



OPERATIONAL SERVICES BRANCH
ENGINEERING LABORATORY REPORT

LP132/2013

End of Train Telemetry Download and Analysis

Montreal, Maine & Atlantic Railway, Train MMA-002

Date of Occurrence: 06-Jul-2013

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PREPARED BY

L. Landriault (Senior Engineering Systems Technologist)

APPROVED BY

D. Gagné (A/Manager, Systems and Engineering Sciences)

RELEASED BY

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

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1.0 INTRODUCTION

1.1 Description of Occurrence

1.1.1 On 6 July 2013, at approximately 0115 Eastern Daylight Time (EDT) a freight train operated by Montreal, Maine & Atlantic Railway (MMA), designation MMA-02, derailed in the town of Lac-Mégantic, Quebec. Tank cars loaded with crude oil caught fire destroying many buildings and causing 47 fatalities.

1.2 Engineering Services Requested

1.2.1 Transportation Safety Board of Canada (TSB) rail investigators responded to the occurrence. They recovered an end-of-train sense and brake unit (SBU, also referred to as an end-of-train telemetry system), which was delivered to the TSB Engineering Laboratory along with a request to extract all relevant data from its non-volatile memory (NVM).

1.3 Parts Received

Table 1: Parts Received

| Item | Manufacturer | Part Number | Serial Number |
|------|----------------------------|-------------|---------------|
| SBU | Wabtec Railway Electronics | 23743 | 0434004 |

2.0 EXAMINATION AND DATA EXTRACTION

2.1 An external examination of the Wabtec Railway Electronics SBU (Figure 1) revealed only damage that was consistent with normal operation in the rail environment. An internal examination did not reveal any damage to the electrical and electronic components housed in the SBU.

2.2 Through consultation with Wabtec Railway Electronics, it was determined that this SBU had non-volatile memory (NVM) that retained data considered relevant to the investigation of this occurrence (Appendix A). Wabtec supplied the TSB Engineering Laboratory with the hardware, ¹ procedures and information required to download and interpret ² the data retained by the SBU's NVM.

2.3 The hardware and procedures provided by Wabtec were used to successfully download the data from the SBU's NVM. The data consisted of 7213 records, each consisting of 27 data fields (Appendix B).

2.4 The data were transferred to an Excel spreadsheet and, along with the Wabtec interpretation information, were provided to the TSB Engineering Laboratory Recorders group for analysis under LP136/2013 "LER Data Retrieval and Analysis".

¹ Wabtec Railway Electronics referred to the hardware required to download these data as TLK-NG-TESTER WPN 24062.

² Wabtec Railway Electronics, "EOT Data Flash Log Download and Analysis", 15 July 2013.

3.0 CONCLUSION

- 3.1 The data retained by the Wabtec Railway Electronics SBU were successfully extracted.



Figure 1: Wabtec Railway Electronics SBU as received

Appendix A: Data Stored in Wabtec Railway Electronics SBU

Table A-1: SBU Data Description

| Column | Column Identifiers |
|--------|--|
| 1 | Message Type ID |
| 2 | Pneumatic Mode |
| 3 | Service Status |
| 4 | Valve State |
| 5 | Head Equalizing Reservoir Pressure |
| 6 | Target Pressure |
| 7 | Battery Status |
| 8 | Sleep Reason |
| 9 | Tilt Indicator |
| 10 | Rear Brake Pipe Pressure: EOT Air Pressure in psi |
| 11 | Generator Voltage (0 – 40 volts): (e.g. 245 = 24.5V) |
| 12 | +V Main Voltage (e.g. 145 = 14.5V) |
| 13 | Battery Voltage (e.g. 145 = 14.5V) |
| 14 | Last Battery Test Stored Voltage (e.g. 145 = 14.5V) |
| 15 | Battery Current Value (mA x 10, e.g. +3 = 30mA) |
| 16 | Charge State (Hold, Trickle, Fast, Float) |
| 17 | EOT Mode Indicator (Bit indicates if Data was Acquired in Air or Batter Mode) |
| 18 | HVM Status (* = ON, o = OFF) |
| 19 | Motion Status (MOV = Moving, STP = Stopped) |
| 20 | Temperature (e.g. +235 = 23.5 Degrees Celsius) |
| 21 | UTC Time: UTC Time or Elapsed Time Timer Value and Day Counter Value if no GPS Installed (hhmmss.ss) |
| 22 | Latitude: (ddmm.mmmm) |
| 23 | Hemisphere: (N = North, S = South) |
| 24 | Longitude: (ddmm.mmmm) |
| 25 | Hemisphere: (E = East, W = West) |
| 26 | Position Fix / Validity: (1 = Valid, 0 = Invalid) |
| 27 | UTC Date: (ddmmyy) |

