Al Conrad <aconrad@lbto.org>

Re: [EXT]

3 messages

DeMars, Peter V - (demars) <demars@arizona.edu> Fri, Mar 8, 2024 at 9:27 PM
To: Dan Rapoza <drapoza@lbto.org>
Cc: Mark Smithwright <msmithwright@lbto.org>, Al Conrad <aconrad@lbto.org>

DAN: Thank you for the detailed review. You found some missing materials. Regarding the Hand Switch 03 (HS-03) issue, there were actually two problems. The HS associated with V-1 was previously identified as HS-02 but we revised it in this iteration, I redlined it as HS-03 but it never made it to the actual document. Fixed, see attached 4-2. Also, the entire paragraph dedicated to HS-03 was written in Word but never transferred to the CAD document. Fixed, see 5-1 and 5-2.

STR stands for motor starter. Undefined as to what this actually is in real life - could be a VFD, across the line contactor, etc., but intended to take a low voltage signal and connect/disconnect the load to/from mains.

WCU stands for Wavefront Calibration Unit, one of Jonathan's support instruments that resides inside the outer enclosure and can be seen on drawings 1-0 and 1-10 attached, see the upper left corner of the outer enclosure. As I understand it, it will/can be used while the instrument is in use and likely represents the only non-near steady state load in the enclosure - one of the reasons I included a step load response test during commissioning. The WCU and the cryo compressor are the only loads that we will circulate cooling water to during a loss of power, loss of plant cooling water, loss of primary of secondary pumps, etc. which requires the installation of V-3 and V-4 to shut off flow to other devices in our project scope (AHU cooling coil and process cabinet/rack electronics).

I'll review the last section of your comments later - probably this weekend, but hopefully they are addressed by adding the missing HS-03 paragraph now included on 5-1.

Thanks again for your review - I value another set of eyes on this.

Peter V. DeMars, P.E.

From: Dan Rapoza <drapoza@lbto.org>
Sent: Friday, March 8, 2024 7:00 PM
To: DeMars, Peter V - (demars) <demars@arizona.edu>
Subject: [EXT]

External Email

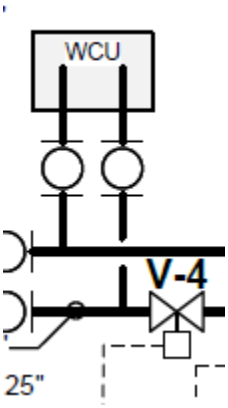
Good evening Peter,

I have been going through the PDFs, and have a few questions.

I am not seeing HS-03 on Page 4-2 B

What is STR? a starter or contactor?
image.png

What is the WCU?



On Page 5-1, Can you confirm that the correct Hand Switches are correlated with the Correct valves. The following is from the "System Select" Section in the second column of writing on the page. I am also not seeing HS-03.

"Manual selector switch HS04 selects pumped coil loop pump options and can be placed in one of three (3) positions. This loop is intended to maintain a constant flow rate of glycol chilled water through AHU cooling coil CC-1, regardless of actual energy transfer, thereby minimizing leaving air temperature stratification. All HS-04 position selections are reported to the system status monitoring software and HMI.• Off: Deenergizes pump P-2 and deenergizes valve V-2 to fail to a closed position.• Hand: Forced selection of loop pump P-2. Upon selection, pump P-2 shall start and loop control valve V-2 shall be energized to operate in any mode selected at HS-05. • Auto: Normal position of selector switch HS04. In auto position, pump operation shall be managed by the control system and HMI. On a detected failure of the pump (detected pressure differential switch PDS-02 after 5 seconds (adjustable at HMI), pump shall be deenergized and an audible local system alarm annunciator shall be energized at the HMI and a remote alarm notice transmitted to the network including the time, date and nature of the failure logged. Manual selector switch HS05 allows manual positioning and automatic positioning of the pumped glycol chilled water control valve V-2 regulating loop bypass, thereby maintaining leaving air temperature at CC-1 and can be placed in one of three (3) positions. All HS-05 position selections are reported to the system status monitoring software and HMI.• Off: Deenergizes valve V-2, failing to a closed position.• Hand: Forced control of V-2, allowing local positioning from full closed to full open positions. • Auto: Normal position of selector switch HS05, providing automatic positioning of V-2 via PID control. On a rise in average temperature at TE-12 and TE-13 above setpoint established at TS-02 (nominal 72F, adjustable at HMI), V-2 shall modulate towards an open position to maintain setpoint. On a fall in average temperature at TE-12 and TE-13 from setpoint established at TS-02, V-2 shall modulate towards a closed position to maintain setpoint. On a failure to meet or maintain +/- 1F (adjustable at HMI) setpoint a remote alarm notice shall be transmitted to the network including the time, date and nature of the failure logged."

