Best Practices

BestPractices Technical Case Study

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OFFICE OF INDUSTRIAL TECHNOLOGIES

ENERGY EFFICIENCY AND RENEWABLE ENERGY, U.S. DEPARTMENT OF ENERGY

BENEFITS

- Saved $220,000 annually in fuel costs
- Saved $30,000 anually in makeup water and chemical
- Increased system reliability

APPLICATIONS

Improving combustion controls and steam trap performance will save money and increase the reliability of almost any steam system. Steam systems are found throughout industry and consume a significant portion of

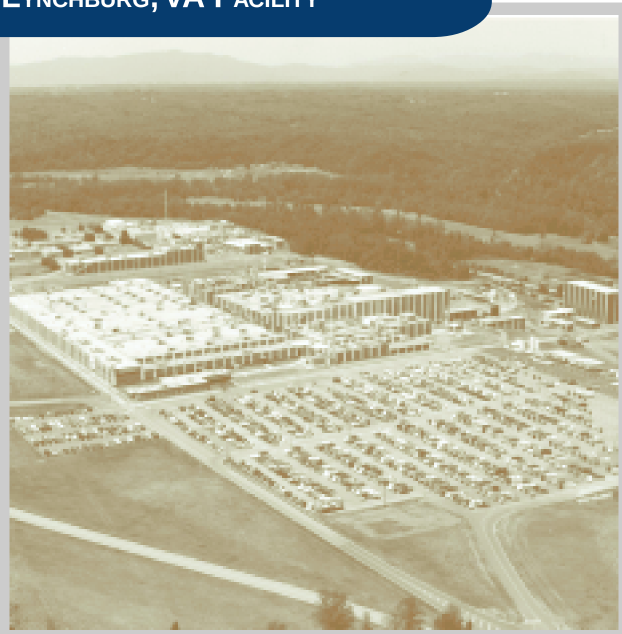
NEW COMBUSTION CONTROL SYSTEM AND STEAM TRAPS SAVE $250,000 ANNUALLY

Summary

A steam project implemented by the Naval Nuclear Fuel Division (NNFD) of BWX Technologies, formerly known as Babcock and Wilcox, significantly reduced plant operating expenses. The project focused on two NNFD plant boiler systems used to provide steam for space heating and for the manufacturing processes.

To upgrade the old steam system, a new combustion control system was installed and over 90% of the steam traps were replaced. The cost of the modifications included an investment of $340,000 for new equipment and produced annual savings of $220,000 in fuel costs and an additional $30,000 in water and boiler chemical costs. Based on the investment, this steam project resulted in a simple payback period of less than one and a

LYNCHBURG, VA FACILITY



half years.

Company Background

The Naval Nuclear Fuel Division in Lynchburg, Virginia, manufactures nuclear components used for military ship propulsion. Due to reductions in defense budgets, contractors such as the NNFD have found it necessary to reduce overhead costs. One of the management strategies employed by NNFD to reduce operating expenses is to minimize utility costs. An area that presented promising efficiency opportunities was the boiler steam system at the NNFD.

Project Overview

During a review of the plant, an energy consultant noticed an abnormally high steam plume rising from the deaerator tank stack. Realizing that the large plume may be a consequence of malfunctioning steam traps, a recommendation was made to further investigate the steam system for efficiency opportunities. In an effort to reduce steam system operational costs, a plan was developed to improve the steam system efficiency by upgrading the combustion control systems and the steam traps.

Before the project was implemented, the steam system was passively maintained with many system inefficiencies. Inspections or changes to the steam system were typically only performed when the steam traps failed shut, impeding the manufacturing process or diminishing space heating performance. Exacerbating the situation was the absence of shut-off valves upstream and downstream of the steam traps, requiring the production lines to be shut down whenever the steam traps were repaired. The objective of the steam project was to develop a more efficient system that was more easily maintained and inspected.

At the outset of the project, an assessment was performed specifying the equipment that would be installed to replace the old components. Babcock and Wilcox's Boiler Service Division assisted by specifying and replacing the combustion control system with a system that effectively controlled the boiler air/fuel mixture in response to the immediate steam demand.

After considering numerous steam trap options, a system was chosen that was designed to allow for easier repair and testing of the steam traps. Before the new steam traps were installed, a prototype was developed using actual components to test the effectiveness of the proposed concept. After the new design was tested, the installation program was initiated to replace the steam traps during weekends and holidays to minimize impacts on production. During the installation of the new traps, 70% of the old traps were found in the failed open or partially open position.

Results

This steam project produced significant performance improvements and cost savings. The new combustion system was much more fuel efficient and the new steam traps contributed to the improved effectiveness of the entire steam system.

