activations and crossing state. The detection of the train arrival was utilized for time calibration and synchronization reference between the LER records and the crossing records. Another record was the speed of the train while passing the crossing. However, there was a difference between the LER recorded speed and the crossing record. Considering that the LER mileage, travel distance, and time had been accurately calibrated, the derived LER speed records were deemed more reliable than the crossing speed records. The LER recorded speeds are used in this report as the official train speeds, unless stated otherwise.
- 2.3.5 The recorded data from the LER, SBU and crossing downloads generally corroborated each other with minor differences. The LER data was used in the following analysis and discussions in this report.

### **3.0 IDENTIFIED EVENTS OF INTEREST**

#### **3.1 Review of LER Records**

- 3.1.1 The downloaded LER records covered 5 days since 2 July, and totalled 2191 pages of data. A compressed graphic of all of the records is shown in Figure 3. By placing tags at designated moments, the period between the train coming to a stop at Nantes and the final stop after the accident was zoomed in (Figure 4). Further zoomed graphics for the period of engine shutdown, runaway, and last backward (westward) movement are shown in Figures 5–7.

- 3.1.2 The records of most interest were the following: speed, automatic brake, brake pipeline pressure (BP), independent brake (IND), brake cylinder pressure (BC), and the positions of the throttle\dynamic brake and the reverser handle. The time was recorded at a resolution level of 1 second, and the distance\mileage was recorded up to 0.01 miles, or 53 feet, which means a maximum round-up of 26.5 feet.
- 3.1.3 The recorded speed was increasing smoothly during the runaway, and there was only one abrupt turning point at the highest speed of 65 mph. After the turning point, the speed decreased nearly linearly until speed was recorded as zero. The speed records indicated that the lead locomotive suffered only one big backward tension force that changed its movement from acceleration into steep deceleration. The afterward deceleration did not show significant impulses that would appear if secondary derailments or surge/breakage occurred. The speed turning point most likely was the moment of the first derailment and the cause of the knuckle separations, and the separations of the locomotive consist in two parts from the derailed train.
- 3.1.4 The last separated speed loop recorded the backward (westward) movement of the front portion of the locomotive consist that was on a descending grade of 1% toward the downtown area. The speed climbed to a peak of 8 mph, and then decreased quickly until the final stop. This speed turning point corresponded to the recontact between the two portions of the locomotive consist, and the deceleration period indicated that the entire buffed locomotive consist moved backward (westward) to the final stop location. The travel distances of the acceleration and the deceleration periods of this speed loop provided the backward movement distance of the front portion alone and the re-coupled entire locomotive consist until the entire locomotive consist came to a final stop.

## 3.2 Events of Interest

- 3.2.1 A number of significant events of interest were identified and are listed in Table 1. These events are described and explained in the following paragraphs. The corresponding events in the SBU records are listed in Table 2. The times of the corresponding events in the LER records and the SBU records could not be meaningfully synchronized due to the large interval of the SBU samplings and various air brake propagation delays.
- 3.2.2 The locomotive engineer started to apply the automatic brake in Event no.1 at 22:43:26, when the lead locomotive was located at Mile 8.01 Sherbrooke Subdivision. The speed was 19 mph, and throttle was moved down from position 4.
- 3.2.3 The locomotive took 5 minutes 46 seconds to slow down to a stop in Event no. 2 at 22:49:12, and the lead locomotive was located at Mile 6.72 (6.718 measured on site) with a BP reduction of 13 psi, from 95 to 82 psi. The SBU recorded the corresponding stop with a BP reduction of 12 psi, from 89 to 77 psi (the SBU time interval from the automatic brake initiation to the stop was 7 minutes 20 seconds, longer than the LER record, which was most likely due to the SBU 60-second record interval and the propagation delay of air brake from train head to end).

- 3.2.4 The locomotive engineer applied IND in Event no. 3 at 22:49:37, 25 seconds after the train stopped. There was no record in SBU data corresponding to this event.
- 3.2.5 The automatic brake was released, and the BP increased to 94 psi in Event no. 4 after about 14 minutes 11 seconds, while the IND remained at the same level. There was no record in SBU data corresponding to this event.
- 3.2.6 Then 54 minutes and 54 seconds later, the lead locomotive engine was shut down after the fire was put out in Event no. 5 at 23:58:42, as indicated by the throttle movement from Idle to D and by the reverser position change from 0 to 1. No corresponding event could be identified in the SBU record.

**Table 1: Identified events of interest**

No.	LER time hhmmss	ΔT hhmmss	LER mile	D ft	Correct mile	V mph	BP psi	BC psi	Thr	Rev	Description
1	224326		8.01		8.01	19	95	0	4	0	Initiate automatic brake to stop
2	224912	000546	6.72	6811	6.72	0	82	0	ID	0	Train MMA-002 stopped at Nantes
3	224937	000025	6.72	0	6.72	0	82	69	ID	0	IND applied on locomotives
4	230348	001411	6.72	0	6.72	0	94	69	ID	0	Auto-brake released but IND remaining
5	235842	005454	6.72	0	6.72	0	95	69	D	1	Engine shut down and reverser on
6	000555	000713	6.72	0	6.72	0	94	70	D	1	BP began to drop and IND BC remaining
7	001355	000800	6.72	0	6.72	0	79	69	D	1	IND BC began to drop, BP dropped 15 psi in 8 minutes
8	005821	004426	6.72	0	6.72	1	32	27	D	1	Train MMA-002 started to run away
9	011530	001709	0.11	34901	0.11	65	16	14	D	1	BP drop to zero in 1 sec, highest speed and turning point
10	011712	000142	-0.84	5016	116.30	0	0	6	D	1	MMA 5017 stopped for first time
11	011739	000017	-0.84	0	116.30	0	0	0	D	1	IND BC dropped to zero
12	024506	012727	-0.84	0	116.30	1	0	0	D	1	Loco portion 1 started to move backward
13	024623	000117	-0.93	475	116.39	8	0	0	D	1	Loco portion 1 at max speed backward and contacted portion 2
14	024642	000019	-0.95	106	116.41	0	0	0	D	1	Loco consist rejoined, moved 106 feet west to final stop
Note											<ol style="list-style-type: none"> <li>1. The train started to run away from Mile 6.718 and final stop at Mile 116.412.</li> <li>2. Reverser did not reflect in mileage increase/decrease, nor direction of travel.</li> <li>3. Event no. 9 indicated derailment and separation moment, and concurrence with crossing activation.</li> <li>4. BP and IND BC did not drop simultaneously, but in a different phase.</li> <li>5. BP dropped 15 psi in the first 8 minutes and at about 1 psi/minute overall.</li> </ol>

- 3.2.7 BP started to drop in Event no. 6 at 00:05:55, 7 minute 13 seconds after the locomotive engine was shut down, but the IND BC remained. The SBU recorded a corresponding BP drop event.



- 3.2.8 IND BC started to drop at 00:13:55 in Event no. 7, 8 minutes after the BP started to drop. The BP dropped 15 psi in the 8 minutes, at a rate of about 2 psi/minutes. No corresponding event could be identified in the SBU record.
- 3.2.9 The train began to run away at 00:58:21 in Event no. 8, when the BP dropped to 32 psi and IND BC dropped to 27 psi. A corresponding MOVE event was recorded in the SBU data, which could be a synchronization reference but the 60-second sampling interval prevented it from being a precise reference.
- 3.2.10 The train accelerated to the highest speed of 65 mph at 01:15:30 in Event no. 9, after running for 17 minutes 9 seconds and travelling 6.61 miles (34901 feet). The speed turned down abruptly into steep deceleration. The remaining BP of 16 psi dropped to zero suddenly in just 1 second. The lead locomotive was at Mile 0.11, where the detector of crossing 117.11 concurrently detected the train and activated the crossing signal. The LER time and the crossing time record were synchronized by this activation event. The SBU recorded a similar BP dropping from 16 psi to zero, 16 minutes 38 seconds after the start-to-move event. The slightly different records of the running times were caused by the SBU record interval.
- 3.2.11 Analysis of the speed record around this turning point and extending to the final stop showed that this moment was the only event when dramatic speed change was observed. The speed turning point indicated most likely the time of the derailment. As no further impulse event was observed afterwards but the locomotive consist was separated before the final stop, it is reasonable to conclude that the separation very likely occurred at the same time of the derailment or at an indistinguishable time difference.
- 3.2.12 The lead locomotive continued travelling for 1 minute 42 seconds over 5016 feet, and stopped at 01:17:12 and Mile 116.30 in Event no. 10, on an ascending grade of 1%. The residual IND BC was 6 psi. The SBU recorded a 1-minute interval from the sudden BP pressure decrease to the stop, shorter than the travelling time of the locomotives. The SBU at the end of train was decelerated quicker by the derailed cars. After the derailment moment, EOT SBU separated from the locomotive consist, and no more corresponding events could be compared.

**Table 2: Corresponding events in SBU records**

Corresponding event no.	SBU time	Time interval	EOT BP	MOV/STP	Comments
	hhmmss	hh:mm:ss	psi		
1	182432		89	MOV	
2	183152	00:07:20	77	STP	synch ref B
3					
4					
5					
6	194654		87	STP	
7					
8	204036		29	MOV	synch ref A
9	205714	00:16:38	16	MOV	
10	205814	00:01:00	0	STP	

- 3.2.13 The IND BC dropped to zero at 01:17:39 in Event no. 11.
- 3.2.14 The front portion of the locomotive consist, MMA 5017, VB-1 and MMA5026, started to move backward at 02:45:06 in Event no. 12, 1 hour 27 minutes and 27 seconds after its first stop. In the later hand brake testing, it was discovered that the hand brake on MMA 5026 was not functional (LP187/2013). The residual hand brake retarding force from MMA 5017 and VB-1 could not hold the entire portion on the 1% grade anymore, so the front portion of the locomotive consist started to move backward.
- 3.2.15 The front portion of the locomotive consist accelerated to a speed of 8 mph and abruptly decelerate at 02:46:23 in Event no. 13, after travelling for 1 minute 17 seconds and 475 feet. The front portion recontacted the rear portion of the locomotive consist and pushed it, moving both backward together.
- 3.2.16 The recoupled entire locomotive consist continued travelling for 19 seconds over 106 feet to the final stop at 02:46:42 in Event no. 14. The lead locomotive, MMA 5017, was located at Mile 116.41 (116.412 measured on site).
- 3.2.17 The standard report of Crossing 117.11 recorded a speed of 58 mph approximately 2 seconds after the derailment/separation/crossing activation moment. The corresponding LER speed record at the time was 63 mph. The crossing record of the train speed was not calibrated, while the LER speed records had been calibrated perfectly with the measured wheel size and travel distance between the departure and final stop locations. Therefore, the LER speed is taken as the official reference speed in this report.

#### **4.0 CALCULATION OF VEHICLE LOCATIONS**

##### **4.1 Rest Position before Runaway**

- 4.1.1 Upon request from the investigation team, the locations of vehicles in the train were calculated at the times of interest after the LER mileage channel was calibrated. With the location of the lead locomotive and the length of each vehicle in the train consist, an Excel template was developed to calculate the locations of vehicles, and this data was compared with the on-site measured locations and distances of interest. A number of cases were calculated (Appendix C).
- 4.1.2 The lead locomotive, MMA 5017, was located at Mile 8.01, Sherbrooke Subdivision, when the locomotive engineer started to apply automatic braking to stop the train at 22:43:26. The rear end of the train was located at Mile 8.89.
- 4.1.3 The train came to a stop at 22:49:12 and rested until it ran away. During this period, the train covered the track section from Mile 6.72 to Mile 7.60 (measured on site at 6.718 to Mile 7.596), Sherbrooke Subdivision. The average grade under the train was calculated to be 0.918% from the on-site survey data (LP167/2013).

