



24/7 INFRARED AND VISUAL MONITORING SYSTEMS

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ABSTRACT

Southern Company is deploying two distinct infrared (IR) camera systems in substations to provide continuous thermal monitoring of in-service equipment. Each of these systems detects the formation or worsening of thermal hotspots through real-time data collection of temperature readings as well as monitors the condition of equipment through this data paired with visual images. Access to such data provides a better understanding of historical, present, and potential future health of major substation equipment, allowing equipment owners to make better informed maintenance decisions.

INTRODUCTION

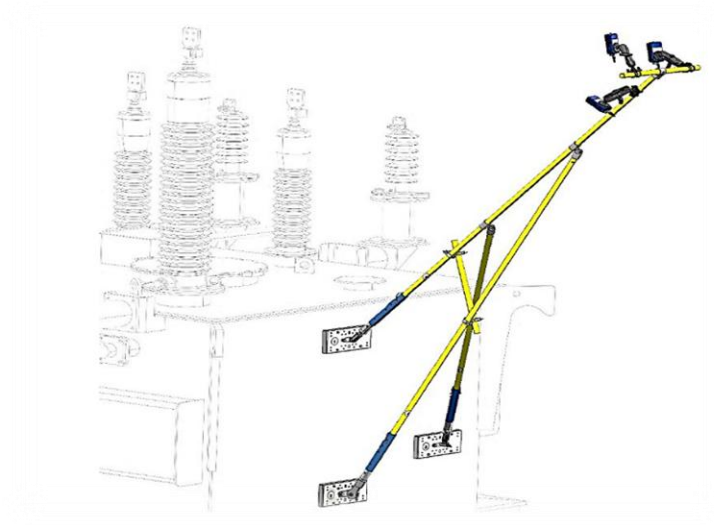
Routine infrared inspections represent a core staple of power transformer maintenance procedures and give insight into the overall health of key pieces of equipment such as bushings, arresters, and all connection points between these separate pieces of equipment. However, these inspections limit the health checks of equipment down to a single data point taken at one specific point in time. Numerous environmental and electrical loading factors constantly contribute to changes in temperatures for these types of equipment, which ultimately creates the possibility for significant differences in data between these periodic inspections. Continuous monitoring provides a solution to remove these data blind spots and enables system owners to better discover, monitor, and repair any thermal hotspots on equipment. Southern Company currently deploys two types of continuous IR camera systems across the Georgia Power Company and Mississippi Power Company electric systems: a static camera system that is installed on individual equipment and a dynamic camera system with pan, tilt, and zoom capabilities that patrols through predetermined locations.

IR CAMERA SYSTEMS

Several factors impacted the decision to invest in and deploy these camera systems in the field. The most crucial requirement centered on the system's ability to provide ample, accurate thermal data and to be able to provide that data reliably and consistently from site to site. Initial installation plans focused on monitoring both high-side and low-side bushings on substation transformers with options to include additional equipment as possible with each camera system. Both the static and dynamic systems meet the data collection requirements, but each system also provides its own benefits and implementation options compared to the other.

Static Camera System

The static camera system deployed by Southern Company provides a close focus on the bushings and arresters of the specific power transformer it monitors. This system utilizes a package of three individual camera modules that are installed in separate locations around the top of the transformer itself. Each camera connects to an extended structure that magnetically mounts to the transformer tank, which allows all cameras to be strategically positioned to ensure proper thermal coverage. Due to the coastal proximity of some of the substations, this magnetic mounting system is rated to withstand Category 2 hurricane wind conditions. Such resiliency also combats potential camera-drift over time, which could impact the quality of data collected. Additionally, the design of this mounting system, as shown in Figure 1 and Figure 2, creates a consistent, safe installation and commissioning process for each project that can be completed without needing to take any equipment outages.

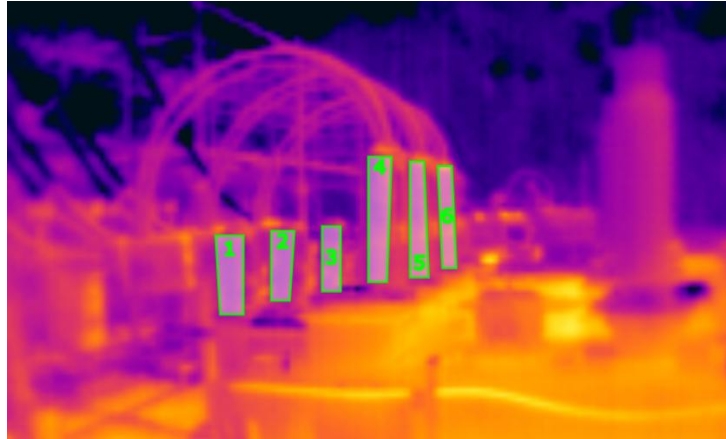


Mounting System for Static Cameras
Figure 1



Example of Static Camera System Installation
Figure 2

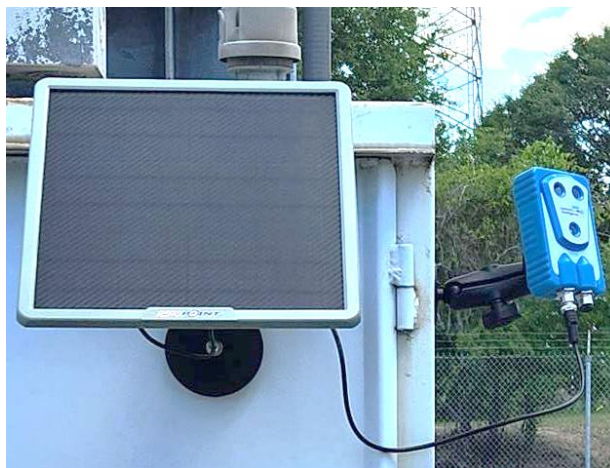
Since the individual cameras and mounting system comprise the bulk of required material, the system only needs minimum additional infrastructure to function properly. Even the data transfer is handled wirelessly, which reduces material even further. The camera sends its data to a manufacturer-owned Cloud entity that can then be accessed by approved end-users as needed for analysis or trending purposes. The data pipeline also enables the end user to set up email notifications of routine snapshots from the thermal, visual, or both camera lenses as well as configure alerts for alarm conditions. The data itself consists of average, minimum, and maximum temperatures detected within defined polygons that are created for each camera during the commissioning process, like those in Figure 3 below.



Thermal Polygons for Static Camera Commissioning
Figure 3

Each polygon can be modified after commissioning as needed to improve data collection. This includes increasing the area to include other points of interest or changing the shape to exclude areas that may be negatively impacting data quality. The standard approach for the static camera system includes drawing one polygon for each monitored transformer bushing or arrester, up to a maximum of six polygons for each individual camera. The camera then continuously measures and uploads the three data points recorded for each polygon; it does not store any of the data for local access. To create additional data access for users, Southern Company worked to create an interface that works with the manufacturer's Cloud server to pull the thermal data into a historical data server created using an AVEVA PI System platform. This second instance of the data is accessed through a web URL on the company network. A dedicated team then provides additional analysis and monitoring of this data to further increase the impact of abundance of thermal measurements now available.

