Chilled Water Plant Energy Upgrade

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Abstract

This project was undertaken to increase the efficiency of the cooling equipment at the Nakamura Courthouse in Seattle, WA which is a building that is managed by the General Services Administration (GSA). The building manager and GSA engineers had complaints that their two 200-tons chillers were consuming too much energy and that there should be a way to upgrade the chilled water plant to increase the efficiency to save energy and still satisfy the load of cooling needed in the building. A work plan was developed to remove one of the old chillers and install a new pony chiller with all its components such as fittings, valves, sensors, and pumps. Also, a new program was developed and implemented in the current server and the controller for the chilled water plant was replaced for the one with the new program which works more efficiently to save energy at low loads. It was proven that the upgraded system saves energy by a 35%.

Introduction

Multi Air Services Engineers Corp (MASE) is a company with a construction division that covers electrical, mechanical, and building automation system projects in Puerto Rico and United States. MASE was awarded a project by the General Services Administration (GSA). In this case the project was in a US Federal Courthouse called William Kenzo Nakamura US Courthouse in Seattle, WA. The building manager and GSA engineers had complaints that their two 200-tons chillers were consuming too much energy and that there should be a way to upgrade the chilled water plant to increase efficiency to save energy and still satisfy the load of cooling needed in the building.
The scope of this project consist of achieving three main modifications to the chilled water plant reduce the energy costs by replacing one of the chillers and other mechanical components in the plant which is in the basement of the building. This paper summarizes the technical aspects of this project.

Background

The mechanical design desired for this project consist of replacing one of the existing chillers for a new pony chiller of 135-tons to use it as the second stage of cooling when building requires cooling and Heat Exchanger operation is not possible, the integration of existing heat exchanger as a parallel equipment to be the first stage of cooling when outside air conditions allow it, and using the existing 200-tons chiller to be the third stage of cooling when pony chiller can not satisfy the load.

Problem

In order to make this possible, the contractor had some challenges to figure out, first the contractor needed to develop a plan to remove one of the 200-ton chillers from the basement which was almost impossible since the basement mechanical room double door was too small to fit the chiller trough it, also, there was the need of a crane to lift the chiller from the basement to the main street, so MASE needed to make a lift plan and request city permits to close a highly transited street. Finally, the contractor needed to provide a design, implement it and prove that this modification reduces the costs of energy in the facilities.

Methodology

During the first phase of the project (planning phase), contractor prepared a Schedule of Values to make a proposal to GSA with the total price and a breakdown of the items required in this project. To be able to provide that Schedule of Values, the project manager had to request quotes to the suppliers for the equipment specified for this project, at least three different suppliers were used to compare prices and the contractor chose the lowest bidder to use its prices in the proposal. Additionally, the contractor created a Project Schedule using Microsoft Project as the software tool. This Schedule had to comply with the specific time frame given by GSA and the project manager performed an analysis of the man hours needed to get the work done in the time frame requested.

The contractor hired a design firm to save time and focus on the management, organization, and on-site items of the project. After having 100% of the design, it was submitted to the client for approval. Once approved, the project manager prepared and sent several submittals for the client's approval prior to placing the orders for the materials and equipment that was going to be used in the project.

Also, the Project Manager worked on providing the following construction documents: Safety Plan, Fire Prevention Plan, Execution Plan, Lift Plan, Testing Adjusting and Balancing Plan, etc. The Project Manager hired the necessary personnel and requested quotes from subcontractors to perform the labor.

After completing the planning process, the client gave the notice to proceed with the on-site work. That's when the Pre-Testing, Adjusting and Balancing phase started, this had to be done to have a record and evidence on how the current system is operating. Tested every mechanical component of the chilled water plant and prepared reports with the obtained data. Figure 1 shows the readings obtained from the primary chilled water pump 1, this same procedure was conducted to every mechanical component in the facility.

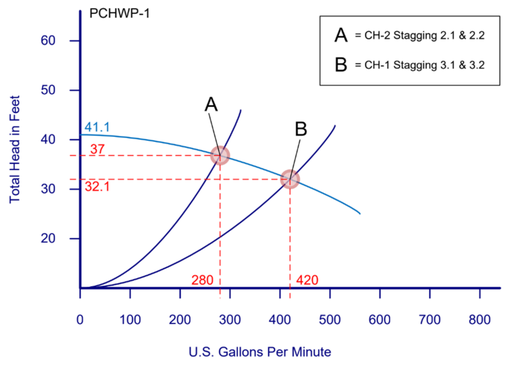

Figure 1: Testing on existing mechanical equipment

Results and Discussion

The lift plan was performed, after weeks of waiting for the city permits to close the street for hours to be able to remove the old chiller from the basement with a crane. Figure 2 shows the lift plan performed.

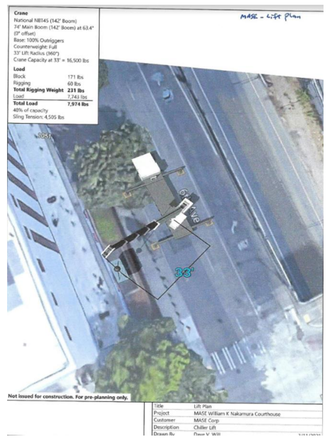

Figure 2: Lift Plan

The contractor had to hire a local subcontractor to remove the doorframe and demolish part of the wall to be able to fit the old Chiller 2 (CH-2) through that door and then inserted the new 135-tons pony chiller with the help of Western Crane operators. P&L Contractors then proceeded to reinstall the double door and frame and made sure that the building was secured. All this happened in a single workday as planned, since the building is a federal courthouse, and it was not an option to leave it exposed to the public. The Figure 3 below shows how the old chiller was being removed from the basement using the crane and the laborers helping by pushing the chiller through the double door.

Figure 3: Removal of 200-ton Chiller

Conclusions

With this work it was achieved the mechanical design integration of existing heat exchanger as a parallel equipment to /be the first stage of cooling when outside air conditions allow it. It was also achieved to set the new pony chiller of 130 Tons to be the second stage of cooling when building requires cooling and Heat Exchanger operation is not possible. And having the existing 200 Tons chiller (CH-1) to be the third stage of cooling when pony chiller cannot satisfy the load.

After finishing the mechanical installation and integrating the new program and sequence of operations, the contractor asked the client for the next months energy bills to compare to the energy bill from the months prior the beginning of the project and see how the new chiller and implementations in the chilled water plants such as new sequence of operations help save energy. After comparing them, it was proven that the upgraded chilled water system reduced the costs of energy at low loads down to 35%.

Future Work

After closing this project MASE was awarded three operations and management (10-year) contracts in the Washington State region. This proves that with organization, teamwork, and good performance, the company will continue growing in the construction and facility maintenance industry.

Acknowledgements

Special thanks to my mentor Eng. Israel Alvarez, President of Multi Air Services and Engineers Corp. who trusted me with this and other projects. This has been a great learning experience, and everything he tough me about project management I can continue to use it for my professional growth. Also, my professor Dr. Cruzado for taking his time and dedication to teach the fundamentals of presenting a project properly and for being diligent and clear on his expectations from this project.

References

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