Thank you,

-Dan R.

Drawing 2300RG13Sf partial.pdf
672K

Dan Rapoza <drapoza@lbto.org> Sat, Mar 9, 2024 at 8:41 AM
To: "DeMars, Peter V - (demars)" <demars@arizona.edu>
Cc: Mark Smithwright <msmithwright@lbto.org>, Al Conrad <aconrad@lbto.org>

Good morning Peter,

is V-A1 referring to V-1?

System Select:
Two basic mechanical systems are needed to operate in Mode 1 or Mode 2

- air side components consisting of a fan, electric heat and glycol chilled water coil which utilizes hand switch 1 (HS01) to assign Hand Mode 1, Hand Mode 2 or Off functions and
- water side components consisting of tertiary loop glycol chilled water pumps (nominal 50F glycol loop) which utilizes hand switch 02 (HS02) to assign hand, off and automatic functions and pumped coil pump (AHU cooling coil) which utilizes hand switch 3 (HS03) to assign hand, off and automatic functions, both as described below.

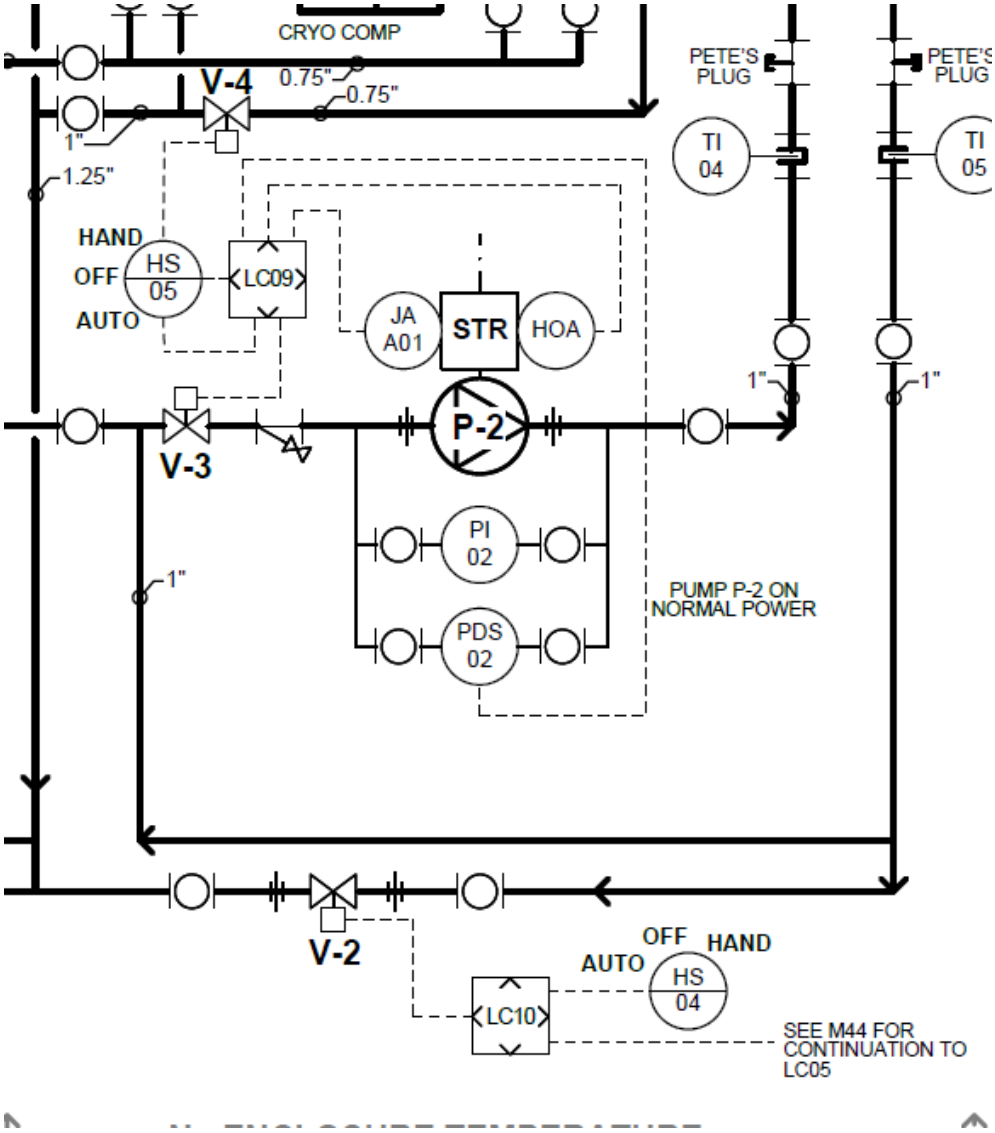
Manual selector switch HS01 selects air side duct options and can be placed in one of three (3) positions. All HS-01 position selections are reported to the system status monitoring software and HMI.

