IDEA Innovation Award 2021

1. Project/Program Title: Application of Everactive Wireless Batteryless Continuous Steam Trap Monitoring at UVA Steam Distribution System

2. Name and Location of District Energy System or Project
University of Virginia, Charlottesville, VA

3. Name of System Owner
Paul Zmick
Director of Energy and Utilities
575 Alderman Road
Charlottesville, VA 22901
Phone: 434-982-5883
email: zmick@virginia.edu

4. Name, relationship to the project/program, address, phone number & email of the person submitting the application
Rafael Reyes
Director Product Marketing
Everactive
3272 Estates Ct. S.
St. Joseph, MI 49085
Phone: 269-277-6643
email: rafael.reyes@everactive.com

5. Executive Summary – In 700 words or less, summarize the project /program, demonstrating the key aspects of what was done and the overall benefits:
The failure rate of steam traps in a large steam distribution system typically ranges from 5 to 25% depending on the level the traps are monitored and maintained. To catch these failed steam traps the University of Virginia (UVA) conduct steam trap surveys over their 1,900 steam traps to locate and replace failed traps and reduce energy losses. This is a time consuming and labor-intensive process, so UVA only performs it once a year. UVA deployed 100 Everactive wireless and batteryless Steam Trap Monitor (STM) sensors in 2018 through a Strategic Infrastructure Fund (SIF) research grant to test the benefits of continuous monitoring in reducing steam trap survey cost and energy losses. In late 2019 the deployment of STM sensors was found successful against manual surveys and other monitoring solutions, and in March 2020 UVA commercially expanded to 391 steam traps in the most critical application, the 180# steam supply to the large UVA Hospital and Medical Research facilities. There are other wireless steam trap monitoring systems in the market, but the STM solution, based on temperature sensing, requiring no batteries and providing continuous reading, provided a cost effective, and sustainable solution to manual steam trap surveys. Since the deployment of STM sensors, UVA has stop conducting annual steam trap surveys, replaces the steam traps as soon as they start to fail, and have reduced its operating cost by $28,147/year resulting in a return of investment (ROI) of 29%. UVA is planning to expand the Everactive's wireless batteryless technology beyond steam distribution and into terminal equipment as well as expanding into vibration monitoring with its Machine Health Monitor (MHM) solution.

6. In 300 words or less, explain how the project/program is innovative and unique:
The wireless batteryless STM solution is unique in:

- The use of temperature vs. ultrasound measurements. Ultrasound measurements are susceptible to noise from the steam operation and temperature is a more stable reading of the status of a steam trap when monitored continuously.

- Continuous monitor of the steam traps allows for more accurate diagnosis, better troubleshooting and can help understand the upsets in the steam distribution system.
- Requires no batteries and harness the energy from the heat of the steam pipe. Compared to other battery-operated monitoring solutions that require the sourcing, inventorying, replacement and management of hundreds of batteries, which is unsustainable for small and large steam system operations. Moreover, for systems with batteries, the readings are duty cycled to maintain an acceptable battery life which results in once or twice a day readings for each steam trap, versus the one-minute duty cycle for the batteryless system.
- An online dashboard user interface where a steam trap details, and historical performance is captured and readily available.
- Everactive's continuous support, follow up and service, focused on customer success.

7. With supporting data, demonstrate the improved energy efficiency benefit offered by the project/program, in 250 words or less.
UVA had 384 continuously monitored traps from March 2020 to March 2021. During this period, a total of 14 steam trap failures were recorded.

Assuming that the failures will have been caught once a year through UVA annual steam trap audits, and based on the steam cost, the steam system pressure, and the steam trap orifice size, we can estimate a potential steam energy loss of 19,923 MMBTUs with an energy cost of $126,013.

With Everactive's STM solution, UVA was able to repair all 14 failed traps shortly after they were identified resulting in a steam energy loss of only 1,820 MMBTUs with an energy cost of $11,466 during the same period.

That is total reduction of 18,103 MMBTUs of energy, a reduction of 953 tons of CO2 (equivalent to 107,186 gallons of gasoline consumed) and reduction of $114,547 in energy cost, resulting in a 90% reduction in steam energy loss, CO2 emissions and energy cost.

