SHOWCASE PROJECT: 3M: BATTERY-LESS CLOUD MONITORING FOR STEAM TRAPS TRIALED AT ONE OF 3M’S LARGEST MANUFACTURING SITES

SOLUTION OVERVIEW

3M Brookings is 3M’s first and largest health care products manufacturing facility. They have been in operation for over 45 years and many of the cross-cutting utility equipment and systems are original to the plant’s construction. The facility has three boilers that provide heat for space heating and steam for processes. Approximately 40% of the steam serves processes, particularly solvent coating ovens that are heated by steam coils. Each steam trap is manually checked monthly for leaks and failures. After installing a real-time steam trap cloud monitoring system, Brookings now monitors the steam traps safely and can attend to failures in a timely manner. The fact that the sensors are battery-free and thermo-electric powered made it easy for 3M Brookings to adopt this cutting-edge technology.

Because the site operates 24/7, steam trap checks are performed while equipment is running. Many of the plant’s steam traps are located behind security fencing that surrounds process equipment, so maintenance personnel need to fill out a bypass form to access them. A trap that is stuck in the open position blows steam constantly, creating energy losses in the system. Blocked traps that are stuck in the closed position can cause temperature control issues within the ovens and affect productivity. With the new cloud monitoring system, the steam traps are monitored by a network of sensors that provide real-time data on the traps’ performance. The total annual savings seen with the monitoring system was estimated to be $32,000 for only 50 traps. 3M Brookings is looking at bringing another cohort of traps online and 3M corporate is currently investigating adopting this technology for the remaining 7,600+ steam traps companywide.

SECTOR TYPE
Industrial

LOCATION
Brookings, South Dakota

https://betterbuildingssolutioncenter.energy.gov/showcase-projects/3m-battery-less-cloud-monitoring-steam-traps-trialed-at-one-3m%E2%80%99s-largest
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SOLUTIONS
A 3M group that worked on exploring advanced technologies came across a system that offered real-time cloud-based steam trap monitoring with no up-front capital costs for 3M Brookings. The battery-less sensor ensures that a reduced number of workers is required to maintain the steam traps, increasing on-site safety. In early 2020, they decided to trial the solution for 50 steam traps and 3M was able to provide funding for the first years' service fee. Since these traps were often in areas where there is rarely any downtime and in safe-guarded quarters, the selection process heavily weighed on low accessibility and high safety risks to the employees. Once there was scheduled downtime available for the equipment to cool down in June 2020, the steam trap monitoring sensors were installed. The sensors were easy to install and all 50 were installed within a day.

3M selected these sensors due to their ease of installation and low maintenance burden. Because the sensors harvest energy from surroundings sources such as sunlight, thermal gradients, and radiofrequency, they do not require batteries and little human intervention is needed for maintenance. Each sensor connects to the cloud and communicates wirelessly via ultra-low-power, proprietary integrated radios. The sensor collects analog data of temperature, humidity, vibration, acceleration, and pressure where it is displayed in an online dashboard that can enable the company to view energy consumption trends and perform analyses.

Data was collected after 6 months to understand savings, which proved to be a significant amount. The total annual savings with the monitoring system was estimated to be $32,000 with just the 50 traps online – equivalent to saving 10,600 pounds of steam/hour at 3M Brookings. The largest benefit from adopting the battery-less steam trap monitoring system is seen by the maintenance crew. First, it reduces the time spent by maintenance staff for locating leaks by 25-30%, which also decreases the number of times these individuals spent inside guarded, high-risk environments.

OTHER BENEFITS
Steam produced by natural gas boilers utilizes a fuel that has a carbon footprint and requires water resources. The numerous benefits of reducing steam-energy loss with the cloud monitoring system include:

- Immediate leak detection: the maintenance staff receives email notifications when failures are detected by the monitoring sensors.
- Reduced engineering and maintenance burden: less time is spent manually checking for steam leaks, which equates to about a 20-30% reduction in labor costs.
- Increased safety for maintenance staff: reduces the frequency in which individuals need to go inside guarded, higher-risk areas.
- After the first 6 months of monitoring by the sensors, 3M Brookings saw a reduction in the amount of time between when a steam trap failed and when the trap was repaired. The average number of days between trap failure and discovery went from 33 to only 12 days compared to the year prior. This reduction in the number of days for steam leaks left unattended:
  - Reduces the amount of natural gas and water required – 10,600 pounds/hour of...
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Steam.
- Lowers the carbon footprint for the site and dependency on fossil fuels.
- Saves $32,000 on energy costs annually.
- Risk mitigation: prolonged and unattended steam trap failures can disrupt production output and product quality. Now there is better control over the steam systems to prevent possible disruptions.

Applying these findings on a corporate level to all 7,600+ identified steam traps would mean a tremendous multiplier for all the benefits described above.

The thermo-electric powered sensors connected to the cloud make 3M’s solution relatively easy to adopt in a short period of time. Given the timeline and smooth implementation process for 3M Brookings, one of the largest U.S. facilities at 3M, potential replication is being investigated for the remaining 90+ sites. This would mean saving around 5% of the total energy cost across 3M’s U.S. sites and approximately 100,000 tons of CO₂ emissions reduced for 3M.

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### Annual Energy Use

| Baseline() | 1 |
| Expected() | 0.95 |

**Energy Savings**
5%

### Annual Energy Cost

| Baseline() | 1 |
| Expected() | 0.95 |

**Cost Savings**
5%

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