

BEYOND

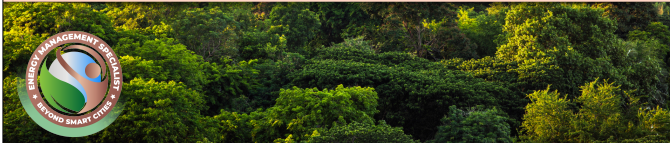
SMART CITIES

MAINTENANCE AND COMMISSIONING - CEM

REFRESHER TRAINING COURSE

KRISHNAJI PAWAR, LEED AP BD+C, GSAS CGP, ISO 14001:2015, GCP

CEM REFRESHER TRAINING COURSE



BEYOND

SMART CITIES

MAINTENANCE +

FOR ENERGY PROFESSIONALS

KRISHNAJI PAWAR, LEED AP BD+C, GSAS CGP, ISO 14001:2015, GCP

ENERGY SPECIALIST CURRICULUM COURSE



WHAT SHOULD YOU LEARN



Maintenance ECMs

Infrared Photography

Infrared Photography Examples

Vibration Analysis

Vibration Analysis Examples



MAINTENANCE ECMS



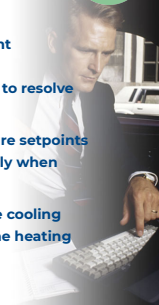
- ✓ Develop a Preventive Operation & Maintenance Program
 - ⇒ A comprehensive O&M plan for a facility should include PM procedures for periodically reviewing and monitoring the operating sequences, strategies and schedules to ensure that the facility operates as efficiently as possible.
 - ⇒ Preventive maintenance should include activities critical to energy-efficient building operation.
- ✓ Develop O&M procedures and forms for tracking actual equipment performance against expected performance.



MAINTENANCE ECMS +



- ✓ Forms may include:
 - ⇒ Task description,
 - ⇒ Checking method and frequency for each piece of equipment
 - ⇒ Reporting formats
 - ⇒ Procedures for addressing non-conformance issues and how to resolve performance deficiencies
- ✓ Periodically review HVAC and lighting schedules, temperature setpoints and occupant/tenant use requirements so equipment runs only when needed.
- ✓ Seasonally adjust control strategies. A good strategy for the cooling season is not necessarily optimal for the “swing” season or the heating season.



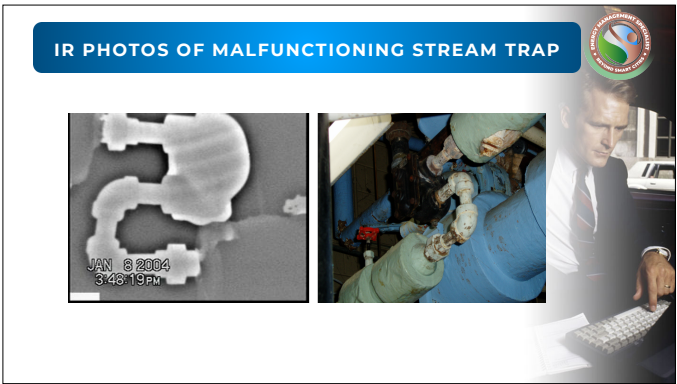
INFRARED PHOTOGRAPHY

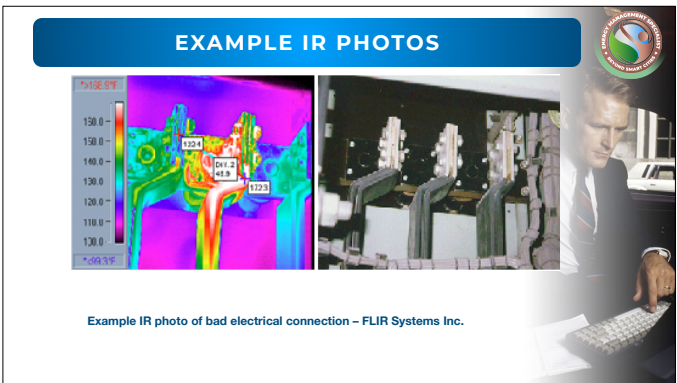


- ✓ Maintenance Help from Interesting Technologies
- ✓ Family of non-destructive testing techniques
- ✓ Produces images of heat usually invisible to the human eye
- ✓ Heat in some mechanical situations can be a sign of impending malfunctions
- ✓ Heat in some electrical wiring can be a sign of bad connections and/or phase problems
- ✓ Heat anomalies in steam systems (e.g. traps)
- ✓ Heat loss through building envelope
- ✓ Averted problems can be significant in nature (e.G. Primary transformer fires, etc.)
- ✓ IR operator needs some level of expertise -Attend training - Contract service
- ✓ One major malfunction discovered and infrared program just paid for itself









Example IR photo of bad electrical connection - FLIR Systems Inc.

VIBRATION ANALYSIS

Another powerful member of the family of non-destructive testing techniques

Measures vibration signatures of machinery (usually rotating)

Two Main Diagnostic Methods

1.Vibration Signatures (Snap-Shot)

2.Trending (Observation Over Time)

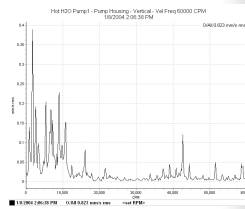
Even more so than infrared photography, training is mandatory (this is a science and an art)

Trending vibration levels over time can remove some of the uncertainty of problems

Technique used to spot: Bad Bearings, Bad Gears and Loose Machine Mountings



VIBRATION ANALYSIS EXAMPLES



☑ Water pump with suspicious (noise-floor) vibrations. Attempts to localize problem began. (Okla. State IAC)



VIBRATION ANALYSIS EXAMPLES