##### **4.2 Derailment/Separation Moment**

- 4.2.1 The train accelerated to the highest speed and abruptly decelerated at 01:15:30 when the lead locomotive was located at Mile 0.11, Sherbrooke Subdivision. This

deceleration was identified to be the derailment moment, and very likely the separation occurred simultaneously or within an indistinguishable time difference. The rear end of the train was located at Mile 0.986. The train occupied the track section with crossing, switch and curves. The front portion of the train was on flat track while the rear portion was on a descending grade of 1.2% and 1.3%.

- 4.2.2 The group of cars no. 6 to no. 11 at this derailment/separation moment covered the area of a crossing, switch, and curves that require a speed limit of 10 mph. These derailed cars finally came to rest scattered along a curved line tangential to the main track (Figure 1). The final position of the derailed cars indicated that the derailment very likely occurred among the group of the cars at this section of vulnerable track (Figure 8).
- 4.2.3 The derailment occurred suddenly at a high speed of 65 mph on the curve under a compression in-train force, causing a sudden change from compression into tension that probably broke the knuckles and separated the cars and locomotive consist. The cars in front of the first derailed car were likely swung out laterally, tangential to the curved track, landing in separated small groups in jackknifed positions. More analysis of the rollover due to over-speed and contribution of in-train force is presented in LP 188/2013.

#### 4.3 Positions of Locomotives after Separation

- 4.3.1 After the derailment and the separation between the second and third locomotives, the LER records showed only the locations of the front portion of the locomotives up to the first stop at 01:17:12. The lead locomotive stopped at Mile 116.30, Moosehead Subdivision. The LER contained no data on the location of other separated locomotives.
- 4.3.2 Almost 1.5 hours later, the front portion of the locomotive consist started to move backward, and it recontacted the second part of the locomotive consist at 2:46:23. The recontact data showed that the third locomotive was stopped at Mile 116.412, 475 feet away from the first stop location of the second locomotive. The lead locomotive was at Mile 116.39 when the recontact occurred.
- 4.3.3 The recoupled locomotive consist moved backward (westward) together for another 106 feet and came to the final stop at 2:46:42. The lead locomotive came to rest at Mile 116.41.

## 5.0 CONCLUSIONS

- 5.1 The LER data was downloaded from the lead locomotive, MMA 5017, without calibration, and the LER records on the other locomotives not in possession of the TSB were not downloaded in time and were lost.
- 5.2 The LER downloaded data was calibrated with the measured wheel size and verified time reference of the detection of the train at the Crossing Mile 117.11. The adjusted LER travel distance perfectly matched the on-site survey of the distance between the departure and final stop locations of the lead locomotive. The LER speed records were calibrated accordingly and are considered very reliable.

- 5.3 The locomotive engineer applied the automatic brake and brought the train to a stop on the main track at Station Nantes. The automatic brake was released and the IND brake was applied on the locomotives together with hand brakes on the locomotive consist and the rail cars.
- 5.4 The engine of the lead locomotive was kept running until it was shut down after a fire was put out. The LER recorded that the throttle was moved from Idle to D position and the reverser record changed from 0 to 1 at 23:58:42.
- 5.5 The brake pipeline pressure (BP) began to drop about 7 minutes after the engine was shut down, but the IND BC pressure remained unchanged until 8 minutes later.
- 5.6 The BP dropped 15 psi in the first 8 minutes and continued dropping at an average rate of about 1 psi/min. The IND BC decreased at a similar rate and in a parallel delayed phase.
- 5.7 The train started to roll at 00:58:21 when the BP dropped to 32 psi and the IND BC dropped to 27 psi.
- 5.8 The train accelerated for 17 minutes 9 seconds to the highest speed of 65 mph, traveled 6.61 miles, then abruptly turned to steep deceleration at 01:15:30 with the lead locomotive at Mile 0.11, Sherbrooke Subdivision, indicating the time of the derailment. The BP dropped from 16 psi to zero in 1 second, indicating the separation of the train line.
- 5.9 The front part of the locomotive consist continued moving 5016 feet in 1 minute 42 seconds to the first stop at 1:17:12 at Mile 116.30 on a grade of 1%, and the IND BC decreased to 6 psi.
- 5.10 IND BC dropped to zero at 1:17:39.
- 5.11 The front part of the locomotive consist started to move backward at 2:45:06 after it had rested for 1 hour 27 minutes and 27 seconds on the 1% grade.
- 5.12 The front part of the locomotive consist moved backward 475 feet in 1 minute 17 seconds, accelerated to 8 mph, and recontacted the second part of the locomotive consist at 2:46:23.
- 5.13 The recoupled locomotive consist continued moving backward at a deceleration for 19 seconds and 106 feet before coming to the final stop on the grade at Mile 116.41, Moosehead Subdivision.
- 5.14 The SBU downloaded data verified that the EOT BP changed parallel with the train automatic brake application, but could not be synchronized due to the 60-second sampling interval and various propagation delays of the air brake along the train brake pipe.
- 5.15 The standard report at Crossing Mile 117.11 provided a verified reference of the detection of the train at the sensor location to calibrate the LER time channel, and allowed the synchronization of the downloaded LER and the crossing data.

- 5.16 The group of cars no. 6 to no. 11 at the derailment/separation moment covered the area of crossing, switch, and curves that require a speed limit of 10 mph. The final positions of these derailed cars indicated that the derailment very likely occurred among this group of cars at this section of vulnerable track.
- 5.17 The derailment occurred suddenly at a high speed of 65 mph on the curve under a compression in-train force, causing a sudden change from compression into tension that probably broke the knuckles and separated the cars and locomotive consist.
- 5.18 The cars in front of the first derailed car were likely swung out laterally, tangential to the curved track, landing in separated small groups in jackknifed positions.
- 5.19 The cars behind the first derailed car rushed into the pile-up one after another, at a decreasing rate of speed, until the last few cars in the train stopped before reaching the derailment.



Figure 1: Aerial view of derailment site



Figure 2: Connection point at Mile 117.14 Moosehead and Mile 0.0 Sherbrooke Subdivision

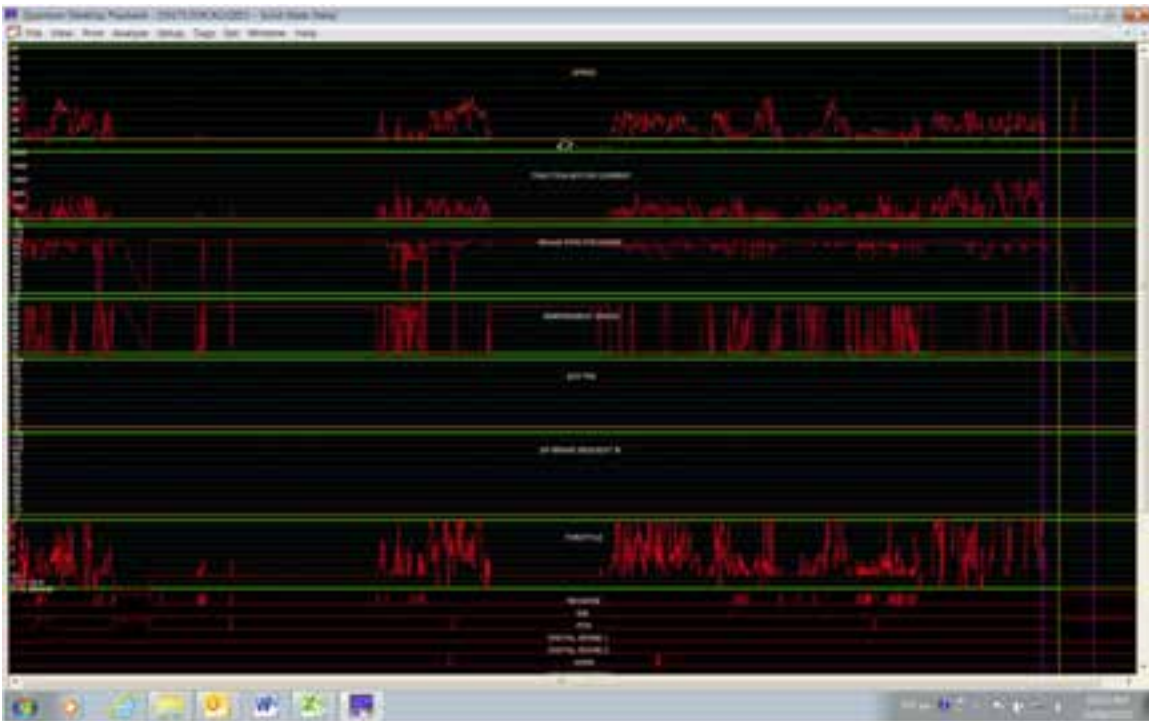


Figure 3: Compressed graphic of entire downloaded LER data

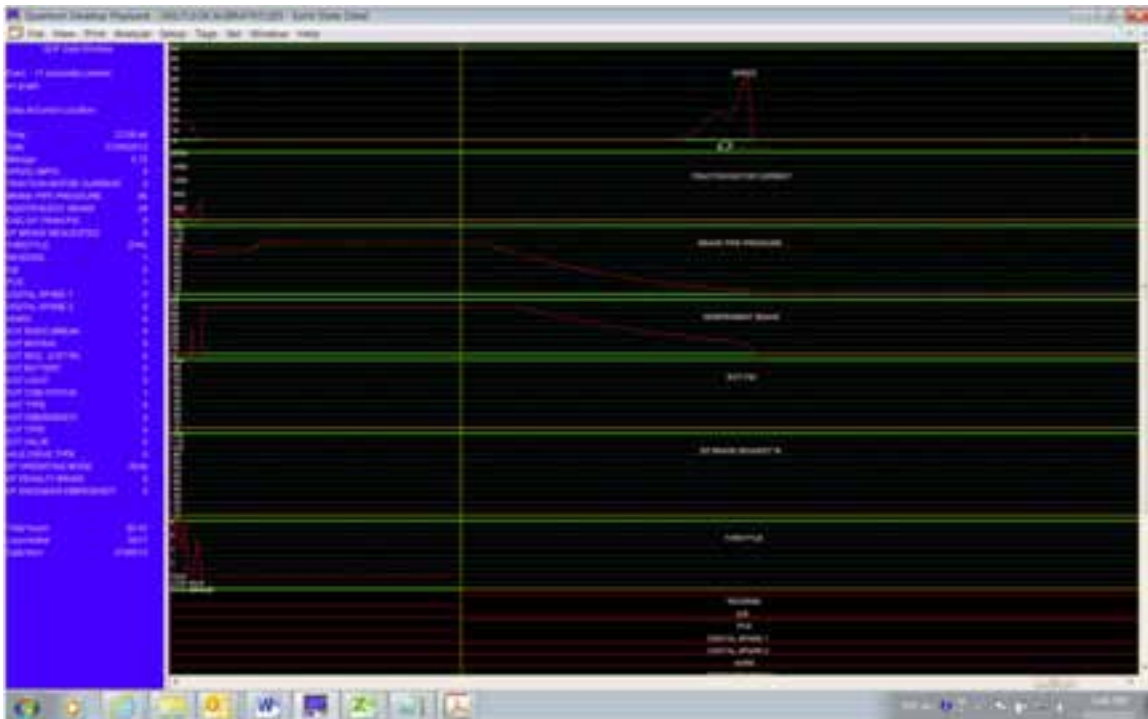


Figure 4: Graphic LER data between stop at Nantes and final stop after derailment



