

Safety Division Investigation into Electrical Contact and Fatality  
with PSNH 3 Phase Distribution System on

April 19, 2014

Keene, NH



*September 18, 2015*

### **Accident Description:**

On Saturday April 19, 2014 at approximately 2:00 p.m., a student called the Keene State College Campus Security and reported a low hanging wire. This was later determined to be a high voltage electric power line. The low wire was located between the NH Route 101 footpath and the walking bridge from Martel Court near the Keene State Athletic Fields.

At 2:22 p.m., the Keene Fire Department notified PSNH of a live low hanging bare conductor that a Keene State maintenance employee, Nathan L. DeMond, possibly made contact with. Mr. DeMond was assisting campus security look for the low hanging wire in response to the student notification to Keene State College. The wire was part of a high voltage primary circuit near the Keene State College Athletic Fields. The area was lightly wooded and contained small areas of brush. Keene Fire Department confirmed that Mr. DeMond made contact with a 7,200 volt rated electrical primary wire and confirmed his death. Mr. DeMond was found with the lower part of the leg in contact with the primary wire, which was approximately 24 inches<sup>1</sup> off the ground. Burn marks on the ground and witness accounts of first responders corroborated the accident. The incident also started a brush fire and caused an electrical power outage impacting approximately 1,065 customers. Electrical service to 1,888 more customers was interrupted when PSNH de-energized the adjoining circuit to make the scene safe to allow crews to make repairs and restore customer service.

Keene State Security, Keene Fire Department and the State Fire Marshall's office responded and investigated the incident. The Safety Division of the Public Utilities Commission was the final investigatory agency involved.

### **Environmental Conditions:**

At the time of the accident, wind speeds were approximately 4 mph and the temperature was 57.2 degrees Fahrenheit. The temperature that day ranged from 28.4 degrees to 57.2 degrees. The sky was partly cloudy. There was no snow on the ground, but otherwise early spring conditions were present, including moist grass.

### **Contributing Factors:**

The Safety Division found two contributing factors to the accident and Mr. DeMond's death. First, there was a single low hanging bare electrical conductor that sagged to a level where the public could come into contact with it. The wire was hanging low

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<sup>1</sup> Various statements by on scene responders estimated the conductor between 18 inches, 24 inches, and 30 inches off the ground.

because the wooden cross arm assembly that was designed to hold the wire at a safe height had decayed, rotted, and broken.

Second, the Safety Division determined that Mr. DeMond's leg came into contact with the high voltage wire. The contact caused burns on Mr. DeMond's leg and created a path for the electrical current to travel to the ground.

Falling trees, branches, and animal disturbances were not factors in the accident.

## **Background Description of the Circuit and Support Structures**

### **Appendix A Maps**

This appendix contains four maps of the area that provide background of the primary circuit and the location of fatality.

#### Appendix A1

Appendix A1 is a map showing an overview of where the accident occurred and identifies major landmarks and the various electrical wires in the area, using PSNH's identifiers. The primary function of the 12.47 kv (rated) three phase circuit identified as W185 is to transmit electrical power from the Keene Switching and Distribution Substation to the easterly side of town eventually terminating in Keene at or near the former Marlboro Street Substation (Marlboro Street at Optical Avenue). The W185 circuit is located in a PSNH right of way (ROW) along with 3 other circuits. The three other PSNH designated circuits consisted of two 115 kv rated circuits, the T-198 and A-152 circuits, and another 12.47 kv rated circuit designated W15. The W185 circuit generally runs southerly past Route 101 and easterly branching just north of the Keene State Athletic Fields. The majority of the circuit is located in the PSNH ROW including the segment where the electrocution occurred, which was in an urban ROW that traverses long portion of Keene. A 12.47 kv three phase to phase circuit has a voltage rating of 7.2 kv phase to ground.

#### Appendix A2

Appendix A2 is a map that provides more detail of the approximate location of the accident. The fatality occurred west of the Ashuelot River and north of the athletic fields where the 125 foot ROW branches east and only the two 12.47 kv circuits remained, the W185 circuit and the W15 circuit. The accident occurred on the northerly circuit W185. The adjoining W15 circuit parallels the W185.

