A Geothermal Energy Generation Facility Embraces Infrared Polymer Window Inspections

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Overview:

A prominent geothermal energy producer in the Philippines has become a leader through the successful development and operation of numerous energy projects. Since 1983, the company has successfully developed, financed, built and operated seven geothermal steam fields for both wet and dry steam and also owns and operates eleven geothermal power plants. Using the company's expertise, they seek continual improvements to ensure the safe and efficient construction and operation of current and future power plants.

Case Study

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Temperature plays a key role in the everyday maintenance and condition monitoring processes of a power plant. Temperature is the first parameter that is monitored to measure the health of the equipment. Maintenance professionals have been integrating thermography in their maintenance programs to increase efficiency and determine if the equipment is still within the allowable temperatures set by its OEM during operation. For an effective thermographic survey, one must have a direct line of site exposing the surface to be measured. Previously, for an electrical inspection of a 4160-volt metal clad switchgear, the inspector had to remove eight bolts, carefully lift and removed the heavy steel back cover away from the panel and then later inspect it with an infrared camera. This procedure is time consuming, troublesome and most of all, dangerous due to the increased risk of producing an arc flash.

Thermography is used in maintenance programs because of three unique characteristics:

1. It can be performed at a safe distance away from the hazards surrounding the equipment without compromising the safety of the plant personnel
2. Two-dimensional inspections enable the visualization of the changes in heat patterns on the surface of the equipment. This assists in the interpretation of "what" or "where" a fault may occur.
3. Real-time visualization of thermal patterns helps analyze the equipment in its fully energized state

Infrared polymer windows, when mounted on fully energized equipment, allow infrared energy to pass through making thermography inspections safe and in compliance with NFPA/CSA/OSHA or any other local safety regulations. Inspections are completed without equipment shut-down providing real-time data assessments of a facility's critical assets.

Installation

Over a period of 3 weeks, twenty-seven (27) IRISS Infrared Windows were recently installed with no lost time or accidents. Due to safety concerns, the previous site survey and visual inspection was limited to external surface temperature measurement and visual inspection of panels with the absence of opening any doors or covers. The preliminary installation design was based on shop drawings that determined the quantity, size and specifications of the infrared windows needed. During the scheduled shutdown, actual visual inspections and de-energized opening of panels was conducted to identify and verify which components would be a main priority for the infrared inspections. Several windows sizes and exact locations were changed once the open panel inspections were performed.

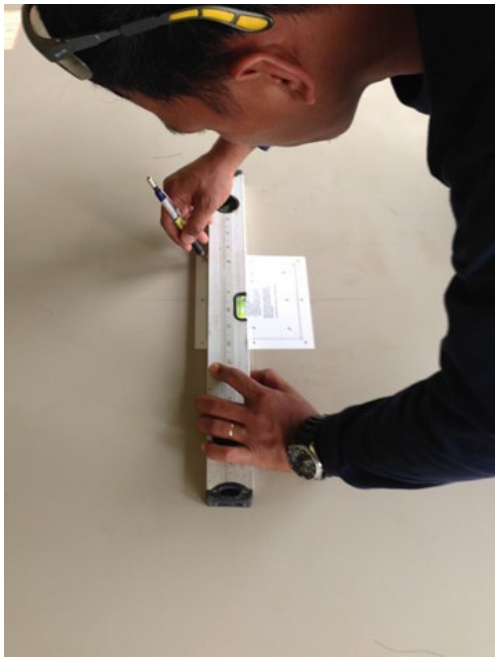
In total, twenty-two (22) CAP-C-6 and five (5) CAP-C-4 windows were installed on twelve (12) 4.16kV panels and fifteen (15) 13.8kV panels, generators and transformers.