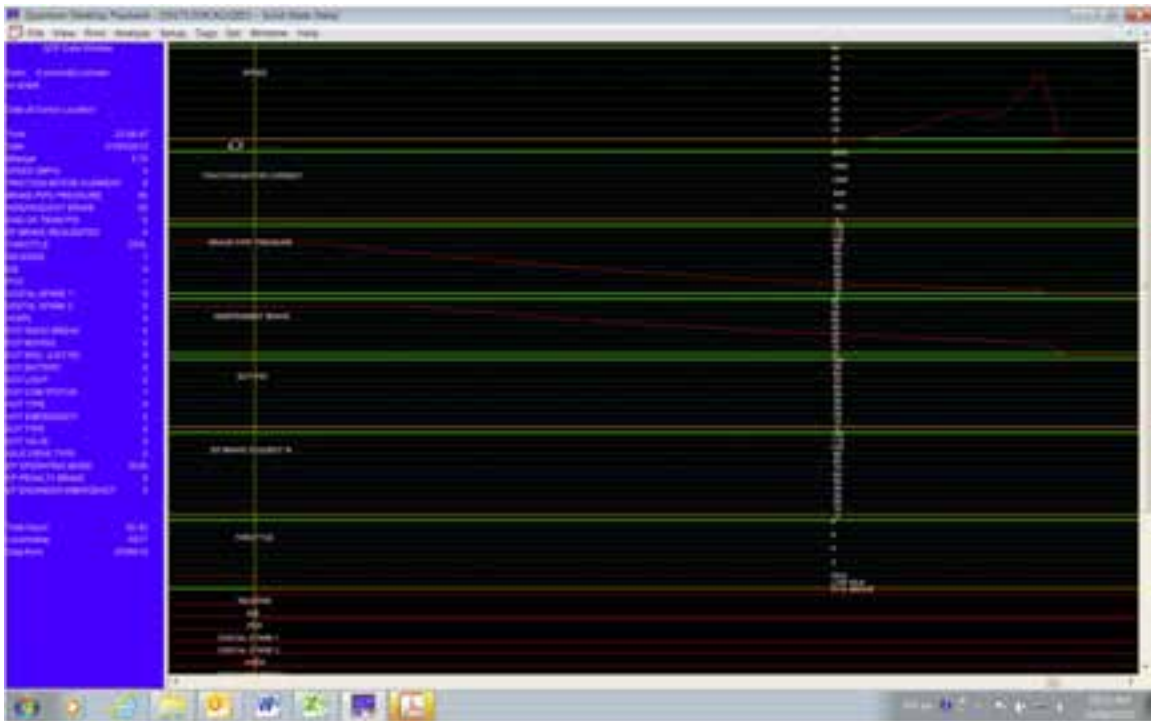


Figure 5: Graphic LER data from engine shutdown to first stop after derailment

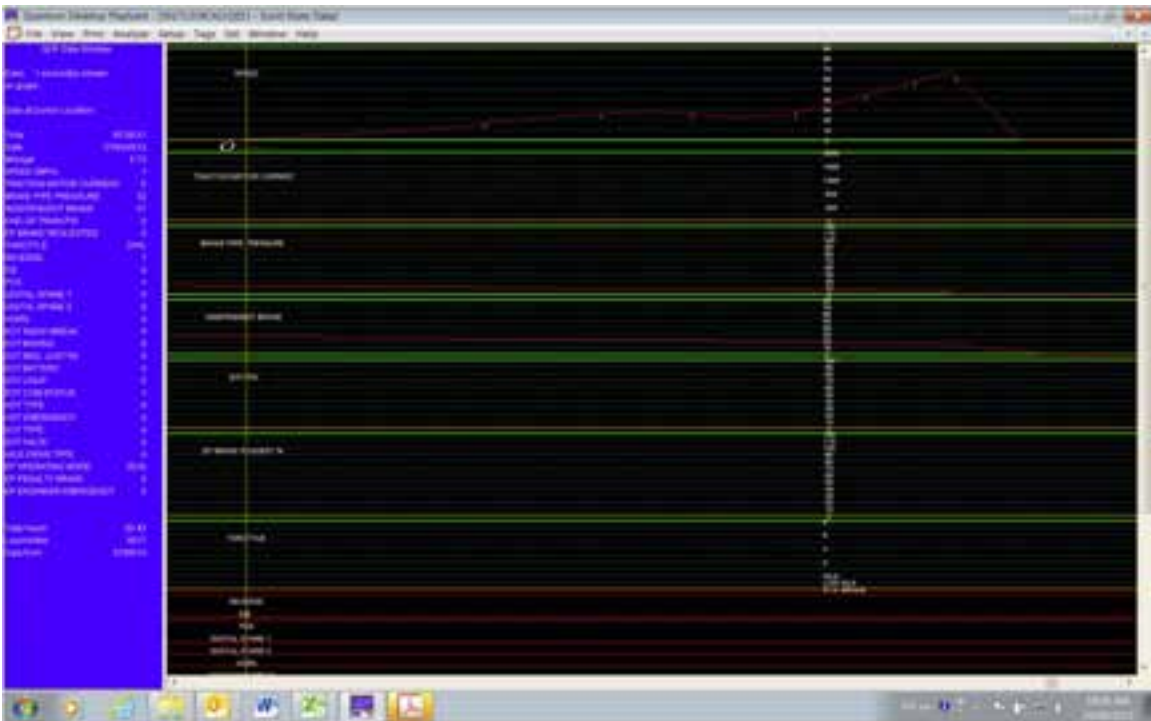


Figure 6: Graphic LER data during the runaway



Figure 7: Graphic LER data during the last backward movement



Figure 8: Switch and curve where the derailment likely occurred

## Appendix A: Edited SBU Download Data

R13D0054 LAC-MÉGANTIC RUNAWAY AND EXPLOSION: EOT SBU DOWNLOADED DATA

Edited Portion for Print Since the Train Stopped and Unattended

See Original Titled Sheet for Complete Data

### Abbreviations of Channels:

Message ID	Message Type ID
PnM	Pneumatic Mode
Serv	Service Status
Valve	Valve State
ERP	Head ERP
TP	Target Pressure
BS	Battery Status
SR	Sleep Reason
Tilt	Tilt Indicator
EOT BP	EOT Pressure (psi)
GV10	Generator Voltage * 10
MV10	Main Voltage * 10
BV10	Battery Voltage * 10
LBV10	Last Battery Test Stored Voltage * 10
BCm10	Battery Current ma * 10
Charg	Charge State
EOTMI	EOT Mode Indicator
HVM	HVM Status
Motion	Motion Status
TC10	Temperature C *10
Time(hhmmss.)	Elapsed Time Timer Value and Day (hhmmss.sss)
Lat	Latitude
Hph	Hemisphere
Lgt	Longitude
Hph	Hemisphere
PFV	Position Fix Validity
Date (ddmmyy)	UTC Date (ddmmyy)

Mess ID	PnM	Serv	Valve	Tilt	EOTBP	EOTMI	HVM	Motion	TC10	Time(hhmmss.)
<b>BTSTRT REL</b>	<b>AAR</b>	<b>REL</b>	<b>V</b>	<b>84</b>	<b>AIR</b>	<b>o</b>	<b>STP</b>	<b>44</b>	<b>152352.687</b>	
<b>SWSTRTREL</b>	<b>AAR</b>	<b>REL</b>	<b>V</b>	<b>85</b>	<b>AIR</b>	<b>*</b>	<b>MOV</b>	<b>44</b>	<b>152422.686</b>	
PRES_C REL	AAR	REL	V	86	AIR	o	MOV	44	152450.684	
PRES_C REL	AAR	REL	V	82	AIR	o	MOV	44	152517.682	
PRES_C REL	AAR	REL	V	82	AIR	o	MOV	44	152518.682	
PRES_C REL	AAR	REL	V	80	AIR	o	MOV	44	152521.682	
PRES_C REL	AAR	REL	V	78	AIR	o	MOV	54	152621.679	
60_SEC REL	AAR	REL	V	77	AIR	o	MOV	44	152722.675	
PRES_C REL	AAR	REL	V	77	AIR	o	MOV	44	152806.672	
PRES_C REL	AAR	REL	V	80	AIR	o	MOV	44	152907.669	
PRES_C REL	AAR	REL	V	83	AIR	o	MOV	44	152908.669	
PRES_C REL	AAR	REL	V	83	AIR	o	MOV	44	152909.668	
PRES_C REL	AAR	REL	V	81	AIR	o	MOV	44	152914.668	
PRES_C REL	AAR	REL	V	83	AIR	o	MOV	44	152943.666	
PRES_C REL	AAR	REL	V	79	AIR	o	MOV	44	153005.665	
PRES_C REL	AAR	REL	V	77	AIR	o	MOV	44	153008.665	
60_SEC REL	AAR	REL	V	77	AIR	o	MOV	44	153108.661	
PRES_C REL	AAR	REL	V	77	AIR	o	MOV	44	153121.661	
60_SEC REL	AAR	REL	V	75	AIR	o	MOV	44	153222.657	
PRES_C REL	AAR	REL	V	75	AIR	o	MOV	44	153255.655	
60_SEC REL	AAR	REL	V	74	AIR	o	MOV	44	153356.651	
60_SEC REL	AAR	REL	V	74	AIR	o	MOV	44	153456.648	

