APPENDIX X

EXAMINATION OF COMPONENTS OF JOY MINING MACHINERY JNA CONTROL SYSTEM

U.S. DEPARTMENT OF LABOR
MINE SAFETY AND HEALTH ADMINISTRATION
TECHNICAL SUPPORT

INVESTIGATIVE REPORT

Examination of Components of Joy Mining Machinery JNA Control System Recovered from a Mine Explosion at Performance Coal Company Upper Big Branch Mine-South (MSHA ID 46-08436) Montcoal (Raleigh County), WV

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EXAMINATION OF COMPONENTS OF JOY MINING MACHINERY JNA CONTROL SYSTEM

1 ABSTRACT

The Approval and Certification Center (A&CC), as requested by Upper Big Branch Mine Accident Investigation Team Leader, Norman Page, assisted the accident investigation team in the examination of components of the Joy Mining Machinery Joy Network Architecture (JNA) Control System associated with the longwall shearing machine. These components were recovered from a fatal mine explosion at the Upper Big Branch Mine-South which occurred on April 5, 2010.

The components examined were:

1. Exhibit No. PE-0164, Joy Mining Machinery JNA0 control unit, S/N 56602AH003, Part No. 00572110-0020, recovered from the Joy longwall shearing machine installed at the mine.
2. Exhibit No. PE-0165, Joy Mining Machinery JNA1 control unit, S/N 100304AC006, Part No. 100133930, recovered from the Joy longwall shearing machine installed at the mine.
3. Exhibit No. PE-0173, Joy Mining Machinery, JNA1 control unit, S/N 113203AH002, Part No. 100133930, recovered in the area of survey spad 22699. The JNA1 recovered as Exhibit No. PE-0173 is reported to be a spare unit.
4. Exhibit No. PE-0204, Joy Mining Machinery JNA0 control unit, S/N 56605AC010, Part No. 00572110-0020, recovered in the area of survey spad 22701. The JNA0 recovered as Exhibit No. PE-0204 is reported to be a spare unit.
5. Exhibit No. PE-0269, Joy Mining Machinery, JNA0 control unit, S/N 50905T0002, Part No. 00572110-0020, recovered by the accident investigation team from the Joy facility in Bluefield, VA, on August 23, 2010.

For Exhibit No. PE-0164, JNA0 unit recovered from the longwall shearer, the electronic event log of April 5, 2010 was viewed. The last two recorded events on April 5, 2010 on the JNA0 unit were: “ERR Right Handheld Dataloss” and “STS Right Handheld Estop.” These records are an error message and a machine status code. No other events were recorded in the event log for approximately 43 minutes prior to the above listed events.

Events recorded in the JNA0 event log are time stamped. In order to determine the actual time that events on April 5, 2010 were recorded in the Exhibit No. PE-0164, JNA0 unit’s electronic event log, a time drift analysis was conducted on

the system clock of the JNA0 unit. At standard laboratory temperature of approximately 20 ºC, the system clock was drifting at a rate between 0.49971 and 0.4824 seconds per day. Assuming that the environmental conditions of the JNA0 unit before it was delivered to the A&CC were constant, the rate of drift of the system clock would remain constant. This means, if the drift was constant from April 5, 2010 until the measurements started, the actual expected time and date for the last "STS Right Handheld ESTOP" event, as recorded on the JNA0 event log, was between 2:59:32 PM and 2:59:38 PM on April 5, 2010.

Functional testing was conducted on Exhibit Nos. PE-0164 (JNA0) and PE-0165 (JNA1) on a Joy shearer test panel which mimicked the functionality of the shearer installed at the longwall. The purpose of this functional testing was to ensure that machine control system events monitored by the JNA system are properly interpreted by the JNA system, the proper actions were taken by the JNA system, and the appropriate events were properly recorded on the JNA0 event log. During the functional testing, machine functions were initiated by Exhibit No. PE-0238, Model TX1 remote control unit after being restored to working order. Events were stored in the Exhibit No. PE-0164 (JNA0) event log when expected. The functional testing indicated that Exhibit Nos. PE-0164 (JNA0) and PE-0165 (JNA1) functioned as expected.

Attempts were made to view the electronic event logs of additional JNA control units recovered during the accident investigation. No event logs were stored in Exhibit Nos. PE-0173, PE-0204, or PE-0269.

2 INTRODUCTION

2.1 Request. The Approval and Certification Center (A&CC), as requested by Upper Big Branch Mine Accident Investigation Team Leader, Norman Page, assisted the accident investigation team in the examination of components of the Joy Mining Machinery JNA Control System associated with the longwall shearing machine. The examinations included recovering data stored in the memory of these units and comparing the internal time clocks of these units with presumed accurate time clocks. These components were recovered from a fatal mine explosion at the Upper Big Branch Mine-South which occurred on April 5, 2010.

2.2 Equipment. The longwall shearing machine installed at the Upper Big Branch Mine-South was a Joy Mining Machinery, Model 07LS1A shearer, serial number (S/N) LSW525C, MSHA Shearer Evaluation No. SE-18630-0. Components of the JNA control system were recovered from the shearer. In addition, the investigation team recovered spare JNA components located underground and at a repair facility.

2.3 Description of JNA control system. The JNA control system was the computer control center for the Joy shearing machine installed in the

longwall shearer at the Upper Big Branch Mine-South Mine. The control system monitored the various machine functions and also contained the circuitry necessary for remote control operation. A display screen was provided to assist in operating or troubleshooting the machine. The display screen was viewed through a window of the main controller enclosure of the shearer. The JNA control system consisted of two components or units, referred to as JNA unit 0 and JNA unit 1, or also as the JNA0 and JNA1 units. The JNA0 unit performed various computer and control functions; it also contained the system display. The JNA1 unit contained the input and output interface to various circuits on the machine.

Some of the functions of the JNA system included:

- Controlling the machine's solenoid-operated hydraulic functions,
- Monitoring the remote control transmitter stations,
- Monitoring and controlling motor currents and motor temperatures,
- Providing motor overcurrent protection,
- Providing diagnostic data on the display, and
- Providing an electronic event log for reviewing machine performance. The event log is a listing of the machine status codes and error messages. The JNA event log is not designed to be downloaded; it can only be viewed on the JNA0 display.

The Machine Application Program (MAP) cartridge is a small cartridge that plugs into a socket on the JNA0 unit. The MAP is programmed at the manufacturer's facility specifically for a certain shearing machine. The MAP cartridge is used by the JNA system to customize the configuration settings, such as motor overload settings, based on the shearer components installed.

2.4 Recovering JNA0 and JNA1 units from Shearer. On July 20, 2010, the main controller enclosure on the longwall shearer at the Upper Big Branch Mine-South was opened, the connections to the JNA0 and JNA1 units were disconnected, and the JNA0 and JNA1 units were secured into protective storage cases. The JNA0 unit, S/N 56602AH003, part number (P/N) 00572110-0020, was designated as Exhibit No. PE-0164. The JNA1 unit, S/N 100304AC006, was designated as Exhibit No. PE-0165. For the purpose of preserving the data, the MAP cartridge, which was installed in the appropriate slot of the JNA0 unit, was not removed from the JNA0 unit during the investigation. The MAP installed in Exhibit No. PE-0164 was P/N 100173695-06. See Appendix A-1 for photographs of the recovery of the JNA units.

3 VIEWING EVENT LOG OF EXHIBIT NO. PE-0164 JNA0 UNIT

3.1 Procedure. Exhibit No. PE-0164, JNA0 unit, was taken to the Joy Mining Machinery facility in Franklin, PA, on July 23, 2010, for the purpose of viewing the event log. Joy personnel conducted the testing under the direction of the investigation team. The examinations were videotaped and photographed. See Appendix A-2 for photographs. An attempt was made to synchronize the timestamp of the video recording to the real time clock available at www.time.gov. A photograph of both the real time clock displayed on a laptop computer and the video recording's timestamp shows a one second difference (see Appendix A-2, slide 10).

3.2 Demonstration Unit. Joy personnel demonstrated how the JNA event log can be viewed on a JNA0 sample unit. The demonstration JNA0 sample unit was powered with a 120 Vac power cord and was controlled using a page turner device. After power was applied and the boot-up sequence finished, the demonstration JNA0 sample unit displayed the main menu. The JNA system's date and time are also displayed on the screen. The operator then toggled to the "Event Log" on the main menu. The JNA event log contained a chronological detail of the operation of the JNA system, and can include any errors, overload conditions, or status events. Approximately 4,000 of the latest events can be stored in the event log; the oldest event is overwritten by newer events being recorded. Each event contains the time stamp, or date and time, of the event's occurrence. The user can select an event's "help text" for more descriptive information explaining an event. It was demonstrated that the demonstration JNA0 sample event log was maintained in memory after powering down and re-starting the demonstration unit. Nine (9) events related to the boot-up sequence were stored in the event log every time the demonstration JNA0 sample unit was powered. As expected, some of these events were due to the demonstration JNA0 sample unit not being connected to a JNA1 unit and other sensors as it would be on a machine.

3.3 Exhibit No. PE-0164 JNA0 Unit. Exhibit No. PE-0164 was taken out of its protective storage case. The JNA0 unit was powered with a 120 Vac power cord and controlled using a page turner device. After the boot-up sequence finished, the JNA0 unit displayed the main menu. The JNA system's date and time were also displayed on the screen. The operator then toggled to the "Event Log" on the main menu. The nine (9) events that related to the boot-up sequence that had just initiated were recorded, beginning with the event "SYS Power Reset". Events recorded just prior to the JNA0 unit being powered on July 23, 2010, were dated April 5, 2010.

3.4 Viewing of Data. Every screen of the event log was recorded via still or video photography. Every screen of data consisted of 20 events, with the latest four events repeated from the previous screen. The date of the

recorded events began on April 5, 2010, and continued until March 30, 2010. On the 57th screen, data recorded on March 30, 2010 was immediately preceded by data recorded on January 7, 2009. This data continued until January 3, 2009. It was believed that the January 2009 data was recorded while this JNA0 unit was installed on another shearing machine, since these dates are prior to the time when this particular shearing machine was delivered to the Upper Big Branch Mine-South.

The two last two recorded events on April 5, 2010 on the JNA0 unit were:

April 5, 2010	18:52:41	ERR Right Handheld Dataloss
April 5, 2010	18:52:39	STS Right Handheld Estop

No events were recorded in the event log for approximately 43 minutes prior to the above listed events.

A "STS Right Handheld Estop" event would occur if the data from the right handheld unit dropped out for 0.5 to 1.5 seconds. According to the manufacturer, examples of a radio communication dropout include:

- The operator pressed the "stop" button on the TX1 remote control unit,
- The radio communications to the receiver dropped out,
- The receiver to the JNA communications dropped out, or
- The internal battery of the TX1 remote control unit was dying.

Also, an "ERR Right Handheld Dataloss" event would occur if the data from the right handheld unit dropped out for more than 1.5 seconds.

3.5 Photographs of Event Log. Slides 12 through 141 of Appendix A-2 show the event log as displayed on the JNA0 unit. The entire procedure of viewing the event log was videotaped; however, not every screen of data of the event log of January 3, 2009 was photographed.

