SHOWCASE PROJECT: GENERAL MOTORS: CHILLED WATER SYSTEM OPTIMIZATION PROJECT

SOLUTION OVERVIEW

The General Motors Spring Hill manufacturing site is a complex that consists of several buildings covering 7.2 million square feet, housing automobile manufacturing, engine manufacturing, sheet metal stamping, and plastic injection molding processes. The site has a central utility complex (CUC) that produces chilled water for comfort and process cooling needs. It currently operates four 6,750-ton and one 2,150-ton electric chillers to meet site demand through a large network of pumps and piping. The plant conducts energy conservation activities and identifies energy-efficiency projects on a regular basis.

The plant engineers reviewed currently available technological advances in chilled water system design and control, and conducted an engineering feasibility study to determine extensive improvements that could be made to the existing chilled water system piping and controls. This would allow the system to meet required demand at reduced pumping power and improved chiller efficiency. The overall goal of the project was to upgrade the system while continuing to operate the plant, and to meet a 2-year simple payback with company investment and utility incentives from partners at the Tennessee Valley Authority.

SECTOR TYPE

Industrial

LOCATION

Spring Hill, Tennessee

PROJECT SIZE

7.2 million Square Feet

FINANCIAL OVERVIEW

Project Cost: $2,000,000

SOLUTIONS

Initial discussion of the feasibility of this project went on for approximately six months prior to a

formal engineering study by an external consulting company. At the completion of the engineering study, it was determined that a project could be executed to meet the financial payback, and funding was established.

Construction took place over the next eight months with the following process modifications implemented:

- Converted the piping system from “primary-secondary” to an “integrated primary” flow scheme, utilizing a new bypass and flow meters to maintain minimum flow through the chillers, thereby decreasing required pumping power and improving the chilled water return temperatures.
- Installed variable frequency drives on cooling tower pump motors to optimize flow, based on actual need vs. full flow and pressure.
- CUC compressed air dryers were supplied by a new small right-sized dedicated chiller, thereby decoupling the site-wide air-drying system from the site chilled water system. This allowed for increased chilled water temperature reset capabilities in the site-wide chilled water system.
- Installed flow control valves in strategic locations to further reduce chilled water flow and improve chilled water temperature differences at the business unit level.
- Installed a soft start on chiller #5 to allow starting of this unit as required to meet chilled water plant demand. Presently, the chiller motor (15kV 5,500hp) cannot be started without manually changing load taps at the primary switchgear to increase site voltage, creating a power quality issue.
- Installing programmer logic controllers (PLC) to consolidate system points, and ensure optimum efficiency over the highly variable load range and weather conditions present at Spring Hill.

The cost to implement this project was approximately $2,000,000, with annual electrical energy savings of $760,000 and utility incentives offering a 2-year simple payback. Execution of this complex project required the help of engineering consultants, construction managers, and skilled trades professionals. Some of the opportunities for improvement were also identified during an Energy Department Pumping System Assessment performed in 2009. Only small portions of the assessment opportunities could be addressed at that time due to payback limitations.

OTHER BENEFITS

After the project was implemented, an annual savings assessment was conducted by comparing historical operating data and current operating data, taking into account weather conditions and other anomalies. The result of this analysis indicated annual energy savings of 8,600 MWh, along with some added maintenance savings and additional cost avoidance. The savings were further substantiated by graphing chilled water efficiency versus chiller load and seeing the improvements in the raw data. The use of this information continues to be evaluated for potential opportunities in GM’s other large chilled water systems in the United States and around the globe.

The chilled water system optimization project increased efficiency of the Spring Hill site and reduced operating costs as a byproduct of that efficiency. GM intends to incorporate the lessons learned at

Spring Hill whenever possible in future project installations and modernizations. GM is currently installing five new chilled water systems at its Arlington, Texas, Wentzville, Missouri, Ft. Wayne, Indiana, and Flint, Michigan, assembly plants, and its Toledo, Ohio, powertrain site, with 29,400 tons of capacity, utilizing the same technology used in the modernization of the Spring Hill site. These systems will operate with greater efficiency than the ones they replaced at a scale comparable to what was realized at Spring Hill.

Annual Energy Use

Baseline(2014)

0.39 MWH (site)/Prod

Actual(2016)

0.38 MWH (site)/Prod

Energy Savings

3.4%

Annual Energy Cost

Baseline(2014)

100%

Actual(2016)

96.6%

Cost Savings

3.4%

Overall Site Layout

Lineup of 6,750-Ton Chillers