Note: Additional information describing data field (column) options can be found in the Wabtec document “EOT Data Flash Log Download and Analysis”. Also no GPS module was installed in the SBU; therefore, data in columns 22 through to 26 are not valid.

Appendix B: Wabtec Railway Electronics SBU Data

Table B-1: SBU Sample Data

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 |
|--------|-----|-----|-----|---|---|---|---|---|----|----|-----|-----|-----|-----|------|-----|----|-----|-----|-----------|----|----|----|----|----|--------|
| PRES_C | REL | AAR | REL | X | X | G | A | V | 80 | 17 | 131 | 131 | 126 | 20 | FAST | AIR | * | MOV | 150 | 33400.232 | 0 | N | 0 | E | 0 | 201122 |
| PRES_C | REL | AAR | REL | X | X | G | A | V | 78 | 18 | 131 | 130 | 126 | 16 | FAST | AIR | * | MOV | 150 | 33405.232 | 0 | N | 0 | E | 0 | 201122 |
| PRES_C | REL | AAR | REL | X | X | G | A | V | 76 | 17 | 130 | 130 | 126 | 15 | FAST | AIR | * | MOV | 150 | 33408.232 | 0 | N | 0 | E | 0 | 201122 |
| PRES_C | REL | AAR | REL | X | X | G | A | V | 74 | 18 | 130 | 130 | 126 | 8 | FAST | AIR | * | MOV | 150 | 33412.231 | 0 | N | 0 | E | 0 | 201122 |
| PRES_C | REL | AAR | REL | X | X | G | A | V | 72 | 19 | 130 | 129 | 126 | 16 | FAST | AIR | * | MOV | 140 | 33442.23 | 0 | N | 0 | E | 0 | 201122 |
| PRES_C | REL | AAR | REL | X | X | G | A | V | 76 | 19 | 130 | 130 | 126 | 17 | FAST | AIR | * | MOV | 150 | 33454.229 | 0 | N | 0 | E | 0 | 201122 |
| PRES_C | REL | AAR | REL | X | X | G | A | V | 80 | 18 | 130 | 130 | 126 | 17 | FAST | AIR | * | MOV | 150 | 33455.229 | 0 | N | 0 | E | 0 | 201122 |
| PRES_C | REL | AAR | REL | X | X | G | A | V | 81 | 17 | 130 | 129 | 126 | 18 | FAST | AIR | * | MOV | 150 | 33455.229 | 0 | N | 0 | E | 0 | 201122 |
| PRES_C | REL | AAR | REL | X | X | G | A | V | 82 | 20 | 129 | 129 | 126 | 13 | FAST | AIR | * | MOV | 150 | 33504.228 | 0 | N | 0 | E | 0 | 201122 |
| PRES_C | REL | AAR | REL | X | X | G | A | V | 84 | 21 | 129 | 129 | 126 | 18 | FAST | AIR | * | MOV | 150 | 33513.228 | 0 | N | 0 | E | 0 | 201122 |
| PRES_C | REL | AAR | REL | X | X | G | A | V | 86 | 20 | 131 | 130 | 126 | 25 | FAST | AIR | * | MOV | 150 | 33527.227 | 0 | N | 0 | E | 0 | 201122 |
| PRES_C | REL | AAR | REL | X | X | G | A | V | 84 | 20 | 131 | 131 | 126 | 26 | FAST | AIR | * | MOV | 150 | 33544.226 | 0 | N | 0 | E | 0 | 201122 |
