Talk On "Introduction to Energy Efficient Chilled Water Plant in Building"

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The need for air conditioning system in tropical regions will continue to rise and one of the main challenges which air conditioning engineers need to overcome increasingly is in designing energy efficient chilled water plant. The success of doing so would translate to environmental benefit as well as operating cost reduction for the owners. The latter is made possible as more efficient chilled water plant means more energy can be saved. Various factors have to be considered during both design stage and operation and maintenance stage for an energy efficient chilled water plant to be implemented in a building.

At the design stage, the key factors which must be taken into account includes the system design, load profile, selection of chiller, design of piping, sizing of pump, selection of cooling towers and energy management system (EMS). An hourly load profile enables better chillers selection as chillers usually perform worst during part load or night time. It also means that the design of part load chiller is crucial. Needless to say, the lifecycle costs of the chillers are also important. When it comes to chiller selection, points to be considered includes the size of chillers serving peak and off peak load, its type, refrigerant and efficiency at full and part load.

Mr. Ong receiving a token of appreciation from EETD main committee member, Ir. Prof. Dr Clarence Augustine Tee

Pressure drop and flow rate are 2 vital factors when it comes to piping design. There are friction losses in any pipe through which water is flowing and the loss depends on water velocity and pipe diameters. Therefore, the challenge lies in designing the piping system and fittings with minimum pressure drop. It is recommended to use low flow system instead of high flow system and to employ 45 degree elbow instead of 90 degree elbow whenever possible to reduce pressure drop and to prevent "bull-heading" in piping arrangement.

In terms of pump sizing, good efficiency is of primary importance. Be mindful of the Net Positive Suction Head (NPSH) of the pumps. Ideally, Variable Speed Drive (VSD) should be installed for all pumps motors and booster pump should be provided for areas of higher head. In the selection of cooling towers, again, selecting the right type is paramount. Sufficient space should be provisioned for air circulation to prevent hot air bypass. Blockage and restriction for air discharge or suction should be prevented. Proper selection of condenser water treatment product is also important, and if possible, recycle condensate water for cooling tower water make-up.

Participants at the talk

The energy management system (EMS) is the most undermined component which actually heavily affects the efficiency of a chilled water plant. All sensors need to be calibrated from time to time to ensure that accurate measurements take place. It is important to keep the history of logged data to allow engineers to analyse them as the paradigm should now be shifted from no-breakdown based maintenance to performance based maintenance. High accuracy instrumentations such as temperature sensor, power meter for all chillers, pumps, cooling towers, flow meter, data logger with 16 bits ADC, and placement of temperature sensors to be in direct contact with water flow are strongly advisable.

After the design stage, the operation and maintenance stage has to be treated with equal importance. From the perspective of operational strategy, coordinate the chillers so that they work at their best efficiency zone. Running of pumps to supply chilled water should be done according to the load. Any unnecessary obstruction along the pumping path should be eliminated. VSD should be used to regulate the flowrate. The condenser water should be kept clean and free of bacteria.

Maintenance wise, the option of annual shutdown of chillers which is rarely practiced in Malaysia should be considered. The cleanliness of the evaporator and condenser tube should be ensured at regular intervals. Pumps, motors and cooling towers in-fills should be kept in good condition and proper condenser water treatment should be administered.

To summarise, there are various factors to be considered when it comes to designing an efficient chilled water plant. As much as we want to reduce the energy required to operate it, the comfort levels of the occupants should not be compromised. Instead of only considering the initial investment, the lifecycle costs should also be accounted for.