

Memorandum

Subject: Test Lab LCW

Date: November 20, 2019

Author: D. Kashy

Distribution: R. Fair, P. Ghoshal, S. Gopinath, E. Sun, P. Denny, M. Polker, C. Jones, C. Whitlach, S. Philip, W. Akers

On November 14, 2019 the pump that delivers LCW to the Test Lab was swapped out. Per conversations with C. Jones, the new pump that was installed has the largest impeller that the motor can handle. The goal was to provide more head and flow capacity. As a quick check I recorded the pressures in the UITF before and after the exchange. Note: These measurements were with much of the TL hardware isolated per P. Adderly and P. Denny.

Figure 1 shows the supply and return pressure at the dump solenoid before the pump change out and figure 2 shows these pressures on the main lines inside the UITF cave.

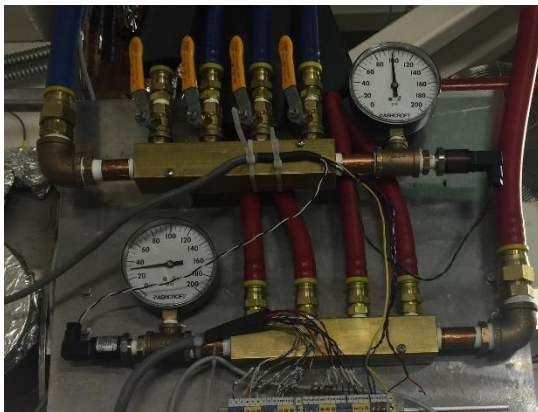


Figure 1. Pressures before the swap at the Dump Solenoid Supply 98psig, Return 31psig



Test Lab LCW Report

D. Kashy 11/21/2019

M:\JLab_Magnet_Group\6. Work Folders\4. Dave\JLab Fac and Infrastructure\Test Lab LCW memo 11_21_2019 final.docx

Figure 2. Pressures before the swap on the UITF header Supply 106psig, Return 28psig

The available DP before the swap at the solenoid was 67psid and at the header 78psid

Figures 3 and 4 show the pressures at the same locations as figures 1 and 2 but after the pump swap.



Figure 3. Pressures after the swap at the Dump Solenoid Supply 115psig, Return 32psig



Figure 4. Pressures after the swap on the UITF header Supply 124psig, Return 29psig

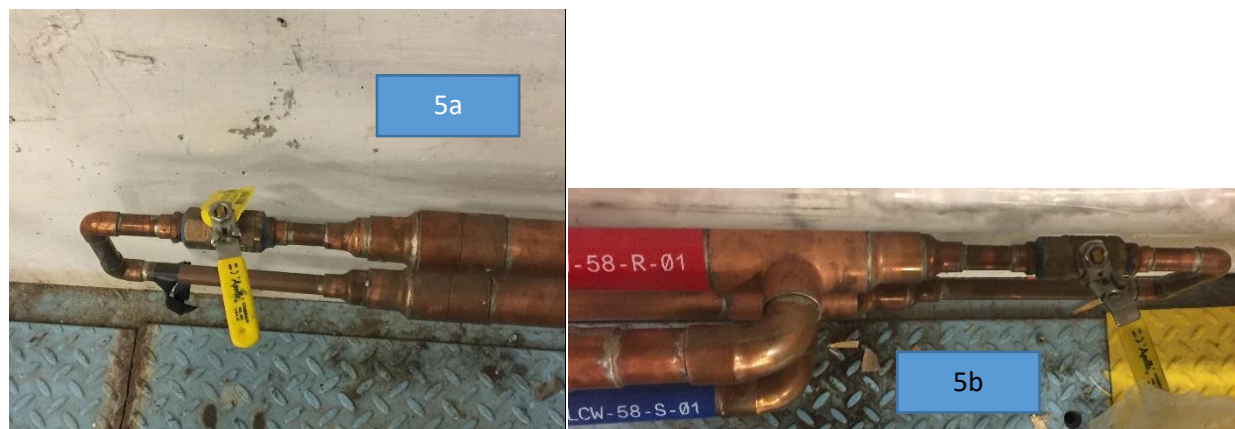
Table 1 shows the summary of the data and the improvement in available DP after the pump swap.

