A Powerful Case for Infrared Windows

Power Generation ROI – Case Study

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A regional Power Generation Facility had been tasked by their insurance carrier to perform regular preventive maintenance on the switchgear within their facility. Unfortunately, regular downtime was not a practical option for them as the processes required to do the live inspections were hazardous and required more manpower and resources than they had to provide. In addition, they too were feeling the pressure of the requirements of NFPA 70E and were starting to re-think their strategy since inspections of energized equipment was becoming more restrictive, more time consuming and more costly.

alternative method of conducting safer, standards-compliant inspections and it was determined that a reduction in hazard liability and maintenance costs could be attained through:

- Use of Infrared Windows for routine inspections of healthy equipment did not require the elevated levels of PPE required in 70E, since as stated in 70E 100: “Under normal operating conditions, enclosed energized equipment that has been properly installed and maintained is not likely to pose an arc flash hazard.”
- Maintaining an “enclosed” state for the switchgear, MCC, Transformer, etc., and maintains energized components and circuit parts in a “guarded” condition, in NFPA terms. Therefore, the hazard/risk category would be equal to that of reading a panel meter, using a visual inspection pane for lockout/tagout confirmations, or walking past enclosed, energized equipment and could even be conducted during peak hours for best diagnostic data.
- Use of IR windows would eliminate the need for a supporting cast of electricians to remove and reinstall panel covers.
- Allowing critical personnel to then be available to perform other tasks which were often being outsourced.
- Providing the ability to perform more frequent inspections feasible for critical or suspect applications to ensure plant uptime and appease the insurance carrier of the reduced insurance liabilities.

The focus was to facilitate inspection of the primary switchgear in their electrical distribution system and several smaller operations within the plant. An impending shutdown increased the sense of urgency since all Phase I installation could be fitted during

Primary Switch	15	0
Secondary Switchgear	23	19
Transformers	15	0
MCC's	24	24
Miscellaneous Switchgear	8	8
Generators	10	10
Total Assemblies	95	61

Investment

A pre-site inspection by IRISS was performed to ascertain the optimal position and quantity of windows which would give thermographers thorough visibility of desired targets. Previously, none of the primary switchgear or transformers had been included in the sites inspections due to the inherent safety hazards associated with their being safely inspected while energized. The review showed that some of the plant’s critical assets were never inspected during the annual survey. The primary goal of Phase I was to bring this equipment into the standard inspection routes. A time study was completed detailing the man-hours and the costs involved in completing Phase I of the IR window installation allowing the inspections to be completed in line with NFPA and OSHA safety mandates.

Typical Cost Analysis of Standard Inspection:

The client had been using a contract thermography company for some time and the survey crew consisted of two in-house electricians and one contact thermographer.

The hourly wrench time (time spent on productive labor) rate for the electrician was calculated at $62, and the contract thermographer’s rate was $150 per hour ($1,200 a day). Typically, the equipment being considered for Phase I window retrofitting would require 19 days to complete. This translated into 497.7 billable hours (as shown in

The entire inspection team dressed in 40 Cal/cm2 PPE (personal protective equipment) in accordance with NFPA 70E and OSHA mandates for energized work. They spent on average 30 minutes to suit-up and dress-down - twice a day. This was a total of 88 hours related to PPE over a 19-day cycle.

The thermographer spent 186.4 hours waiting for panel covers to be opened/closed to provide him with access. Similarly, the electricians spent 58.8 hours (29.4 hours x two men) waiting for the thermographer to complete his work once the panels were removed.

After analyzing the time studies, facility management was surprised to learn that a staggering 468.3 hours (94%) of the total project time for the traditional open-panel surveys was non-productive (PPE suit-up, thermographer wait-time, electrician wait-time, etc.) The task breakdown is reflected within Table 2.

Table 3 details the man-hour costs for the infrared survey using a contract thermographer without infrared windows or viewports. The following assumptions are made:

Inspection Compartments	**147**	
PPE Suit-up Time	0.5 Hrs.	**57.0**
Time Taken to Remove Covers	0.4 Hrs.	**117.6**
Time Taken for IR Inspection	0.2 Hrs.	**29.4**
Time Taken to Replace Covers	0.4 Hrs	**117.6**
Electrician Waiting Time		**58.8**
Thermographer Waiting Time		**117.6**
Total Billable Man-Hours		**497.7**
Unproductive Man-Hours		**468.3**

- Total man-hours per inspection of “inspectable” equipment: 497.7 hours (19 days)
- Staff electrician internal charge-out rate $62 per hour
- Contract thermographer charge-out rate $150 per hour
- PPE suit-up twice daily, per man (30 minutes per man, per suit-up)
- 48 minutes per compartment panel for safe removal, refitting (per man for a two-man team)
- 12 minutes per panel for infrared scan.
- 147 individual panels to inspect (Table2)

Table 3:		
Total Cost of Traditional Inspection:		
Removaland Replacement of Panels	235.2	$ 14,582
Infrared Inspection	29.4	$ 4,410
Electrician Wait-Time	58.8	$ 3,646
Contract Thermographer Wait-Time	117.6	$ 17,640
PPE Suit-up Time	57	$ 5,206
Total		**$45,484**

Infrared Windows

In search for an alternative approach that was both safer and standards-compliant, the corporate reliability engineer investigated how infrared inspection windows (commonly referred to as IR windows, viewports or sight

conducted during periods of peak-load without elevating risk to either plant assets or processes.