| PRES_C | REL | AAR | REL | X | X | G | A | V | 81 | 19 | 131 | 131 | 126 | 27 | FAST | AIR | * | MOV | 150 | 33547.226 | 0 | N | 0 | E | 0 | 201122 |
| PRES_C | REL | AAR | REL | X | X | G | A | V | 79 | 18 | 131 | 131 | 126 | 26 | FAST | AIR | * | MOV | 150 | 33549.226 | 0 | N | 0 | E | 0 | 201122 |
| PRES_C | REL | AAR | REL | X | X | G | A | V | 78 | 17 | 131 | 131 | 126 | 25 | FAST | AIR | * | MOV | 150 | 33552.225 | 0 | N | 0 | E | 0 | 201122 |
| PRES_C | REL | AAR | REL | X | X | G | A | V | 81 | 20 | 130 | 130 | 126 | 23 | FAST | AIR | * | MOV | 150 | 33632.223 | 0 | N | 0 | E | 0 | 201122 |
| PRES_C | REL | AAR | REL | X | X | G | A | V | 83 | 20 | 130 | 130 | 126 | 21 | FAST | AIR | * | MOV | 150 | 33640.223 | 0 | N | 0 | E | 0 | 201122 |
| PRES_C | REL | AAR | REL | X | X | G | A | V | 85 | 20 | 130 | 130 | 126 | 20 | FAST | AIR | * | MOV | 150 | 33648.222 | 0 | N | 0 | E | 0 | 201122 |
| PRES_C | REL | AAR | REL | X | X | G | A | V | 86 | 20 | 131 | 131 | 126 | 32 | FAST | AIR | * | MOV | 150 | 33709.221 | 0 | N | 0 | E | 0 | 201122 |
| 60_SEC | REL | AAR | REL | X | X | G | A | V | 88 | 18 | 132 | 132 | 126 | 34 | FAST | AIR | * | MOV | 150 | 33809.217 | 0 | N | 0 | E | 0 | 201122 |
| PRES_C | REL | AAR | REL | X | X | G | A | V | 88 | 20 | 132 | 132 | 126 | 29 | FAST | AIR | * | MOV | 150 | 33835.216 | 0 | N | 0 | E | 0 | 201122 |
| 60_SEC | REL | AAR | REL | X | X | G | A | V | 89 | 20 | 132 | 132 | 126 | 27 | FAST | AIR | * | MOV | 140 | 33935.212 | 0 | N | 0 | E | 0 | 201122 |
| BTWSTR | REL | AAR | REL | X | X | G | A | V | 89 | 21 | 132 | 132 | 126 | 23 | FAST | AIR | * | MOV | 150 | 33941.212 | 0 | N | 0 | E | 0 | 201122 |
| SWWSTR | REL | AAR | REL | X | X | G | A | V | 89 | 33 | 127 | 127 | 127 | -8 | FAST | AIR | * | MOV | 150 | 34012.21 | 0 | N | 0 | E | 0 | 201122 |
| 60_SEC | REL | AAR | REL | X | X | G | A | V | 89 | 31 | 133 | 127 | 127 | 9 | FAST | AIR | * | MOV | 150 | 34112.206 | 0 | N | 0 | E | 0 | 201122 |
| 60_SEC | REL | AAR | REL | X | X | G | A | V | 89 | 20 | 132 | 132 | 127 | 35 | FAST | AIR | * | MOV | 150 | 34213.203 | 0 | N | 0 | E | 0 | 201122 |
| 60_SEC | REL | AAR | REL | X | X | G | A | V | 89 | 19 | 133 | 133 | 127 | 31 | FAST | AIR | * | MOV | 150 | 34313.199 | 0 | N | 0 | E | 0 | 201122 |
| PRES_C | REL | AAR | REL | X | X | G | A | V | 86 | 20 | 132 | 132 | 127 | 28 | FAST | AIR | * | MOV | 150 | 34337.198 | 0 | N | 0 | E | 0 | 201122 |