Installation Photos

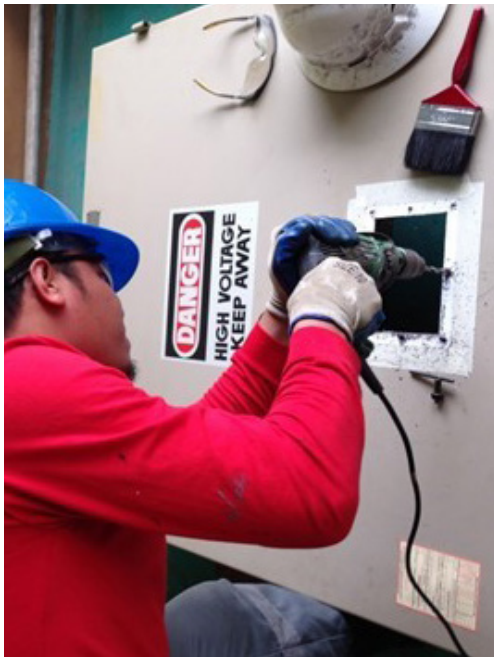
Pre-Installation

Post Installation

Step 1: Lay Out



Step 2: Cutting & Drilling



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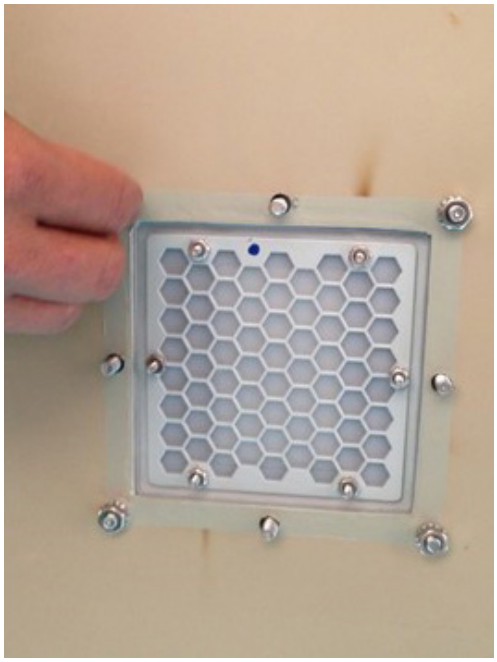
Step 3: Touchup Painting

Step 4: Mounting



Equipment Testing

The last few days were allocated for bench testing, simulation of readings using multiple OEM IR camera types and training of personnel. The simulation of readings using the various camera types and a Black Body temperature source through the IRISS infrared polymer windows measured distance corrected ambient temperature, emissivity usage values and parameter setting on the respective devices.

Bench Testing:

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Black Body Simulation:

Where possible, connections were taped with known emissivity insulating tape. In this way, more accurate temperature readings can be taken of the target potential hot spots.

Emissivity Tape Mounting:

As an opaque polymer optic was used on this project, digital photos were taken and laminated and then placed adjacent to the respective inspection window. Target locations for IR inspection were included on the digital image as well as the proper transmission rate for each camera type that might be used by the inspector. In this way, the future IR inspector will have a better idea of what they are looking at with the IR image and it will ensure consistent and accurate temperature data collection methods.

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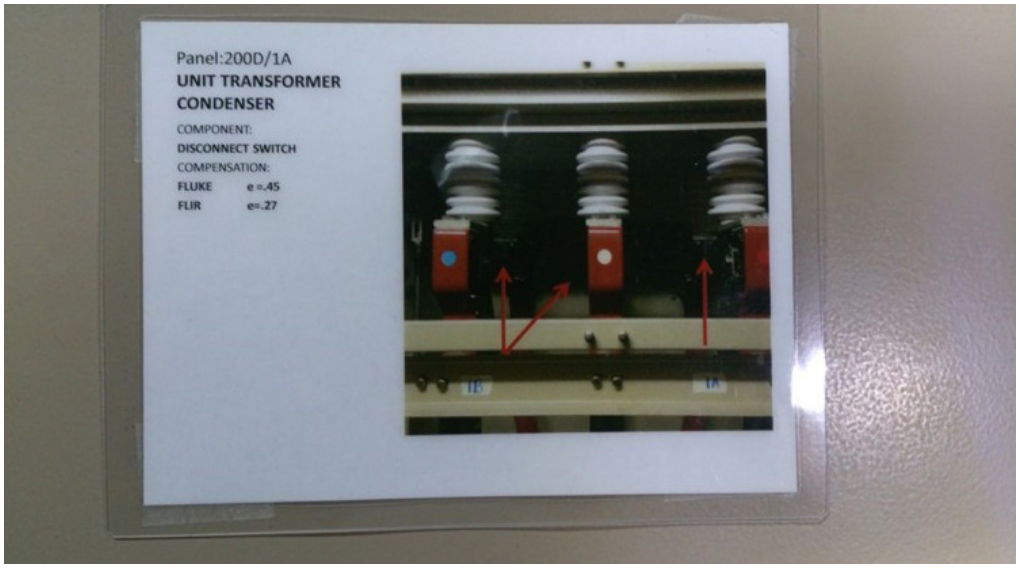
Labelling:



Conclusion

Since the initial IR Window installation, the program has helped the inspection team decrease the time required to conduct inspections as it does not require a “hot work” permit and can be done by a single person with no need for special personal protective equipment (PPE). As of publication of this document, they have not found any serious faults but have observed some slight temperature rise on some assets that are being trended and monitored for future change. Plans are being made to expand the use of IR windows on other equipment at this site as well as other power plants owned by the power producer.

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