Technical Bulletin

Enhanced Fire-Resistant uPoles

Background

Many countries, including the US, Canada, and Australia, have witnessed an increase in the number of wildfires in recent years causing massive damage and leaving thousands of people without power.

Much of the existing infrastructure includes wood utility poles that are more susceptible to damage from these wildfires. Because of this, there has been an increased demand for replacing the wood poles with an alternative that is more fire-resistant to decrease the number and duration of dangerous power outages and reduce the number of poles that require replacement after a fire event.

Ameron™ uPoles™ are fiberglass reinforced polymer (FRP) poles that provide a robust alternative to wood poles. The uPole has undergone extensive fire testing with various coating types and coating thicknesses by a nationally recognized independent fire research laboratory to demonstrate that an intumescent fire-resistant coating provides the best protection to minimize the loss of strength of the pole during and after a wildfire event.

Fire test setup

FRP poles are relatively new to the power industry thereby having few formally documented testing procedures and guidelines. Currently, there are no testing procedures or acceptance criteria recognized across the industry to test FRP poles in wildfire conditions. In a collaborative effort between a nationally recognized independent fire research laboratory and a large independently owned utility (IOU) company, a full-scale testing procedure was set up to measure the residual strength of the uPole after a wildfire event.

Two 45-foot Class 1 uPoles enhanced with a fire-resistant coating of 3 mm thickness were selected for testing – one to undergo a 2-minute flame exposure and one to undergo a 3-minute flame exposure. The intumescent coating was filament wound onto the poles. Filament winding of the intumescent coating is a more efficient way to manufacture the poles and allows for better control of the coating thickness. Each pole was outfitted with six thermocouples to measure flame temperature, six thermocouples to measure internal and external pole surface temperatures, and three copper disk calorimeters to measure heat flux (see Test Results section below). The poles were then installed with an embedment depth of 7.5 feet and a tension load was applied at 2 feet below pole tip. The tension load equated to 1,125 lbs horizontal load and 700 lb vertical load. The pole's lower area was encased with a 20–gage, 30 inch diameter spiral wound metal shield with an air gap at the bottom. Four propane gas burners were placed equidistant around the pole at the bottom of the shield. The burners were positioned such that the flames were directed perpendicular to each other and would spiral clockwise around the test pole.

Fire test set up with shroud, instrumentation, and propane torches

Test procedure

Once the uPoles were installed and all instrumentation was secured on each pole, the test was ready to run. The full tension load was applied and the timer began. The poles were loaded while unignited for a full minute to capture a baseline. Once the timer reached the 1-minute mark, the fire was ignited and continued for two or three minutes of exposure. When the fire exposure time concluded, the propane was shut off and the instrumentation continued to capture data until the timer reached 10 minutes. After 10 minutes of test time, the remaining load was recorded and then released.

After the fire test, the poles were then subjected to strength testing adhering to ASTM D1036 to determine how much of the poles' original strength was preserved. The charred material on the pole was scraped off and the pole was secured in the test rig. The poles were bent until failure and the breaking load and maximum deflection was recorded.

Enhanced Ameron uPole fire test, 2-minute exposure

Test results

The goal of the fire test was to provide a flame temperature of 2,100°F to simulate the average wildfire. This goal was achieved for both of the uPoles. Both the 2-minute and 3-minute test poles exhibited lightly charred areas within the shield area with a black discoloration. The 2-minute test uPole had no permanent deflection at the conclusion of the fire test, while the 3-minute test uPole exhibited 2.9 inches of permanent deflection.

The final test results are shown in the tables below.

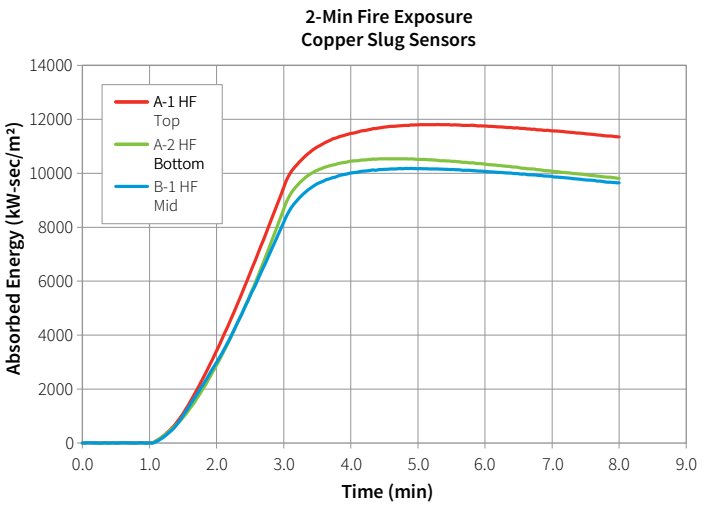
Post-fire test enhanced Ameron uPole, 2-minute exposure