| PRES_C | REL | AAR | REL | X | X | G | A | V | 84 | 19 | 133 | 132 | 127 | 30 | FAST | AIR | * | MOV | 150 | 34340.197 | 0 | N | 0 | E | 0 | 201122 |
| PRES_C | REL | AAR | REL | X | X | G | A | V | 83 | 19 | 132 | 132 | 127 | 23 | FAST | AIR | * | MOV | 150 | 34351.197 | 0 | N | 0 | E | 0 | 201122 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 60_SEC | REL | AAR | REL | X | X | G | A | H | 0 | 0 | 121 | 121 | 121 | -11 | TRKL | BAT | * | MOV | 220 | 2036.763 | 0 | N | 0 | E | 0 | 211122 |
| 60_SEC | REL | AAR | REL | X | X | G | A | H | 0 | 0 | 121 | 121 | 121 | -11 | TRKL | BAT | * | STP | 230 | 2137.76 | 0 | N | 0 | E | 0 | 211122 |
| 60_SEC | REL | AAR | REL | X | X | G | A | H | 0 | 0 | 121 | 121 | 121 | -21 | TRKL | BAT | * | MOV | 220 | 2237.756 | 0 | N | 0 | E | 0 | 211122 |
| 60_SEC | REL | AAR | REL | X | X | G | A | H | 0 | 0 | 121 | 121 | 121 | -10 | TRKL | BAT | * | MOV | 220 | 2337.753 | 0 | N | 0 | E | 0 | 211122 |
| 60_SEC | REL | AAR | REL | X | X | G | A | H | 0 | 0 | 121 | 121 | 121 | -32 | TRKL | BAT | * | MOV | 220 | 2438.749 | 0 | N | 0 | E | 0 | 211122 |
| SLPLOG | REL | AAR | REL | X | X | G | T | H | 0 | 0 | 120 | 121 | 121 | -32 | TRKL | BAT | * | STP | 220 | 2456.748 | 0 | N | 0 | E | 0 | 211122 |
| 60_SEC | REL | AAR | REL | X | X | D | A | H | 0 | 24 | 119 | 118 | 118 | -10 | TRKL | BAT | o | STP | 210 | 45.997 | 0 | N | 0 | E | 0 | 201122 |
| 60_SEC | REL | AAR | REL | X | X | D | A | H | 0 | 24 | 117 | 118 | 118 | -34 | TRKL | BAT | * | STP | 210 | 145.993 | 0 | N | 0 | E | 0 | 201122 |
| 60_SEC | REL | AAR | REL | X | X | D | A | H | 0 | 23 | 117 | 118 | 118 | -10 | TRKL | BAT | * | STP | 210 | 246.989 | 0 | N | 0 | E | 0 | 201122 |
| 60_SEC | REL | AAR | REL | X | X | D | A | H | 0 | 3 | 118 | 117 | 117 | -21 | TRKL | BAT | * | STP | 210 | 346.986 | 0 | N | 0 | E | 0 | 431122 |
| 60_SEC | REL | AAR | REL | X | X | D | A | H | 0 | 1 | 118 | 118 | 118 | -10 | TRKL | BAT | * | STP | 210 | 446.982 | 0 | N | 0 | E | 0 | 201122 |
| SLPLOG | REL | AAR | REL | X | X | D | H | H | 0 | 1 | 118 | 118 | 118 | -10 | TRKL | BAT | * | STP | 210 | 446.982 | 0 | N | 0 | E | 0 | 201122 |
| SLPLOG | REL | AAR | REL | X | X | D | E | H | 0 | 10 | 124 | 126 | 128 | -7 | TRKL | BAT | o | STP | 230 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 60_SEC | REL | AAR | REL | X | X | D | A | H | 0 | 23 | 124 | 123 | 123 | -9 | TRKL | BAT | o | STP | 210 | 45.997 | 0 | N | 0 | E | 0 | 201122 |