3.6 Event Log with Adjustments for Time Drift. Efforts were made to determine the actual time that events occurred in the event log (see Time Drift Study in Section 4 below). Based on the time drift analysis, the time of recorded events in the event log was calculated for a range of "earliest" and "latest" possible actual time. The resulting actual time range for the events recorded on April 5, 2010 is shown in Appendix B.

3.7 Event Log Help Text. "Help Text" information could be selected by the user for more descriptive information explaining an event. Joy provided a "JNA Event Dictionary File" which listed all events that are possible to record in the event log of the JNA system installed at the shearer used on the longwall. The help text information for this large list of events (machine

status codes and error messages) recorded on April 5, 2010 is shown in Appendix C.

3.8 Exhibit No. PE-0164 JNA0 Parameter Screens. After viewing the event log of the JNA0, the parameter screens and other menus of the unit were viewed, videotaped and photographed. These screens are shown in Appendix A-2, slides 142 to 205. The power was then removed and the JNA0 unit was placed back into its protective storage case.

3.9 Questions asked of the manufacturer, Joy Mining Machinery. Questions regarding the JNA control system and its electronic event log were gathered from the representatives of parties of the accident investigation team. The questions and Joy's response, titled "Response to MSHA Questions for Joy", is filed in the folder for this investigation.

4 TIME DRIFT STUDY OF EXHIBIT NO. PE-0164 JNA0 UNIT

4.1 Background. An attempt was made to coordinate the recorded time data associated with selected events in the JNA0 electronic event log for Exhibit No. PE-0164 with time from established sources. The time and date recorded by the internal clock of the JNA0 unit was displayed and observed over a period of approximately fourteen months. This time was compared to presumed accurate time clocks. The rate of change was calculated from this data and used to extrapolate the JNA0 unit's time on April 5, 2010.

The JNA0 unit featured an internal clock. The length of a time period measured by these clocks can deviate from the length of the same time period measured by more precise means; one second measured by the JNA0 unit can differ from one second as measured by the National Institute of Standards and Technology (NIST).

In laboratory environmental conditions, it was noted that the clock did, indeed, differ in time from that obtained from external sources. Given the tolerances of each time measurement, calculations were made to determine the minimum and maximum rates of drift of the JNA0 unit's internal clocks as compared to the time from external sources.

The minimum and maximum rate of drift was compared to the events recorded in the event log which occurred on April 5, 2010.

The following were correlated: (a) the time from the JNA0 event log with (b) the actual Eastern Daylight Time when certain events in the data were recorded. The JNA0 unit uses clocks that rely on crystals or resonators connected to integrated circuits. The frequency of the crystal or the resonator determines the operation of the clock. Changes in the frequency of the crystal or resonator, or mismatches in impedance between the

external circuitry and the internal circuitry of the integrated circuit, will have an effect on the clock, causing it to differ from the actual time. One major factor that can affect the frequency of a crystal is its temperature.

The manufacturer indicated that when the JNA0 unit is repaired at the Matric Limited rebuild facility, the clock is set to the UST format, according to their test procedure. The acronym "UST" stands for Universal Standard Time; it is analogous to the better-known Greenwich Mean Time (GMT). This means that during Eastern Daylight Time, the clock of the JNA0 unit is set four hours ahead of Matric Limited's network time, and during Eastern Standard Time, the clock of the JNA0 unit is set five hours ahead of the Matric Limited's network time. The manufacturer indicated that when the clock is reset, the event log is cleared.

4.2 Measurement Procedures. The JNA0 unit was energized and the displayed time and date were recorded. Simultaneously, the time and date displayed on a MSHA-owned personal computer, with the web browser directed to www.time.gov, were recorded. The data was recorded by handwritten notation in a record book and photographs were taken. The time and date of the JNA0 unit was displayed in the upper right hand corner of the JNA0 Main Menu. At the request of the State of West Virginia Office of Miners' Health, Safety & Training, measurements were also taken with a Garmin etrex Legend GPS Receiver.

4.3 Analysis Procedures.

4.3.1 Precision of measurements. The reference time readings in 2010 and 2011 were taken from the National Institute of Standards and Technology (NIST) website at www.time.gov and a Garmin etrex Legend GPS Receiver connected to at least four satellites.

4.3.2 WWW.TIME.GOV. Notes from this website indicate: "This public service is cooperatively provided by the two time agencies of the United States: a Department of Commerce agency, the National Institute of Standards and Technology (NIST), and its military counterpart, the U. S. Naval Observatory (USNO). Readings from the clocks of these agencies contribute to world time, called Coordinated Universal Time (UTC). Additionally, the website says "This web site is intended as a time-of-day service only. It should not be used to measure frequency or time interval, nor should it be used to establish traceability to NIST or the USNO." This time is synchronized with NIST every ten minutes."

Additionally, the website displays an accuracy statement. This is provided in the format "Accurate within X.X seconds" on a measurement of the round-trip network delay. This delay is measured using the local computer clock as a timer each time synchronization is made. Most measurements

were displayed as less than 1 second, but informal observations, using the widget provided by NIST, indicated delay of up to 4 seconds.

4.3.3 Global Positioning System (GPS) Time. The GPS Navigation Message Words six through 10 of page 18 of subframe four of the GPS broadcast navigation message contain the values of Coordinated Universal Time (UTC) parameters that permit a GPS receiver to determine UTC corresponding to a particular instant of GPS Time. This page is transmitted once during the 12 ½-minute-long navigation message. The parameters include the current number of UTC leap seconds since January 1980, when GPS Time was set equal to UTC, as well as information on the most recent or announced future leap second. The navigation message also transmits the coefficients of a first-order polynomial describing the subsecond relationship between GPS Time and UTC. The parameters of this polynomial also provide data to allow the GPS receiver to accommodate leap seconds. An observation of the time observed on a GPS receiver indicated that the difference between the time displayed by the receiver and MSHA network time was approximately one second.

4.3.4 Calculations. When calculating the differences between the time displayed by the instruments and the reference time, the tolerances of the reference time were initially based on the information found above. E.g., when the MSHA network was used as a reference, it was considered to have a one second tolerance. However, based on the observations of the NIST time widget, and the statement by NIST that the www.time.gov time should not be used for interval measurements, the tolerance was widened.

Calculations were made to determine the largest and smallest differences between (a) the observed time on the instrument and (b) the observed reference time. This range for each time measurement was plotted on a linear-linear graph; there were therefore two y-data points (representing the smallest and largest differences) for each x-data point (representing the observation period, with the first observation at time=0). Because the duration of the observations was approximately 420 days, the variation of each data point in the horizontal (x) direction was insignificant. The same tolerance was used for each data point. Additionally, the time recordings were adjusted to allow for daylight savings time as appropriate.

Because a straight line would not fit between the upper and lower limits of all data points when these points were plotted, the tolerance was adjusted to nine seconds to allow this straight line to fit because a linear drift was expected. Then, based on observation, the minimum and maximum slopes of the straight lines that fit the points were measured. These slopes were then used to determine the maximum and minimum time drift

of the JNA0 system clock. The time drift values were then used to extrapolate the data to recorded events of the event log on April 5, 2010.

4.4 RESULTS

4.4.1 Time recordings. The listing of time recordings can be found in Table 1 below. This data has been adjusted for Daylight Savings Time. The recordings made on July 23, 2010 and on November 19, 2010 were made from video taken at the Joy facility in Franklin, PA and Matric Limited in Seneca, PA, where the video recording's time was synchronized to www.time.gov. Recordings made from November 30, 2010 through February 9, 2011 were made by comparing the JNA0 unit time to www.time.gov displayed on a MSHA-owned personal computer. Recordings made from May 27, 2011 to September 15, 2011 were made by comparing the JNA0 time to GPS time.

Table 1. JNA0 Time Measurements

Date	Reference Time	Instrument Time
7/23/2010	10:43:59	14:36:17
7/23/2010	10:44:03	14:36:21
7/23/2010	12:16:43	16:09:00
7/23/2010	14:19:11	18:11:29
7/23/2010	15:23:50	19:16:07
7/23/2010	16:10:32	20:02:50
11/19/2010	10:20:00	14:11:13
11/30/2010	15:26:00	19:17:09
11/30/2010	15:27:00	19:18:09
11/30/2010	15:32:00	19:23:08
1/8/2011	11:31:57	15:22:46
1/8/2011	11:34:37	15:25:26
1/8/2011	11:35:00	15:25:50
1/8/2011	11:36:00	15:26:49
1/26/2011	15:49:05	19:39:43
1/26/2011	15:50:37	19:41:16
1/26/2011	15:55:10	19:45:50
1/27/2011	15:49:41	19:40:27
1/27/2011	15:50:55	19:41:41
1/27/2011	15:51:54	19:42:40
1/28/2011	15:40:38	19:31:18
1/28/2011	15:42:10	19:32:50
1/28/2011	15:43:38	19:34:18
1/31/2011	15:54:14	19:44:53
1/31/2011	15:55:47	19:46:26
1/31/2011	15:56:45	19:47:24
2/1/2011	15:42:25	19:33:03
2/1/2011	15:43:25	19:34:03
2/1/2011	15:44:34	19:35:12
2/3/2011	15:39:16	19:29:49

2/4/2011	16:16:36	20:07:12
2/4/2011	16:17:28	20:08:06
2/4/2011	16:18:35	20:09:12
2/7/2011	15:08:41	18:59:06
2/7/2011	15:11:02	19:01:27
2/7/2011	15:12:54	19:03:18
2/8/2011	15:28:19	19:18:53
2/8/2011	15:29:20	19:19:55
2/8/2011	15:30:06	19:20:41
2/9/2011	15:41:04	19:31:39
2/9/2011	15:42:03	19:32:38
2/9/2011	15:43:40	19:34:15
5/27/2011	16:23:27	20:13:13
5/27/2011	16:24:15	20:14:01
5/27/2011	16:26:57	20:16:43
5/27/2011	16:29:08	20:18:53
6/1/2011	16:06:49	19:56:33
6/1/2011	16:10:46	20:00:30
6/6/2011	17:11:17	21:00:57
6/6/2011	17:16:25	21:06:05
6/8/2011	15:37:59	19:27:40
6/8/2011	15:39:50	19:29:30
6/10/2011	15:41:30	19:31:08
6/10/2011	15:42:29	19:32:07
6/14/2011	16:19:42	20:09:19
6/14/2011	16:21:34	20:11:10
6/17/2011	18:08:49	21:58:23
6/17/2011	18:15:47	22:05:23
6/23/2011	13:59:36	17:49:09
6/23/2011	14:00:37	17:50:11
6/23/2011	14:01:57	17:51:31
6/24/2011	14:36:29	18:26:01
6/24/2011	14:37:13	18:26:45
6/24/2011	14:38:52	18:28:24
6/28/2011	15:39:08	19:28:38
6/28/2011	15:40:33	19:30:03
6/29/2011	11:39:40	15:29:09
6/29/2011	11:49:30	15:38:58
8/12/2011	16:34:41	20:23:48
8/12/2011	16:36:27	20:25:35
8/12/2011	16:37:07	20:26:14
8/23/2011	16:13:52	20:02:55
8/23/2011	16:19:05	20:08:08
8/25/2011	16:54:31	20:43:32
8/25/2011	16:56:28	20:45:29
8/25/2011	16:58:50	20:47:51
9/7/2011	9:01:32	12:50:27
9/7/2011	9:05:14	12:54:09
9/9/2011	17:04:30	20:53:24
9/9/2011	17:06:02	20:54:56

