Infrared diagnostic of substation feeder problems

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ABSTRACT

Mississippi Power Company, being a leader and trendsetter in finding new and better ways to improve dependability and increase customer satisfaction. For this reason we have implemented a program of annual infrared inspection of all our substation feeders along with our industrial, commercial customers and padmount transformers.

During the infrared inspection of substation feeders, we have detected an average of 40 problems per substation. By classifying these problems I identified them and put them in four categories. They are 1."Hot" Lightning Arresters 2. Line Fuses 3. Connections 4. Compression crimps.

By finding, identifying and correcting these problems we will be able to greatly reduce the outages and blinks to our customers, Therefore improving dependability and customer satisfaction.

This paper will describe the program and the findings and explain the diagnostics of the problems found during infrared scanning substation feeders.

Keywords: Proactive, Customer Satisfaction, Lightning Arresters, fuses, Connections and Compression Crimps

1. FINDING THE PROBLEMS, IDENTIFYING THEM AND FIXING THE PROBLEM

By implementing a program of infrared scanning our substation feeders Mississippi Power Company has gone the extra step to give our customers the best possible uninterrupted power service we can supply. By finding an average of 40 problems per substation, I identified the problems and put them into four categories. They are "Hot" Lightning Arresters, Cutout Fuses, Connections and Compression Crimps.

This method of identifying the problems helped me track the problems and discover we had a major lightning arrester problem. About 50% of the problems were identified as being "Hot" lightning arrester problems. We are in the process of having an independent lab test and evaluate the arresters and supply us with critical data we need to solve this problem.

Connections and compression crimps were 40% of the problems identified and line fuses were about 10% of the problems found. Several of the problems found could have resulted in major outages to our customers if they had not been found and fixed in time. By identifying and correction the problem before it occurred most of our customers never knew there was a threat of an outage.

Through awareness, training, and using the proper tools, we have been able to greatly reduce the problems on our feeders and greatly improve our customer satisfaction. By letting the customer know what we are doing this, we have a better working relationship with them.

2. "HOT" LIGHTNING ARRESTERS, CUTOUT FUSES, CONNECTIONS AND COMPRESSION CRIMPS

"HOT" Lightning arresters is a label I gave the arresters because it was an easy way to track and distinguish the good ones from the bad ones using the infrared camera. Through investigations I have discovered that the MOV (Metal Oxide Varister) non-gaped are the only line arresters showing heating while in service. The old porcelain type arrester and the new porcelain gap type do not show heat. The main reason for using the MOV non-gap arrester was for the purpose of not operating the breaker at the substation. The MOV would conduct letting the surge of current go to ground and not operating the breaker. The type of MOV non-gaped arrester that we are looking at has a 22 cartage without the primmer in the in the bottom of the MOV where the stud bolt is and the ground wire attach to the lightning arrester. When lightning strikes the line the MOV arrester shorts the high current to ground. The high current of lightning is used as the primer to activate the powder and blow the ground stud out of the unit and should not operate the breaker at the substation. What we are seeing is the MOV showing "Hot" on the pole. This implies the MOV is conducting current through the MOV arrester and the current is proportional to the temperature. We suspect the powder is wet or deteriorated and will not blow the ground stud out of the arrester base, therefore letting the arrester leak excessive amount of current through the MOV. We have employed an independent research laboratory to do further testing so that we can come up with a solution to the problem. Below (figure 1)are two examples of "Hot" lightning arresters in the field in service. The left picture shows ambient temperature at 86deg F., two of the lightning arresters at 92deg. F. and the "Hot" lightning arrester at 142deg. F.