### Appendix A3

Appendix A3 is a photograph that shows detail where the fatality occurred with pole designations and dimensions between poles. Mr. DeMond made contact with the wire approximately 75 feet from the easterly side of Pole 24. As designed, the 370 foot span between Pole 24 and Pole 25 also crosses the Ashuelot River. The path of this segment was approximately 40 feet inside the northern edge of the ROW. The map also shows the 283 foot span between Poles 23 and 24 that crosses a brushy area that is slightly marshy depending upon the season. The broken cross arm was located on Pole 24. Once the wire became detached from Pole 24, the span became 653 feet between Pole 23 and Pole 25. The W15 circuit is located in the same ROW but had no role in the accident; it is shown for reference only.

### Appendix A4

Appendix A4 is a diagram that shows a profile view of the sag and distance between the poles for circuit W185. Poles 24 and 25 are 45 feet tall and are typically embedded approximately 6.5 feet into the ground. The wooden Pole 23 is 40 feet long and embedded 6 feet deep, so its elevation from ground level was approximately 34 feet high. Thus the elevation to the top of the Pole 24 was approximately 38.5 feet above ground level. The ground elevation was approximately the same throughout both spans. Calculated sags were provided by PSNH but do not correspond well to actual observations, indicating assumptions for conductor tensioning may have differed from field conditions. The purpose Appendix A4 is to illustrate how much the sag can be affected when span lengths are modified because of equipment failures.

## **Appendix B Photographs**

Appendix B contains photographs taken at the scene including:

- (a) those found on Mr. DeMond's camera, taken April 19, 2014;
- (b) those taken by the first responders<sup>2</sup> on April 19, 2014;
- (c) those taken by PSNH employees on April 19, 2014; and
- (d) those taken by the Safety Division on April 21, 2014 both at the location of the accident and at PSNH's Keene area work center. The photos are labeled sets B1, B2, B3 and B4.

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<sup>2</sup> First responders for purposes of this report also includes the NH Fire Marshall's Investigation Office

### **Appendix C Utility Records**

Appendix C contains maintenance records of PSNH's last inspection of Pole 24 on the W185 circuit. Appendix C includes a record apparently documenting a January 15, 2014, inspection of Pole 24 on the W185 circuit. The handwritten notes indicate "broken cross arm," and "1 guy loose & 1 guy broken." Attached to this maintenance record are two photographs of a wooden utility pole.

### **Appendix D Public Outreach Safety Training**

Appendix D is a copy of the MUST Safety Training presented in Keene on March 19, 2014.

### **Appendix E NH Fire Marshall's Official Report**

Appendix E is a copy of the New Hampshire Fire Marshall's report, which contains reports of witness interviews and the Marshall's narrative report.

## **Installation History**

PSNH Data Responses indicate Poles 23, 24 and 25 were installed in 1949 and the 10 foot long x 5 inch x 5 inch wooden cross arms were installed in 1950. The wooden cross arm dimensions are greater than the NESC requirements of Rule 261. The pole design included a double cross arm configuration on each side of the wooden pole supporting three phases of conductors that are separated by an appropriate distance. Single wooden class 3 poles that varied between 40 feet and 45 feet in height were used for the identified poles of W185. Three separate insulators, one per phase, prevented contact with the conductors and the wooden cross arm and wooden pole. The conductor consisted of 4/0 Copper with a 230 ampacity rating. All clearances and height requirements met NESC requirements.

A review of the easement information confirmed that PSNH had in place easements for the land west of the Ashuelot River and east of the Ashuelot River dating back to 1949.

A record research of Commission orders granting licenses for the Ashuelot River in Keene could not find an order granting a license for the span of W185 or W15 that crossed the Ashuelot River. The Ashuelot River is on the State of New Hampshire's list of public waters.<sup>3</sup> See RSA 371:17.