9/9/2011	17:08:30	20:57:25
9/15/2011	16:11:54	20:00:45
9/15/2011	16:12:51	20:01:42

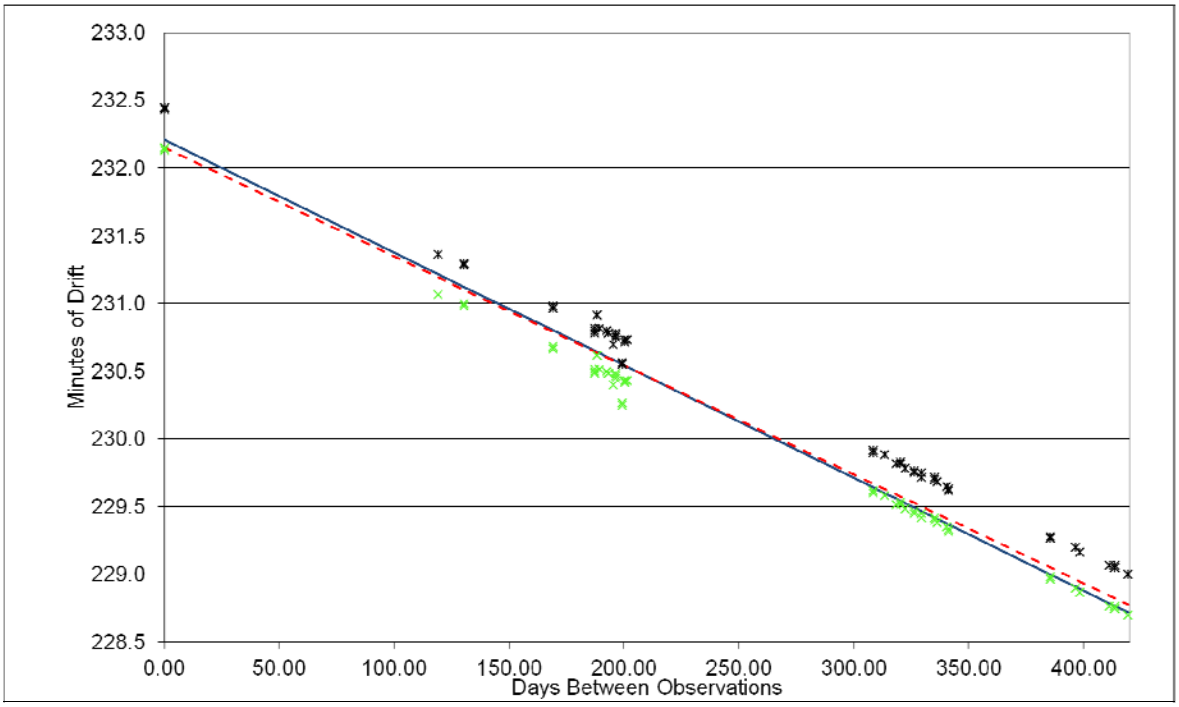
4.4.2 Analysis. The data from Table 1 was used to calculate the minimum and maximum deviation of the system clock of the JNA0 unit from Eastern Daylight Time. First, the number of days between the first observation and each subsequent observation was calculated and served as the horizontal axis of Figure 1. Then, through systematic trial and error, the tolerance on the reference time was determined. No tolerance on the JNA0 time observation was used.

The smallest tolerance on the time observed on the MSHA network and www.time.gov that would allow a straight line to fit all points, as shown on Figure 1 below, was the minimum allowable tolerance of ±9 seconds. This tolerance was then applied to the reference time, resulting in the points on Figure 1; the points represented by asterisks were the largest possible deviation, and those represented by X were the smallest possible deviation.

Once again, by systematic trial and error, straight lines were fit between the two sets of data (largest and smallest deviation) by adjusting the y-intercept and slope of the lines until the minimum and maximum possible slopes were obtained. These slopes were the minimum and maximum rates of drift of the JNA0 system clock.

The maximum and minimum slopes were 0.49971 and 0.4824 seconds per day. This means, if the drift was constant from April 5, 2010 until measurements started on July 23, 2010, the actual expected time and date for the last “STS Right Handheld ESTOP” event which was recorded at 6:52:39 PM on April 5, 2010 was between 2:59:32 PM and 2:59:38 PM on April 5, 2010.

Figure 1. Calculated Minimum and Maximum Clock Drift Rates, Exhibit No. PE-0164



5 FUNCTIONAL TESTING OF EXHIBIT NO. PE-0164 (JNA0), EXHIBIT NO. PE-0165 (JNA1) AND EXHIBIT NO. PE-0238 (TX1 REMOTE CONTROL)

5.1 Procedure. The Exhibit Nos. PE-0164 (JNA0) and PE-0165 (JNA1) were taken for functional testing at the Matric Limited facility in Seneca, PA, on November 19, 2010. The purpose of this functional testing was to ensure that machine control system events monitored by the JNA system are properly interpreted by the JNA system, the proper actions taken by the JNA system, and properly recorded on the JNA0 event log. A Joy shearer test panel was used to mimic the functionality of the shearer, with the JNA system connected to the test panel. Joy personnel conducted the testing under the direction of the investigation team.

Joy provided a “JNA event dictionary file” which listed all the events that could have been recorded in the event log of the JNA system installed at the shearer used on the longwall. Joy also provided a document titled “Response to MSHA Questions for Joy”, which included fifty (50) of those events from the dictionary file that the MSHA investigation team asked Joy to simulate during the functionality test of the JNA0 and JNA1 units recovered from the longwall shearer. Appendix D lists those events that the investigation team asked Joy to simulate. Joy indicated that some of the events were no longer used or the events could not be simulated on the Joy test panel. Therefore, some of the events in Appendix D are shaded. The events that are non-shaded or lightly shaded were those that were

simulated during the functional test. The events that are darkly shaded could not be simulated during the functional test.

The functional testing was videotaped and photographed. See Appendix A-4, slides 1 through 174, for photographs of the functional testing.

5.2 Demonstration of Test Panel with sample JNA0 and JNA1 units. Joy personnel first demonstrated the functions of the Joy shearer test panel by connecting a Joy sample JNA0 unit and a sample JNA1 unit. It was necessary to prepare a replacement MAP cartridge for the Joy sample JNA0 unit. It was shown that the test panel was operating properly by energizing sample components such as relays and motors. Machine functions were initiated by a Joy-supplied umbilical (hard-wire connected) remote control device.

5.3 Functional testing of Exhibit No. PE-0165 (JNA1) with Joy sample JNA0 unit installed on test panel: Exhibit No. PE-0165 (JNA1) was taken out of its protective storage case and installed on the Joy test panel, with the Joy sample JNA0 unit still installed. Functional testing was conducted of the non-shaded and lightly shaded events shown in Appendix D. Machine functions were initiated by a Joy-supplied umbilical (hard-wire connected) remote control device. The Exhibit No. PE-0165 (JNA1) functioned as expected. Events were stored in the Joy sample JNA0 event log when expected.

5.4 Functional testing of Exhibit No. PE-0164 (JNA0) with Joy sample JNA1 unit installed on test panel: This testing was prescribed in the original functional testing protocol, but was not conducted. All parties present at the testing felt it was unnecessary and it was agreed to proceed to the next step of the functional testing.

5.5 Functional testing of Exhibit No. PE-0164 (JNA0) with Exhibit No. PE-0165 (JNA1) on test panel, using Exhibit No. PE-0238 (Model TX1) remote control unit: Exhibit No. PE-0164 (JNA0) was taken out of its protective case and installed on the Joy test panel, with Exhibit No. PE-0165 (JNA1) still installed from the previous step.

Joy personnel installed a Joy supplied sample 472 MHz receiver to the right-handheld input to the test panel. Exhibit No. PE-0238, Matric Limited TX1 remote control unit, recovered at Shield 100 of the longwall face, was then used during this step of the functional testing. This TX1 unit was repaired by a Matric Limited technician on November 19, 2010, and restored to working order. Refer to the report “Remote Control Units Recovered from a Mine Explosion at Performance Coal Company” for further information concerning Exhibit No. PE-0238.

Functional testing was conducted on the non-shaded and lightly shaded events shown in Appendix D, with machine functions being initiated by Exhibit No. PE-0238 (Model TX1) remote control unit. Exhibit Nos. PE-0164 (JNA0) and PE-0165 (JNA1) functioned as expected. Events were stored in the Exhibit No. PE-0164 (JNA0) event log when expected.

Special emphasis and additional tests were conducted to recreate the last two event data recordings for April 5, 2010 shown in Appendix B. Although these event data recordings can be created several ways, as noted earlier, investigators only recreated the last two event data recordings by activating the remote stop function of the TX1 unit at the Matric facility. Each time the remote stop function was actuated, a "ERR Right Handheld Dataloss" occurred within 2 seconds.

6 VIEWING OF EVENT LOGS OF ADDITIONAL JNA UNITS

6.1 Background. Additional JNA control units were recovered during the course of the investigation. These additional units were recovered both from the longwall section and from a repair facility. These additional units were kept as spares for the longwall section. Attempts were made to view any event logs stored on these spare JNA0 units.

6.2 Exhibit No. PE-0173. This exhibit was a JNA unit recovered in the area of survey spad 22699 along "headgate 21". This unit was later examined at the Matric Limited facility in Seneca, PA, by the team on November 19, 2010. Upon inspection, the unit was a JNA1 unit, S/N 113203AH002, P/N 100133930. No event logs are stored on JNA1 units, so this unit was not powered. No further evaluation was conducted on this JNA1 unit.

6.3 Exhibit No. PE-0204. This exhibit was a plastic protective case containing a JNA0 unit, S/N 56605AC010, P/N 00572110-0020, recovered in the area of survey spad 22701. The case was taken to the Joy Mining Machinery facility in Franklin, PA, on August 11, 2010, for the purpose of viewing the event log on the JNA0 unit. See Appendix A-3 for photographs.

The exterior and interior of the protective case was covered in soot and dirt, as was the JNA0 unit located inside. Upon examination, there was dirt in the empty MAP cartridge slot and other connection slots and ports. Joy personnel cleaned the unit with a vacuum, and wiped the unit clean. Since the event log could not be viewed without a MAP cartridge, a replacement MAP cartridge was prepared to mimic the configuration of the shearer at the Upper Big Branch Mine-South. The MAP cartridge was inserted into the JNA0 unit, and the unit was powered. However, upon examination, the event log was empty. No further evaluation was conducted on this JNA0 unit.

6.4 Exhibit No. PE-0269: It was determined that a JNA unit was sent back to a Joy repair facility in Bluefield, VA near the date of April 5, 2010. A member of the MSHA accident investigation team recovered it on August 23, 2010. The unit was a JNA0 unit, S/N 50905T0002, P/N 00572110-0020. The unit was later examined at the Matric Limited facility in Seneca, PA, by the team on November 19, 2010. See Appendix A-4, slides 175 through 185, for photographs of this examination. Upon inspection, the unit appeared to have been processed at a repair facility. A Matric Limited tracking tag with the unit showed a received date of April 7, 2010, and a final inspection of April 21, 2010. No MAP cartridge was installed. The unit was powered, and no event log was stored.

