FOSS PERFORMANCE MATERIALS LLC

REPORT ON ENERGY AUDIT

NEW HAMPSHIRE PUC DOCKET NO. DG 16-855

DECEMBER, 2021

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I. BACKGROUND

The New Hampshire Public Utilities Commission ("PUC" or "Commission") approved a firm gas transmission special contract between Northern Utilities, Inc. ("Northern") and Foss Manufacturing Company, LLC (now Foss Performance Materials LLC and referred to herein as "Foss") by Order No. 26,107 (February 28, 2018) in Docket No. DG 16-855. The Commission conditioned its approval of the special contract on Foss' execution of an energy audit of its facility and operations. Accordingly, Foss engaged Waldron Engineering & Construction, Inc. ("Waldron") to conduct the required energy audit.

Waldron developed an energy model to capture Foss' annual cost of purchasing and generating utilities for its facility and operations. The model was utilized as a screening level comparison for a business-as-usual operating case to assess operating cost improvements associated with various energy investments. Modeling results were then used to calculate savings under various scenarios, including budget level costs and simple paybacks associated with associated projects. On December 27, 2018, Waldron issued its energy audit, which it titled "Foss Performance Materials Utility Study" ("Energy Audit"). See Attachment A.

In addition to requiring the Energy Audit, the Commission directed Foss to file a report on the audit results and a timeline for implementation of recommendations, including an explanation of the extent to which such recommendations would be implemented. Foss addressed the reporting requirement in a Motion to Amend Order that it filed with the Commission on September 7, 2021. See Attachment B. By Order

No. 26,526 (September 23, 2021) the Commission set December 31, 2021 as the deadline for this Report on Energy Audit. See Attachment C.

II. ENERGY AUDIT SUMMARY

Waldron identified a number of interconnected resources that contribute to Foss meeting its annual energy needs, including a combined heat and power facility, a reciprocating engine generator, utility electric connections, boilers at multiple steam pressures, hot oil boilers, and steam driven absorption chillers. In addition, in order to develop a model of the facility energy loads that could be used to evaluate the current operation strategy and assess different equipment line-ups, Waldron focused its study on three particular aspects, namely, (1) operation of the combined heat and power plant ("CHP Plant"), (2) energy efficiency improvements, and (3) thermal load uncertainty.

With respect to the CHP Plant, Waldron considered a range of options regarding operation and non-operation, including connecting the entire facility load to the electric grid and not running the CHP Plant. The value of running the CHP Plant in terms of utility cost savings was estimated to be between $400,000 and $1,400,000 annually, with the variation in the range driven by unknowns regarding the steam load, the chiller load, and a portion of the electric supply cost. Because connecting the entire facility load to the electric grid would also require a significant capital investment to upgrade the electrical system, Waldron did not find utility cost savings by not operating the CHP Plant.

Waldron also considered several energy efficiency improvements, focusing on the high level of unutilized condensed or vented steam produced from the heat recovery steam generator ("HRSG"). It concluded that the most important means of improving plant energy efficiency and achieving savings was found in utilizing HRSG waste heat. Options that showed potential included upgrading the HRSG, installing a steam-to-hot oil heat exchanger, installing a back pressure steam turbine, and installing a hot oil heat recovery system.

As for the facility's thermal load, Waldron noted that there was a lack of reliable steam and chilled water metering in the facility, which led to uncertainty in accurately quantifying potential energy savings measures. Consequently, Waldron suggested either metering the condensing and venting lines directly or metering production and use.

Based on its review of the existing energy systems, site energy requirements, and Foss' operating strategy, Waldron developed a combined hourly and monthly model that dispatches equipment to meet the plant's energy load profile. The model was then used to identify a base case and twelve other cases with different equipment line-ups and/or operating strategies as a means for comparing potential cost and energy savings.

With respect to operating strategy, Waldron concluded that it made sense from an operating cost perspective to continue to operate the CHP Plant. It found that shutting the CHP Plant down entirely and importing electricity from the grid would require a significant capital investment and result in operations costs of at least a half million dollars.

With respect to potential energy efficiency improvement projects, Waldron identified six specific cases, numbered 14 through 19, which assume significant levels of condensed or vented steam from the CHP Plant. A simple payback analysis for cases 14 through 18 showed paybacks in the range between nine and thirteen years, while case 19 showed a payback of five years, assuming that there would be no cost to upgrade the Heat Setter Ovens by converting them from steam to hot oil.

In summary, Waldron recommended that steam and chilled water flow meters with data logging capability be installed so that demand could be monitored over the course of the year. Waldron also recommended that potential energy efficiency projects be developed further to identify the most beneficial opportunities.

III. IMPLEMENTATION & OTHER ACTION ITEMS

In addition to conducting an energy audit, the Commission directed that Foss file a report addressing the results of the energy audit and including an explanation of the extent to which Foss implemented any of the recommendations. As explained below, Foss studied the relative impacts of the various energy efficiency scenarios prepared by Waldron, and determined that they were not cost effective.