- **Off:** Deenergizes all components of the system including power to fans and electric heat.
- **Mode 1**: Selection of mode 1 shall signal SF-1 VFD to operate at 1,000 cfm (adjustable) as measured at flow station FS-1. Failure of fan to operate, either as detected by current alarm (JA-01) or internal VFD fault detection (phase loss, over current, low voltage, no voltage, etc.) as a VFD output or by failure to meet flow station setpoint (FS-1) +/- 5% within 10 seconds (adjustable) shall de-energize fan and send an alarm signal to the HMI. No fault conditions reported within the time limit shall send a confirmation signal to the HMI of fan start.
- **Mode 2:** Selection of mode 2 shall signal SF-1 VFD to operate at 2,000 cfm (adjustable) as measured at flow station FS-1. Failure of fan to operate, either as detected by current alarm (JA-01) or internal VFD fault detection (phase loss, over current, low voltage, no voltage, etc.) as a VFD output or by failure to meet flow station setpoint (FS-1) +/- 5% within 10 seconds (adjustable) shall de-energize fan and send an alarm signal to the HMI. No fault conditions reported within the time limit shall send a confirmation signal to the HMI of fan start.

Manual selector switch HS02 selects tertiary pump options and can be placed in one of four (4) positions. This loop is intended to control the glycol chilled water from the secondary site loop at 42-47F to an entering tertiary loop temperature of 50F, adjustable (TS-02), at the HMI. All HS-02 position selections are reported to the system status monitoring software and HMI.

- **Off:** Deenergizes both tertiary pumps (P-1A and P-1B) and deenergizes valve V-1 to fail to a closed position.
- **A**: Forced selection of tertiary loop pump P-1A. Upon selection, pump P-1A shall start and loop control valve V-A1 shall be energized to operate in any mode selected at HS-03.
- **B**: Forced selection of tertiary loop pump P-1B. Upon selection, pump P-1B shall start and loop control valve V-A1 shall be energized to operate in any mode selected at HS-03.

Should HS-05 and HS-04 be switched in location on the P&ID Page?


CRYO COMP
V-4
0.75"
0.75"
1"
1.25"
PETE'S PLUG
PETE'S PLUG
TI 04
TI 05
HAND
OFF
AUTO
HS 05
LC09
JA A01
STR
HOA
1"
1"
P-2
V-3
PI 02
PDS 02
PUMP P-2 ON NORMAL POWER
1"
V-2
OFF
HAND
AUTO
HS 04
LC10
SEE M44 FOR CONTINUATION TO LC05

Manual selector switch HS04 selects pumped coil loop pump options and can be placed in one of three (3) positions. This loop is intended to maintain a constant flow rate of glycol chilled water through AHU cooling coil CC-1, regardless of actual energy transfer, thereby minimizing leaving air temperature stratification. All HS-04 position selections are reported to the system status monitoring software and HMI.

- **Off:** Deenergizes pump P-2 and deenergizes valve V-2 to fail to a closed position.
- **Hand**: Forced selection of loop pump P-2. Upon selection, pump P-2 shall start and loop control valve V-2 shall be energized to operate in any mode selected at HS-05.
- **Auto:** Normal position of selector switch HS04. In auto position, pump operation shall be managed by the control system and HMI. On a detected failure of the pump (detected pressure differential switch PDS-02 after 5 seconds (adjustable at HMI), pump shall be deenergized and an audible local system alarm annunciator shall be energized at the HMI and a remote alarm notice transmitted to the network including the time, date and nature of the failure logged.