The real-time clock of the JNA unit was examined. On November 19, 2010, the date and time were compared to UST time, and it was one minute and 37 seconds behind UST, as the JNA0 displayed time was '19:02:00' compared to '14:03:37' from a video timestamp synched to www.time.gov. The manufacturer stated that they serviced the unit on April 21, 2010; their service procedures are reported to include synchronization of the JNA clock to UST. Using these two data points, the rate of drift of the clock of Exhibit No. PE-0269 from April 21, 2010 to November 19, 2010 is comparable to the rate of drift observed on Exhibit No. PE-0164. No further evaluation was conducted on this JNA0 unit.

6.5 Service Reports: The service reports for each of the exhibits were provided by Matric Limited. No repairs relative to this investigation were noted. The service records show the date the unit was built and the last repair date for each of the exhibits:

Exhibit No.	New Date	Last Repair Date
PE-0164	03/01/2006	05/22/2008
PE-0165	04/27/2001	08/29/2008
PE-0173	(not stated)	05/13/2008
PE-0204	05/23/2001	05/14/2009
PE-0269	06/23/1995	04/21/2010

7 CONCLUSION

For Exhibit No. PE-0164, JNA0 unit recovered from the longwall shearer, the electronic event log of April 5, 2010 was viewed. The last two recorded events on April 5, 2010 on the JNA0 unit were: "ERR Right Handheld Dataloss" and "STS Right Handheld Estop." These records are an error message and a machine status code. No other events were recorded in the event log for approximately 43 minutes prior to the above listed events.

Events recorded in the JNA0 event log are time stamped. In order to determine the actual time that events on April 5, 2010 were recorded in the Exhibit No.

PE-0164, JNA0 unit's electronic event log, a time drift analysis was conducted on the system clock of the JNA0 unit. At standard laboratory temperature of approximately 20 ºC, the system clock was drifting at a rate between 0.49971 and 0.4824 seconds per day. Assuming that the environmental conditions of the JNA0 unit before it was delivered to the A&CC were constant, the rate of drift of the system clock would be constant. This means, if the drift was constant from April 5, 2010 until the measurements started, the actual expected time and date for the last "STS Right Handheld ESTOP" event, as recorded on the JNA0 event log, was between 2:59:32 PM and 2:59:38 PM on April 5, 2010.

Functional testing was conducted on Exhibit Nos. PE-0164 (JNA0) and PE-0165 (JNA1) on a Joy shearer test panel which mimicked the functionality of the shearer installed at the longwall. The purpose of this functional testing was to ensure that machine control system events monitored by the JNA system are properly interpreted by the JNA system, the proper actions were taken by the JNA system, and the appropriate events were properly recorded on the JNA0 event log. During the functional testing, machine functions were initiated by Exhibit No. PE-0238, Model TX1 remote control unit after being restored to working order. Events were stored in the Exhibit No. PE-0164 (JNA0) event log when expected. The functional testing indicated that Exhibit Nos. PE-0164 (JNA0) and PE-0165 (JNA1) functioned as expected.

Attempts were made to view the electronic event logs of additional JNA control units recovered during the accident investigation. No event logs were stored in Exhibit Nos. PE-0173, PE-0204, or PE-0269.

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APPENDIX A-1, PHOTOGRAPHS (JULY 20, 2010)

Photographs taken underground by the MSHA investigation team during the recovery of Exhibit Nos. PE-0164 (JNA0 unit) and PE-0165 (JNA1 unit) at the shearing machine installed at the mine.

1. Exhibit No. PE-0164, JNA0 unit display, as seen through window of middle bay of main controller
2. Exhibit No. PE-0164, JNA0 unit, middle bay of main controller enclosure (enclosure cover removed)
3. Foreground: Exhibit No. PE-0164, JNA0 unit, being removed from main controller enclosure; Background: Exhibit No. PE-0165, JNA1 unit
4. Exhibit No. PE-0164, JNA0 unit, without protective cover so that cable connectors may be removed
5. Exhibit No. PE-0164, JNA0 unit, being placed inside protective case
6. Exhibit No. PE-0164, JNA0 unit, inside protective case with connector cover installed
7. Exhibit No. PE-0165, JNA1 unit, inside enclosure with Exhibit No. PE-0164 (JNA0) unit removed
8. Exhibit No. PE-0165, JNA1 unit, with cables connected on reverse side of unit
9. Exhibit No. PE-0165, JNA1 unit, being placed inside protective case

APPENDIX A-2, PHOTOGRAPHS (JULY 23, 2010)

Photographs of the procedure of the viewing of data on Exhibit No. PE-0164, JNA0 unit, at the Joy facility in Franklin, PA, on July 23, 2010.

1. Exhibit No. PE-0164: Overall case of JNA0 Unit in Box
2. Exhibit No. PE-0164: Overall case of JNA0, Bottom
3. Exhibit No. PE-0164: Overall case of JNA0, Top
4. Exhibit No. PE-0164: Case opened of JNA0
5. Exhibit No. PE-0164: JNA0 Unit on Table (Removed from Box)
6. Exhibit No. PE-0164: Side view, showing MAP Cartridge still installed
7. Exhibit No. PE-0164: JNA0 Unit with Backplate Removed (Bottom Angle)
8. Exhibit No. PE-0164: JNA0 Unit with Backplate Removed (Top Angle)
9. Exhibit No. PE-0164: Back of Backplate (Removed from JNA0)
10. Exhibit No. PE-0164: Shot of Projector Screen and Laptop Screen (Showing the Official Time)
11. Exhibit No. PE-0164: JNA0 during boot-up

Slides 12 through 141: Exhibit No. PE-0164: JNA0 Event Log

142. Exhibit No. PE-0164: Parameters
143. Exhibit No. PE-0164: JNA System
144. Exhibit No. PE-0164: Parameters
145. Exhibit No. PE-0164: Optional Features
146. Exhibit No. PE-0164: Optional Features
147. Exhibit No. PE-0164: Optional Features
148. Exhibit No. PE-0164: Parameters
149. Exhibit No. PE-0164: Optional Features 2
150. Exhibit No. PE-0164: Parameters
151. Exhibit No. PE-0164: Overloads
152. Exhibit No. PE-0164: Overloads
153. Exhibit No. PE-0164: Parameters
154. Exhibit No. PE-0164: Motion
155. Exhibit No. PE-0164: Parameters
156. Exhibit No. PE-0164: Time Delays
157. Exhibit No. PE-0164: Time Delays
158. Exhibit No. PE-0164: Parameters
159. Exhibit No. PE-0164: Event Logger
160. Exhibit No. PE-0164: Parameters
161. Exhibit No. PE-0164: Machine Position
162. Exhibit No. PE-0164: Machine Position

163. Exhibit No. PE-0164: Parameters
164. Exhibit No. PE-0164: Parameters
165. Exhibit No. PE-0164: Speed Control
166. Exhibit No. PE-0164: Speed Control
167. Exhibit No. PE-0164: Speed Control
168. Exhibit No. PE-0164: Speed Control
169. Exhibit No. PE-0164: Parameters
170. Exhibit No. PE-0164: Speed Control 2
171. Exhibit No. PE-0164: Speed Control 2
172. Exhibit No. PE-0164: Parameters
173. Exhibit No. PE-0164: Transducers
174. Exhibit No. PE-0164: Main Menu
175. Exhibit No. PE-0164: Main Menu
176. Exhibit No. PE-0164: Histograms
177. Exhibit No. PE-0164: Left Haul Temp Histogram
178. Exhibit No. PE-0164: Main Menu
179. Exhibit No. PE-0164: Main Menu
180. Exhibit No. PE-0164: Meters
181. Exhibit No. PE-0164: Meters
182. Exhibit No. PE-0164: View Hourmeters
183. Exhibit No. PE-0164: Meters
184. Exhibit No. PE-0164: Main Menu
185. Exhibit No. PE-0164: Main Menu
186. Exhibit No. PE-0164: Overloads
187. Exhibit No. PE-0164: All Overloads
188. Exhibit No. PE-0164: Overloads
189. Exhibit No. PE-0164: LH Pump OL
190. Exhibit No. PE-0164: Main Menu
191. Exhibit No. PE-0164: Machine Switches
192. Exhibit No. PE-0164: Main Menu
193. Exhibit No. PE-0164: Motor Circuits
194. Exhibit No. PE-0164: Pump Logic
195. Exhibit No. PE-0164: Left Cutter Logic
196. Exhibit No. PE-0164: Right Cutter Logic
197. Exhibit No. PE-0164: Main Menu
198. Exhibit No. PE-0164: ESR Circuit
199. Exhibit No. PE-0164: Dataloss Logic
200. Exhibit No. PE-0164: ESR Circuit
201. Exhibit No. PE-0164: ESR Logic
202. Exhibit No. PE-0164: Main Menu

203. Exhibit No. PE-0164: Automatic Control
204. Exhibit No. PE-0164: Main Menu
205. Exhibit No. PE-0164: Remote Station Status Lights
206. Exhibit No. PE-0164: Picture of MAP intact with cover on JNA0
207. Exhibit No. PE-0164: Unit Back in Pelican Box
208. Exhibit No. PE-0164: JNA0 sealed in Pelican Box under Evidence tape

APPENDIX A-3, PHOTOGRAPHS (AUGUST 11, 2010)

Photographs of the procedure of the viewing of data on Exhibit No. PE-0204, JNA0 unit, at the Joy facility in Franklin, PA, on August 11, 2010.

1. Exhibit No. PE-0204: JNA0 Unit in protective case with original seal
2. Exhibit No. PE-0204: JNA0 Unit inside protective case
3. Exhibit No. PE-0204: connector side of JNA0 Unit with Matric repair tag
4. Exhibit No. PE-0204: close-up of MAP socket of JNA0 Unit
5. Exhibit No. PE-0204: close-up showing connectors of JNA0 Unit
6. Exhibit No. PE-0204: close-up showing connectors of JNA0 Unit
7. Exhibit No. PE-0204: connector side of JNA0 Unit, with additional repair tag
8. Exhibit No. PE-0204: connector side of JNA0 Unit; two Matric repair tags
9. Exhibit No. PE-0204: JNA0 Unit, initial start-up screen
10. Exhibit No. PE-0204: JNA0 Unit, start-up sequence
11. Exhibit No. PE-0204: JNA0 Unit, start-up sequence
12. Exhibit No. PE-0204: JNA0 Unit, start-up sequence
13. Exhibit No. PE-0204: JNA0 Unit, start-up sequence
14. Exhibit No. PE-0204: JNA0 Unit, start-up sequence
15. Exhibit No. PE-0204: JNA0 Unit, main menu
16. Exhibit No. PE-0204: JNA0 Unit event log
17. Exhibit No. PE-0204: JNA0 Unit event log
18. Exhibit No. PE-0204: JNA0 Unit event log
19. Exhibit No. PE-0204: JNA0 Unit main menu

APPENDIX A-4, PHOTOGRAPHS (NOVEMBER 19, 2010)

Photographs of the procedure of the functional testing of Exhibit Nos. PE-0164 (JNA0) and PE-0165 (JNA1), and the procedure of the viewing of data on Exhibit No. PE-0269 (JNA0) at the Matric Limited facility in Seneca, PA, on November 19, 2010.