- Use of IR windows would eliminate the need for a supporting cast of electricians to remove and reinstall panel covers. These critical personnel would then be available to perform other tasks which were often being outsourced.
- Use of IR windows and closed-panel inspection would eliminate high-risk tasks during inspections – increasing safety for thermographers.
- Use of infrared windows for routine inspections of healthy equipment did not require the elevated levels of PPE required in 70E, since as stated in 70E 100: "Under normal operating conditions, enclosed energized equipment that has been properly installed and maintained is not likely to pose an arc flash hazard."
- In NFPA terms, an IR window maintains electrical equipment in an "enclosed" state and it maintains energized components and circuit parts in a "guarded" condition. Therefore, the hazard/risk category would be equivalent to reading a panel meter, using a visual inspection pane for lockout/tag-out confirmation, or walking past enclosed, energized equipment.
- Use of infrared windows would improve inspection efficiency. It would allow increases in inspection frequency for those mission critical or suspect applications.

Investment

The 203 installed IRISS infrared windows represented an investment of $48,841.00. IRISS, Inc. also provided a cost benefit analysis comparing in-house installation versus

Table 4:	
IR Window Supply & Contracted Installation Team	
Infrared Windows	$36,255
Install Costs for 203 IR Windows	$12,586
Total	**$48,841**

Table 5:	
Application	**Quantity**
Primary Switch	15
Secondary Switchgear	23
Transformers	15
MCC's	24
Miscellaneous Switchgear	8
Generators	10
Total Assemblies	95
Inspection Compartments	147
IR Windows	203

The Installation

The installation of the inspection panes was conducted during a shutdown, using two install teams. The majority of the windows were installed while equipment was de-energized, in what NFPA terms an "electrically safe work condition." However, some installations involved energized gear and needed to employ the traditional safety measures such as use of PPE, energized work permits, etc. The work occurred during normal business hours since this allowed more flexibility.

Cost Analysis with Windows:

With the infrared windows installed, there was no requirement to remove panels or wear increased levels of PPE. In addition, inspections were now performed on their applications that had previously been considered "un-inspectable." Finally, the entire task became a one-man job.

The windows also increased efficiency and

Table 6:		
Total Cost of Inspection Using IR Windows:		
Inspection Time	33	$4,950
PPE Suit-up Time	0	$0.00
Total		**$4,950**

Because of the efficiencies achieved, the facility saves $40,534 per inspection – that's a savings greater than 90%.

ROI

Table 7 combines the data from the previous tables to illustrate the ROI (return on investment) that the facility realized from Phase I of its infrared window program. The table details the total investment using 2 scenarios: 1) Traditional open-panel inspections with a contract thermographer and two staff electricians; 2) the same contractor using infrared windows.

Switching to infrared windows is shown to pay dividends in just two inspection cycles. Over $33,227 in savings can be put back into the budget by the end of the second cycle. After just five inspection cycles, the facility shows a savings of over $153,829.

Because inspections can now be completed with greater ease and without increased risk to plant, personnel and processes, the facility increased the frequency of inspections to quarterly, reflecting best-practice recommendations that originally were not considered feasible.

Conclusion:

The new inspection process using infrared windows brought significant ROI to the plant in just two inspection cycles, while reducing the risk of catastrophic failure among the plant's critical power distribution systems.

Management succeeded in:

while saving money

- Safeguarding profitability by eliminating high-risk behavior that posed a risk to plant assets and production

In the future the facility is planning to purchase its own IR camera and training for the maintenance engineers, which will quickly pay dividends and allow the plant to improve the maintenance program while operating in full compliance with the requirements of NFPA and OSHA.

An infrared window program provides a cost-effective and safer alternative to traditional open-panel inspections. To learn more, visit www.iriss.com where you will find the FREE ROI calculator, case studies and white papers.

	Traditional No. of IR Windows Fitted	IR Inspection
Windows Fitted		
203 Windows: One-Time Investment	$0	$36,255
Window Installation: One-Time Investment	$0	$12,586
Labor Costs: Per Inspection Cycle	$45,484	$4,950
Inspection Cycle 1	$45,484	$53,791
Inspection Cycle 2	$90,968	$58,741
Inspection Cycle 3	$136,452	$63,691
Inspection Cycle 4	$181,936	$68,641
Inspection Cycle 5	$227,420	$73,591
5yr Costs: QUARTERLY Inspection Cycle	**$909,680**	**$147,841**