Manual selector switch HS05 allows manual positioning and automatic positioning of the pumped glycol chilled water control valve V-2 regulating loop bypass, thereby maintaining leaving air temperature at CC-1 and can be placed in one of three (3) positions. All HS-05 position selections are reported to the system status monitoring software and HMI.

- **Off:** Deenergizes valve V-2, failing to a closed position.
- **Hand**: Forced control of V-2, allowing local positioning from full closed to full open positions.
- **Auto:** Normal position of selector switch HS05, providing automatic positioning of V-2 via PID control. On a rise in average temperature at TE-12 and TE-13 above setpoint established at TS-02 (nominal 72F, adjustable at HMI), V-2 shall modulate towards an open position to maintain setpoint. On a fall in average temperature at TE-12 and TE-13 from setpoint established at TS-02, V-2 shall modulate towards a closed position to maintain setpoint. On a failure to meet or maintain +/- 1F (adjustable at HMI) setpoint a remote alarm notice shall be transmitted to the network including the time, date and nature of the failure logged.

Should this be TS-01?

Manual selector switch HS05 allows manual positioning and automatic positioning of the pumped glycol chilled water control valve V-2 regulating loop bypass, thereby maintaining leaving air temperature at CC-1 and can be placed in one of three (3) positions. All HS-05 position selections are reported to the system status monitoring software and HMI.

- **Off:** Deenergizes valve V-2, failing to a closed position.
- **Hand:** Forced control of V-2, allowing local positioning from full closed to full open positions.
- **Auto:** Normal position of selector switch HS05, providing automatic positioning of V-2 via PID control. On a rise in average temperature at TE-12 and TE-13 above setpoint established at TS-02 (nominal 72F, adjustable at HMI), V-2 shall modulate towards an open position to maintain setpoint. On a fall in average temperature at TE-12 and TE-13 from setpoint established at TS-02, V-2 shall modulate towards a closed position to maintain setpoint. On a failure to meet or maintain +/- 1F (adjustable at HMI) setpoint a remote alarm notice shall be transmitted to the network including the time, date and nature of the failure logged.

Should this be TS-01?

Outer Enclosure Temperature Control

TE14 and TE15 located in the leaving air stream of the cooling coil shall be either selected individually at the HMI or averaged via logic controller LC06 to obtain the measured leaving air temperature downstream of the glycol cooling coil. This value shall be compared with setpoint TS02 at LC06. On a call to lower temperature as measured by TE14 and/or TE15 to meet setpoint, control valve V-2 shall modulate toward an open position under PID control. On a call to raise temperature as

Can you make the following paragraph a little more clear? and instead of using the LCXX notation use the actual sensor or element labels such as TE-11.

Outer Enclosure Temperature Control – cont.

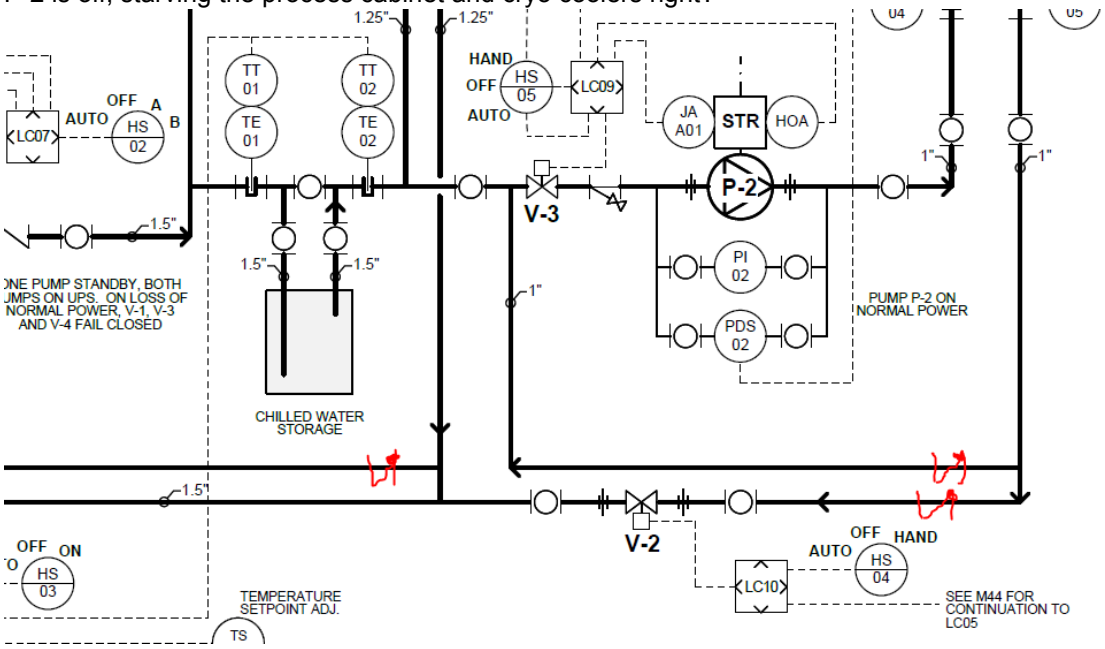
HS-01 set to Mode 1, Mode 2 or Auto and supply fan SF-1 energized, fan flow proven via flow elements FS-1, enclosure temperature at LC02 shall be compared with enclosure temperature set point (nominal 75F with adjustable range of +/- 5F) selected at TS01 and used to reset the PID loop variables of the fast loop at LC04 (leaving air temperature) to sequence the electric heating elements via LC03 to meet set point. On a rise in temperature at LC02, EF-1 controllers shall sequence to reduce output using PID control and on a drop in temperature at LC02, EF-1 controllers shall sequence to increase output using PID control.

