

Should panel covers be removed to perform an IR survey of electrical switchgear?

By Gregory R. Stockton

Introduction

As infrared thermographers, from time to time we are asked if we could perform an electrical infrared survey without removing the panel covers...that it might be a more efficient way to perform the survey. This is a great question. It would be more efficient, but an IR survey should not be accomplished in this manner.

Why Not?

There are two reasons why someone might be inclined to ask about this: (1) They want to reduce the risk of tripping a breaker or causing a failure during the panel cover removal and replacement (R&R) process. (2) They want to save some time [money] because the R&R process takes longer.

These are both noble causes and I don't blame any manager for considering either a valid reason to ask the question. I have to take issue with the rationale however, because saving money and reducing risks are the very motivation for performing these surveys in the first place. True, surveying the panels without removing the panel covers will reduce the risk of tripping a breaker, is safer and will save time on the survey. Surveying with the covers on, while better than no IR, is largely ineffective and could actually increase liabilities.

Physics and the Case for R&R

The reason for performing this type of survey is to find electrical problems so that maintenance personnel can repair them. Faults need to be found in their nascent stage, that is, before damage has occurred and especially before component failure. This infrared technique is predicated on the fact that there is a locked relationship between temperature [rise] and an increase in the chance of failure. Electrical (and mechanical) problems in this stage often show very little temperature rise. It takes an experienced thermographer with a good piece of infrared equipment to find and document problems in this stage. Anybody can point an imager at anything that is burning hot and find a problem. And, while finding 'hot spots' is important, that is not why professional thermographers are hired. It is because they have the expertise to distinguish between a real problem and a non-problem and for the expert documentation of all the components – not just the hot ones. Small problems seen on an IR survey will often become big problems if not addressed. A skilled thermographer would probably find some true positive results while surveying with the covers on, but these true positives are not all the problems.

Infrared pictures (thermographs) show ONLY surface temperatures. So, can all problems inside electrical panels be seen through solid steel? Absolutely not. But, one could argue that a guess (albeit an educated guess) can be made from looking at the surface temperature patterns of the panel and the exposed surfaces of the breakers and that just those [few] panels could be removed and inspected, narrowing down the R&R operation and thereby reducing the associated risks/costs proportionally. The theory sounds viable at first look, but there are several crucial flaws:

- 1) It is almost impossible to tell the difference between a medium-loaded breaker in a panel and a breaker with a loose bus connection (see Figures 1-5). So in order to perform a dutiful survey, the thermographer would need to report for removal, almost every panel that contains even a slightly loaded breaker. What is the sense in going through, for example, 500 panels, finding some heat on 400 of them and having them taken apart and re-inspected on a separate mobilization? –Or waiting around for the electricians to remove the panel.
- 2) The space between the panel cover surface plane and the component is filled with air – an excellent insulator [of heat]. Even if there is a serious problem there may not be enough mass to send a recognizable amount of heat to the surface. These will be missed.
- 3) What about all those lightly-loaded circuits or the less-obvious problems like a component that is in an annealed state –relatively cool at the moment because it is making a pretty good connection in that part of the fault cycle? These will also be missed.
- 4) Visual inspection of the inside of a panel by a trained eye is a bonus by-product of any IR inspection and should not be discounted. Visual inspections sometimes reveal problems that cannot even be seen with IR...like broken components and burn marks left from a cyclical thermal event, a circuit that is not operating or a failed component (see Figure 6).

Typical standards for IR thermography address the issue of panel cover removal. At present, no one has to follow any particular standard, but liability is increased if one has not followed an accepted procedure and a catastrophe occurs.

Real Documentation

There can be no valuable documentation of panels that are covered. For reasons stated above, recording video or snapping an IR image of the covered panel would be almost meaningless. In fact, documenting the fact that the survey was performed without removing panel covers will increase the liability to all parties. What is needed is hard documentation of all of the IR imagery of all the panels and components, whether or not there is a perceived problem. This protects the client (and the thermographer) because in the case of a failure claim, the insurer (and your boss) will want to know why the component failed, since it was just checked. If there is complete documentation, the thermographer can show the exact

thermal state of that particular component at the time of the inspection. This methodology is sound business practice. Think about it...the contractor will be all the more conscientious owing to the fact that he is documenting everything.

Complete documentation is also needed with panel covers removed. With modern infrared imagers, thermographers can digitally record the IR video and/or save fully-radiometric images to an on-board drive. There is basically no documentation for all those components that were considered *not* to be a problem by the thermographer, if the thermographer only takes pictures of what he considers to be a problem.