1. JNA Test Set-up Area
2. Input-Output Layout Chart
3. Vertical Shot: Test Panel With Labels
4. Vertical Shot: Cables/Wiring Test Panel
5. Test Panel Components (JNA Test Set-up)
6. Test Area Shot
7. Joy Demo JNA0 Test Screen Joy Equipment Set-up (JNA Screens)
8. Joy Demo JNA0 Test Screen Joy Equipment Set-up (JNA Screens)
9. Joy Demo JNA0 Test Screen Joy Equipment Set-up (JNA Screens)
10. Panel Labels
11. Control Panel Labels/Buttons/Handles
12. Control Panel Labels
13. Vertical Shot Labels on Control Test Panel
14. Vertical Shot Labels on Control Test Panel
15. PE-0165 JNA Evidence Case (JNA1)
16. PE-0165 JNA Evidence Case Open
17. PE-0165 JNA1 – Tag/Serial #
18. PE-0165 JNA1 – Tag/Serial # Close-up JNA Unit Tag
19. PE-0165 JNA1 – Tag/Serial # Close-up JNA Unit Tag
20. PE-0165 JNA1 tested with Joy Sample JNA0: Screen – Start-up Joy Symbol
21. PE-0165 JNA1 tested with Joy Sample JNA0: Rt Trm VFD Communication Restored
22. PE-0165 JNA1 tested with Joy Sample JNA0: ESR ON – Screen
23. PE-0165 JNA1 tested with Joy Sample JNA0: Cutter Feedback (Screen)
24. PE-0165 JNA1 tested with Joy Sample JNA0: WRN LtVFD No Amps Reported (Screen)
25. PE-0165 JNA1 tested with Joy Sample JNA0: Screen Display SYS INBY LostComm
26. PE-0165 JNA1 tested with Joy Sample JNA0: Pump Motor On Screen
27. PE-0165 JNA1 tested with Joy Sample JNA0: ERR LCutter Start False Amps Screen
28. PE-0165 JNA1 tested with Joy Sample JNA0: SYS Inby Lost Comm With Outby Screen
29. PE-0165 JNA1 tested with Joy Sample JNA0: ERR Methane Monitor Interlck Screen
30. PE-0165 JNA1 tested with Joy Sample JNA0: ESR Off Screen
31. PE-0165 JNA1 tested with Joy Sample JNA0: ESR Off Screen

32. PE-0165 JNA1 tested with Joy Sample JNA0: ERR No 110VAC – Screen Display
33. PE-0165 JNA1 tested with Joy Sample JNA0: ERR No 110VAC – Screen Display
34. PE-0165 JNA1 tested with Joy Sample JNA0: Pump Motor On Screen
35. PE-0165 JNA1 tested with Joy Sample JNA0: Pump Motor On Screen
36. PE-0165 JNA1 tested with Joy Sample JNA0: SYS Inby LostComm Screen
37. PE-0165 JNA1 tested with Joy Sample JNA0: SYS Inby LostComm Screen
38. PE-0165 JNA1 tested with Joy Sample JNA0: ERR Left Handheld DataLoss Screen
39. PE-0165 JNA1 tested with Joy Sample JNA0: ESR OFF Screen
40. PE-0165 JNA1 tested with Joy Sample JNA0: ERR Left Handheld DataLoss Screen
41. PE-0165 JNA1 tested with Joy Sample JNA0: ERR Stuck Button Left Side Screen
42. PE-0165 JNA1 tested with Joy Sample JNA0: ESR OFF
43. PE-0165 JNA1 tested with Joy Sample JNA0: ERR Stuck Button Right Side
44. PE-0165 JNA1 tested with Joy Sample JNA0: ESR OFF
45. PE-0165 JNA1 tested with Joy Sample JNA0: Pump Motor On Screen
46. PE-0165 JNA1 tested with Joy Sample JNA0: Data On DeSelected – Screen
47. PE-0165 JNA1 tested with Joy Sample JNA0: ERR Right Handheld DataLoss
48. PE-0165 JNA1 tested with Joy Sample JNA0: Both Stations Disconnected
49. PE-0165 JNA1 tested with Joy Sample JNA0: Right Cutter Jam Overload
50. PE-0165 JNA1 tested with Joy Sample JNA0: SYS Inby LostComm With Outby Screen
51. PE-0165 JNA1 tested with Joy Sample JNA0: SYS Inby LostComm With Outby Screen
52. PE-0165 JNA1 tested with Joy Sample JNA0: SYS Inby LostComm With Outby Screen
53. PE-0165 JNA1 tested with Joy Sample JNA0: Tram Right – Screen
54. PE-0165 JNA1 tested with Joy Sample JNA0: Tram Right – Screen
55. PE-0165 JNA1 tested with Joy Sample JNA0: SYS Inby LostComm With Outby – Screen
56. PE-0165 JNA1 tested with Joy Sample JNA0: Tram Left – Screen
57. PE-0165 JNA1 tested with Joy Sample JNA0: Rt Trm VFD Communication Restored Screen
58. PE-0165 JNA1 tested with Joy Sample JNA0: SYS Inby LostComm With Outby
59. PE-0165 JNA1 tested with Joy Sample JNA0: ESR OFF – Screen
60. PE-0165 JNA1 tested with Joy Sample JNA0: SYS Inby LostComm With Outby – Screen
61. PE-0165 JNA1 tested with Joy Sample JNA0: ESR ON – Screen
62. PE-0165 JNA1 tested with Joy Sample JNA0: Pump Motor ON – Screen
63. PE-0165 JNA1 tested with Joy Sample JNA0: Pump Motor ON – Screen

64. PE-0165 JNA1 tested with Joy Sample JNA0: Pump Motor ON – Screen
65. PE-0165 JNA1 tested with Joy Sample JNA0: Pump Motor ON – Screen
66. PE-0165 JNA1 tested with Joy Sample JNA0: SYS Inby LostComm With Outby
67. PE-0165 JNA1 tested with Joy Sample JNA0: SYS Inby LostComm With Outby
68. PE-0165 JNA1 tested with Joy Sample JNA0: Left Pump Overload Clear – Screen
69. PE-0165 JNA1 tested with Joy Sample JNA0: Left Pump Overload Clear – Screen
70. PE-0165 JNA1 tested with Joy Sample JNA0: ESR OFF – Screen
71. PE-0165 JNA1 tested with Joy Sample JNA0: Pump Motor On
72. PE-0165 JNA1 tested with Joy Sample JNA0: SYS Inby LostComm With Outby
73. PE-0165 JNA1 tested with Joy Sample JNA0: SYS Inby LostComm With Outby
74. PE-0165 JNA1 tested with Joy Sample JNA0: Pump Motor On
75. PE-0165 JNA1 tested with Joy Sample JNA0: LH Cutter OL – Screen
76. PE-0165 JNA1 tested with Joy Sample JNA0: SYS Inby LostComm With Outby
77. PE-0165 JNA1 tested with Joy Sample JNA0: Left Cutter Ovrld Clear In 235
78. PE-0165 JNA1 tested with Joy Sample JNA0: Left Cutter Ovrld Clear In 220
79. PE-0164 Evidence Case – Closed
80. PE-0164 Evidence Case Open
81. PE-0164 Joy Tag – Metal Close-up S/N 56602AH003
82. PE-0164 JNA0 Unit In-Case
83. PE-0164 Joy Screen/JNA Unit
84. PE-0164 Start-up Screen
85. Joy Sample Remote Control Receiver Unit
86. Test Panel Controls
87. PE-0164 JNA0 tested with PE-0165 JNA1: ESR OFF – Screen
88. PE-0164 JNA0 tested with PE-0165 JNA1: ESR OFF – Screen
89. PE-0164 JNA0 tested with PE-0165 JNA1: ERR LCutt – Screen
90. PE-0164 JNA0 tested with PE-0165 JNA1: Pump Motor On – Screen
91. PE-0164 JNA0 tested with PE-0165 JNA1: ERR LCutter Start – Screen
92. PE-0164 JNA0 tested with PE-0165 JNA1: Pump Motor On – Screen
93. PE-0164 JNA0 tested with PE-0165 JNA1: ESR OFF – Screen
94. PE-0164 JNA0 tested with PE-0165 JNA1: ERR Methane Monitor Interlck (Screen)
95. PE-0164 JNA0 tested with PE-0165 JNA1: ESR OFF
96. PE-0164 JNA0 tested with PE-0165 JNA1: Remote Motor Start – Screen
97. PE-0164 JNA0 tested with PE-0165 JNA1: ESR ON – Screen
98. PE-0164 JNA0 tested with PE-0165 JNA1: ERR No 110VAC ESR Feedback

99. PE-0164 JNA0 tested with PE-0165 JNA1: ESR OFF – Screen
100. PE-0164 JNA0 tested with PE-0165 JNA1: Pump Motor On – Screen
101. PE-0164 JNA0 tested with PE-0165 JNA1: Pump Motor WRN LtVFD No Amps Reported Screen
102. PE-0164 JNA0 tested with PE-0165 JNA1: SYS Inby LostComm With Outby
103. PE-0164 JNA0 tested with PE-0165 JNA1: Pump Motor On – Screen
104. PE-0164 JNA0 tested with PE-0165 JNA1: SYS Inby LostComm With Outby
105. PE-0164 JNA0 tested with PE-0165 JNA1: Pump Motor On – Screen
106. PE-0164 JNA0 tested with PE-0165 JNA1: Pump Motor On – Screen
107. PE-0164 JNA0 tested with PE-0165 JNA1: Pump Motor On – Screen
108. PE-0164 JNA0 tested with PE-0165 JNA1: ERR Right Handheld DataLoss – Screen
109. PE-0164 JNA0 tested with PE-0165 JNA1: ERR Right Handheld DataLoss – Screen
110. PE-0164 JNA0 tested with PE-0165 JNA1: ERR Right Handheld DataLoss – Screen
111. PE-0164 JNA0 tested with PE-0165 JNA1: ERR Right Handheld DataLoss – Screen
112. PE-0164 JNA0 tested with PE-0165 JNA1: ERR Right Handheld DataLoss – Screen
113. PE-0164 JNA0 tested with PE-0165 JNA1: ERR Right Handheld DataLoss – Screen
114. PE-0164 JNA0 tested with PE-0165 JNA1: ERR Right Handheld DataLoss – Screen
115. PE-0164 JNA0 tested with PE-0165 JNA1: ERR Left Handheld DataLoss – Screen
116. PE-0164 JNA0 tested with PE-0165 JNA1: ERR Left Handheld DataLoss – Screen
117. PE-0164 JNA0 tested with PE-0165 JNA1: ERR Left Handheld DataLoss – Screen
118. PE-0164 JNA0 tested with PE-0165 JNA1: Pump Motor On – Screen
119. PE-0164 JNA0 tested with PE-0165 JNA1: ERR Right Handheld DataLoss
120. PE-0164 JNA0 tested with PE-0165 JNA1: Data On Deselected – Screen
121. PE-0164 JNA0 tested with PE-0165 JNA1: ERR Right Handheld DataLoss – Screen
122. PE-0164 JNA0 tested with PE-0165 JNA1: ERR Left Handheld DataLoss – Screen
123. PE-0164 JNA0 tested with PE-0165 JNA1: ERR Left Handheld DataLoss – Screen
124. PE-0164 JNA0 tested with PE-0165 JNA1: Data On Deselected Rite Side
125. PE-0164 JNA0 tested with PE-0165 JNA1: Both Stations Disconnected
126. PE-0164 JNA0 tested with PE-0165 JNA1: 3 Phase Ac Amp – Screen
127. PE-0164 JNA0 tested with PE-0165 JNA1: Right Cutter Jam Overload