Table 1 – Total heat energy (kW-sec/m^2) during fire exposure

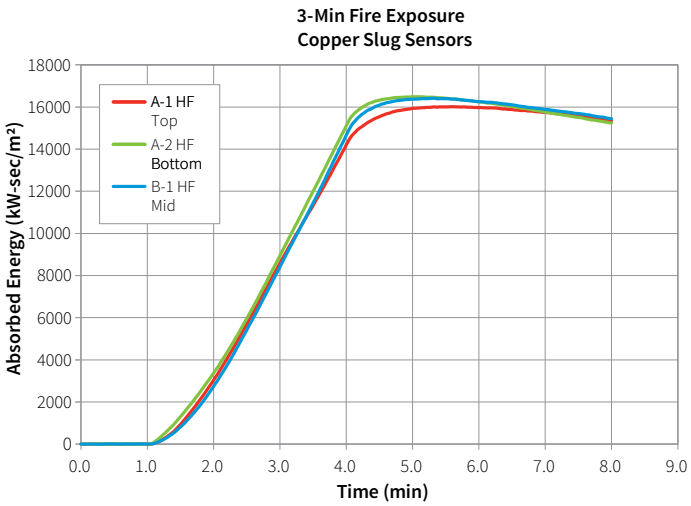
Fire exposure time	Sensor location (from ground line)	@ 1 min	@ 2 min	@ 3 min
2-min	3 ft	2,885	8,670	-
	6 ft	2,990	8,181	-
	9 ft	3,420	9,468	-
3-min	3 ft	3,368	8,944	15,104
	6 ft	2,740	8,410	14,662
	9 ft	3,035	8,590	14,202

Table 2 – Preserved strength of enhanced Ameron upoles after fire event

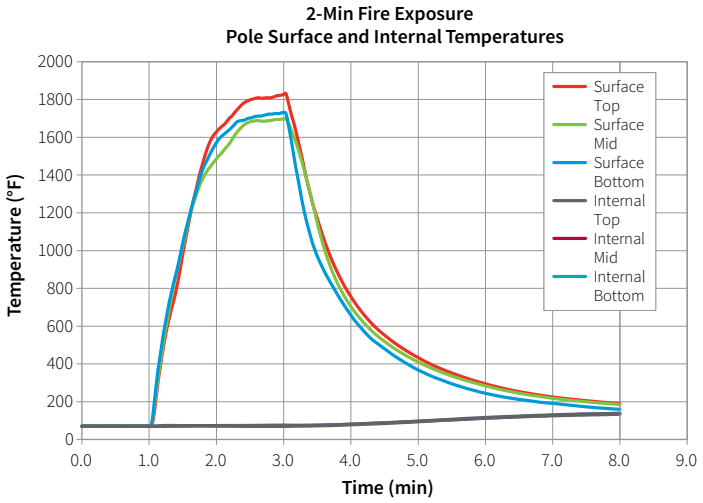
Fire exposure time	Breaking load (lbs)	Baseline load (lbs)	Strength preserved %
2-min	3,569	3,631	98%
3-min	3,248	3,631	89%



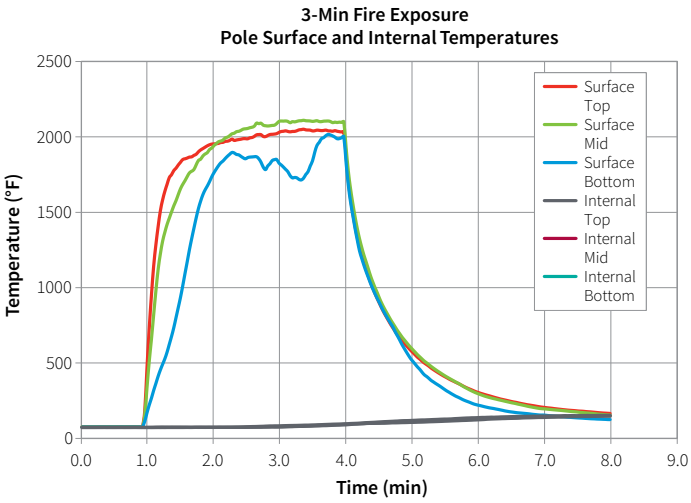
Enhanced Ameron uPole fire test, 2-minute exposure – copper slug sensors, absorbed energy



Enhanced Ameron uPole fire test, 3-minute exposure – copper slug sensors, absorbed energy



Enhanced Ameron uPole fire test, 2-minute exposure – pole external and internal surface temperatures



Enhanced Ameron uPole fire test, 3-minute exposure – pole external and internal surface temperatures

Conclusion

Enhanced fire-resistant uPoles were exposed to severe conditions meant to simulate wildfires for 2- and 3-minute durations. The poles were then subjected to a full-scale break test per ASTM D1036. The final results of the break test prove that the 3 mm thick intumescent coating is the optimal thickness to preserve 85% of the uPole's original strength or more. uPoles are able to withstand a wildfire and continue supporting design loads both during and after the fire event when enhanced with a fire-resistant coating.