60_SEC REL	AAR	REL	V	74	AIR	o	MOV	44	153557.644
60_SEC REL	AAR	REL	V	74	AIR	o	MOV	44	153657.641
60_SEC REL	AAR	REL	V	74	AIR	o	MOV	44	153758.637
60_SEC REL	AAR	REL	V	74	AIR	o	MOV	44	153859.633
BTSTRT REL	AAR	REL	V	74	AIR	o	MOV	44	153901.633
SWSTRTRREL	AAR	REL	V	74	AIR	o	MOV	34	153931.631
60_SEC REL	AAR	REL	V	74	AIR	o	MOV	34	154032.628
60_SEC REL	AAR	REL	V	74	AIR	o	MOV	34	154132.624
PRES_C REL	AAR	REL	V	72	AIR	o	MOV	44	154230.621
60_SEC REL	AAR	REL	V	71	AIR	o	MOV	34	154330.617
PRES_C REL	AAR	REL	V	71	AIR	o	MOV	34	154340.616
60_SEC REL	AAR	REL	V	70	AIR	o	MOV	34	154441.613
PRES_C REL	AAR	REL	V	78	AIR	o	MOV	34	154447.612
PRES_C REL	AAR	REL	V	79	AIR	o	MOV	34	154448.612
PRES_C REL	AAR	REL	V	80	AIR	o	MOV	34	154544.609
PRES_C REL	AAR	REL	V	81	AIR	o	MOV	34	154627.606
PRES_C REL	AAR	REL	V	83	AIR	o	MOV	34	154721.603
60_SEC REL	AAR	REL	V	85	AIR	o	MOV	34	154821.6
PRES_C REL	AAR	REL	V	86	AIR	o	MOV	34	154836.599
60_SEC REL	AAR	REL	V	87	AIR	o	MOV	34	154937.595
60_SEC REL	AAR	REL	V	87	AIR	o	MOV	34	155037.592
PRES_C REL	AAR	REL	V	87	AIR	o	MOV	34	155053.591
60_SEC REL	AAR	REL	V	88	AIR	o	MOV	34	155153.587
60_SEC REL	AAR	REL	V	88	AIR	o	MOV	34	155254.583
60_SEC REL	AAR	REL	V	88	AIR	o	MOV	34	155354.58
BTSTRT REL	AAR	REL	V	89	AIR	o	MOV	34	155409.579
SWSTRTRREL	AAR	REL	V	88	AIR	o	MOV	34	155440.577
60_SEC REL	AAR	REL	V	89	AIR	o	MOV	34	155540.573
60_SEC REL	AAR	REL	V	89	AIR	o	MOV	34	155641.57
60_SEC REL	AAR	REL	V	89	AIR	o	MOV	34	155742.566
60_SEC REL	AAR	REL	V	89	AIR	o	MOV	34	155842.563
60_SEC REL	AAR	REL	V	89	AIR	o	MOV	34	155943.559
60_SEC REL	AAR	REL	V	89	AIR	o	MOV	34	160043.555
60_SEC REL	AAR	REL	V	89	AIR	o	MOV	34	160144.552
60_SEC REL	AAR	REL	V	89	AIR	o	MOV	34	160244.548
60_SEC REL	AAR	REL	V	89	AIR	o	MOV	34	160345.544
60_SEC REL	AAR	REL	V	89	AIR	o	MOV	34	160446.541
60_SEC REL	AAR	REL	V	89	AIR	o	MOV	34	160546.537
60_SEC REL	AAR	REL	V	89	AIR	o	MOV	34	160647.534
60_SEC REL	AAR	REL	V	89	AIR	o	MOV	34	160747.53
60_SEC REL	AAR	REL	V	89	AIR	o	MOV	34	160848.526
BTSTRT REL	AAR	REL	V	89	AIR	o	MOV	34	160918.525
SWSTRTRREL	AAR	REL	V	89	AIR	o	MOV	34	160948.523
60_SEC REL	AAR	REL	H	89	AIR	o	MOV	34	161049.519
60_SEC REL	AAR	REL	V	89	AIR	o	MOV	34	161150.515
60_SEC REL	AAR	REL	V	89	AIR	o	MOV	34	161250.512
60_SEC REL	AAR	REL	V	89	AIR	o	MOV	34	161351.508
60_SEC REL	AAR	REL	H	88	AIR	o	MOV	34	161451.505
60_SEC REL	AAR	REL	V	89	AIR	o	MOV	34	161552.501
60_SEC REL	AAR	REL	V	89	AIR	o	MOV	34	161653.497
60_SEC REL	AAR	REL	V	88	AIR	o	MOV	34	161753.494
60_SEC REL	AAR	REL	V	89	AIR	o	MOV	34	161854.49
60_SEC REL	AAR	REL	V	89	AIR	o	MOV	34	161954.487
60_SEC REL	AAR	REL	H	89	AIR	o	MOV	24	162055.483
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	24	162155.479
PRES_C REL	AAR	REL	V	84	AIR	*	MOV	24	162227.477
PRES_C REL	AAR	REL	V	83	AIR	*	MOV	34	162229.477
PRES_C REL	AAR	REL	V	81	AIR	*	MOV	24	162316.474
PRES_C REL	AAR	REL	V	79	AIR	*	MOV	24	162335.473
PRES_C REL	AAR	REL	V	84	AIR	*	MOV	24	162424.47
PRES_C REL	AAR	REL	V	86	AIR	*	MOV	24	162425.47
BTSTRT REL	AAR	REL	V	84	AIR	*	MOV	24	162427.47
PRES_C REL	AAR	REL	V	84	AIR	*	MOV	24	162433.47
PRES_C REL	AAR	REL	V	84	AIR	*	MOV	34	162452.469
SWSTRTRREL	AAR	REL	V	85	AIR	*	MOV	24	162457.468
60_SEC REL	AAR	REL	V	86	AIR	*	MOV	24	162558.465
PRES_C REL	AAR	REL	V	86	AIR	*	MOV	24	162619.464

60_SEC REL	AAR	REL	V	87	AIR	*	MOV	14	162720.46
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	24	162820.456
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	24	162921.453
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	24	163021.449
PRES_C REL	AAR	REL	V	88	AIR	*	MOV	24	163121.446
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	24	163221.442
60_SEC REL	AAR	REL	H	88	AIR	*	MOV	24	163322.438
60_SEC REL	AAR	REL	V	89	AIR	*	MOV	24	163423.435
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	24	163523.431
60_SEC REL	AAR	REL	V	89	AIR	*	MOV	24	163624.427
60_SEC REL	AAR	REL	V	89	AIR	*	MOV	24	163724.424
60_SEC REL	AAR	REL	V	89	AIR	*	MOV	24	163825.42
60_SEC REL	AAR	REL	H	89	AIR	*	MOV	24	163926.417
BTSTRT REL	AAR	REL	V	89	AIR	*	MOV	24	163936.416
SWSTRTREL	AAR	REL	V	88	AIR	*	MOV	24	164006.414
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	24	164107.411
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	24	164207.407
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	24	164308.403
PRES_C REL	AAR	REL	V	85	AIR	*	MOV	24	164345.401
PRES_C REL	AAR	REL	V	84	AIR	*	MOV	24	164346.401
PRES_C REL	AAR	REL	V	83	AIR	*	MOV	24	164348.401
PRES_C REL	AAR	REL	V	81	AIR	*	MOV	24	164411.4
PRES_C REL	AAR	REL	V	79	AIR	*	MOV	24	164440.398
PRES_C REL	AAR	REL	V	77	AIR	*	MOV	14	164507.396
PRES_C REL	AAR	REL	V	75	AIR	*	MOV	24	164535.394
PRES_C REL	AAR	REL	V	83	AIR	*	MOV	24	164611.392
PRES_C REL	AAR	REL	V	84	AIR	*	MOV	24	164612.392
PRES_C REL	AAR	REL	V	82	AIR	*	MOV	24	164617.392
PRES_C REL	AAR	REL	V	83	AIR	*	MOV	14	164708.389
60_SEC REL	AAR	REL	V	85	AIR	*	MOV	14	164809.385
PRES_C REL	AAR	REL	V	85	AIR	*	MOV	14	164815.385
60_SEC REL	AAR	REL	V	87	AIR	*	MOV	24	164915.381
60_SEC REL	AAR	REL	V	87	AIR	*	MOV	24	165016.378
PRES_C REL	AAR	REL	V	87	AIR	*	MOV	14	165021.377
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	14	165121.374
PRES_C REL	AAR	REL	V	84	AIR	*	MOV	14	165221.37
PRES_C REL	AAR	REL	V	82	AIR	*	MOV	14	165224.37
PRES_C REL	AAR	REL	V	81	AIR	*	MOV	24	165253.368
PRES_C REL	AAR	REL	V	79	AIR	*	MOV	14	165303.368
PRES_C REL	AAR	REL	V	78	AIR	*	MOV	14	165338.366
60_SEC REL	AAR	REL	V	76	AIR	*	MOV	14	165438.362
BTSTRT REL	AAR	REL	V	76	AIR	*	MOV	14	165444.362
SWSTRTREL	AAR	REL	H	76	AIR	*	MOV	14	165515.36
60_SEC REL	AAR	REL	V	76	AIR	*	MOV	14	165615.356
60_SEC REL	AAR	REL	V	76	AIR	*	MOV	14	165716.353
60_SEC REL	AAR	REL	V	76	AIR	*	MOV	14	165816.349
60_SEC REL	AAR	REL	V	76	AIR	*	MOV	14	165917.345
60_SEC REL	AAR	REL	H	76	AIR	*	MOV	14	170018.342
60_SEC REL	AAR	REL	V	76	AIR	*	MOV	14	170118.338
60_SEC REL	AAR	REL	V	76	AIR	*	MOV	14	170219.335
60_SEC REL	AAR	REL	V	76	AIR	*	MOV	4	170319.331
60_SEC REL	AAR	REL	V	76	AIR	*	MOV	14	170420.327
60_SEC REL	AAR	REL	V	76	AIR	*	MOV	14	170521.324
60_SEC REL	AAR	REL	V	76	AIR	*	MOV	4	170621.32
60_SEC REL	AAR	REL	V	76	AIR	*	MOV	14	170722.316
60_SEC REL	AAR	REL	V	76	AIR	*	MOV	4	170822.313
60_SEC REL	AAR	REL	V	76	AIR	*	MOV	14	170923.309
PRES_C REL	AAR	REL	V	84	AIR	*	MOV	4	170931.309
PRES_C REL	AAR	REL	V	84	AIR	*	MOV	4	170932.309
PRES_C REL	AAR	REL	V	82	AIR	*	MOV	4	170938.308
BTSTRT REL	AAR	REL	V	82	AIR	*	MOV	4	170953.307
PRES_C REL	AAR	REL	V	84	AIR	*	MOV	14	171019.306
SWSTRTREL	AAR	REL	V	84	AIR	*	MOV	14	171023.306
60_SEC REL	AAR	REL	V	85	AIR	*	MOV	14	171124.302
PRES_C REL	AAR	REL	V	85	AIR	*	MOV	14	171132.301
60_SEC REL	AAR	REL	V	87	AIR	*	MOV	14	171233.298
60_SEC REL	AAR	REL	V	87	AIR	*	MOV	4	171333.294

PRES_C REL	AAR	REL	V	88	AIR	*	MOV	14	171354.293
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	171455.289
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	171556.286
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	171656.282
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	171757.278
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	14	171857.275
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	171958.271
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	14	172058.268
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	14	172159.264
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	172300.26
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	172400.257
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	14	172501.253
BTSTRT REL	AAR	REL	V	88	AIR	*	MOV	4	172502.253
SWSTRTREL	AAR	REL	V	88	AIR	*	MOV	4	172532.251
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	172633.248
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	172733.244
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	14	172834.24
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	172934.237
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	14	173035.233
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	173136.23
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	173236.226
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	173337.222
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	173437.219
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	173538.215
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	173639.211
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	173739.208
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	173840.204
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	173940.201
BTSTRT REL	AAR	REL	V	88	AIR	*	MOV	4	174011.199
SWSTRTREL	AAR	REL	H	88	AIR	*	MOV	4	174041.197
60_SEC REL	AAR	REL	H	88	AIR	*	MOV	4	174141.193
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	174242.19
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	174343.186
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	174443.183
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	174544.179
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	174644.175
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	174745.172
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	174845.168
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	174946.164
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	175047.161
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	175147.157
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	175248.154
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	175348.15
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	175449.146
BTSTRT REL	AAR	REL	V	88	AIR	*	MOV	4	175519.145
SWSTRTREL	AAR	REL	V	88	AIR	*	MOV	4	175550.143
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	175650.139
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	175751.135
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	175851.132
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	175952.128
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	180052.125
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	180153.121
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	180254.117
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	250	180354.114
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	180455.11
PRES_C REL	AAR	REL	V	84	AIR	*	MOV	4	180500.11
PRES_C REL	AAR	REL	V	83	AIR	*	MOV	4	180501.11
PRES_C REL	AAR	REL	V	82	AIR	*	MOV	4	180503.11
60_SEC REL	AAR	REL	V	82	AIR	*	MOV	4	180603.106
PRES_C REL	AAR	REL	V	86	AIR	*	MOV	4	180605.106
PRES_C REL	AAR	REL	H	82	AIR	*	MOV	4	180700.103
PRES_C REL	AAR	REL	V	80	AIR	*	MOV	250	180703.102
PRES_C REL	AAR	REL	V	78	AIR	*	MOV	4	180752.1
PRES_C REL	AAR	REL	V	84	AIR	*	MOV	4	180835.097
PRES_C REL	AAR	REL	V	83	AIR	*	MOV	4	180836.097
PRES_C REL	AAR	REL	H	82	AIR	*	MOV	4	180840.097
PRES_C REL	AAR	REL	V	84	AIR	*	MOV	4	180910.095