The success of the static camera system in monitoring transformer bushings and arresters eventually led to the development of a mobile camera system that could be deployed to provide coverage to other pieces of equipment as needed. This new hybrid system combines the same camera type and data stream as the traditional static system but also adds a solar charged battery system and new magnetic mount for installation flexibility as shown in Figure 4. Additionally, this system only utilizes one camera that is directed at the area of concern.



Mobile Static Camera System for Temporary Monitoring
Figure 4

The camera can be configured to take measurements and snapshots over a specific interval depending on the situation at hand. The standard approach is to record new entries every 24 or 12 hours for lower priority situations and to record new entries every 4 hours for situations with higher levels of concern. Deploying this mobile system for temporary monitoring replaces the need for personnel to take manual measurements or IR scans weekly or even daily.

Dynamic Camera System

The dynamic camera system offers the same impactful collection of thermal data as the static camera system but comes with its own benefits and options for implementation. While both systems provide thermal and visual resources for monitoring equipment, the details of these resources and how they are collected differ greatly. The dynamic camera system utilizes a more complex camera that provides extra flexibility and options for installation and commissioning. However, this system also requires in-depth project designs and additional system components. The main components of the dynamic camera system are the physical camera housing, Figure 5, and a local video server, Figure 6.



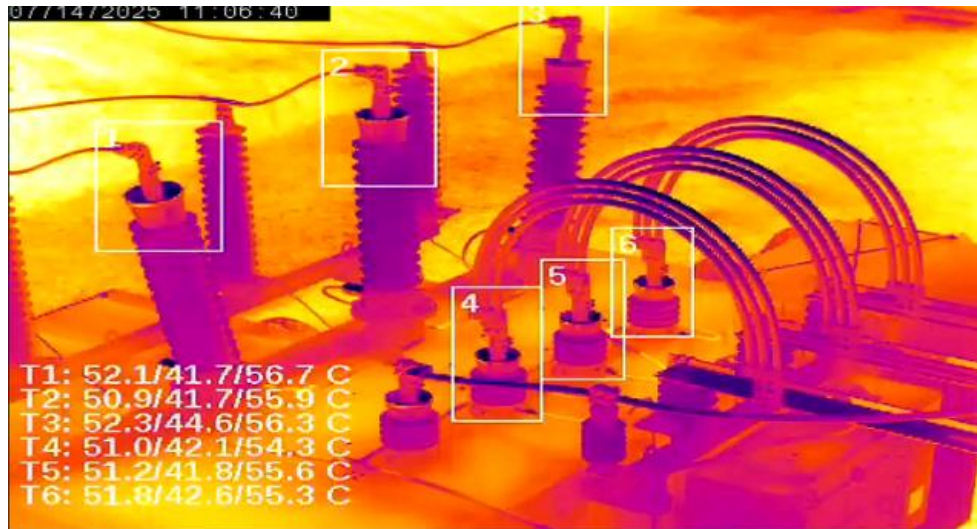
Dynamic Camera Housing Containing Fixed Thermal Lens and Variable Visual Lens
Figure 5



Dynamic Camera System Local Video Server
Figure 6

Each installation requires at least one camera housing that is installed in the field with line of sight to the monitored equipment. The housing can be installed on a variety of equipment including electrical bus and pole structures by utilizing different brackets and mounting options. Every camera housing contains one thermal lens with a fixed focal length and a visual lens with a 36x variable zoom. The focal length of the thermal lens is decided during the project design and depends on the distance between the camera's location and its intended target(s) while the visual lens is identical for each housing. The bottom of the housing contains a motor system that enables pan and tilt movement of the entire housing. As such, the dynamic camera system can adjust its orientation to view numerous pieces of equipment across the substation; this expands its monitoring zone to any equipment within its line of sight. The impact of each camera system grows exponentially with the amount of equipment it can cover.

The video server is a rack mounted device that is installed in the substation control house or outdoor control cabinet, and this server drives the operation of each camera housing and the dynamic system as a whole. The video server utilizes fiber connections to communicate over a local area network with each camera housing individually through a smart-junction box that is installed with each housing. The camera housing connects to the smart junction box using a CAT-6 ethernet cable. Through these connections, the video server both receives data streams from the thermal and visual camera lenses and sends commands to move the cameras through preset thermal configurations for each thermal target. The server can process up to eight camera housing connections simultaneously and run these systems independently of each other. Each of these thermal configurations contains up to six numbered rectangular boxes that measure minimum temperature, average temperature, and maximum temperature of the area within. These boxes are drawn around areas of interest such as transformer bushings, arresters, and fans. Figure 7 gives an example of a configured preset with a box drawn for each bushing of the transformer. Each camera housing can be programmed with a maximum of 32 preset configurations for a total maximum of 256 thermal scenes for each dynamic camera system.



Dynamic Camera System Thermal Preset Example
Figure 7

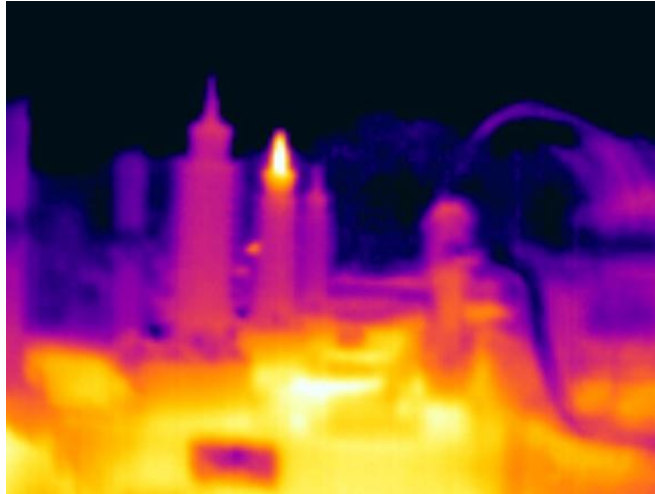
A standard, fully commissioned dynamic camera system collects thermal data for each camera's configured presets and provides analytics over that data all locally within the video server. The server holds the camera in each preset for 30 minutes and collects data every 2 seconds during that time. Once the preset time interval is met, the server drives the camera housing to the next preset configuration to repeat the process. The thermal data and corresponding video streams are archived in local memory for future reference. Additionally, the video server contains customizable DNP3 point lists for data transfer to external systems. Southern Company is actively working to utilize this protocol to transmit binary and analog data to its AVEVA PI server to mirror the systems in place for the static camera system. Both local and remote ethernet connections to the video server are available through instances of vendor software. These connections provide the same capabilities including access to the camera system settings, thermal preset configurations, archived thermal data and video stream, and manual movement control of each camera housing. All these capabilities provide robust systems for detecting and analyzing any arising thermal abnormalities or hot spots, and are customized for every installation.