The six energy efficiency recommendations identified by Waldron, numbered 14 through 19, assumed that significant levels of condensed or vented steam from the CHP Plant might have the potential to be harnessed, which, in turn, could offset some quantity of the natural gas used to produce steam. Waldron also pointed out that its estimates are for the upper end of potential savings and that if the quantity of steam condense or vented is negligible then savings will be negligible. In addition, with respect to scenario 19, the option with the fastest payback (five years), Waldron pointed out that if the cost of required oven upgrades were included then it may not be the fastest and that it was also the scenario with the riskiest assumptions in terms of steam load and steam production.

The payback periods for the six potential energy efficiency recommendations (5 to 13 years) were lengthy and therefore fell out of the acceptable range for Foss, which is between two and three years. When the payback for a plant investment falls below the range, it becomes incumbent upon the plant to invest in higher value projects. In each of the six projects, it was determined that they would have little impact and too lengthy a payback, and did not provide a strong enough business case to implement the projects.

As explained above, the potential energy efficiency improvement projects identified by Waldron were not cost effective in terms of payback periods on investment, although Foss did pursue a number of energy efficiency measures that were not reflected in the Energy Audit. In particular, Foss (1) replaced 65 high bay lighting fixtures, (2) replaced 228 8-ft. fluorescent lighting fixtures, (3) added a small compressor properly sized to reduce larger compressor run times, and (4) replaced 25 DC motors with more efficient AC motors as part of an ongoing project to increase power factor. See Attachment D.

Foss has directed its attention towards implementing overall production facility efficiency and work force efficiency by investing in new, state-of-the-art manufacturing equipment, upgrading old equipment motors, and launching a lean manufacturing training initiative ("Lean"). Prior to the AstenJohnson purchase, Foss did not have Lean training capability, which was originally created by Toyota to eliminate waste and inefficiency in its manufacturing operations. For an American manufacturing company, Lean training is critical for competing against lower-cost countries.

The goal of Lean is to eliminate waste—the non-value-added components in any process. Unless a process has gone through Lean multiple times, it contains some element of waste. When done correctly, Lean can create huge improvements in efficiency, cycle time, productivity, material costs, and scrap reduction, leading to lower costs and improved competitiveness. The process is taught in gradations from Green belt (novice) to Black belt (master).

A. In 2018, five Foss associates earned their Lean Green Belt after two weeks of training and completion of a qualified project. All five associates remain employed by Foss. Green belt represents completion of the first level of Lean.

B. In the third quarter of 2021, selected Foss employees completed five hours of Lean White Belt basics training and worked on qualifying projects. This was for 12 associates, a mix of operators and first-line supervisors.

C. Foss also added three experienced department and continuous improvement leaders: Greg Bouquet, Bruce Mayhew, and Bob Benjamin. All three are very active with improvement projects with their team members.

D. For 2022, Foss will be adding more focus to the standard AstenJohnson tool of Hoshin Kanri X-Matrix for high priority improvement projects. The Hoshin Kanri X-Matrix template is a single-page document that includes goals, strategies, strategic projects (initiatives), and owners.

E. In Lean management, the goal of applying the X-Matrix is to align long-term needs with strategic initiatives, identify the most important activities along the way, and list the metrics that need to be improved.

F. A few recent noteworthy projects that were completed by these trainees, include : (1) July Quality Improvement for less scrap and rework for the Fabric Department, which produced a savings of $50,000 per year; (2) September Fiber "sticks" defect reduction on the fiber line; and, (3) October Fabric Department efficiency improvement for machine line to run at designed speed, and reduced machine work rate (over-processing) producing an annual savings value of $79,000 per year.

Finally, Foss pursued a number of cost reduction projects since the acquisition occurred in 2017. It negotiated new packaging contracts with vendors for corrugated, poly film and strapping products that yielded savings of approximately $350,000 over a 24-month period. In addition, it negotiated new agreements with local waste haulers that saved over $35,000 over the same period and it negotiated as well the early termination of a contract for uniforms for employees that saved over $150,000.

IV. CONCLUSION & NEXT STEPS

The Commission directed Foss to file a report that "(1) addresses the energy audit results and a timeline for its implementation of any recommendations made in the audit; and (2) 'include[s] an explanation of the extent to which Foss will implement the audit recommendations.'" As explained above, Foss engaged Waldron to develop an energy model that could be used to screen various operating cases and develop potential energy efficiency improvements.

The energy model produced six operating scenarios identified as potential energy efficiency improvement projects. The payback analyses, however, showed paybacks in the range of 5 to 13 years, with the fastest payback scenario being the riskiest in terms of assumptions about future steam loads. In light of the lengthy paybacks, Foss determined that it would not be cost effective to implement any of the specific energy efficiency scenarios and it focused instead on capital investments in manufacturing equipment and efforts to transition away from its historic reliance on self-generation of electricity. Nevertheless, as described above, Foss implemented a number of energy efficiency measures and it continues to look at other opportunities.

Finally, while the combined heat and power system has served Foss well over the years, current and future gas prices based on energy production and NYMEX (New York Mercantile Exchange) prices, along with concerns about the volatility and reliability of supply, has caused Foss to consider other power alternatives. As a result, Foss is working with Unitil to optimize its operations so that its power needs can be supplied by generating power from natural gas and/or purchasing power from the grid in the most efficient and cost-effective manner.