60_SEC REL	AAR	REL	V	85	AIR	*	MOV	4	181011.091
PRES_C REL	AAR	REL	V	86	AIR	*	MOV	4	181019.091
BTSTRT REL	AAR	REL	V	86	AIR	*	MOV	250	181028.09
SWSTRTRREL	AAR	REL	V	86	AIR	*	MOV	250	181058.088
60_SEC REL	AAR	REL	V	87	AIR	*	MOV	250	181159.085
PRES_C REL	AAR	REL	V	88	AIR	*	MOV	4	181225.083
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	250	181326.08
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	250	181426.076
60_SEC REL	AAR	REL	H	88	AIR	*	MOV	250	181527.072
60_SEC REL	AAR	REL	V	89	AIR	*	MOV	250	181627.069
60_SEC REL	AAR	REL	H	89	AIR	*	MOV	250	181728.065
60_SEC REL	AAR	REL	V	89	AIR	*	MOV	250	181829.061
60_SEC REL	AAR	REL	H	89	AIR	*	MOV	250	181929.058
60_SEC REL	AAR	REL	V	88	AIR	*	MOV	4	182030.054
60_SEC REL	AAR	REL	V	89	AIR	*	MOV	250	182130.051
60_SEC REL	AAR	REL	V	89	AIR	*	MOV	250	182231.047
60_SEC REL	AAR	REL	H	88	AIR	*	MOV	250	182331.043
60_SEC REL	AAR	REL	V	89	AIR	*	MOV	250	182432.04
PRES_C REL	AAR	REL	V	84	AIR	*	MOV	250	182512.037
PRES_C REL	AAR	REL	V	82	AIR	*	MOV	250	182515.037
BTSTRT REL	AAR	REL	V	82	AIR	*	MOV	250	182537.036
SWSTRTRREL	AAR	REL	H	82	AIR	*	MOV	250	182607.034
60_SEC REL	AAR	REL	V	82	AIR	*	MOV	240	182708.03
PRES_C REL	AAR	REL	V	81	AIR	*	MOV	250	182719.03
PRES_C REL	AAR	REL	V	79	AIR	*	MOV	250	182752.028
PRES_C REL	AAR	REL	V	77	AIR	*	MOV	250	182851.024
60_SEC REL	AAR	REL	V	77	AIR	*	MOV	250	182951.021
60_SEC REL	AAR	REL	V	76	AIR	*	MOV	250	183052.017
60_SEC REL	AAR	REL	V	77	AIR	*	STP	250	183152.014
60_SEC REL	AAR	REL	V	77	AIR	*	STP	240	183253.01
60_SEC REL	AAR	REL	V	77	AIR	*	STP	250	183353.006
60_SEC REL	AAR	REL	V	77	AIR	*	STP	250	183454.003
60_SEC REL	AAR	REL	V	77	AIR	*	STP	250	183554.999
60_SEC REL	AAR	REL	V	77	AIR	*	STP	240	183654.995
60_SEC REL	AAR	REL	V	77	AIR	*	STP	250	183755.992
60_SEC REL	AAR	REL	V	77	AIR	*	STP	240	183855.988
60_SEC REL	AAR	REL	V	77	AIR	*	STP	240	183956.985
BTSTRT REL	AAR	REL	V	77	AIR	*	STP	240	184044.982
SWSTRTRREL	AAR	REL	V	77	AIR	*	STP	240	184115.98
60_SEC REL	AAR	REL	V	77	AIR	*	STP	240	184215.976
60_SEC REL	AAR	REL	V	77	AIR	*	STP	250	184316.973
60_SEC REL	AAR	REL	V	77	AIR	*	STP	240	184416.969
60_SEC REL	AAR	REL	V	77	AIR	*	STP	240	184517.965
PRES_C REL	AAR	REL	V	83	AIR	*	STP	240	184522.965
PRES_C REL	AAR	REL	V	85	AIR	*	STP	240	184523.965
PRES_C REL	AAR	REL	V	85	AIR	*	STP	240	184524.965
PRES_C REL	AAR	REL	V	83	AIR	*	STP	240	184528.965
PRES_C REL	AAR	REL	V	80	AIR	*	MOV	240	184601.963
PRES_C REL	AAR	REL	V	78	AIR	*	MOV	240	184604.963
PRES_C REL	AAR	REL	V	80	AIR	*	MOV	240	184613.962
PRES_C REL	AAR	REL	V	82	AIR	*	STP	240	184632.961
PRES_C REL	AAR	REL	V	84	AIR	*	STP	240	184703.959
60_SEC REL	AAR	REL	V	85	AIR	*	STP	240	184804.955
PRES_C REL	AAR	REL	V	85	AIR	*	STP	240	184816.955
60_SEC REL	AAR	REL	V	86	AIR	*	STP	240	184916.951
60_SEC REL	AAR	REL	V	87	AIR	*	STP	240	185017.947
PRES_C REL	AAR	REL	V	87	AIR	*	STP	240	185110.944
60_SEC REL	AAR	REL	V	88	AIR	*	STP	240	185210.941
60_SEC REL	AAR	REL	V	88	AIR	*	STP	240	185311.937
60_SEC REL	AAR	REL	V	88	AIR	*	STP	240	185411.933
60_SEC REL	AAR	REL	V	88	AIR	*	STP	240	185512.93
BTSTRT REL	AAR	REL	V	88	AIR	*	STP	240	185553.927
SWSTRTRREL	AAR	REL	V	88	AIR	*	STP	240	185624.926
60_SEC REL	AAR	REL	V	88	AIR	*	STP	240	185724.922
60_SEC REL	AAR	REL	V	88	AIR	*	STP	240	185825.918
60_SEC REL	AAR	REL	V	88	AIR	*	STP	240	185925.915
60_SEC REL	AAR	REL	V	88	AIR	*	STP	240	190026.911



60_SEC REL	AAR	REL	V	88	AIR	*	STP	240	190126.907
60_SEC REL	AAR	REL	V	88	AIR	*	STP	240	190227.904
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	190328.9
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	190428.897
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	190529.893
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	190629.889
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	190730.886
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	190831.882
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	190931.879
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	191032.875
BTSTRT REL	AAR	REL	V	88	AIR	*	STP	230	191102.873
SWSTRTRREL	AAR	REL	V	88	AIR	*	STP	230	191132.871
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	191233.868
60_SEC REL	AAR	REL	V	88	AIR	*	STP	240	191333.864
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	191434.86
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	191535.857
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	191635.853
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	191736.85
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	191836.846
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	191937.842
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	192038.839
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	192138.835
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	192239.831
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	192339.828
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	192440.824
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	192541.821
BTSTRT REL	AAR	REL	V	88	AIR	*	STP	230	192611.819
SWSTRTRREL	AAR	REL	V	88	AIR	*	STP	230	192641.817
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	192742.813
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	192842.81
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	192943.806
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	193043.803
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	193144.799
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	193245.795
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	193345.792
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	193446.788
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	193546.784
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	193647.781
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	193748.777
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	193848.774
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	193949.77
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	194049.766
BTSTRT REL	AAR	REL	V	88	AIR	*	STP	230	194120.764
SWSTRTRREL	AAR	REL	V	88	AIR	*	STP	220	194150.763
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	194251.759
60_SEC REL	AAR	REL	V	88	AIR	*	STP	230	194351.755
60_SEC REL	AAR	REL	V	88	AIR	*	STP	220	194452.752
60_SEC REL	AAR	REL	V	88	AIR	*	STP	220	194552.748
60_SEC REL	AAR	REL	V	87	AIR	*	STP	220	194653.745
60_SEC REL	AAR	REL	V	87	AIR	*	STP	230	194753.741
PRES_C REL	AAR	REL	V	86	AIR	*	STP	230	194813.74
60_SEC REL	AAR	REL	V	85	AIR	*	STP	220	194913.736
PRES_C REL	AAR	REL	V	85	AIR	*	STP	220	194935.735
60_SEC REL	AAR	REL	V	83	AIR	*	STP	220	195036.731
PRES_C REL	AAR	REL	V	83	AIR	*	STP	220	195052.73
60_SEC REL	AAR	REL	V	81	AIR	*	STP	220	195153.727
PRES_C REL	AAR	REL	V	81	AIR	*	STP	230	195212.726
60_SEC REL	AAR	REL	V	79	AIR	*	STP	220	195313.722
PRES_C REL	AAR	REL	V	78	AIR	*	STP	220	195331.721
60_SEC REL	AAR	REL	V	77	AIR	*	STP	220	195431.717
PRES_C REL	AAR	REL	V	77	AIR	*	STP	220	195448.716
60_SEC REL	AAR	REL	V	75	AIR	*	STP	220	195549.713
PRES_C REL	AAR	REL	V	74	AIR	*	STP	220	195558.712
BTSTRT REL	AAR	REL	V	74	AIR	*	STP	220	195628.71
SWSTRTRREL	AAR	REL	V	73	AIR	*	STP	230	195659.708
PRES_C REL	AAR	REL	V	73	AIR	*	STP	220	195720.707
60_SEC REL	AAR	REL	V	71	AIR	*	STP	220	195820.704