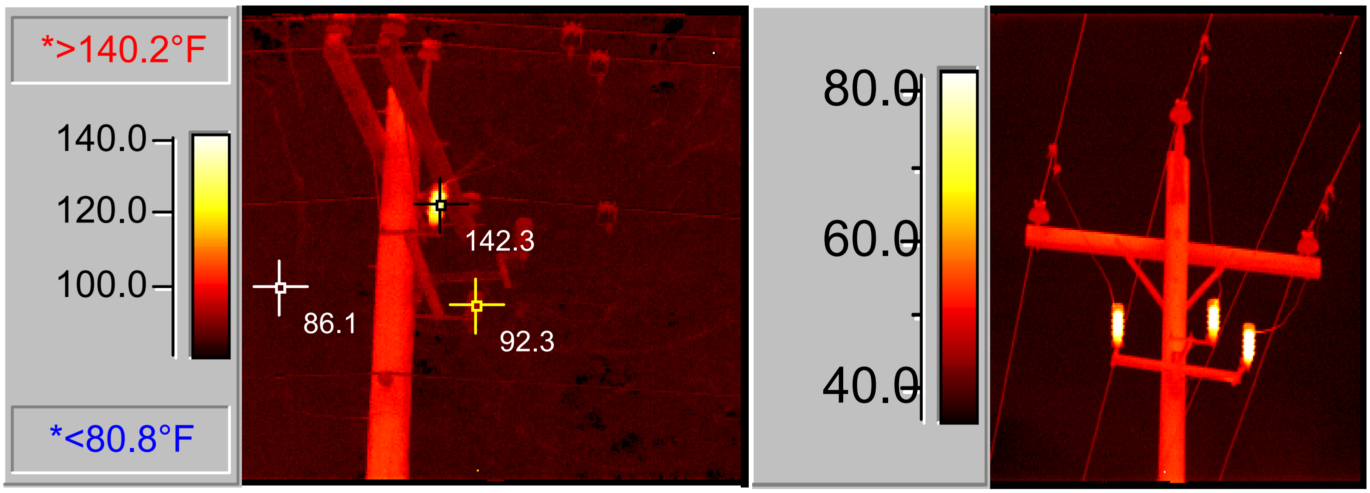

Figure 1. Examples of "Hot" lightning arresters in the field in service

Fused Cutouts were found to be 10% of all problems identified. Two problems were found with the cutouts, loose hardware and overheating of the fuse barrel cap. Loose hardware occurred during installation or was loose from the factory and not detected. Overheating of the fuse barrel caps occurred from improper installation of the fuse cap on to the fuse barrel. This problem incurred by the way the cap was tightened down on the fuse barrel before the fuse was installed in the cutout. If the fuse cap was tightened by hand with gloves on, holding the barrel in one hand and tightening the cap with the other hand, the cap could not always be tightened properly. Therefore if the fuse cap was loose it would began arcing, causing heat and eventually melt the fuse, causing the fuse barrel to fall open. A better method to tighten the cap on the fuse barrel is to secure the barrel in holding device and use pliers to tighten the cap down securely.

Second, some of the 200amp-fused cutouts had a design problem. The manual stop was not properly set. The manual stop was set too far back, therefore letting the fuse overlatch which greatly reduced the amount of current carrying capability of the cutout. This resulted in the fuse cap overheating and causing the fuse to melt out. By moving the manual stop toward the fuse barrel one fourth of an inch this would eliminate the problem. **Figure 2** illustrates two examples of fuse related problems.