Tertiary Glycol Loop Temperature Control

Control valve V-1 is provided in the tertiary loop to meet a

DO we want to have check valves in these locations? water will be shunted back to the return of the secondary loop if

P-2 is off, starving the process cabinet and cryo coolers right?



Very Cool design, I am excited to work with you on this project, and learn about it.

Thank you,

-Dan R.

[Quoted text hidden]

DeMars, Peter V - (demars) <demars@arizona.edu> Sat, Mar 9, 2024 at 8:31 PM
To: Dan Rapoza <drapoza@lbto.org>
Cc: Mark Smithwright <msmithwright@lbto.org>, Al Conrad <aconrad@lbto.org>

DAN:
Yes, V-A1 should read V-1.

In the section currently reading as "Manual selector switch HS04...", replace HS04 with HS05 and HS05 with HS04.

In the section currently reading as "Manual selector switch HS05...", relace HS04 with HS04.

Regarding the TS01 and TS02 setpoints - I have to rewrite these sections. I think I will also simplify the number of logic controllers. Back in earlier versions, we had redundant control valves for V-1 and V-2 (hence the V-1A and V-1B, etc.) that required additional logic and dedicated binary acting isolation valves at each modulating control valve. Requirements got simpler, budgets got tighter, and an overall control philosophy of subcooling then reheating to a tight tolerance was adopted which allowed for less expensive chilled water control valves. The control valves are actually pretty reliable, and I was probably overreacting in the early days of design providing too much redundancy. At some point, more parts and control begin to create

reliability issues that degrade the design, and we were probably approaching those limits.

All that said, I need to spend some quite time with the SOOs and wring out some of the legacy design and make sure the control loops are clean, not interacting with each other, etc. The TS01 and TS02 are examples of poor coordination on my part. Each has a very specific purpose (one loop to manage the leaving temperature of the cooling coil and the second fast loop to do the final reheat to meet the outer enclosure temperature set point). But they are spread across two sheets (4-1B and 4-2) so I need to get them coordinated properly. I've moved point numbers around so many times that it is generating confusion for those who are actually looking this material over with a critical eye. I don't want to waste your time so instead of fixing this on the fly, I really want to spend a couple of hours doing the cleanup. And I want to do that AFTER we've had some time to agree on how many logic controllers are really needed, etc. I think we can do this pretty quickly just by considering the various loop that are needed.

Again, thanks for spending time with material and producing a critical review.

Peter

ps. I don't think your proposed check valves are needed; they don't hurt except a small pressure drop but I'll be happy to trace the flows with you to make sure some odd set of circumstances doesn't produce the conditions you are worried about.

From: Dan Rapoza <drapoza@lbto.org>
Sent: Saturday, March 9, 2024 11:41 AM
To: DeMars, Peter V - (demars) <demars@arizona.edu>
Cc: Mark Smithwright <msmithwright@lbto.org>; Al Conrad <aconrad@lbto.org>
Subject: Re: [EXT]

External Email

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