PRES_C REL	AAR	REL	V	71	AIR	*	STP	220	195845.702
60_SEC REL	AAR	REL	V	69	AIR	*	STP	220	195945.698
PRES_C REL	AAR	REL	V	68	AIR	*	STP	230	200011.697
60_SEC REL	AAR	REL	V	67	AIR	*	STP	230	200112.693
PRES_C REL	AAR	REL	V	66	AIR	*	STP	220	200135.692
60_SEC REL	AAR	REL	V	65	AIR	*	STP	220	200236.688
PRES_C REL	AAR	REL	V	65	AIR	*	STP	220	200304.687
CHRGSTREL	AAR	REL	V	65	AIR	*	STP	220	200306.686
CHRGSTREL	AAR	REL	V	64	AIR	*	STP	220	200307.686
CHRGSTREL	AAR	REL	V	64	AIR	*	STP	220	200309.686
CHRGSTREL	AAR	REL	V	64	AIR	*	STP	220	200311.686
60_SEC REL	AAR	REL	V	63	AIR	*	STP	220	200412.682
PRES_C REL	AAR	REL	V	62	AIR	*	STP	230	200438.681
60_SEC REL	AAR	REL	V	61	AIR	*	STP	220	200539.677
PRES_C REL	AAR	REL	V	61	AIR	*	STP	230	200617.675
60_SEC REL	AAR	REL	V	59	AIR	*	STP	220	200718.671
PRES_C REL	AAR	REL	V	59	AIR	*	STP	220	200757.669
60_SEC REL	AAR	REL	V	57	AIR	*	STP	220	200858.665
PRES_C REL	AAR	REL	V	57	AIR	*	STP	220	200938.663
60_SEC REL	AAR	REL	V	55	AIR	*	STP	220	201039.659
PRES_C REL	AAR	REL	V	54	AIR	*	STP	230	201126.657
BTSTRT REL	AAR	REL	V	54	AIR	*	STP	220	201137.656
SWSTRTREL	AAR	REL	V	54	AIR	*	STP	220	201207.654
60_SEC REL	AAR	REL	V	53	AIR	*	STP	220	201308.65
PRES_C REL	AAR	REL	V	53	AIR	*	STP	220	201314.65
60_SEC REL	AAR	REL	V	52	AIR	*	STP	220	201415.646
PRES_C REL	AAR	REL	V	51	AIR	*	STP	220	201506.643
60_SEC REL	AAR	REL	V	50	AIR	*	STP	220	201607.64
PRES_C REL	AAR	REL	V	49	AIR	*	STP	220	201701.637
60_SEC REL	AAR	REL	V	48	AIR	*	STP	220	201802.633
CHRGSTREL	AAR	REL	V	47	AIR	*	STP	220	201821.632
CHRGSTREL	AAR	REL	V	47	AIR	*	STP	220	201822.632
BTSTRT REL	AAR	REL	V	47	AIR	*	STP	220	201823.632
SWSTRTREL	AAR	REL	V	47	AIR	*	STP	220	201853.63
PRES_C REL	AAR	REL	V	46	AIR	*	STP	230	201900.629
CHRGSTREL	AAR	REL	V	46	AIR	*	STP	220	201924.628
CHRGSTREL	AAR	REL	V	46	AIR	*	STP	220	201929.628
60_SEC REL	AAR	REL	V	45	AIR	*	STP	220	202029.624
PRES_C REL	AAR	REL	V	45	AIR	*	STP	220	202101.622
60_SEC REL	AAR	REL	V	44	AIR	*	STP	220	202201.619
60_SEC REL	AAR	REL	V	43	AIR	*	STP	220	202302.615
PRES_C REL	AAR	REL	V	43	AIR	*	STP	220	202306.615
60_SEC REL	AAR	REL	V	42	AIR	*	STP	220	202406.611
CHRGSTREL	AAR	REL	V	41	AIR	*	STP	220	202505.608
CHRGSTREL	AAR	REL	V	41	AIR	*	STP	220	202510.607
BTSTRT REL	AAR	REL	V	41	AIR	*	STP	220	202511.607
PRES_C REL	AAR	REL	V	41	AIR	*	STP	220	202517.607
SWSTRTREL	AAR	REL	V	40	AIR	*	STP	220	202541.605
CHRGSTREL	AAR	REL	V	40	AIR	*	STP	220	202612.604
CHRGSTREL	AAR	REL	V	40	AIR	*	STP	220	202625.603
PRES_C REL	AAR	REL	V	38	AIR	*	STP	220	202722.599
60_SEC REL	AAR	REL	V	38	AIR	*	STP	210	202823.596
60_SEC REL	AAR	REL	V	37	AIR	*	STP	220	202923.592
PRES_C REL	AAR	REL	V	37	AIR	*	STP	220	202942.591
60_SEC REL	AAR	REL	V	36	AIR	*	STP	220	203042.588
60_SEC REL	AAR	REL	V	35	BAT	*	STP	210	203143.584
PRES_C REL	AAR	REL	V	35	BAT	*	STP	220	203207.582
60_SEC REL	AAR	REL	V	34	BAT	*	STP	210	203307.579
60_SEC REL	AAR	REL	V	33	BAT	*	STP	210	203408.575
PRES_C REL	AAR	REL	V	32	BAT	*	STP	220	203440.573
60_SEC REL	AAR	REL	V	32	BAT	*	STP	220	203540.57
60_SEC REL	AAR	REL	V	31	BAT	*	STP	210	203641.566
PRES_C REL	AAR	REL	V	31	BAT	*	STP	210	203734.563
60_SEC REL	AAR	REL	V	30	BAT	*	STP	220	203834.559
60_SEC REL	AAR	REL	V	29	BAT	*	STP	210	203935.556
60_SEC REL	AAR	REL	V	29	BAT	*	MOV	210	204035.552
PRES_C REL	AAR	REL	V	29	BAT	*	MOV	210	204055.551

60_SEC	REL	AAR	REL	V	28	BAT	*	MOV	220	204156.547
60_SEC	REL	AAR	REL	V	27	BAT	*	MOV	210	204256.544
60_SEC	REL	AAR	REL	V	27	BAT	*	MOV	220	204357.54
PRES_C	REL	AAR	REL	V	27	BAT	*	MOV	210	204428.538
60_SEC	REL	AAR	REL	V	26	BAT	*	MOV	210	204528.535
60_SEC	REL	AAR	REL	V	25	BAT	*	MOV	210	204629.531
60_SEC	REL	AAR	REL	H	25	BAT	*	MOV	210	204729.527
PRES_C	REL	AAR	REL	V	25	BAT	*	MOV	210	204803.525
60_SEC	REL	AAR	REL	V	24	BAT	*	MOV	210	204904.522
60_SEC	REL	AAR	REL	V	23	BAT	*	MOV	210	205004.518
60_SEC	REL	AAR	REL	V	23	BAT	*	MOV	210	205105.514
PRES_C	REL	AAR	REL	V	22	BAT	*	MOV	210	205132.513
60_SEC	REL	AAR	REL	V	22	BAT	*	MOV	210	205232.509
60_SEC	REL	AAR	REL	V	21	BAT	*	MOV	210	205333.506
PRES_C	REL	AAR	REL	V	21	BAT	*	MOV	210	205426.502
60_SEC	REL	AAR	REL	V	20	BAT	*	MOV	220	205526.499
60_SEC	REL	AAR	REL	H	19	BAT	*	MOV	210	205627.495
PRES_C	REL	AAR	REL	H	19	BAT	*	MOV	220	205645.494
PRES_C	REL	AAR	REL	V	16	BAT	*	MOV	210	205710.493
PRES_C	REL	AAR	REL	V	0	BAT	*	MOV	220	205714.492
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	210	205814.489
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	210	205915.485
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	210015.482
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	210116.478
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	210	210216.474
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	210316.471
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	210417.467
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	210517.464
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	210618.46
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	210718.456
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	210819.453
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	210919.449
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	211019.446
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	211120.442
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	211220.438
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	211321.435
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	211421.431
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	211521.427
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	211622.424
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	211722.42
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	211823.417
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	211923.413
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	212024.409
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	212124.406
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	212224.402
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	212325.399
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	212425.395
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	212526.391
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	212626.388
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	212726.384
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	212827.38
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	212927.377
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	213028.373
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	213128.37
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	213228.366
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	213329.362
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	213429.359
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	213530.355
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	213630.352
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	213731.348
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	213831.344
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	213931.341
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	214032.337
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	214132.334
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	214233.33
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	214333.326
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	214433.323

60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	214534.319
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	214634.316
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	214735.312
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	214835.308
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	214935.305
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	215036.301
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	215136.298
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	215237.294
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	215337.29
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	215438.287
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	215538.283
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	215638.279
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	215739.276
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	215839.272
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	215940.269
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	220040.265
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	220140.261
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	220241.258
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	220341.254
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	220442.251
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	220542.247
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	220642.243
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	220743.24
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	220843.236
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	220944.233
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	221044.229
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	221144.225
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	221245.222
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	221345.218
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	221446.214
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	221546.211
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	221646.207
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	221747.204
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	221847.2
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	221948.196
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	222048.193
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	222149.189
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	222249.186
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	222349.182
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	222450.178
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	222550.175
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	222651.171
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	222751.168
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	222851.164
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	222952.16
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	223052.157
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	223153.153
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	223253.15
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	223354.146
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	223454.142
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	223554.139
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	223655.135
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	223755.131
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	223856.128
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	223956.124
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	224056.121
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	224157.117
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	224257.113
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	224358.11
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	224458.106
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	224558.103
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	224659.099
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	224759.095
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	224900.092
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	225000.088
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	225101.085
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	225201.081

60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	225301.077
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	225402.074
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	225502.07
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	225603.066
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	225703.063
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	225803.059
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	225904.056
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	230004.052
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	230105.048
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	230205.045
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	230305.041
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	230406.038
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	230506.034
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	230607.03
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	230707.027
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	230808.023
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	230908.02
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	231008.016
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	231109.012
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	231209.009
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	231310.005
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	231410.002
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	231509.998
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	231610.994
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	231710.991
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	231811.987
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	231911.984
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	232011.98
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	232112.976
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	232212.973
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	232313.969
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	232413.965
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	232514.962
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	232614.958
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	232714.955
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	232815.951
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	232915.947
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	233016.944
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	233116.94
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	233216.937
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	233317.933
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	233417.929
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	233518.926
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	233618.922
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	233718.919
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	233819.915
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	233919.911
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	234020.908
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	234120.904
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	234220.901
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	234321.897
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	234421.893
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	234522.89
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	234622.886
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	234723.882
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	234823.879
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	234923.875
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	235024.872
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	235124.868
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	235225.864
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	235325.861
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	230	235425.857
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	235526.854
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	235626.85
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	235727.846
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	235827.843
60_SEC	REL	AAR	REL	V	0	BAT	*	STP	220	235928.839

60_SEC REL	AAR	REL	V	0	BAT	*	STP	220	28.836
60_SEC REL	AAR	REL	V	0	BAT	*	STP	230	128.832
60_SEC REL	AAR	REL	V	0	BAT	*	STP	220	229.828
60_SEC REL	AAR	REL	V	0	BAT	*	STP	220	329.825
60_SEC REL	AAR	REL	V	0	BAT	*	STP	230	430.821
60_SEC REL	AAR	REL	V	0	BAT	*	STP	220	530.817
60_SEC REL	AAR	REL	V	0	BAT	*	STP	220	630.814
60_SEC REL	AAR	REL	V	0	BAT	*	STP	230	731.81
60_SEC REL	AAR	REL	V	0	BAT	*	STP	230	831.807
60_SEC REL	AAR	REL	V	0	BAT	*	STP	220	932.803
60_SEC REL	AAR	REL	V	0	BAT	*	STP	230	1032.799
60_SEC REL	AAR	REL	V	0	BAT	*	STP	220	1132.796
60_SEC REL	AAR	REL	V	0	BAT	*	STP	230	1233.792
60_SEC REL	AAR	REL	V	0	BAT	*	STP	220	1333.789
60_SEC REL	AAR	REL	V	0	BAT	*	STP	220	1434.785
60_SEC REL	AAR	REL	V	0	BAT	*	STP	220	1534.781
60_SEC REL	AAR	REL	V	0	BAT	*	STP	220	1635.778
60_SEC REL	AAR	REL	V	0	BAT	*	STP	230	1735.774
60_SEC REL	AAR	REL	V	0	BAT	*	STP	230	1835.771
60_SEC REL	AAR	REL	V	0	BAT	*	STP	220	1936.767
60_SEC REL	AAR	REL	H	0	BAT	*	MOV	220	2036.763
60_SEC REL	AAR	REL	H	0	BAT	*	STP	230	2137.76
60_SEC REL	AAR	REL	H	0	BAT	*	MOV	220	2237.756
60_SEC REL	AAR	REL	H	0	BAT	*	MOV	220	2337.753
60_SEC REL	AAR	REL	H	0	BAT	*	MOV	220	2438.749
SLPLOG REL	AAR	REL	H	0	BAT	*	STP	220	2456.748
60_SEC REL	AAR	REL	H	0	BAT	o	STP	210	45.997
60_SEC REL	AAR	REL	H	0	BAT	*	STP	210	145.993
60_SEC REL	AAR	REL	H	0	BAT	*	STP	210	246.989
60_SEC REL	AAR	REL	H	0	BAT	*	STP	210	346.986
60_SEC REL	AAR	REL	H	0	BAT	*	STP	210	446.982
SLPLOG REL	AAR	REL	H	0	BAT	*	STP	210	446.982
SLPLOG REL	AAR	REL	H	0	BAT	o	STP	230	0
60_SEC REL	AAR	REL	H	0	BAT	o	STP	210	45.997
60_SEC REL	AAR	REL	H	0	BAT	*	STP	200	145.993
60_SEC REL	AAR	REL	H	0	BAT	*	STP	200	246.989
60_SEC REL	AAR	REL	H	0	BAT	*	STP	210	346.986
60_SEC REL	AAR	REL	H	0	BAT	*	STP	200	446.982
SLPLOG REL	AAR	REL	H	0	BAT	*	STP	200	446.982
60_SEC REL	AAR	REL	H	0	BAT	o	STP	200	45.997
60_SEC REL	AAR	REL	H	0	BAT	*	STP	210	145.993
60_SEC REL	AAR	REL	H	0	BAT	*	STP	210	246.989
60_SEC REL	AAR	REL	H	0	BAT	*	STP	210	346.986
60_SEC REL	AAR	REL	H	0	BAT	*	STP	210	446.982
SLPLOG REL	AAR	REL	H	0	BAT	*	STP	210	446.982
60_SEC REL	AAR	REL	H	0	BAT	o	STP	210	45.997
60_SEC REL	AAR	REL	H	0	BAT	*	STP	210	145.993
60_SEC REL	AAR	REL	H	0	BAT	*	STP	210	246.989
60_SEC REL	AAR	REL	H	0	BAT	*	STP	210	346.986
60_SEC REL	AAR	REL	H	0	BAT	*	STP	210	446.982