See attached calculation spreadsheet.

8. With supporting data and graphics, explain the financial advantages of this project / program in 250 words or less.
The cost of monitoring the 384 traps with continuous STM solutions for one year is $96,000.
UVA avoided the cost of conducting annual steam trap audit of $9,600.
UVA saved $114,547 in energy cost by implementing the continuous STM solution.

So, the net savings per year are $114,547 + $9,600 – $96,000= $28,147. And the annual return on investment is $28,147 / ($96,000 + $16,000) = 29%

9. In 250 words or less, please provide any additional information about the project/program (What challenges did you face? How did your customer base or community react?, etc.)
<u>Challenges:</u>
Getting the utilities, the steam community, and the UVA steam maintenance team to accept temperature measurement versus ultrasound measurement as a valid mechanism to monitor steam traps, and to move away from the annual manual audits was a clear challenge. The SIF grant for the STM pilot provided a risk free method for evaluating the capability and reliability of the solution. In the end, the data was able to convince the steam community of the validity of the continuous STM technology. As an example, Armstrong the largest steam trap manufacturer in the world, was selling initially against the STM solution to continue to use their manual ultrasound readers coupled with annual audits. Armstrong was so impressed by the results of the pilot that it eventually became a partner with Everactive and is now an investor as well.

What plans do you have for the Future:
As long as UVA has a steam distribution system, UVA will continue to use the wireless and batteryless continuous STM solution. UVA is also currently exploring other applications of the wireless and batteryless monitoring technology in the form of vibration monitors, to assess the health of their rotating machines on campus and avoid costly failures and service interruption to critical services.

How did your customer base or community react?
The UVA steam maintenance team has been sold on the technology and is now expanding its STM deployment beyond steam distribution and into terminal equipment (i.e. critical air handler at the hospital).