INVESTIGATION OF DETECTED THERMAL HOTSPOTS

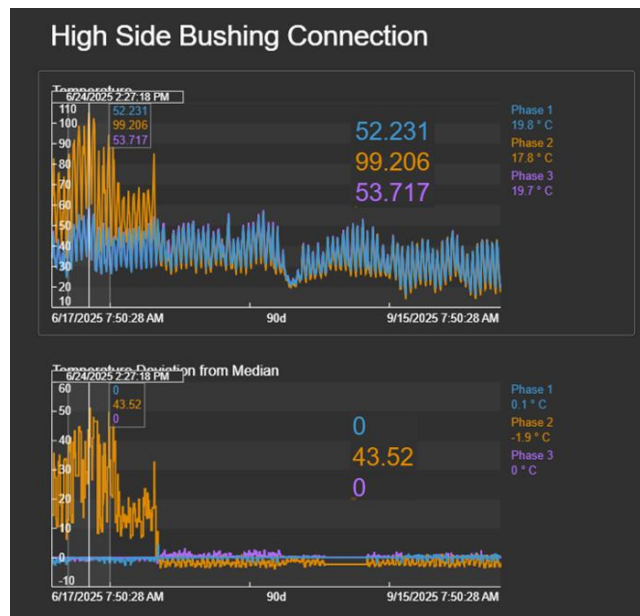
Since being commissioned across numerous substations on the Southern Company system, both types of camera systems have detected several instances of thermal hotspots or other unexpected equipment heating. This early detection enabled the operating companies to proactively address the issue to prevent further degradation, unexpected outages, or even catastrophic failure. The availability of real-time data also captured the impact of environmental and electrical factors that would not have been available through traditional thermal inspections. This data also showed the immediate impact of repair work to confirm that the issue was completely resolved. While the details of each observation may differ, the general process of each observation and repair followed a consistent process. First, the in-service camera system detected some sort of abnormality, whether it was an outlier of similar equipment or a deviation from baseline or historical behavior. Then, the combination of data and images allowed the user to gauge the severity of the issue, appropriate response time, potential root causes, and possible repair options. Outages were taken to perform necessary inspections, repairs, or replacements. The new data then allowed users to confirm that the equipment returned to normal operation and that the issue was resolved.

Static Camera Observations

The static camera systems excel in detecting the presence and formation of thermal differences and hotspots on transformer bushings and arresters. This first example in Figure 8 shows a thermal snapshot from a camera monitoring the high-side bushings on a distribution transformer. The initial thermal data included in Figure 9 shows a maximum temperature of approximately 100 °C while the other two maximum temperatures only reach 53°C, which represents an almost 50°C delta between phases and an immediate concern for the health of the monitored equipment.



Detection of High-Side Bushing Thermal Issue
Figure 8



Thermal Data from Southern Company PI Server Interface
Figure 9

Personnel scheduled an emergency outage for investigation and repairs, during which they found a loose draw lead nut on the bushing lead and evidence of severe arcing between bushing components as shown in Figures 10 and 11. The bushing pin had severe pitting and was close to complete failure which could have catastrophically failed the transformer.

The camera systems also excel in monitoring the impact of repairs on equipment once it's been returned to service by giving immediate feedback on thermal temperatures. This feedback continues for future readings and provides a depth of information unavailable through traditional scans and inspections. Such data feedback and immediate impact of repairs is shown above in the latter half of data shown in Figure 9, which comes from the Southern Company PI Server display that was built out for this specific camera system. After repairs, all three maximum temperatures for the transformer's high-side bushings trend together, and the deviation between phase temperatures disappears almost completely. This confirms successful repairs made during the outage and shows the improvement in the health of the transformer.

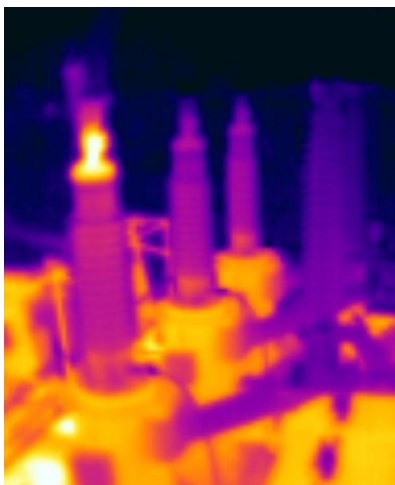


Physical Damage to Bushing from Arcing
Figure 10

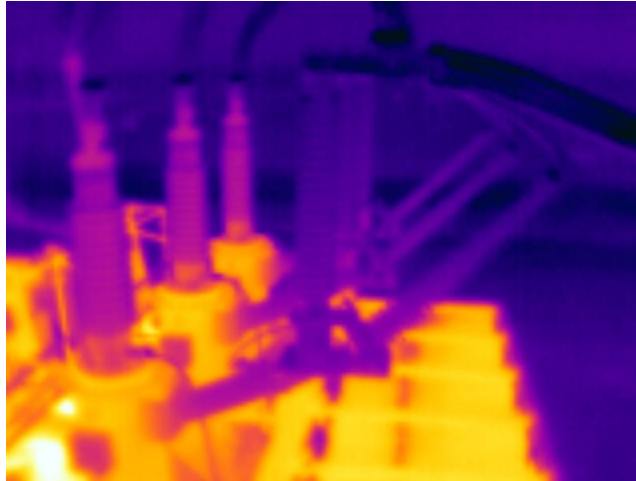


Physical Damage to Bushing Pin
Figure 11

While the raw thermal data from the camera systems detects the presence of a possible area of concern, the images themselves play a crucial role in determining the exact equipment involved and what may be necessary to correct the issue. The following figures show several examples of equipment heating due to external components of the bushing as opposed to the internal draw lead nut of the last example. Figure 12 shows the top portion of a high-side bushing heating due to the ring clamp for the pad connector being loose, and Figure 13 demonstrates how simply tightening that clamp removed the thermal issue entirely.