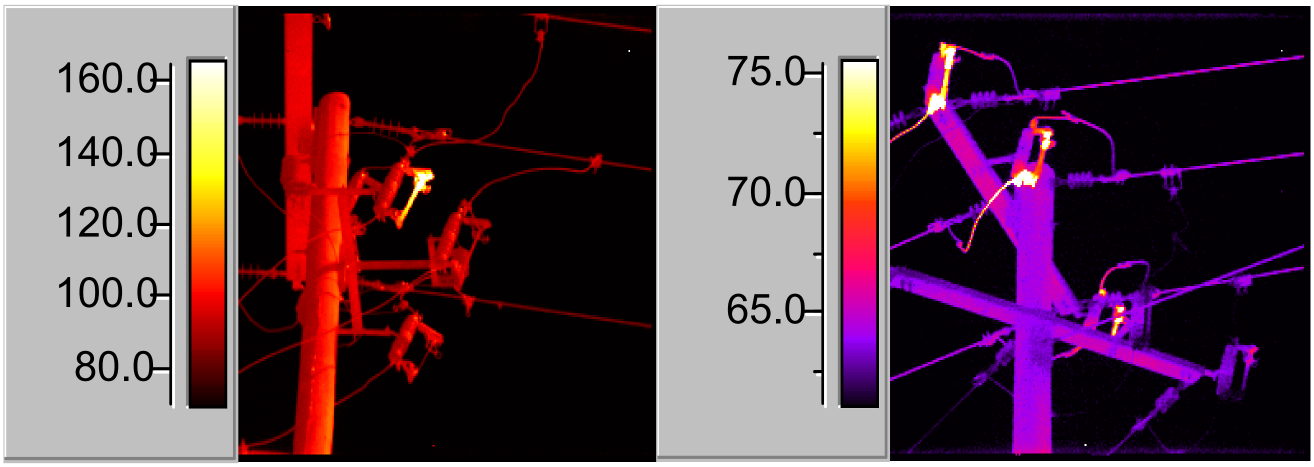

Figure 2. Examples of two fuse-related problems

Connections were about 25% of the problems found. These were bad connections due mostly to human error. Some of the reasons were weather, heat, improper tools for the job, improper connections of metals and rushing to get power restored as soon as possible to the customer. Making people aware of these improper connections and through training, we have been able to greatly reduce this problem. If a connection is not made properly it will eventually cause an outage or interrupt power service to our customers, which in turn cost our customers and us. The severity of the problem depends on where the problem is located, whether in a substation, on our distribution lines or on the customers distribution system. Figure 3 illustrates two pictures of connection problems.