128. PE-0164 JNA0 tested with PE-0165 JNA1: SYS Inby LostComm With Outby
129. PE-0164 JNA0 tested with PE-0165 JNA1: Remote Motor Start – Screen
130. PE-0164 JNA0 tested with PE-0165 JNA1: Pump Motor On – Screen
131. PE-0164 JNA0 tested with PE-0165 JNA1: WRN LtVFD No Amps Reported
132. PE-0164 JNA0 tested with PE-0165 JNA1: Tram Right – Screen
133. PE-0164 JNA0 tested with PE-0165 JNA1: Rt Tram VFD Off: Current Present
134. PE-0164 JNA0 tested with PE-0165 JNA1: ESR ON – Screen
135. PE-0164 JNA0 tested with PE-0165 JNA1: SYS Inby LostComm With Outby
136. PE-0164 JNA0 tested with PE-0165 JNA1: WRN LtVFD No Amps Reported
137. PE-0164 JNA0 tested with PE-0165 JNA1: SYS Inby LostComm With Outby
138. PE-0164 JNA0 tested with PE-0165 JNA1: Tram Right – Screen
139. PE-0164 JNA0 tested with PE-0165 JNA1: Tram Right – Screen
140. PE-0164 JNA0 tested with PE-0165 JNA1: ESR ON – Screen
141. PE-0164 JNA0 tested with PE-0165 JNA1: ESR ON – Screen
142. PE-0164 JNA0 tested with PE-0165 JNA1: ESR ON – Screen
143. PE-0164 JNA0 tested with PE-0165 JNA1: VFD Trip Cleared – Screen
144. PE-0164 JNA0 tested with PE-0165 JNA1: ESR On – Screen
145. PE-0164 JNA0 tested with PE-0165 JNA1: SYS Inby LostComm With Outby Screen
146. PE-0164 JNA0 tested with PE-0165 JNA1: Pump Motor On Screen
147. PE-0164 JNA0 tested with PE-0165 JNA1: Pump Motor On Screen
148. PE-0164 JNA0 tested with PE-0165 JNA1: SYS Inby LostComm With Outby
149. PE-0164 JNA0 tested with PE-0165 JNA1: Left Pump Overload Clear In 226
150. PE-0164 JNA0 tested with PE-0165 JNA1: ESR OFF
151. PE-0164 JNA0 tested with PE-0165 JNA1: Left Pump Jam Overload
152. PE-0164 JNA0 tested with PE-0165 JNA1: SYS Inby LostComm With Outby
153. PE-0164 JNA0 tested with PE-0165 JNA1: SYS Inby LostComm With Outby
154. PE-0164 JNA0 tested with PE-0165 JNA1: Pump Motor On
155. PE-0164 JNA0 tested with PE-0165 JNA1: SYS Inby LostComm With Outby
156. PE-0164 JNA0 tested with PE-0165 JNA1: Rt Pump Overload Clear In 225
157. PE-0164 JNA0 tested with PE-0165 JNA1: SYS Inby LostComm With Outby
158. PE-0164 JNA0 tested with PE-0165 JNA1: Rt Pump Overload Clear In 30
159. PE-0164 JNA0 tested with PE-0165 JNA1: ESR OFF
160. PE-0164 JNA0 tested with PE-0165 JNA1: Left Cutter Ovrld Clear In 240
161. PE-0164 JNA0 tested with PE-0165 JNA1: Left Cutter Ovrld Clear In 225

162. PE-0164 JNA0 tested with PE-0165 JNA1: SYS Inby LostComm With Outby
163. PE-0164 JNA0 tested with PE-0165 JNA1: Pump Motor On
164. PE-0164 JNA0 tested with PE-0165 JNA1: ESR ON
165. PE-0164 JNA0 tested with PE-0165 JNA1: STS Right Handheld Estop
166. PE-0164 JNA0 tested with PE-0165 JNA1: ESR ON
167. PE-0164 JNA0 tested with PE-0165 JNA1: Pump Motor On
168. PE-0164 JNA0 tested with PE-0165 JNA1: ESR OFF
169. PE-0164 JNA0 tested with PE-0165 JNA1: ESR OFF – Screen
170. PE-0164 JNA0 tested with PE-0165 JNA1: ERR Right Handheld DataLoss
171. PE-0164 JNA0 tested with PE-0165 JNA1: STS Right Handheld Estop
172. PE-0164 JNA0 tested with PE-0165 JNA1: ERR Right Handheld DataLoss
173. PE-0164 JNA0 tested with PE-0165 JNA1: ESR OFF
174. PE-0164 JNA0 tested with PE-0165 JNA1: ESR OFF
175. PE-0269 Evidence Box: JNA Unit – Closed S/N 50905T002
176. PE-0269 Evidence Box: JNA Unit – Closed S/N 50905T002
177. PE-0269 Box Open – Showing – JNA Wrapped in Plastic Inside Box
178. PE-0269 JNA in Plastic Bag
179. PE-0269 JNA on Work Bench
180. PE-0269 JNA Joy Tag
181. PE-0269 JNA Unit Serial #’s
182. PE-0269 JNA Unit #’s Close-up
183. PE-0269 JNA Unit on Bench Table Top
184. PE-0269 Matric Tag - Close-up
185. PE-0269 Matric Tag - Close-up
186. PE-0164 Evidence Case
187. PE-0165 Top of Case – Evidence
188. PE-0165 Evidence Case – Different Angle

APPENDIX B - EXHIBIT NO. PE-0164 EVENT LOG

Event log of April 5, 2010 for JNA0 Unit, Exhibit No. PE-0164, with recorded event times corrected due to time drift analysis.

Recorded Time	Earliest	Latest	Event
4:53:03	0:59:56	1:00:01	Sys Power Reset
4:53:40	1:00:33	1:00:38	Testing Current Sensors…
4:53:40	1:00:33	1:00:38	Tram Cntl in Normal Ops Mode
4:53:45	1:00:38	1:00:43	Left Tram VFD Comm Restored
4:53:45	1:00:38	1:00:43	Right Tram VFD Comm Restored
4:53:45	1:00:38	1:00:43	SYS Inby Lost Comm with Outby
4:53:53	1:00:46	1:00:51	Current Sensor Test - Passed
4:53:53	1:00:46	1:00:51	Both Stations Disconnected
4:54:28	1:01:21	1:01:26	ERR Stuck Button Left Side
4:54:28	1:01:21	1:01:26	ERR Right Handheld Dataloss
6:18:51	2:25:44	2:25:49	ERR Left Handheld Dataloss
7:30:41	3:37:34	3:37:39	STS Left Handheld Estop
7:30:42	3:37:35	3:37:40	ERR Left Handheld Dataloss
9:24:05	5:30:58	5:31:03	STS Left Handheld Estop
9:24:07	5:31:00	5:31:05	ERR Left Handheld Dataloss
9:38:15	5:45:08	5:45:13	STS Left Handheld Estop
9:38:16	5:45:09	5:45:14	ERR Left Handheld Dataloss
9:50:59	5:57:52	5:57:57	STS Left Handheld Estop
9:51:00	5:57:53	5:57:58	ERR Left Handheld Dataloss
9:57:48	6:04:41	6:04:46	STS Left Handheld Estop
9:57:50	6:04:43	6:04:48	ERR Left Handheld Dataloss
9:57:53	6:04:46	6:04:51	Both Stations Disconnected
10:43:14	6:50:07	6:50:12	ERR Left Handheld Dataloss
10:43:38	6:50:31	6:50:36	Both Stations Disconnected
10:43:40	6:50:33	6:50:38	ERR Left Handheld Dataloss
10:43:44	6:50:37	6:50:42	Both Stations Disconnected
10:43:46	6:50:39	6:50:44	ERR Left Handheld Dataloss
10:47:36	6:54:29	6:54:34	Both Stations Disconnected
10:47:38	6:54:31	6:54:36	ERR Left Handheld Dataloss
10:50:40	6:57:33	6:57:38	Both Stations Disconnected
10:50:43	6:57:36	6:57:41	ERR Left Handheld Dataloss
10:51:17	6:58:10	6:58:15	Both Stations Disconnected
10:51:20	6:58:13	6:58:18	ERR Left Handheld Dataloss
10:51:21	6:58:14	6:58:19	Both Stations Disconnected
10:51:22	6:58:15	6:58:20	ERR Left Handheld Dataloss
10:51:22	6:58:15	6:58:20	Both Stations Disconnected
10:51:24	6:58:17	6:58:22	ERR Left Handheld Dataloss
10:51:24	6:58:17	6:58:22	Both Stations Disconnected
10:51:29	6:58:22	6:58:27	ERR Left Handheld Dataloss
10:51:36	6:58:29	6:58:34	Both Stations Disconnected
10:51:39	6:58:32	6:58:37	ERR Left Handheld Dataloss
10:51:48	6:58:41	6:58:46	Both Stations Disconnected

