

PURVEYOR TO EXCELLENCE

Project Status Memorandum		
To:	Mr. Shane Cunningham CalFire PO Box 994246 Sacramento, CA 94244-2460	Subject: Status to date Re: Investigation of Valley Fire, Lake Co 8015 High Valley Rd, Kelseyville, CA Incident # CALNU 008670 Request # O-351 DOL 9/12/2015 Contract # 7CA02326
From:	Jim Nolt, P.E.	Date: September 30, 2015

1 When:

- 1.01 Date of Loss: 9/12/2015
- 1.02 Date of Exam: 9/14/2015

2 Where:

- 2.01 Loss address: 8015 High Valley Rd, Kelseyville (Cobb), CA
- 2.02 Exam address: same as loss address

3 What's There:

- 3.01 I was asked by CalFire to assist with the examination of the subject fire scene.
- 3.02 When I completed my initial site survey (see photos 2 through 4 as typical) my attention was directed at the remains of an electrical conductor splice (see photos 5 & 6 as typical).
- 3.03 This splice was one of two splices made in the branch circuit conductors providing power from a 2-pole 40-amp circuit breaker (see photos 4 & 17 as typical) to an operating spa/hot-tub (see photos 9 & 10 as typical).
- 3.04 The splice closest to the power source (line) can be seen in photos 5 thru 8. The splice closest to the spa (load) can be seen in photo 9.
- 3.05 Power to the hot tub was provided by a 2-pole 40-amp circuit breaker. See photos 4, 17 and 18 as typical. This circuit breaker was found in the tripped position.
- 3.06 Branch conductors for this circuit ran from the circuit breaker inside a sub-panel (see photo 4 as typical) through an exterior wall to an exterior single-gang junction box near the area of interest. See photos 25 through 27 as typical. These individual branch conductors were in white PVC conduit that was installed about 1 inch below finished grade. (Table 300.5 of the National Electrical Code specifies that nonmetallic conduit, for circuits less than 600V but more than 120V, be installed 18 inches below finished grade.) Photo 26 shows much of the white conduit and some gray water piping (run in parallel) after it had been pulled up to the surface by hand.
- 3.07 The junction box shown in photos 25, 27 and 28 was originally 18 to 24 inches above finished grade. It was not secured structurally with the support required by the National Electrical Code, section 314.23B, Supports. At my examination, it appeared to have been held in place only by the conduit.
- 3.08 The splice of interest is shown in the photo 25 near the yellow-number-one tag. It is also shown in more detail in photos 5 through 8 as typical. The orange wire ties are there to indicate the area of interest as found.
- 3.09 The splice of interest connected the partially underground individual unjacketed branch

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- conductors to a large jacketed extension cord that was run along the ground surface and the deck surface to the hot tub. See photos 7 and 9 as typical.
- 3.10 Near the hot tub the jacketed conductors were again spliced to other unjacketed conductors (see photo 9 as typical) that were terminated onto an electrical terminal strip inside the hot tub control enclosure. See the conductors labeled "R" & "B" depicted in photo 22 as typical. Photo 23 shows the same terminations after the conductors had been removed for collection.
 - 3.11 The entire length of branch circuitry including the source circuit breaker, all the conductors, the junction box and some of the conduit, the time clock and the conductors terminated on the terminal strip were taken and secured as evidence by CalFire. See photo 28 as typical.
 - 3.12 The 91°F temperature of the water in the hot tub was maintained by a 5.5 kW, 240V heater (see photos 10 and 16 as typical). The heating element appeared to be functional.
 - 3.13 A time clock was also used to control power to the hot tub. This time clock allowed the heater and related water circulation pumps to operate twice daily, each time for about two hours. At the time of my examination the time clock was in the "on" position and appeared to have stopped operating at about 09:00 hours. See photo 13 as typical.
 - 3.14 I was able to confirm that conductors at the splice of interest were provided power by the 2-pole 40-amp circuit breaker. See photos 18 through 21 as typical.
 - 3.15 Observe in photo 20 the resistance between the steel spring of the wire nut and the circuit breaker is about 2100 ohms instead of less than 2 ohms. That same measurement made directly to the conductor (see photo 21 as typical), thereby circumventing the damaged wire nut resulted in 1.2 ohms, as expected. Thus, there appeared to be significant electrical resistance at the wire nut to conductor interface that is also exhibiting the most thermal damage. See photo 8 as typical.
 - 3.16 Observe in photo 8 the clear evidence of both copper melting and arcing. Copper melts at 1981°F. I was told that the vegetative debris likely to have been in that area before ignition would not by its combustion create that temperature. See photo 6 as typical. Therefore, the most likely failure mode would have been thermal-resistance heating at the wire nut because of a poor electrical connection. The conditions of this connection would have been exacerbated by the relatively high current required by the operation of the hot tub heater and pumps.

4 What's Not There:

- 4.01 There are three fuses on the printed circuit board that provided controls for the hot tub. None of those fuses were blown. See photo 15 as typical.
- 4.02 The junction box shown in photos 25, 27 and 28 was originally 18 to 24 inches above finished grade. It was not secured structurally with the support required by the National Electrical Code (NEC), section 314.23B, Supports. At my examination, it appeared to have been held in place only by the conduit.
- 4.03 None of the holes in metal or wood panels through which conductors were installed had the code-required insulating bushings installed that are intended to protect the conductor insulation from the sharp edge of the hole or fitting. See photos 4, 12, 14, 22 and 23 as typical.
- 4.04 Neither of the splices seen in photos 7 and 9 were installed within the code-required junction box. See Article 314 of the NEC.

5 Why?/How?/Who?/Explain:

- 5.01 The most likely failure mode would have been thermal-resistance heating at the wire nut because of a poor electrical connection at the wire nut. The conditions of this connection

would have been exacerbated by the relatively high current and regular operation required by the hot tub heater and pumps (approx 23-30 amps at 240V, depending on which of the 2 pumps were operating and their horsepower(s)).

6 Evidence and Photos Taken:

- 6.01 Items taken as evidence and stored in a secure facility by JHNolt Associates:
 - 6.01.01 None
- 6.02 During my examination I took a total of 135 color digital photographs of which 28 are included in this memorandum as printed images.
- 6.03 Colored lens filters were not used. These photographs were taken to provide demonstrative evidence. Photos included in this document or that have been provided otherwise have had their file size electronically reduced from the range of 5MB to 6MB each to an average of 95KB each for processing convenience. All photo files have been preserved outside this document in their original size and resolution.

7 Recommended Next Step(s):

- 7.01 Get smart meter electric data from the utility for PG&E meter #1007978062 in 1 hr increments for DOL and for the 14 days before. See photo 3 as typical.
- 7.02 Conduct a multi-party evidence examination of the collected conductor evidence in a lab with binocular microscope and/or x-rays as necessary.
 - 7.02.01 examine as necessary conductors, wire nuts and wire nut splices from area of interest. See photos 5 thru 8 as typical.
 - 7.02.02 examine as necessary conductor splice from nearest to the spa. See photo 9 as typical.
- 7.03 Conduct a multi-party evidence examination of the collected Eaton 2 pole, 40 amp molded case circuit breaker as necessary. See photos 4, 17 - 18 & 24 as typical.
- 7.04 This memorandum, its observations, conclusions and recommendations may be only one part of the multi-disciplinary investigations and examinations that are often necessary. It is rare that data from one particular discipline, when viewed selectively or in isolation, can encompass or provide understanding about the entirety of an event or issue. Therefore, it is recommended that the necessary actions and/or meetings among experts be conducted so that the material in this memorandum can be integrated with material from other disciplines so as to create a more complete picture and understanding of this event.

8 Other:

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- 8.02 Reservations - This completes my project status memorandum based on the tasks I have completed to date and/or been asked to complete to date. This work, its observations, its analysis, its conclusions and its recommendations are part of a very context sensitive and iterative process which may include critical information that may have been destroyed, obscured, missed or not yet understood within the context of the incident. Therefore, I reserve the right to amend or augment these opinions and/or this memorandum if new pertinent information or data is provided to me or is discovered by me at a later date.

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Photos

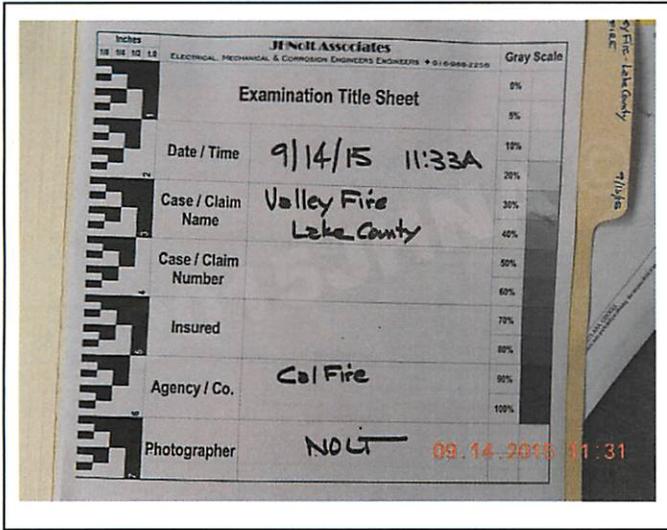


Photo 1

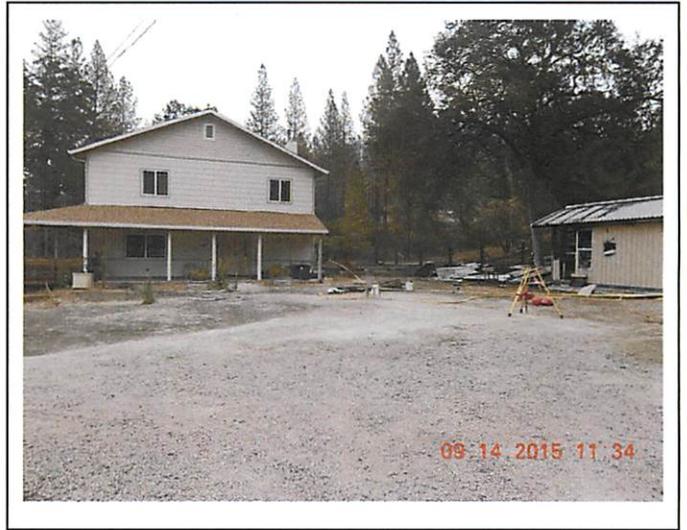


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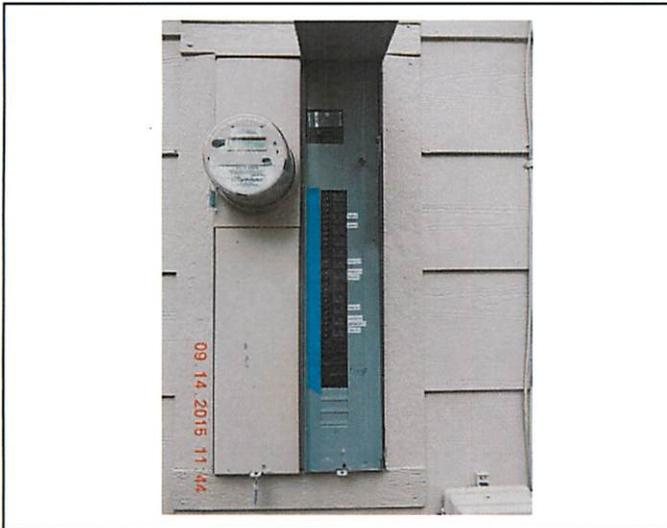


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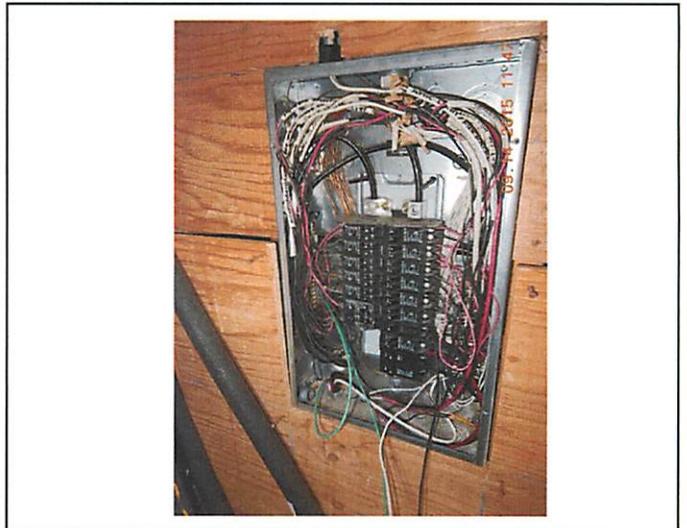


Photo 4



Photo 5



Photo 6

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Photos



Photo 7



Photo 8

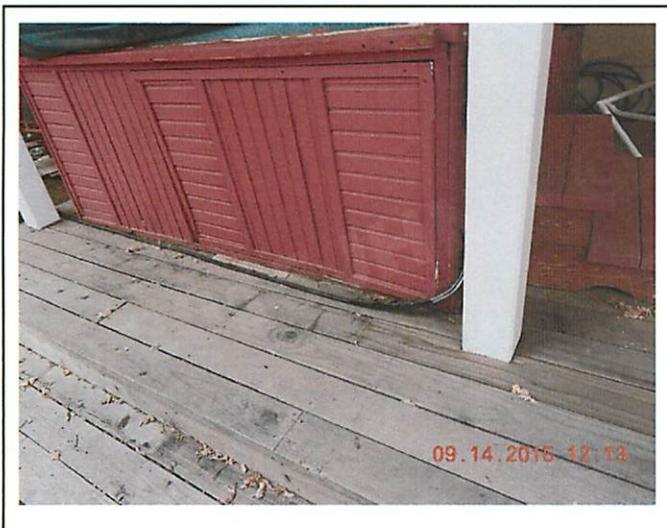


Photo 9

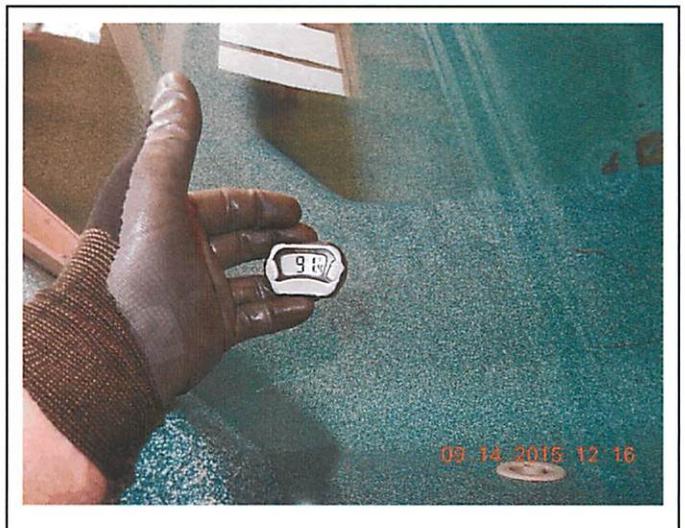


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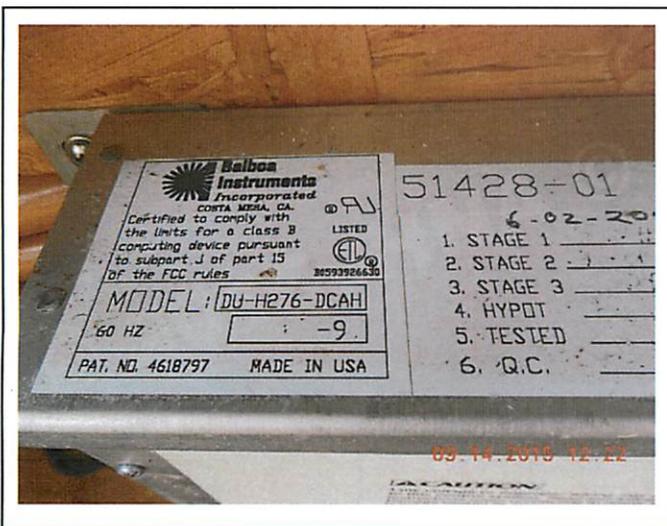


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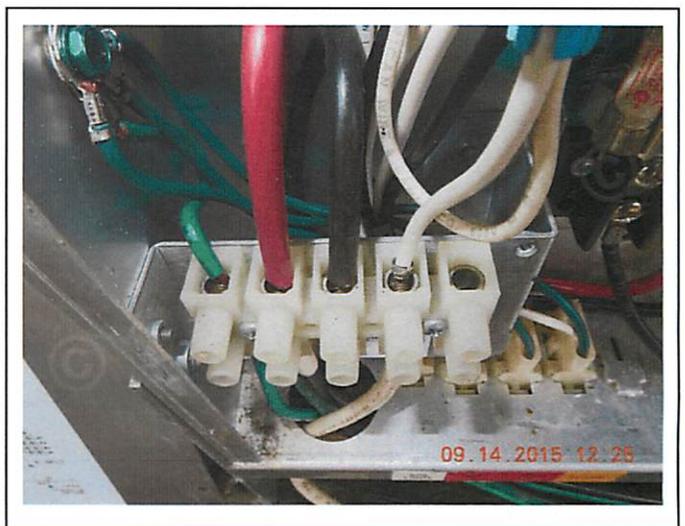


Photo 12

Photos

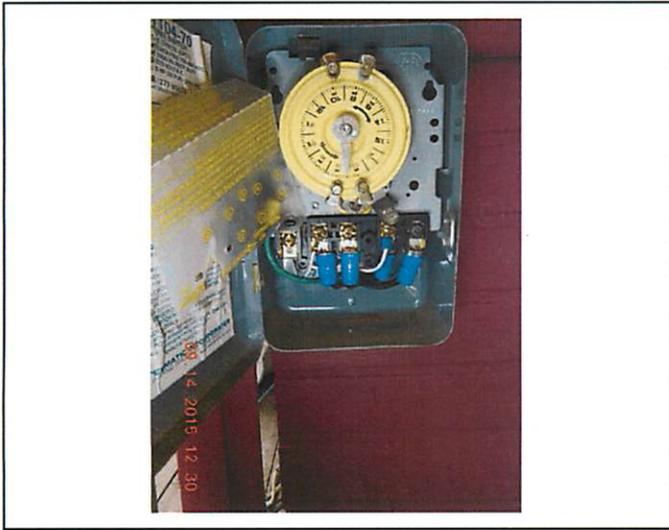


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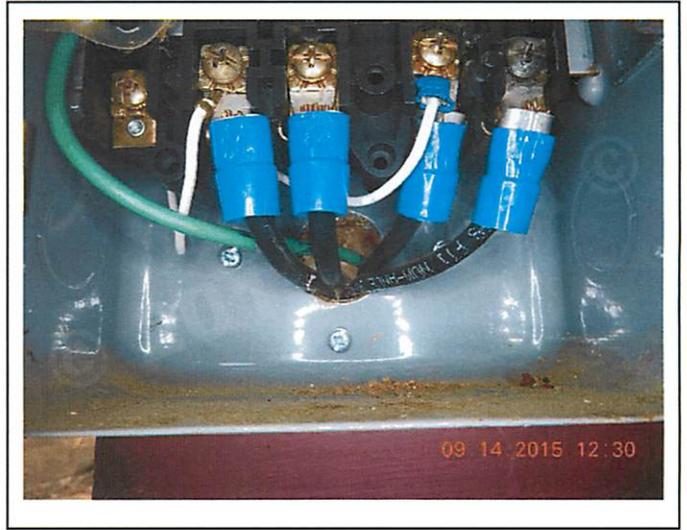


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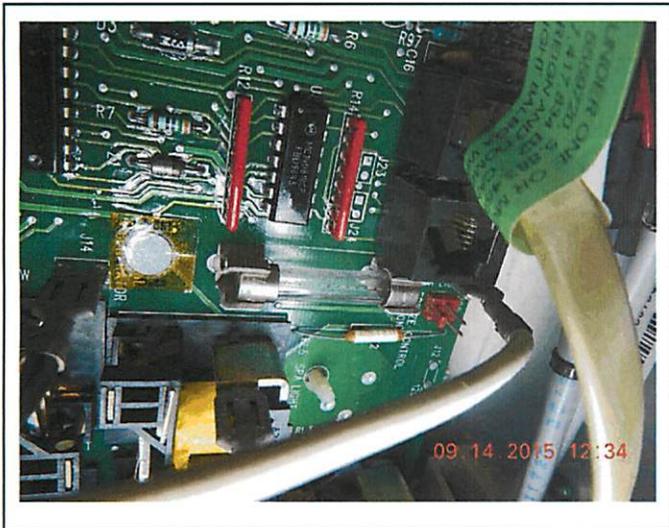


Photo 15



Photo 16

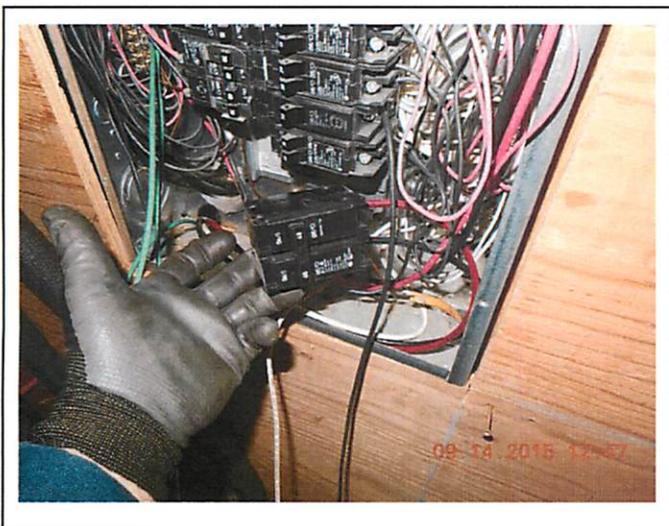


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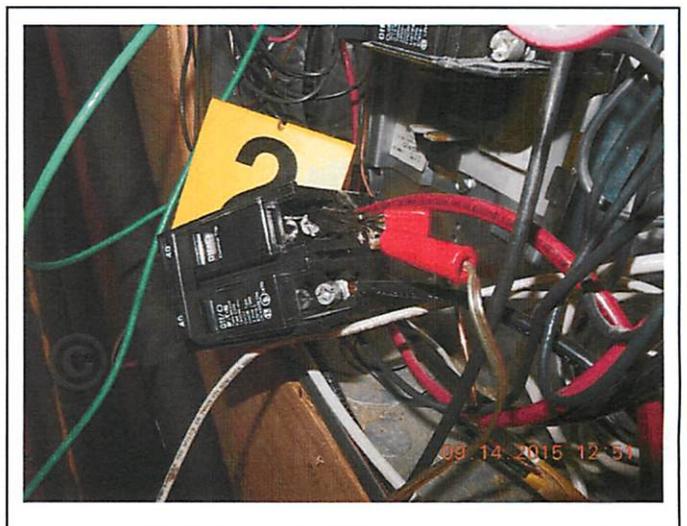


Photo 18

Photos



Photo 19

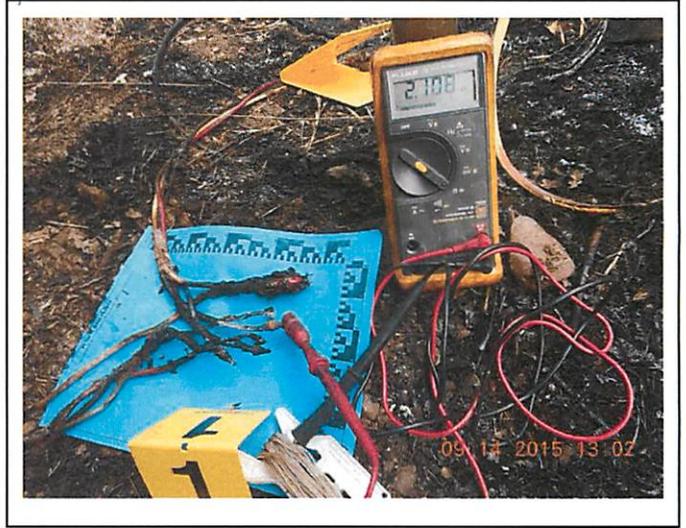


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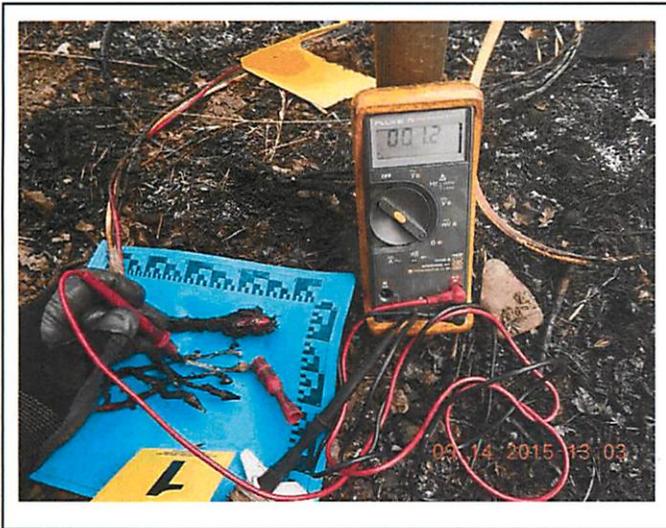


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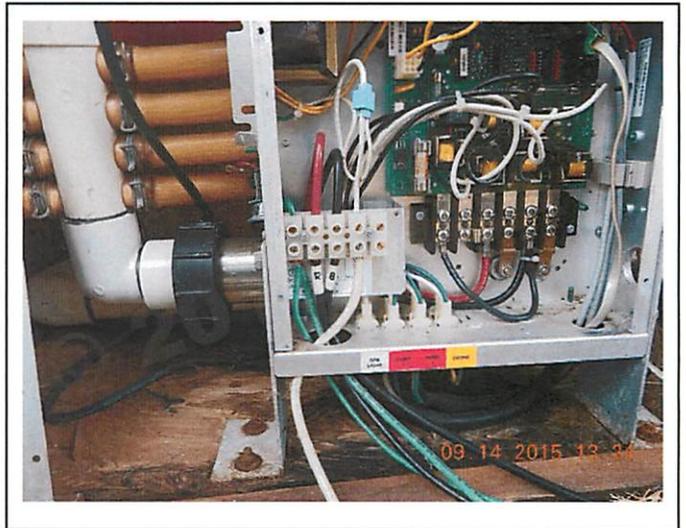


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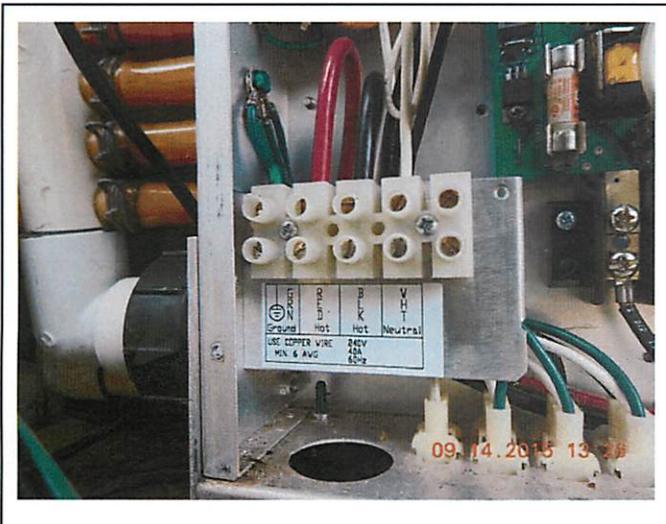


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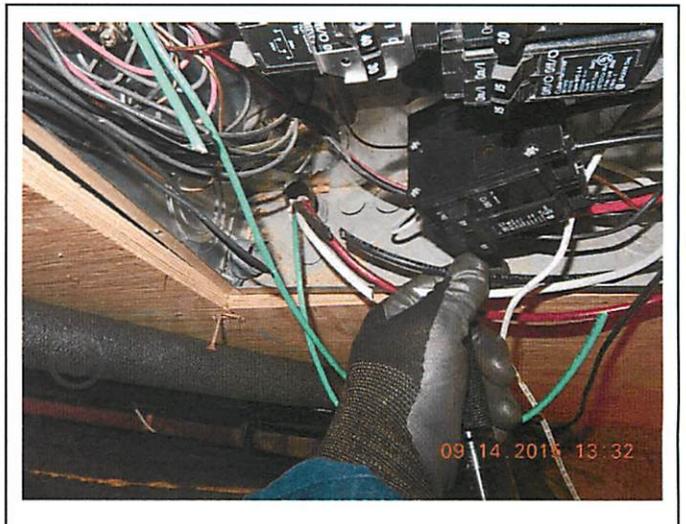


Photo 24

Photos



Photo 25



Photo 26



Photo 27

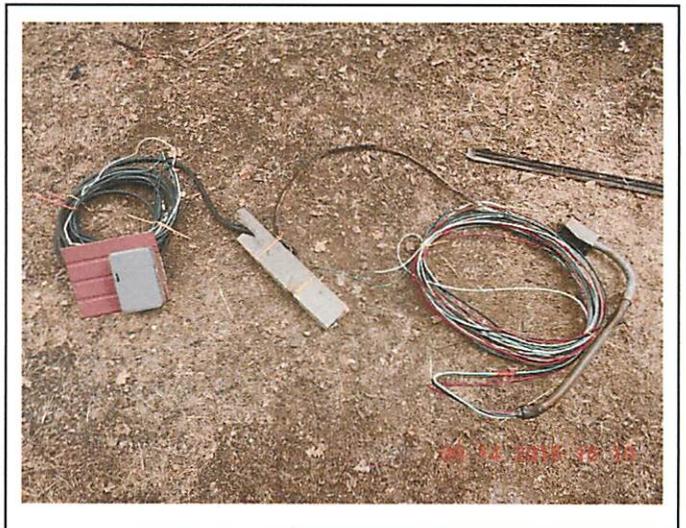


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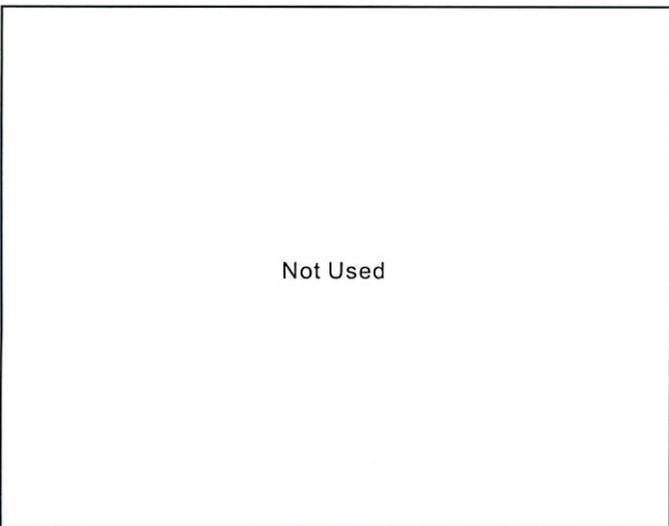


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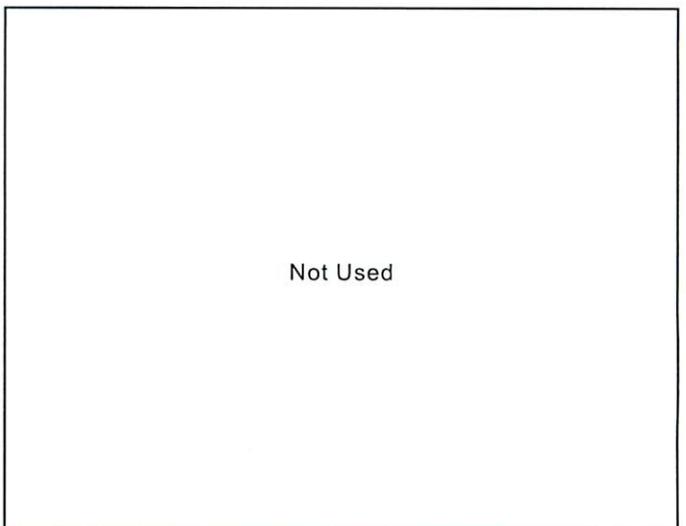


Photo 30