## **Maintenance History:**

PSNH Maintenance records indicate that Pole 23 was set in 1962, Pole 24 was set in 1969 and Pole 25 was estimated to be set in 1956. PSNH records indicated that "test and treat" maintenance was performed on October 8, 2008 for all three poles near the ground level, which resulted in some of the poles being treated to resist environmental degradation.

PSNH's pole maintenance procedure at the time of accident was known as NUMM (Northeast Utilities Maintenance Manual). The procedure required inspection of poles no less than once every 10 years, and "back bone" circuits needed to have drive-by inspections annually, and can include infrared inspections to determine hot spots.

PSNH last inspected Pole 24 of circuit W185 on January 15, 2014, approximately 94 days prior to the accident. PSNH's inspection records say that on January 15, 2014, Pole 24 had a "broken cross arm," one loose guy wire, and one broken guy wire that supported Pole 24. Photographs included with the documentation indicate that the cross arm was still attached to the pole, but they show the cross arm is broken or partially broken because the outside conductor can be seen sagging lower than the other side of the cross arm. Reference Appendix C.

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<sup>3</sup> <http://des.nh.gov/organization/commissioner/pip/publications/wd/documents/olpw.pdf>

### **Code Compliance Issues:**

Puc 306.01(a)(1) requires that “[e]ach utility shall construct, install, operate and maintain its plant, structures and equipment and lines ... [i]n accordance with good utility practice.” Puc 306.01(b)(1), in turn, defines “good utility practice” to mean “in accordance with the standards established by ... the National Electrical Safety Code C2-2012.” The utility must weigh “all factors, including potential delay, cost and safety issues, in such a manner to best accommodate the public.”

The National Electrical Safety Code (NESC) states: “All electric equipment shall be constructed, installed, and maintained so as to safeguard personnel as far as practical.”

The NESC further requires prompt replacement of defective equipment during Inspections of In-Service Equipment. “Electric equipment shall be inspected and maintained at such intervals as experience has shown to be necessary. Equipment or wiring found to be defective shall be put in good order or permanently disconnected.”

The Safety Division finds that PSNH did not repair the broken cross arm on pole 24 in a prompt manner. Timely repair would have avoided the collapse of the insulator and the ensuing sagging of the Phase 1 wire. The cross arm was in imminent danger of complete failure to support the energized primary wire because it was noticeably broken as reported during the inspection on January 15, 2014. It fits the PSNH criteria for replacement because “it was partially decayed across the grain,” and/or was a support structure “having a hollow heart with appearances of sound wood.” Subsequent inspection of the cross arm by the Safety Division at the local PSNH work center revealed significant decay of the wood. See photographs taken by the Safety Division on April 21, 2014, at PSNH’s Keene area work center, Appendix B.

### **PSNH Emergency Response:**

The Safety Division finds the PSNH Emergency Response Time to be adequate. PSNH was notified at 2:22 pm of an electrical contact and was on scene at 2:37 pm. At the time of arrival, an outage of W185 circuit resulted from the fault. The PUC was notified at 2:50 pm of an electrocution as required by Puc 306.06. The outage was reported as 237,510 customer minutes or approximately 4 hours. The cross arms were replaced and the conductors re-energized. PSNH filed the required ten day and 60 day written reports in accordance with Puc 306.06.

### **PSNH Public Electrical Safety Education and Outreach:**

PSNH did not have any records of conducting electrical safety training sessions known as “Fires and Wires” for Keene State College. PSNH provides a training session for municipal departments such as Keene Fire Department approximately every 3 years.

Records indicate that a training session was last given to Cheshire Medical Facility in Keene during February 2013.

A MUST (Managing Underground Safety Training) was held at Keene State College on March 19, 2014 by a collaborative group of utilities<sup>4</sup> (gas/electric/telecom) safety session and focuses on underground damage prevention but also has a segment regarding electrical hazards both above ground and below ground was held. The March 2014 MUST session was attended by twelve Keene State College employees including Mr. DeMond. Unitil Electric Service gave that electrical safety presentation. Reference Appendix D.

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<sup>4</sup> This includes PSNH, Unitil, Liberty Utilities and New Hampshire Electric Cooperative.