Incident Summary (Reference #5577396) (Final)

SUPPORTING INFORMATION	Incident Date			February 14, 2016
	Location			Near Pink Mountain
	Regulated industry sector			Boiler and Pressure Vessel System
	Impact	Injury	Qty Injuries	0
			Injury description	No injuries
			Injury rating	None
		Damage	Damage description	Front and rear doors, control panel and gas piping damaged.
			Damage rating	Major
	Incident rating			Major
	Incident overview			A high pressure diesel fired steam boiler combustion chamber explosion occurred. The burner management system may have failed resulting in an explosive mixture of diesel and combustion air upon ignition.
INVESTIGATION CONCLUSIONS	Site, system and components			The incident occurred at a remote drilling rig north of Fort St. John. The burner management flame monitor is a microprocessor based control system designed to provide the proper burner sequencing, ignition, and flame monitoring protection on automatically ignited oil, gas and combination fuel burners. In conjunction with limit and operating controls, it programs the burner/blower motor, ignition and fuel valves to provide for proper and safe burner operation.
	Failure scenario(s)			**Scenario 1:** Burner management flame monitor sent out on February 17, 2016 to the manufacture for analysis to determine if it contributed to the event. **Scenario 2:** A licensed BC Class A contractor has done an initial review of the burners and reported that the nozzles were so heavily sooted up it looked like fuel may have only been spraying out of nozzle #4 or #1 of the 4 nozzles. This build up may have contributed to the misfire. **Scenario 3:** Class A contractor reported that the electrodes appeared to be set too far apart and this may have contributed to late ignition. **Scenario 4:** The Class A contractor also reported that the possible failure of the fuel solenoid valve on the fuel line from the fuel pump to the nozzles may have provided enough fuel for an explosive situation. **Scenario 5:** Did shift operator(s) recognize a potential abnormality? **Scenario 6:** Do maintenance records indicate contributing factors?

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	Facts and Evidence	**Scenario 1:** The Burner management flame monitor sent out to the manufacture for analysis with findings submitted to BCSA on April 5, 2016. The manufacture's report concluded that there was no indication that the control is malfunctioning. However, the report noted that photos observed from site, wiring differences between the photos taken with the control in the panel vs pictures of the terminal blocks on the bench. For example, S2 wire is black in the panel but blue on the bench. Panel photos may indicate the presence of jumpers which are missing on the bench photo. Interviews conducted on February 15, 2016 with the shift personnel who were on site the day of the incident responsible for the boiler operation reported that there was nothing unusual or out of the ordinary with the boiler operation during the shift. Discussion with the rig manager on April 7, 2016 determined that when he sent in the unit for analysis by the manufacturer that he forgot to send in the wiring and terminal blocks. When the rig manager did sent them in, he incorrectly wired the terminal blocks thus accounting for the difference in wiring. **Scenario 2:** Heavily sooted burner nozzles: A licensed BC Class A contractor has done an initial review of the burners and reported that the nozzles were so heavily sooted up it looked like fuel may have only been spraying out of nozzle #4 or #1 of the 4 nozzles. This build up may have contributed to the misfire. In a later report dated February 25, 2016 by the Class A contractor provides a further explanation relating to the heavily sooted nozzles: This is a good indication that there was an after burn occurring, which is fuel burning after the burner was shut off. This may have been from the bimba piston that forces the air damper open on high fire. When the burner shuts off the fuel that forces this piston open is forced out of the piston by a spring. The solenoid that allowed the fuel in to open the piston closes and the fuel escapes out the nozzles. If this fuel was able to pool and burn at the end of the gun, it would cause soot to build up. This small amount of fuel seems unlikely to be enough to cause much more than a hard start. **Scenario 3:** The Class A contractor reported that the electrodes appeared to be set too far apart and this may have contributed to late ignition. In the February 25, 2016 report the contractor describes that the flame controller should lock out if it doesn't see a flame within 10 seconds. **Scenario 4:** The possible failure of fuel solenoid valve on the fuel line from the fuel pump to the nozzles which may have provided enough fuel for an explosive situation. The Class A contractor in the February 25, 2016 report indicated that the amount of fuel it would take to cause this boiler door to blow open seems more likely to be a failed solenoid valve on the fuel line. **Scenario 5:** Did shift operator(s) recognize a potential abnormality? Crew members do not hold BC Oil well boiler certificates of qualification. The following personnel on shift during the incident hold ABSA Special Oilwell Operator certificates of qualification including; the Rig Manager, Driller, and one of two derrick hands. However, the motor hand who was responsible for the boiler blow-downs during the shift on the date of incident does not hold either the BC or Alberta operator certificate of qualifications.