Recorded Time	Earliest	Latest	Event
10:51:50	6:58:43	6:58:48	ERR Left Handheld Dataloss
10:51:54	6:58:47	6:58:52	Both Stations Disconnected
10:51:59	6:58:52	6:58:57	ERR Left Handheld Dataloss
10:52:00	6:58:53	6:58:58	Both Stations Disconnected
10:52:06	6:58:59	6:59:04	ERR Left Handheld Dataloss
10:52:08	6:59:01	6:59:06	Both Stations Disconnected
10:52:10	6:59:03	6:59:08	ERR Left Handheld Dataloss
10:52:12	6:59:05	6:59:10	Both Stations Disconnected
10:52:17	6:59:10	6:59:15	ERR Left Handheld Dataloss
10:59:57	7:06:50	7:06:55	STS Right Handheld Estop
11:01:18	7:08:11	7:08:16	Data on Deselected Left Side
11:01:19	7:08:12	7:08:17	ERR No 110 VAC ESR Feedback
11:03:05	7:09:58	7:10:03	Left VFD Overcurrent Trip
11:03:06	7:09:59	7:10:04	VFD Trip Cleared
11:03:24	7:10:17	7:10:22	STS Right Handheld Estop
11:03:46	7:10:39	7:10:44	STS Right Handheld Estop
11:03:48	7:10:41	7:10:46	STS Right Handheld Estop
11:04:02	7:10:55	7:11:00	STS Right Handheld Estop
11:04:10	7:11:03	7:11:08	ERR Left Handheld Dataloss
11:04:14	7:11:07	7:11:12	Both Stations Disconnected
11:04:39	7:11:32	7:11:37	STS Right Handheld Estop
11:04:46	7:11:39	7:11:44	STS Right Handheld Estop
11:04:55	7:11:48	7:11:53	STS Right Handheld Estop
11:04:56	7:11:49	7:11:54	ERR Right Handheld Dataloss
11:05:44	7:12:37	7:12:42	STS Right Handheld Estop
11:07:03	7:13:56	7:14:01	STS Right Handheld Estop
11:19:00	7:25:53	7:25:58	Both Stations Disconnected
11:29:01	7:35:54	7:35:59	STS Right Handheld Estop
11:29:32	7:36:25	7:36:30	ERR Right Handheld Dataloss
11:29:53	7:36:46	7:36:51	STS Right Handheld Estop
11:30:00	7:36:53	7:36:58	STS Right Handheld Estop
11:30:33	7:37:26	7:37:31	STS Right Handheld Estop
11:30:39	7:37:32	7:37:37	STS Right Handheld Estop
11:30:42	7:37:35	7:37:40	STS Right Handheld Estop
11:30:44	7:37:37	7:37:42	STS Right Handheld Estop
11:30:47	7:37:40	7:37:45	STS Right Handheld Estop
11:30:49	7:37:42	7:37:47	STS Right Handheld Estop
11:30:51	7:37:44	7:37:49	STS Right Handheld Estop
11:30:53	7:37:46	7:37:51	STS Right Handheld Estop
11:30:54	7:37:47	7:37:52	STS Right Handheld Estop
11:31:10	7:38:03	7:38:08	STS Right Handheld Estop
11:31:11	7:38:04	7:38:09	Both Stations Disconnected
11:39:41	7:46:34	7:46:39	Both Stations Disconnected
11:39:42	7:46:35	7:46:40	STS Left Handheld Estop
11:40:02	7:46:55	7:47:00	ERR Left Handheld Dataloss
11:40:22	7:47:15	7:47:20	STS Left Handheld Estop
11:40:41	7:47:34	7:47:39	OVL JAM Warning - RH Cutt

Recorded Time	Earliest	Latest	Event
11:40:41	7:47:34	7:47:39	OVL JAM Trip - RH Cutt
11:42:56	7:49:49	7:49:54	STS Right Handheld Estop
11:42:57	7:49:50	7:49:55	ERR No 110 VAC ESR Feedback
11:44:14	7:51:07	7:51:12	Both Stations Disconnected
11:44:19	7:51:12	7:51:17	STS Right Handheld Estop
11:44:36	7:51:29	7:51:34	STS Right Handheld Estop
11:45:07	7:52:00	7:52:05	STS Right Handheld Estop
11:45:31	7:52:24	7:52:29	STS Right Handheld Estop
11:45:32	7:52:25	7:52:30	STS Right Handheld Estop
11:45:59	7:52:52	7:52:57	STS Right Handheld Estop
11:46:04	7:52:57	7:53:02	STS Right Handheld Estop
11:46:27	7:53:20	7:53:25	STS Right Handheld Estop
11:46:57	7:53:50	7:53:55	STS Right Handheld Estop
11:52:05	7:58:58	7:59:03	STS Right Handheld Estop
12:54:01	9:00:54	9:00:59	STS Left Handheld Estop
13:00:53	9:07:46	9:07:51	STS Right Handheld Estop
13:35:53	9:42:46	9:42:51	STS Right Handheld Estop
14:02:46	10:09:39	10:09:44	STS Right Handheld Estop
14:08:10	10:15:03	10:15:08	Both Stations Disconnected
14:08:34	10:15:27	10:15:32	Both Stations Disconnected
14:08:48	10:15:41	10:15:46	Both Stations Disconnected
14:08:50	10:15:43	10:15:48	STS Right Handheld Estop
14:09:13	10:16:06	10:16:11	STS Right Handheld Estop
14:09:33	10:16:26	10:16:31	STS Right Handheld Estop
14:10:43	10:17:36	10:17:41	Both Stations Disconnected
14:10:54	10:17:47	10:17:52	STS Right Handheld Estop
14:11:03	10:17:56	10:18:01	STS Right Handheld Estop
14:11:27	10:18:20	10:18:25	STS Right Handheld Estop
14:11:52	10:18:45	10:18:50	STS Right Handheld Estop
14:12:02	10:18:55	10:19:00	STS Right Handheld Estop
14:12:03	10:18:56	10:19:01	STS Right Handheld Estop
14:12:12	10:19:05	10:19:10	STS Right Handheld Estop
14:12:28	10:19:21	10:19:26	STS Right Handheld Estop
14:12:32	10:19:25	10:19:30	STS Right Handheld Estop
14:12:37	10:19:30	10:19:35	STS Right Handheld Estop
14:16:51	10:23:44	10:23:49	STS Right Handheld Estop
14:16:52	10:23:45	10:23:50	ERR Right Handheld Dataloss
14:17:05	10:23:58	10:24:03	Both Stations Disconnected
14:17:06	10:23:59	10:24:04	ERR Right Handheld Dataloss
14:17:06	10:23:59	10:24:04	Both Stations Disconnected
14:32:32	10:39:25	10:39:30	ERR Left Handheld Dataloss
14:45:18	10:52:11	10:52:16	STS Right Handheld Estop
14:45:20	10:52:13	10:52:18	ERR Right Handheld Dataloss
15:07:59	11:14:52	11:14:58	Both Stations Disconnected
15:18:47	11:25:40	11:25:46	ERR Right Handheld Dataloss
15:18:47	11:25:40	11:25:46	Data On Deselected Left Side
15:33:07	11:40:00	11:40:06	STS Left Handheld Estop

Recorded Time	Earliest	Latest	Event
15:33:08	11:40:01	11:40:07	ERR Left Handheld Dataloss
16:37:24	12:44:17	12:44:23	STS Left Handheld Estop
16:37:25	12:44:18	12:44:24	ERR Left Handheld Dataloss
17:25:56	13:32:49	13:32:55	Data On Deselected Rite Side
17:26:20	13:33:13	13:33:19	STS Left Handheld Estop
17:26:21	13:33:14	13:33:20	ERR Left Handheld Dataloss
17:30:43	13:37:36	13:37:42	ERR Right Handheld Dataloss
17:42:09	13:49:02	13:49:08	STS Right Handheld Estop
17:42:10	13:49:03	13:49:09	ERR Right Handheld Dataloss
17:50:52	13:57:45	13:57:51	STS Left Handheld Estop
17:50:54	13:57:47	13:57:53	ERR Left Handheld Dataloss
18:09:56	14:16:49	14:16:55	STS Right Handheld Estop
18:52:39	14:59:32	14:59:38	STS Right Handheld Estop
18:52:41	14:59:34	14:59:40	ERR Right Handheld Dataloss

APPENDIX C – JNA EVENTS HELP TEXT

Help text for events recorded in the electronic event log of April 5, 2010, Exhibit No. PE-0164, JNA0 unit. The event log consisted of a listing of machine status codes and error messages.

Event	Event Help Text	Additional Info
SYS Power Reset	EVENT 0001: The JNA System has had it's power reset. If this event seems to happen too often or at unexpected times, then the events are most likely caused by a problem with the wiring of the power to Unit 0. Check all wires and connectors in the circuit feeding power to the unit. It is also possible that Unit 0 has an internal power supply fault that would produce the same symptoms. ***** END *****	This event will always be the first event logged when the JNA system is powered on.
Testing Current Sensors	EVENT 3287: No Help Text	The JNA system induces a voltage through a test winding of the pump and cutter motor current sensor during JNA system power up. This event indicates that the test has been started.
Tram Cntl in Normal Ops Mode	EVENT 3436: The tram system is being controlled by normal operating parameters.	
Both Stations Disconnected	EVENT 3265: No Help Text	This event will not always occur on JNA system power up - it is dependent on the position of the station selector switch and if the left/right radio is powered.
OVL Sensor Failed - LH Pump	EVENT 3590: An unexpected reading from the Left Pump motor motor current sensor has occurred. Please check the current sensor's circuit. If connections seem to be correct, consider replacing the current sensor.	This event indicates the Left Pump motor has failed the current sensor test. The Left Pump will be disabled until the circuit is corrected.

Event	Event Help Text	Additional Info
OVL Sensor Failed - RH Pump	EVENT 3598: An unexpected reading from the Right Pump motor motor current sensor has occurred. Please check the current sensor's circuit. If connections seem to be correct, consider replacing the current sensor.	This event indicates the Right Pump motor has failed the current sensor test. The Right Pump will be disabled until the circuit is corrected.
OVL Sensor Failed - LH Cutt	EVENT 3606: An unexpected reading from the left cutter motor current sensor has occurred. Please check the current sensor's circuit. If connections seem to be correct, consider replacing the current sensor.	This event indicates the Left Cutter motor has failed the current sensor test. The Left Cutter will be disabled until the circuit is corrected.
OVL Sensor Failed - RH Cutt	EVENT 3614: An unexpected reading from the right cutter motor current sensor has occurred. Please check the current sensor's circuit. If connections seem to be correct, consider replacing the current sensor.	This event indicates the Right Cutter motor has failed the current sensor test. The Right Cutter will be disabled until the circuit is corrected.
Current Sensor Test - Failed	EVENT 3288: No Help Text	This event reports the results of the current sensor test. The JNA system has deteceted a problem with the current sensor, current sensor to JNA wiring or the JNA units. The failed motor current detection circuit will be identified by individual events.
Current Sensor Test - Passed	EVENT 3289: No Help Text	This event reports the results of the current sensor test. The JNA system has detected that all current sensor circuits are fully functional.
Left VFD Comm Restored	EVENT 3460: The communication link from the left tram inverter to the JNA control system has been restored. All possible causes for the loss of communication have been cleared.	This event indicates the initial comms link to the Left VFD has been established.
Right VFD Comm Restored	EVENT 3461: The communication link from the right tram inverter to the JNA control system has been restored. All possible causes for the loss of communication have been cleared.	This event indicates the initial comms link to the Right VFD has been established.

Event	Event Help Text	Additional Info
SYS Inby LostComm with Outby	The Inby JNA System has lost communications with the Outby JNA System. If this event seems to happen too often or at unexpected times, then the events are most likely caused by a problem with the wiring of the Line Coupler. Check all wires and connectors in the circuit between the JNA Unit and the Line Coupler and between the Line Coupler and the high voltage 3 phase lines and ground. It is also possible that there is an internal failure in the JNA Unit that contains the interface to the Line Coupler.	This event will always be shown when the JNA system is powered on if outby comms are down.
Data on Deselected Left Side	EVENT 3263: No Help Text	Indicates left radio detected when station selector is set to right only.
Data on Deselected Rite Side	EVENT 3264: No Help Text	Indicates right radio detected when station selector is set to left only.
STS Left Handheld Estop	EVENT 3252: The data from the Left Handheld dropped out for 0.5 to 1.5 seconds. It is assumed that estop caused this data dropout	
STS Right Handheld Estop	EVENT 3256: The data from the Right Handheld dropped out for 0.5 to 1.5 seconds. It is assumed that estop caused this data dropout.	
ERR Left Handheld Dataloss	EVENT 3253: The data from the Left Handheld dropped out for more than 1.5 seconds. This is assumed to be a dataloss.	
ERR Right Handheld Dataloss	EVENT 3257: The data from the Right Handheld dropped out for more than 1.5 seconds. This is assumed to be a dataloss.	

