Alternative Communications Methods For Electronic Control Modules

ON-ENGINE EXPERIENCE

Backgound

NORTH BERWICK, Maine -- Police say safety lights were flashing and gates were down when a tractor-trailer crossed into the path of an Amtrak train that hit the truck in North Berwick, killing the driver, Peter Barnum, 35, of Farmington, N.H., and injuring the train engineer and several passengers.
A witness told News 8's Jim Keithley that the driver of the truck slammed on the brakes and skidded into the intersection before being hit by the train around 11 a.m. Monday.

None of the train's 112 passengers or two crew members suffered life-threatening injuries. Police say the truck driver was hauling trash to an incinerator in Biddeford.

"For some unknown reason he did not stop at the railroad crossing. The gates were down; the lights were flashing," said North Berwick Police Chief Stephen Peasley.

Witnesses said both the truck and locomotive caught fire. "I heard the train coming. I looked down. I see the truck coming down. He had his breaks on, trying to stop; blue smoke blowing up from underneath the truck. He slid right through the train. They collided; just one big cloud of smoke, big ball of fire," said David Davis, who witnessed the crash.

Firefighters had to put out fires in the ditches. Officials credited the engineer for his quick action to save the passengers on board. "There was smoke, and the engine was on fire. He disconnected it from the remaining train to keep the fire from coming to the rest of the train. He took the reaction to stop the train, getting it separated, getting the people off. He did a real good job," said North Berwick Deputy Fire Chief Larry Straffin.

Patricia Quinn from the Northern New England Passenger Rail Authority told News 8 that train 681 was traveling northbound with 112 passengers on board when the collision happened. The Downeaster had left Boston's North Station just after 9 a.m. and was due to arrive in Portland at 11:35 a.m. Passengers were taken to Noble High School and later bused back to the train station in Portland.

When they returned to Portland, passengers spoke about what they experienced when the collision happened. "To tell you the truth, when I saw the flames, I thought I was a goner. When I saw the flames I really did, but I realized I was going through the smoke," said passenger Mary Ellen McCarthy. Kelly Greenough was coming up from Massachusetts to visit her three daughters for the week. She said she wanted to take the train to save gas, and now she has quite a story to tell:
"We saw sparks, flames; the cabin filled up with smoke. I was in the seat that had the exit window. I pushed it out and just waited until they got us off the train, and we sat there on the tracks after that," said Greenough.

Despite the initial shock and uncertainty following the crash, many said there was no real sense of panic. People were looking to assist others, and they were also amazed with the condition of the engineer. "He was shaken up and dirty and all of that, but not the injuries you would expect from someone coming out of that smoke-covered car," said passenger Marsha Fitzpatrick.

Downeaster officials report that the 11:20 p.m. train is expected to make all stops between Boston and Portland. Normal service is expected for Tuesday morning.

http://www.wmtw.com/news/28509710/detail.html

The Truck

The vehicle was a 2009 Kenworth W900 truck-tractor, towing a refuse compaction semi-trailer. Upon inspection, a significant portion of the locomotive's front walkway and handrail was intertwined with the reminder of the truck-tractor.

The ensuing fire consumed the anti-lock brake system's electronic control unit. Some remaining foundation brake components were sufficiently damaged to prevent pressure plate/pushrod movement, making assessment of brake performance complex.

The Engine

The ISX 07 Cummins engine was recovered approximately 200 feet from the area of initial impact.

Engine Type	ISX 07	ECM Code	AV10051.25	Last Tool Used	Insite
Engine Serial Number	0	Software Phase	8.0.0.54	Customer Name	Customer Name**
Unit Number	0000000000	ECM Runtime hh:mm:ss	7025:14:5	PowerSpec Version	4.2.3.6

The ECM was damaged. The cab wiring harness was pulled completely out of the connector. The engine harness was secured to its connector, but the connector was broken from the ECM housing.

The left side four-pin connector was intact. The corresponding connection of the 3164185 calibration adapter harness could be securely connected. The cab connector was sufficiently damaged as to prevent a secure mount of the 3164185 calibration adapter harness' programming connection.

In our initial attempt at communications, specially constructed "Jumper" wires were used to connect the harness female pins to the appropriate ECM male pins to enable communications via the J1708/1939 data links. It was apparent switched power was available from the calibration adapter cable, as the Inline 5 Data Link Adapter was receiving electrical power.