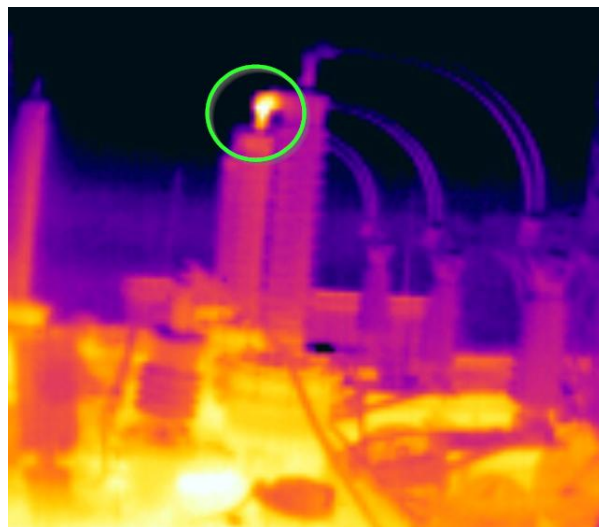


Bushing Heating Due to Loose Clamp
Figure 12

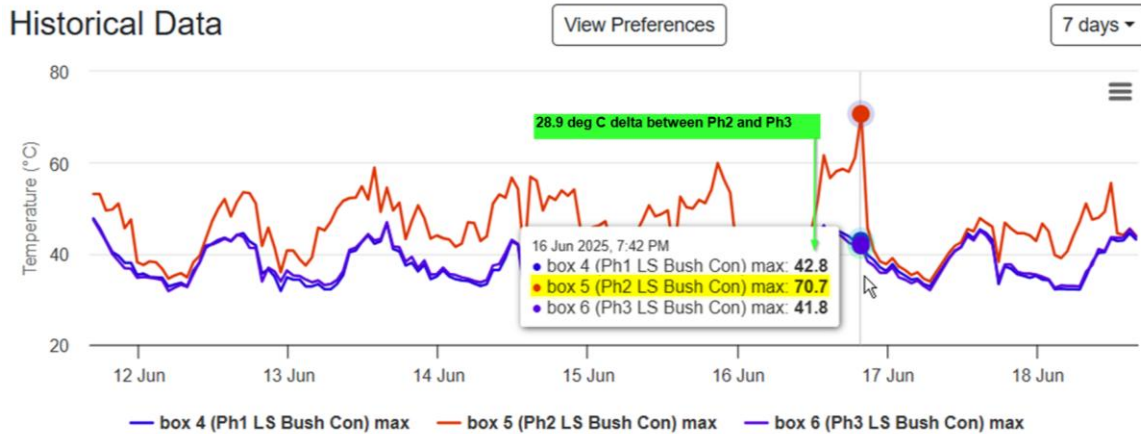


Thermal Snapshot Verifying Successful Repairs
Figure 13

Figure 14 gives another example of an external thermal issue where the bolts between the bushing pad and the lead were not properly tightened, and the thermal image clearly shows the exact area of issue that had developed approximately a 30°C delta, as shown by the data in Figure 15, compared to the other phases. Personnel knew to suspect possible loose connections before arriving onsite for their investigation based on the location and behavior of the thermal hot spot. The loose bolted connection was visible from the ground, and Figure 16 contains the original picture taken onsite during the investigation and includes a zoomed portion to showcase the loose bolts between the lead wire and the pad connection.



Connection Point Heating Due to Loose Bolts
Figure 14

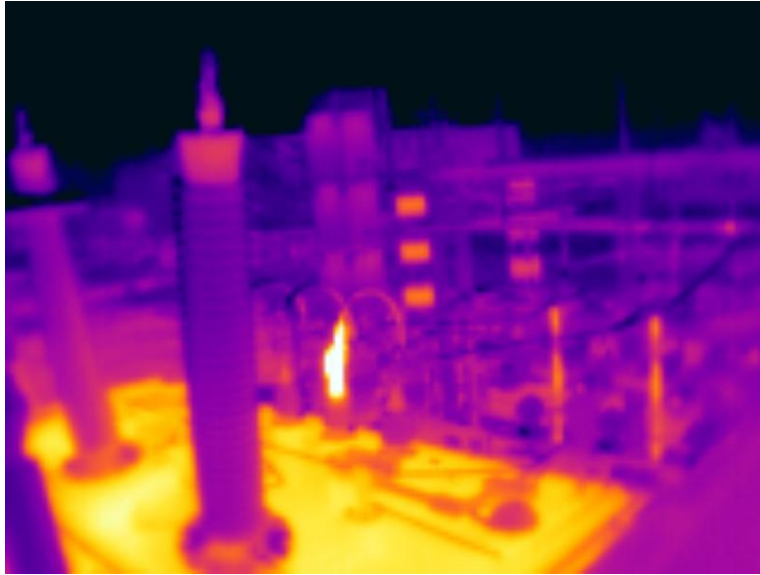


Thermal Data from Cloud Interface Showing Temperature Delta
Figure 15

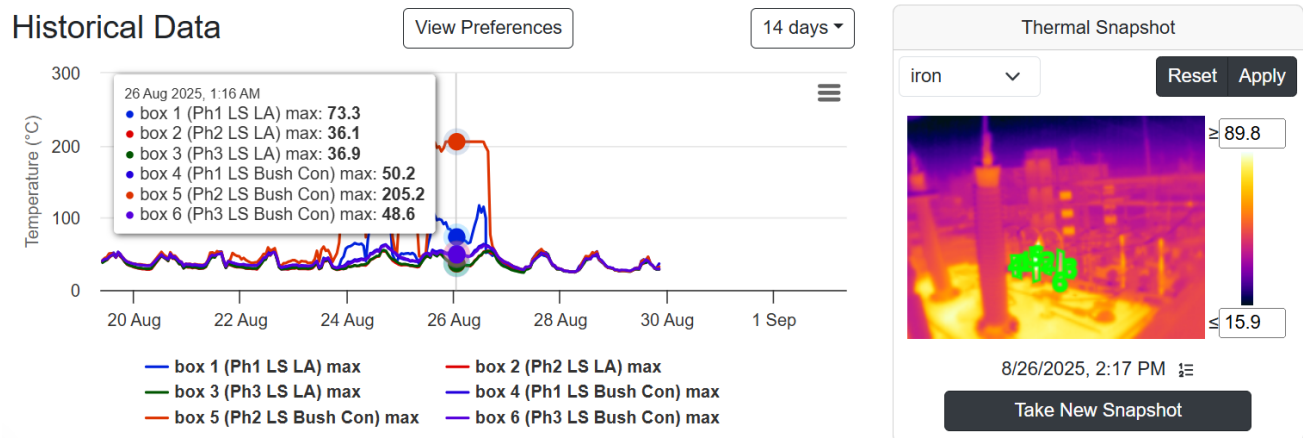


Image Showing Loose Bolted Connection on Bushing Pad
Figure 16

Combining the available thermal images from the static camera system with the actual numbers of the thermal data gives insight into the full nature of a thermal hot spot, which then influences the appropriate response plan. The magnitude of the temperature readings, the location of the heating, and the trending of the data all play a pivotal part in deciding the next course of action, what resources should be available, and the necessary timeframe. Figure 17 and Figure 18 show a thermal snapshot and the thermal data for another hot spot due to loose bolted connections, but at another level of severity than the previous example. This camera system measured temperatures above 200°C over an extended timeframe including nighttime data samples. Additionally, the heating encompassed the entire top portion of the low-side bushings, thus further signifying a serious issue that actively compromised the health of this specific bushing and the entire transformer.



Thermal Snapshot Showing Extreme Heating of Low-Side Bushing
Figure 17



Thermal Data from Cloud Interface Showing 200°C Readings
Figure 18

Because of the static camera system insight, personnel immediately scheduled an emergency outage and prepared the necessary equipment for a full bushing replacement due to the extended exposure to such high temperatures. During the outage, field personnel confirmed physical damage to the bushing and evidence of arcing between the connection points. This damage at the connection point is seen in Figure 19 as well as Figure 20, which shows degradation away from the bolted connection.