| 60_SEC | REL | AAR | REL | X | X | D | A | H | 0 | 23 | 123 | 123 | 123 | -10 | TRKL | BAT | * | STP | 200 | 145.993 | 0 | N | 0 | E | 0 | 201122 |
| 60_SEC | REL | AAR | REL | X | X | D | A | H | 0 | 23 | 123 | 123 | 123 | -44 | TRKL | BAT | * | STP | 200 | 246.989 | 0 | N | 0 | E | 0 | 201122 |
| 60_SEC | REL | AAR | REL | X | X | D | A | H | 0 | 0 | 122 | 123 | 123 | -11 | TRKL | BAT | * | STP | 210 | 346.986 | 0 | N | 0 | E | 0 | 201122 |
| 60_SEC | REL | AAR | REL | X | X | D | A | H | 0 | 0 | 123 | 122 | 122 | -11 | TRKL | BAT | * | STP | 200 | 446.982 | 0 | N | 0 | E | 0 | 201122 |
| SLPLOG | REL | AAR | REL | X | X | D | H | H | 0 | 0 | 123 | 122 | 122 | -11 | TRKL | BAT | * | STP | 200 | 446.982 | 0 | N | 0 | E | 0 | 201122 |
| 60_SEC | REL | AAR | REL | X | X | D | A | H | 0 | 23 | 124 | 123 | 123 | -9 | TRKL | BAT | o | STP | 200 | 45.997 | 0 | N | 0 | E | 0 | 201122 |
| 60_SEC | REL | AAR | REL | X | X | D | A | H | 0 | 23 | 123 | 123 | 123 | -9 | TRKL | BAT | * | STP | 210 | 145.993 | 0 | N | 0 | E | 0 | 201122 |
| 60_SEC | REL | AAR | REL | X | X | D | A | H | 0 | 0 | 123 | 123 | 123 | -20 | TRKL | BAT | * | STP | 210 | 246.989 | 0 | N | 0 | E | 0 | 201122 |
| 60_SEC | REL | AAR | REL | X | X | D | A | H | 0 | 0 | 122 | 123 | 123 | -9 | TRKL | BAT | * | STP | 210 | 346.986 | 0 | N | 0 | E | 0 | 201122 |
| 60_SEC | REL | AAR | REL | X | X | D | A | H | 0 | 0 | 123 | 123 | 123 | -11 | TRKL | BAT | * | STP | 210 | 446.982 | 0 | N | 0 | E | 0 | 201122 |
| SLPLOG | REL | AAR | REL | X | X | D | H | H | 0 | 0 | 123 | 123 | 123 | -11 | TRKL | BAT | * | STP | 210 | 446.982 | 0 | N | 0 | E | 0 | 201122 |
| 60_SEC | REL | AAR | REL | X | X | D | A | H | 0 | 23 | 124 | 123 | 123 | -9 | TRKL | BAT | o | STP | 210 | 45.997 | 0 | N | 0 | E | 0 | 201122 |
| 60_SEC | REL | AAR | REL | X | X | D | A | H | 0 | 23 | 123 | 123 | 123 | -9 | TRKL | BAT | * | STP | 210 | 145.993 | 0 | N | 0 | E | 0 | 201122 |
| 60_SEC | REL | AAR | REL | X | X | D | A | H | 0 | 23 | 123 | 123 | 123 | -20 | TRKL | BAT | * | STP | 210 | 246.989 | 0 | N | 0 | E | 0 | 201122 |
| 60_SEC | REL | AAR | REL | X | X | D | A | H | 0 | 23 | 123 | 123 | 123 | -9 | TRKL | BAT | * | STP | 210 | 346.986 | 0 | N | 0 | E | 0 | 201122 |
| 60_SEC | REL | AAR | REL | X | X | D | A | H | 0 | 23 | 123 | 123 | 123 | -9 | TRKL | BAT | * | STP | 210 | 446.982 | 0 | N | 0 | E | 0 | 201122 |

Note: Only the first and last 30 records are shown.