Appendix B: Standard Report Crossing 117.11

[40m[2J[1;1H[1m[32;45m[1;1HRue de la Gare  
 [37;40m[36;45m[1;61HTue 15:49 07-09-2013[37;40m[2;1H-----  
 -----[23;1H-----  
 [3;31H[4;31H[5;31H[6;31H[7;31H[8;31H[9;31H[10;31H[11;31H[12;31H[13;31H[14;31H[15;31H[  
 16;31H[17;31H[18;31H[19;31H[20;31H[21;31H[22;31H[33m[3;12HReports[37m[34;47m[5;1HA)  
 Standard Report [37;40m[6;1HB) Field Report [7;1HC) Configuration Report [8;1HD)  
 Incident Report [9;1HE) Repair History Report [10;1HF) Application Report [11;1HG)  
 Basic Report [12;1HH) Inspection Report [13;1HI) Version Report [14;1HJ)  
 GCP3000 Parameters [15;1HK) Bitmap Labels [16;1HL) Exit  
 [24;1H[K[33m[24;1HDisplays standard format event report[37m[3;32HEnter date/time range for the  
 report.[4;32HThe default is the last 24 hours.[5;32HEnter all zeros to view the entire event  
 buffer.[7;32HStart Date: [ 07-08-2013 ][2D[1D[1D[4D5[3C[10D07-05-2013 [7;32HStart Date: 07-05-  
 2013 [8;32HStart Time: [ 15:49:37 ][2D[1D[1D[2D[1D[2D[1D00[1C00[1C00[10D00:00:00 [8;32HStart  
 Time: 00:00:00 [9;32H End date: [ 07-09-2013 ][2D[12D07-09-2013 [9;32H End Date: 07-09-2013  
 [10;32H End time: [ 15:50:01 ][2D[10D15:50:01 [10;32H End Time: 15:50:01 [12;32H Format:  
 [ On Screen ]^v[17DOn Screen [13D[2DOn Screen  
 [14;32HSearching...[40m[2J[1;1H[1m[32;45m[1;1HStandard Event Report  
 [37;40m[36;45m[1;61HTue 15:50 07-09-2013[37;40m[2;1H-----  
 -----[23;1H-----  
 [3;1H[K[4;1H[K[5;1H[K[6;1H[K[7;1H[K[8;1H[K[9;1H[K[10;1H[K[11;1H[K[12;1H[K[13;1H[K[14;1H[K[  
 15;1H[K[16;1H[K[17;1H[K[18;1H[K[19;1H[K[20;1H[K[21;1H[K[22;1H[K[3;1H Site Name: Rue de la  
 Gare Time Zone: Eastern (-05:00)  
 Milepost: 117.11 Executive: 9V645-A01AB  
 DOT #: Tester: Crossing  
 CDL File: xr001c.cdl (XR001c)  
 Logic File: none  
 Label File: none

From: Fri 07-05-2013 00:00:00 To: Tue 07-09-2013 15:50:01

Fri 07-05-2013 08:50:36.07 XR1: DOWN  
 Fri 07-05-2013 08:50:36.16 main gcp1: T2 Detect  
 Fri 07-05-2013 08:50:36.16 main gcp1: Track 2 EZ 91  
 Fri 07-05-2013 08:50:36.24 CROSSING ACTIVE and NO PREEMPTION  
 Fri 07-05-2013 08:50:36.40 ISSCC: VII Off  
 Fri 07-05-2013 08:50:36.80 BELLK1: ON  
 Fri 07-05-2013 08:50:37.12 ISSCC: 1 L1 Flashing  
 Fri 07-05-2013 08:50:37.12 ISSCC: 1 L2 Flashing  
 Fri 07-05-2013 08:50:37.12 ISSCC: 2 L1 Flashing  
 Fri 07-05-2013 08:50:37.12 ISSCC: 2 L2 Flashing  
 Fri 07-05-2013 08:50:37.12 ISSCC: 1 Bell On  
 [24;1H[K[33m[24;1HTop of report. ESC = Exit DOWN = Next RIGHT =  
 End[37m[40m[2J[1;1H[1m[32;45m[1;1HRue de la Gare  
 [37;40m[36;45m[1;61HTue 15:54 07-09-2013[37;40m[2;1H-----  
 -----[23;1H-----

[3;31H[4;31H[5;31H[6;31H[7;31H[8;31H[9;31H[10;31H[11;31H[12;31H[13;31H[14;31H[15;31H[  
 16;31H[17;31H[18;31H[19;31H[20;31H[21;31H[22;31H[33m[3;12HReports[37m[34;47m[5;1HA)  
 Standard Report [37;40m[6;1HB) Field Report [7;1HC) Configuration Report [8;1HD)  
 Incident Report [9;1HE) Repair History Report [10;1HF) Application Report [11;1HG)  
 Basic Report [12;1HH) Inspection Report [13;1HI) Version Report [14;1HJ)  
 GCP3000 Parameters [15;1HK) Bitmap Labels [16;1HL) Exit  
 [24;1H[K[33m[24;1HDisplays standard format event report[37m[3;32HEnter date/time range for the  
 report.[4;32HThe default is the last 24 hours.[5;32HEnter all zeros to view the entire event  
 buffer.[7;32HStart Date: [ 07-08-2013 ][2D[1D[1D[4D[1D05[3C[10D07-05-2013 [7;32HStart Date: 07-  
 05-2013 [8;32HStart Time: [ 15:54:58 ][2D[10D15:54:58 [8;32HStart Time: 15:54:58 [9;32H End

date: [ 07-09-2013 ][2D[12D07-09-2013 [9;32H End Date: 07-09-2013 [10;32H End time: [ 15:55:06  
 ][2D[10D15:55:06 [10;32H End Time: 15:55:06 [12;32H Format: [ On Screen ]^v[17DOn  
 Screen [13D[2DOn Screen [14;32HSearching...[40m[2J[1;1H[1m[32;45m[1;1HStandard Event  
 Report [37;40m[36;45m[1;61HTue 15:55 07-09-2013[37;40m[2;1H----  
 -----[23;1H-----

[3;1H[K[4;1H[K[5;1H[K[6;1H[K[7;1H[K[8;1H[K[9;1H[K[10;1H[K[11;1H[K[12;1H[K[13;1H[K[14;1H[K  
 [15;1H[K[16;1H[K[17;1H[K[18;1H[K[19;1H[K[20;1H[K[21;1H[K[22;1H[K[3;1H Site Name: Rue de la  
 Gare Time Zone: Eastern (-05:00)  
 Milepost: 117.11 Executive: 9V645-A01AB  
 DOT #: Tester: Crossing  
 CDL File: xr001c.cdl (XR001c)  
 Logic File: none  
 Label File: none

From: Fri 07-05-2013 15:54:58 To: Tue 07-09-2013 15:55:06

**Sat 07-06-2013 01:19:29.45 AC/POK: OFF**

Sat 07-06-2013 01:19:29.48 AC POWER OFF FOR 3859 min MINUTES

Sat 07-06-2013 01:19:29.70 TRBL LITE: OFF

Sat 07-06-2013 01:19:30.98 XR1: DOWN

**Sat 07-06-2013 01:19:31.04 main gcp1: T2 Detect**

Sat 07-06-2013 01:19:31.04 main gcp1: Track 2 EZ 42

Sat 07-06-2013 01:19:31.28 TRAIN MOVE WHILE AC POWER OFF

Sat 07-06-2013 01:19:31.31 CROSSING ACTIVE and NO PREEMPTION

Sat 07-06-2013 01:19:31.33 1SSCC: VII Off

Sat 07-06-2013 01:19:31.64 BELLK1: ON

Sat 07-06-2013 01:19:31.97 1SSCC: 1 L1 Flashing

[24;1H[K[33m[24;1HTop of report. ESC = Exit DOWN = Next RIGHT =

End[37m[3;1H[K[4;1H[K[5;1H[K[6;1H[K[7;1H[K[8;1H[K[9;1H[K[10;1H[K[11;1H[K[12;1H[K[13;1H[K  
 [14;1H[K[15;1H[K[16;1H[K[17;1H[K[18;1H[K[19;1H[K[20;1H[K[21;1H[K[22;1H[K[3;1HSat 07-06-

2013 01:19:31.97 1SSCC: 1 L2 Flashing

Sat 07-06-2013 01:19:31.97 1SSCC: 2 L1 Flashing

Sat 07-06-2013 01:19:31.97 1SSCC: 2 L2 Flashing

Sat 07-06-2013 01:19:31.97 1SSCC: 1 Bell On

Sat 07-06-2013 01:19:31.97 1SSCC: 2 Bell On

Sat 07-06-2013 01:19:31.97 1SSCC: 2 GC De-energized

Sat 07-06-2013 01:19:32.30 FR: DOWN

Sat 07-06-2013 01:19:32.86 NXT: DOWN

Sat 07-06-2013 01:19:33.06 main gcp1: Track 2 Warn Time 1

Sat 07-06-2013 01:19:33.06 main gcp1: Track 2 Det Speed 58

**Sat 07-06-2013 01:19:33.06 main gcp1: Track 2 Avg Speed 58**

Sat 07-06-2013 01:19:33.06 main gcp1: Track 2 Isl Speed 58

Sat 07-06-2013 01:19:33.12 WARN TIME TK1 IGNORED: 2 sec

Sat 07-06-2013 01:19:33.19 ISLAND NO GATE - HIRAIL

Sat 07-06-2013 01:19:33.23 1SSCC: VI2 Off

Sat 07-06-2013 01:19:33.23 1SSCC: VI3 Off

Sat 07-06-2013 01:19:33.48 main gcp1: Island 1 Down

Sat 07-06-2013 01:19:33.90 main gcp1: Island 2 Down

Sat 07-06-2013 01:19:33.91 main gcp1: Track 2 EZ 16

Sat 07-06-2013 01:19:33.91 main gcp1: Track 2 EX 98

[24;1H[K[33m[24;1HESC - Exit DOWN = Next UP = Prev RIGHT = End LEFT =

Start[37m[3;1H[K[4;1H[K[5;1H[K[6;1H[K[7;1H[K[8;1H[K[9;1H[K[10;1H[K[11;1H[K[12;1H[K[13;1H[K  
 K[14;1H[K[15;1H[K[16;1H[K[17;1H[K[18;1H[K[19;1H[K[20;1H[K[21;1H[K[22;1H[K[3;1HSat 07-06-