**Image Showing Loose Connection and Damage
Figure 19**

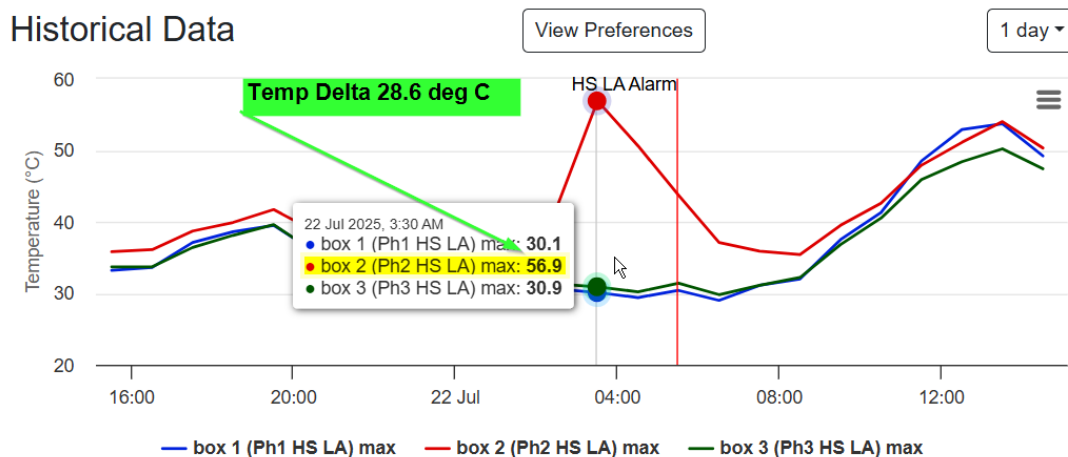


**Image Showing Impact of Extreme Heat on Bushing Seals and Oil
Figure 20**

In addition to traditional hot spots and thermal heating, the continuous monitoring of the static camera system also can capture unexpected behavior or abnormal developments like the high-side arrester shown in Figure 21. This transformer suffered a blown high-side fuse, which resulted in an open circuit configuration on the high side. Immediately, the arrester between the blown fuse and the transformer bushing began rapidly heating and soon produced over a 20°C delta compared to the adjacent arresters with intact upstream fuses, as shown in Figure 22. Thanks to this additional information, field personnel knew to take additional precautions to ensure effective and safe repairs to the affected equipment.

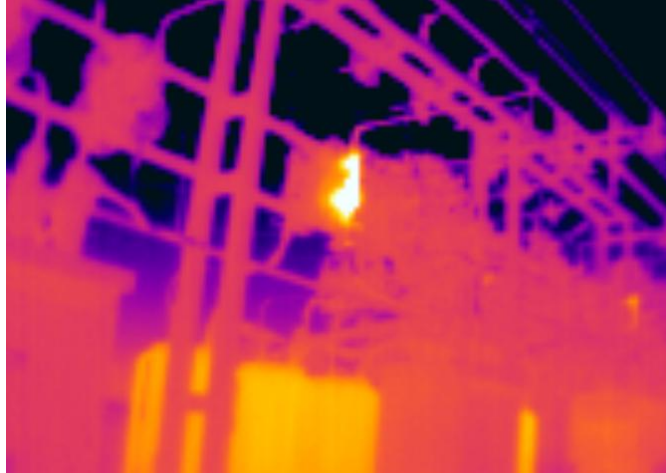


Thermal Snapshot Showing Arrester Heating During Open-Delta Situation
Figure 21



Thermal Data Showing Arrester Heating Following Blown High-Side Fuse
Figure 22

One of the only drawbacks of the standard application of the static camera system comes from the limited types of equipment it can monitor; however, the development of the mobile static camera system greatly expands the coverage that these cameras can now provide to new points and equipment of interest. The mobile system excels in situations where any additional thermal data is beneficial or where equipment may be difficult to access for manual IR scans. The snapshot in Figure 23 shows a situation of a known distribution switch that was heating. However, it was part of the system feeding power to an important customer that could not immediately come offline without major impact. Personnel deployed the manual camera system to provide continuous monitoring of the situation and to ensure the issue was not worsening. This extra time allowed the customer to safely come offline and allow personnel to replace the damage switch that is shown in Figure 24.



Thermal Snapshot from Mobile Static System Showing Heating Switch
Figure 23



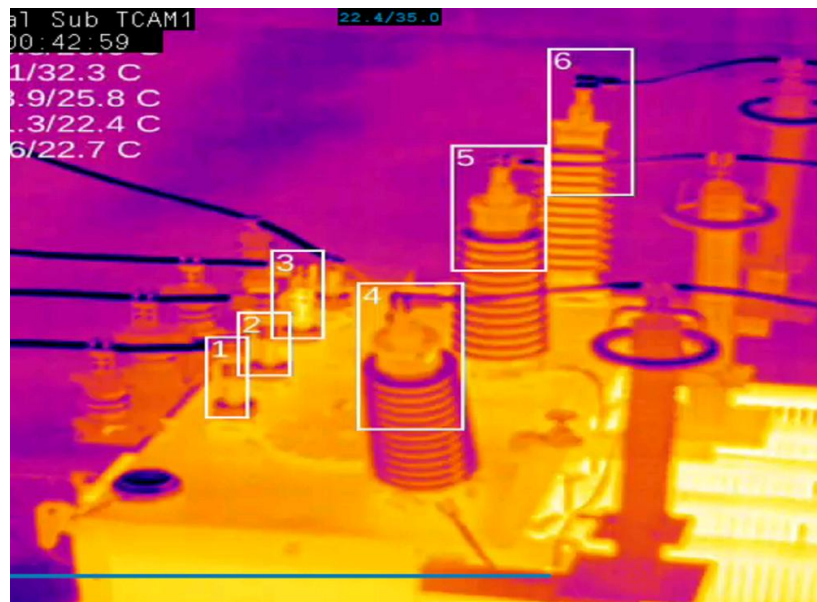
Image Detailing Damage on Monitored Switch
Figure 24

Dynamic Camera Observations

The first phases of Southern Company dynamic camera systems have been in service for just over a year and have already contributed to several thermal observations across a variety of equipment. This access to equipment thermal data is another tool that is being utilized to build a full picture of equipment health and performance. For example, Figure 25 and Figure 26 show the changing status of a substation transformer approximately four hours apart during a night in early January 2026. The first figure shows 25.7°C as the maximum temperature of its third box which is drawn around a low-side bushing. The maximum temperature of that same box increases up to 32.3°C over the next four hours while all the other boxes' maximum temperatures decrease with the falling ambient temperature of the winter nighttime. This unexpected behavior is one of the anomalies that signifies some sort of equipment issue.