	Supply before Swap	Return before swap	Supply after swap	Return after swap	DP Before swap	DP after swap	Head gain psi
Pressures at Solenoid (psig)	98	31	115	32	67	83	16
Pressure in UITF Header (psig)	106	28	124	29	78	95	17

Table 1. Pressures in UITF before and after Pump Swap

As can be seen the increased head was ~16psi in the UITF. On the dump solenoid we have a flow meter. Prior to the pump change the flow measured 4.3 gpm, after the pump change with the higher DP the flow measured 4.9gpm. Thus the pump swap did make a positive and significant improvement in the available head for operating hardware in the test lab. There were other improvements to the system as discussed below:

October 30, 2019: I found two fully open bypass ½” ball valves, see figure 5a and 5b, on top of the UITF so I throttled them, this raised the pressure available in the UITF by 20psi and dropped the return pressure ~6psi. I calculated each was bypassing about 30gpm, and this was a big waste of LCW capacity.



Figures 5a and 5b: 5a throttled bypass valve on the North end of the cave roof and 5b is the throttled valve on the south end of the cave roof.

November 15, 2019: Working closely with Larry Farrish, Leonard Page and Joe Beaufait we had reviewed 3 major loads on the LCW system. These include the klystrons for the UITF, The SSA's for the LCLS II cryomodules, the 1497's for CEBAF cryomodules and the NPS magnet and its power supply. We throttled the SSA's and the flow to the NPS magnet and its power supply. The resulting flows are summarized in Table 2.

Load	Flow rate on 11/15 after adjustments
SSA's for LCLS II modules	8 x 12-14 liter/min
1497's (full flow)	37 gpm
UITF Solenoid	4 gpm
UITF Solenoid power supply	2.5 gpm
UITF Klystrons	12 gpm
UITF other loads	Undetermined
Bypass valves	Undetermined
NPS Magnet with HKS PS	7.3 gpm

Table 2. Loads on the LCW system

With all the above loads running at the listed flow rates in table 2, and the bypass valves mentioned above throttled, the new LCW pump was fully loaded but not quite making the pressure set point of 136psig. The pump and bypass valve are shown in figure 6a, and the pump bypass valve controller is shown in figure 6b with all the above loads flowing. The purpose of the bypass valve is to protect the

pump and limit the system supply pressure to 150 psig to protect the piping and downstream loads. To Keep the NPS magnet system from taking too much flow the supply and return valves have been tagged with “Administrative Tagout” tags. The Supply tag indicates not to adjust without approval of J. Beaufait or D. Kashy and the return valve tag says “open and close slowly” to avoid spiking the pressure in the system.