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	Scenario 5 (continued): Training records indicate that as of January 29, 2016: The motor hand received second period training. Period one training included 4 hours on introduction to boilers with an outcome of: monitor rig boiler, identify normal from abnormal operations (under the supervision of a certified special oil-well class holder).This training included seven sub categories: 1. Describe boiler system, 2. Describe lockouts for boiler and steam systems, 3. Describe hazards and precautions required for working with boilers and steam, 4. Describe the precautions needed for handling de-scaling chemicals, 5. Describe daily boiler inspection and daily maintenance including blowdown, 6. Describe boiler instrumentation and controls, 7. Describe blowing down steam lines. During an interviews on February 15, 2016 with the Driller confirmed that his duties include the overseeing that blow-downs are occurring. The Motor hand in interview indicated that he has three years experience as a Motor hand. Interviews with the personnel from the hift during the incident all indicated that there was nothing unusual about the boiler during the shift. Boiler logbook entries were reviewed dating back to January 1, 2016 and show that each day items are checked at both 9:00am and 9:00pm the entries are single line entries with the same findings for both times of day entries include: time , ph levels of boiler and tank, chemical type, amount added, fuel pressure, stack temperature and boiler blow-down in seconds. There are no comments entered in the section entitled “problems occurred or comments” and no signature under sections repaired by or boiler man. There are no signatures of the supervisor (driller) or rig manager indicating follow-up of shift entries. **Scenario 6:** Do maintenance records indicate contributing factors? The last service report completed by a licensed Class A contractor dated October 16, 2015 indicates that the boiler annual service was performed including cleaning and check of all burner controls, fuel lines, all electrical connections and all operating and safety controls as well as firing the boiler.
Causes and Contributing Factors	It is unlikely that the burner flame control was the primary contributing factor in this case as the manufacture tested the unit and concluded that after testing there was no indication that the unit was malfunctioning. It is very unlikely that any wiring was jumpered as the rig manager declared that when he sent in the unit for analysis at the manufacturer that he forgot to send in the wiring and terminal blocks. When the rig manager did sent them in, he incorrectly wired the terminal blocks thus accounting for the difference in wiring. The heavy soot build up is less likely in itself to have resulted in the outcome of this incident as the Class A contractor reviewing the burner nozzles post incident indicates that this may only have resulted in a hard start.

