Design Change of Tower Cooling Water System for Proton Accelerator Research Center

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1. Introduction

The Tower Cooling Water System (TC) is designed to reject the heat load generated by operating the accelerators and the utility facilities through the component cooling water (CCW) heat exchangers.

The circulating water discharged from the circulating water pumps passes through the CCW heat exchangers, the Chiller condenser and the air compressor, and the heated circulating water is return to the cooling tower for the heat removal.

In this study, The design of Tower Cooling Water System is changed as follows : At First, The quantity of cells is changed into six in order to operate the cooling tower accurately correspond with condition of each equipment of head loads. The fans of cooling tower are controlled by the signal of TEW installed in the latter parts of it. The type of circulation water pump is modified to centrifugal pump and debris filter system is deleted.

2. Tower Cooling water System Design

2.1 The previous Design Criteria

Design inlet air temperature for the cooling tower is determined by considering a recirculation temperature based on the outdoor ambient air design temperature in the General Design Criteria.

The cooling tower is the wet-dry, forced inducted type in order to minimize environmental effects due to plume at winter season, and consists of three (3) 33⅓ percent capacity cells by considering economy and an operability according to the construction stage of the Proton Accelerator Facility and each heat load. Range and approach for the cooling tower design are 7℃ and 3.5℃, respectively.

The cooling tower has a capacity of 30MWt based on the maximum Accelerator operation load of 250 MeV and the operation load of the utility facilities. The cooling tower load can be controlled by adjusting operating numbers of the circulating water pump and the cooling tower cell depending on the construction stage of the Proton Accelerator Facility and seasonal heat loads.

The TC system has four (4) 33⅓ percent capacity circulating water pumps including a standby pump. The circulating water flow through the pump discharge header to each component is returned to the cooling tower through the return pipeline.

Total developed head for the circulating water pumps shall be sufficient to supply the cooling water to the highest point of the cooling tower.

In order to maintain the circulating water quality against deterioration of the water due to continuous evaporation, drift and dust, etc., a chemical injection facility, a continuous blow-down and makeup water provisions are provided in the system. Flow lost by a continuous evaporation, drift, blow-down is replaced by the Process and Potable Water System . The blow-down water is discharged to the Waste Water Treatment System.

Bottom basin of the cooling tower shall have a sufficient depth to accommodate the normal amount of transient reverse flow that collects in the basin at shutdown. A screen shall be provided in the basin sump to remove debris entering the circulating water system. A filtering provision such as screen or filter, is also provided to protect the process equipment.

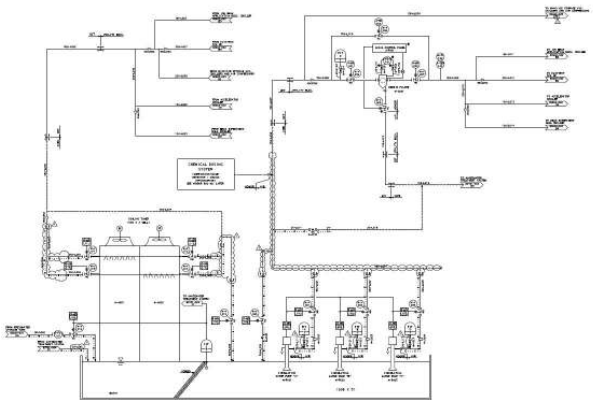

Fig. 1. P&ID of Tower Cooling Water System(previous)

2.2 The Modified Design Criteria

The cooling tower is changed to induced draft, double cross flow and consists of six, 16.7 % capacity cells operate the cooling tower accurately correspond with condition of each equipment of head loads. Range of cooling tower design stayed 7℃ : Hot water temperature is 38℃ and cold water temperature is 31℃. The Detail specification of each equipment is as follows :

1) General
- Water Flow : 1300m^3/hr
- Inlet water temp. : 38℃
- Outlet water temp. : 31℃
- Wet bulb temp. : 27℃

- Motor : 25Hp X 6 sets

2) Structural Detail
- Nominal cell dimension(L X W) : 2,300 X 5,270
- Height : 3,360(2-ladder access to fan deck)
- base skid material : SS400 + galvanic

3) Mechanical Equipment Fans
- Type : 6 cells, axial flow
- No. of blade per fan : 5EA

4) Speed reducer
- Type : V-velt reducer
- Reduction ratio : 4.59:1
- Fan motor : 3PH X 4P X 60Hz X 460V
- Fan motor rated power : 19.5kW

5) Water distribution part
- Type : open gravity type
- No. : 12 hot water basin

6) Anti-scale equipment
- Tank : 0.6m^3 , 880 Φ X 1330(H) X 8T
- Pump : 3.6LPH*10bar, Elec.Motor driven, diaphragm type

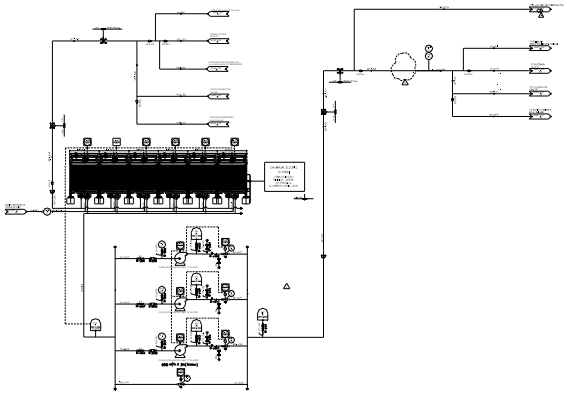

Fig. 2. P&ID of Tower Cooling Water System (Modified)

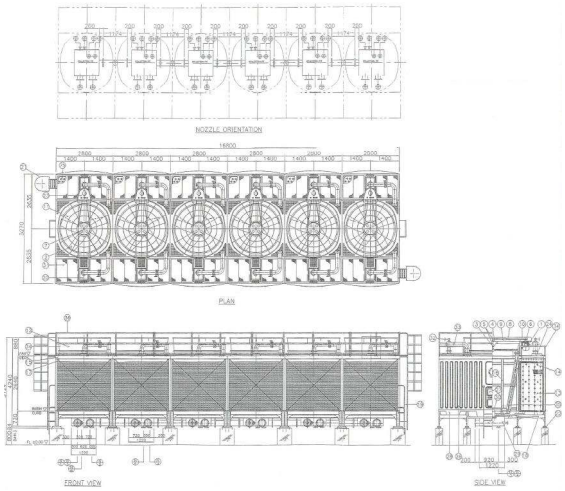

Fig. 3. Schematic Diagram of Modified Cooling Tower

4. Conclusion

The design of Tower Cooling Water System is changed as follows : The quantity of cells is changed into six in order to operate the cooling tower accurately correspond with condition of each equipment of head loads. The fans of cooling tower are controlled by the signal of TEW installed in the latter parts of it. The type of circulation water pump is modified to centrifugal pump and debris filter system is deleted.

5. Acknowledgments

This work was supported by the Ministry of Education, Science and Technology of the Republic of Korea through the Proton Engineering Frontier Project.

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