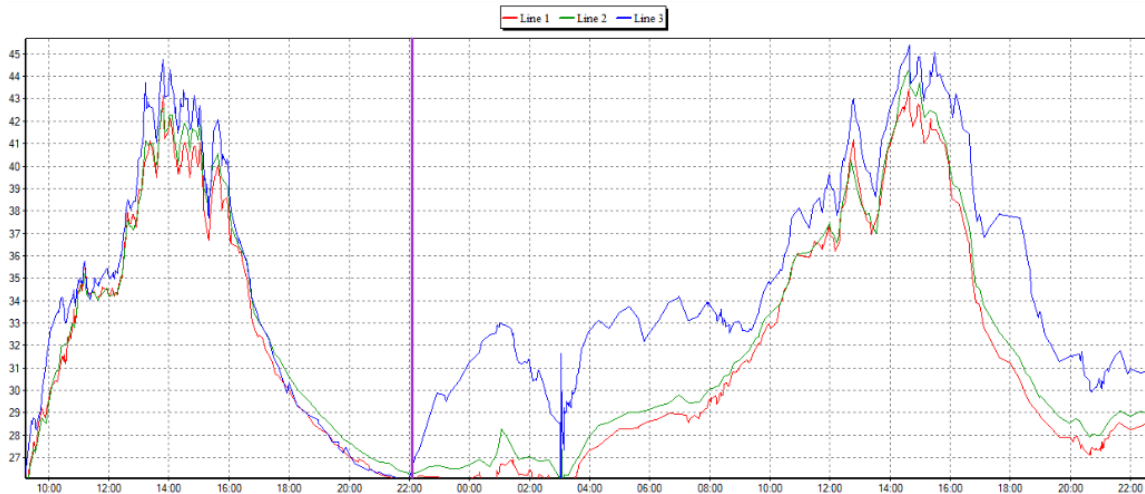


**Thermal Image Showing Low-Side Bushing Temperature 25.7 °C before Load Increase
Figure 25**



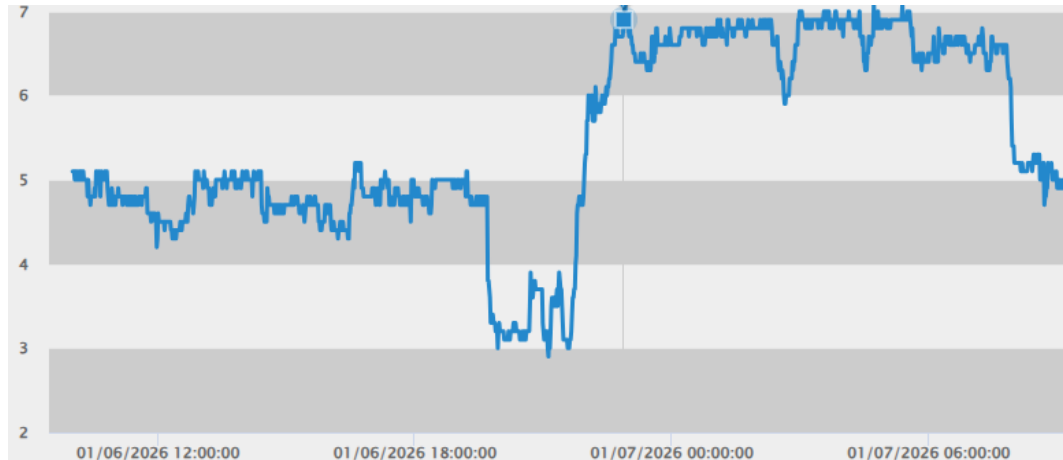
**Thermal Image Showing Low-Side Bushing Temperature 32.3 °C after Load Increase
Figure 26**

The historical data records in the video server further showed that this same bushing consistently ran hotter than the other low-side phases, especially through the evening hours when there was less solar influence on temperatures. Most of the observed maximum temperature deltas came in the form of sudden spikes that would gradually close over time. One such situation is shown in Figure 27 that shows thermal data from January 6th through January 7th and corresponds to the figures mentioned above. A large delta forms around 22:00 and only begins to close around 10:00 the next morning.



Archived Data from Video Server Showing Low-Side Bushing Temperatures
Figure 27

A sudden change in temperature represents either a notable change in bushing behavior or an external change affecting the system. When looking at the loading data of this transformer that is shown in Figure 28 below, the load jumps from around 3 MW up to 7 MW the same time the delta appears in the thermal measurements. It also falls from the 7 MW mark down to 5 MW around the same time the delta closes around 10:00 the next morning. Both instances support the idea that this thermal hotspot is directly affected by the load to the transformer and confirm that this low-side bushing is behaving abnormally.

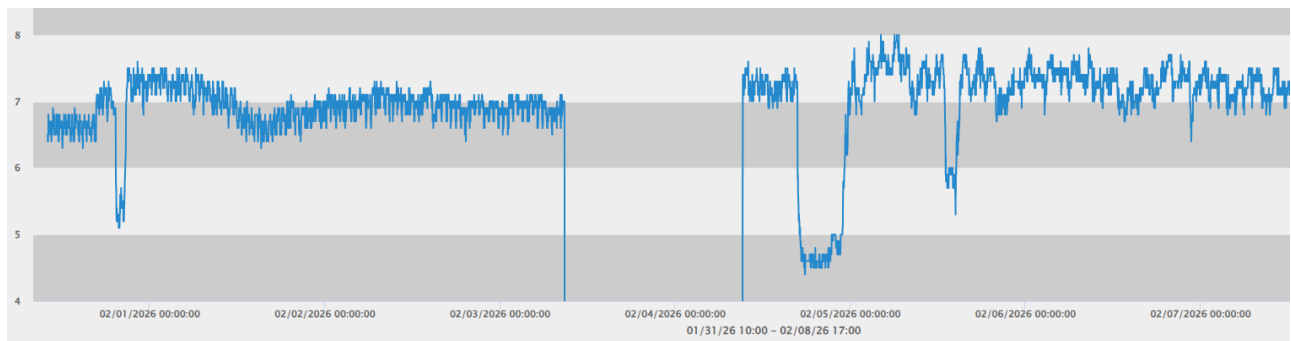


MW Load Data for Transformer on 01/06/26
Figure 28

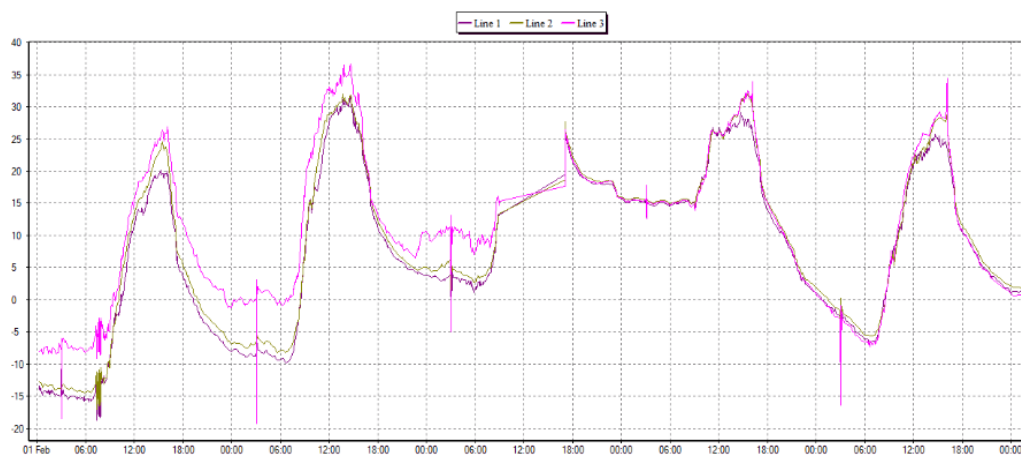
A maintenance outage was scheduled for the bank where the bushing was thoroughly inspected and cleaned before returning to service with confirmed tight connections. Similarly to the static camera system, the dynamic camera system also provides the benefit of confirming the impact of repairs on thermal hot spots. This is especially important in a situation such as this one where the issue was dependent on the load of the equipment, and it may be difficult to complete a thermal scan during the desired conditions. The following figures show the ability to fully monitor and confirm the effectiveness of repair work or equipment replacement. Figure 29 shows a snapshot taken at the 10:00 timeframe several days after the outage whereas Figure 30 and Figure 31 show the correlation between loading on the transformer and the delta between the maximum temperature readings of the low-side bushings.