Event	Event Help Text	Additional Info
OVL Jam Warning - RH Cutt	EVENT 3613: The right cutter motor is nearing a jam trip. Be aware that a jam trip may soon occur. For more information, check the pages in the OVERLOADS menu.	
OVL Jam Trip - RH Cutt	EVENT 3611: The right cutter motor jam overload has tripped.	
OVL Jam Warning - RH Tram	EVENT 3637: The right haulage motor is nearing a jam trip. Be aware that a jam trip may soon occur. For more information, check the pages in the OVERLOADS menu.	
OVL Jam Trip - RH Tram	EVENT 3635: The right haulage motor jam overload has tripped.	
ERR No 110 VAC ESR Feedback	EVENT 3180: The 110 volt AC signal supplied by the ESR relay has not been received by the JNA control system. The ESROn command has been turned off. Check the wiring from the ESR relay to the JNA control system. Also check the ESR relay to ensure that it is not faulty.	
Left VFD Overcurrent Trip	EVENT 3480: The left variable frequency drive has tripped due to an overcurrent condition.	This condition is reported by the VFD - JNA receives a trip bit from the drive and will simply display this message.
VFD Trip Cleared	EVENT 3483: No Help Text	This message indicates that a VFD trip bit is no longer being receive from the VFD.
ERR Stuck Button Left Side	EVENT 3254: A Button press was detected while the left station was powering up.	

APPENDIX D – EVENTS USED FOR FUNCTIONAL TESTING OF EXHIBIT NOS. PE-0164 AND PE-0165

The events listed below are those that the investigation team asked Joy to simulate. Joy indicated that some of the events were no longer used or the events could not be simulated on the Joy test panel. Therefore, some of the events listed are shaded. The events that are non- shaded or lightly shaded were those that were simulated during the functional test; events that are darkly shaded could not be simulated during the functional test.

Event can be generated on Joy test panel
Event is no longer used and has been replaced by another event
Event is no longer used and has no replacement or event cannot be simulated on Joy test panel

Item	EVENT #	STATUS TEXT	Reply To MSHA
1	3072	ERR PUMP RUN NO ESR	Not used in 100173695-05 Replaced by 3180 - SEE ITEM 9
2	3079	ERR PUMP STARTNOESR	Not used in 100173695-05
3	3096	ERR LEFT CUTTER RUN NO PUMP	Not used in 100173695-05
4	3100	ERR LCUTT RUN NO MOTOR AMPS	1. Energize left cutter motor 2. Use left cutter current pot to reduce simulated motor amps to 0
5	3101	ERR LCUTTER START NO PUMP	Not used in 100173695-05
6	3105	ERR LCUTTER START FALSE AMPS	1. Begin motor start process 2. Simulate motor current before start delay expires
7	3106	ERR RIGHT CUTTER RUN NO PUMP	Not used in 100173695-05
8	3174	ERR METHANE MONITOR INTERLCK	1. Energize pump, cutter and haulage motors 2. Use Methane Monitor switch on panel to generate methane fault
9	3180	ERR NO 110 V AC ESR FEEDBACK	1. Energize ESR 2. Remove ESR relay from socket
10	3200	ERR LEFT HAULAGE MOTOR RTD	Replaced by 3511 1. Energize pump and haulage motors 2. Use left haulage motor RTD pot to increase temp to >180 deg C
11	3201	ERR RIGHT HAULAGE MOTOR RTD	Replaced by 3511 1. Energize pump and haulage motors 2. Use left haulage motor RTD pot to increase temp to >180 deg C

Item	EVENT #	STATUS TEXT	Reply To MSHA
12	3203	ERR PUMP START NO ESR	Not used in 100173695-05
13	3251	ERR LEFT HANDHELD DROPOUT	No way to force dropout
14	3252	STS LEFT HANDHELD ESTOP	1. With radio powered on press the estop button
15	3253	ERR LEFT HANDHELD DATALOSS	1. With radio powered on disconnect the radio from cable
16	3254	ERR STUCK BUTTON LEFT SIDE	1. With radio off, press and hold any button except 2nd/On 2. Power radio on while continuing to hold "stuck" button
17	3255	ERR RIGHT HANDHELD DROPOUT	No way to force dropout
18	3256	STS RIGHT HANDHELD ESTOP	1. With radio powered on press the estop button
19	3257	ERR RIGHT HANDHELD DATALOSS	1. With radio powered on disconnect the radio from cable
20	3258	ERR STUCK BUTTON RIGHT SIDE	1. With radio off, press and hold any button except 2nd/On 2. Power radio on while continuing to hold "stuck" button
21	3259	PUMP MOTOR ON	Not recorded in event log 1. Start pump motor
22	3263	DATA ON DESELECTED LEFT SIDE	1. Place station selector switch in Right Only position 2. Turn on left radio
23	3264	DATA ON DESELECTED RITE SIDE	1. Place station selector switch in Left Only position 2. Turn on right radio
24	3265	BOTH STATIONS DISCONNECTED	1. Place station selector switch in Both position 2. Turn on left and right radios 3. Turn off left or right radio 4. Turn off the remaining radio
25	3279	LEFT PUMP JAM OVERLOAD	Not used in 100173695-05 Replaced by 3587 - SEE ITEM 42
26	3280	RIGHT PUMP JAM OVERLOAD	Not used in 100173695-05 Replaced by 3595 - SEE ITEM 46
27	3281	LEFT CUTTER JAM OVERLOAD	Not used in 100173695-05 Replaced by 3603 - SEE ITEM 49
28	3282	RIGHT CUTTER JAM OVERLAOD	Not used in 100173695-05 Replaced by 3611 1. Start Pump and cutter motors 2. Increase simulated motor current to 282 amps
29	3284	LEFT HAULAGE JAM OVERLOAD	Not used in 100173695-05 Replaced by 3627 Not setup to simulate 3627 on panel
30	3285	RIGHT HAULAGE JAM OVERLOAD	Not used in 100173695-05 Replaced by 3635 Not setup to simulate 3635 on panel
31	3327	REMOTE MOTOR START DISABLED	Not recorded in event log 1. Set Optional Features.Remote Motor Start to 0 2. Energize ESR 3. Press and hold 2nd + Halt buttons to attempt remote start

Item	EVENT #	STATUS TEXT	Reply To MSHA
32	3425	LEFT TRM MTRTRQ SHAFT BREAK	1. Energize pump and haulage motors 2. Verify that haulage motor freq is greater than Speed Control 2.Breakage Low Frequency (default = 25) 3. Set the left haulage motor current greater than 10 amps and less than Speed Control 2.Shaft Break Lo Setpt (default = 50) 4. Set the right haulage motor current greater than Speed Control 2.Shaft Break Hi Setpt (default = 70) 5. Maintain the above for the duration of Speed Control 2.Shaft Break Timer (default = 20)
33	3426	RGHT TRM MTR TRQ SHAFT BREAK	1. Energize pump and haulage motors 2. Verify that haulage motor freq is greater than Speed Control 2.Breakage Low Frequency (default = 25) 3. Set the right haulage motor current greater than 10 amps and less than Speed Control 2.Shaft Break Lo Setpt (default = 50) 4. Set the left haulage motor current greater than Speed Control 2.Shaft Break Hi Setpt (default = 70) 5. Maintain the above for the duration of Speed Control 2.Shaft Break Timer (default = 20)
34	3450	LT TRAM VFD IN CURRENT LIMIT	Not setup to simulate on panel
35	3451	RT TRAM VFD IN CURRENT LIMIT	Not setup to simulate on panel
36	3475	LEFT VFD OVERVOLTAGE TRIP	With power off. Connect negative of 9 V battery to X3/pin 2 (negative bus) and positive to TP19 through NO switch. With power on, momentarily close switch. NOTE: battery circuit at bus potential.
37	3476	RIGHT VFD OVERVOLTAGE TRIP	With power off. Connect negative of 9 V battery to X3/pin 2 (negative bus) and positive to TP19 through NO switch. With power on, momentarily close switch. NOTE: battery circuit at bus potential.
38	3480	LEFT VFD OVERCURRENT TRIP	Prepare jumper with 33 R resistor. Apply momentarily from center pin of TPX10 or TPX12 (CT inputs) to TP6 (+15 V) or TP7 (-15 V). NOTE: resistor will get hot.
39	3481	RIGHT VFD OVERCURRENT TRIP	Prepare jumper with 33 R resistor. Apply momentarily from center pin of TPX10 or TPX12 (CT inputs) to TP6 (+15 V) or TP7 (-15 V). NOTE: resistor will get hot.
40	3483	VFD TRIP CLEARED	Will be generate when above events 3475/3476/3480/3481 clear
41	3586	OVL THERMAL WARN. - LH PUMP	1. Start Pump motor 2. Increase simulated motor current to 45 amps 3. When Thermal OL meter reaches 90% warning will be generated
42	3587	OVL JAM TRIP - LH PUMP	1. Start Pump motor 2. Increase simulated motor current to 48 amps

Item	EVENT #	STATUS TEXT	Reply To MSHA
43	3589	OVL JAM WARNING - LHPUMP	Note: This event is hard to generate on the panel without generating a 3587 1. Start Pump motor 2. Increase simulated motor current to just below 48 amps
44	3592	OVL THERMALTRIP-RHPUMP	1. Start Pump motor 2. Increase simulated motor current to 45 amps 3. Thermal OL meter will begin to increase over several minutes Thermal OL will take 4 minutes to clear before pumps can be started again
45	3594	OVL THERMAL WARN. - RHPUMP	1. Start Pump motor 2. Increase simulated motor current to 45 amps 3. When Thermal OL meter reaches 90% warning will be generated
46	3595	OVL JAM TRIP - RH PUMP	1. Start Pump motor 2. Increase simulated motor current to 48 amps
47	3600	OVL THERMAL TRIP - LH CUTT	1. Start Pump and cutter motors 2. Increase simulated motor current to 270 amps 3. Thermal OL meter will begin to increase over several minutes Thermal OL will take 4 minutes to clear before cutters can be started again
48	3602	OVL THERMAL WARN - LH CUTT	1. Start Pump and cutter motors 2. Increase simulated motor current to 270 amps 3. When Thermal OL meter reaches 90% warning will be generated
49	3603	OVL JAM TRIP - LH CUTT	1. Start Pump and cutter motors 2. Increase simulated motor current to 282 amps
50	3605	OVL JAM WARNING -LH CUTT	Note: This event is hard to generate on the panel without generating a 3603 1. Start Pump motor 2. Increase simulated motor current to just below 282 amps

APPENDIX E - MSHA PERSONNEL INVOLVED IN THE INVESTIGATION

Mine Safety and Health Administration

Dean Cripps
Kenneth Darby
Kevin Hedrick
Robert Holubeck
Matthew Heightland
Charles J. Maggard

APPENDIX Y

EXECUTIVE SUMMARY OF INVESTIGATION OF A DIGITAL VIDEO RECORDER (DVR)