However, communications with the ECM could not be achieved. It appeared switched power was being interrupted by the damage to the ECM's circuit board. Additional "Jumper" wires were employed to complete the calibration adapter harness' intended connections.

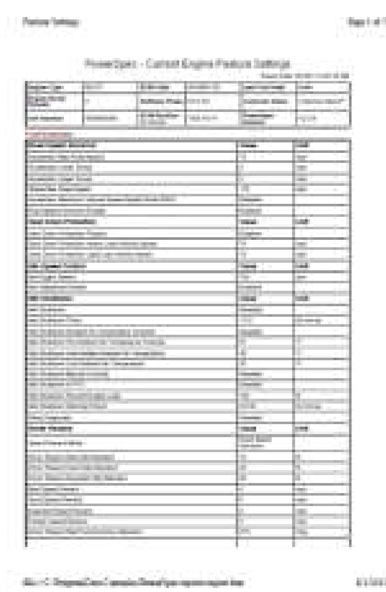
Upon completion of these connections, activity was evident across the data links as seen via the Inline 5's indicator lights.

As soon as Insite signaled a connection to the ECM, a Work Order was created and the ECM was "Imaged."

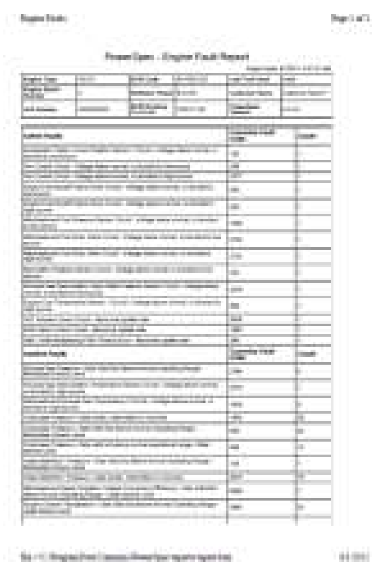
Following the imaging, the ECM was interrogated with Cummins' PowerSpec software. All anticipated reports were preserved.

PowerSpec - Sudden Deceleration Data Report

PowerSpec - Engine Dataplate Information



PowerSpec - Current Engine Feature Settings

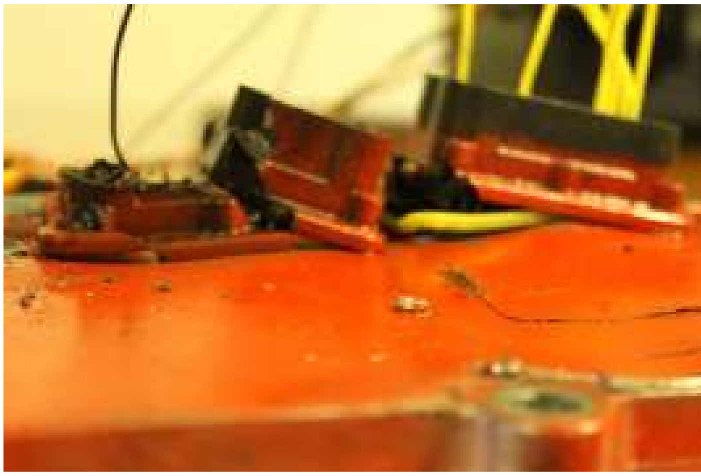


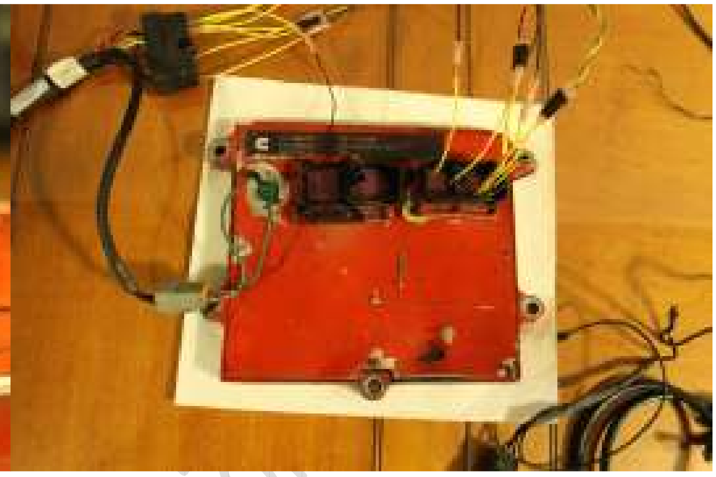
After retrieving the available PowerSpec reports, Insite was again employed to preserve each individual report directly from the ECM. However, after retrieving slightly more than half of the available reports, communications was lost with the ECM. Having the ability to access the remaining reports from the ECM Image, no additional attempts were made to re-establish communications.