Thermal Image Showing Bushing Temperatures after Repair
Figure 29



MW Load Data During Outage and Following Repairs
Figure 30



Archived Data from Video Server Showing Lack of Delta During Load Shifts
Figure 31

The load data shows the outage lasted for approximately one full day from 2/3/26 to 2/4/26 with the bank returning to full load service shortly after. Most notably, the transformer experiences the same load shift just around 0:00 on 2/5/26, which created the temperature delta at the end of 1/6/26. The load shifted from 5 MW suddenly to 7 MW in this instance, but the thermal data from the camera does not show the development of any similar temperature delta for this timeframe. The temperature traces instead trend almost identically to each other for every low-side bushing which confirms the issue is resolved.

The thermal lens and its data are crucial to detecting the presence of unwanted hot spots on equipment and highlighting the affected areas. The visual lens and its pan, tilt, and zoom capabilities add another level of investigation that can further the effectiveness of the dynamic camera system as shown in the following example. Figure 32 comes from the commissioning process on a newly installed camera system that measured a difference between maximum temperatures of high-side bushings. The largest delta in this observation equals about 7°C, which is notable but does not usually create an emergency response.



Thermal Image Showing High-Side Temperature Delta During Commissioning
Figure 32

However, while continuing with the commissioning process of the camera system, the feed from the visual lens showed discoloration on the same bushing with the highest temperature. Figure 33 is a snapshot taken by manually controlling the visual lens and utilizing the variable zoom to better inspect the areas of high temperature. This image shows discoloration across a majority of the top of the bushing as well as the presence of residue that seems to be tracking down the equipment. This additional information pushed personnel to take an outage to quickly correct the issue before the condition could worsen. All bushing connections were tightened, and the bushing was thoroughly cleaned before returning to service. Figure 34 shows the performance of the bushing five months after repairs during the peak loading of summer with almost no delta present between the high-side phases.



**Image from Visual Camera Lens Showing Residue and Discoloration on Heating Bushing
Figure 33**

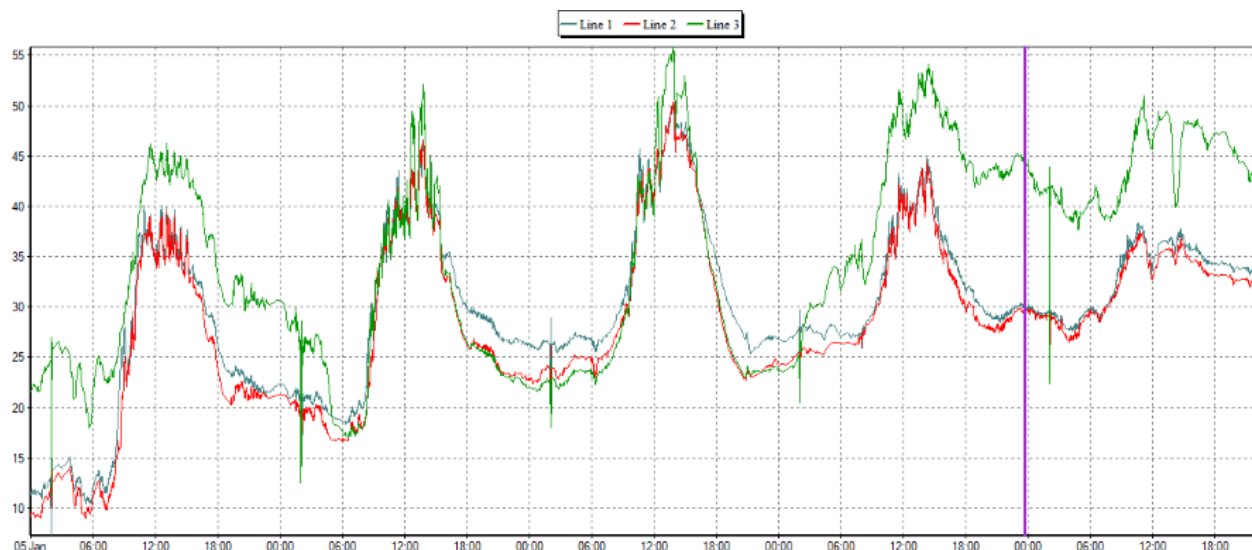


**Thermal Image 5 Months after Repairs with No Temperature Delta
Figure 34**

As mentioned in the static camera system section, one of the main benefits of continuous monitoring systems comes from being able to actively watch known issues to see how they progress over time until repairs or replacement can be completed. Figure 35 shows another example of a temperature delta between high-side bushings on a distribution transformer feeding a large industrial customer. The historical data confirmed the presence of this delta over a wide timeframe with it steadily reaching 20°C and holding overnight as evidenced by Figure 36. Once again, this nighttime period highlights the difference between phases since there is no solar heating to skew the measurements.