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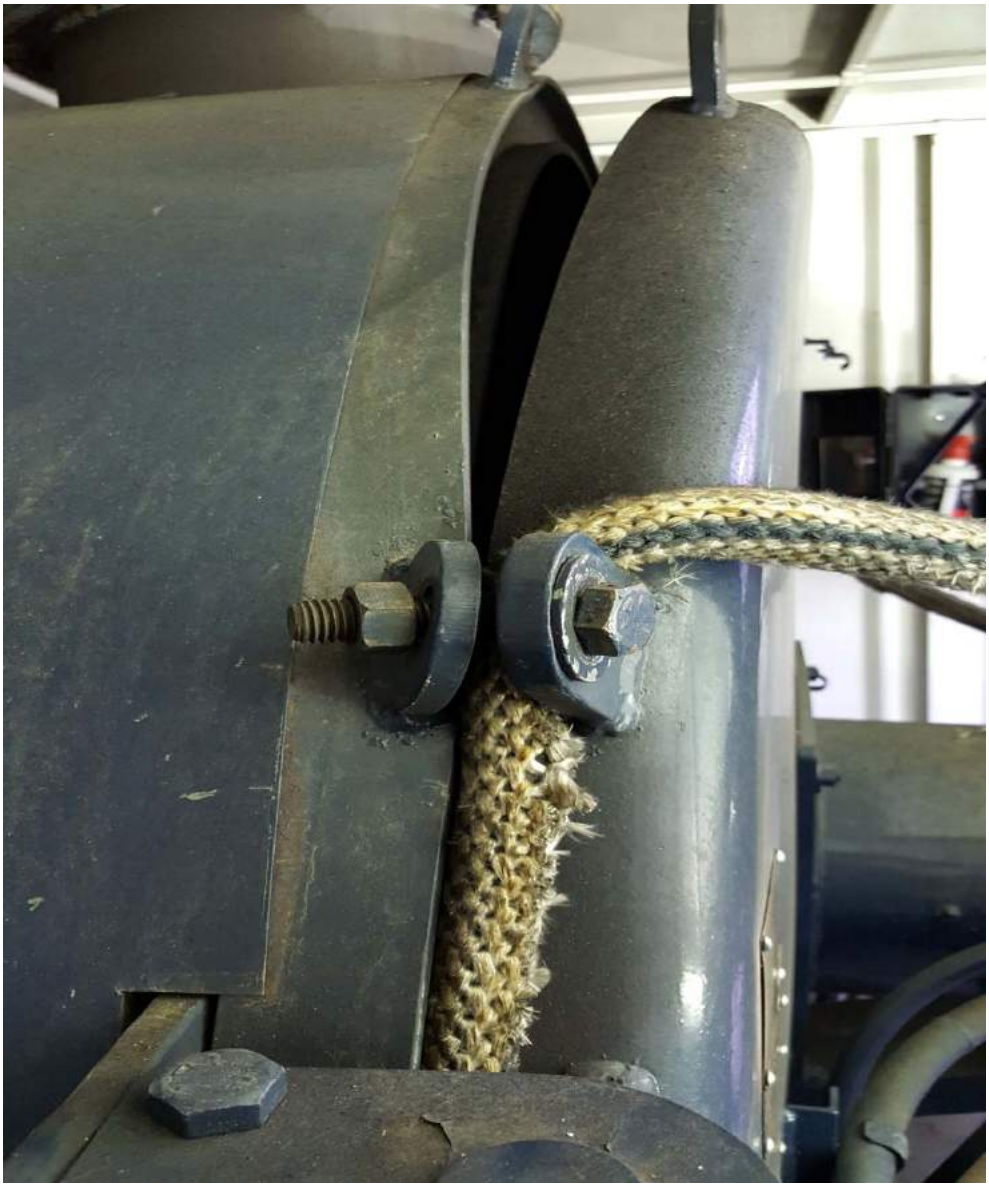
		The electrodes apparently being set too far apart is an unlikely cause as the contractor describes that the flame controller should lock out if it doesn't see a flame within 10 seconds. And the manufacture of the unit after testing the unit post incident concluded that there is no indication that the unit is malfunctioning. It is probable that a failure of the fuel solenoid valve on the fuel line from the fuel pump to the nozzles may have provided enough fuel for an explosive situation. Motor hand training may have contributed to the outcome as the training program indicates only 4 hours of boiler operation instruction. Logbook records for the time period reviewed do not include comments about observation findings during daily checks and no one preforming the daily checks is signing the logbook. There is no objective evidence in the logbook to support supervisor verification of personnel preforming boiler related duties. Maintenance records provide support that it is unlikely that a known contributing factor existed.

Photos next page:

Front of Boiler



Front door damage

Burner nozzles