As a buyer of infrared services, you will find resistance to this methodology even if you are willing to pay for it, for these reasons:

- Many thermographers feel that it is a waste of time to save an image just to prove they did a proper job.
- Some thermographers are worried that they might miss something and that this fact will be documented. We are human, and while thermography is not a perfect science [it used to be a more an art form], it is still somewhat subjective.
- The thermographer will have to find and survey every panel and it is more work since all the items on the equipment list cannot merely receive a checkmark.
- Often contracts for infrared thermography are written as a lump sum and finishing 'early' allows for more 'profit'.
- A tape recorder and/or a data logging device is just another piece of equipment that the thermographer must buy and maintain, and another piece of equipment that could fail in mid-survey.

Corporations benefit greatly from standards which managers, engineers and thermographers can hold as the way to perform infrared surveys. With specifications in place, all those bidding on IR work are on a more level playing field. Any company with high value sites, mission critical and/or critically insured properties is remiss if they do not use a written set of specifications to prevent misunderstandings and sub-standard work.

Risky Business

Which panels can be opened without removing any covers? The answer is none. All exposed electrical circuitry in all buildings must be in an enclosure of some type. All electrical panel covers can be surveyed by using a safe procedure. If the panel cover cannot be removed while energized, the manufacturer will have designed it that way. For those panels, IR windows are a great option.

How much more does it cost and how much more risk there is to R&R the panel covers? I cannot answer this question for several reasons. I am not privy to actuarial data from failure analysis v. maintenance activities at any corporation. I have searched for this data but never found any reliable source. Nor can I find any data [FACTS] about how many people are hurt or killed each year while performing IR surveys, or how many thermographers are following NFPA 70E to the letter and what thermographic hard data, was used to come up with it, if any.

There is little hard data available on how much money has been saved by building owners doing IR although there has been no shortage of case studies presented over the years by thermographers. Where case studies are great for marketing purposes, they have little actuarial value. Insurance companies are requiring more IR every day? Maybe they know the numbers...they should, since risk IS their business.

The power/influence pendulum has swung over the last few years in favor of the risk managers. We have had to change our Certificates of Insurance by upgrading the limits and the liabilities that we incur in favor of our clients. This trend has cost us more and in turn our clients more, but they do not seem to mind the increased costs based on the reduction in liability that they now enjoy.

Conclusions

With reducing risk becoming increasingly a priority, does anyone think that facility managers will not be willing to pay a few more dollars a day to remove the covers or install IR windows so that the thermographer can do a proper job? One fact is beyond question. Infrared as a predictive/preventive maintenance (P/PM) activity is more popular than ever and it is a very effective P/PM activity.

Should an IR survey of any building be carried out without removing the panel covers or inspecting through IR windows? ABSOLUTELY NOT. In fact, the specifications should specifically disallow this practice.

FIGURES BELOW.....



Figure 1 – Typical electrical panel



.Figure 2 – Visual and thermal image of a panel with covers on.



Figure 3 – Visual and thermal image of a panel with only the deadfront cover on.

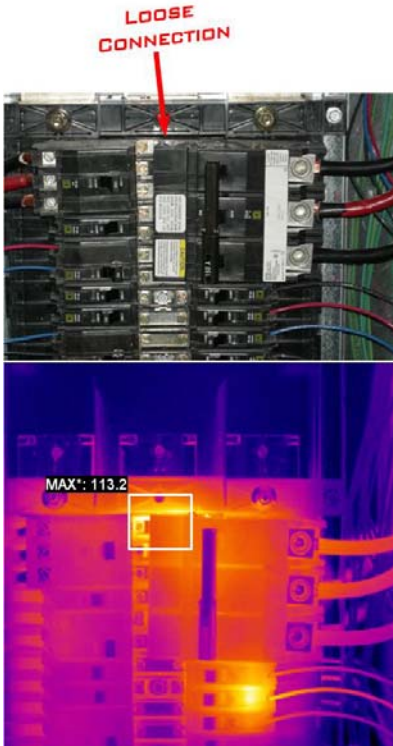


Figure 4 – Visual and thermal image of a panel with both covers removed.

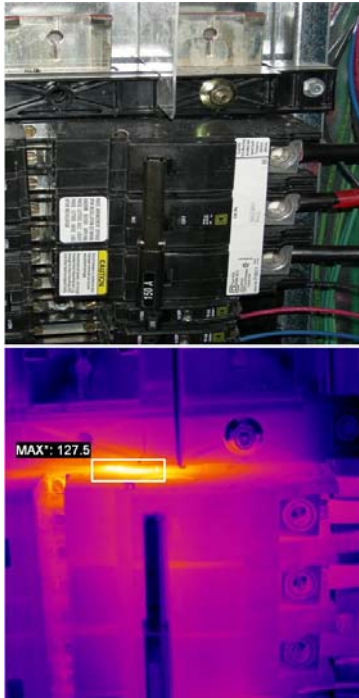


Figure 5 – Visual and thermal image of a panel with both covers removed at the proper angle to see the problem.



Figure 6 – Fused disconnect showing blown fuse.