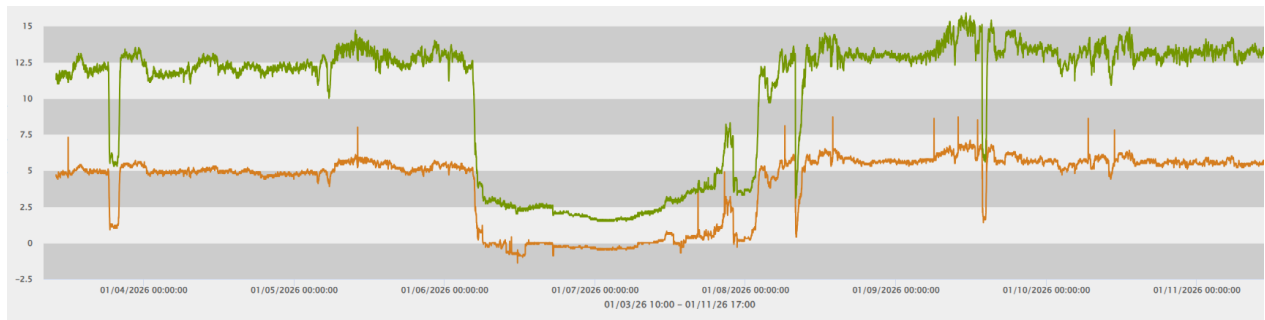


Thermal Image Showing 20°C Delta Between High-Side Bushings
Figure 35



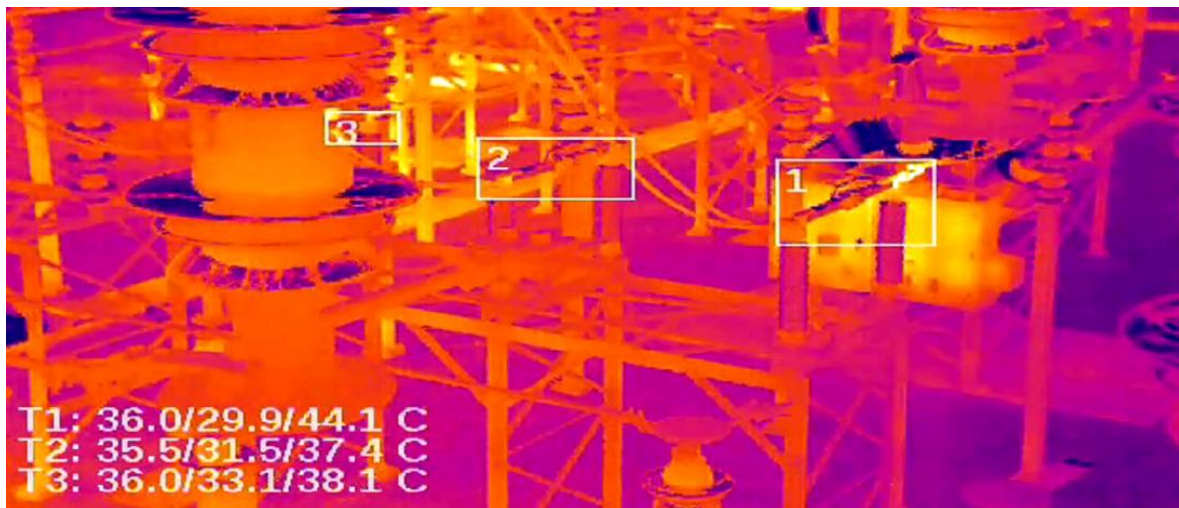
Archived Thermal Data for High-Side Bushings 01/05/26 to 01/10/26
Figure 36

Due to the nature of the customer and this being a single bank substation, it is more difficult to get an outage scheduled for maintenance work. Moreover, the loading data for this transformer showed that the larger temperature deltas did coincide with higher loads on the bank, but the maximum delta was holding steady over the past two months. Figure 37 corresponds to the timeframe of the thermal data in Figure 36 and shows the MW and MV load on the bank. The periods of low loading from 1/6/26 to 1/8/26 match the closing of the temperature delta shown in the middle of the graph above. Knowing that the delta was load-related and did not actively worsen during full load conditions allowed personnel to begin working with the customer to schedule an outage at a time beneficial to both parties. At the time of drafting this paper, this hot spot has not been corrected as the outage is still being scheduled. The dynamic camera system data is being reviewed on a weekly basis to detect any changes that could signify the bushing condition is worsening.



MW and MV Load Data for Transformer 01/04/26 to 01/12/26
Figure 37

One of the driving factors for considering the dynamic camera system stems from the flexibility and customization such a system offers. While initial goals centered on monitoring transformer bushings and arresters, the dynamic system grants the opportunity to expand that coverage to numerous other equipment types including transmission breakers, Load-Tap-Changer tanks, and transmission and distribution switches. Figure 38 shows an example of a thermal preset configuration comparing each phase of a transmission switch at a site where coverage expanded beyond transformer presets. This preset originally only focused on the switch interlocks, but the boundary of thermal box 1 picked up elevated temperatures that came from a connection point just beyond the switch. Because of this, box 1 was redrawn to include the heating connection for trending and tracking purposes until an outage could be taken to investigate the situation.



Thermal Image Showing Heating on Transmission Switch Connection and 7 °C Delta
Figure 38

With this flexibility, the dynamic camera system provides coverage tailored to each specific site and to each specific piece of equipment at that site. This coverage can also be expanded to include additional targets over time or to account for any major equipment replacements.

CONCLUSIONS

Thermal imaging continues to play a pivotal role in determining the health of critical substation equipment. While it is still beneficial, conducting traditional IR scans over a predefined time interval still leaves ample room for improvement by contributing to possible data blind spots between inspections. These blind spots could miss crucial thermal developments, especially situations directly impacted by equipment loading or weather conditions. The implementation of a continuous thermal monitoring system improves the fundamentals of traditional IR inspections by granting access to a plethora of thermal data, thermal snapshots, and visual images. This abundance of new data allows equipment owners to determine real-time health conditions of equipment and compare those conditions to historical averages or expected behaviors. The data also creates trends that can model the direct impact of load changes and other external environmental factors to better assess current conditions.

Once installed, these systems provide important insight into equipment conditions, and that same insight is difficult to replicate with traditional IR systems. The continuous thermal monitoring systems provide an understanding of the equipment during a normal, healthy status and help create an expected baseline. The thermal data and imaging from the cameras then detect the formation of any possible thermal issues through a change in routine measurements. That data then allows personnel to determine likely causes of the issue at hand due to the location of the hot spot and the temperatures that are being measured by the camera. This same information also grants the ability to determine the severity of the issue, which allows for proper planning of outages, material, and manpower when determining the response plan. In situations where an immediate outage is not needed or not possible, these systems continue to provide instantaneous updates of the equipment's condition to verify whether the issue is stable or worsening. Finally, once the issue is addressed, the camera systems confirm successful repairs as soon as the equipment returns to service as well as the impact of those repairs over time.

Both camera systems, however, rely on proper setup to function as intended. A poor commissioning process directly impacts the long-term benefits and performance of the static and dynamic cameras. Additionally, any sort of camera drift can temporarily render either system useless until the issue is corrected. This correction normally requires adjusting the thermal polygons/boxes or physically adjusting the camera mounts. Finally, a loss of communication to any camera also reduces the impact of both systems by severing the data flow and system accessibility. Thankfully, any issue impacting the performance of the camera systems quickly becomes apparent due to the consistent thermal measurements. A large shift in thermal data for all measurements highlights possible camera drift, and the loss of data entirely will represent either a communication issue or hardware issue with the system itself; both instances allow for a quick investigation and repair of whatever the problem may be.

The two camera systems deployed by Southern Company each accomplish the goal of providing this important continuous thermal monitoring of equipment, but the individual systems provide their own benefits. The static camera system, for example, represents a consistent, predictable system that can be deployed quickly, not only on specific installations, but also across an entire system. Each installation and commissioning process is the same from site to site and requires little extra infrastructure or design work. The transfer of data to a Cloud server creates convenient access for data checks and effective alarm communication. Conversely, the dynamic camera system requires much more planning and design work but gives ample flexibility in its implementation and customization. One camera housing can provide coverage to numerous pieces of equipment and can be mounted across a variety of structures. All of the dynamic system capabilities are accessible through a direct connection to the video server, which gives the end user a variety of investigative and troubleshooting tools that can be used immediately and remotely. Overall, as shown in this paper, both the static and dynamic camera systems create a continuous thermal monitoring option that has made and will continue to make an impact on the thermal health of substation equipment, which would not be possible to replicate through traditional IR maintenance scans and inspections.

BIOGRAPHY



Drew Mohundro earned his B.S. in Electrical Engineering with a minor in Computer Science from Mississippi State University in 2021. He joined Mississippi Power as a Field Engineer in System Protection and Control before becoming the company's first Condition-Based Maintenance (CBM) Engineer in 2023. In this role, he oversees installation, commissioning, and operation of CBM equipment monitors, providing data analysis, alarm investigation, and serving as the primary contact for all CBM systems.



Roger Ely is an Engineer with 40 years of service at Georgia Power Company. Roger has a broad range of experience with Transmission and Distribution in areas of substation asset management, distribution engineering, system reliability, and supervision. His current role is the Substation Support Engineer for all Transmission Maintenance Centers across the state of Georgia with a focus on conditioned based maintenance. Roger is a graduate of Auburn University with a Bachelor of Science in Electrical Engineering, a licensed Professional Engineer in the state of Georgia, and participates as a current member of IEEE.