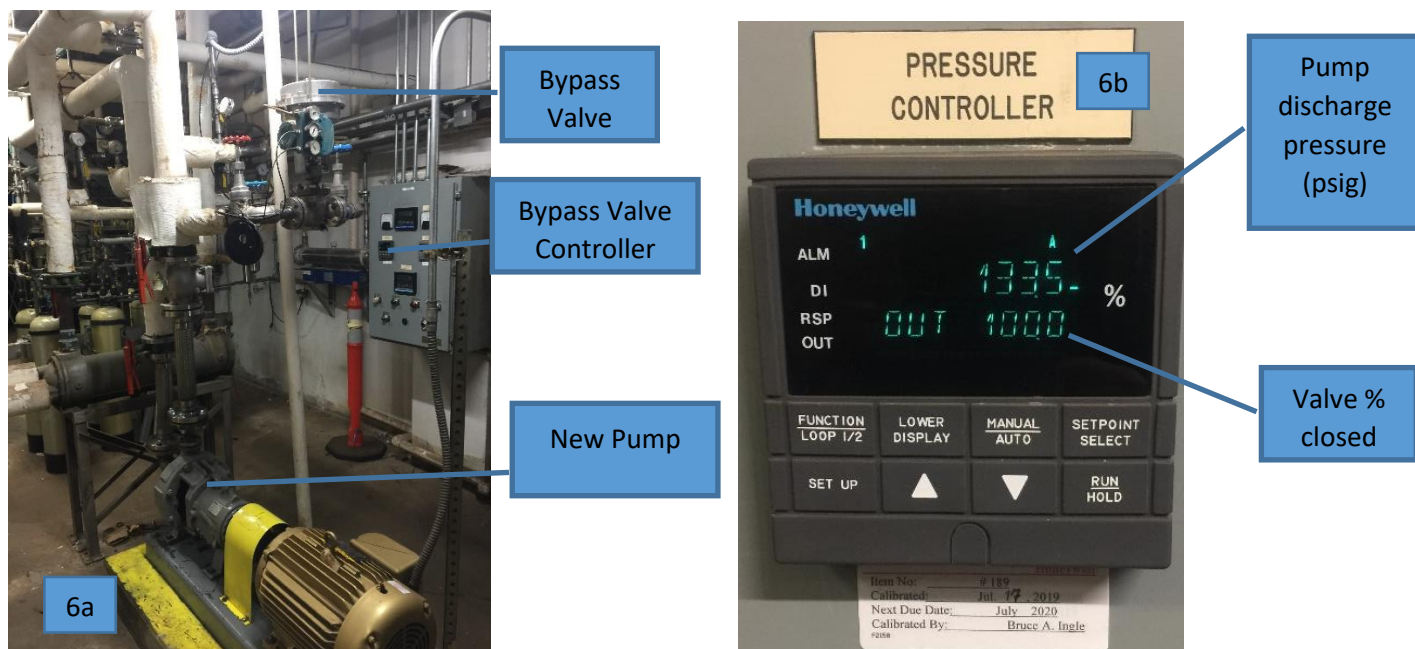


Figure 6a, 6b. 6a. Test Lab LCW Pump, Bypass valve and controller in the TL basement. 6b. Pressure controller with valve output position at 100% this is percentage closed so this valve is fully closed.

After reviewing all the loads and seeing the performance, I was still suspect that not all flows were understood.

November19, 2019: I found a third ½” bypass valve at the end of the SSA header that was full open. I throttled this valve, see figure 7.

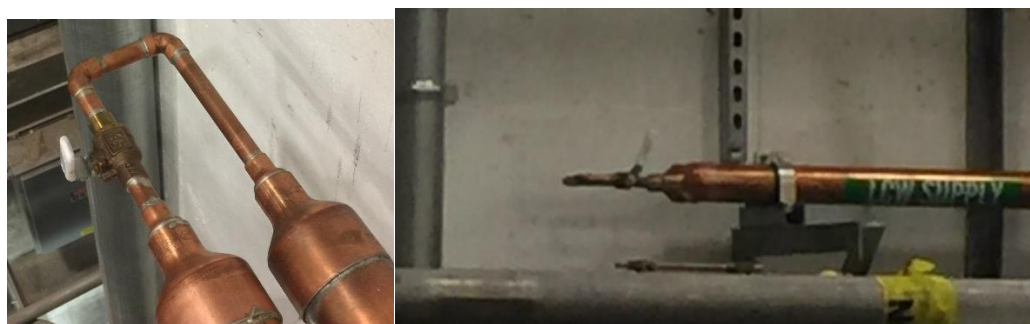


Figure 7. Throttled bypass valve at end of SSA header seen from two view points

With the all three of these bypass valves throttled the flow to the 1497’s increased from 37gpm to 40gpm due to the increased available pressure drop, figure 8. With all the loads listed above on line including the NPS magnet the LCW pump system made its set point pressure and the bypass valve

opened 30% to limit the discharge pressure, see figure 9. If one wanted to determine the spare capacity a flow meter could be installed between any supply and return valves in the test lab and then the flow could be adjusted until the pressure control bypass valve fully closes.



Figure 8. Flow meter on 1497's



Figure 9. Pump bypass valve controller with the valve open 30%, i.e. the valve is 70% closed and the output pressure is 136psig.

A portion of the UITF along with the NPS magnet and its power supply were isolated from the LCW system. This reduced the total load on the system and required the bypass valve to open to 45% as shown in figure 10.



Figure 10. Pressure controller (bypass valve positioner) 45% open with reduced loads on they system

Per C. Jones, there was a time during the pump swap that the pressure controller was fully open and the pressure rose high enough to open the pressure relief valve. This indicates that it is not big enough to handle the full pump flow. A manual bypass was opened which is in parallel with the bypass. Thus the LCW users in the test lab must communicate when they need to start up or shut off large LCW flows.