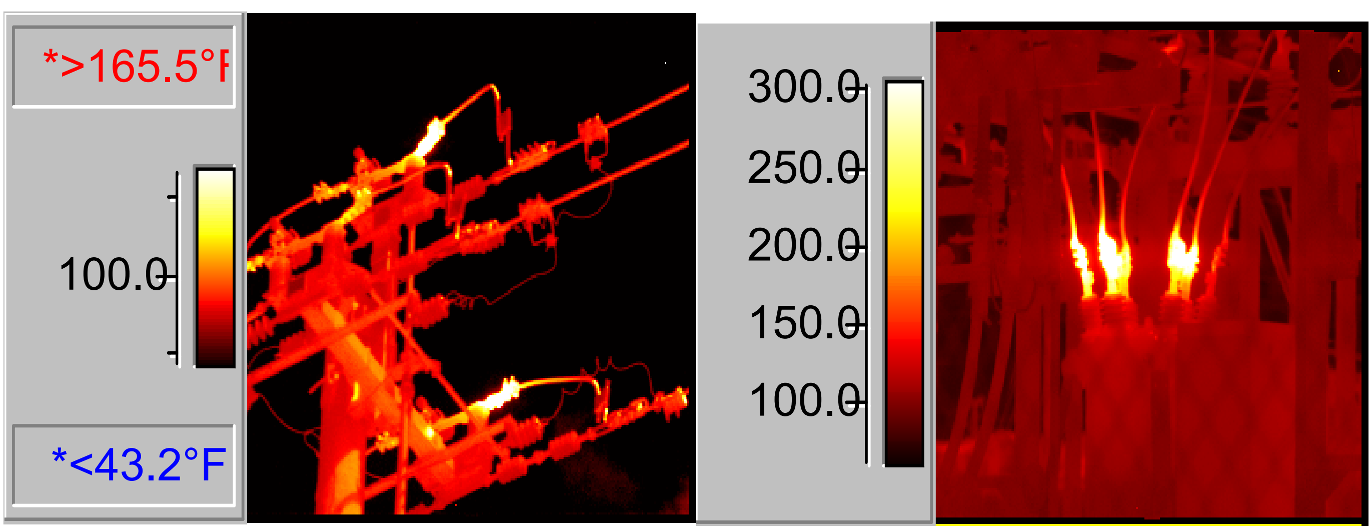

Figure 3. Examples of two connection-related problems

Compression Crimps were about 20% of the problems found on distribution lines. There are several reasons for the causes of these hot spots. They include the wrong size compression crimps used, wrong dye in crimping tool, crimping tool out of adjustment and improper crimping. By bringing these problems to their attention and with better awareness by the people doing the work, many of these problems can be eliminated. **Figure 4** illustrates two examples of compression crimp problems.

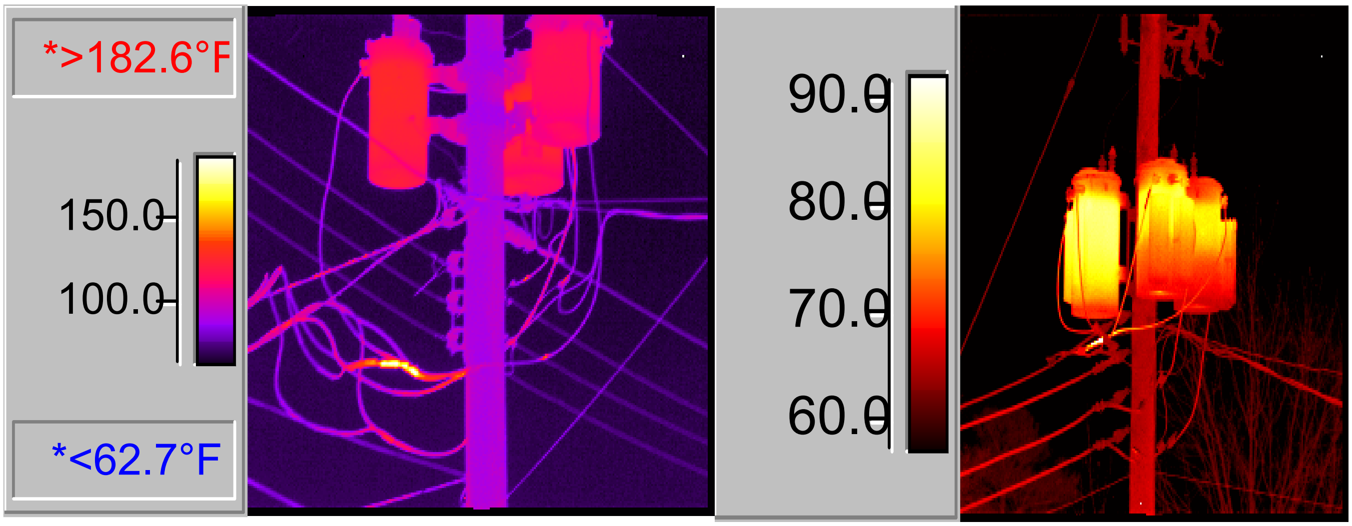

Figure 4. Examples of two compression crimp -related problems

3. SUMMARY

Of the five substations used in this project, each substation had an average of four distribution feeders. There were 212 problems identified with these feeders. About 45% were "Hot" Lightning arresrters, 25% were Connections, 20% were Compression Crimps and 10% were Cutout fuses. Approximately 50% of these problems had the potential to cause an outage lasting several hours or an interruption for a short period of time. These interruptions could affect one of our customers or several hundred of our customers. The dollar loss is kept to a minimum by finding these problems and setting up an interruption with our customers, then repairing the problem. Not only is there a saving in outage time but also a savings in overtime call-outs for someone to repair the job after an outage has occurred. Mississippi Power Company has taken the initiative to be the best provider of electricity to our customers and a trendsetter for the future. By finding these problems, identifying them and having trained and informed people doing the job, we can reduce our potential outages and problems to a minimum. Therefore resulting in great customer satisfaction and a win-win for all involved.