The three Sudden Deceleration Records appear to have been created over 27,000 miles prior to the instant collision. Record 1 bears an odometer stamp of 133,050.7. Records 2 and 3 bear odometers stamps of 136,862.1 and 147,252.8, respectively. With a current reported mileage of 174,989.4, it is clear these records are unrelated to the instant collision. The ECM writes the data from the circular buffer to electronically erasable programmable read-only memory (EEPROM) when the ignition key is turned off. This would constitute a loss of switched power, while unswitched power was still available to the ECM. The circumstances of this collision apparently created a loss of unswitched power, before the ECM detected the loss of switched power, which would have commanded the writing of data.

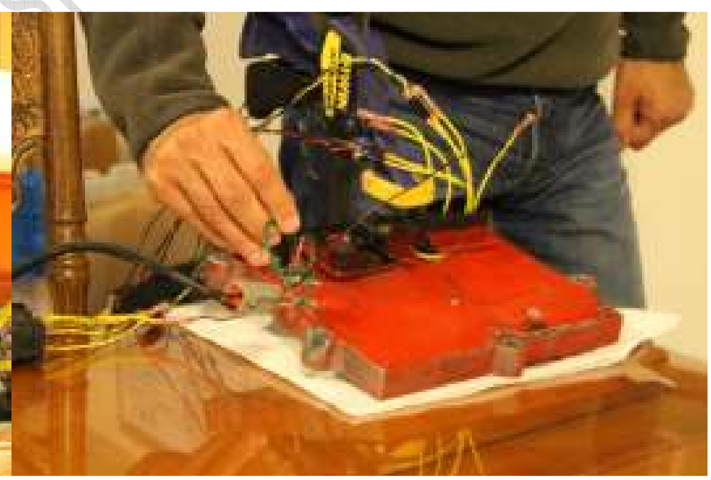
BENCH-TOP EXPERIENCE

We have had a number of opportunities to acquire data from Cummins ECMs on the workbench. Due to their forward position on the upper left side of the engine, Cummins ECMs are susceptible to damage from direct contact.





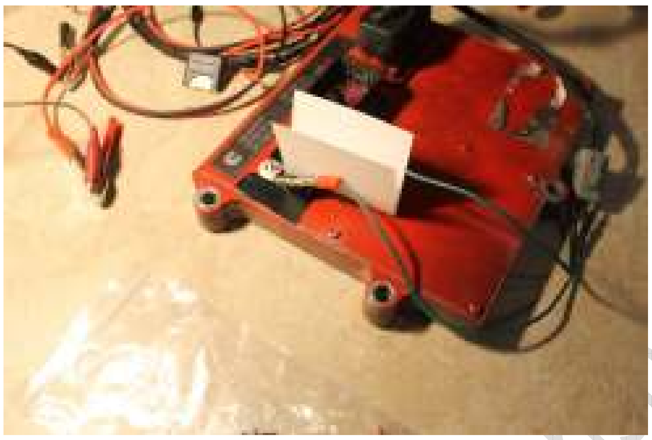
The leading four pin connector and front seventy-two pin connector are the most at risk, but the rearmost seventy-two pin connector is not immune. In this case, the housing of the four pin connector was destroyed and had to be removed to access the pins. Also, a clamp was needed to push the rearmost seventy-two pin connector back onto the circuit board. Once the connector was back in contact with the circuit board, jumpers were installed to achieve communications.



Once communications were established, the activity on the comm adapter increased and was a key indicator we had completed our connections.

In another case, the four pin connector appeared to simply have been pulled away from the circuit board. However, upon closer examination, the connector required removal, as its only connection to the ECM were the mounting screws. Careful work with a Dremel tool severed the screws, which could then be removed to prevent shorting.

Once the four pin connector was removed, special jumpers were constructed to allow clips to grasp the pins' connections on the terminal ribbon built into the circuit board.



Because of the close proximity of the ECM's aluminum housing, it was necessary to insulate the housing with electrical tape. As the clips had a tendency to twist toward each other, an index card was used to keep them separated, since it would not conduct electricity. With communications achieved, data began to flow: