# Incident Summary #II-1624875-2023 (#40684) (FINAL)

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| SUPPORTING INFORMATION | Incident Date | | October 23, 2023 |
| | Location | | Manning Park |
| | Regulated industry sector | | Electrical - Low Voltage electrical system (30V to 1000V) |
| | Impact – Injury | Qty injuries | 0 |
| | | Injury description | N/A |
| | | Injury rating | None |
| | Impact – Damage | Damage description | Two (2) conductor #12 American Wire Guage (AWG) non-metallic sheathed cable (NMSC) was severely damaged inside of the wall in the basement of a cabin, as well as other NMSC that were in contact with that #12 NMSC. There was also damage to a tv, a wireless speaker adaptor, an air cleaner, coffee machine, electric range controls, and light bulbs. |
| | | Damage rating | Moderate |
| | Incident rating | | Moderate |
| | Incident overview | | A hot conductor and a neutral conductor were crossed in an electrical system, causing an electrical fault that resulted in severely damaged non-metallic sheathed cable, and damaged electronic appliances. |
| INVESTIGATION CONCLUSIONS | Site, system and components | | The property has a 200-amp (A), 120/240-volt (V) utility service that provides power to an existing cabin and a new detached shop. The utility meter has an integral 200A main breaker and is mounted to a private electrical pole (Image 1).<br><br>There is a 250KCMil ACWU cable coming from the 200A breaker that goes to a junction box on the pole. There is a splice in the junction box with #1 aluminum conductors that go to a 100A panel that's also mounted to the pole, and a 250 KCMil ACWU cable that goes underground to a 200A panel in the cabin.<br><br>There is also a #1 ACWU cable from a 60A breaker in the 100A panel on the pole, underground to a 60A panel in the new detached shop. |
| | Failure scenario(s) | | Originally the 250KCMil ACWU cable ran underground straight from the utility meter 200A breaker to the 200A panel in the cabin. An electrician added the junction box on the pole to accommodate the addition of the 100A panel on the pole, as well as maintaining the 200A power feed to the cabin. When this was done a new 250KCMil ACWU was installed between the combination meter and the junction box, due to the original cable being too short. There are three conductors inside each of the ACWU cables. In a 120/240V electrical system the three conductors are used for two hot wires and a neutral, with the hots identified black and red, and the neutral identified white. 120V is measured between each hot conductor and neutral, and 240V is measured between the red and black hot conductors.<br><br>In the new 250KCMil ACWU cable, the conductors are factory colour coded black, red, and blue. The typical color coding for the neutral conductor is white, but since the cable was factory coded with black, red, and blue, the neutral had to be identified with white tape. Identification of the neutral conductor was inconsistent (Image 2).<br><br>One end of the cable the black conductor was identified as the neutral with white tape, and on the other end of the cable the blue conductor was identified with white |

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| | | tape. Because of this mislabeling the black hot conductor and the neutral conductor were crossed. When the power was turned on there was now 240V between the red-hot conductor and neutral, 120V between the black hot conductor and neutral, and 120V between the red and the black hot conductors.<br><br>The existing cabin had several household items plugged into 120V receptacles, as well as 120V light fixtures with light bulbs that were now damaged due to 240V being present. |
| | Failure scenario(s) | Originally the 250 KCMil ACWU cable was ran underground straight from the utility meter 200A breaker to the 200A panel in the cabin. An electrician added the junction box on the pole to accommodate the addition of the 100A panel on the pole, as well as maintaining the 200A power feed to the cabin. When this was done a new 250 KCMil ACWU was installed between the combination meter and the junction box, due to the original cable being too short. There are three conductors inside each of the ACWU cables. In a 120/240V electrical system the three conductors are used for two hot wires and a neutral, with the hots identified black and red, and the neutral identified white. 120V is measured between each hot conductor and neutral, and 240V is measured between the red and black hot conductors.<br><br>In the new 250 KCMil ACWU cable, the conductors are factory colour coded black, red, and blue. The typical color coding for the neutral conductor is white, but since the cable was factory coded with black, red, and blue, the neutral had to be identified with white tape.<br><br>Identification of the neutral conductor was inconsistent (**Image 2**). One end of the cable the black conductor was identified as the neutral with white tape, and on the other end of the cable the blue conductor was identified with white tape. Because of this mislabeling the black hot conductor and the neutral conductor were crossed. When the power was turned on there was now 240V between the red-hot conductor and neutral, 120V between the black hot conductor and neutral, and 120V between the red and the black hot conductors. The existing cabin had several household items plugged into 120V receptacles, as well as 120V light fixtures with light bulbs that were now damaged due to 240V being present.<br><br>In the basement of the cabin there was a circuit that had a fault on it due to the hot and neutral being swapped. Neutral conductors do not have over current protection installed on them, and with the hot and neutral being swapped there was no over current to protect that circuit from sustaining damage from instantaneous high current and high heat (**Image 3**). |