10. Please provide 3 to 5 attachments as images, diagrams or photographs in jpeg format with identifying captions.

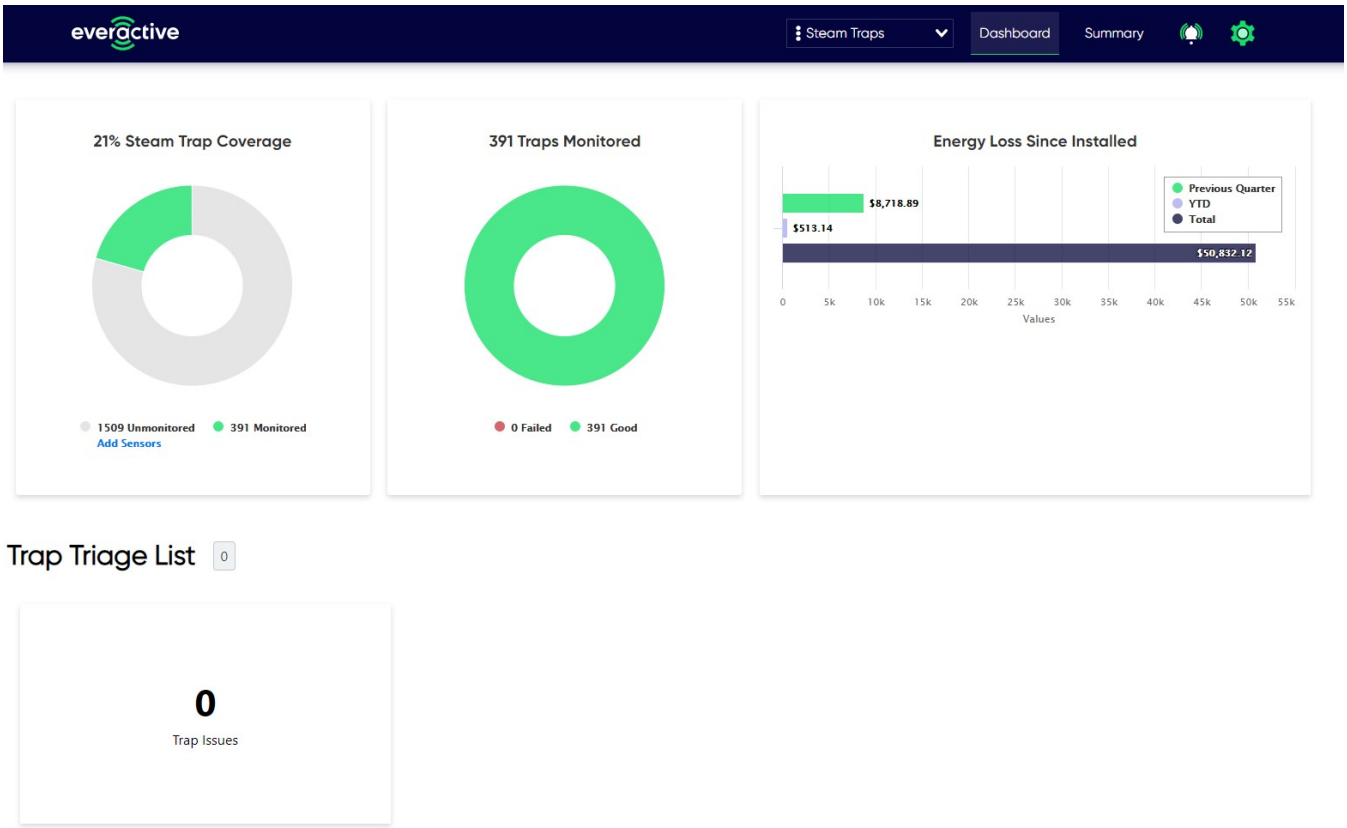

Figure 1: UVA Evercloud Dashboard Example.

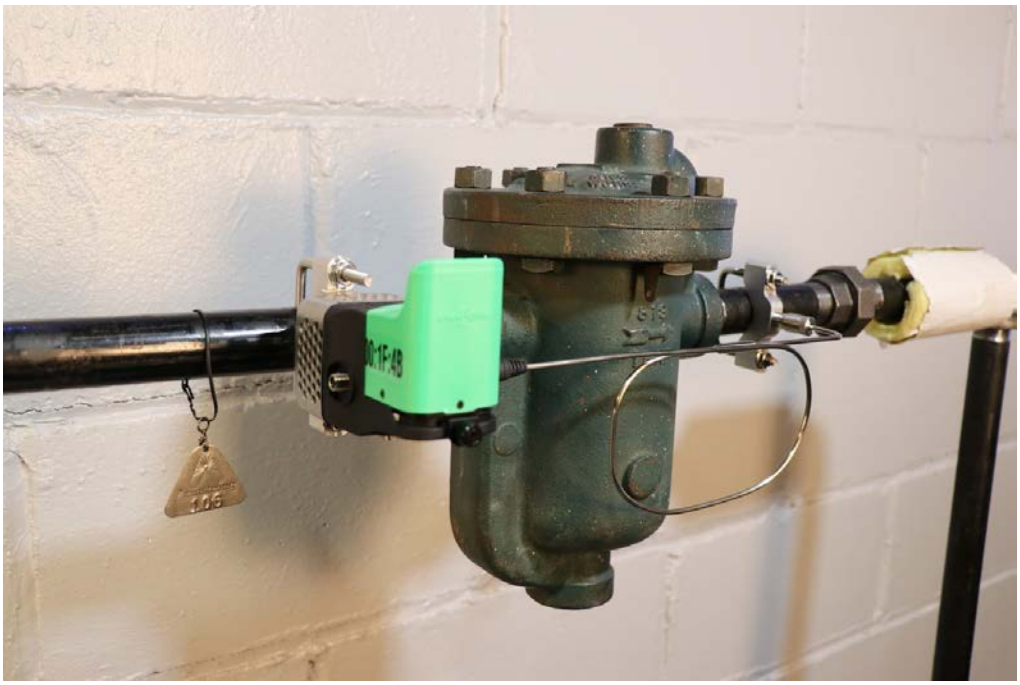

Figure 2: Steam Trap Monitor Solution.

Figure 3: STM installed in at an UVA steam trap.

Learn more about Everactive STM solution including videos on how the system works
https://everactive.com/remote-asset-monitoring-solutions/steam-trap-monitoring/

Use case of STM implementation in manufacturing facility for additional reference.
https://everactive.com/case-study-trinity-manufacturing/