I have two final observations and potential areas for improvement. In the supply lines from the pump to the loads, the typical pressure drop is 30 to 45 psig depending on the location in the test lab and the flow to that area, while the pressure drop in the return is 5 to 15psig. In all locations the supply and return lines locally match, thus the pressure drop should also match. The most likely cause of the extra 25-30psi drop is the temperature control valve see figure 11. For the first part of futures upgrades I suggest looking at that as step 1. Finally, I propose that for future LCW loads in the High Bay we do not use the UITF piping as part of the path to bring the water. Some rather sensitive equipment is being temperature controlled in the cave, specifically a buncher and a chopper. These are sensitive to pressure swings and need to maintain a relatively constant flow and a minimum flow. When the flow dips too low because of pressure swings they trip off. There are two large valves near the stair case to the SSA's and 1497's above the CMTF cave. These valves see figure 12 are not being used and if loads are tapped of there they will have less impact when turned on and off because the additional load on the system will not affect the pressure drop in the UITF supply and return lines because it will not flow through those pipes.

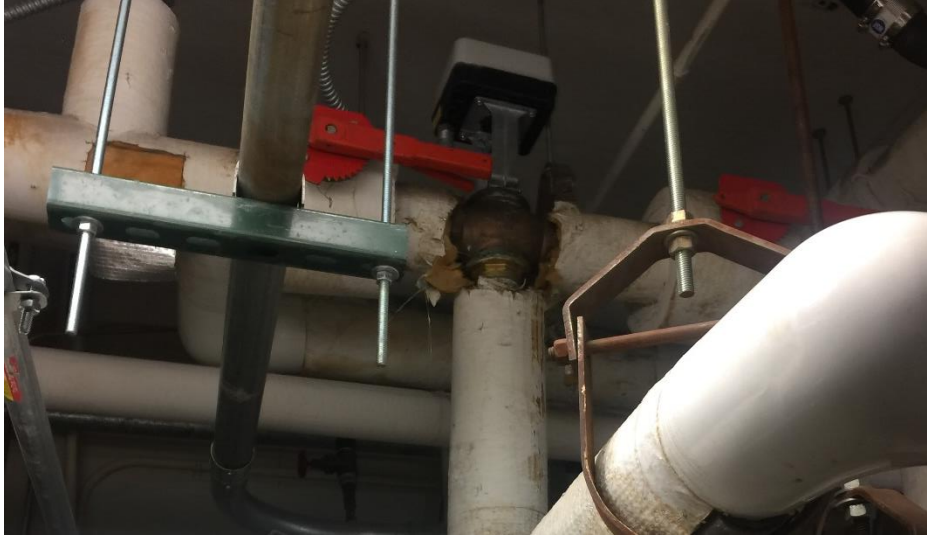


Figure 10. Temperature control valve



Figure 11. Spare valves that could be used for future LCW temporary loads in the TL high bay.

Conclusions:

- 1) The pump upgrade with the larger impeller has provided more head and more flow to the TL LCW users.
- 2) Three ½" bypass valves at the ends of lines were fully open and wasting lots of capacity and were throttled.
- 3) The test lab LCW system is capable of handling the present loads.
- 4) LCW users must communicate with P. Denny and or C. Jones prior to starting up or shutting off major loads.
- 5) A simple test of the system could be done by adding an additional flow meter at an open port to determine its additional capacity for very low cost.

- 6) The temperature control valve is eating ~25-30 psi of supply head and should be considered as a candidate for any future upgrades
- 7) Future high bay LCW loads should not be connected through the UITF and we should consider moving the NPS magnet and its power supply to these valves to limit the possible impact on UITF/HDIce running this winter/spring
- 8) The system should be monitored on a regular basis by looking at the position of the bypass valve to see that it is not fully closed. This will be a monitor on the system health and combined loads. If the bypass valve goes fully closed the loads should be reviewed to see if additional loads have been added and if all bypass valves are still nicely throttled. If there were no changes then the pump may be having issues.
- 9) If needed, and when the bypass valve is fully closed, the largest loads not being used such as the 1497's or SSA's should be throttled.