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| Facts and evidence | Site investigation was completed with the homeowner present. The electrical panel in the cabin was assessed, and the labels on the breakers were consistent with the damage to the appliances and lighting throughout the cabin where 240V would have been present.<br><br>The damaged non-metallic sheathed cable was no longer onsite, and pictures were submitted from the homeowner of the damaged wire.<br><br>A picture was submitted of the misidentified neutral conductor inside the junction box on the pole.<br><br>Interview with the homeowner that was present at time of incident:<br>• Within seconds of the power being turned on melting insulation could be smelled, and smoke could be seen from wall outlets.<br>• Homeowner yelled out to the electrician and the power was turned off approximately ten seconds after it was turned on.<br>• Drywall was removed and damaged wiring was found in the basement that had signs of high heat with melted insulation and discoloured copper conductors.<br>• Certain light bulbs in the cabin were no longer functioning.<br>• Certain electronic devices such as a TV, a coffee machine, and electric range in the kitchen no longer worked.<br>• No physical damage was found in other circuits throughout the cabin, or the detached shop, suggesting the damage was due to the fault on the basement receptacle circuit that was physically damaged.<br><br>Interview with electrician:<br>• Confirmed that the neutral conductor was mislabeled when he added a new piece of 250KCMil ACWU cable between the combination meter and the junction box.<br>• It was confirmed that the basement receptacle circuit non-metallic sheathed cable was damaged, as well as other cables that were in contact with it above the electrical panel.<br>• Confirmed that when he turned the power on, the homeowner yelled out to him to turn it off seconds later, and the power was on for approximately ten seconds total. |
| Causes and contributing factors | It is highly likely that the heat damage and damage to appliances occurred when the black hot conductor and the neutral conductor were misidentified and crossed in the electrical system.<br><br>Contributing factors are:<br>• Sensitive electronic appliances rated for 120V that were plugged into wall receptacles where 240V was present.<br>• The neutral conductor that became a hot conductor did not have overcurrent protection on it, and that led to the physically damaged wiring in the cabin before the power was turned off. |

Image 1 - 200A combination meter with main breaker mounted to private pole.

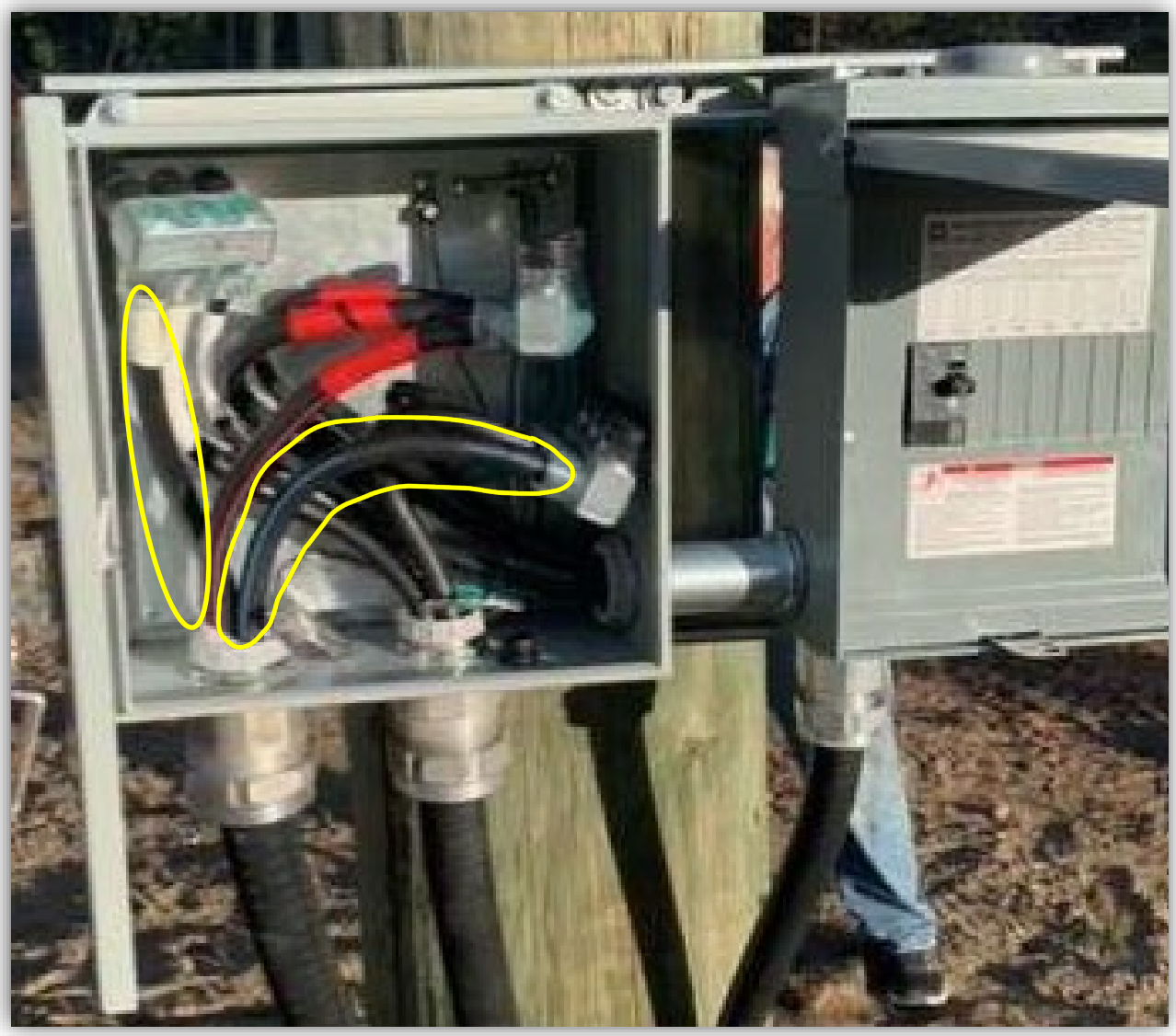

Image 2 - Junction box with splice to accommodate 100A panel on pole. [Circled] Misidentified conductors.

Image 3 - Damaged wiring inside the cabin.