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Lincolnwood Middle School Piping

United's initial findings were as follows:
*Pump 1 & 2 were both running to maintain differential setpoint
*Pump 4 was running and pump 3 was off
*Pumps 7 & 8 were running to maintain differential pressure setpoint

Pump 1 & 2 were not evaluated for flow during the assessment as they were not on the piping loop causing issues.

Pump 4 would flow 358-412 GPM depending on the operation of Pumps 7 & 8. During design conditions and the bypass shut, pump 4 would run 362 GPM with heavy cavitation. (The triple duty valve set to 52 with a manufacture min. of 50)

Pumps 7 & 8 had a range of 42-65 GPM with both pumps running (should be 200 GPM). This is due to a restriction in the piping feeding pumps 3, 4, 7 & 8. In order to get design flow pumps 3 and 4 needed to be powered off. While those pumps were off, one pump ran 94 GPM while both pumps ran 98-101 GPM showing that the piping size only allows 100 GPM total flow that should be provided by one pump.

At the end of United's assessment, the bypass for pumps 3, 4, 7, & 8 was opened until there was no cavitation. This prevents the installed controls form working but it also stops the extreme damage associated with cavitation.

Final Recommendations:

*Controls must be updated to have each set of pumps run as lead lag only. This means that you may run either pump 1 or 2, 3 or 4, 7 or 8 anytime but never both pumps together
(The reasoning for this is that the piping on all associated pumps is sized for one pump operation and not for any set of pumps to run at the same time.)

*Pumps 3 and 4 must have VFDs installed and set up for total flow and then allowed to run on differential pressure following setup.
(As describe above, you have piping sized for individual pumps only. The flow requirements for pumps 1 or 2, 3 or 4, and 7 or 8 are 595, 340, and 100 GPM respectively. The supply from the heat exchanger is 6 inches meaning that at 8 ft/sec. the pipe would flow 720 GPM and at 12 ft/sec the pipe is capable of flowing 1080 GPM. The ideal range of flow is 4 to 8 ft/sec and while 12 ft/sec is

not ideal, it is at the end of the range of acceptable. If all sets of pumps are to run only one pump then the total flow would be 1035 GPM. Adding VFDs to pump 3 and 4 allows those pumps to only use the water required alleviating additional flow from 6-inch pipe that is already performing above the ideal range.)

Piping for pumps 1 and 2 need to have the bypass removed and reinstalled as a 6-inch pipe for proper flow during a bypass situation.

Piping for pumps 3, 4, 7, and 8 must be redone. Currently it goes from 5-inch piping down to 3-inch creating a massive restriction causing cavitation during normal operation. All piping from the return, supply, and discharge of the 3-way valve must be changed to 5-inch including the 3-way valve as well. Additionally, the 3-inch bypass needs to be changed from 3-inch piping to 5-inch piping for times when the bypass needs to be utilized.

Piping takeoff for pumps 7 & 8 does not need to be changed but during changes to other pumps and piping they simply need to be maintained at 3-inch when they are hooked up again.

All pumps need to have bridge gauges installed across the strainer and pump to be able to properly maintain the pumps. (3 ports: one at the strainer inlet, one at the pump inlet, and one at the discharge of the pump)

United recommends putting in an actuator on each boiler so that each boiler can be isolated from the system when only one boiler is running. As the system stands, when one boiler is running with a setpoint of 180° F, the other boiler allows water flow thus bypassing the first boiler and then mixing the cold bypassed water with the 180° F discharge from the first boiler. This mixing immediately cools down the water so the first boiler is not delivering the design setpoint boiler water temperature.

Lastly, the temperatures from the boiler should be at 190° F anytime it is below 35° F outside. The building heat exchangers should be set to 180° F below 30° F. This will prevent the need for the boilers to ever catch up to the rest of the system during a heating call and will always be 10 degrees higher than the heat exchanger setpoint of 180° F. The loops for the individual systems can be adjusted lower but absolutely should not be lower than 160° F during freezing conditions.
(When United started at Lincoln Hall, the heat exchanger was set to 143° F and the loops less than that in the 130° F range. What this does is prevent large amounts of the building from ever satisfying a call for heat. When they can't satisfy, the second set of pumps turn on to help the first set of pumps thereby causing increased cavitation. Now there are multiple extra pumps on that can't move the required flow through piping that isn't sized correctly and even if it was sized correctly would never satisfy because the heat needed to do so is not being delivered from the boiler or heat exchanger.)

***All recommended pipe sizing gives may be increased from sizing gives but it cannot be decreased without risking additional cavitation and erosion of piping.

An engineer should review all associated piping to see if further changes are warranted.

***Attached is a drawing using the current controls diagram to simplify what work needs to be done

Lincoln Hall Heating/Cooling Plant

Yellow Lines:
*Need to be repiped to be 5 inch pipe

Dotted Yellow Line:
*It is a bypass that needs to be changed to 5 inch piping

Green Line:
*It is a takeoff for both bypasses and needs to be changed to a 6 inch line

Dotted Green Line:
*It is currently 3 inches and needs to be changed to 6 inch