2013 01:19:40.22 NXT: UP

Sat 07-06-2013 01:19:40.56 main gcp1: Island 1 Up

Sat 07-06-2013 01:19:40.56 main gcp1: Track 1 EX 94

Sat 07-06-2013 01:19:40.63 1SSCC: VI2 On

Sat 07-06-2013 01:19:40.63 1SSCC: VI3 On

Sat 07-06-2013 01:19:40.98 main gcp1: Island 2 Up

Sat 07-06-2013 01:19:41.24 XB12: 15.1 V  
 Sat 07-06-2013 01:19:41.47 XR1: UP  
 Sat 07-06-2013 01:19:41.48 main gcp1: T1 Prime Timeout  
 Sat 07-06-2013 01:19:41.48 main gcp1: Track 1 EZ 6  
 Sat 07-06-2013 01:19:41.79 GC: DOWN  
 Sat 07-06-2013 01:19:41.85 1SSCC: VI1 On  
 Sat 07-06-2013 01:19:41.90 main gcp1: T2 Prime Timeout  
 Sat 07-06-2013 01:19:41.90 main gcp1: Track 2 EX 99  
 Sat 07-06-2013 01:19:42.19 1SSCC: 1 GC De-energized  
 Sat 07-06-2013 01:19:43.09 GP: DOWN  
 Sat 07-06-2013 01:19:43.45 1SSCC: VI8 Off  
 Sat 07-06-2013 01:19:49.05 B12: 12.7 V  
 Sat 07-06-2013 01:19:50.33 GD1: DOWN  
 Sat 07-06-2013 01:19:50.33 GD2: DOWN  
 [24;1H[K[33m[24;1HESC - Exit DOWN = Next UP = Prev RIGHT = End LEFT =  
 Start[37m[3;1H[K[4;1H[K[5;1H[K[6;1H[K[7;1H[K[8;1H[K[9;1H[K[10;1H[K[11;1H[K[12;1H[K[13;1H[K[14;1H[K[15;1H[K[16;1H[K[17;1H[K[18;1H[K[19;1H[K[20;1H[K[21;1H[K[22;1H[K[3;1H[Sat 07-06-2013 01:19:58.86 XB12: 14.5 V  
 Sat 07-06-2013 01:19:58.87 GC: UP  
 Sat 07-06-2013 01:19:58.88 BELLK1: OFF  
 Sat 07-06-2013 01:19:59.05 FR: UP  
 Sat 07-06-2013 01:19:59.22 1SSCC: 2 Bell Off  
 Sat 07-06-2013 01:19:59.22 1SSCC: 2 GC Energized  
 Sat 07-06-2013 01:19:59.44 1SSCC: 1 Bell Off  
 Sat 07-06-2013 01:19:59.44 1SSCC: 1 GC Energized  
 Sat 07-06-2013 01:19:59.64 GD1: NOT DOWN  
 Sat 07-06-2013 01:19:59.65 GD2: NOT DOWN  
 Sat 07-06-2013 01:20:04.50 GP: UP  
 Sat 07-06-2013 01:20:04.96 1SSCC: VI8 On  
 Sat 07-06-2013 01:20:06.16 1SSCC: 1 L1 Off  
 Sat 07-06-2013 01:20:06.16 1SSCC: 1 L2 Off  
 Sat 07-06-2013 01:20:06.16 1SSCC: 2 L1 Off  
 Sat 07-06-2013 01:20:06.17 1SSCC: 2 L2 Off  
 Sat 07-06-2013 01:21:22.54 B12: 12.2 V  
 Sat 07-06-2013 03:18:41.79 B12: 11.7 V  
 Sat 07-06-2013 07:00:41.29 XB12: 14.0 V  
 Sat 07-06-2013 07:00:52.16 XB12 Low Voltage: 14.0 VDC  
 [24;1H[K[33m[24;1HESC - Exit DOWN = Next UP = Prev RIGHT = End LEFT =  
 Start[37m[3;1H[K[4;1H[K[5;1H[K[6;1H[K[7;1H[K[8;1H[K[9;1H[K[10;1H[K[11;1H[K[12;1H[K[13;1H[K[14;1H[K[15;1H[K[16;1H[K[17;1H[K[18;1H[K[19;1H[K[20;1H[K[21;1H[K[22;1H[K[3;1H[Sat 07-06-2013 07:15:43.06 Int. Temp: 95 F  
 Sat 07-06-2013 13:02:39.77 Int. Temp: 100 F  
 Sat 07-06-2013 13:48:10.80 B12: 11.2 V  
 Sat 07-06-2013 13:48:21.28 B12 Low voltage: 11.2 VDC  
 Sat 07-06-2013 15:57:38.09 Int. Temp: 106 F  
 Sat 07-06-2013 22:22:32.65 XB12: 13.5 V  
 Sat 07-06-2013 23:45:58.28 Int. Temp: 100 F  
 Sun 07-07-2013 05:11:13.71 Int. Temp: 95 F  
 Sun 07-07-2013 10:14:34.25 Int. Temp: 100 F  
 Sun 07-07-2013 12:22:20.23 Int. Temp: 106 F  
 Sun 07-07-2013 15:36:33.87 Int. Temp: 111 F  
 Sun 07-07-2013 20:12:30.23 Int. Temp: 106 F  
 Sun 07-07-2013 23:07:38.16 Int. Temp: 100 F  
 Mon 07-08-2013 04:05:12.28 Int. Temp: 95 F  
 Mon 07-08-2013 13:29:43.94 Int. Temp: 100 F  
 Mon 07-08-2013 15:35:37.73 Int. Temp: 106 F  
 Mon 07-08-2013 23:36:06.12 Int. Temp: 100 F  
 Tue 07-09-2013 02:58:22.52 Int. Temp: 95 F  
 Tue 07-09-2013 11:22:49.70 Int. Temp: 100 F  
 Tue 07-09-2013 15:42:58.85 Terminal login, USER port



[24;1H[K[33m[24;1HESC - Exit DOWN = Next UP = Prev RIGHT = End LEFT =  
Start[37m[3;1H[K[4;1H[K[5;1H[K[6;1H[K[7;1H[K[8;1H[K[9;1H[K[10;1H[K[11;1H[K[12;1H[K[13;1H[K  
K[14;1H[K[15;1H[K[16;1H[K[17;1H[K[18;1H[K[19;1H[K[20;1H[K[21;1H[K[22;1H[K[3;1HTue 07-09-  
2013 15:46:48.73 Terminal logout, USER port  
Tue 07-09-2013 15:48:31.49 Terminal login, USER port  
Tue 07-09-2013 15:48:56.65 Standard event report viewed  
Tue 07-09-2013 15:50:08.95 Standard event report viewed  
[24;1H[K[33m[24;1HEnd of report. ESC = Exit UP = Prev LEFT =  
Start[37m[40m[2J[1;1H[1m[32;45m[1;1HRue de la Gare  
[37;40m[36;45m[1;61HTue 15:55 07-09-2013[37;40m[2;1H-----  
-----[23;1H-----  
[3;31H[4;31H[5;31H[6;31H[7;31H[8;31H[9;31H[10;31H[11;31H[12;31H[13;31H[14;31H[15;31H[  
16;31H[17;31H[18;31H[19;31H[20;31H[21;31H[22;31H[33m[3;12HReports[37m[34;47m[5;1HA)  
Standard Report [37;40m[6;1HB) Field Report [7;1HC) Configuration Report [8;1HD)  
Incident Report [9;1HE) Repair History Report [10;1HF) Application Report [11;1HG)  
Basic Report [12;1HH) Inspection Report [13;1HI) Version Report [14;1HJ)  
GCP3000 Parameters [15;1HK) Bitmap Labels [16;1HL) Exit  
[24;1H[K[33m[24;1HDisplays standard format event report[37m

### Appendix C: Calculated Locations of Vehicles in Train MMA-002

No	Car no.		Length	Distance to head	Locations at times					
					22:43:26	22:49:12	1:15:30	1:17:12	2:46:23	2:46:42
			ft	ft	Start auto-brake	Rest	Derailement /separation	First stop	Recontact	Final stop
L1	MMA	5017	67	0	8.01	6.72	0.11	116.30	116.39	116.41
1	VB	1	50	67	8.023	6.733	0.123	116.313	116.403	116.423
L2	MMA	5026	67	117	8.032	6.742	0.132	116.322	116.412	116.432
L3	CITX	3053	68	184	8.045	6.755	0.145	loco part 1	116.425	116.445
L4	MMA	5023	67	252	8.058	6.768	0.158		116.438	116.458
L5	CEFX	3166	68	319	8.071	6.781	0.171		116.451	116.471
2	CIBX	172032	69	387	8.084	6.794	0.184	entire loco consist		
3	TILX	316547	59	456	8.097	6.807	0.197			
4	WFIX	130608	59	515	8.108	6.818	0.208			
5	TILX	316359	59	574	8.119	6.829	0.219			
6	TILX	316338	59	633	8.13	6.84	0.23	switch at mile 0.227		
7	NATX	310428	59	692	8.141	6.851	0.241	crossing at mile 0.269		
8	CTCX	735541	59	751	8.152	6.862	0.252	curve mile 0.053 to 0.28		
9	DBUX	303879	59	810	8.163	6.873	0.263			
10	WFIX	130682	59	869	8.174	6.884	0.274			
11	TILX	316641	59	928	8.185	6.895	0.285			
12	TILX	316570	59	987	8.196	6.906	0.296			
13	NATX	310457	59	1046	8.207	6.917	0.307			
14	WFIX	130638	59	1105	8.218	6.928	0.318			
15	NATX	310473	59	1164	8.229	6.939	0.329			
16	TILX	316379	59	1223	8.24	6.95	0.34			
17	ACFX	79709	59	1282	8.251	6.961	0.351			
18	TILX	316333	59	1341	8.262	6.972	0.362			
19	TILX	316549	59	1400	8.273	6.983	0.373			
20	CTCX	735527	59	1459	8.284	6.994	0.384			
21	NATX	310477	59	1518	8.295	7.005	0.395			
22	WFIX	130603	59	1577	8.306	7.016	0.406			
23	TILX	316556	59	1636	8.317	7.027	0.417			
24	CTCX	735629	59	1695	8.328	7.038	0.428			
25	ACFX	76605	59	1754	8.339	7.049	0.439			
26	PROX	44293	55	1813	8.35	7.06	0.45			
27	NATX	310581	59	1868	8.36	7.07	0.46			
28	PROX	44202	55	1927	8.371	7.081	0.471			
29	TILX	316234	59	1982	8.381	7.091	0.481			
30	TILX	316584	59	2041	8.392	7.102	0.492			
31	WFIX	130571	59	2100	8.403	7.113	0.503			
32	TILX	316330	59	2159	8.414	7.124	0.514			
33	NATX	310412	59	2218	8.425	7.135	0.525			
34	TILX	316317	59	2277	8.436	7.146	0.536			
35	WFIX	130545	59	2336	8.447	7.157	0.547			
36	ACFX	79698	59	2395	8.458	7.168	0.558			
37	NATX	302784	59	2454	8.469	7.179	0.569			
38	ACFX	71505	59	2513	8.48	7.19	0.58			
39	ACFX	71121	59	2572	8.491	7.201	0.591			
40	CTCX	735537	59	2631	8.502	7.212	0.602			
41	NATX	303128	59	2690	8.513	7.223	0.613			
42	CTCX	735572	59	2749	8.524	7.234	0.624			
43	WFIX	130616	59	2808	8.535	7.245	0.635			