Performance improvements were immediately apparent in the condensate return line. The temperature in the condensate line was reduced from 250°F to 207°F, and the pressure in the line was reduced from 50 psi to 10 psi. Along with reducing stresses in the system, the annual demand for makeup water was reduced by over 50%, saving three million gallons. The improved output from the system reduced the demand for steam generation, thereby increasing the system's capacity to support future plant expansion. The changes in performance were significant enough to eliminate the need for operating one of the boilers during the winter months.

Steam Trap Failure and Condensate Loss

Steam traps that fail open allow steam to directly enter the condensate return system. Because some steam traps operate poorly against high back pressure, the increased pressure in the condensate lines can cause several problems. Often these problems are caused by a chain reaction that is triggered by a single steam trap failure. One problem that often results from a trap failing shut is poor performance of the heat exchanger due to condensate backup. Another potential problem is water hammer, the risk of which is increased by large amounts of steam in the condensate return system. A third potential problem line is relief valve release, which occurs at high condensate pressures, causing condensate loss from the system. In some systems, condensate loss may be due to manual bypass of the steam traps by operators attempting to drain heat exchangers in order to maintain production, allowing live steam into the condensate line. These problems not only diminish system performance, but unnecessarily increase operating costs due to losses in energy, condensate, and chemicals.

In a typical steam system, the returning condensate contains more energy than the make-up water. Consequently, excessive loss of condensate significantly increases system fuel consumption. Additionally, since make-up water must be treated with chemicals to maintain the necessary corrosion protection and anti-scaling properties, condensate loss increases the need for additional treatment chemicals. Since condensate chemicals tend to kill the bacteria in wastewater treatment plants, condensate loss not only adds to the load on the treatment plant, it reduces the plant's effectiveness.

This steam project achieved the goal of significantly reducing operating expenses. Annual boiler fuel use was reduced by 47% saving $220,000 in fuel costs. An additional $30,000 was saved through reductions in the required make-up water and boiler chemicals. The total estimated annual savings of $250,000 was achieved with a total investment of $340,000, yielding a simple payback of less than one and a half years.

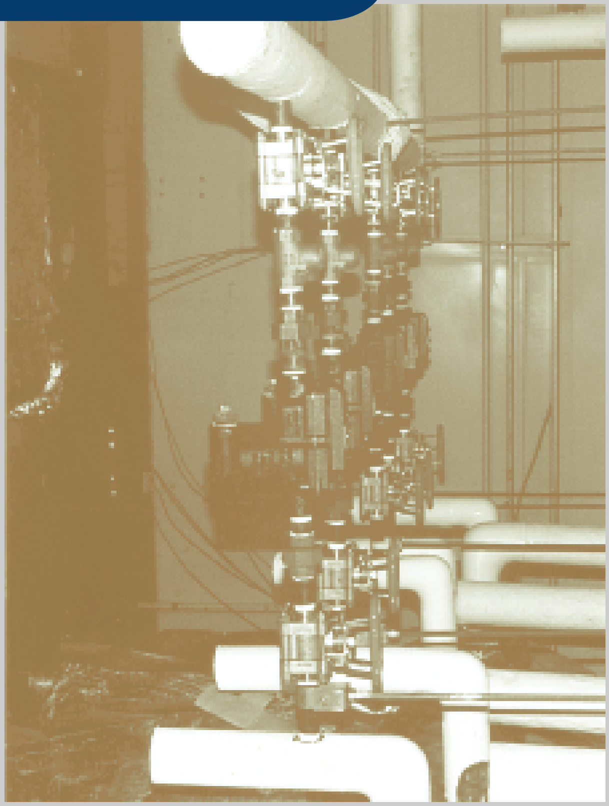
Another major goal of the upgrade was to enable plant staff to maintain the system more easily and facilitate regular inspections. Both of these were accomplished with the addition of the new components and the purchase of an infrared gun used to check the operation of each steam trap. Another valuable aspect of this project was the opportunity to develop an inventory of the steam traps for future maintenance and upgrades.

Lessons Learned

In an effort to reduce operational costs associated with a steam system, BWX replaced the combustion control system and overhauled the steam traps in the system. Although operational, the old system was very inefficient in terms of fuel consumption, water use, and chemical use.

By installing equipment that is easily maintained and by keeping a good inventory of components, the NNFD plant will be able to maintain a high level of operating efficiency and have the additional capacity to accommodate future expansion.

NEW STEAM TRAP SYSTEM



BestPractices is part of the Office of Industrial Technologies' (OIT's) Industries of the Future strategy, which helps the country's most energy-intensive industries improve their competitiveness. BestPractices brings together the best-available and emerging technologies and practices to help companies begin improving energy efficiency, environmental performance, and productivity right now.

BestPractices focuses on plant systems, where significant efficiency improvements and savings can be achieved. Industry gains easy access to near-term and long-term solutions for improving the performance of motor, steam, compressed air, and process heating systems. In addition, the Industrial Assessment Centers provide comprehensive industrial energy evaluations to small and medium-size manufacturers.

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